THE
GARDENS' BULLETIN
SINGAPORE

Vol. XX 1963–1964

Published by Authority

PRINTED BY LIM BIAN HAN, GOVERNMENT PRINTER, SINGAPORE

1964

CONTENTS

THE GARDENS' BULLETIN
SINGAPORE

Vol. XX, Part I 31st January, 1963

CONTENTS

To be purchased at the Botanic Gardens, Singapore
Price: $8

Published by Authority

PRINTED BY LIM BIAN HAN, ACTING GOVERNMENT PRINTER, SINGAPORE
1963

June 14

THE

GARDENS' BULLETIN

SINGAPORE

Vol. XX, Part I 31st January, 1963

Florae Malesianae Precursores—XXXIV

A Revision of The Genus Poikilospermum (Urticaceae)*

By CHEW WEE-LEK

Botanic Gardens, Singapore

Summary

POIKILOSPERMUM is a genus of *Urticaceae* with twenty species segregated into two subgenera viz., subgen. *Poikilospermum* and subgen. *Ligulistigma*.

Morphologically, this genus is rather intermediate between the *Moraceae* and the *Urticaceae:* the vegetative structures are moraceous while the reproductive parts are urticaceous. Decision to regard this genus as one of *Urticaceae* is based mainly on the fact that ovules of all the species of *Poikilospermum* are orthotropous and basally fixed, a characteristic of the *Urticaceae*.

Species of subgenus *Poikilospermum* are mainly found in Eastern Malaysia whereas those of subgenus *Ligulistigma* are mainly Western Malaysian.

New name: subgenus *Ligulistigma* Chew.

New species: *P. inaequale* Chew (subgen. *Poikilospermum*). *P. tangaum* Chew (subgen. *Ligulistigma*).

New combinations: *P. naucleiflorum* (Roxb. apud Lindl.) Chew (subgen. *Ligulistigma*). *P. subtrinervium* (Miq.) Chew (subgen. *Ligulistigma*).

* This paper is based on part of a dissertation submitted by the author for the Degree of Doctor of Philosophy in Cambridge University, England in April 1960.

Introduction

Poikilospermum is a small and relatively unknown genus of the family *Urticaceae*. Merrill in 1934 accounted for thirty-six species. Of these, only twenty species are here distinguished. The special interest of this genus lies in the controversy over its systematic position.

Prior to 1894, this genus had been regarded as two segregate genera, namely: *Conocephalus* Bl. (1825) and *Poikilospermum* Zipp. ex Miq. (1864). While *Conocephalus* had been regarded as a genus of *Moraceae, Poikilospermum* had, on the other hand, always been taken for a member of the *Urticaceae*. In that year, 1894, Warburg considered these two congeneric, and as a consequence, he reduced *Poikilospermum* to a synonym since it was antedated by *Conocephalus*. (He, however, failed to realise that the epithet *Conocephalus* of Blume is a later homonym of Necker's *Conocephalus* which appertains to a group of Hepatics). In any event, his decision to bring the two genera together created a problem. Should the combined genus be *Moraceae* or *Urticaceae?* Warburg himself considered it a Moraceous genus and this was adhered to by Merrill in 1934. In that year, the latter rightly re-established the epithet *Poikilospermum* and relegated *Conocephalus* Bl. to a synonym. On the other hand, botanists like Winkler (1922) and Gagnepain (1929) maintained that it should belong to the *Urticaceae*.

This naturally led me to look into the delimitation of the two families concerned. I therefore worked systematically through (on a generic level) most of the collections of these two families (particularly the *Urticaceae*) in the herbaria of Kew, Cambridge and Singapore using the monumental works of Weddell, Baillon and others to check the characters of these families. The upshot of this subsidiary investigation is two-fold. Firstly, I came to the conclusion that *Poikilospermum* is an urticaceous genus that possesses some characters quite in accord with the *Moraceae* family. Secondly, I further conclude that there is only one distinguishing character between the *Moraceae* and the *Urticaceae*. In the *Urticaceae*, the ovules are always basal and orthotropous, whereas in the *Moraceae*, they are either laterally or apically fixed and are never orthotropous excepting the genera *Cecropia, Musanga* and *Coussapoa*. Since these three genera possess ovules quite similar to those of *Poikilospermum* and others of the *Urticaceae*, it is here considered necessary to transfer them together with *Poikilospermum* from the *Moraceae* to the *Urticaceae*. In this manner, the two families *Moraceae* and *Urticaceae* will be easily distinguished from each other at least on one character.

This revision is mainly based on herbarium materials supplemented by one year's field observation in the Malay Peninsula in 1956. Opportunity is here taken to express my gratitute to the Directors of the following herbaria for the loan of their materials as well as for their hospitality given me during my visits to their botanical institutions:—

Botanisches Museum, Berlin-Darlem, Germany. (B).

British Museum of Natural History, London, England. (BM).

Herbarium Bogoriense, Bogor, Indonesia. (BO).

Jardin Botanique de l'Etat, Bruxelles, Belgium. (BR).

Botanical Museum & Herbarium, Copenhagen, Denmark. (C).

Botany School, University of Cambridge, England. (CGE).

Royal Botanic Garden, Edinburgh, Scotland. (E).

Herbarium Universitatis Florentinae, Istituto Botanico, Firenze, Italy. (FI).

Conservatoire et Jardin Botaniques, Geneve, Switzerland. (G).

Royal Botanic Gardens, Kew, England. (K).

Rijksherbarium, Leiden, Netherlands. (L).

Department of Forests, Papua and New Guinea. (LAE).

Botanical Institute of the Academy of Sciences, Leningrad, U.S.S.R. (LE).

Botanische Staatssammlung, Munchen, Germany. (M).

Museum National d'Histoire Naturelle, Laboratoire de Phanerogamie, Paris, France. (P).

Philippine National Herbarium, National Museum, Manila, Philippines. (PNH).

Botanic Gardens, State of Singapore. (SING).

Botanical Museum & Herbarium, Utrecht, Netherlands. (U).

My gratitude also extends to the following for their valuable advice and information: Mr. H. M. Burkill, Director of the Singapore Botanic Gardens, Prof. Dr. C. G. G. J. van Steenis, Director of Flora Malesiana Foundation, Leiden, Netherlands, and Dr. S. M. Walters, Curator of the Herbarium, Botany School, Cambridge University, England.

Last, but not least, I should like to thank my supervisor in the University of Cambridge, Mr. E. J. H. Corner, F.R.S., for whose continued interest and guidance, I am indeed greatly indebted.

Historical Review

From a nomenclatural point of view, the genus *Poikilospermum* is post-Linnean. From a botanical view point, however, a species of it had already been published in pre-Linnean literature. It was Rumpf who published a description and drawing of a species from Amboyna in 1750 which he named *Funis muraenarum latifolius*. The credit for the discovery of this pre-Linnaean trinomial goes to Merrill who, in 1917, equated it with *Poikilospermum amboinense*. I have studied Rumpf's publication of this species critically and could find no cause whatsoever to disagree with Merrill. As far as I have been able to trace, it seems to me that this is the only pre-Linnaean reference to the genus.

Poikilospermum is now a combination of three genera which had been regarded as separate. These are: *Conocephalus* Bl. (1825), *Poikilospermum* Zipp. ex Miq. (1864) and *Balansaephytum* Drake (1896).

Blume founded *Conocephalus* in 1825 with only one species *suaveolens* which he based on a Javanese collection. He, however, did not realise that the generic name *Conocephalus* had already been given to a group of Hepaticae by Necker in 1790; in other words, he was using a later homonym.

Three years later in 1828, Lindley added another species to the genus, this time from India; and he named it *naucleiflorus*. He based this entirely on Roxburgh's description and drawing of *Urtica naucleiflora* which was still in the latter's manuscript. No more species were described between Lindley's publication and 1847.

In the latter year, Trecul published his "Memoire Sur La Famille Des Artocarpees". In this work, he reviewed Blume's genus and accounted for nine species namely: *suaveolens, lanceolatus, ovatus, roxburghii, pubescens, ellipticus, acuminatus, microphyllus* and *naucleiflorus*. He added seven species to the two already known. In a way, this work can be taken to be the first attempt at a revision of this genus. He was the first to have recorded the presence of *suaveolens* in the Philippine Islands, by correctly identifying a collection of it from Luzon. His *lanceolatus* and *roxburghii* were based on collections from India made by Griffith, and Wallich and Gaudichaud respectively. The species *ovatus* and *pubescens* were both founded by him on Javanese materials; while *acuminatus* and *microphyllus* were described from collections from the Philippines. According to him, the Malay Peninsula had only one species which he named *ellipticus*. As for *naucleiflorus*, he was unable to equate any collections with it thereby noting it as a "species mihi ignota". He commented that *suaveolens, lanceolatus* and *ovatus* are closely related and that later collections might contain intermediates that might prove them to be conspecific. With the other species, he made no comments.

Sometime between 1847 and 1848 Gaudichaud while publishing his drawings of plants he had come across on his world cruise on the "Bonite", added one more species to *Conocephalus* which he named *blumei* in honour of Blume. This species was based on his own collection from the Philippines. Miquel in 1851 also added one more species which he named *gratus* basing on a collection of Junghuhn from Java. By this year, the total number of species known of this genus had reached eleven.

In 1859, Miquel published his "Flora van Nederlandsch Indie"; and here he accounted for those species that occur in Malaysia. In this connection he enumerated four species: *suaveolens, microphyllus, ellipticus* and *acuminatus* ignoring the three species that had been described from India. He seemed to have overlooked the species *blumei* which should have been included since it had been described from the same part of Malaysia as *microphyllus* and *acuminatus*. Anyway, it was in this Flora that he regarded Trecul's *ovatus* and *pubescens* as being conspecific with *suaveolens;* and accordingly he made them varieties of the latter species; he even reduced his species *gratus* described only eight years previously. Two years later, in 1861, he published a supplement to this Flora and in it he added one more species named *subtrinervius* which he based on a collection of Korthals from Sumatra. He was therefore the first author to have recorded the genus from that land.

The year 1864 saw two publications relevant to this genus. One of these was the result of the joint effort of Teysmann and Binnendijk who added the second species of this genus to the Sumatran list. They named it *azureus*, basing it on a Sumatran specimen collected by Diepenhorst. The other publication, which is the more important one, was by Miquel who described a new monotypic genus called *Poikilospermum* noting it as a "Genus Novum Urticacearum". The type species, *amboinense*, was based entirely on Zippelius's manuscript. The authors of this new genus certainly had *Conocephalus* in their minds when they described it, for they noted that it is a "Frutex . . . habitu fere Conocephali". This statement certainly led numerous botanists at a much later date to look closely into the relationship of these two genera.

By 1864, most of the countries of Western Malaysia had already been noted as having at least one species of *Conocephalus*. Java was the first to be recorded (Blume 1825), followed by India (Lindley 1828), the Malay Peninsula and the Philippine Islands (Trecul 1847) and then Sumatra (Miquel 1861). The huge island of Borneo had not yet come into the list. It was not till 1867 that Miquel described two species from that island. He named them *borneensis* and *micranthus;* both were based on Korthals collections from South Borneo. It is of interest to note that with regard to *borneensis*, he contrasted it with *suaveolens;* and in the other species, he drew attention to the fact that *micranthus* is similar in habitat to *Poikilospermum* which had been published by himself three years previously.

In 1880, two botanists, F. Villar and A. Naves, published their "Novissima Appendix ad Florum Philippinarum Blanco" and it was here that the Philippine species of *Conocephalus* were revised since Trecul's work of 1847. They maintained that there were only four species in those islands: *suaveolens, microphyllus, acuminatus* and *erectus*. Their contribution towards the knowledge of this genus lay in their interpretation of two species described by Blanco in 1837 as *Procris violacea* and *Procris erecta*. *P. violacea* was considered by them conspecific with *suaveolens* and was consequently reduced to a synonym. With *P. erecta*, however, they were unable to equate it with any of the species known of *Conocephalus*. The upshot was that they recognised it as a distinct species of the genus and changed the epithet to *erectus* thus adding one more species.

The younger Hooker in 1888 revised the *Urticaceae* in his "Flora of British India". He took into consideration not only species that occur in India proper, but also those occuring in the Malay Peninsula. In all he enumerated five species: *suaveolens, amoenus, scortechinii, subtrinervius* and *concolor* as well as three species groups from which he refrained to give any specific epithet. Species *amoenus* and *scortechinii* were described by him from King's manuscript and were both based on materials collected from the Malay Peninsula. Regarding the species *suaveolens*, he not only upheld Miquel's decision in considering it to include the species *ovatus, pubescens* and *gratus,* but also extended it to cover the two Indian species *naucleiflorus* and *roxburghii*. Practically all botanists working on this group followed his decision. It has now been revealed that the Indian species in question are distinct from *suaveolens* and that their status should be re-established. The fourth species *subtrinervius,* which had been described from Sumatra, was wrongly interpreted by him. A few collections from the Malay Peninsula made by Griffith, Maingay, Scortechini, Kunstler and Lobb were equated by him with Miquel's *subtrinervius*. This has now been found to be erroneous: he was actually handling specimens of a species that had not yet been described. (See notes on *P. microstachys*). The species *concolor,* described by Dalzell from India, was relegated by him to a species in doubt.

With regard to the three species groups which he described but to which he applied no names, I have been able to identify only the third group, which was typified by a collection of Wray from Perak in the Malay Peninsula. This collection has now been found to belong to the species *suaveolens*. With the remaining two species groups, I have not been able to locate the specimens he cited; neither could I interpret the very general and short descriptions he supplied.

It has been mentioned earlier that Miquel, when publishing Zippelius's *Poikilospermum* in 1864, noted the similarity between Zippelius's genus and Blume's *Conocephalus*. In 1894, Warburg took a decision on this, considered the two genera congeneric and formally joined them together. He naturally relegated Zippelius's *Poikilospermum* to a synonym of Blume's *Conocephalus* since the former was antedated by the latter; and combined *P. amboinense* to *C. amboinensis*. He apparently had still not realised the fact that the generic name *Conocephalus* of Blume which he upheld is actually a later homonym of Necker's *Conocephalus*. In any event, his main contribution lay in his decision in regarding these two genera congeneric.

The first attempt to solve this nomenclatural problem was made in 1898. In that year, a certain O. Kuntze, realising that Blume's generic name is not valid, proposed the name *Conocephalopsis* to replace it. He made no combinations under this name; neither was he taken notice of except by Merrill in 1934.

Wright in 1899, described a species from Yunnan in China. He named it *sinensis* basing it on a collection by Henry. With this publication, the 19th century history of this genus came to a close.

Early in the present century, a second attempt was made to revise the genus. It was a certain Italian named Bargagli-Petrucci who published his "Rivista del genre Conocephalus Bl." in 1902. Apart from the species *sinensis* of Wright which he overlooked, he accounted for all the species known at his time namely: *ellipticus, micranthus, suaveolens, borneensis, amoenus, acuminatus, microphyllus, scortechinii, subtrinervius, lanceolatus, amboinensis, azureus, blumei, concolor* and *erectus*. He lengthened this list by describing eight more new species: six from the island of Borneo, one from Sumatra and one from Papua in New Guinea. These new species were based entirely on collections made by Beccari from Malaysia.

Taken generally, Bargagli-Petrucci's contribution to a better understanding of this genus is to be found in the introductory part of his revision. Here he maintained that generally Blume's *Conocephalus* could be regarded as congeneric with Miquel's *Poikilospermum;* but added that these two genera deserve to be placed in separate sections within the genus. He clearly enumerated the characters that could be used to separate these two on an infrageneric basis. The result was the establishment of three groups within *Conocephalus* thus:

A. *Diandroconocephalus.*

"Stamens 2; perianth 2-fid, . . . rarely 4-fid." species: *ellipticus, micranthus, intermedius* etc.

B. *Euconocephalus.*

"Stamens 4; perianth 4-fid; persistent perianth enclosing fruit." species: *suaveolens.*

C. *Poikilospermum.*

"Stamens 4; persistent perianth forming a cup at the base of fruits; stigma sessile, discoidal, symmetrical." species: *amboinensis* and *papuanus.*

He may not have clearly delimited the first from the second group, but he certainly fared very well in distinguishing *Poikilospermum,* the third group.

Between the years 1905 and 1921, eleven species were added to those so far recognised. One of these was re-established after it had been reduced to a synonym; another was a type species of a genus which was destined to become the third one to be considered congeneric with Blume's genus; while the rest, nine species, were new creations by various botanists.

The monotypic genus named *Balansaephytum* was founded by Drake in 1896 on a collection of Balansa from Indo-China. The type species was named *tonkinense.* It was not till 1907 that Renner, while working on the ". . . Anatomie und Systematik der Artocarpeen und Conocephaleen . . .", discovered that *Balansaephytum* is congeneric with *Conocephalus.* He therefore combined the type species to *C. tonkinensis.* Incidentally, Renner was the first man to have investigated the anatomy of this genus.

The year 1922 witnessed the first publication of the *Conocephalus* Flora of New Guinea by a German named Winkler. It is very surprising that in this work he still retained the generic name *Conocephalus* despite the fact that he knew it to be a later homonym. He enumerated five species for that vast island, four of which were of his own creation, namely: *hirsutus, subscaber, paxianus* and *gjellerupii;* and the other species is of course Zippelius's *amboinensis.* He was aware of the work of Bargagli-Petrucci, but he overlooked the one species published by Ridley in 1916, i.e. *nobilis.* The status of Zippelius's and Blume's genera were discussed by Winkler in great detail; and he arrived at the conclusion that (*a*) the species *acuminatus* described by Trecul in 1847 from the Philippines is exactly intermediate between *Poikilospermum* and *Conocephalus;* and (*b*) that these two genera should be retained in their entirety as subgenera within the genus *Conocephalus.* In this respect, he differed from Bargagli-Petrucci who, twenty-years earlier, had divided the genus into three infrageneric groups. The two subgenera were named by him *Euconocephalus* and *Poikilospermum.* He placed all the New Guinea species under subgenus *Poikilospermum* and the rest in the other subgenus excepting the species *acuminatus,* the intermediate one, which he did not indicate to which subgenus it should belong.

Regarding his delimitation of the species, it has been revealed that of the four new species he described, only one is good, namely *paxianus.* His *hirsutus, subscaber* and *gjellerupii* are found to be none other than variations of *amboinensis*. This is mainly due to the fact that he based his species on hairs of the plants, which characters happen to be quite untrustworthy as far as this genus is concerned. His specific descriptions are no doubt very detailed, but he used wrong characters in their delimitation.

In the following year, 1923 to be precise, Merrill published "An Enumeration of Philippine Flowering Plants". Like all former botanists, he upheld the generic name *Conocephalus*. Nine species were enumerated by him from the Philippine Islands, namely: *acuminatus, diffusus* (with two varieties), *erectus, grandis, grandifolius, mollis, piperi, suaveolens* and *warburghii*. This work is truly an enumeration, for he supplied neither specific descriptions nor keys. He merely equated collections with specific epithets!

Following this Enumeration, came Ridley's "Flora of the Malay Peninsula" in 1924. This Peninsula was claimed by him to have four species: *amoenus, suaveolens, scortechinii* and *subtrinervius*.

His treatment of the species *suaveolens* and *scortechinii* was good. Into the former species, he correctly reduced part of King's *amoenus*. It has now been revealed that the whole of King's species *amoenus* should be reduced to *suaveolens* as well. Further, he considered Trecul's *ellipticus* as conspecific with *suaveolens* which is very true. With *scortechinii,* he rightly equated numerous collections from the Malay Peninsula.

Nevertheless, he made mistakes too. In the first place, he wrongly equated a few collections with *amoenus*. His own collections from Langat, Selangor and those of Yapp from Gunong Inas in Malacca are notable examples. These collections are actually the Malayan counterparts of the Bornean species *cordifolius* founded by Bargagli-Petrucci. The other mistake was his presumption that the interpretation of *subtrinervius* by Hooker was correct.

The year 1929 saw the first account of this genus from Indo-China. Gagnepain described four species in Lecomte's "Flore Generale de l'Indo-Chine" in that year, namely: *suaveolens, tonkinensis, annamensis* and *mollis,* the last two being his new species. He did not seem to be aware of the fact that the epithet *mollis* had already been used by Merrill in 1921 for a species in the Philippine Islands. The species *suaveolens* was set apart by him from the other three because, according to him, the female perianth of it is free at the apical half whereas in the others, the greater part of the female perianth is gamophyllous. This character has now been found to be extremely variable. Very many collections of this species from the Malay Peninsula have female perianths which are free only a third of its length.

The species *tonkinensis* and *mollis* are now reduced to *suaveolens*. Only his *annamensis* is a distinct species.

So far, only one botanist had undertaken to reject Blume's generic epithet *Conocephalus* from this genus. It was Kuntze who in 1898, as mentioned earlier, proposed a new name *Conocephalopsis* to replace it; but he made no combinations under this name.

It was not till 1934 that a final decision was taken on this. In that year, Merrill published his "Plants Collected in Sumatra . . ." in the "Contributions from the Arnold Arboretum"; and in it, he rejected Blume's *Conocephalus* in favour of Zippelius's *Pokilospermum* which is the earliest name available for this genus. The name *Poikilospermum* which had been relegated by Warburg in 1894 to a synonym has at last been rightly re-established. Merrill then proceeded to make new combinations of all the species so far described and which he recognised as distinct. In all, he made thirty-six new combinations in this genus which will henceforth be known as *Poikilospermum*. It was noted by him that there are other names available for it, namely: *Balansaephytum* Drake (1896) and *Conocephalopsis* Kuntze (1898), but that these are all antedated by Zippelius's name.

General Morphology

Morphologically, the genus *Poikilospermum* is very interesting. It belongs to the family *Urticaceae* and yet possesses characters that are commonly associated with the *Moraceae*. Vegetatively it is moraceous while reproductively, it is more urticaceous. It is therefore hardly surprising that few botanists can find common grounds on the systematic position of this genus.

Apart from some adventitious roots developed by many species, these plants do not possess any specialized organs for climbing. It is doubtful if these roots do in fact help the plants to "climb" at all. Many field botanists have recorded plants of this genus as "epiphytes", "woody epiphytes", "woody climbers" or "scrambling shrubs". Strickly speaking, these plants are no more epiphytic than, for example, the Grape Vine. Neither can these plants be termed "climbers" in the strict sense. In my opinion, the term "woody scrambler" will circumscribe the habit of them fairly well as will be explained presently.

It seems quite clear to me that these plants probably start life as true epiphytes. The achenes are small and are probably carried by birds to the angles of branches of trees. These achenes then germinate, and as the seedlings grow, roots are sent downwards to the soil. Once root systems are established in the soil, the plants begin to branch profusely, horizontally as well as vertically. The branches then begin to "scramble" from branch to branch of the host tree and usually extend to neighbouring trees as well; and in this process, one plant may cover a surprisingly large area. It is therefore not surprising that a collector, when confronted by one of these end twigs, should note it an "epiphyte". Should the collector on the other hand come across the main plant, he would probably record it a "climber." Hence, the term "woody scrambler" is preferred in this paper.

Incidentally, this habit of growth is certainly very reminiscent of that exhibited by the popular strangling figs except that no trees have yet been recorded as having been strangled by any species of *Poikilospermum*.

Vegetative Organs

Twigs. The twigs, especially the leafy part, offer fairly good taxonomic characters. Their sizes may vary very considerably even within a species, but certain species do have a maximum size to which they would normally attain. Species like *microstachys* and *scortechinii* usually have very slim twigs. On the other hand, species like *cordifolium* have very thick ones. The appearance of the periderm of the twig is even more valuable as a taxonomic character (fig. 1). Species of subgenus *Poikilospermum** usually have periderm that may be deeply ridged, but never split; whereas in subgenus *Ligulistigma*, many species have periderm splitting into small copper-brown flakes (as in *suaveolens*) or into large white-greyish sheets (as in *cordifolium*).

Leaves. The leaves of the plants of this genus as a whole are fairly uniform. These are typically dorsi-ventral, petiolate, simple, entire, generally coriaceous and spirally arranged. Delimitation of the two subgenera on the basis of the leaves is quite impossible; in fact, it is sometimes extremely difficult even to decide from leaves whether a specimen is *Poikilospermum* or not! Nevertheless, within each of the subgenera, certain species can roughly be identified by their lamina form. For instance, *microstachys* usually has long oblanceolate lamina with acuminate apex and very cuneate strongly tri-nerved base. The species *nobile* (subgenus *Poikilospermum*) has enormous obovate lamina which may reach a length of seventy centimetres with more than eighteen pairs of lateral veins. Then there is the species *peltatum* (subgen. *Ligulistigma*) which is the only one in the whole genus to have peltate laminas.

Petioles. These, for the genus as a whole, are usually canalized on the upper surface and they range from two to as much as thirty centimetres in length. They may be very thin, as in *lanceolatum* and *microstachys* or extremely thick and fleshy as in *cordifolium* and *suaveolens*. It is difficult to distinguish subgenus *Poikilospermum* from subgenus *Ligulistigma* on the basis of the petioles. Within the latter subgenus, however, the species tend to segregate into two groups depending on the appearance of the periderm of the petioles. In the first group, e.g. *lanceolatum, microstachys* and *scortechinii*, the periderm of the petioles seem

* In this work, two subgenera are recognised for the genus *Poikilospermum* as had been done by Winkler in 1922.

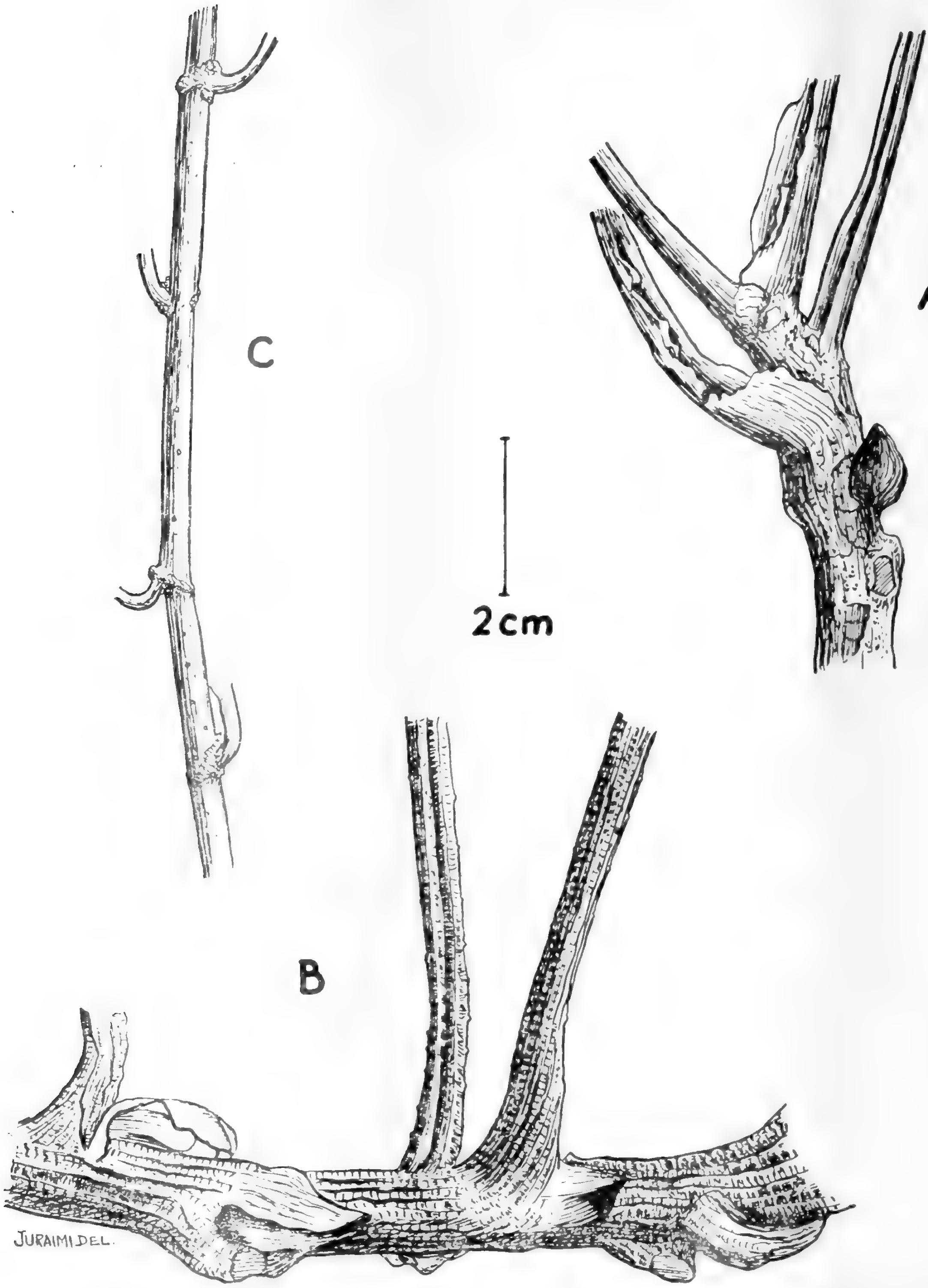


Fig. 1. Periderm of twigs. A, periderm splitting in sheets (*P. cordifolium*). B, periderm splitting in flakes (*P. suaveolens*). C, periderm not splitting (*P. scortechinii*).

to be smooth and not splitting at all. In the other group, as in the species *suaveolens, naucleiflorum, azureum* and a few others, the periderm usually split into small copper-brown flakes similar to those found on their twigs. These flakes may vary in size and profusion. For example, specimens of *suaveolens* from Continental Asia and the Philippines tend to have petioles with very profuse and large flakes, where as those from Java tend to have small and fewer flakes. Such flaky petioles have so far not been observed in any of the species of subgens *Poikilospermum*.

Stipules. These are connate and intrapetiolar without exceptions. Their shapes, texture and persistence are often useful for identifying sterile materials. Firstly, it can be generalized that all the species of subgenus *Ligulistigma* have arched to strongly crescentic stipules. In subgenus *Poikilospermum,* only one species has arched stipules; all the other four species have very long and straight ones. Then there is the texture of the stipules. In the species *microstachys,* these tend to be fairly chartaceous compared with many of the other species which have very coriaceous or even woody ones. Again, in the species *tangaum,* these can be so chartaceous that they curl up into scale-like structures (fig. 2). Lastly the persistence of the stipules. In the species

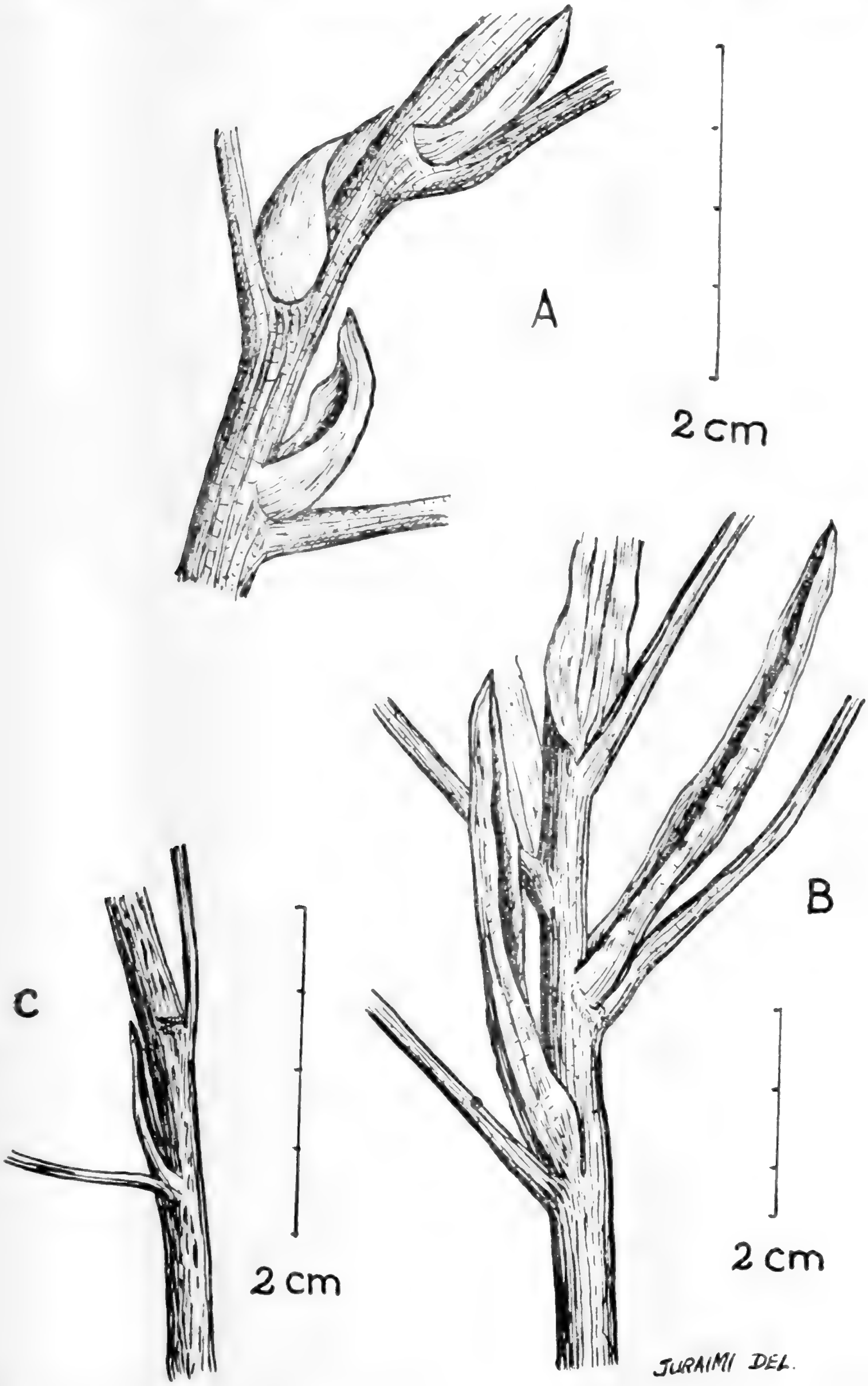


Fig. 2. Stipules. A, crescentic type. B, long and straight type. C, small chartaceous type.

suaveolens, microstachys and *acuminatum,* the stipules are generally persistent; and when they eventually fall, they do not normally leave very prominent scars on the twigs. On the other hand, species like *scortechinii* are noted for the caducousness of the stipules which always leave very prominently raised stipular scars.

Microscopical Structures of the Lamina

Jarrett, in her dissertation submitted in 1956 for her doctorate degree in Cambridge University (published subsequently in the Journ. Arnold Arbor. in 1959) indicated that the anatomy of the lamina is useful in many ways in the taxonomy of the genus *Artocarpus* as well as its allied genera of the *Moraceae.* She found that valuable taxonomic characters can be obtained from a detailed study of glandular hairs as well as the spongy mesophyll. DeWolf, in 1958, also in his dissertation for the same degree at Cambridge, found that as far as the American Figs are concerned, the lamina offer good taxonomic characters in their stomata, indument and cystoliths.

The lamina of *Poikilospermum* were investigated in the same way. To my surprise I found that all the species are very uniform in their microscopic structures of their lamina. Before revealing the results of the present investigation, the work done by others on the anatomy of this genus will be reviewed.

Renner in 1907 was probably the earliest botanist to investigate these structures of *Poikilospermum.* Three species were studied by him: *suaveolens, lanceolatum* and *tonkinense.* In fact, he actually investigated only two species, *suaveolens* and *naucleiflorum.* Due to his erroneous identification, *lanceolatum* (sensu Renner) was actually *naucleiflorum;* while his *tonkinense* is now held to be conspecific with *suaveolens.* In any event, he could not indicate whether any specific characters could be obtained from lamina anatomy. All he did amounts to a contribution towards the knowledge of lamina anatomy of the genus as evident from a study of these two species. He found that the epidermis of the lamina is three to four layers in thickness. The hypodermis has much bigger cells than those of the epidermis and that the innermost ones have mucilaginous walls. The stomata are of the cruciferous type and totally confined to the abaxial surface. Hairs are claimed by him to be one-celled, with or without lumen. Cystoliths occur on both surfaces of the lamina. Those on the adaxial surface are spread all over and are either elongate or punctiform; whereas those of the abaxial surface are mainly confined to the veins and intercostals. He also found that the cystoliths of the adaxial surface often extend deeply into the hypodermis except those on the veins. The hydathodes are very numerous on the adaxial surface and each has thirty to forty water pores.

In 1950, Metcalfe and Chalk in their joint work on the "Anatomy of Dicotyledons" confirmed Renner's results regarding the microscopic structures of the lamina of this genus. They further found that glands with unicellular stalks are present in groups of two to five and that the lower epidermis seems to be similar in a few species of *Poikilospermum* and *Ficus!*

In the present investigation, transverse sections and epidermal peels were made from lamina of random samples of many species.

Hairs. These seem to be unicellular, with or without lumen. They are non-glandular. Such hairs are totally absent from *scortechinii* and a few others. In *suaveolens, acuminatum* and *amboinense,* they may be present or absent. On the other hand, species like *erectum* and *paxianum* have very dense hairs which may be very long. In these species the hairs tend to be concentrated on the abaxial surfaces, very few being on the other side. As far as glandular hairs are concerned, it is found that not many species have these structures. Even in those species that do have such hairs, it is found that not all plants possess them. They always have unicellular stalks with one to many-celled heads. The hairs, whether glandular or not, have now been found to be of no taxonomic value whatsoever by themselves. They can be of use to a limited extent if taken in conjunction with many other characters. Winkler in 1922 tried to use hairs in the delimitation of the New Guinea species with the result that his species turned out to be "bad".

Cystoliths. These are present on both surfaces of the lamina. In shape, they mainly appear elongate, very rarely punctiform. On the adaxial surface, they occur all over and are arranged pointing towards hydathodes (fig. 3). On the abaxial surface. however, these cystoliths are found along the mid-rib, the lateral veins, intercostals and veinlets, and are arranged with their long axes parallel to these veins if they are elongate in shape. These whitish coloured cystoliths represent greatly enlarged epidermal cells each containing a large crystal. The crystals may be elongate or round depending on whether the cystoliths, in which they are found, are elongate or punctiform. If a good transverse section of the lamina is made, a few cystoliths may be seen deeply penetrated in the inner tissue of the upper surface of the lamina. Such a phenomenon has not been observed on the lower part of the lamina.

In connection with the cystoliths, it has been found that practically all the species of subgenus *Ligulistigma* have the elongate type of cystoliths whereas in subgenus *Poikilospermum* some species have the elongate type and others the other type. This character, however, cannot be used to delimit any species within subgenus *Poikilospermum* for the simple reason that there are a few plants which have cystoliths that are intermediate in shape between elongate and punctiform.

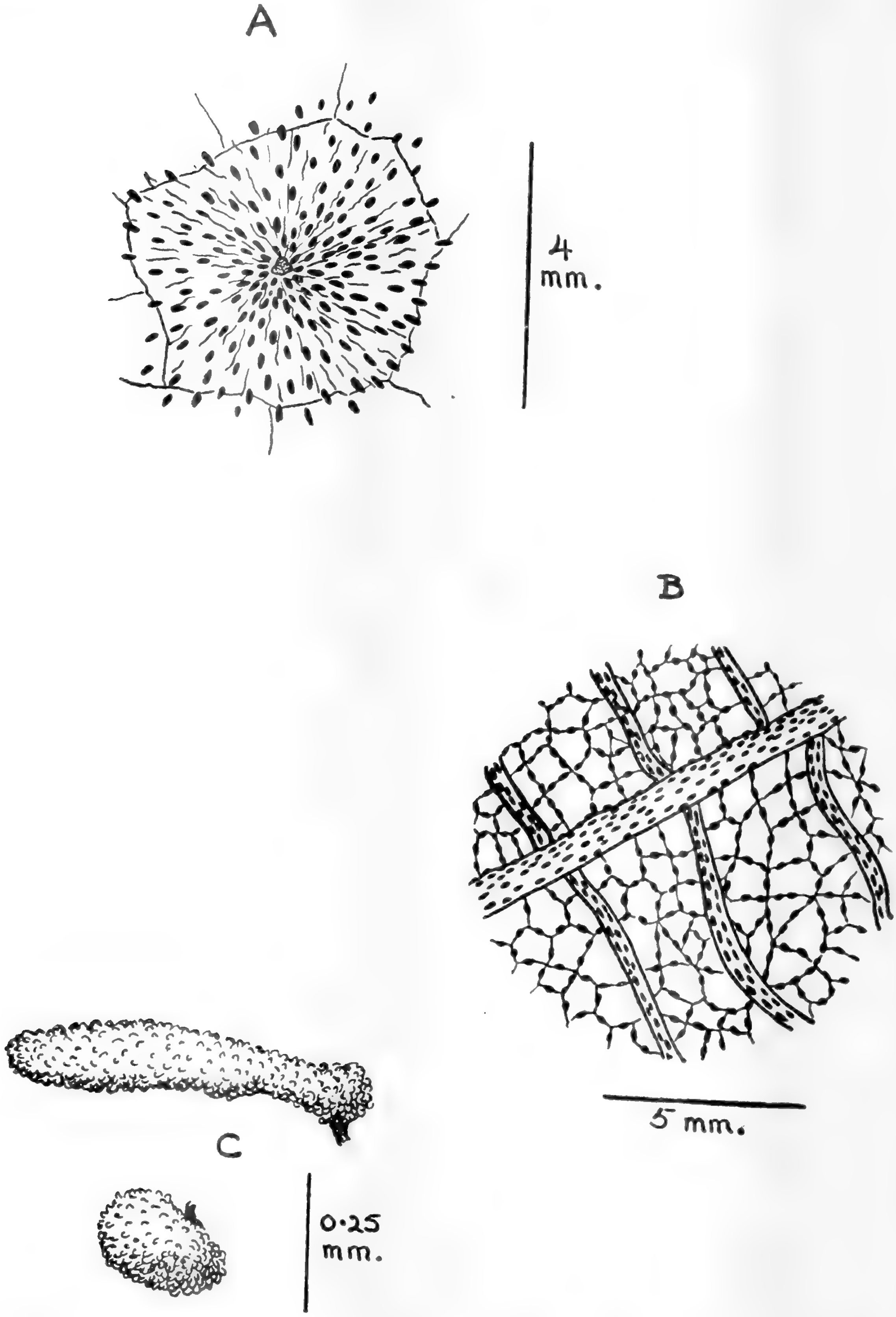


Fig. 3. Cystoliths. A, around a hydathode on adaxial surface of lamina. B, on veins of abaxial surface. C, elongated and round crystals.

Stomata. It has been found that almost without exception, the stomata are all concentrated on the abaxial surface of the lamina and tend to be congregated in the spaces between the veins. They are all superficial, i.e. not sunken into pits and are generally of the so-called cruciferous type i.e. surrounded by a set of three subsidiary cells one of which is usually smaller than the others. However, in a few collections of *suaveolens,* stomata with four subsidiary cells have been found on the same lamina as those with three subsidiary cells (fig. 4). All in all, it can be safely stated

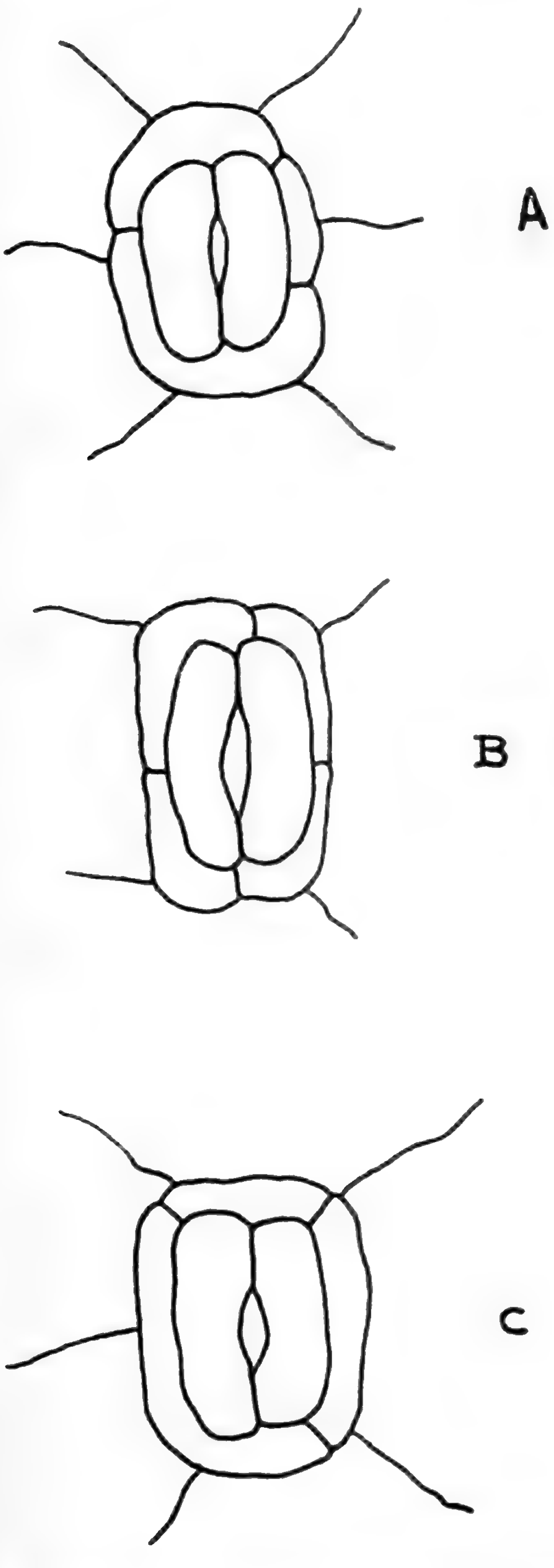


Fig. 4. Stomata. A, stoma with 3 subsidiary cells, the smallest one at the side. B, stoma with 4 subsidiary cells. C, stoma with 3 subsidiary cells, the smallest at one end of stoma.

that stomata structure is not useful for either the infrageneric or the specific delimitation of *Poikilospermum*.

From the foregoing, one can visualize how moraceous these plants appear vegetatively. In the first place, the leaves are definitely moraceous. The very coriaceous, entire and smooth-edged laminas are more like those of some Figs than those of for example, *Urtica* or *Fleurya*. In fact during the course of this research, many sterile duplicates of fertile collections of *Poikilospermum* have been encountered bearing determination labels written "Ficus sp.?" As far as the stomata are concerned, the cruciferous type seems to be a common characteristic of both *Urticaceae* and *Moraceae*.

The stipules of this genus, which are mainly connate and intrapetiolar, are certainly more in accord with those of the *Moraceae*. The species *amboinense*, for instance, has stipules which are very similar indeed to those of some species of *Artocarpus*.

Reproductive Organs

As to be expected, the reproductive structure offer most of the taxonomic characters of this genus and its taxa.

Inflorescences. These are found to be of prime importance for the recognition of the two subgenera. They are all axillary, unisexual, cymose and are almost always solitary. The peduncles are bracteate, the bracts being invariably paired and decussate in arrangement.

The species of subgenus *Ligulistigma* are characterised by their "capitulate" inflorescences, that is, the flowers are borne very crowded upon swollen peduncular receptacles. In subgenus *Poikilospermum*, on the other hand, the flowers are not so borne, but are in groups which are here conveniently termed "agglomerations" (fig. 5). (It must be mentioned here that the term "capitulate" as applied in this work to the inflorescences of subgenus *Ligulistigma* in no way implies that these plants possess true capitula as those of the *Compositae:* rather it simply means "head-like".) Such capitula may be small as in *lanceolatum* or very large as in *suaveolens*. These capitula are not found in species of subgenus *Poikilospermum*, as mentioned earlier, excepting one species, *acuminatum*. In this species, which is in many respects rather intermediate between the two subgenera, the flowers are borne upon extremely minute swellings of the peduncular receptacles that it is impossible for one to decide whether this species should belong to one subgenus or the other on the basis of this character alone; and it is only with the aid of floral characters that it is now held to belong to subgenus *Poikilospermum*.

In addition to this major difference between the two subgenera, there is the question of the presence or absence of solitary terminal flowers at the axils of the ultimate dichotomies of the inflorescences. In subgenus *Poikilospermum*, practically all the male inflorescences have such flowers, whereas in the other subgenus, these flowers are totally absent. In the female plants, however, the subgenus *Poikilospermum* suffers an exception in the intermediate species *acuminatum*. This is the only species in this subgenus which does not have solitary terminal flowers in its female inflorescences whereas in the others, they are always present.

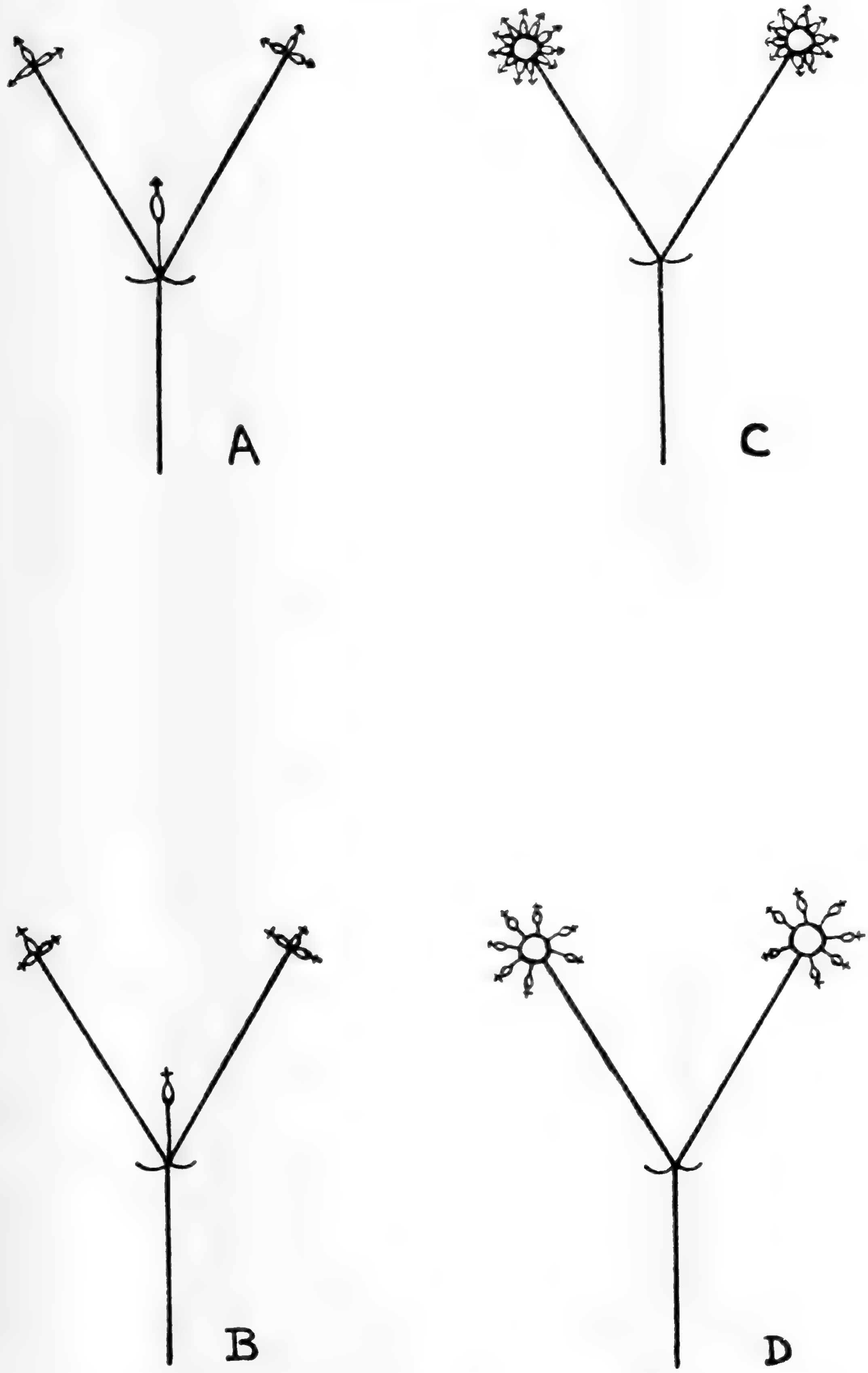


Fig. 5. Diagrams of inflorescences. A and B, male and female typical of subgen. *Poikilospermum*. C and D, male and female typical of subgen. *Ligulistigma*.

On the specific level, the inflorescences also prove to be useful. It has already been mentioned earlier that the inflorescences are mostly solitary with the exception of two species. These two species are *microstachys* (subgen. *Ligulistigma*) and *inaequale* (subgen. *Poikilospermum*). They may have solitary, paired to numerous inflorescences at each leaf axil. They are thus quite clearly distinguished from the species of their respective subgenera. The extent to which the inflorescences are branched is another good taxonomic character as far as the subgenus *Ligulistigma* is concerned. Species like *suaveolens, cordifolium, annamense* and a few others constantly have the female inflorescences branching only once, at most twice to produce usually two, very rarely four very large capitula. Species like *scortechinii*, on the other hand, have greatly ramified female inflorescences with eight or more capitula in each inflorescence. In the male inflorescences of species like *suaveolens, annamense* and *cordifolium*, the peduncles of the third branching order are so short that the male capitula become arranged into two umbel-like groups. Such male inflorescences are not found in species like *scortechinii, peltatum, erectum* and a few others in which the inflorescences are greatly ramified.

The nature of the peduncular bracts is also used to a certain extent for species delimitation. These may be extremely large and foliaceous as in *suaveolens* or they may be extremely minute as in *lanceolatum*. In *scortechinii* the bracts are early caducous and usually leave very prominently raised bract-scars on the primary and secondary peduncles.

Flowers. The value of the inflorescences as taxonomic characters is greatly enhanced if these are taken in conjunction with floral characters. Typically, the flowers of the genus as a whole are unisexual and very small. The male flowers are usually four-tepalled with usually an equal number of stamens surrounding a pistillode in the centre. The female flowers are gamophyllous, with four-lobed or -toothed perianths; and each has an ovary terminated by a simple almost sessile stigma. Rudiments of the stamens are not found in the female flowers. Unlike *Artocarpus*, the perianths of these flowers never fuse with each other in the inflorescence.

Male Flowers. With the exception of the species *paxianum* (subgen. *Poikilospermum*) all male flowers are sessile. The nature of the filaments of stamens is quite different in the two subgenera. In subgenus *Poikilospermum*, the filaments are commonly inflexed in the bud whereas in subgenus *Ligulistigma*, they are always erect. Apart from this, the male flowers are quite uniform for the genus as a whole; and are therefore not of much use in the delimitation of the species.

Female Flowers. The female flowers of subgenus *Poikilospermum* are different from those of subgenus *Ligulistigma*. In the former subgenus, the flowers are mainly sessile, excepting the species *paxianum*. The perianths are gamophyllous with four-toothed apices and the stigmas are subsessile and are always capitate and brush-like. In the latter subgenus, all the species have pedicellate flowers the perianths of which are also gamophyllous, but with four-lobed apices. The stigma are subsessile alright but they are always longish ligulate. On these characters, one can easily separate the two subgenera (fig. 6). The ovaries are, on the other hand, exceedingly

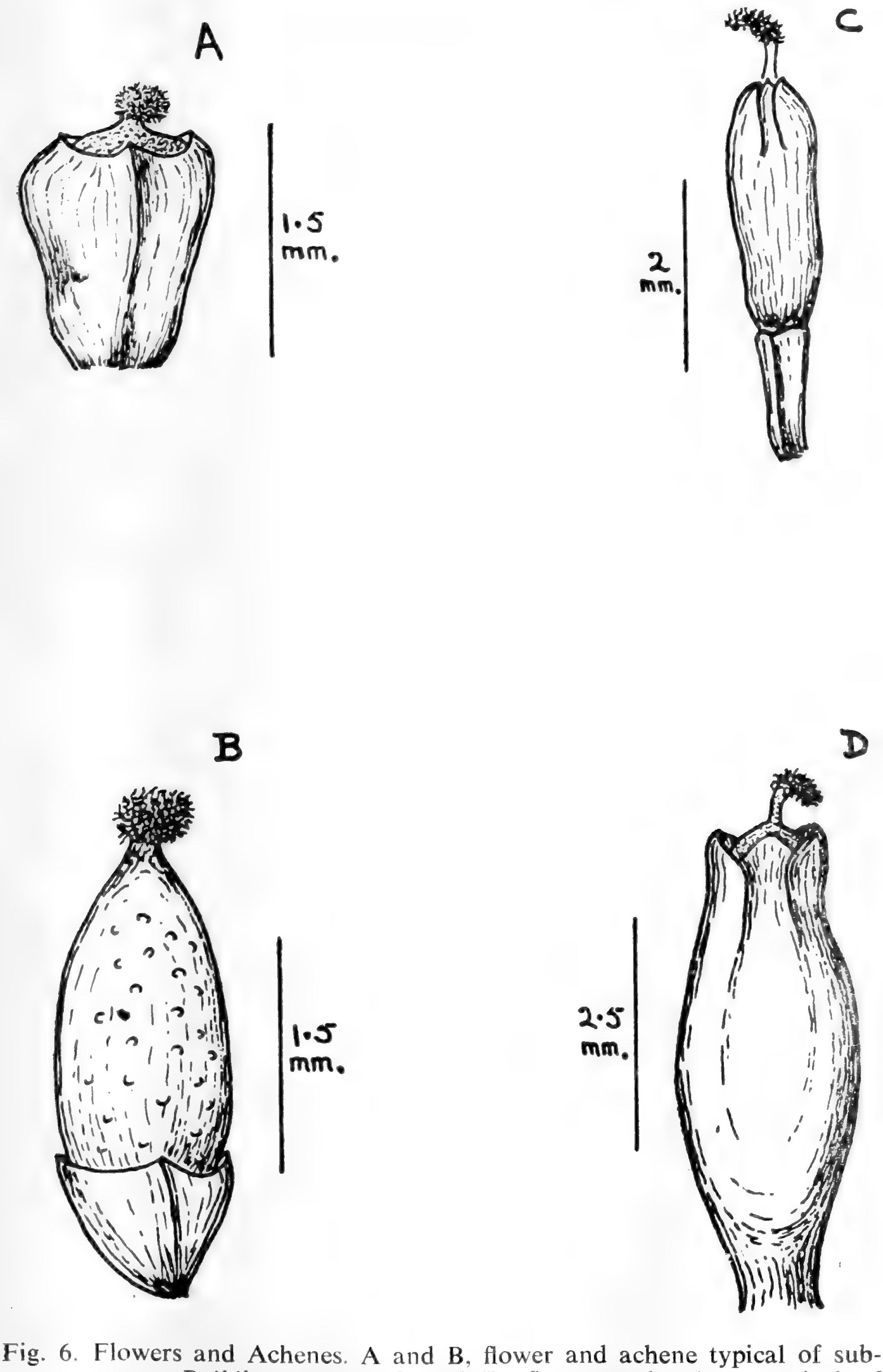


Fig. 6. Flowers and Achenes. A and B, flower and achene typical of subgen. *Poikilospermum*. C and D, flower and achene typical of subgen. *Ligulistigma*.

similar in the two subgenera. They are typically flat ovoid, one-carpelled, one-loculed and each containing a single ovule which is always basal and orthotropous.

Achenes. These are generally small and ovoid; and in length, they may vary from two to four millimetres. Their absolute lengths are of very little taxonomic value; but when compared with the lengths of the perianths, which usually persist, they certainly provide one of the most diagnostic characters of the two subgenera. In subgenus *Poikilospermum,* the achenes at maturity are usually exserted a long way out of the persistent perianths which usually form cups at their bases. In *Ligulistigma,* however, the achenes are almost always totally enclosed by the persistent perianths (fig. 6). Each achene contains a straight embroyo of about two millimetres in length. The cotyledons are oblong in shape and are about one and a half millimetres long. The radicle is about half a millimetre long.

The ejection of the achene from the perianth is rather interesting. Bargagli-Petrucci in 1902 observed that (as far as species of *Ligulistigma* are concerned) when the achene matures, the internal surface of the perianth becomes mucilaginous, gets detached from the underlying tissues and then becomes inflated. This inflation naturally pushes the ripe achene out of the perianth cover ready for dispersal. He added that this phenomenon has not been observed in the species of subgenus *Poikilospermum* probably because in these plants the achenes are already so exserted from the perianth that they are ready for dispersal. This peculiar phenomenon has also been observed by Corner in Java (1959).

In the reproductive organs, not only urticaceous but also moraceous characters are encountered. The fleshy inflorescences of the species of subgenus *Ligulistigma* are very reminiscent of those of *Artocarpus.* However, those of the other subgenus *Poikilospermum* are definitely very urticaceous. Then there is the male flower. Those of the species of *Ligulistigma* have erect filaments which again is a moraceous character; whereas those of the species of *Poikilospermum* have inflexed stamens which character is very common amongst the *Urticaceae.* As for the female flowers, these are mainly urticaceous in character. Their stigmas are not split like those of some species of Ficus. Besides, the ovary contains a basal and orthotropous ovule like those of all other species of *Urticaceae.*

Systematic Position in the Urticales

I have already mentioned in the Introduction that there is a controversy over the systematic position of this genus *Poikilospermum* and that this controversy led me to investigate the relationship and delimitation of the two families, *Moraceae* and *Urticaceae.* After much research, I now come to the conclusion that *Poikilospermum* belongs to the *Urticaceae* and that the cause of this controversy lies in the delimitation of these two families. They are so very closely related to each other morphologically that it is quite difficult to draw a line between them. The only difference is that while the ovules of the plants of *Urticaceae* are always basal and orthotropous, those of the plants of *Moraceae* are either apically or laterally fixed and are never orthotropous. Most of the early workers on these families underestimated the importance of this character; and as a consequence a few genera that are rather intermediate in character between these two families have been erroneously placed, as the following short history of the classification of the Order *Urticales* will show.

The classification of the *Urticales* did not begin till 1789. In that year, De Jussieu established an "Ordo" which he named *Urticeae* to accommodate the Nettles and their allies then known. He divided the "Ordo" into three parts to which he applied no names, thus:

I. "Flores in communi involucro monophyllo reconditi."
Genera: *Ficus, Dorstenia* and other alien genera.

II. "Flores receptaculo communi multifloro impositi, aut squamis involucrantibus capitati, aut distincti sparsi."
Genera: *Cecropia, Artocarpus, Morus, Elatostema, Boehmeria, Procris, Urtica, Forskahlea, Parietaria, Humulus* and *Cannabis,* and other alien genera.

III. "Genera Urticis Affinia."
Genera: *Coussapoa, Pourouma* and a few other alien genera.

In this context, De Jussieu took the *Urticeae* in its widest sense; so wide that many genera of other Orders had been included. The genera *Ulmus* and *Celtis* then known to him, were placed outside this "Ordo" and into the next one which he named, *Amentaceae*. Within the *Urticeae*, the genera *Coussapoa* and *Pourouma* were considered as affinities of the Nettles, a decision which is hard to interpret since the inflorescences of these two genera are rather similar to those of *Ceropia*. While the first part of the *Urticeae* in which he placed the genera *Ficus* and *Dorstenia* may in many respects be considered as fairly natural, the second part is certainly a large odd collection of *Urticales* which had been conveniently put together. He based his broad divisions of this "Ordo" mainly on the characters of the inflorescences without giving considerations to floral characters.

However imperfect his system may seem, De Jussieu still deserved credit, for he was the first botanist to bring the genera together into one group upon which the modern concept of *Urticales* is built.

A slight improvement in this system was put forward in the year 1806. Lamarck and DeCandolle in that year published their joint work of "Flora Gallica . . ."; and in it they improved Jussieu's treatment of the *Urticeae* by dividing the "Ordo" into two distinct tribes: *Artocarpeae* and *Urticeae* proper on the basis of the embryo structure. All the genera that have fleshy fruits. that have flowers borne on common receptacles and with curved embryos were put by them into the *Artocarpeae:* while the others that may even have curved embryos were taken as belonging to *Urticeae proper.* This work was certainly an improvement if only on the fact that the flowers and fruits were given more importance as taxonomic characters. Then in 1815, these same botanists in their "Flore Francaise" stated that the *Artocarpeae* and the *Urticeae* proper might one day become two distinct families.

It has been remarked earlier that the *Ulmus* and *Celtis* had been left by Jussieu in the *Amentaceae* as distinct from *Urticeae.* In 1815, a certain Mirbel formed a new family based on these two genera and named it *Ulmaceae.* He did not indicate whether this family was related to the *Urticeae* or not.

It was not till 1818 that Jussieu's "Ordo" of *Urticeae* began to be split. In that year, Brown raised Lamarck's and DeCandolle's *Artocarpeae* to the status of family. This system of Brown, however, was not widely followed by many botanists some of whom persistently adhered to that of Jussieu.

Blume for example, in 1825, while studying the plants of the Dutch Indies, put all the genera he knew of the *Urticales* into one family, the *Urticeae,* which he subdivided into four taxa namely: *Pholeosantheae, Artocarpeae, Coenosantheae* and *Cannabineae.* In the first taxon, *Pholeosantheae,* he placed the genera *Brongniartia* and *Ficus* i.e. those plants whose flowers are enclosed within receptacles. The second taxon *Artocarpeae* was taken to include those plants whose flowers are borne on fleshy receptacles such as *Artocarpus.* It was amongst these plants that he placed the genus *Conocephalus* Bl. (now the subgenus *Ligulistigma* of *Poikilospermum*). His third taxon, *Coenosantheae,* was a "Taxonomic dustbin" into which he placed the genera *Urtica, Procris, Morus* and even *Celtis* which Mirbel had already put into a new family earlier. The last taxon was specially created by him to cover the genus *Cannabis.*

In the following year, 1826, Gaudichaud presented his system of classifying the *Urticales;* and here he also ignored Brown's work. He not only adhered to the system of Jussieu, but also extended the *Urticaceae* to cover many piperaceous plants. The *Urticeae* was divided by him into five taxa which he stated could be taken either as tribes or subfamilies. Of these five, only the first three taxa need concern us since the other two are mainly piperaceous. The first taxon was named by him *Urticeae proper* and as for the rest, he refrained from applying names. These taxa were distinguished by him thus:

1. *Urticeae* proper, with erect ovules, originally fixed by the second end, with . . . straight embryo.

   Tribes: *Elatostemeae, Urereae, Boehmerieae, Parietarieae, Forskahleae* and *Cecropieae.*

2. *Urticeae* with laterally or apically fixed ovules, with curved embryos . . . .

   Tribes: *Celtideae, Cannabineae, Broussonetieae, Moreae, Ficeae* and *Dorstenieae.*

3. *Urticeae* with laterally fixed ovules which are straight to variable: with fleshy recumbent embryos.

   Tribes: *Pouroumeae* and *Artocarpeae.*

His main contribution to the taxonomy of this group is to be found in the way he demarcated the *Urticeae* proper from the rest of the Order, thus creating the rudiments of the modern concept of the *Urticaceae* (sensu stricto). He is the first botanist to recognise the importance of the ovule and it is gratifying to note that he included the *Cecropieae* amongst the Nettles. It is to be noted also that he put the *Artocarpeae* farther away from the Nettles.

Within each one of his subfamilies, he further sorted the genera into numerous tribes many of which still stand today. In many respects, therefore, Gaudichaud can be called the "Father of Urticaceae (sensu stricto)".

On the other hand, a few botanists like Lindley and Endlicher believed in the splitting up of the old family of *Urticeae.* The former botanist, in 1830, recognised three families, the *Ulmaceae* as created by Mirbel, the *Artocarpeae* by Brown and the *Urticeae* proper. The main characteristics of the *Urticeae* proper were claimed by him to be: "Apetalous dicots with definite erect ovules: . . . and an embryo with the radicle remote from the hilum." In short, the *Urticeae* proper has plants with straight embryos.

In the year 1833, Endlicher changed the family name of *Urticeae* to *Urticaceae* which is the one in vogue today. Four years later, this same botanist published his "Genera Plantarum" and in it he split Jussieu's family into more parts than any of his predecessors had done. He not only upheld the families of Brown and Mirbel, that is *Ulmaceae* and *Artocarpeae,* but also considered the *Celtideae,* the *Moreae* and the *Cannabineae* as also deserving family recognition. Six families were thus recognised by him: *Urticaceae, Ulmaceae, Artocarpeae, Celtideae, Moreae* and *Cannabineae.* The families *Ulmaceae* and *Celtideae* were regarded by him as two very closely related ones. Similarly, he held the same view regarding the *Moreae, Artocarpeae* and *Urticaceae*. He further stated that the creation of the family *Artocarpeae* would leave the *Moreae* better defined. In other words, he in a way recognised the heterogenous nature of the *Artocarpeae:* and this is quite true as the description he gave for it will clearly testify: "*Artocarpeae:* Flowers unisexual, . . . on flat or convex receptacles . . . ovules orthotropous, basal, or amphitropous, parietal, . . . rarely apical anatropous." This system was quite closely followed by many later botanists such as Brongniart (1843) and again Lindley (1846) with only few modifications.

Lindley, it will be recalled, recognised only three families in 1830. In 1846, he changed his mind and in his "Vegetable Kingdom" he enumerated five families: *Urticaceae, Cannabinaceae, Moraceae, Artocarpaceae* and *Ulmaceae*. He placed the *Celtis* and *Ulmus* back to one family which he removed to a different Order entirely, thus differing from Endlicher in one way. Modern terminations were given by him to all the names of these families. In connection with the *Urticaceae,* he remarked, "Their great distinction consists in their having a single erect ovule in a simple carpel, . . . Nettleworts will then be easily known from the Morads and the Hempworts which have a hooked embryo, . . ." With the *Cannabinaceae,* he had this to say: "These plants, formerly regarded as a division of Nettleworts, differ from that Order in having their seeds suspended, their embryos coiled . . . To the *Artocarpads,* they approach in technical characters, differing chiefly in their embryos; but they have no milky juice, and are widely different in appearance. From the Morads, they are hardly distinguishable . . ." His remark on the family *Artocarpaceae* is very interesting: "The massive heads into which the fruits of the Breadfruit trees are collected represent the typical condition of the genera of this Order . . . The Artocarpads will be distinguished from the Hempworts and the Morads by their straight embryos with their large cotyledons . . . From the Nettleworts the difference is rather one of habit than of real structure, as far as our information at present goes. Brown, indeed, who first proposed the Order, stated that the ovule was erect, which however, is not the case in either *Artocarpus* or *Maclura* . . . Perhaps the large convolute stipules may form a further characteristic of Artocarpads."

This clearly shows that Lindley realised very well the lack of distinguishable characters in the *Artocarpaceae*. It is very surprising that, on the one hand, he delimited *Urticaceae* from the rest on the basis of the ovules mainly; and on the other hand, he allowed this very important structure to be superseded in taxonomic value by the so-called fleshy inflorescence in the *Artocarpaceae*.

In the following year, 1847 to be precise, Trecul revised this very troublesome family *Artocarpaceae*. (He used the older name

Artocarpeae.) This family was divided by him into six tribes: *Conocephaleae, Pouroumeae, Euartocarpeae, Olmedieae, Ficeae* and *Brosimeae* whose tribal characters he very clearly laid out in a synoptic chart.

The tribe *Conocephaleae,* evidently based on Blume's *Conocephalus,* was set by him apart from the rest of the *Artocarpaceae* on the basis of the ovules which are basal and orthotropous. The second tribe, *Pouroumeae,* which contains only one genus, *Pourouma,* was distinguished by him from the others on its semi-anatropous and laterally fixed ovules. All the other tribes were put closer to each other because their ovules are apically fixed. Thus he clearly contrasted the *Conocephaleae* against all the others of the *Artocarpaceae.*

He did not leave the matter as such. He went on to compare the *Artocarpaceae* with the other families and arrived at the following conclusions. With the *Moraceae,* he realised that only the nature of the stamens could be used to delimit them. He maintained that in the *Artocarpaceae,* the filaments are erect excepting the genus *Trophis;* while in the *Moraceae,* they are inflexed excepting the figs. Unfortunately, he failed to realise how useless this filament character is.

Then when he compared the *Artocarpaceae* with the *Urticaceae,* he realised that the tribe *Conocephaleae* is very urticaceous in its female reproductive structures! It was only the nature of the filaments that made him place the *Conocephaleae* in this family.

Trecul thus rendered a great service to the Botany of this group by clearly pointing out the urticaceous nature of the *Conocephaleae.* Besides, he very wisely subjugated the importance of the inflorescence as a characteristic of the *Artocarpaceae;* but in his search for better characters he introduced yet another equally bad character namely the filaments of the stamens. What he should have done was to dissolve the family *Artocarpaceae,* place the tribe *Conocephaleae* in the *Urticaceae* and the rest in the *Moraceae.*

In 1856, Weddell published his monograph of the *Urticaceae* and in the introductory part, he delimited the families of *Urticales* thus:

1. Filaments erect in bud
    2. Flowers hermaphrodite or polygamous ...... *Ulmaceae.*
    2. Flowers unisexual
        3. Herbs with aqueous juice .... *Cannabinaceae.*
        3. Trees or shrubs with latex .... *Artocarpaeae.*
1. Filaments inflexed in bud
    2. Ovules anatropous, pendulous .... *Moreae.*
    2. Ovules erect, basal .... *Urticaceae.*

One can clearly see that Weddell certainly took the suggestions made by Trecul and gave prime importance to the filaments of the stamens. As far as his treatment of the *Urticaceae* is concerned, his system was directly patterned along the lines set up by Gaudichaud in 1826; and he made no effort whatsoever to transfer Blume's *Conocephalus* to *Urticaceae*.

In the years 1869 and 1873, the *Urticales* was revised by various botanists in DeCandolle's Prodromus. In this system, five families were recognised: *Cannabineae, Urticaceae, Ulmaceae, Moraceae* and *Artocarpaceae*. The composition of the families were much the same as those of the earlier botanists. Bureau distinguished the *Moraceae* from the *Urticaceae* by its apically fixed anatropous ovules and the presence of latex, and from the *Artocarpaceae* by the inflexed stamens as had been done by earlier botanists. He could not use the female flowers for delimiting the *Moraceae* from the *Artocarpaceae* as could be done for the Urticaceae, simply because some genera of *Artocarpaceae* agreed in many respects with the *Moraceae* and others *(Conocephaleae)* with *Urticaceae*. In short, Bureau was still seeking the best characters to distinguish *Artocarpaceae*.

In the year 1880, Bentham and Hooker published their "Genera Plantarum". They apparently gave up completely the attempt to distinguish the families of *Urticales* and restored everything back to one family as De Jussieu had done, namely *Urticaceae* (sensu lata). This family was divided by them into eight tribes:

Ovulum Pendulum

Tribe 1. *Ulmaceae:* Flowers mostly hermaphrodite . . . Fruit not a drupe . . . embryo erect.

Tribe 2. *Celtideae:* Flowers unisexual or sometimes hermaprodite . . . Fruit a drupe . . . embryo curved.

Tribe 3. *Cannabineae:* Flowers dioecious . . . stamens erect stamens erect.

Tribe 4. *Moreae:* Flowers unisexual . . . filaments inflexed

Tribe 5. *Artocarpeae:* Flowers unisexual, males or both sexes numerous on fleshy receptacles . . . . . . achenes small.

Ovulum Erectum, Orthotropum

Tribe 6. *Conocephaleae:* Flowers unisexual, stamens erect.

Tribe 7. *Urticeae:* Flowers unisexual, very rarely hermaphrodite; filaments inflexed . . . embryo erect.

Tribe 8. *Thelygoneae:* Not *Urticales!*

For the first time, the *Conocephaleae* is completely removed from the *Artocarpeae*. Bentham and Hooker realised the importance of the ovules in distinguishing the sixth and the seventh tribes from the others.

Engler and Prantl, in 1889, solved the problem differently. They simply brought the *Artocarpaceae* and the *Cannabinaceae* completely into the *Moraceae*. Three families were thus recognised by them: *Ulmaceae, Moraceae* and *Urticaceae*.

They divided the *Moraceae* into four subfamilies: *Moroideae, Artocarpoideae, Conocephaloideae* and *Cannaboideae*. In this system, the genus *Conocephalus* of Blume thus became the type genus of a subfamily! This is the system which many botanists of today adopt.

Now it is fully understandable why the genus *Poikilospermum* in its present concept is both *Moraceae* and *Urticaceae*. A part of this genus which was formerly known as *Conocephalus*, had been gradually brought from tribe *Artocarpeae* to occupy eventually a firm position in the *Moraceae*.

It has been pointed out earlier that this genus is now held to belong to the *Urticaceae*. The problem is solved by splitting the subfamily *Conocephaloideae* into two portions. One portion containing the genera *Cecropia, Coussapoa* and *Musanga* is brought over to the *Urticaceae* as a separate tribe since these genera have the typical basal and orthotropous ovules. The other portion containing the genera *Pourouma* and *Myrianthus* is retained in the *Moraceae*. This will definitely leave the two families clearly distinguished from each other so that *Poikilospermum* can safely be taken as belonging to the *Urticaceae*.

Belonging to the tribe *Boehmerieae*, this genus *Poikilospermum* seems to be related, morphologically, to genera *Touchardia. Debregeasia and Villebrunea.*

Of the three, *Touchardia* seems to be the closest relative, especially with subgenus *Ligulistigma*. While in *Ligulistigma* the inflorescences are bracteate, those of *Touchardia* are not; also, sessile capitulas are never present in the axils of peduncular branches as these are in *Touchardia*. Regarding the genera *Debregeasia* and *Villebrunea*. these differ from *Poikilospermum* chiefly in the perianth of the female flowers. In *Debregeasia,* the perianth is generally succulent at fruit and in *Villebrunea,* it becomes adnate to the fruit. These phenomena are not found in *Poikilospermum*

Geographical Distribution

Poikilospermum is a genus of woody scramblers confined entirely to the Rain Forests of the Indo-Malaysian Formation. The twenty species recognised for this genus are all evergreen, and they flower and fruit practically throughout the year. Riverine and swampy forests or similarly damp habitats of lowlands seem to be their preferences. However, a few collections had been made by some botanists from drier habitats like limestone hills, but these are indeed very rare; while a few others had come from altitude as high as 2,000 metres.

It is necessary that the geographical divisions should be defined before proceeding with the discussion of the phytogeography of the genus. Van Steenis in 1950, laid down the limits of the Malaysian Region which he claimed to be ". . . accepted as a natural geographical unit." The Malay Peninsula, Sumatra, Borneo, the Philippine Islands, Java, Lesser Sunda Islands, Celebes, Moluccas, New Guinea and part of the Bismarck Archipelago are the territories which he accepted as within Malaysia (fig. 7). Siam, Indo-China, Burma and the rest of the mainland of Asia are excluded from it; so are the Solomon Islands, which lie just outside the south eastern boundary. Within Malaysia, three floristic subdivisions are recognised by him. The Malay Peninsula, Sumatra, Borneo and the Philippine Islands are collectively termed Western Malaysia; and the Celebes, Moluccas and New Guinea as well as part of the Bismarck Archipelago make up Eastern Malaysia. The rest, that is Java and the Lesser Sunda Islands, are referred by him as Southern Malaysia.

In this work, the term Malaysia is taken to include the whole of the Bismarck Archipelago. Within Malaysia itself, a slight change is also made. The Philippine Islands are here considered as forming a distinct floristic unit by themselves.

The genus as a whole is mainly centred in Malaysia. North and north-westward, it extends to as far as the Sino-Himalayan Region, that is slightly north of the Tropic of Cancer; and is not found either in Peninsula India or in Ceylon (fig. 8). Neither is it present in the island of Hainan which lies to the south-east of Tonkin. To the south it stops short at Java, and is singularly absent from the Lesser Sunda Islands. The Woodlark Island marks the eastern limit of the genus. This pattern of distribution of the genus fits almost perfectly with that of *Parartocarpus* (*Moraceae*) as drawn by Jarrett with two exceptions. While *Parartocarpus* is totally absent from Continental Asia, *Poikilospermum* is represented there by four species. Then again in the Solomon Islands, *Parartocarpus* is represented but not *Poikilospermum*. The absence of both genera from the Lesser Sunda Islands is perhaps due to the fact that these genera cannot tolerate the dry season of these islands.

The distribution of all the species of *Poikilospermum* is clearly laid out in figure 9 at the base of which are two horizontal columns. The first one shows for each country the total number of species present while the lower column records the number of endemic species.

From this chart, one can clearly see that Borneo has the lion's share of the species. Of a total of twenty, eight have been recorded from this huge island, three of which are endemics. Next comes Sumatra which has seven with also three endemics. The Malay Peninsula, the Philippine Islands and New Guinea have

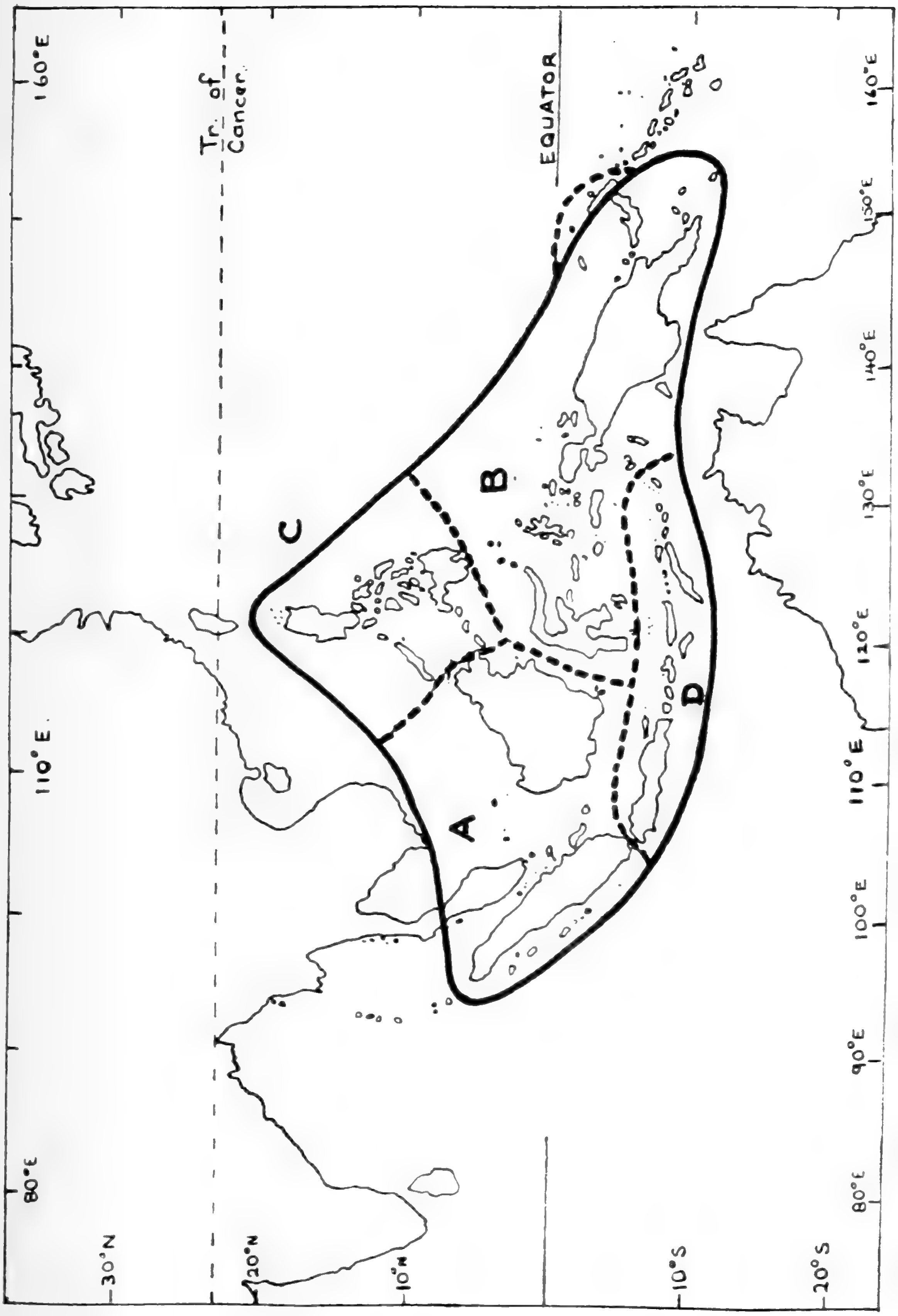


Fig. 7. Floristic divisions of Malaysia. A, Western Malaysia. B, Eastern Malaysia. C, Northern Malaysia. D, Southern Malaysia.

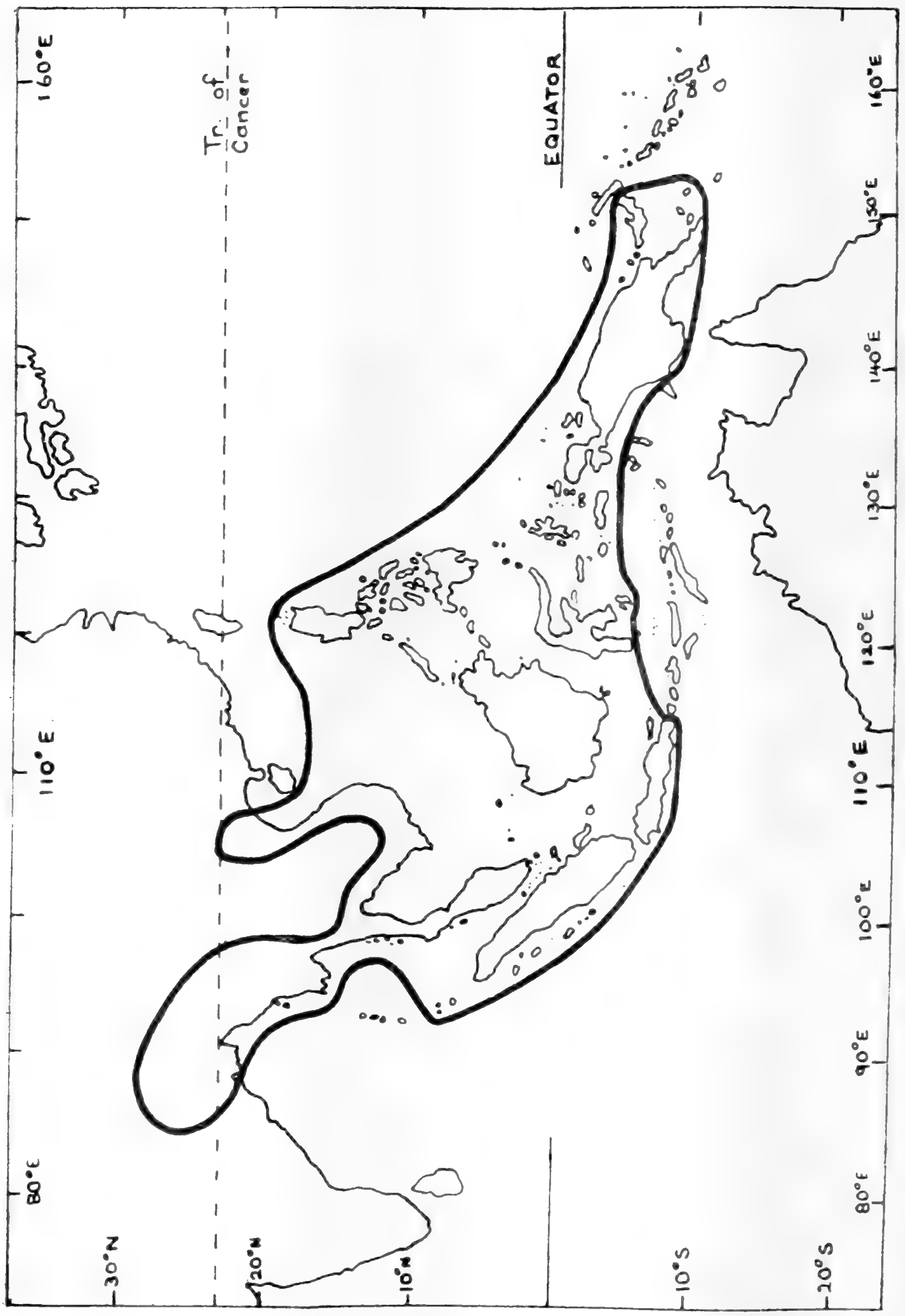


Fig. 8. Distribution of genus *Poikilospermum* Zipp. ex Miq.

Subgenus	SPECIES \ COUNTRIES	ASIA: INDIA	ASIA: BURMA	ASIA: CHINA	ASIA: SIAM	ASIA: INDOCHINA	ANDAMAN IS.	NICOBAR IS.	WESTERN MALAYSIA: SUMATRA	WESTERN MALAYSIA: MALAY PEN.	WESTERN MALAYSIA: BORNEO	PHILIPPINE IS.	SOUTH MALAYSIA: JAVA	SOUTH MALAYSIA: L. SUNDA IS.	EASTERN MALAYSIA: CELEBES	EASTERN MALAYSIA: MOLUCCAS	EASTERN MALAYSIA: NEW GUINEA	EASTERN MALAYSIA: BISMARCK IS.
Subgen. POIKILOSPERMUM	acuminatum											●						
	nobile																●	
	paxianum																●	
	inaequale																●	●
	amboinense															●	●	●
Subgen. LIGULISTIGMA	microstachys								●	●	●							
	tangaum										●							
	oblongifolium										●	●						
	annamense					●												
	cordifolium								●	●	●							
	subtrinervium								●									
	suaviolense	●		●	●	●		●	●	●	●	●	●		●	●		
	erectum											●						
	naucleiflorum	●	●		●													
	singalense								●									
	azureum								●									
	peltatum										●							
	lanceolatum	●	●	●														
	scortechinii								●	●	●							
	scabrinervium										●							
	Total no. species	3	2	2	2	2	NIL	1	7	4	8	4	1	NIL	1	2	4	2
	Endemic species	NIL	NIL	NIL	NIL	1	–	NIL	3	NIL	3	2	NIL	–	NIL	NIL	2	NIL

Fig. 9. Distribution Chart of species of *Poikilospermum* Zipp. ex Miq.

four species each; but while no endemic has been recorded from the former territory, half of the number of species in the latter territories are endemics. In Continental Asia, four species have been recorded. India has three and the rest have two species each. Taken individually, only Indo-China amongst the Continental countries has one endemic species, the rest nothing. On the other hand, if Continental Asia is taken as a unit, three of the four species can be accorded endemic status, namely *P. annamense, P. naucleiflorum* and *P. lanceolatum.*

In short, it can be generalized that this genus has two centres of distribution in Malaysia and a minor one in Continental Asia. The centres in Malaysia are (*a*) The Bornean centre in Western Malaysia and (*b*) The New Guinean Centre in Eastern Malaysia. To realise fully the significance of this generalization, it is necessary to examine critically the distribution pattern of the two subgenera of this genus.

Subgenus *Poikilospermum:* This subgenus has five species: *P. acuminatum, P. nobile, P. paxianum, P. inaequale and P. amboinense.* Of these, only one, *P. acuminatum,* is absent from Eastern Malaysia; it is an endemic of the Philippine Islands (fig. 10). The other four species are totally confined to Eastern Malaysia, especially in the island of New Guinea. It will be recalled that the species *P. acuminatum* is very odd in that it combines characters of the two subgenera *Poikilospermum* and *Ligulistigma* and is the only species of the former subgenus to approach the latter in circumscription. It is indeed very significant that this species should be confined to the Philippine Islands.

Regarding the other four species of Eastern Malaysia, all have been recorded from New Guinea. Two of these, *P. nobile* and *P. paxianum,* are endemics. It was Ridley who described *P. nobile* from only two collections made in South New Guinea. Up till now, no subsequent collection of it has yet been made. The other endemic species, *P. paxianum,* has so far been collected from Central New Guinea. The area covered by this species is certainly much larger than that of the former. The third species, *P. inaequale,* covers even a larger area. It is not only found in the north-eastern half of New Guinea, but also found in the western half of the island of New Britain. The fourth species *P. amboinense,* is the most widespread and extends from New Britain in the east, right across the north-eastern two-thirds of New Guinea to as far west as Ceram and Boeroe in south Moluccas. The reasons for the absence of *P. amboinense* from the south-western part of New Guinea are hard to find. It cannot be entirely due to the lack of exploration of this part since the north-western peninsula of New Guinea, from which this species has been recorded, is as much unexplored as the south-western. It is probably due to a combination of two factors: lack of exploration as well as the scarcity of the species from that region.

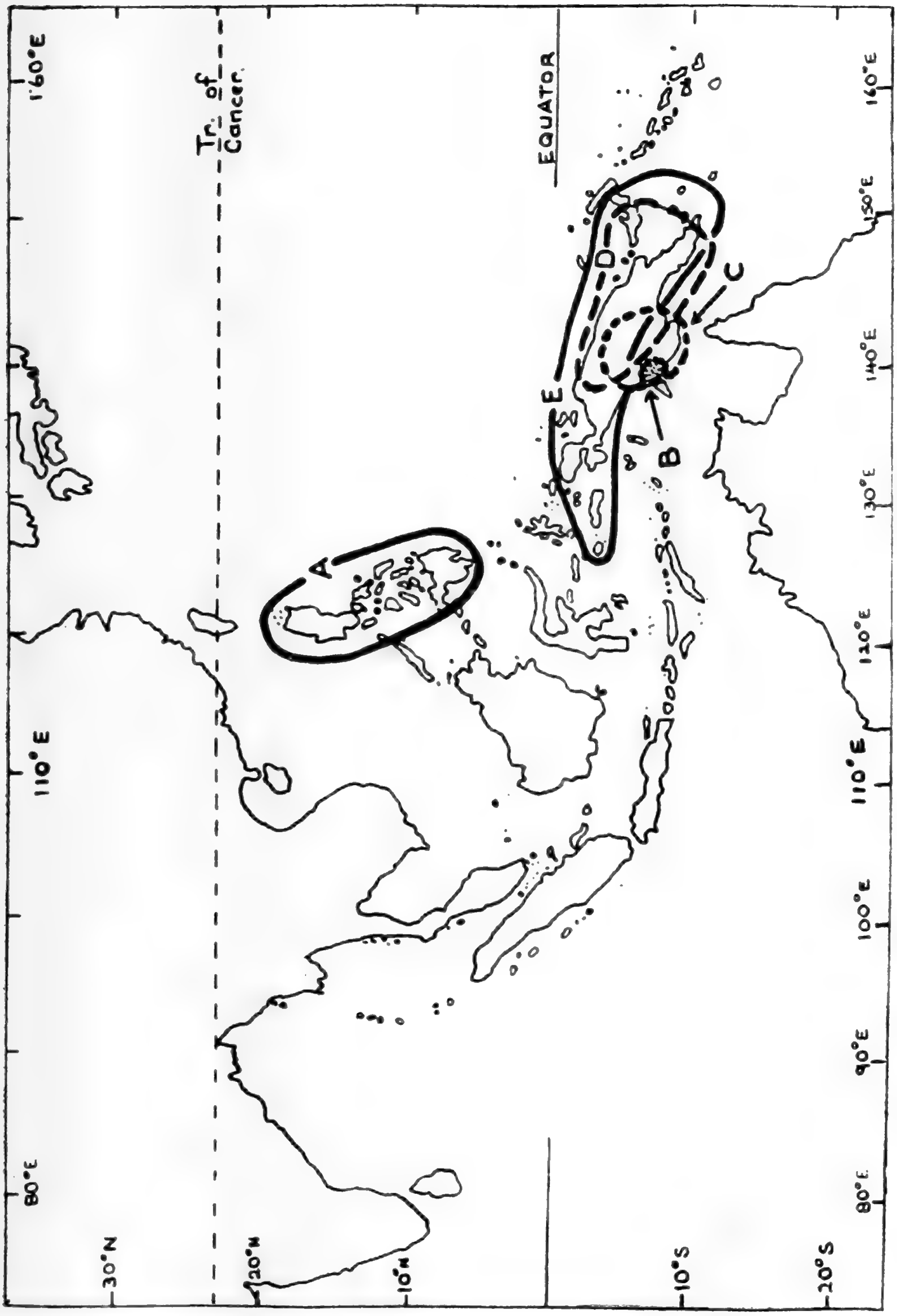


Fig. 10. Distribution of: *P. acuminatum* (A); *P. nobile* (B); *P. paxianum* (C); *P. inaequale* (D); *P. amboinense* (E).

The subgenus *Poikilospermum* therefore shows a discontinuous pattern of distribution. The main part of it is centred in New Guinea while the other part, which contains only one species, is endemic in the Philippine Islands.

Subgenus *Ligulistigma:* Fifteen species have so far been record ed for this subgenus. It is to this subgenus that the species with the widest distribution belongs, namely *P. suaveolens*. As shown in figure 11, this species occurs practically everywhere in Western Malaysia, the Philippine Islands and Celebes; but in Continental Asia, Southern Malaysia and the Moluccas, it occurs only in some parts. Its absence from the Lesser Sunda Islands is probably due to the presence there of a distinct dry season. In Continental Asia. its absence from Burma and the interior of Siam is probably due to the fact that these places are still very poorly explored. Consistent with its wide distribution, this species is the most variable, morphologically, in the genus (see notes under the specific description). Also, in each country, this species is given a different vernacular name. For instance, it is known as Chentawan, Sentawan or Mentawan in Malaya. In the Philippines it is known as Anopo, Anopol or Hanopol while in Java it is known as Kekkegoan aroy.

The other fourteen species are segregated fairly well into two distributional areas. Three species, *P. annamense, P. naucleiflorum* and *P. lanceolatum* are confined to Continental Asia while the others are mainly Western Malaysian species with few extensions to the Philippine Islands. Of the Continental species, *P. annamense* seems to be the most restricted. As shown in figure 12, it has so far been recorded from Annam in Indo-China. The other two species, *P. naucleiflorum* and *P. lanceolatum,* are centred around the Sino-Himalayan region. Only *P. naucleiflorum* has so far been recorded from Peninsular Siam close to the north-western boundary of Malaysia. In other words, if Continental Asia is taken as a unit, it has three endemic species. This explains the reason for an earlier statement that Continental Asia can be taken to be a minor centre of distribution of *Poikilospermum.*

Regarding the Western Malaysian centred species, seven are endemics. Three of these are confined to Sumatra namely, *P subtrinervium, P. singalense* and *P. azureum* (fig. 13); another three in Borneo namely *P. peltatum, P. tangaum* and *P. scabrinervium* (fig. 14); and one in the Philippines i.e. *P. erectum* (fig. 15). The species *P. oblongifolium,* first recorded from Borneo by Beccari, is the only other Western Malaysian species apart from *P. suaveolens* to have managed to reach the Philippine Islands—and only the southern island of Mindanao (fig. 15).

Lastly, there are three species of this subgenus which show very similar distributional patterns. These are *P. microstachys. P. cordifolium* and *P. scortechinii* (fig. 16). They cover almost the same area except that (*a*) *P. microstachys* is found throughout Borneo while the others are mainly north Bornean, and (*b*) *P. scortechinii* seems rather scarce in North Sumatra.

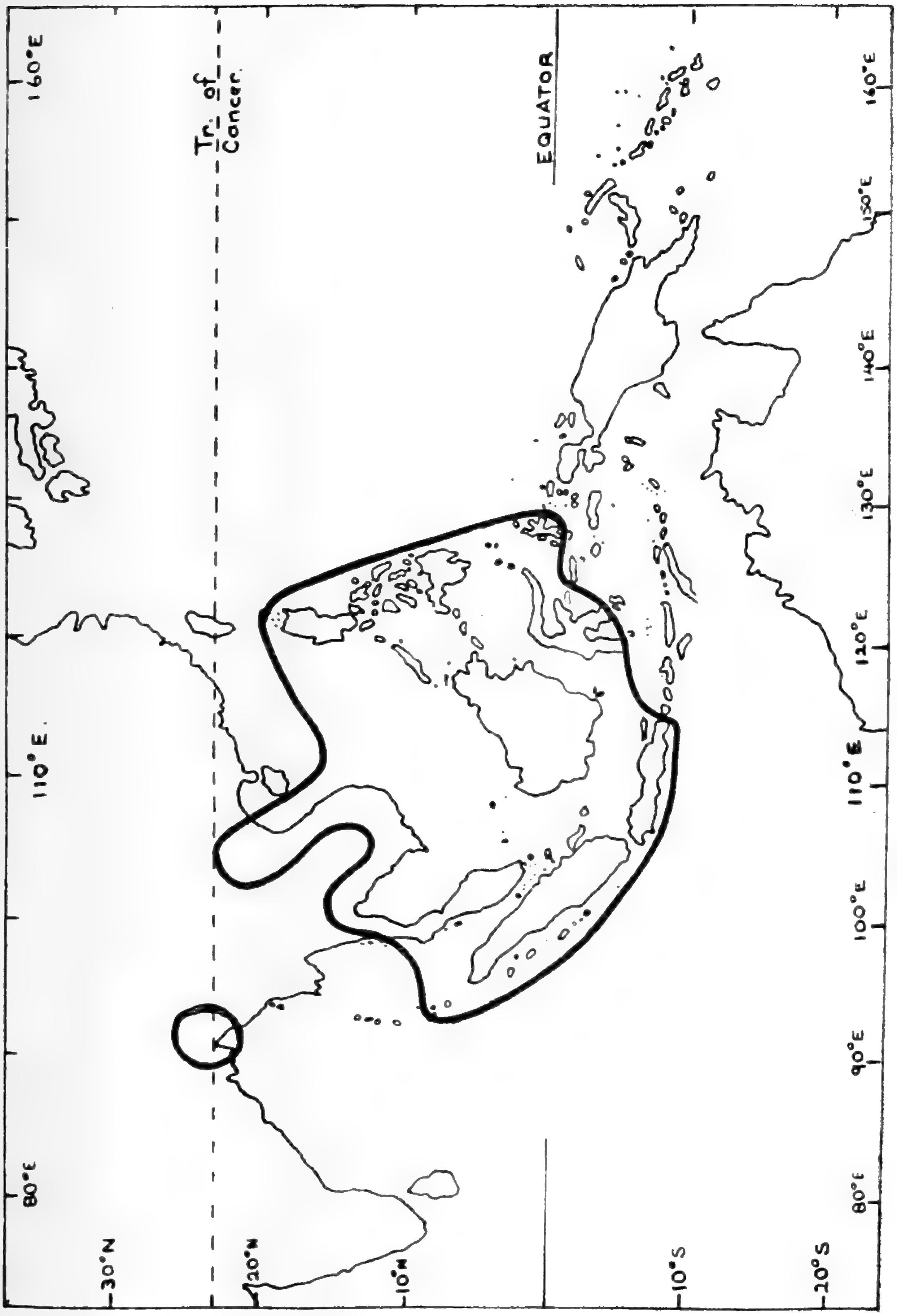


Fig. 11. Distribution of *P. suaveolens.*

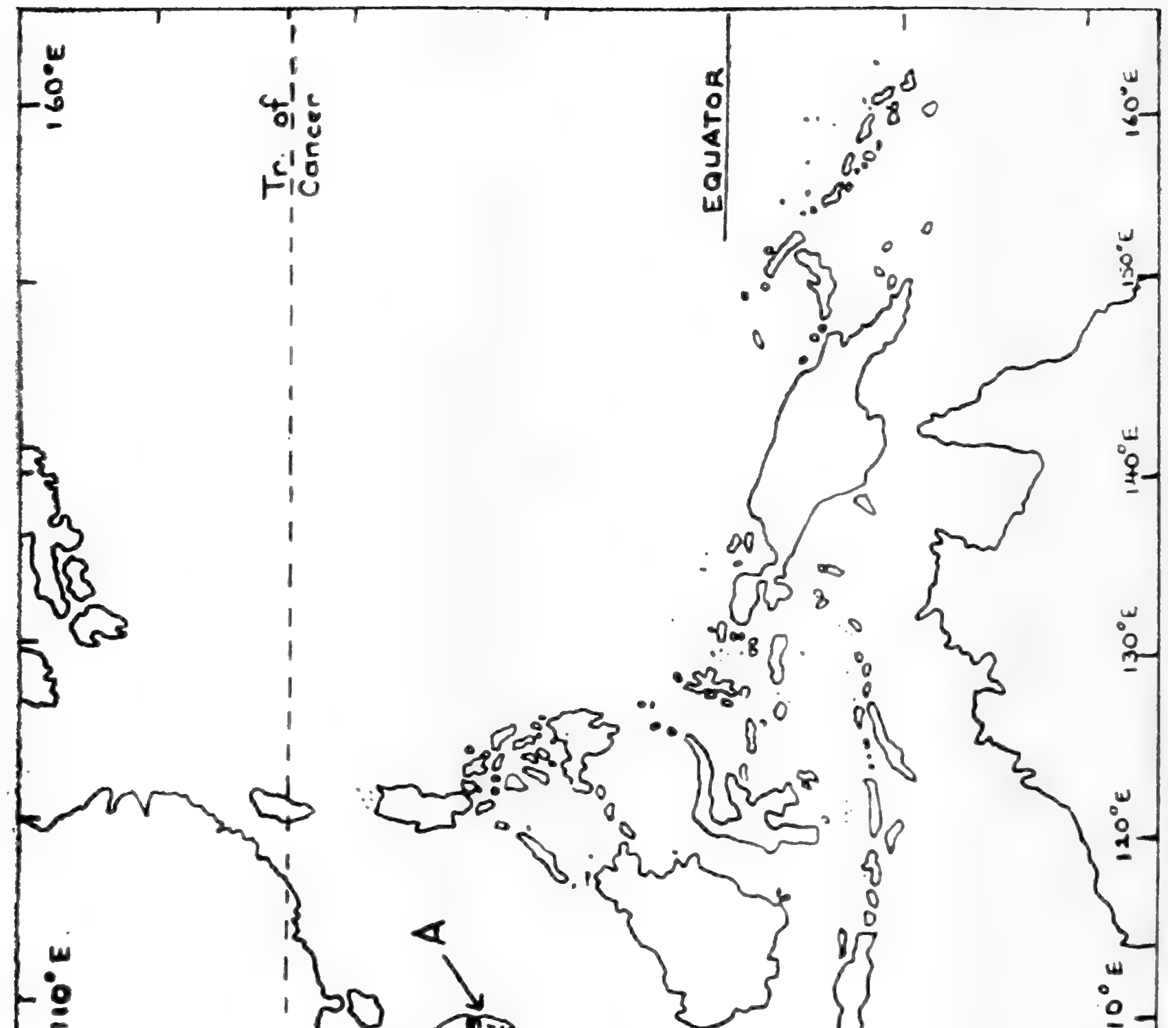


Fig. 12. Distribution of: *P. annamense* (A); *P. naucleiflorum* (B); *P. lanceolatum* (C).

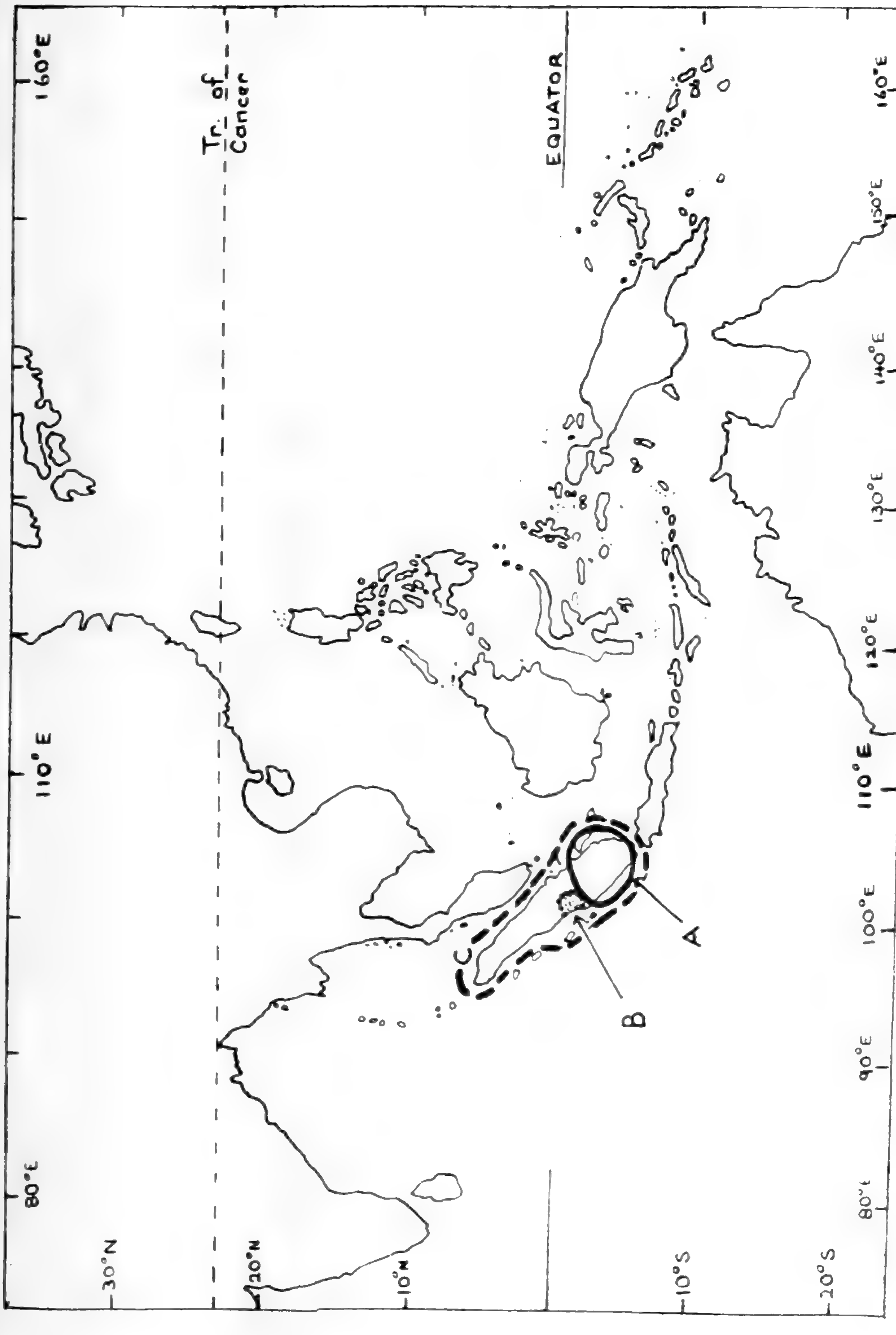


Fig. 13. Distribution of: *P. subtrinervium* (A); *P. singalense* (B); *P. azureum* (C).

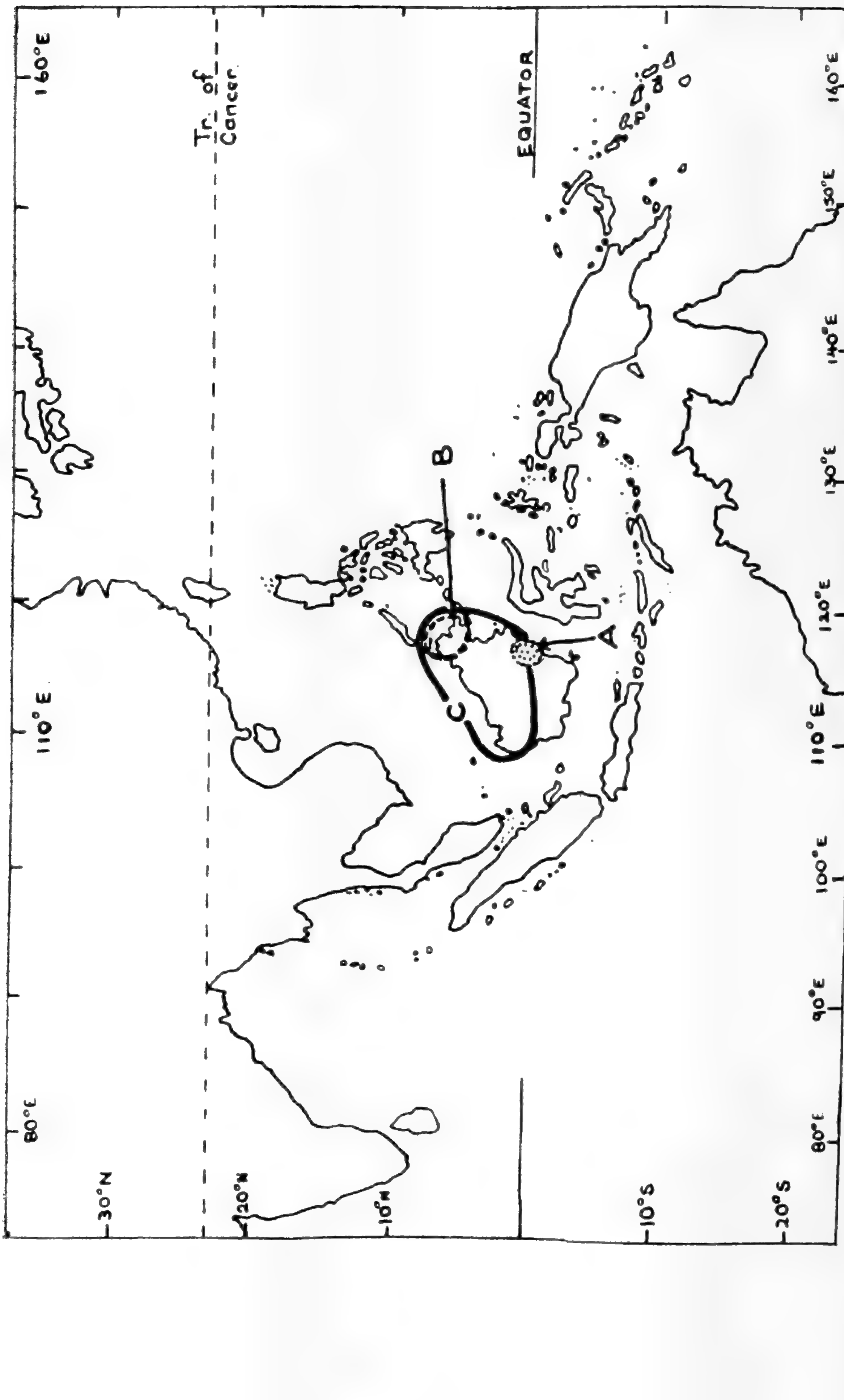


Fig. 14. Distribution of: *P. peltatum* (A); *P. tangaum* (B); *P. scabrinervium* (C).

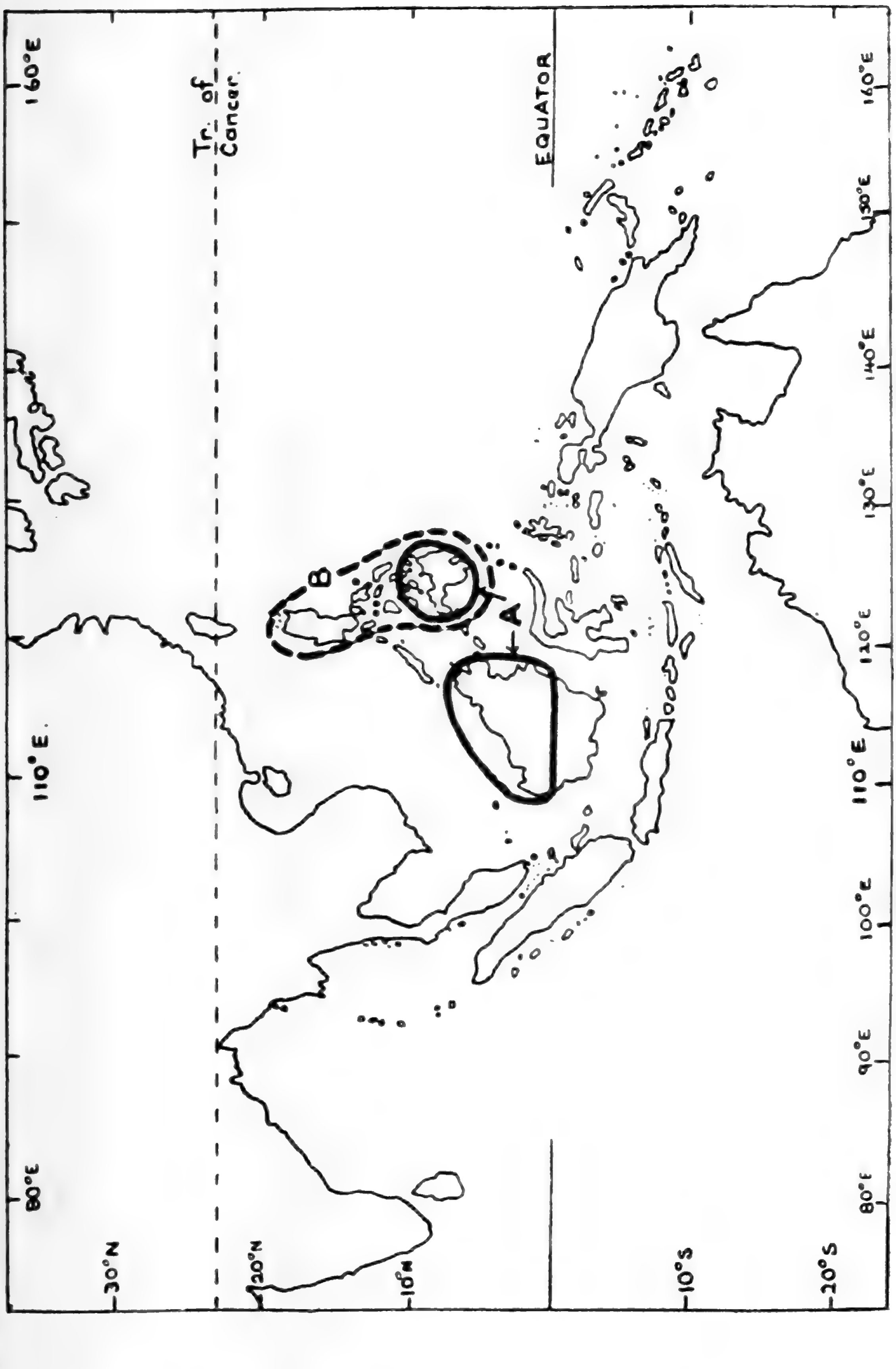


Fig. 15. Distribution of: *P. oblongifolium* (A); *P. erectum* (B).

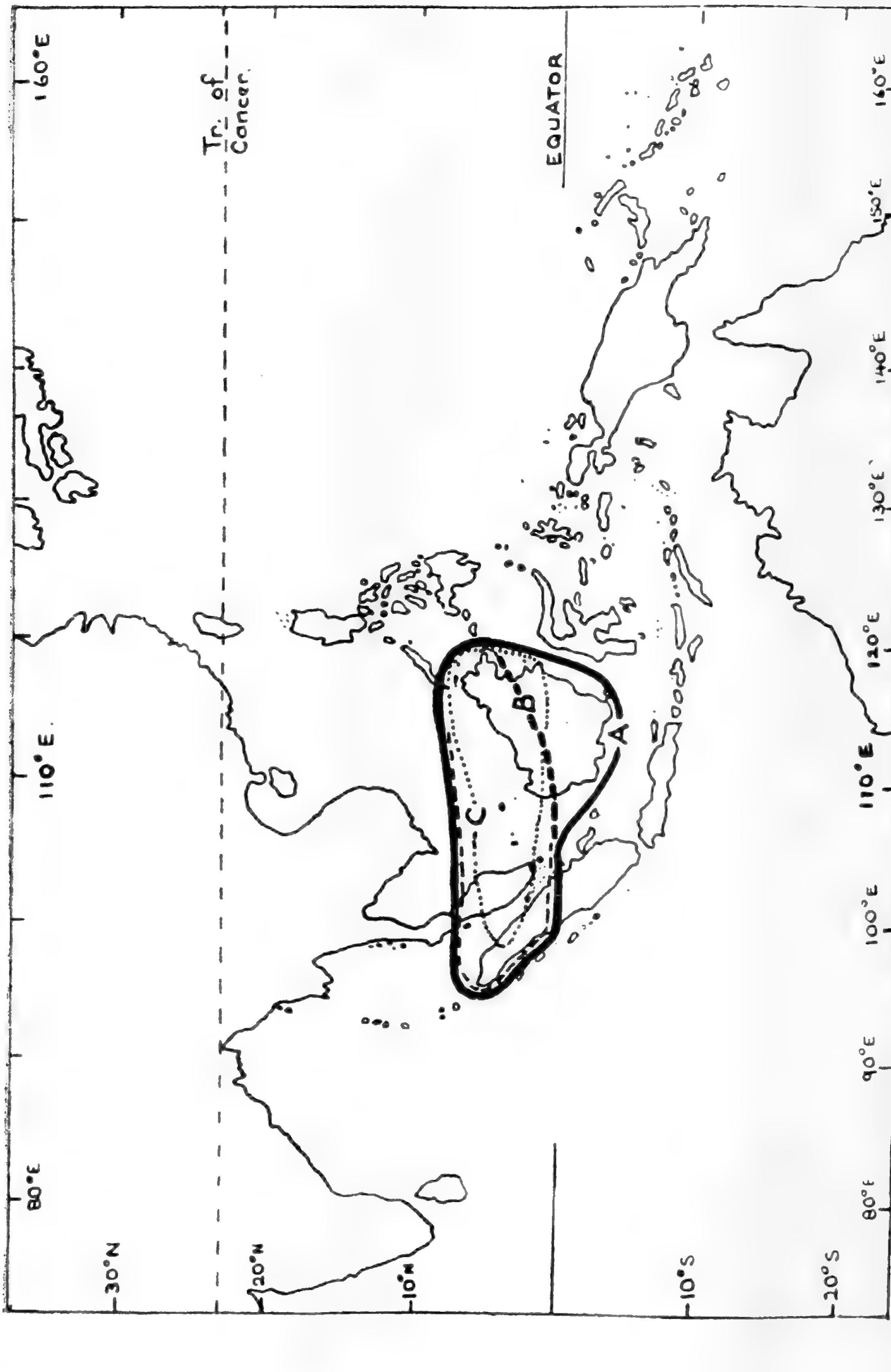


Fig. 16. Distribution of: *P. microstachys* (A); *P. cordifolium* (B); *P. scortechinii* (C).

From the details given above, one can clearly see that the Poikilospermum-flora of Continental Asia and Western Malaysia is wholly dominated by the species of subgenus *Ligulistigma,* one of which has even managed to cross the so-called "Wallace's Line" into Eastern Malaysia.

In general, one can conclude that the genus *Poikilospermum,* though small, does in fact bear out the floristic nature of Malaysia remarkably well. The Malaysian Archipelago has been claimed by numerous botanists to be a fairly natural phytogeographical unit. The distribution of *Poikilospermum* can therefore be an added evidence of this claim for it is essentially a Malaysian genus with only a slight extension to Continental Asia.

About the subdivisions of Malaysia itself, there have been considerable differences of opinion although most people agree generally that Malaysia can primarily be divided into a Western subdivision (or Sundaland) and an Eastern one (or Sahulland). Van Steenis (1950) divided, as mentioned earlier, Malaysia into three parts: Western Malaysia, Eastern Malaysia and Southern Malaysia basing his evidence on the generic distribution of lowland flowering plants. Southern Malaysia, according to him, has a relatively poor flora. This is certainly shown very well by the distribution of *Poikilospermum.* Of a total of twenty species, only one, *P. suaveolens,* and a very widespread one too, occurs in Southern Malaysia.

Regarding Western and Eastern Malaysia, much evidence has already been gathered to maintain that the floras of these two regions are rather dissimilar. Merrill (1926) stated, "In considering Malaysia as a whole, it is clear that two secondary centres of origin and distribution have been established since the break-up of the Cretaceous continental area. One of these is composed of Sunda Islands or Sundaland; the other is New Guinea or Papualand." The distribution of *Poikilospermum* clearly justifies this statement. It has been found that subgenus *Ligulistigma* dominates the Poikilospermum-flora of Western Malaysia, while the counterpart in Eastern Malaysia is subgenus *Poikilospermum.*

Lastly, the Philippine Islands. Geologically, these islands do not properly lie within the Sundaland, and yet, as pointed out by Merrill, the flora is certainly very closely allied with that of Western Malaysia. However, he also noted that there are other elements present in the Philippines which are closely related with those of Papualand. Airy-Shaw (1941) suggested that it would be better to consider the Philippines as constituting a separate subdivision of Malaysia ". . . in view of the very considerable affinities shown by certain other elements in the Philippine flora with Celebes, the Moluccas and New Guinea." to quote his words. Jarrett (1956), basing on the distribution of *Artocarpus* (*Moraceae*), also maintained that these islands should belong to a separate subdivision. The distribution of *Poikilospermum* clearly supports the separation of these islands from others of Malaysia. It is no doubt true that the Poikilospermum-flora of these islands is a mixture of both Sundaland and Papualand elements; but on closer examinations, those occurring in the Philippines do show some distinction. To begin with, there are four species of this genus present in these islands. Two of these are endemics: *P. acuminatum* (subgenus *Poikilospermum*) and *P. erectum* (subgenus *Ligulistigma*). The other two, *P. oblongifolium* and *P. suaveolens* are doubtless species mainly centred in Western Malaysia; but the Philippine populations of these are somewhat different from their Western Malaysian counterparts. For example, the Philippine populations of *P. oblongifolium* seem to have, in the male flowers, pistillodes with rather swollen and globular heads whereas such pistillodes have not been observed in those of Borneo. Two geographical subspecies could easily have been established for it but for the fact that not much material has been available to assess the reliability of this character. With *P. suaveolens*, the Philippine populations tend to have leaves that are never so coriaceous as those of Western Malaysia; besides, their twigs seem to be more lenticellate than those of, for example, populations of the Malay Peninsula.

For these reasons, it is preferred in this work to treat the Philippine Islands as forming a distinct subdivision of Malaysia as had been done by Jarrett (1956). Perhaps, we can call the Philippine subdivision North Malaysia.

POIKILOSPERUM Zipp. ex Miq.

Poikilospermum Zipp. ex Miq. Ann. Mus. Bot. Ludg.—Bat. **1:** 203 (1864); Wedd. DC. Prodr. **16** (1): 235[15] (1869); Baillon, Nat. Hist. Pl. **3:** 529 (1874); Benth. et Hk. f. Gen. Pl. **3:** 389 (1880); Engl. in Engl. et Prantl, Pflanzen. **3** (1): 114 (1889); Merr. Contr. Arnold Arbor. **8:** 47 (1934); Backer, Bek. Fl. Java **6:** 53 (1948).

TYPE SPECIES: *P. amboinense* Zipp. ex Miq.

Conocephalus Bl. Bijdr. 483 (1825), non Necker (1790); Endlich. Gen. Pl. 281 (1836–1840); Trec. Ann. Sci. Nat. ser. 3. **8:** 87 (1847); Miq. Fl. Ind. Bat. **1** (2): 283 (1859); Bur. DC. Prodr. **17:** 284 (1873); Kurz, For. Fl. Br. Burm. **2:** 429 (1877); Benth. et Hk. f. l. c. 380; Baillon, l. c. **6:** 215 (1880); Hk. f. Fl. Br. Ind. **5:** 545 (1888); Engl. l. c. 93; Warb. Bot. Jahrb. **18:** 189 (1894); Barg.—Petr. Nuovo G. Bot. Ital. n. ser. **9:** 213 (1902); Renner, Bot. Jahrb. **39:** 407 (1907); Winkl. Bot. Jahrb. **57:** 595 (1922); Ridl. Fl. Mal. Pen. **3:** 356 (1924); Gagnepain, in Lecomte, Fl. Gen. Indo-Chine **5:** 830 (1929).

Balansaephytum Drake, Bull. Soc. Bot. France **43:** 83 (1896).
Conocephalopsis Kuntze, Rev. Gen. Pl. **3** (2): 136 (1898).

Dioecious woody scramblers. Twigs with smooth to split periderm. *Lamina* variable in shape and size; always simple, entire and spirally arranged; petiolate; usually coriaceous; cystoliths of adaxial surface arranged in circular groups, those of abaxial surface arranged along veins, either punctiform or elongate in shape. *Petioles* variable in length, canalised on upper surface; periderm smooth, cystoliths visible or not, or split into copper-brown flakes. *Stipules* connate, intrapetiolar, always canalised on the back; usually very coriaceous, sometimes woody; strongly crescentic to long and straight in shape; caducous to persistent. *Inflorescences* axillary, cymose; often solitary, rarely paired to numerous; branched once to many times; peduncles bracteate; peduncular bracts small to large and foliaceous, usually paired; flowers borne crowded together on swollen peduncular receptacles, or in agglomerations without such receptacles or even free; interfloral bracts minute, very often absent; solitary terminal flowers present or absent from the axils of ultimate dichotomies of inflorescences. *Flowers* generally small to minute, unisexual, sessile to long pedicellate. *Male flowers:* perianth glabrous to thick pubescent; tepals 2 to 4, free or slightly gamophyllous, usually strongly incurved at apex; stamens 2 to 4, inserted around the pistillode and opposite to tepals, filaments straight to inflexed; anthers laterally dehiscent; pistillode always present, large to very small. *Female flowers:* perianth glabrous to pubescent, gamophyllous; apex 4-toothed or 4-lobed, the lobes usually 2 + 2 decussate-imbricate; ovary superior, 1-carpelled, unilocular, ovoid to ellipsoid; ovule solitary, basal and orthotropous; stigma subsessile, ligulate, oblique-capitate to peltate-capitate; rudiments of stamens absent. *Fruits* dry, small brownish achenes, ovoid to ellipsoid, pericarp slightly warty; either totally enclosed by perianth or protruding a long way out of it; embryo straight, with rather oblong, equal cotyledons.

DISTRIBUTION: From the Sino-Himalayan Region in Continental Asia, through Malaysia to the Bismarck Archipelago, the eastern-most limit of Malaysia.

KEY TO THE SUBGENERA

1. a. Inflorescences non-capitate; male inflorescences with solitary terminal flowers in axils of ultimate dichotomies; filaments inflexed in bud; female flowers with 4-toothed perianths and with capitate, subsessile stigmas; matured achenes usually greatly exserted from the persistent perianths; plants mainly of eastern Malaysia
subgen. Poikilospermum.

b. Inflorescences capitate; without solitary terminal flowers; filaments erect in bud; female flowers with 4-lobed perianths; stigmas ligulate, subsessile; matured achenes usually totally enclosed by persistent perianths; plants mainly of western Malaysia
subgen. Ligulistigma.

Subgenus Poikilospermum

Conocephalus group *Poikilospermum* Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 216 (1902).

Conocephalus subgen. *Poikilospermum* Winkl. Bot. Jahrb. **57:** 595 (1922).

Periderm of twigs not splitting. *Stipules* usually long and straight, very rarely crescentic. *Male inflorescences* free-flowered, rarely with flowers in small agglomerations; solitary terminal flowers present in ultimate dichotomies; peduncular bracts small to large, very rarely foliceous. *Female inflorescences* same as the males excepting the absence of solitary terminal flowers in ultimate dichotomies of species *acuminatum*. *Male flowers* sessile to subsessile, very rarely pedicellate; filaments of stamens inflexed in the bud. *Female flowers* sessile to subsessile, very rarely pedicellate; perianth 4-toothed; stigma oblique-capitate or peltate-capitate. *Achenes* at maturity at least half, often more, exserted from the persistent perianth.

DISTRIBUTION: Plants of the Philippine Islands and Eastern Malaysia.

KEY TO SPECIES OF SUBGEN. POIKILOSPERMUM

1. a. Solitary terminal flowers absent from ultimate dichotomies of female inflorescences, present only in the male; flowers in "incipient" capitula; stigmas oblique-capitate; filaments inflexed at apices only; stipules strongly crescentic .... (1) **P. acuminatum.**

   b. Solitary terminal flowers present in ultimate dichotomies of male and female inflorescences; flowers separate or at most in small agglomerations; stigmas peltate-capitate; filaments usually wholly inflexed; stipules straight, long or only slightly curved .... 2.

2. a. Filaments as broad as tepals; stamens 4; flowers subsessile; lamina very large, at least 40 to 70 cm. long × 18 to 25 cm. broad; obovate; lateral veins very prominent, closely set, more than 18 pairs; intercostals very straight and prominent, very numerous and closely set .... (4) **P. nobile.**

   b. Filaments much narrower than tepals; stamens 2 to 4; flowers sessile, subsessile to pedicellate; lamina small, 8 cm. long × 3 cm. broad, to as large as those of above species, elliptic or ovate i.e. broadest at or below the middle; lateral veins 6 to 16 pairs, rarely 18; intercostals almost not evident, to very many and prominent .... 3.

3. a. Male and female flowers distinctly pedicellate; pedicel as long, sometimes longer, than perianth; peduncles thickly canescent; lamina large elliptic; lateral veins 13 to 18 pairs, closely set; intercostals prominent ....(5) **P. paxianum.**

   b. Male and female flowers sessile or subsessile; pedicel shorter than perianth; only the solitary terminal flowers distinctly pedicellate; peduncles glabrous to thickly pubescent, very rarely canescent; lamina variable; lateral veins less than 14 pairs .... 4.

4. a. Perianth of male flowers splitting irregularly into 2 to 5 unequal parts; secondary peduncles of male inflorescences of unequal lengths, very thin and flimsy; flowers free or at most 5 in each agglomeration; usually more than 2 inflorescences at each axil; plants very frail; twigs thin and weak; lamina elliptic; intercostals very faint (3) **P. inaequale.**

   b. Perianth of male flowers splitting regularly into 2 to 4 equal parts; peduncles stouter, secondary ones usually equal in length; more than 5 flowers in each male floral agglomeration; generally less than 2 inflorescences at each axil; plants stout, twigs thick to very robust; lamina variable; intercostals prominent (2) **P. amboinense.**

1. **Poikilospermum acuminatum** (Trec.) Merr. Contr. Arnold Arbor. **8:** 48 (1934).

Conocephalus acuminatus Trec. Ann. Sci. Nat. ser. 3. **8:** 91 (1847); Miq. Fl. Ind. Bat. **1** (2): 284 (1859); F.-Villar, Novis. App. Fl. Philipp. Blanco 203 (1880); Vidal, Phan. Cuming. Philipp. 146 (1885) et Rev. Pl. Vasc. Filip. 255 (1886); Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 221 (1902); Winkl. Bot. Jahrb. **57:** 596 (1922); Merr. Enum. Philipp. Fl. Pl. **2:** 70 (1923).

Procris grandis Wedd. Arch. Mus. Hist. Nat. **9:** 337 (1856) et DC. Prodr. **16** (1): 193 (1869); Miq. l.c. 249; Vidal, Phan. Cuming. Philipp. 146 (1885) et Rev. Pl. Vasc. Filip. 256 (1886).

Conocephalus grandifolius Warb. in Perkins, Frag. Fl. Philipp. 167 (1904); Merr. l.c. 71.

Conocephalus warburghii Elmer, Leafl. Philipp. Bot. **1:** 278 (1908).

Conocephalus diffusus Merr. Philipp. J. Sci. **9:** 355 (1914) et Enum. Philipp. Fl. Pl. **2:** 70 (1923), incl. vars.

Conocephalus mollis Merr. Philipp. J. Sci. **18:** 51 (1921) et Enum. Philipp. Fl. Pl. **2:** 71 (1923).

Conocephalus grandis (Wedd.) Merr. Enum. Philipp. Fl. Pl. **2:** 70 (1923).

Poikilospermum diffusum (Merr.) Merr. Contr. Arnold Arbor. **8:** 49 (1934).

Poikilospermum grande (Wedd.) Merr. l.c. 50.

Poikilospermum grandifolium (Warb.) Merr. l.c. 50.

Poikilospermum molle (Merr.) Merr. l.c. 51.

Poikilospermum warburghii (Elmer) Merr. l.c. 52.

TYPE SPECIMENS:—*C. acuminatus* Trec.: *Cuming 755*, Philippine (Holotype: P; isotypes: C, CGE, FI, G & LE). —*P. grandis* Wedd.: *Cuming 1730*, Samar (Isotype: BM). —*C. grandifolius* Warb.: *Haenke s.n.*, Luzon, Philippines, 24 Mai 1897 (Holotype: B).—*C. warburghii* Elmer: *Elmer 8973*, Baguio, Luzon, Philippines, March 1907 (Isotypes: FI & G).—*C. diffusus* Merr.: *Wenzel 857*, Leyte, Buenavista, Philippines, 6 June 1914 (Isotypes: BM & G). — *C. mollis* Merr.: *Ramos Bur. Sci. 17582*, Samar, Ambalete, Philippines, 7 April 1914 (Isotype: K).

Twigs 0.5–1 cm. diam.; periderm lightly fissured, not splitting into sheets or small copper-brown flakes; glabrous to lightly pubescent; stipular-scars quite prominent; grey-white in dry state. *Lamina* 15–25 cm. long, 7–16 cm. broad; ovate, broad ovate to rhombic, very rarely elliptic; quite coriaceous; glabrous to dense hairy; base cuneate, round to profound cordate; apex sharp acuminate; lateral veins straight, 9–11 pairs, basal pair usually prominent; intercostals numerous, straight, quite distinct. *Petioles* 4–9 cm. long, quite thin; periderm not splitting, smooth, often with visible cystoliths; glabrous to fairly dense hairy. *Stipules* 2.5–5 cm. long; strongly crescentic, coriaceous, very rarely woody; glabrous, very rarely hairy; often very persistent. *Male inflorescences* often to as much as 20 cm. across, very widespread; solitary; branched dichotomously 8–9 times; primary peduncles 2–4 cm. long, secondary ones as long or sometimes longer; peduncular bracts early caducous, bract scars prominent; floral agglomerations 2–3 mm. diam., very numerous in each inflorescence; solitary terminal flowers present at the axils of ultimate dichotomies. *Female inflorescences* similarly ramified, as widespread as the males; floral agglomerations also very numerous, each 0.2–0.3 cm. diam.; peduncles as long as those of the males; peduncular bracts also caducous, leaving prominent scars; solitary terminal flowers absent from the ultimate dichotomies; branches of peduncles puberulous. *Male flowers* sessile, 1–1.25 mm. long, 0.75–1 mm. broad; lightly pubescent; perianth with 4 tepals, incurved at the apex; stamens usually 4, filaments slightly inflexed at the apex; pistillode ca. 1.25 mm. long, transparent and columnar; interfloral bracts very minute. *Female flowers* sessile; 0.75–1 mm. long; perianth lightly pubescent, 4-toothed; ovary 0.5–0.75 mm. long; stigma oblique-capitate, brush-like; interfloral bracts very minute. *Achenes* 1–2 mm. long, 0.5–1 mm. broad; with the persistent perianth at the base as a small cup.

ECOLOGY: This species is apparently widespread in the lowland rain forests of the Philippine Islands, and may even be found at altitudes of 1,500 metres. Many collections had been made from secondary forests while Merrill (1923) had recorded its occurrence in the mossy forests on higher mountains. Most collectors seemed to have found these plants growing in damp habitats.

ECONOMIC USES: Apart from some records of potable water having been obtained from cut stems, these plants seem to have neither commercial nor other uses.

VERNACULAR NAMES: Anapul Anopal, Anopo, Bukol, Hanopol, Himbabalud, Opol and Pongau (Philippines).

As apparent from the synonymy, five species have been reduced into this species. These had all been described from Philippine materials.

Trecul, who first applied the specific epithet *acuminatus* to this species, based it on a specimen collected by Cuming from Manila; and this specimen was cited by him as "Cuming 775" in the original description. After having seen the holotype at Paris, and having checked it with Vidal's "Phanerogamie Cumingianae . . .", I realised that Trecul made an error in his type citation. It should have been "Cuming 755".

Procris grandis was described by Weddell in 1856. In 1923, Merrill succeeded in tracing the type specimen of this binomial; he claimed that the type is actually a collection of Cuming from the Philippines and that Weddell made an error by stating that it was a New Guinea plant. Merrill further claimed that it was actually a species of *Conocephalus;* he therefore combined it to *C. grandis*. This was then brought to *Poikilospermum grande* in 1934 when he transferred all species of *Conocephalus* to *Poikilospermum*. I have studied this collection of Cuming at the British Museum and have found it to belong to Trecul's *acuminatum*.

This species *acuminatum* is very distinct. In all the others of the genus, solitary terminal flowers are either present in both sexes or totally absent. In this species, only the males have such terminal flowers and not the females. Vegetatively, this species is very variable. Its lamina may be rhombic, ovate to profound cordate. It may be entirely glabrous to dense pubescent. It is this variability that causes the creation of many "bad" species. For instance, Warburgh's *grandifolius* was based on a plant with large profound cordate lamina. Merrill's *mollis* was certainly the most hairy one of this species.

Winkler (1922) was the first botanist to have realised the intermediate nature of this species between the two subgenera of this genus. The following are the intermediate characters:

(*a*) Flowers neither in large fleshy capitula (subgen. *Ligulistigma*), nor borne freely (subgen. *Poikilospermum*); but on very minute peduncular receptacles.

(*b*) Filaments only slightly inflexed at the apex.

(*c*) Stigmas neither ligulate, nor peltate-capitate; but oblique-capitate

Nevertheless, this species is placed within the subgenus *Poikilospermum* in view of the following characters which are more in accord with it:

(*a*) The presence of solitary terminal flowers in the male inflorescences.

(*b*) Achenes not wholly enclosed by the persistent perianth.

(*c*) The stigmas, though differing from the ordinary very peltate-capitate ones of subgenus *Poikilospermum*, are after all just capitate as opposed to ligulate.

DISTRIBUTION: Philippine Islands

Philippine Islands: *Backer 3508*, Mt. Malailing, 1 June 1914 (SING).—*Clemens 16590*, Mt. Moises, Isabela, Luzon, April 1926 (BM & SING).—*Convocar PNH 2821*, Mt. Isarog, Camarines, Luzon, June 1947 (PNH).—*Cuming 755* (C, CGE, FI, G, LE & P); *1730*, Samar (BM).—*Edano PNH. 34492*, Mt. Malinao, Albay, Luzon, 27 Jan. 1956 (BR, L & PNH); *79378*, Mt. Mapolapola, Camiguin Island, Babuyanes, April 1930 (BO & SING).—*Edano & Gutierrez PNH. 38498*, Mt. Bulusan, Sorsogon, Luzon, May 1957 (L).—*Elmer 6079*, Baguio, Luzon (P); *7832*, Tayabas, Luzon, May 1907 (FI & G): *8725*, Benguet, Baguio, Luzon, March 1907 (FI & G); *8973*, Baguio, Luzon, March 1907 (FI & G); *9227*, Tayabas, Luzon, May 1907 (FI & G); *15296*, Sorsogon, Luzon, Dec. 1915 (C, FI, G & P); *16275*, Sorsogon, Luzon, June 1916 (C, FI, G & P); *17512*, Mt. Maquiling, Laguna, Luzon, June-July 1917 (BM, C, FI, G & P); *17720*, Laguna, Luzon, June-July 1917 (C, FI, G & P); *22002*, Mt. Pinatubo, Pampanga, Luzon, May 1927 (BO, C, G, P & SING).

Fenix 12627, Benguet, Luzon, Nov-Dec. 1910 (C & P); *28269*, Apayao, Luzon, May 1917 (K & P).—*Haenke s.n.*, Luzon, 24 Mai 1897 (B).—*Loher 6910* (M); *6920* (M).—*Mendoza PNH. 18161*, Mayan Volcano, Albay, Luzon, 28 May 1953 (L).—*Mendoza & Convocar PNH. 10485*, Mt. Kabatuan, Surigao, Mindanao, 21 March 1949 (PNH).—*Merrill 1710*, Benguet, Luzon, May 1914 (BM, G, P & SING); *7656*, Benguet, Luzon, May 1911 (BM & P).—*Oro 30803*, Kinatakutan, Tayabas, Luzon, Jan. 1929 (SING).—*Paniza PNH. 9390*, Mt. Upao, Capiz, Panay Island, 6 March 1949 (PNH).—*Ramos Bur. Sci. 17582*, Samar, Ambalete, 7 April 1914 (K); *20585*, Luzon, Feb. 1913 (P); *23714*, Sorsogon, Luzon, July-Aug. 1915 (P); *41588*, Cabalian, Leyte, Dec. 1922 (B & P); *76738*, Penablanca, Cagayan, Luzon, March-May 1929 (SING); *77005*, Mt. Dos Cuernos, Cagayan, Luzon, April 1929 (SING).—*Ramos & Edano 28488*, Tayabas, Luzon, May 1917 (P); *31284*, Capize, Panay, April-May 1918 (P); *45714*, Mt. Alzapan, Tayabas, Luzon, May-June 1925 (B & P).—*Robinson 11979*, Baguio, Benguet, Luzon, May 1911 (BM & K).—*Sinclair & Edano 9584*, Lake Bulusan, Sorsogon, 16 June 1958 (L).—*Sulit PNH. 3641*, Mt. Bulusan, Sorsogon, Luzon, 31 July 1947 (BR & PNH); *PNH. 7044*, Mt. Kakiling, Laguna, 17 May 1947 (L & PNH); *PNH. 14343*, Mt. Cansayao, Catarman, Samar, 3 April 1951 (L & PNH).—*Vanoverbergh 2739*, Bontoc, Luzon, March 1913 (P).—*Wenzel 176*, Leyte, 17 June 1913 (G): *857*, Leyte, 6 June 1914 (BM & G): *908*, Leyte, 20 June 1914 (BM & G).

2. **Poikilospermum amboinense** Zipp. ex Miq. Ann. Mus. Bot. Lugd.-Bat. **1:** 203 (1864); Merr. Contr. Arnold Arbor. **8:** 48 (1934).

Funis muraenarum latifolius Rumph. Herb. Amb. **5:** 68. t. 36 (1750).

Conocephalus amboinensis (Zipp. ex Miq.) Warb. Bot. Jahrb. **18:** 189 (1894); Schum. & Lauterb. Fl. deutsch. Schutzgeb. Sudsee, 289 (1901); Barg.-Petr. Nuovo G. Bot. Ital. n. ser.

9: 227 (1902); Merr. Interpret. Rumph. Herb. Amb. 199 (1917); Winkl. Bot. Jahrb. **57:** 600 (1922), exclud. var. *longifolius*.

Conocephalus papuanus Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 228. t. 13 (1902).

Conocephalus hirsutus Winkl. Bot. Jahrb. **57:** 598. t. 14 (1922).

Conocephalus subscaber Winkl. l. c. 599.

Conocephalus gjellerupii Winkl. l. c. 602.

Conocephalus forbesii Moore, J. Bot. Lond. **63:** suppl. 112 (1925).

Poikilospermum forbesii (Moore) Merr. Contr. Arnold Arbor. **8:** 49 (1934).

Poikilospermum gjellerupii (Winkl.) Merr. l. c. 50

Poikilospermum hirsutum (Winkl.) Merr. l. c. 50.

Poikilospermum subscaber (Winkl.) Merr. l. c. 52.

TYPE SPECIMENS:—*P. amboinense* Zipp. ex Miq.: *Zippelius* sp. fem., Amboina (lost?).—*C. papuanus* Barg.-Petr.: *Beccari 73,* Kapaor, New Guinea (Holotype: FI).—*C. hirsutus* Winkl.: *Ledermann 7916,* Malu, New Guinea, 1912 (Holotype: B).—*C. subscaber* Winkl.: *Ledermann 6723,* Malu, Sepik, New Guinea, 22 March 1912 (Holotype: B; isotype: SING).—*C. amboinensis* var. *crassus* Winkl.: *Moszkowski 12,* Mamberamo, North New Guinea, 20 May 1910 (Holotype: B).—*C. gjellerupii* Winkl.: *Gjellerup 203,* Begowri, North New Guinea, 24 June 1910 (lost?).—*C. forbesii* Moore: *Forbes 3257,* Paso, Amboina, 1882 (Holotype: BM; isotype: LE).

Twigs 0.5–1.5 cm. diam.; smooth to very rough lenticellate; generally glabrous, young ones light pubescent to long hairy; stipular —and petiolar-scars quite prominent. *Lamina* (10–)15–30 (–40) cm. long, (5–)10–15(–20) cm. broad; elliptic, ovate to broad ovate; coriaceous; generally glabrous, young ones lightly pubescent to dense hairy, especially the abaxial surface; base round to profound cordate, very rarely cuneate; apex usually acuminate, long or short; lateral veins 9–13 pairs, prominent; intercostals generally very prominent and straight; cystoliths on the adaxial surface elongate or punctiform. *Petioles* (2–)5–12(–14) cm. long, 0.3–0.5 cm. broad, generally glabrous, smooth, young ones usually pubescent to long rough hairy. *Stipules* 3–7 cm. long, usually straight; glabrous, young ones often lightly pubescent, very rarely rough hairy; persistent to caducous. *Male inflorescences* 2–10 cm. long, 2–20 cm. broad; solitary; branched dichotomously many times; peduncular branches thick, not flimsy, primary ones short to very long, secondary ones usually longer, glabrous to dense canescent; peduncular bracts persistent to early caducous, very large and foliaceous to small; floral agglomerations with more than five flowers each. *Female inflorescences* about same dimensions as the male; solitary; branched dichotomously many times; peduncular branches thick, primary and secondary ones about the same length; indument same as the male; peduncular bracts small to as long as 2 cm., persistent to caducous; floral agglomerations with 3 to 5 flowers each, rarely more. *Male flowers* sessile, rarely subsessile; 1–1.5 mm. long, 0.75–1 mm. broad; perianth generally glabrous, rarely pubescent or canescent; tepals 4, equal sized, slightly gamophyllous at the base; stamens 4, rarely 3 or 2; filaments narrow, rarely broad; inflexed in the bud; pistillode slightly smaller than perianth, variable in shape; interfloral bracts very minute, often totally absent. *Female flowers* sessile to subsessile; ca. 1 mm. long; perianth generally glabrous, very rarely pubescent; minutely 4-toothed; ovary slightly shorter than perianth; stigma peltate-capitate, usually brush-like; interfloral bracts very minute. *Achenes* ca. 2 mm. long, half as broad; with persistent perianth at the base.

ECOLOGY: This species seems to be quite common in riverine forests or close to water courses. It occurs from sea-level to as high as 550 metres (van Royen).

VERNACULAR NAMES: Aideka, Ipoer, Sehpoka and Wali (New Guinea).

This is a very variable species. Nevertheless, Zippelius' description which was published by Miquel, is so clear that there is little difficulty in identifying the specimens cited below as belonging to this species.

The species *papuanus*, described by Bargagli-Petrucci, was claimed by him to be different from *amboinense* in the more elongated lamina and the wider bracts of the female inflorescences. It is now found that in *amboinense* the lamina and peduncular bracts vary greatly in size and shape. Bargagli-Petrucci's *papuanus* is indistinguishable from *amboinense*.

The other three species considered conspecific with *amboinense* were described by Winkler from New Guinea. He delimited them mainly on hairs. As *amboinense* has now been found to vary greatly from glabrous to dense hairy, Winkler's species, *hirsutus, subscaber* and *gjellerupii*, are therefore considered conspecific with *amboinense*.

Regarding the species *forbesii*, Moore, the author, noted that it is nearest to *oblongifolium* which is a species of subgenus *Ligulistigma*. What he actually had was a collection of this species *amboinense*.

DISTRIBUTION: Moluccas, New Guinea and Bismarck Archip.

Moluccas: *Buwalda 5663,* Kp. Kiandorat, G. Kilia, East Ceram, 19 Aug. 1938 (BO, L, LAE & SING).—*Eyma 2637,* Riring-Batoe, West Ceram, 18/19 Jan. 1938 (BO, L & SING); *2795,* Wae Toeba, West Ceram, 4 Feb. 1938 (BO & L); *3219,* Loa Div. 1, G. Loa, West Ceram, 7 April 1938 (BO).—*Forbes 3257,* Paso, Amboyna, 1882 (BM & LE); *3272,* Amboyna, 1882 (BM).—*Kornassi (exp. Rutten) 1138,* Ambon, 15 April 1918 (B).—*Riedel Com. per Dr. Meyer 11/82,* Buru (K).—*Robinson 170,* Amboyna, July/Nov. 1913 (BM & P); *172,* Amboina, July/Nov. 1913 (P & SING).—*Smith 202,* Honimoa, Ceram, 1797 (?) (BM).

New Guinea: *Aet 307,* Sg. Si-era, 19 June 1941 (BO, L & SING).—*Aet & Idjan 808,* Jappen, Biak, 16 Sept. 1939 (L).—*Beccari 73,* Kapaor, Papua, April 1872 (FI); *173,* Sorong, 1872 (FI).—*Brass 25601,* Lebudowa River, Normandy Island, 26 April 1956 (L); *28613,* Kulumadan, Woodlark Isl., 4 nov. 1956 (L); *28937,* Modewa Bay, 20 Dec. 1956 (L).—*Carr 16207,* Kokoda, 23 March 1936 (L); *16419,* Kokoda, 17 April 1936 (L & SING).—*Forbes 685,* Sogeri Region, 1885/1886 (BM & LE). *Gjellerup s.n.* (BO).—*Gray & Floyd 8070,* Seribi River, 20 July 1955 (L).

Hoogland 3284, Amboga River, 11 July 1953 (L); *3633,* Patkiari Village, 15 Aug. 1953 (L).—*Kalkman 3523,* Manowani, 13 June 1956 (L).—*Kanehira & Hatusima 11422,* Nabire, Geelvink Bay, 23 Feb. 1940 (BO); *13413,* Momi, Manokwari, 3 April 1940 (BO).—*Kostermans 2648,* Warnapi, Vogelkop, 23 July 1948 (L); *2788,* Momi, Vogelkop, 16 Aug. 1948 (BO, K & L).—*Lam 404,* Mamberamo, 26 June 1920 (U); *647,* Mamberamo, 17 July 1920 (U); *983,* Mamberamo, 31 Aug. 1920 (U).—*Ledermann 6723,* Sepik, Malu, 22 March 1912 (B & SING); *7916,* sine loc., 1912/1913 (B).—*van Leeuwen 9308,* sine loc., May 1926 (BO); *10173,* Rouffaer River, Aug. 1926 (K & U); *11333,* Mamberamo, Albatross Bivak, Nov. 1926 (K & U); *11374,* Mamberamo, Nov. 1926 (K & U); *11383,* Mamberamo, Nov. 1926 (U).

Meijer-Drees 526, Koode River, Aug. 1938 (L).—*Moszkowski 12,* sine loc., 18 Oct. 1910 (B).—*Pleyte 513,* Kadamak, Sorong, 11 Aug. 1948 (BO, L & SING).—*Pulsford & Floyd 5411,* Dagua, Sepik, 17 Oct. 1953 (BO, L & SING).—*Romer 542,* sine loc., 14 Oct. 1909 (BO).—*Royen 3446,* Steenkool, 23 April 1954 (L); *4943,* Kebar Valley, Api River, 5 Nov. 1954 (L); *5282,* sine loc. (L).—*Thomsen 696,* Mamberamo, 23 April 1914 (U).

Bismarck Archipelago: *Floyd 6693,* Keravat, New Britain, 31 Dec. 1954 (L & SING).

3. **Poikilospermum inaequale** Chew, **spec. nov.**

TYPE SPECIMEN: *Floyd & Womersley 6850,* Baiyer River, Western Highlands, Territory of New Guinea, 26 Nov. 1954 (Holotype: L; isotype: LAE).—**Fig. 17.**

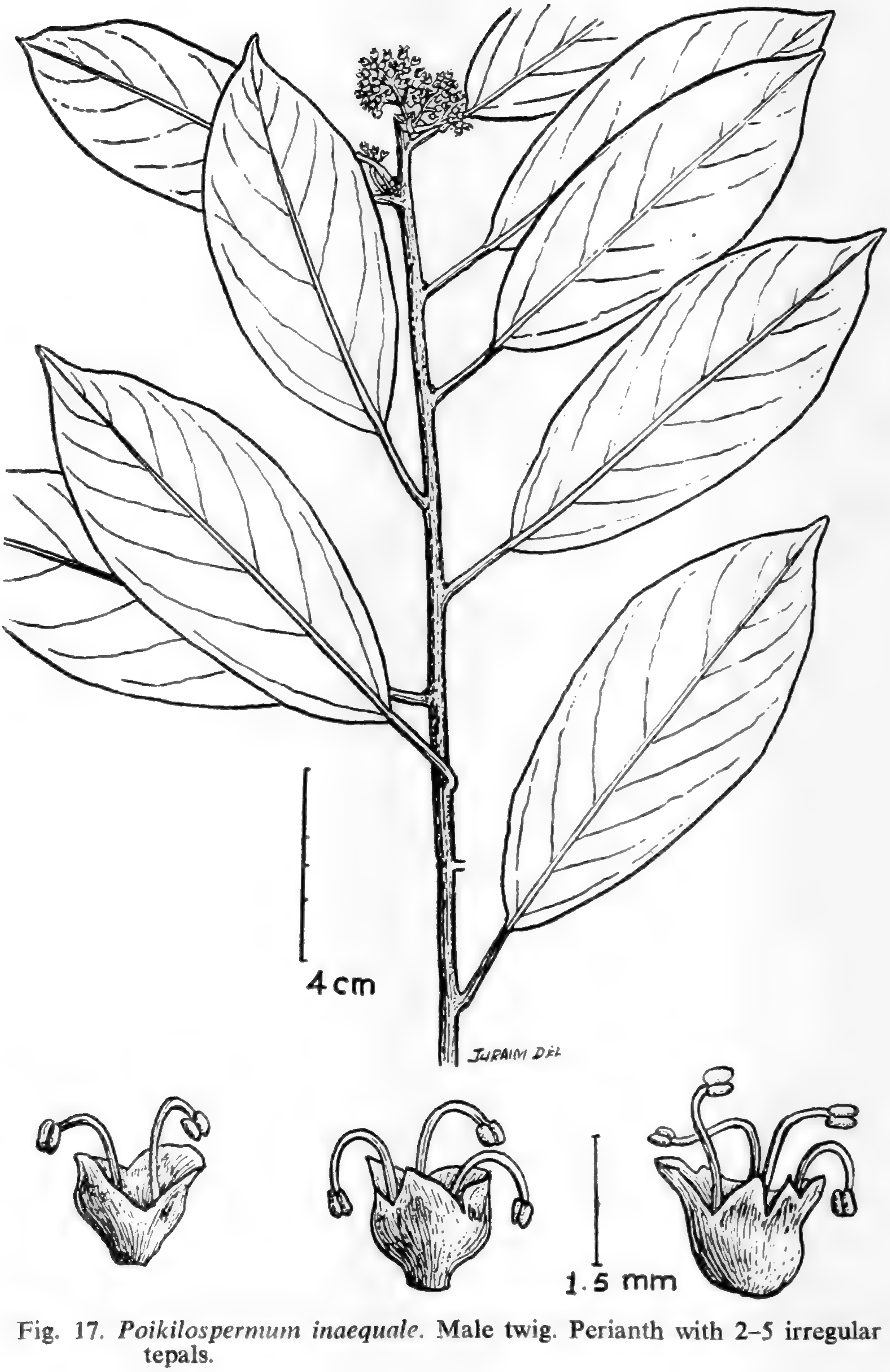


Fig. 17. *Poikilospermum inaequale*. Male twig. Perianth with 2–5 irregular tepals.

Ramuli 0.3–0.7 cm. diam., sparse vel dense lenticellati; paullum pubescentes, mox glabri; cortice fuscescenti levi, mox fisso; cicatricibus stipularum et petiolarum elevatis. *Laminae* ellipticae, raro late ellipticae; (6–) 8–17 (–20) cm. longae, (2–) 4–8 (–10) cm. latae; basi cuneatae, raro rotundatae; apice acuminatae, acumine ca. 2 cm. longo; glabrae; saepe coriaceae; costis lateralibus utrinsecus (8–) 10–13, subtus aliquanto elevatis; intercostis obscuris. *Petioli* (1–) 2–4 (–6) cm. longi, gracillimi, glabri. *Stipulae* 2–3 cm. longae, erectae, lineares, paullum pubescentes, caducae. *Inflorescentiae masc.* 1–3 cm. × 1–3 cm., glabrae vel paullum pubescentes, solitariae, geminatae vel complures; bracteis plerumque persistentibus parvis scaphiformibus; ramulis inaequalibus, gracilibus; floribus 1–5 fasciculatis. *Inflorescentiae fem.* latiores, 4–7 cm. × 4–7 cm.; plerumque paullum pubescentes, solitariae, vel geminatae, rarissime plures; bracteis plerumque persistentibus 0.3–0.6 cm. longis; ramulis aequalibus crassioribus; floribus 1–5, raro pluribus, fasciculatis. *Flores masc.* sessiles, raro subsessiles, plerumque glabri, 1–1.25 mm. longi, ca. 1 mm. lati, bracteolis minutissimis intermixti; perianthio gamophyllo, dein in lacinias 2–5 inaequales fisso; staminibus 4, raro 2 vel 3; pistillodio parvo pellucido. *Flores fem.* sessiles, 1–1.25 mm. longi, ca. 1 mm. lati, glabri; bracteolis minutis tam longis quam parte perianthio quinta; perianthio minutissime 4-denticulato, quam ovario paullum longiori; stigmate crasso peltato-capitato. *Achaenium* ca. 2 mm. longa, 1 mm. lata, e perigonio persistenti semi-exsertum.

ECOLOGY: Most of the collections of this species were from New Guinea Highlands and usually above the 1,000 metre contours, very few being collected below this altitude. It seems to be a common climber in swampy forests.

The main characteristics of this species are found in the male plants. As indicated in the key, this is the only species that has the perianth splitting irregularly at anthesis into unequal parts. Besides, the branches of the peduncle seem to grow at different rates resulting in their unequal lengths at maturity. Hence the epithet *P. inaequale*.

DISTRIBUTION: New Guinea & Bismarck Archipelago.

New Guinea: *Barrett 4212*, Mageni, 10 Aug. 1951 (L).—*Brass 5450*, Bella Vista, 1933 (BO).—*Carr 12079*, Koitaki, 29 April 1935 (L); *13977*, Lala River, 24 Dec. 1935 (L & SING); *15167*, Isuarava, 4 Feb. 1936 (L & SING); *15632*, Isuarava, 18 Feb. 1936 (L & SING); *15728*, Isuarava, 24 Feb. 1936 (L & SING); *15931*, Isuarava, 4 March 1936 (L & SING); *15936*, Isuarava, 4 March 1936 (L & SING).

Clemens 334, Sattelberg, Morobe District, 5 Oct. 1935 (B & L); *612*, sine loc., 24 Oct. 1935 (BR); *8291*, Boana, Morobe Distri., 27 May 1938 (B).—*van Leeuwen 9671*, sine loc. (U).—*White et al. NGF. 1692*, sine loc. (LAE).—*Womersley & Floyd 6804*, Western Highlands (L).

New Britain: *Floyd 6559*, Malalia, 18 Aug. 1954 (L).

4. **Poikilospermum nobile** (Ridl.) Merr. Contr. Arnold Arbor. **8:** 51 (1934).

Conocephalus nobilis Ridl. Trans. Linn. Soc. Bot. **9:** 150 (1916).

Conocephalus albiflora Ridl., nom. nud. in herb.

TYPE SPECIMEN:—*C. nobilis* Ridl. (1916): *Boden-Kloss s.n.*, Camp I, Dutch New Guinea, 1912–1913 (Holotype: BM).—**Fig. 18.**

Twigs unknown. *Lamina* obovate, very large, to 70 cm. long, ca. 25 cm. broad; glabrous throughout; very coriaceous; base broad cuneate; apex short acuminate, or cuspidate; lateral veins more than 18 pairs, all curving towards the apex, very prominent; intercostals very numerous, straight and closely set. *Petioles* 4–20 cm. long, ca. 0.3 cm. broad, smooth and glabrous. *Stipules* unknown. *Male inflorescences* 5 cm. long, 9 cm. broad; solitary; branched dichotomously many times, peduncular branches very short and thick, hence inflorescences very congested; primary peduncles ca. 4 mm. long; all covered with long white hairs; peduncular bracts ca. 1.5 cm. long, foliaceous, persistent. *Male flowers* sessile to slightly subsessile; 1.5 mm. long, half as broad; perianth lightly pubescent at the apex; tepals 4, slightly gamophyllous at the base; stamens 4; filaments as broad as the tepals; pistillode ca. 1 mm. long, transparent, fleshy, broad obpyramidal; interfloral bracts almost absent.

This species is known only from two collections from the Dutch part of South New Guinea; and these collections are still well preserved at the British Museum. Ridley, the author, named the two specimens *C. albiflora*, but in his publication he somehow changed his mind and named them *nobilis*.

Despite the paucity of collections, this species seems to be quite distinct. The shape and veination of lamina of this species is very different from those of all the New Guinea collections I have examined. Besides, this is the only species in the subgenus *Poikilospermum* to have filaments as broad as the tepals.

DISTRIBUTION: New Guinea.

New Guinea: *Boden-Kloss s.n.*, Camp I, Dutch New Guinea, 1912–1913 (BM); *s.n.*, Canoe Camp, Dutch New Guinea, 1912–1913 (Paratype: BM).

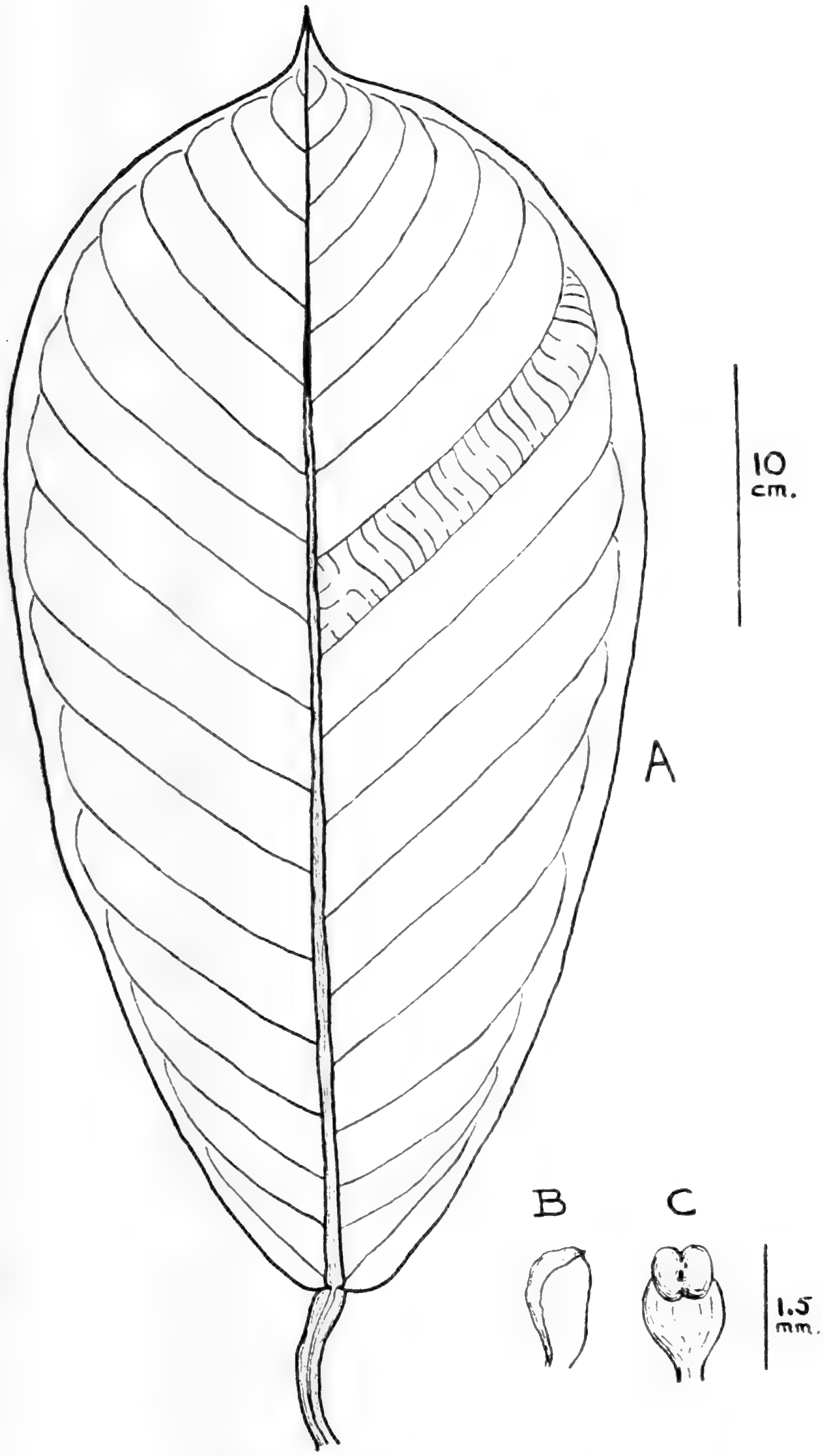


Fig. 18. *Poikilospermum nobile*. A, lamina. B, tepal. C, stamen.

5. **Poikilospermum paxianum** (Winkl.) Merr. Contr. Arnold Arbor. **8:** 51 (1934).

Conocephalus paxianus Winkl. Bot. Jahrb. **57:** 602 (1922).
Conocephalus amboinensis var. *longifolius* Winkl. Bot. Jahrb. **57:** 601 (1922).

TYPE SPECIMENS:—*C. paxianus* Winkl. (1922): *Gjellerup 193*, Nordl. New Guinea, 24 June 1910 (Holotype lost?). —*C. amboinensis* var. *longifolius* Winkl. (1922): *Versteeg 1779*, Sudwestl. Neu-Guinea, 1 June 1907 (Holotype lost?). —**Fig. 19.**

Twigs 0.5–1 cm. diam.; rough lenticellate, young ones often dense canescent, soon glabrous; brown to dirty-grey coloured in dry state; stipular- and petiolar-scars scarcely prominent. *Lamina* 20–40 cm. long, 8–16 cm. broad; ovate to long elliptic; coriaceous; adaxial surface sparse canescent on the veins, abaxial surface usually densely canescent; base broad cuneate to round, very rarely cordate; apex short, abrupt acuminate; lateral veins (13–)15–18 pairs, prominent, closely set, curving towards apex; intercostals numerous, closely set, prominent. *Petioles* 5–12 cm. long, ca. 0.3 cm. broad, young ones lightly to very thick canescent. *Stipules* 3–7 cm. long; quite straight; lightly to densely canescent, especially young ones; often persistent. *Male inflorescences* ca. 4 cm. long, ca. 4 cm. broad; usually solitary; primary peduncles ca. 2 cm. long, secondary ones shorter; all branches rather canescent; peduncular bracts large, persistent, quite canescent; floral agglomerations fairly compact. *Female inflorescences* more wide-spread than the males; ca. 5 cm. long, ca. 7 cm. broad; solitary; primary and secondary peduncles about the same length; all branches glabrous to light canescent; peduncular bracts ca. 0.5 cm. long; floral agglomerations wide-spread. *Male flowers* pedicellate; perianth ca. 1 mm. long; glabrous; tepals 4, slightly gamophyllous at the base; stamens 4, rarely 3; filaments narrow to broad; pistillode small, obpyramidal, transparent; interfloral bracts very minute; pedicels as long as perianth, glabrous to light pubescent. *Female flowers* pedicellate; ca. 1 mm. long, half or less as broad; perianth glabrous, minutely 4-toothed; ovary slightly shorter than perianth; stigma thick peltate-capitate; pedicels 1–1.25 mm. long, rarely shorter; interfloral bracts ca. one-fifth the length of the perianth. *Achenes* ca. 2–3 mm. long, half as broad; greatly exserted from the persistent perianth; pedicel almost as long as achene.

Winkler's description of this species is so detailed that there is no difficulty in equating with it the collections cited below. The most important character that distinguishes it from the others of the subgenus *Poikilospermum* is the presence of distinct pedicels. Besides, the number of lateral veins of the lamina is also quite characteristic.

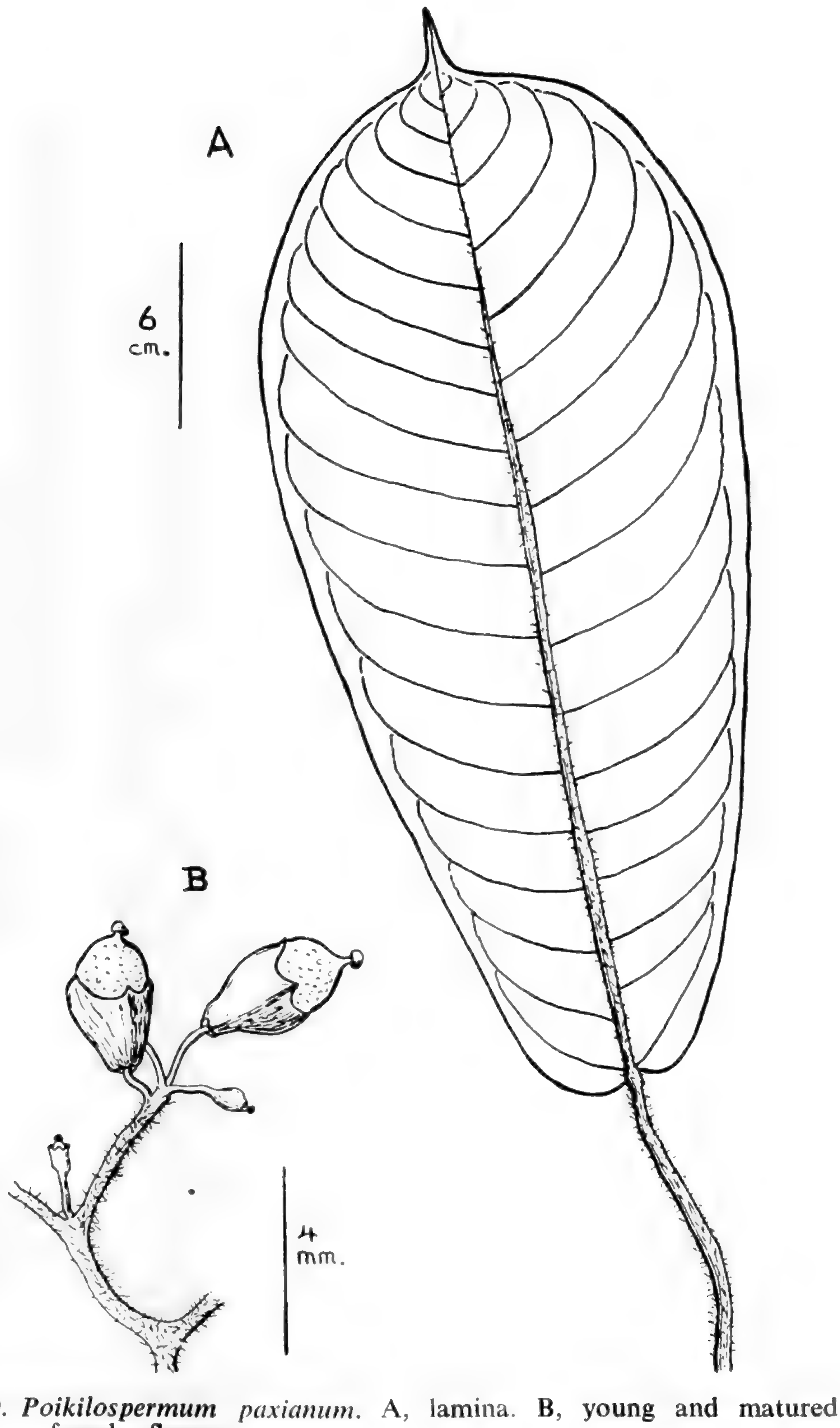


Fig. 19. ***Poikilospermum*** *paxianum*. A, lamina. B, young and matured female flowers.

Winkler noted that this species is nearest to his own *C. hirsutus* (= *P. amboinense*) and that they differ in the hairiness of the lamina as well as in the size of inflorescences. He obviously overlooked the most important character which is now made use of.

As for his *C. amboinensis* var. *longifolius*, the description is so very similar to that of *P. paxianum* that I cannot help regarding this variety the same as *paxianum*.

DISTRIBUTION: New Guinea.

New Guinea: *Brass 6744*, Papua, May 1936 (L).—*Gray & Floyd 8071*, Seribi River, Gulf Division, Papua, 20 July 1955 (L) —*Lam 950*, Pranwenbivak, 29 Aug. 1920 (BO).—*Pullen 1384*, Balek Creek, Ninihok Valley, Sepik District, 30 July 1959 (L).

Subgenus Ligulistigma Chew, **nom. nov.**

Balansaephytum (genus) Drake, Bull. Soc. Bot. France **43:** 83 (1896).

Conocephalopsis (genus) Kuntze, Rev. Gen. Pl. **3** (2): 136 (1898).

Conocephalus group *Diandroconocephalus* Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 216 (1902).

Conocephalus group *Euconocephalus* Barg.-Petr. l. c.

Conocephalus subgen. *Euconocephalus* Winkl. Bot. Jahrb. **57:** 595 (1922).

Periderm of twigs smooth or splitting into lenticellate sheets or copper-brown flakes. *Stipules* usually crescentic. *Male inflorescences* with flowers on swollen peduncular receptacles; solitary terminal flowers absent; peduncular bracts usually paired, small to large and foliaceous. *Female inflorescences* same as the males except with more flowers in each floral capitulum. *Male flowers* sessile; filaments of stamens straight. *Female flowers* pedicellate, sometimes very long pedicellate; perianth 4-lobed; perianth lobes 2 + 2 decussate-imbricate; stigma ligulate. *Achenes* at maturity almost totally enclosed by the persistent perianth.

DISTRIBUTION: Plants of the South-east part of Continental Asia, the Philippine Islands and Western Malaysia; rare in Southern and Eastern Malaysia.

KEY TO SPECIES OF SUBGEN. LIGULISTIGMA

1. a. Inflorescences not repeatedly dichotomous; male floral capitula 2, or if numerous, then arranged in two pseudo-umbellate groups; female floral capitula medium-sized to very large, 2 to 4 in number, very rarely more . . . . 2.
   b. Inflorescences repeatedly dichotomous; male floral capitula very numerous, usually wide spread; female capitula usually small-sized often 8 to many in each inflorescence. . . . . 8.

2. a. Male and female capitula 2 in each inflorescence; Male inflorescences 2 to 5 at each leaf axil; peduncles of both sexes very thin and filiform; lamina large oblanceolate, apex long acuminate; basal pair of lateral veins extremely prominent; stipules persistent, very chartaceous; dried leaves light brown coloured. (11) **P. microstachys.**

   b. Male and female capitula more than 2 in each inflorescence; male ones solitary at each leaf axil with capitula arranged in 2 pseudo-umbellate groups; peduncles usually stout and not thin or filiform; lamina ovate, elliptic, oblong or even obovate; stipules caducous, if persistent usually very woody; dried leaves very rarely light brown. . . . . 3.

3. a. Female flowers subsessile to very short pedicellate; tertiary peduncles of male inflorescences very short, hence male inflorescences appear 2 to 4 capitulate; achenes broad pear-shaped; periderm of twigs splitting into broad smooth sheets; stipules scale-like and usually early caducous. . . . . (20) **P. tangaum.**

   b. Female flowers distinctly pedicellate; tertiary peduncles of male inflorescences longer, hence floral capitula clearly in 2 pseudo-umbellate groups; achenes usually long ellipsoid; periderm of twigs either not splitting or splitting into rough sheets or flakes; stipules usually fairly foliaceous. . . . . 4.

4. a. Pedicels of female flowers not elongating at maturity, usually shorter than achenes; periderm of petioles and twigs not splitting, usually roughly ridged; lenticels few, mostly at nodes; lamina long to short acuminate. . . . . (13) **P. oblongifolium.**

   b. Pedicels of female flowers elongating greatly at maturity, hence longer than achenes; periderm of twigs and petioles usually splitting into either copper-brown flakes or broad white-greyish sheets; smooth periderm usually in plants with acute-apex lamina. . . . . 5.

5. a. Periderm of twigs and petioles not splitting into sheets or flakes; lamina exact ovate, base rounded, apex obtuse, very rarely acute; male inflorescences 4 × 4 cm. overall; female capitula ca. 3 cm. diam.; plants entirely glabrous . . . . (6) **P. annamense.**

   b. Periderm of twigs especially, splitting into copper-brown flakes or into broad white-greyish sheets; lamina variable. . . . . 6.

6. a. Huge-leafed plants; stems, twigs, petioles of large sizes; periderm splitting into large white-greyish and densely lenticellate sheets; lamina with wavy edges; lateral veins very lax and well-spaced; intercostals prominent only at points of departure from lateral veins, the rest often not visible, quite anastomosing. (8) **P. cordifolium.**

   b. Smaller-leafed plants; stems, twigs, petioles of small to medium size; periderm splitting into copper-brown flakes; lamina with smooth edges; lateral veins not lax, but very rigid and slightly arched; intercostals straight, faint to prominent . . . . 7.

7. a. Lamina usually with long acuminate apex, very rarely short acuminate, or even sharp acute, 8 to 14 cm. long; petioles short, ca. 1 to 3.5 cm.; stipules very small, very early caducous; female capitula very rarely exceed 2 cm. diam. at maturity. (19) **P. subtrinervium.**

   b. Lamina commonly with obtuse-apex, very rarely sharp acute, 10 to 40 cm. long; petioles much longer, 4 to 14 cm.; stipules large, usually 2 to 4 cm. long, often persistent; female capitula usually 3 to 7 cm. diam. at maturity . . . . (18) **P. suaveolens.**

8. a. Periderm of twigs splitting into small copper-brown flakes, or into large white-greyish densely lenticellate sheets. . . . . 9.

   b. Periderm of twigs at most longitudinally ridged, but never splitting into flakes or sheets . . . . 13.

9. a. Periderm splitting into large to small, lightly to densely lenticellate sheets; plants of Borneo and the Philippines. .... 10.

b. Periderm splitting into small copper-brown flakes, and not like above; plants of Continental Asia and Sumatra. .... 11.

10. a. Lamina very broad ovate, apex obtuse to acute, abaxial surface usually densely canescent, very rarely glabrous or pubescent, edges of lamina very wavy; lateral veins usually lax and well-spaced; peduncles light to densely canescent; plants of the Philippine Islands. .... (9) **P. erectum.**

b. Lamina elliptic or oblong, apex blunt acuminate, abaxial surface glabrous, edges smooth, not wavy; lateral veins not like those of above species; peduncles at most lightly pubescent, often glabrous; plants of Borneo. .... (20) **P. tangaum.**

11. a. Peduncles, abaxial surfaces of lamina, petioles and twigs without white hairs nor red-stellate ones; these parts at most thickly pubescent; male perianth with dense sharp transparent hairs; plants of Continental Asia. .... (12) **P. naucleiflorum.**

b. Peduncles, petioles and twigs well covered with white hairs intermixed with red-stellate ones; male perianth at most light pubescent, never with hairs of above species; plant of Sumatra. .... 12.

12. a. Perianth not elongating at fruit; pedicels of female flowers usually very short, ca. 1 mm., and hence much shorter than perianth; lamina ovate, with 10 to 13 pairs of very straight and parallel lateral veins .... (17) **P. singalense.**

b. Perianth elongating to twice or more of the length of achene; pedicels of female flowers usually much longer than perianth or achenes; lamina with 14 to 17 pairs of lateral veins; lateral veins usually arched progressively towards apex of lamina. (7) **P. azureum.**

13. a. Lamina very broad cordate, peltate, apex very rounded, base usually 7-veined, lateral veins ca. 10 pairs; periderm of twigs very thick; petioles commonly 15 to 20 (to 26 sometimes) cm. long, usually very twine-like. .... (14) **P. peltatum.**

b. Lamina variable in shape, but never peltate, apex acute to long acuminate, extremely rarely rounded, base at most 5-veined, usually less; periderm of twigs and petioles not thick; petioles not more than 15 cm. long, or if so, never twine-like but rather rigid .... 14.

14. a. Peduncular bracts extremely minute, ca. 0.2 cm. long, persistent, paired, often solitary; female perianth often very broad at apex, hence inverted pear-shaped; lamina lanceolate to diamond-shaped; lateral veins 11–12 pairs; plants of Continental Asia. (10) **P. lanceolatum.**

b. Peduncular bracts much larger than 0.2 cm., persistent to caducous, always paired; female perianth narrower, usually campanulate; lamina elliptic to broad cordate; lateral veins 7 to 14 pairs; plants of Western Malaysia .... 15.

15. a. Petioles 1 to 2.5 cm. long, usually ca. 2 cm. long, i.e. very short compared to lamina length; lamina generally elliptical; twigs very smooth and straight with very prominent stipular—and petiolar-scars, hence twigs bamboo-like in appearance; male inflorescences very greatly ramified, floral capitula very numerous, and at anthesis, white-dotted in appearance; peduncular bracts very early caducous; plants entirely glabrous .... (16) **P. scortechinii.**

b. Petioles much longer, at least (and very rarely) 3 cm. long; lamina oblong to broad cordate, very rarely elliptic; twigs very rough with lenticels, very rarely straight, not bamboo-like at all; male inflorescences less ramified, floral capitula not like those of above species; peduncular bracts persistent, very rarely caducous; plants pubescent only on young parts, soon glabrous. (15) **P. scabrinervium.**

6. **Poikilospermum annamense** (Gagnep.) Merr. Contr. Arnold Arbor. **8:** 49 (1934).

Conocephalus annamensis Gagnep. in Lecomte, Fl. Gen. Indo-Chine **5:** 832. *t. 96, 1–10* (1929).

TYPE SPECIMEN:—*C. annamensis* Gagnep.: *Poilane 8280*, Route de Nhatrang, Ninh-Hoa, Annam, 18 Oct. 1923 (Lectotype: P).

Twigs ca. 0.7 cm. diam., periderm not splitting longitudinally, but never into flakes; rough, with numerous prominent lenticels; glabrous; stipular- and petiolar-scars often very prominent; dark brownish in dry state. *Lamina* 10–22 cm. long, 5–14 cm. broad; ovate, broad or narrow; coriaceous; glabrous; base broad cuneate to round; apex obtuse, very rarely acute; lateral veins ca. 11 pairs, very straight, parallel and very prominent on abaxial surface; intercostals numerous, straight, fairly prominent. *Petioles* 2–5 cm. long, ca. 0.3 cm. diam; periderm smooth, not splitting into flakes; glabrous throughout. *Stipules* 1–2 cm. long, glabrous, slightly woody, slightly curved, early caducous. *Male inflorescences* ca. 4 cm. long, 4 cm. broad; solitary; branched dichotomously 2–3 times, rarely more; primary and secondary peduncles about the same length, ca. 2 cm. long, tertiary and later branches very numerous, all about the same length, very short, hence the capitula arranged in 2 umbel-like groups; all branches glabrous; peduncular bracts ca. 1 cm. long, prominently boat-shaped, glabrous, early caducous; floral capitula ca. 0.5 cm. diam., very numerous. *Female inflorescences* 4 cm. long, 6 cm. broad; solitary; dichotomously branched once; primary peduncle ca. 1 cm. long, secondary ones slightly longer; glabrous; peduncular bracts paired, early caducous; floral capitula ca. 3 cm. diam., 2 in each inflorescence. *Male flowers* sessile; ca. 2 mm. long, half as broad; perianth lightly to densely pubescent; tepals 4, incurved at apex; stamens 4, rarely less, slightly shorter than the perianth; filaments short, straight; rudimentary ovary ca. 1.5 mm. long, peltate-capitate at the apex. *Female flowers* pedicellate; perianth 3–4 mm. long, ca. 1 mm. broad, 4-lobed, tepals pubescent; ovary slightly shorter than perianth; stigma ca. 1 mm. long; pedicel 7–10 mm. long. *Achenes* ca. 3–4 mm. long, ca. 1 mm. broad; covered by persistent perianth; pedicel elongating greatly.

ECOLOGY: According to Poilane's field notes, this species seems to be a highland one of Indo-China, occurring from 500 to 900 metres above sea level.

VERNACULAR NAME: Rum (Indo-Chinese).

Gagnepain cited three collections of Poiline as types without any indication as to which one his description was based upon. My choice of the above specimen as a lectotype is mainly based on the present condition of the specimens since his description certainiy covers all these collections very well.

This species is very close to *P. suaveolens*. It differs from the latter in having smooth and unsplit periderm. Besides, these specimens seem to indicate that this species is quite frail in nature.

DISTRIBUTION: Indo-China.

Poilane 8280, Route de Nhatrang, Ninh-hoa, Annam, 18 Oct. 1923 (Lectotype: P); *8323,* same locality, 19 Oct. 1923 (P) and *9972,* Ka Rom prov., Phanrang, 7 March 1924 (P).

7. **Poikilospermum azureum** (Teysm. & Binn.) Merr. Contr. Arnold Arbor. **8:** 49 (1934).

Conocephalus azureus Teysm. & Binn. Nat. Tijdschr. Ned. Ind. **27:** 26 (1864); Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 229 (1902).

TYPE SPECIMEN:—*C. azureus* Teysm. & Binn.: *Diepenhorst s.n.* Priaman, Sumatra (Holotype lost?).

Twigs 0.7–1.5 cm. diam.; periderm splitting into very numerous copper-brown flakes, densely lenticellate, lenticels of large size; lightly to densely covered with white hairs as well as reddish-stellate ones; petiolar- and stipular-scars usually very prominent; copper-brown in dry state. *Lamina* (18–) 20–30 cm. long, (13–) 15–25 cm. broad; very broad ovate, slightly asymmetrical; very coriaceous; pubescent on abaxial surface; base rounded, truncate to profound cordate; apex obtuse to acute; lateral veins 14–17 pairs, very rigid and prominent, curving progressively towards apex, hence not parallel to each other; intercostals very numerous, rigid and prominent, very closely set. *Petioles* (4–) 10–26 cm. long, 0.3–0.4 cm. broad; periderm splitting into copper-brown flakes, often with large lenticels; with white hairs intermixed with red-stellate ones, especially the basal part. *Stipules* 2–4 cm. long; somewhat crescentic; similarly covered with hairs as petioles and twigs; often caducous. *Male inflorescences* 6–7 cm. long, 7–8 cm. broad; solitary; branched dichotomously many times; primary and secondary peduncles about the same length, ca. 2 cm. long; peduncular branches well covered with hairs similar to those of twigs; peduncular bracts ca. 1 cm. long, broad foliaceous, very rarely small, usually early caducous; floral capitula 0.3–0.5 cm. diam. very numerous. *Female inflorescences* (10–) 13 cm. long, 15–20 cm. broad; solitary; branched dichotomously 3–4 times; primary and secondary peduncles about the same length, ca. 3–4 cm. long; peduncular branches similarly covered with hairs as those of the males; peduncular bracts ca. 2 cm. long, very broad and foliaceous, very early caducous; floral capitula ca. 3.5 cm. diam., 8–16 in each inflorescence. *Male flowers* sessile; 1–2 mm. long, about half as broad; perianth lightly pubescent; tepals 3 or 4, incurved at apex; stamens 3 or 4, about the same length as perianth; filaments short, erect; pistillode ca. 1 mm. long, thin at the base, thicker at the apex; interfloral bracts extremely minute. *Female flowers* pedicellate; perianth 2–3 mm. long, half as broad, 4-lobed, apex densely pubescent, soon glabrous; tepals 2 + 2 decussate-imbricate, inner ones broader than outer pair, incurved at the apex; ovary slightly shorter than perianth; stigma ca. 0.5–0.75 mm. long; pedicels 7–8 mm. long; interfloral bracts absent. *Achenes* ca. 3.5 mm. long, ca. 1.5 mm. broad; totally enclosed by persistent perianth, of ca. 5–7 mm. long; pedicels slightly longer than perianth.

ECOLOGY: This species has been recorded from altitude as high as 1,000 metres above sea-level; and seems to grow well along riverine secondary forests (Meijer, 1955 field notes).

VERNACULAR NAMES: Loendang, Poepoe and Pus-pus (Indonesian Malay).

The type specimen of this species has not been examined—it is probably lost. However, from the description, it is not difficult to identify the specimens cited below.

The younger Hooker in 1888 was probably the first botanist to refer to this species. It has already been pointed out in the Historical Review that Hooker described three species groups without names. He noted that the third species group probably belonged to this species *azureum*. I have found that this is not so, and that Hooker's specimens are actually those of *P. suaveolens*.

Then came Bargagli-Petrucci in 1902, but he could not interpret this species *azureum*. He left it as a "species Poco Note". Lastly, in 1934, Merrill noted that this species is probably the same as Bargagli-Petrucci's *cordifolium* from Borneo.

This is actually a distinct species. It is apparently close to another Sumatran species, *P. singalense* which was described by Bargagli-Petrucci in 1902. In *P. singalense,* the lamina have 10–13 pairs of lateral veins each, the pedicels are shorter than the perianth or achenes, and the perianth does not elongate to twice the length of the achenes. In *P. azureum,* however, the lamina have more lateral veins, usually 14–17 pairs, the pedicels are much longer than either the perianth or the achenes, and the perianth elongate to twice the length of the achenes at fruit.

DISTRIBUTION: Sumatra.

Alston 14611, Gunong Gurah, Residency of Atjeh, 22 March 1954 (BM).—*Boden-Kloss SFN. 13085,* Island of Siberut, 12 Sept. 1924 (SING); *SFN. 14549,* Island of Siberut, 21 Sept. 1924 (SING).—*Iboet 421,* Island of Sipora, 16 Oct. 1924 (SING).—*Meijer 3333,* Pajakumbuh, Mt. Sago, Central Sumatra, 14 May 1955 (BO); *7612,* Mt. Sago, 28 April 1957 (L).—*de Voogd 537.* Moearadoea, Palembang, 13 Dec. 1929 (L).

8. **Poikilospermum cordifolium** (Barg.-Petr.) Merr. Contr. Arnold Arbor. **8:** 49 (1934).

Conocephalus cordifolius Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 220. *t.7* (1902); Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921).

Conocephalus amoenus King ex Hk. f. sensu Ridl. Fl. Mal. Pen. **3:** 357 (1924), partim.

TYPE SPECIMEN:—*C. cordifolius* Barg.-Petr.: *Beccari 2864*. Kuching, Sarawak (Holotype: FI).—**Fig. 20.**

Twigs 1–2 cm. diam.; periderm soon splitting into large sheets, lightly to densely lenticellate; generally glabrous, very rarely light pubescent; stipular- and petiolar-scars large and prominent, not raised; whitish-grey in dry state. *Lamina* (20–) 30–50 (–65) cm. long, (15–) 20–35 (–40) cm. broad; very broad ovate, or very broad elliptic; coriaceous; generally glabrous, young ones lightly pubescent on veins of abaxial surface; base round to very profound cordate; apex obtuse, rarely acute; lateral veins (8–) 10–12 pairs, very lax and curved, well-spaced, very prominently raised on abaxial surface; intercostals numerous, prominent only at points of departure from lateral veins, the rest often not visible, generally anastomosing. *Petioles* (7–) 10–40 (–50) cm. long, (0.2–) 0.4–0.7 cm. broad; lightly to densely lenticellate; periderm not splitting; generally glabrous, young ones sometimes lightly canescent, soon glabrous. *Stipules* (2.5–) 4–6 (–7) cm. long; usually strongly crescentic; young ones sparsely canescent, soon glabrous; generally fairly persistent, rarely caducous. *Male inflorescences* 4–6 cm. long, 5–6 cm. broad; solitary; branched dichotomously; primary peduncle 2–3.5 cm. long, secondary peduncles 1.5–3 cm. long, tertiary ones very numerous, extremely short and all arranged at ends of secondary peduncles, peduncular branches glabrous, pubescent to dense canescent; peduncular bracts foliaceous and conspicuous, ca. 1 cm. long, glabrous, pubescent to canescent; floral capitula numerous, ca. 0.5 cm. diam. *Female inflorescences* 4–10 (–12) cm. long, 4–10 (–15) cm. broad; solitary; branched once or twice, very rarely more; primary peduncle (1.5–) 3–4 cm. long, secondary one (1.5–) 2–4 cm. long; peduncular branches glabrous, pubescent to canescent; peduncular bracts same as the male or slightly larger, glabrous, pubescent to sparse canescent; floral capitula (1.5–) 3–5 cm. diam; 2 or 4 in each inflorescence, rarely more. *Male flowers* sessile, very rarely subsessile; ca. 2 mm. long, ca. 1 mm. broad; perianth glabrous to light canescent; tepals 4, incurved at the apex; stamens generally 4, rarely less; filaments straight, very thin; pistillode very thin and transparent; interfloral bracts usually absent. *Female flowers* pedicellate; perianth 2–3 mm. long, 1–1.5 mm. broad, generally glabrous, very rarely pubescent, 4-lobed; tepals strongly incurved at the apex; ovary ca. 1.5 mm. long,

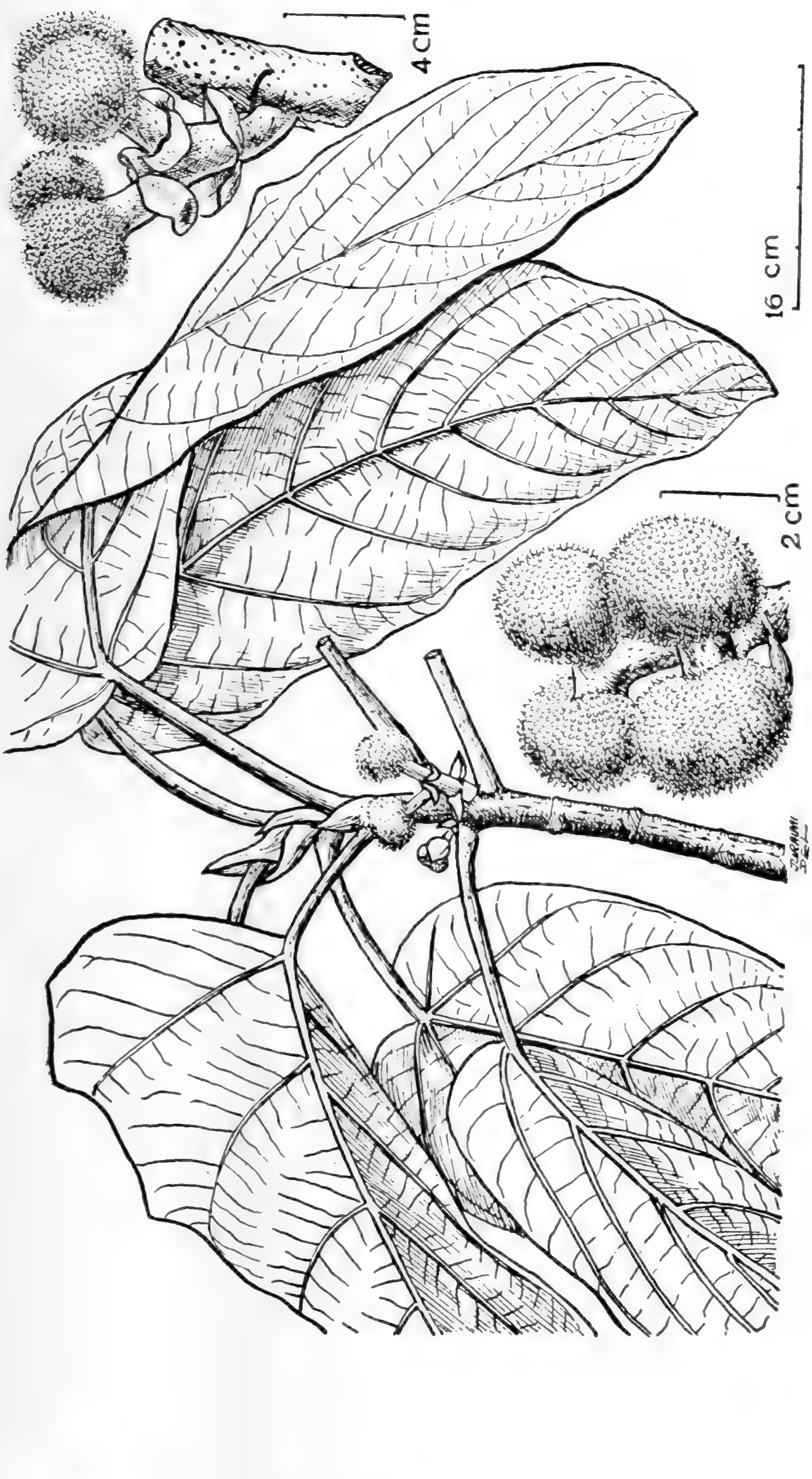


Fig. 20. ***Poikilospermum cordifolium.*** **Twig and female inflorescences.**

half as broad; stigma ca. 1 mm. long, rarely shorter; pedicel ca. 4–6 mm. long. *Achenes* 3–5 mm. long, 1–1.5 mm. broad; enclosed by persistent perianth; pedicel very long compared to achene.

ECOLOGY: Many collectors have found plants of this species frequenting streams at low altitudes. I have found them along streams as well as in Malay villages. They seem to prefer slightly shaded areas to dark forest interiors.

ECONOMIC USES: Corner (1932) recorded the use of the dried stems by the Malays in Johore for keeping fire alive. He noticed that the dried stems would smoulder for hours; and that whenever fire was needed, it was readily rekindled, thus saving the matches which the natives could ill afford.

VERNACULAR NAMES: Akar satuwan and Semelit papan (Malay Peninsula). Bunatol, Gunatol and Saringkarang (Borneo).

Plants of this species have been known to attain the greatest dimension in the subgenus *Ligulistigma*. The petioles of some of the plants may be much thicker than the twigs of those of, for example, *P. microstachys*. Their huge stems are fairly lianoid in habit.

Although this species is quite common in the Malay Peninsula, it has escaped from Malayan botanical literature because of mistaken identity. Ridley equated a lot of collections of this species with Hooker's *amoenus,* which happens to be a Malayan form of *P. suaveolens.*

There is no doubt about the distinctness of this species. It is true that the inflorescences of *P. cordifolium* and *P. suaveolens* are very similar; but they differ from each other very clearly on veination of lamina, on the periderm appearance of the twigs and petioles and on the overall size of the plant.

This species is absent from Java. The two collections from the Bogor Botanic Gardens were made from plants whose origin was Sumatra (Forman, field notes, 1956).

DISTRIBUTION: Sumatra, Malay Peninsula and Borneo.

Sumatra: *Batten-Pool s.n.,* unknown locality, 3 June 1939 (SING).—*Nur SFN. 7237,* Sibolangit, 12 Aug. 1921 (SING).

Malay Peninsula: *Burkill & Haniff SFN. 13625,* Grik, Perak, 19 June 1924 (SING).—*Chew Wee-Lek CWL. 1,* Singapore, 31 Dec. 1956 (SING); *CWL. 77,* Jerangau For. Res., Trengganu, 30 March 1957 (CGE & SING).—*Chew Wee-Lek & Kiah CWL. 90,* Bukit Bakar, Kelantan, 2 April 1957 (SING); *CWL. 94,* same loc. & date. (CGE & SING).—*Corner s.n.,* S. Sedili Johore, 26 March 1932 (SING).—*Deshmukh s.n.,* Singapore, 20 July 1921 (SING).—*Henderson SFN. 19623.* Gua Ninik, Kelantan. 24 Oct. 1927 (SING).—*Nur SFN. 8962,* Batu Caves, Selangor, 2 Oct. 1922 (SING); *s.n.,* Singapore, 10 Sept. 1918 (SING).—*Ridley 4820 Langat,* Selangor, 17 Nov. 1892 (BM & SING).—*Seimund 573,* Kuala Teku, Pahang (SING).—*Yapp 594,* Perak, 3 Jan. 1900 (CGE).

Borneo: *Beccari 2864,* Kuching, Sarawak (FI).—*Boden-Kloss SFN. 18715,* Samawang, Sandakan, 14 July 1927 (SING).—*Chew Wee-Lek CWL. 330,* Niah Caves, Niah District, Sarawak, 7 June 1962 (A, E, L, SAR & SING).—*Creigh s.n.,* Sandakan North Borneo, April 1895 (BM).—*Elmer 20671* Tawao, Br. North Borneo (BM, BR, C, G, M, P & SING).—*Kadir A3603,* Elopura, Sandakan, N. Borneo, 31 Aug. 1951 (BO, L & SING).

Java (cultivated): *Corner XV. B. 105,* Hort. Bogor, 1959 (CGE).—*Forman 42,* Hort Bogor, 21 Feb. 1956 (L).

9. **Poikilospermum erectum** (Blco.) Merr. Contr. Arnold Arbor. **8:** 49 (1934).

Procris erecta Blco. Fl. Filip. 707 (1837).

Conocephalus erectus (Blco.) F.-Villar, Novis. App. 203 (1880); Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 230 (1902); Merr. Bur. Govt. Lab. **27:** 80 (1905) et Species Blancoanae 129 (1918), exclud. syn. *C. grandifolius* Warb. et Enum. Philip. Fl. Pl. **2:** 70 (1923).

Conocephalus canescens Warb., in Perkins, Frag. Fl. Philip. 167 (1904).

TYPE SPECIMENS:—*P. erecta* Blco.: Type specimen destroyed! *Merrill Sp. Blco. 960.* Cavite Prov., Luzon, Philippine Islands, May 1915 (Neo-type: BM; duplicates; B & K).—*C. canescens* Warb.: *Warburg 12479,* Marivelis, Bataan, Luzon, Philippine Islands (Holotype: B).

Twigs 1–2 cm. diam; periderm lightly to densely lenticellate, frequently peeling into sheets; glabrous to very dense pubescent, especially young parts; stipular- and petiolar-scars often very prominent; light grey to light brown in dry state. *Lamina* (15–) 20–40 cm. long, (10–) 12–30 cm. broad; very broad ovate; very coriaceous; generally thickly canescent on abaxial surface, very rarely glabrous or pubescent; base round, cordate to profound cordate; apex obtuse to slightly acute; lateral veins 8–10 (–12) pairs, very prominent beneath; lax, curved and well-spaced; intercostals prominent to almost faint, well-spaced, frequently anastomosing. *Petioles* (6–) 8–25 cm. long, 0.5–0.7 cm. diam.; smooth to densely lenticellate; generally light canescent or pubescent, very rarely glabrous. *Stipules* 4–6 cm. long; straight to strongly crescentic; glabrous to thickly pubescent, very rarely canescent; generally persistent, rarely caducous. *Male inflorescences* 8–12 cm. long, 8–16 cm. broad; solitary; branched dichotomously 5–7 times; secondary peduncles generally longer than primary one, rarely shorter; peduncles generally light to dense canescent, peduncular bracts conspicuous, ca. 1 cm. long, light to dense canescent, floral capitula 0.3–0.5 cm. diam.; very numerous. *Female inflorescences* 9–12 cm. long, 12–20 cm. broad; solitary; branched dichotomously about 4 times; primary peduncle ca. 3 cm. long, secondary one usually longer, generally light canescent, soon sparse canescent;

peduncular bracts same as male; floral capitula ca. 1.5 cm. diam.; ca. 16 in each inflorescence. *Male flowers* sessile; ca. 1.25 mm. long, ca. 1 mm. broad; perianth thickly canescent, especially the apex; tepals 4, incurved at the apex; stamens 4, rarely less, ca. 1 mm. long, with straight filaments; pistillode ca. 0.75 mm. long, thin, transparent; interfloral bracts almost absent. *Female flowers* pedicellate; perianth 3–3.5 mm. long, ca. 1.25 mm. broad; 4-lobed; lobes light canescent to light pubescent, very rarely glabrous, very often with cystoliths; tepals incurved at the apex; ovary ca. 2 mm. long, ca. 1 mm. broad; stigma ca. 1 mm. long; pedicel short, 1–2.5 mm. *Achenes* ca. 3 mm. long, ca. 1.5 mm. broad; apex slightly appearing above the persistent perianth; pedicel often very short compared to achene.

ECOLOGY: Herbarium labels provide practically no ecological information of this species whatsoever apart from the fact that these plants are fairly common along rivers in the Philippine Islands. Merrill (1923) recorded that these plants occur ". . . in forests at low and medium altitudes."

ECONOMIC USES: Sulit recorded that cut stems might yield potable water. Apart from this, this species seems fairly useless economically.

VERNACULAR NAME: Hanopol (Tagalog.).

Blanco was the first botanist to have recorded this species from the Philippine Islands; and being unmindful of Blume's publication of *Conocephalus*, he named it *Procris erecta* in 1837. The holotype was probably destroyed by fire in Manila; and repeated attempts to trace it in Spain or elsewhere have been futile.

F. Villar in 1880 transferred this species to its proper place; and he combined it to *Conocephalus erectus*. Then in 1918, Merrill published his "Species Blancoanae", and in it he tried to identify Blanco's species by means of illustrative specimens collected from all the localities which Blanco was supposed to have visited. As far as this species is concerned, Merrill represented it by means of his "Sp. Blco. 960".

I have compared this specimen very critically with Blanco's description and could find no cause whatsoever to disagree with Merrill. Hence, this collection is here taken as a Neo-type.

Regarding Warburg's *canescens*, which is again based on a Philippine collection, I have found that the type specimen is a younger (and smaller) plant of this species. Merrill had already reduced it to this species in 1923, to whose decision I fully subscribe.

DISTRIBUTION: Philippine Islands.

Philippine Islands: *Edano PNH. 37105*, Sorsogon, Luzon, 11 June 1956 (L & PNH).—*Elmer 7284*, Leyte, Jan. 1906 (G); *10651*, Davao, Mindanao, May 1909 (BM, FI & G); *13901*, Agusan, Mindanao, Sept. 1912 (C, FI, G, K & P); *15250*, Sorsogon, Luzon, Dec. 1915 (BM & L).—*Loher 6904*, sine loc. (M).—*Merrill Sp.*

Blco. 871, Rizal, Luzon, March 1915 (K & P); *960,* Cavite, Luzon, May 1915 (B, BM, K & P).—*Ramos 42703,* Bohol, Oct. 1923 (G & SING).—*Ramos & Pascasio 34905,* Siargao Island, June 1919 (SING).—*Sulit PNH. 6052,* Loquilocon, Wright, Samar, 14 April 1948 (PNH); *PNH. 7042,* Laguna, Luzon, 18 April 1947 (PNH).—*Warburg 12479,* Mariveles, Luzon (B).—*Wenzel 3449,* Surigao, 1 June 1928 (C, K & M).

10. **Poikilospermum lanceolatum** (Trec.) Merr. Contr. Arnold Arbor. **8:** 50 (1934), exclud. syn. *C. subtrinervius* Miq.

Conocephalus lanceolatus Trec. Ann. Sci. Nat. ser. 3. **8:** 88 (1847); Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 226 (1902).

TYPE SPECIMEN:—*C. lanceolatus* Trec.: *Griffith s. n.*, India, 1843 (Holotype: P).

Twigs 0.5–1.5 cm. diam., periderm splitting longitudinally to narrow, long sheets; young parts very light pubescent, soon glabrous; scarcely lenticellate; stipular- and petiolar-scars quite prominent; brown to light brown in dry state. *Lamina* (13–) 15–30 cm. long, (6–) 8–15 cm. broad; lanceolate, elliptic to very broad elliptic; slightly coriaceous; very sparsely to densely pubescent on abaxial surface; base cuneate to very round; apex acute to long acuminate; acumen 0.75–2 cm. long; lateral veins 11–12 pairs, very rarely more, quite prominent; intercostals very numerous, quite prominent. *Petioles* (2.5–) 5–11 cm. long, ca. 0.4 cm. broad, smooth; young ones light pubescent, soon glabrous. *Stipules* 1.5–3 cm. long, quite straight; lightly pubescent; early caducous. *Male inflorescences* 2.5–5 cm. long, 2–9 cm. broad; branched dichotomously 3–6 times; secondary peduncles generally longer than primary one, rarely shorter; peduncles generally light pubescent; peduncular bracts small, inconspicuous, ca. 0.2 cm. long, usually paired, sometimes single; floral capitula 0.3–0.5 cm. diam., 8–40 (–60) in number. *Female inflorescences* 3–4 cm. long, 4–5 cm. broad; branched dichotomously ca. 3 times; primary and secondary peduncles about the same length; all branches generally light pubescent; peduncular bracts same as the male; floral capitula 1–1.5 cm. diam., (4–) 6–8 in number. *Male flowers* sessile; perianth ca. 2 mm. long, 2.5 mm. broad, short obpyramidal; completely glabrous, well-covered with elongate cystoliths; tepals 4, rarely less; stamens 4, with straight short filaments; rudimentary ovary large, obpyramidal. *Female flowers* short pedicellate; perianth 2.5 mm long, half as broad, inverted pear-shaped; glabrous, apex with cystoliths; 4-lobed; tepals curved at apex; ovary about the length of perianth; stigma short; pedicel about the same length as perianth. *Achenes* 3.5–4.5 mm. long, 2–2.5 mm. broad; apex slightly appearing above the persistent perianth; pedicel extremely short compared to achene.

ECOLOGY: This species seems to be common in Monsoon Forests, and has been found at altitudes of above 2,000 metres.

VERNACULAR NAME: Monkakrik (N.-E. India).

Merrill (1934) considered Miquel's *C. subtrinervius* (= P. *subtrinervium*) conspecific with this species and he therefore reduced the former to a synonym. Miquel's type specimen was collected from Sumatra, while this species is entirely confined to Continental Asia. I have not yet come across any specimen from Malaysia that approaches this species in circumscription. This led me to study Miquel's description more critically. Having compared Miquel's description with Trecul's description, type specimen and even later collections of *P. lanceolatum,* I realised that *P. lanceolatum* and *P. subtrinervium* are two totally different species.

DISTRIBUTION: N.-E. India, Burma and China.

N.-E. India: *Barnard s.n.,* Digboi, Upper Assam, May 1935 (BM).—*Chatterjee s.n.,* Ghagra, Assam, April 1902 (P).—*Clarke 13918,* Sikkim, 3 March 1871 (BM); *27621,* Nampok, Sikkim, April 1876 (K); *27914,* Sikkim, 13 March 1876 (BM); *38008A,* Sonari, Seebsangur, 22 April 1885 (K); *43042,* India (K).—*Gamble 402A,* Taipu River, March 1876 (K): *2430A,* Chenga River, Sikkim, 15 Jan. 1877 (K); *7620,* Bhutan (K); *7673,* W. Duars, Jan. 1880 (K).—*Griffith 4674,* East Bengal (K & M).—*Haines 612,* West Duars, Feb. 1896 (K).—*Hooker s.n.,* Sikkim, India (BM, C, CGE, G, M & P).—*King s.n.,* Bhutan, 1875–1876 (K).—*Lacaita 16573,* Sikkim, 26 April 1913 (P); *16574,* Sikkim, 26 April 1913 (BM).—*Masters s.n.,* Assam (M).—*Meebold 10879,* Laimatak, Manipur, Feb. 1906 (SING).

Burma: *Haines 5838,* Katha, Upper Burma, 3 March 1915 (K).—*Rogers 821,* Myikyina, 7 May 1910 (E); *s.n.,* Kahta, March 1915 (K).

China: *Henry 11795 & 11795A,* Szemen, Yunnan (K).—*Rock 2388,* Muang Han & Muang Hai, S. Yunnan, Feb. 1922 (E).

11. **Poikilospermum microstachys** (Barg.-Petr.) Merr. Contr. Arnold Arbor. **8:** 50 (1934).

Conocephalus subtrinervius Miq. sensu Hooker f. Fl. Br. Ind. **5:** 546 (1888); Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 226 (1902); Merr. J. Straits Br. Asiat. Soc **Special:** 230 (1921); Ridl. Fl. Mal. Pen. **3:** 358 (1924).

Conocephalus microstachys Barg.-Petr. l. c. 223. *t. 9.;* Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921).

Conocephalus amethystinus Winkl. Bot. Jahrb. **49:** 359 (1913); Merr. J. Straits Br. Asiat. Soc. **Special:** 228 (1921).

Poikilospermum amethystinum (Winkl.) Merr. Contr. Arnold Arbor. **8:** 48 (1934).

TYPE SPECIMENS:—*C. microstachys* Barg.-Petr.: *Beccari 123,* Kuching, Sarawak, Borneo (Holotype: FI).—*C. amethystinus* Winkl.: *Winkler 2828,* Batu Babi, S-O Borneo, 10 July 1908 (Holotype: B; isotypes: BM, P & SING).—**Fig. 21.**

Fig. 21. *Poikilospermum microstachys.* Twig with female inflorescences.

Twigs 0.3–0.5 (–0.75) cm. diam.; frail, straight and glabrous; densely lenticellate; white-grey, grey to light brown coloured in dry state; periderm not splitting into flakes or sheets; stipular- and petiolar-scars not very prominent; prostrate parts usually with adventitious roots. *Lamina* (10–) 12–27 cm. long, 3–7 cm. broad; oblanceolate, very rarely elliptic; bases cuneate to round; apex acuminate, rarely acute; lateral veins (6–) 7–9 pairs, strongly arched, basal pair straight and prominent; intercostals quite prominent; chartaceous; entirely glabrous; brown to light brown when dried. *Petioles* (3–) 4–13 cm. long, 0.2–0.3 cm. broad; frail, straight and smooth, cystoliths often visible; entirely glabrous. *Stipules* 1–2 cm. long; slightly crescentic; chartaceous; edges always wavy; glabrous; persistent. *Male inflorescences* 0.5–2 cm. long, 0.5–1.5 cm. broad; solitary, paired to numerous; usually once branched; primary peduncle filiform, very short; secondary peduncles filiform, slightly longer; peduncular bracts paired, persistent, prominent; floral capitula 2, each 0.25–0.5 cm. diam. *Female inflorescences* 1–2 cm. long, 1.5–3 cm. broad; usually solitary, very rarely paired; once branched; primary and secondary peduncles filiform, about the same length; peduncular bracts same as for the males; floral capitula 2, each 0.5–2 cm. diam. *Male flowers* sessile to subsessile; perianth 1–1.5 mm. long, ca. 0.5 mm. broad; sparsely pubescent; tepals 4, apex sharp acute, deeply incurved; stamens 4, slightly shorter than tepals; filaments short and erect; pistillode ca. 1 mm. long, thin, transparent; interfloral bracts minute. *Female flowers* pedicellate; perianth 2–3.5 mm. long, 1–2 mm. broad; 4-lobed; tepals 2 + 2 decussate-imbricate, strongly incurved; ovary ca. 1.5 mm. long, 0.5 mm. broad; stigma 0.5–0.75 mm. long; pedicels 1.5–2 mm. long; interfloral bracts minute. *Achenes* 2.5–3.5 mm. long, 1–1.25 mm. broad; enclosed by persistent perianth; much longer than pedicels.

ECOLOGY: This species seems to prefer damp forests such as swamps. It is also common along rivers. It seems to be very scarce in either very dry and exposed habitates or dark forest interiors.

ECONOMIC USES: Burkill noted that the Malay name "Landong" probably refers to the use made of the stems as crude ropes.

VERNACULAR NAMES: Akar sasaran and Landong Padi (Malaya). Aloepoen and Langkoekoe (Borneo).

Although the authorship of this species is credited to Bargagli-Petrucci, he was by no means the first to describe it. Hooker had earlier in 1888 described it, but he erroneously equated it with Miquel's *subtrinervium*. This error was perpetuated by many later botanists.

The other epithet, *amethystinus*, was created by Winkler in 1913, and was also based on a Bornean collection. Winkler's type specimen is found to be conspecific with *microstachys*. The differences he drew between *amethystinus* and *microstachys* are merely individual differences, namely size and shape of lamina.

This is a very distinct species; and can easily be recognised either in the field or in the herbarium. The inflorescences of the male plants are very greatly reduced in size as well as in the number of floral capitula. Besides, most of the male plants tend to have more than one inflorescence at each leaf axil.

DISTRIBUTION: Sumatra, Malay Peninsula and Borneo.

Sumatra: *Rahmat-si-Boeea 849,* Taloen Djoring, July-Aug. 1928 (SING); *6766,* Hoeta Bagasan, Asahan, 7 Sept. 1934 (SING).

Malay Peninsula: *Alvins 308,* Malacca, 15 Dec. 1885 (SING); *3327,* Negri Sembilan, 31 Oct. 1885 (SING).—*Burkill SFN 4106,* Kuala Langat, Selangor, 4 May 1919 (SING); *SFN. 6395,* Gemas, Negri Sembilan, 16 Sept. 1920 (SING); *SFN. 7013,* Klang, Selangor, 13 March 1921 (SING); *SFN. 7028,* Klang, Selangor, 13 March 1921 (SING).—*Burkill & Haniff SFN. 17064,* 8 miles S. of K. Lipis, Pahang, 17 Nov. 1924 (SING).—*Burn-Murdoch SFN. 172,* Temerloh, Pahang, 12 June 1913 (SING).—*Chew Wee-Lek CWL. 33,* Ulu Sedili, Johore, 26 Feb. 1957 (SING); *CWL. 73,* Jerangau For. Res., Trengganu, 30 March 1957 (CGE, L & SING); *CWL. 127,* Sungei Charok Durian, Baling, Kedah, 10 April 1957 (SING). —*Chew Wee-Lek & Kiah CWL. 86,* Jalan Kelantan, Trengganu, 31 March 1957 (CGE, L & SING); *CWL. 92,* Sungei Merkill, Bukit Bakar, Kelantan, 2 April 1957 (SING); *CWL. 95,* Sungei Merkill, Bukit Bakar, Kelantan, 2 April 1957 (CGE & SING); *CWL. 102,* Kemahang For. Res., Kelantan, 3 April 1957 (CGE, L & SING); *CWL. 110,* Sungei Merkill, Bukit Bakar, Kelantan, 4 April 1957 (CGE, L & SING).

Corner SFN. 30135, Ulu Bendong, Kemaman, 1 Nov. 1935 (SING); *SFN. 30723,* Mawai-Jemaluang Road, Johore, 12 Jan. 1936 (SING).—*Curtis 1009,* Penara Bukit, Penang, Oct. 1886 (SING).—*Flippance s.n.,* Botanic Gardens, Singapore, 9 May 1921 (SING).—*Haniff SFN. 14190,* Telok Anson, Perak, 24 Sept. 1924 (SING).—*Henderson SFN. 19546,* Gua Ninik, Kelantan, 27 Oct. 1927 (SING); *SFN. 24814,* Sungei Ketil, Kelantan, 30 May 1931 (SING).—*Hullet s.n.,* Penang Hill, Penang, April 1884 (SING).—*Hume 8298, 8314a,* Semenyih, Selangor, 27 July 1921 (SING).—*Kiah SFN. 31967,* Sungei Kayu, Johore, 7 Oct. 1936 (L & SING); *SFN. 35129,* Koh Mai For. Res. Kedah, 2 April 1938 (SING).—*King's Coll. 510,* Gopeng, Perak (FI); *3423,* Larut, Perak, Oct. 1882 (BM); *10003,* Perak (P).—*King s.n.,* Malaya, 1879 (FI).—*Lobb 282,* Singapore, 1846 (BM, CGE, FI & G).—*Maingay KD 1487,* Malaya (BM).—*Nur s.n.,* Botanic Gardens, Singapore, 9 Sept. 1919 (SING).—*Ridley 2311,* Kuala Tembeling, Pahang, 1891 (SING); *7630,* Bukit Hitam, Selangor, May 1896 (SING); *14642,* Ulu Temangu, Perak, July 1909 (SING); *s.n.,* Gunong Tungal, Dindings, Jan. 1897 (SING).—*Scortechini s.n.,* Perak (CGE, G & P).—*Sinclair SFN. 39271,* Tiger Hill, Penang, 10 Oct. 1951 (L & SING).—*Sinclair & Kiah SFN. 39868,* Bukit Besi, Trengganu, 10 July 1953 (L & SING).

Symington 24082, Kajang, Selangor, 28 March 1930 (SING).—*Wray Jr. 1338*, Tapa, Perak (SING); *1393*, Tapa, Perak (SING); *2574*, Assam Kumbang, Perak, July 1888 (SING); *3295*, *Relau* Tujor, Perak, Oct. 1888 (SING).

Borneo: *Anderson 8552*, Betong, Sarawak, 13 Aug. 1957 (L). —*Beccari 39*, Kuching, Sarawak, June 1865 (FI); *123*, Kuching, Sarawak (FI); *244, 853, 854, 2696, 2709 and 2939*, Sarawak (FI). —*Brooke 8637 and 9407*, Kuching, Sarawak, 1954 (L); *8700, 8794 and 8844*, Sarawak 1954 (G & L).—*Elmer 20668*, Tawao, Br. N. Borneo, Oct. 1922/March 1923 (C, G, P & SING); *21269*, same loc. & date, (BM, C, G, L, P & SING).—*Enoh* 309, Pontianak, Poenggoer, 25 Sept. 1948 (L & SING).—*Hullet s.n.*, Matang, Sarawak, 1890 (SING).—*Illias 8083*, Sarawak, 14 May 1957 (L). —*Keith 9097*, Hulu Biyudun River, N. Borneo, 11 June 1938 (SING).—*Kloss SFN. 19032*, Bettotan, Sandakan, 31 July 1927 (SING).

Loibatt s.n., Kuching, Sarawak, 4 Jan. 1895 (SING).—*Mondi 25*, 12 March 1931 (U).—*Polak 643*, W. Borneo, 9 Oct. 1940 (L.) —*Purseglove P. 4389*, Kuching, Sarawak, 14 Sept. 1955 (L & SING).—*Purseglove & Shah P. 4383*, Kuching, Sarawak, 14 Sept. 1955 (L & SING).—*Ridley s.n.*, Bau, July 1903 (SING); *s.n.*, Kuching, Aug. 1904 (SING).—*Saheb s.n.*, Sarawak, 1911 (SING). —*Samsuri b. Tahir 9272*, Sarawak, 7 Nov. 1957 (L).—*Slooten 2202*, Tanahboemboe, Batoebitjin, 30 Oct. 1928 (SING); *2245*, Tanahboemboe, 1 Nov. 1928 (B.)—*Smythies et al. S. 5859*, Brunei, 14 April 1957 (L).—*Teysmann 11258*, Pontianak (FI).—*Winkler 2828*, Batu Babi, S.-O. Borneo, 10 July 1908 (B, BM, P & SING).—*Wyatt-Smith 80289*, Jesselton, N. Borneo, 3 Aug. 1954 (L).

Java: Warburg 1305, May 1886 (B)—cultivated!

12. **Poikilospermum naucleiflorum** (Roxb. apud Lindl.) Chew. **comb. nov.**

Conocephalus naucleiflorus Roxb. apud Lindl. Bot. Reg. **14:** 1203, A & B. (1828), (Basionym!); Trec. Ann. Sci. Nat. ser. 3. **8:** 92 (1847); Koords. Exkursionfl. Java, **2:** 122. *t. 27* (1912), quoad spec. typ. tantum.

Urtica naucleiflora Roxb. Fl. Ind. **3:** 592 (1832); Ic. Roxb. *t. 2379.*

Conocephalus roxburghii Trec. l. c. 89.

Conocephalus suaveolens Bl. sensu Benn. in Horsfield, Pl. Jav. rar. 47 (1838), exclud. spec. typ. et tab.; Hk. f. Fl. Br. Ind. **5:** 545 (1888), partim; Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 218 (1902), partim; Cooke, Fl. Bomb. 659 (1907), partim; Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921), partim et Enum. Philipp. Fl. Pl. **2:** 71 (1923), partim.

Conocephalus naucleiformis Lindl. ex Jackson, Ind. Kew. **1:** 597 (1893), typo. err.

Poikilospermum suaveolens (Bl.) Merr. Contr. Arnold Arbor. **8:** 47 (1934), partim.

TYPE SPECIMENS: *C. naucleiflorus* Roxb. apud Lindl : Type not available; *Icones Roxburghianæ t. 2379* (K).—*C. roxburghii* Trec.: *Wall. Cat. 4624A*, Silhet, N.E. India (Holotype: P; isotypes: CGE, G, K, LE & M).

Twigs ca. 1 cm. diam.; periderm splitting into numerous flakes; lenticels sparse, rarely crowded; young parts pubescent, soon glabrous; stipular-scars not prominent, petiolar-scars very prominent; dirty-brownish in dried state. *Lamina* 10–25 cm. long, 6–18 cm. broad; narrow to broad ovate, very rarely elliptic; more or less coriaceous; very rarely pubescent on the abaxial surface, generally glabrous; base round, subcordate to cordate; apex obtuse to sharp acute, very rarely acuminate; lateral veins 10–13 pairs; intercostals not many, well-spaced. *Petioles* (4–) 6–12 cm. long, ca. 0.2–0.3 cm. broad; periderm splitting into flakes of same appearance as those of twigs; young ones light pubescent, soon glabrous. *Stipules* 1–2 cm. long, usually arched; young ones slightly pubescent; early caducous, very rarely persistent. *Male inflorescences* 3–7 cm. long, 3–8.5 cm. broad; solitary; dichotomously branched 3–5 times; primary, secondary and tertiary peduncles about the same length; young peduncles generally dense to very dense pubescent, soon quite glabrous, peduncular bracts paired, ca. 1 cm. long, persistent, usually foliaceous, lightly pubescent, soon glabrous; floral capitula very numerous, each 0.3–0.5 cm. diam. *Female inflorescences* 4–9 cm. long and broad; solitary; branched dichotomously 3–4 times; primary peduncle about twice as long as the secondary ones, tertiary peduncles usually slightly shorter; all parts light pubescent when young, soon glabrous; peduncular bracts about the same as for the males; floral capitula ca. 1–2 cm. diam., rarely larger; 4–8 capitula in each inflorescence. *Male flowers* sessile; 1–2 mm. long, ca. 1 mm. broad; perianth 4-partite, lightly to very densely covered with short to long, sharp transparent hairs; apex of tepals slightly curved; stamens 3–4, with short erect filaments; pistillode columnar, slightly shorter than stamens. *Female flowers* pedicellate; perianth 2–3 mm. long, ca. 1 mm broad; 4-lobed; usually pubescent, sometimes glabrous; tepals slightly incurved, with cystoliths; ovary slightly shorter and narrower than perianth; stigma usually short, about one-quarter the length of the ovary; pedicels about the same length as perianth. *Achenes* ca. 2 mm. long, ca. 1 mm. broad; completely covered by persistent perianth; pedicel very long compared to achene.

ECOLOGY: This species seems to prefer the monsoonal forests of north-eastern India and has not been found in the Rain Forests of Malaysia.

VERNACULAR NAMES: Dolea Lat and Lat Cadam (Indian).

It was Roxburgh who first named this species *Urtica naucleiflora* in 1814; but to which he gave no description. It was much later that he described it in manuscript only. In 1828, Lindley then published Roxburgh's manuscript; but instead of retaining *nauclei-flora* as a species of *Urtica,* he rightly combined it to *Conocephalus naucleiflorus.*

Typification of this species presents some difficulties. In the first place, Roxburgh did not typify it in his description. There are a few collections from India that bear Roxburgh's handwriting; but whether these had been seen by him before or after his description one can hardly say.

In the Kew Herbarium, there is a large plate of this species by Roxburgh and this plate corresponds very closely with the specimens that bear his handwriting. I therefore see no reason why one should not typify this species by Roxburgh's plate.

In 1847, Trecul created his *C. roxburghii* which he based on a collection of Wallich, namely *Wall. Cat. 4624A* from Silhet in N.-E. India. This collection corresponds also very closely to Roxburgh's plate: Trecul's *roxburghii* is therefore regarded as conspecific with *naucleiflorum.*

Bennett in the year 1838, considered this species to be conspecific with Blume's *suaveolens,* which decision met the approval of numerous botanists. I have compared the two species very carefully and come to the conclusion that they are different from each other. In the first place, their stigmas bear different ratios to their respective ovaries. In *suaveolens,* the stigmas are as long if not longer than the ovaries; whereas in *naucleiflorum,* the stigmas are very short compared to the ovaries. Besides, the inflorescences are greatly ramified; while in *suaveolens,* such a phenomenon is not observable.

DISTRIBUTION: India, Burma and Thailand.

India: *Clarke 8407,* Syllet Station, 30 March 1869 (K).—*Gaudichaud 445.* Calcutta (G & P).—*Hooker & Thomson s.n.,* Mount Khasia (C, CGE & P).—*King's Coll. 350.* Chittagong Hill Tracts, 1887 (CGE); *491,* Chittagong Hill Tracts, 1886 (E, G & P).—*Lemann s.n.,* Bengal (CGE).—*Lister s.n.,* Chittagong Hill Tracts, 1876 (K).—*Pierre 4803.* Hort. Bot. Calcutta, 4, 1863 (P).—*Roxburgh ? s.n.,* India, 1815 (P).—*Wall. Cat. 4624A.* Silhet (CGE, G, K, LE, M & P).—*Wall. Cat. 4624B,* Hort. Bot. Calcutta (CGE & P).—*Wall. Cat. 4624C,* 1825 (M).—*Wall. Cat. 4634,* Nepal, 1832 (P).

Burma: *Gallatly 807*, Tenasserrim, 16 April 1877 (K); *933*, Chu-ku Plains, Tenasserrim, 27 April 1877 (K).—*Griffith 1111*, Mergui (K).—*Kurz 3124*, Pegu (K).—*Mg. Tha. Myang 145*, Amherst, 27 April 1910 (K).—*Parkinson 1973*, Kananggyi, S. Tenasserrim, 4 March 1926 (K).

Thailand: *Bloembergen & Kostermans 502*, Kwae Noi Basin, 4 May 1946 (BO, K, L & SING).

13. **Poikilospermum oblongifolium** (Barg.-Petr.) Merr. Contr. Arnold Arbor. **8:** 51 (1934).

Conocephalus oblongifolius Barg.-Petr. Nuovo G. Bot. Ital n. ser. **9:** 222. *t.* 8 (1922); Merr. J. Straits Br. Asiat. Soc **Special:** 229 (1921).

TYPE SPECIMEN: *C. oblongifolius* Barg.-Petr.: *Beccari 3360*, Sungei Unpanang, Pontianak, West Borneo (Holotype: FI).

Twigs 0.5–1 cm. diam.; periderm longitudinally ridged, not splitting into flakes or sheets; lenticels few, large, mainly at the nodes; entirely glabrous; petiolar-scars very prominent, stipular-scars not so; light dirty-grey in dry state. *Lamina* 17–26 cm. long, 5–9 cm. broad; oblong to oblanceolate, rarely elliptic, generally broadest at or above the middle; very coriaceous; veins on the abaxial surface extremely sparse canescent; otherwise glabrous; base truncate, round to very cuneate; apex acuminate, acumen extremely short to as long as 2.5 cm., very rarely acute; lateral veins 8–10 (–12) pairs, usually very rigid, straight and closely set, basal pair more prominent; intercostals very numerous, straight and closely set. *Petioles* 2–6 (–11) cm. long, ca. 0.3 cm. broad; periderm very smooth, not splitting, non-lenticellate; entirely glabrous. *Stipules* 2–4 cm. long; very rigid, often strongly crescentic; young ones very sparsely pubescent, soon glabrous; often persistent, sometimes early caducous. *Male inflorescences* 1.5–5 cm. long, 4–7 cm. broad; solitary; dichotomously branched many times; primary peduncles ca. 1.–2 cm. long, secondary peduncles slightly shorter; tertiary peduncles usually extremely short, hence the pseudo-umbellate arrangement of floral capitula; peduncular branches light to dense pubescent, soon glabrous; peduncular bracts 0.5–1 cm. long, broad foliaceous, light pubescent, soon glabrous; floral capitula ca. 0.3–0.5 cm. diam., numerous. *Female inflorescences* ca. 5 cm. long and broad; solitary; branched dichotomously twice; primary and secondary peduncles ca. 2–3 cm. long, tertiary ones extremely short; peduncular branches light pubescent, soon glabrous; peduncular bracts ca. 1 cm. long, very broad and foliaceous; floral capitula ca. 1 cm. diam.; usually 4 in each inflorescence. *Male flowers* sessile; 1–2 mm. long, 0.5–1 mm. broad; perianth dense pubescent, soon glabrous; tepals 4, incurved at the apex; stamens 3–4, much shorter than perianth; filaments short, straight; pistillode about the same length as perianth, either straight and thin or with a globular head: interfloral bracts minute and often absent totally. *Female flowers* pedicellate; perianth ca. 2 mm. long, ca. 1 mm. broad; densely pubescent, soon glabrous, 4-lobed; tepals 2 + 2 decussate-imbricate, inner ones broader, incurved at the apex; ovary slightly shorter than perianth; stigma 0.5 mm. long; pedicels ca. 2 mm. long; interfloral bracts extremely minute, often absent. *Achenes* ca. 3 mm. long, ca. 1 mm. broad; apex slightly exserted above persistent perianth; pedicels not elongating, much shorter than achenes.

ECOLOGY: Most of the collections had come from lowland riverine forests, but one was collected from as high as 1,800 metres in the Philippine Islands. Kostermans noted that his collection came from loam soil with limestone.

VERNACULAR NAME: Hanopol (Philippine Islands).

Vegetatively, this species can easily be mistaken for *P. microstachys*. This is especially so with those plants having long acuminate lamina. The reproductive structures of these two species are, however, vastly different as one can see from the key.

This species was based by Bargagli-Petrucci on a collection of Beccari from the Dutch part of West Borneo. Merrill in 1921 had equated three collections of Clemens from Borneo with it. I cannot confirm Merrill's identification of these collections since I have not been able to trace these specimens.

It has now been found that this species also occurs in the Philippine Islands; and the three collections cited below came from the southern part of these islands.

It is interesting to note that the Philippine materials appear to be slightly different from the Bornean one. The pistillodes of the male flowers of the former materials tend to have rather enlarged globular heads, whereas those of the latter materials do not have such pistillodes. This may be a good character on which two geographical subspecies could be recognised; but since only three collections of the Philippine materials have been examined, it might be well to await for more collections before a decision is taken on this.

DISTRIBUTION: Borneo and Philippine Islands.

Borneo: *Beccari 3360,* Sungei Unpanang, Pontianak, West Borneo (FI).—*Chew Wee-Lek CWL. 460,* S. Melinau Gorge, Baram Distr., Sarawak, 25 June 1962 (A, E, K, L, SAR & SING). —*Kostermans 5240,* East Kutei, East Borneo, 15 June 1951 (BO & L).—*Puasa 1396,* Sapagaya, Br. N. Borneo, 4 July 1931 (K).—*Purseglove P. 5357,* Tau Range, Sarawak, 4 June 1956 (K, L, SAR & SING).

Philippine Islands: *Britton PNH. 19715,* Isabela, Basilan Island, 28 Oct. 1953 (L & PNH).—*Santos 4235,* Barrio Maloong, Zamboanga, May 1948 (L).—*Sulit PNH. 10081,* Mt. Katanglad, Mindanao, 23 March 1949 (L & PNH).

14. **Poikilospermum peltatum** (Winkl.) Merr. Contr. Arnold Arbor. **8:** 51 (1934).

Conocephalus peltatus Winkl. Bot. Jahrb. **49:** 360 (1913); Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921).

TYPE SPECIMEN: *C. peltatus* Winkl.: *Winkler 2661,* Muara Uja, S.-E. Borneo, 5 May (Lectotype: B; Syntype: B).

Twigs ca. 1 cm. diam.; periderm not splitting, very thick; usually with large lenticels; generally glabrous; stipular- and petiolar-scars fairly prominent; dark grey in dry state. *Lamina* (15–) 20–40 cm. long, (10–) 15–25 cm. broad; very broad cordate; quite coriaceous; sparsely pubescent on abaxial surface; base profound cordate-peltate; apex very round; lateral veins ca. 10 pairs, symmetrically arched; base ca. 7-veined; intercostals numerous, fairly prominent, scarcely straight. *Petioles* (10–) 15–20 (–26) cm. long, 0.2–0.4 cm. broad; periderm not splitting, very thick, sparsely lenticellate; generally glabrous. *Stipules* ca. 5 cm. long; strongly crescentic; well-covered with reddish-stellate hairs, soon glabrous; quite persistent. *Male inflorescences* 6–8 cm. long, 7–9 cm. broad; solitary; branched dichotomously 6–7 times; primary and secondary peduncles about the same length, ca. 2 cm. long; peduncular branches almost glabrous; peduncular bracts paired, very early caducous; floral capitula ca. 0.3 cm. diam., very numerous. *Female inflorescences* ca. 8 cm. long and broad; solitary; branched dichotomously ca. 5 times; primary and secondary peduncles ca. 2 cm. long; all branches glabrous; peduncular bracts paired, very early caducous; floral capitula ca. 1 cm. diam., ca. 32 in each inflorescence. *Male flowers* sessile; ca. 1 mm. long and broad; perianth sparsely pubescent; tepals 4, strongly incurved at the apex; stamens 4, very rarely less, ca. 0.75 mm. long; filaments very short, straight; pistillode ca. 0.7 mm. long, thin and transparent; interfloral bracts absent. *Female flowers* pedicellate; perianth ca. 2 mm. long, 1.5 mm. broad, almost glabrous; 4-lobed; tepals 2 + 2 decussate-imbricate, the inner pair broader than the outer; ovary ca. 1 mm. long, half as broad; stigma ca. 1 mm. long; pedicels usually as long as the perianth; interfloral bracts extremely small. *Achenes* ca. 2 mm. long, ca. 1 mm. broad; apex slightly exserted from the persistent perianth; pedicels not elongating at maturity.

ECOLOGY: No information whatsoever can be found in the herbarium labels with regard to the ecology of this species. Only Winkler noted that it is a "Liana".

VERNACULAR NAME: Lopon (Borneo).

Winkler cited his own collection 2661 as the type. In the Berlin Herbarium, there are two sheets of this number, one containing a very large peltate lamina and noted on the label as having been collected on the 5th May; while the other contains a female inflorescence in a packet and was said to have been collected on July the 5th. Both sheets bear the word "Original" in the author's handwriting. The discordant dates of the collections were probably mere writing error, and I am willing to regard these two sheets as having come from one plant.

However, in the British Museum in London, there is a specimen also bearing the type number "Winkler 2661" which specimen does not at all agree with those of the Berlin Herbarium. This London specimen, which contains a male inflorescence, actually belongs to the Bornean species *P. cordifolium* described by Bargagli-Petrucci.

A critical study of Winkler's description of this species *peltatum* revealed that Winkler based his description mainly on the Berlin specimens; and since the London specimen does not bear any handwriting of the author, I can conclude that the London specimen has nothing to do with the type collection of this species *P. peltatum*.

It was noted by Winkler that *P. peltatum* is close to *P. cordifolium*. This is not so. The species *P. scabrinervium* is the one closest to *P. peltatum* in the structure of the inflorescences and twigs. This species *P. peltatum* is easily distinguished by its peltate lamina, by the very long and twine-like petioles and by the very thick periderm which seems to resist splitting at practically all stages of growth.

DISTRIBUTION: Borneo.

Borneo: *Endert 2428,* W. Koetai, Central East Borneo, 9 Aug. 1925 (BO, K, L & SING).—*Kostermans 10591*, Central Kutai, G. Kelopok, 23 April 1955 (K & L).—*Winkler 2661*, Muara Uja, S.-O. Borneo, 5 May 1908 (B), excl. spec. in herb. BM.

15. **Poikilospermum scabrinervium** (Barg.-Petr.) Merr. Contr. Arnold Arbor. **8:** 51 (1934).

Conocephalus scabrinervius Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 223. *t. 10* (1902); Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921).

TYPE SPECIMEN: *C. scabrinervius* Barg.-Petr.: *Beccari 2938*, Mt. Mattang, Sarawak, Dec. 1866 (Holotype: FI).

Twigs 0.5–1.5 cm. diam.; periderm never splitting into flakes or sheets, longitudinally ridged, very rough, with numerous very large lenticels; young parts pubescent, soon glabrous; stipular- and petiolar-scars usually quite prominent; dark brownish in dry state. *Lamina* (15–) 20–40 (–50) cm. long, (6–) 10–20 (–25) cm. broad; obovate, oblong to elliptic; very coriaceous; sparsely pubescent, especially on veins of abaxial surface; base truncate, round to cordate; apex acuminate, rarely acute or obtuse; lateral veins (7–) 10–12 pairs, very rigid and prominent; intercostals numerous, straight, closely set. *Petioles* (6–) 10–22 cm. long, 0.2–0.4 cm. broad; periderm never splitting, ridged longitudinally, rough with numerous large lenticels; lightly pubescent, soon glabrous. *Stipules* 2–5 cm. long; slightly crescentic; lightly to densely pubescent, soon glabrous; persistent to early caducous. *Male inflorescences* 6–8 cm. long, 7–10 cm. broad; solitary; branched dichotomously 6–8 times; primary peduncles 2–3.5 cm. long, rarely shorter; secondary ones 2–4 cm. long; all branches light pubescent, soon glabrous; peduncular bracts 1–1.5 cm. long, broad foliaceous, paired, usually persistent, very rarely early caducous; floral capitula 0.2–0.7 cm. diam., usually very numerous. *Female inflorescences* (5–) 7–10 cm. long, 6–8 (–11) cm. broad; solitary; branched dichotomously 3–4 times; primary peduncles 1.5–4 cm. long, secondary ones 1–2.5 cm. long; all branches light pubescent; peduncular bracts slightly larger than those of the males, otherwise same; floral capitula 1–1.75 cm. diam., 8–16 in each inflorescence, very rarely less. *Male flowers* sessile; perianth 1–2 mm. long, ca. 1 mm. broad, very sparsely pubescent, soon glabrous; tepals 2, 3 or 4, incurved at the apex; stamens 2, 3 or 4, about the same length as perianth; filaments short, straight; pistillode thin and transparent, slightly shorter than perianth; interfloral bracts almost absent. *Female flowers* pedicellate; perianth 2–3 mm. long, 1–2 mm. broad, usually fairly glabrous, 4-lobed: tepals 2 + 2 decussate-imbricate, strongly incurved at the apex; ovary slightly shorter than perianth; stigma short; pedicels 1–3 mm. long; interfloral bracts absent. *Achenes* 2.5–3.5 mm. long, 1–2 mm. broad; enclosed by persistent perianth; pedicels at most as long as the achenes at fruit.

VERNACULAR NAMES: Gunatol, Lupun and Saringkarang (Borneo).

The very broad ovate lamina of this species can easily be mistaken for those of *P. cordifolium*. As far as the inflorescences are concerned, this species is far removed from *P. cordifolium* This species is not only close to *P. peltatum* but also to *P. scortechinii* as well.

The male flowers seem to be of two sorts. Those from capitula of 0.4 cm. in diameter or larger, tend to have perianths averaging 2 mm. in length and are often 3– to 4– staminate. On the other hand those flowers from smaller sized capitula tend to have perianth which are rarely longer than 1 mm. and are usually 2-staminate. This character is not used for subdividing the species into two varieties simply because these types of male flowers have very often been found on the same plant!

DISTRIBUTION: Borneo.

Borneo: *Agama A. 2635,* Elopura, Sandakan, 13 Sept. 1949 (K, L & SING).—*Beccari 2938*, Mt. Mattang, Sarawak, Dec. 1866 (FI).—*Boden-Kloss SFN. 18957*, Bettotan, Sandakan, 24 July 1927 (K & SING).—*SFN. 19075*, Bettotan, Sandakan, 7 Aug. 1927 (K & SING).—*Chew Wee-Lek CWL. 342,* Gunong Mulu, Baram District, Sarawak, 13 June 1962 (A, E, L, SAR & SING); *CWL. 430,* S. Melinau Gorge, Baram District, 22 June 1962 (E, L, SAR & SING).—*Clemens 21393,* Kapit, Upper Rejang, Sarawak, 1929

(K & SAR); *21918*, Gat, Upper Rejang, Sarawak, 6 July 1929 (K & SAR); *26631*, Mt. Kinabalu, Tenompok, North Borneo, 28 Sept. 1931 (G & K); *28762*, Mt. Kinabalu, Tenompok, North Borneo, 26 Feb. 1932 (G & K); *29588*, Mt. Kinabalu, Tenompok, North Borneo, 7 May 1932 (B, G & K); *29769*, Tenompok, North Borneo, 26 May 1932 (B, K & SING).—*Darnton 357*, Kahung, North Borneo, 5 March 1954 (BM).—*Haviland 3691*, Kuching, Sarawak, 9 Jan. 1895 (CGE).—*Haviland & Hose 3691B*, Kuching, Sarawak, 9 Jan. 1895 (BM).—*Kostermans 4982*, East Kutei, East Borneo, 6 June 1951 (BO & L); *9160*, Island of Nunukan, N.E. Borneo, 30 Dec. 1953 (K & L).—*Main 1835*, Selimban, 4 Oct. 1949 (BO & L); *2107*, Selimban, 11 Oct. 1949 (BO & L).—*Matusop 7428*, Sandakan, N. Borneo, 25 July 1937 (SING).

16. **Poikilospermum scortechinii** (King apud Hooker f.) Merr. Contr. Arnold Arbor. **8:** 51 (1934).

Conocephalus scortechinii King apud Hooker f. Fl. Br. Ind. **5:** 545 (1888); Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 224 (1902); Ridl. Fl. Mal. Pen. **3:** 357 (1924).

Conocephalus intermedius Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 218. *t. 6* (1902); Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921).

Conocephalus dubius Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 225. *t. 11* (1902); Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921).

Poikilospermum dubium (Barg.-Petr.) Merr. Contr. Arnold Arbor. **8:** 49 (1934).

Poikilospermum intermedium (Barg.-Petr.) Merr. l.c. 50.

TYPE SPECIMENS: *C. scortechinii* King apud Hooker f.: *King's Coll. 7911*, Perak, Malaya, July 1885 (Lectotype: SING; syntype: SING).—*C. intermedius* Barg.-Petr.: *Beccari 3951*, Bantin, Sarawak, Borneo, Nov. 1867 (Holotype: FI).—*C. dubius* Barg.-Petr.: *Beccari 3193*, Marop prov., Batan-Lupar, Sarawak, Borneo, April 1867 (Holotype: FI).—**Fig. 22.**

Twigs 0.5–0.7 cm. diam., commonly 0.5 cm.; periderm lightly lenticellate, longitudinally fissured, not splitting into sheets or flakes; glabrous; stipular- and petiolar-scars very prominent; greyish in dry state; often bamboo-like in appearance. *Lamina* (7–) 9–15 (–17) cm. long, (3–) 5–7 cm. broad; elliptic, rarely oblong; quite coriaceous; entirely glabrous; base truncate to round; apex acuminate; lateral veins 7–9 pairs, slightly arched, basal pair often faint; intercostals few, not prominent. *Petioles* (0.75–) 1.75–2.5 cm. long, 0.1–0.2 cm. broad; smooth and glabrous, cystoliths often visible. *Stipules* 0.5–1 cm. long, very early caducous, leaving very prominent scars; young ones very crescentic. *Male inflorescences* 5–12 cm.

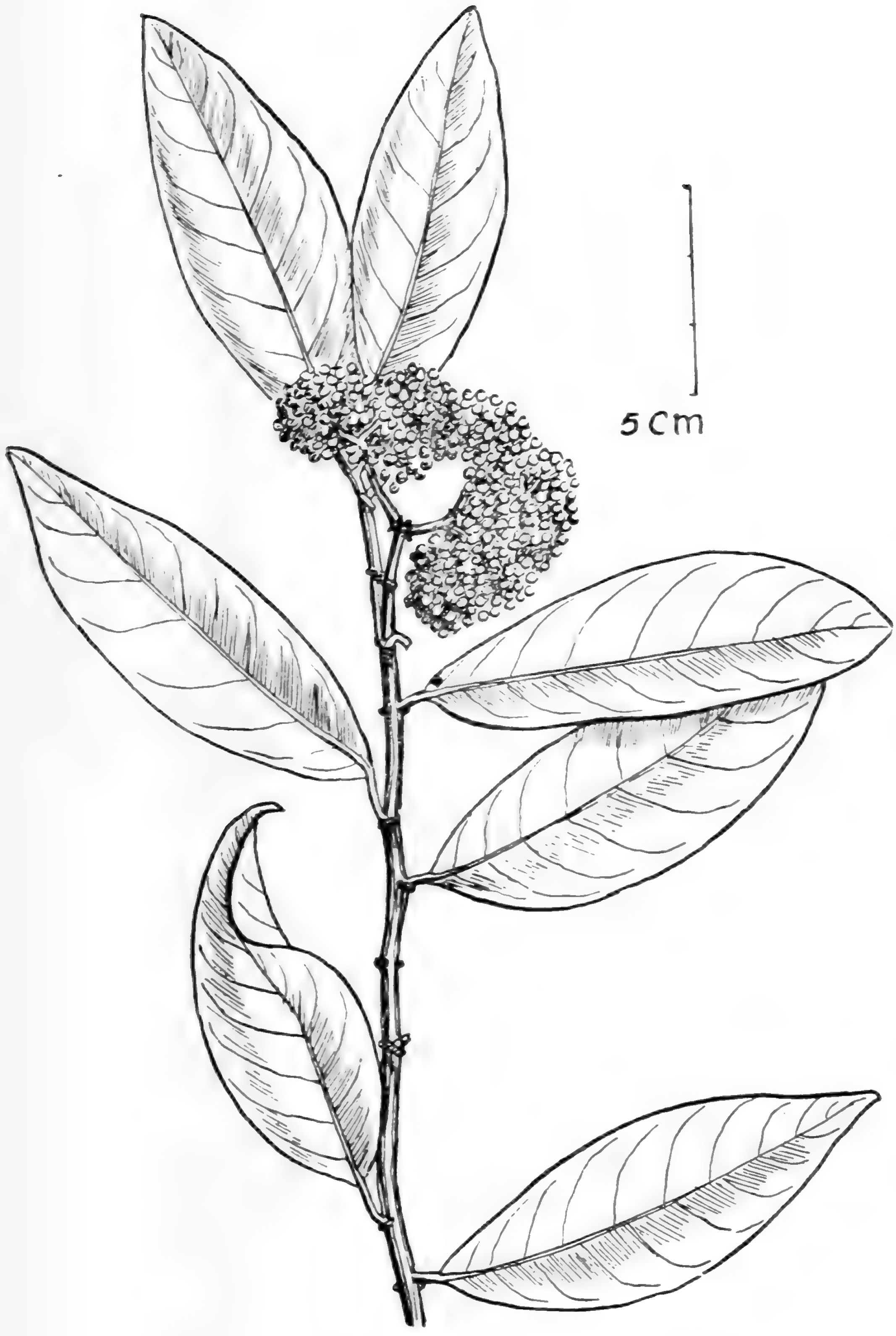


Fig. 22. *Poikilospermum scortechinii.* Twig with male inflorescence.

wide; solitary; branched dichotomously 6–7 times; primary and secondary peduncles about the same length, 1–3 cm.; branches glabrous; peduncular bracts very early caducous; bract scars very prominent; floral capitula very numerous, each 2–3 mm. diam. *Female inflorescences* about the same dimension as the male; solitary; branched dichotomously 3–4 times; primary peduncles (1.5–) 2–3 cm. long; secondary ones about the same length; all branches glabrous; peduncular bracts early caducous; bract scars very prominent; floral capitula generally 8, rarely more, each 2–3 cm. diam. *Male flowers* sessile; perianth 0.75–1.25 mm. long, 0.5–1 mm. broad; glabrous; tepals 4, sometimes 3 or 2; stamens 4, 3 or 2, slightly shorter than perianth; filaments straight, short; pistillode about the same length as the stamens; interfloral bracts very minute. *Female flowers* pedicellate; perianth 2–3 mm. long, glabrous, 4-lobed; tepals 2 + 2 decussate-imbricate; ovary slightly shorter than perianth; stigma 1–2 mm. long; interfloral bracts very minute. *Achenes* 3–5 mm. long, 1–1.5 mm. broad; enclosed by the persistent perianth.

ECOLOGY: In primary rain forests up to 300 metres; frequent near water courses, swamps and peat swamps.

VERNACULAR NAMES: Ara nasi and Ara Umoo (Malay).

Vegetatively, this species is not very variable, although the Bornean populations tend to have slightly more ovate lamina than those of the Malay Peninsula. Besides, it is very distinct from the others. It is therefore hardly surprising that this species has not been confused with the others of the subgenus *Ligulistigma*.

Bargagli-Petrucci (1902) regarded *P. scortechinii*, *P. intermedium* and *P. dubium* as three distinct species. He distinguished *P. intermedium* from the other two on the basis that its male flowers are 2-staminate. Since 2-staminate flowers have been found intermixed with 4-staminate ones in the same inflorescence of many Malayan materials, this character is therefore considered unimportant.

The species *P. dubium* was considered by him distinct from *P. scortechinii* on the grounds that the female inflorescence is not so divaricate in the former species as it is in the latter; and that glands found in *P. scortechinii* are absent from the other species. Both these differences are again found to be unimportant because of the following reasons: (*a*) all young inflorescences of *P. scortechinii* are always compact and not divaricate; and the holotype of *P. dubium* certainly had a very young inflorescence; and (*b*) glands are not always present in *P. scortechinii* either. These three species are therefore here considered conspecific.

DISTRIBUTION: Sumatra, Malay Peninsula and Borneo.

Sumatra: *Lorzing 15049* (partim), N.NE. Medan, 21 Jan. 1929 (L).

Malay Peninsula: *Abu 3040,* Sungei Buloh, Selangor, 13 March 1919 (SING).—*Burkill SFN. 126,* Kukob, Johore, 10 Aug. 1913 (SING); *SFN. 3130,* Klang, Selangor, 22 Sept. 1918 (SING); *SFN. 4107,* Klang, Selangor, 4 May 1919 (SING); *SFN. 6563,* Selangor, 18 Sept. 1921 (SING); *SFN. 7030,* Klang, Selangor, 13 March 1921 (SING).—*Corner SFN. 28484,* Jassu Bay, Johore, 11 June 1934 (SING); *SFN. 30125,* Ulu Bendong, Kemaman, 1 Nov. 1935 (SING); *SFN. 36286,* Gunong Panti, Johore, 28 May 1939 (SING).—*Curtis 2384,* Kuala Lumpur, Selangor, Feb. 1890 (SING).—*Fielding s.n.,* Pulau Aor, Johore, 1893 (SING).—*Haniff SFN. 14326,* Telok Anson, Perak, 29 Sept. 1924 (SING).—*Holttum SFN. 9361,* Kluang, Johore, 18 Nov. 1922 (SING).—*King's Coll. 5845,* Gopeng, Perak (FI); *6033,* Perak, May 1884 (G); *7911,* Perak, July 1885 (SING).—*Ngadiman SFN. 36700,* Pontian, Johore, 3 July 1939 (SING).—*Nur SFN. 33976,* Klang, Selangor, 2 Oct. 1937 (L & SING).—*Ridley 9193,* Johore, April 1898 (SING); *13221,* Sungei Tebrau, Johore, 1908 (SING).—*Scortechinii 144,* Perak (FI).—*Teruya 298,* Kota Tinggi, Johore, Dec. 1925 (SING).—*Wray 1323 and 1339,* Tapa, Perak (SING).

Borneo: *Beccari 3193,* Marop prov., del Batan-Lupar, April 1867 (FI); *3951,* Bantin, Sarawak, Nov. 1867 (FI); *3968,* Sungei Mahon, Kuching, Sarawak (FI).—*Garai 2458/1964,* Kuching, Sarawak, 26 Nov. 1892 (SAR).—*Haviland 396/345,* Sarawak, b.z.e.p. (SAR).—*Haviland & Hose 3691A,* Kuching, Sarawak, 9 Jan. 1895 (SAR).—*Kostermans 13689,* Karangan River, Sankulirang, East Borneo, 3 Sept. 1957 (L).—*Synge S. 573,* Niah, IV Division, Sarawak, Nov. 1932 (K & L).—*Native Collector. 187,* Sarawak (P).

17. **Poikilospermum singalense** (Barg.-Petr.) Merr. Contr. Arnold Arbor. **8:** 51 (1934).

Conocephalus singalensis Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 226. *t. 12* (1902).

TYPE SPECIMEN: *C. singalensis* Barg.-Petr.: *Beccari s.n.,* Mt. Singalan, Sumatra occid., alto Padang, 1878 (Holotype: FI).

Twigs 0.7–1.5 cm. diam.; periderm splitting into small brown flakes, or rarely not, lightly to very densely lenticellate; young ones well covered with white and red stellate hairs, soon glabrous; stipular- and petiolar-scars scarcely to very prominent; usually brown in dry state. *Lamina* 13–20 cm. long, 5–11 cm. broad; exact ovate to broad elliptic; coriaceous to very coriaceous; young ones with red stellate hairs on veins of abaxial surface, soon glabrous; base cuneate to round; apex obtuse to at most very acute; lateral veins 10–13 pairs, very straight, very prominent; intercostals numerous, closely set, very straight and very prominent. *Petioles* 3–6 cm. long, 0.2–0.3 cm. broad; periderm densely lenticellate or splitting into small brown flakes; often covered with white hairs intermixed with red ones, soon glabrous. *Stipules* 1–2 cm. long; slightly crescentic; often covered with hairs similar to those of petioles; very early caducous. *Male inflorescences* 6–8 cm. long, 8–12 cm. broad; solitary; branched dichotomously 5–7 times; primary peduncle short, ca. 1 cm. long; secondary peduncles much longer, ca. 2–3 cm. long; all branches densely covered with white hairs intermixed with red stellate ones; bracts very early caducous; floral capitula ca. 0.3 cm. diam., very numerous. *Female inflorescences* ca. 7 cm. long, ca. 8 cm. broad; solitary; branched dichotomously ca. 4 times; primary and secondary peduncles ca. 2.5 cm. long; all branches with red stellate hairs, soon glabrous; peduncular bracts very early caducous; floral capitula ca. 1.2–1.5 cm. diam., about 10 in each inflorescence. *Male flowers* sessile, perianth ca. 1 mm. long and broad; light pubescent at the apex; tepals 4, incurved; stamens 4; filaments short, straight; pistillode small, pale or transparent; interfloral bracts absent. *Female flowers* very shortly pedicellate; perianth ca. 2 mm. long, ca. 1 mm. broad, glabrous, 4-lobed; tepals slightly incurved; ovary slightly shorter than perianth; stigma short, ca. 1 mm. long; pedicel ca. 1 mm. long. *Achenes* unknown.

Bargagli-Petrucci based this species on a female plant collected by Beccari from Mt. Singalan, but he was unable to trace the male ones. After having studied the holotype at Florence (Firenze) very carefully, I therefore equated with confidence the two specimens of male plants to be enumerated below with this species. These specimens had been collected very close to the type locality in West Sumatra.

The same author remarked that this species was similar to *P. lanceolatum* in the sizes of the lamina and petioles, but different in the shapes of lamina and stipules. This species is in fact quite far removed from *P. lanceolatum* in many other respects. As far as I can judge, *P. singalense* seems closest to *P. azureum* which is also from Sumatra.

DISTRIBUTION: Sumatra.

Sumatra: *Alston 13960,* Gunong Labu, 1 March 1954 (BM).—*Beccari s.n.,* Mt. Singalan, Sumatra occid., Alto Padang, 1878 (FI).—*Borssum Waalkes 1703,* N.W. of Painan, West Coast Sumatra, 9 June 1957 (L).

18. **Poikilospermum suaveolens** (Bl.) Merr. Contr. Arnold Arbor. **8:** 47 (1934), partim; Backer, Bek. Fl. Java **6:** 53 (1948).
Conocephalus suaveolens Bl. Bijdr. 484 (1825); Benn. in Horsfield, Pl. Jav. rar. 47. *t. 12* (1838), exclud. syn. *C. naucleiflorus:* Trec. Ann. Sci. Nat. ser. 3. **8:** 87 (1847); Bl. Mus. Bot. Lugd.-Bat. **2:** *t. 39* (1856); Miq. Fl. Ind. Bat. **1 (2):** 283 (1859) et Suppl. **1:** 416 (1861) et Ann. Mus. Bot. Lugd.-Bat. **3:** 210 (1867); Kurz, For. Fl. Br. Bur. **2:** 430

(1877); F.-Villar, Novis. App. Fl. Philipp. Blanco. 203 (1880); Vidal, Sinop. Pl. Filip. Atlas 40. t. 88. f. D (1883); Hk. f. Fl. Br. Ind. **5:** 545 (1888), partim; Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 218 (1902), partim; Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921), partim, et Enum. Philipp. Fl. Pl. **2:** 71 (1923), partim; Ridl. Fl. Mal. Pen. **3:** 357 (1924); Gagnep. in Lecomte, Fl. Gen. Indo-Chine **5:** 831 (1929).

Procris violacea Blanco, Fl. Filip. 706 (1837); Merr. Bur. Govt. Lab. **27:** 80 (1905).

Conocephalus ovatus Trec. Ann. Sci. Nat. ser. 3. **8:** 89 (1847).

Conocephalus pubescens Trec. l.c. 90.

Conocephalus ellipticus Trec. l.c. 91; Barg.-Petr. l.c. 217.

Conocephalus microphyllus Trec. l.c. 92; F.-Villar. l.c. 203; Barg.-Petr. l.c. 222.

Conocephalus blumei Gaudich. Bot. Voy. Bonite Atlas *t. 96* (1847–1848) et apud D'Alleizette, Bot. Voy. Bonite 163 (1866); Barg.-Petr. l.c. 230.

Conocephalus gratus Miq. Pl. Jungh. 43 (1851).

Conocephalus borneensis Miq. Ann. Mus. Bot. Lugd.-Bat. **3:** 210 (1867); Barg.-Petr. l.c. 219; Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921).

Conocephalus amoenus King apud Hk. f. l.c. 545; Barg.-Petr. l.c. 220; Ridl. l.c. 357.

Balansæphytum tonkinense Drake, Bull. Soc. Bot. France **43:** 83. *t. 1* (1896).

Conocephalus sinensis Wright in Forbes et Hemsley, J. Linn. Soc. Bot. **26:** 471 (1899).

Conocephalus violaceus (Blanco) Merr. Bur. Govt. Lab. **27:** 80 (1905).

Conocephalus tonkinensis (Drake) Renner, Bot. Jahrb. **39:** 409 (1907).

Conocephalus piperi Elmer, Leafl. Philipp. Bot. **8:** 2770 (1915); Merr. Enum. Philipp. Fl. Pl. **2:** 71 (1923).

Conocephalus oblanceolatus Ridl. Kew Bull. 81 (1926).

Conocephalus mollis Gagnepain, in Lecomte, l.c. 834 (non Merr. 1921).

Poikilospermum amoenum (King apud Hooker f.) Merr. Contr. Arnold Arbor. **8:** 48 (1934).

Poikilospermum borneense (Miq.) Merr. l.c. 49.

Poikilospermum gagnepainii Merr. l.c. 50.

Poikilospermum oblanceolatum (Ridl.) Merr. l.c. 51.

Poikilospermum piperi (Elmer) Merr. l.c. 51.

Poikilospermum sinense (Wright) Merr. l.c. 51

Poikilospermum tonkinense (Drake) Merr. l.c. 52.

Urtica amoena King, nom. nud. in herb.

Urtica superba King, nom. nud. in herb.

TYPE SPECIMENS: *C. suaveolens* Bl.: *Blume s.n.,* Java (Lectotype: L; syntype: B).—*P. violacea* Blanco: Type destroyed; Merr. *Sp. Blancoanæ 110,* Luzon, Philippines, Nov. 1914 (illustrative specimens: B & P).—*C. ovatus* Trec.: *Zollinger 285,* Java (Lectotype: P; syntype: G & K).—*C. pubescens* Trec.: *Leschenault s.n.,* Java (Lectotype: P).—*C. ellipticus* Trec.: *Gaudich. 105,* Pulo Pinang, Malay Peninsula, March 1837 (Holotype: P; isotype: FI & G).—*C. microphyllus* Trec.: *Callery 54,* Manille-Calawan, Philippines (Holotype: P).—*C. blumei* Gaudich.: *Gaudichaud 144,* Manilla, Philippines, Nov. 1836 (Lectotype: P). —*C. gratus* Miq.: Junghun, Djatikalangan, G. Gomping, Java, April (lost?).—*C. borneensis* Miq.: *Korthals,* Banjermassing, Borneo australis (lost?).—*C. amoenus* King apud Hooker f.:*Porter Wall. cat. 4626,* Penang, Malay Peninsula (Holotype: K).—*B. tonkinense* Drake: *Balansa 2488,* Tonkin, Indo-Chine, April 1888 (Lectotype: P).—*C. sinensis* Wright: *Henry 11074,* Mengtze, Yunnan, China (Holotype: K).—*C. piperi* Elmer: *Elmer 13653,* Agusan, Mindanao, Philippines, Aug. 1912 (Isotypes: B, BM, FI, G & P).—*C. oblanceolatus* Ridl.: *Kloss 14714,* Sipora, Sumatra, 12 Oct. 1924 (Isotype: SING). *C. mollis* Gagnep.: *Poilane 7328,* Annam, Indo-Chine, 24 July 1923 (Lectotype: P).—**Fig. 23.**

Twigs (0.3–) 0.5–1.25 (–1.5) cm. diam.; periderm splitting into transverse copper-brown flakes, flakes extremely profuse to few, prominent to inconspicuous; glabrous to dense white pubescent; stipular- and petiolar-scars fairly prominent; copper-brown in dry state. *Lamina* 10–40 cm. long, 6–25 cm. broad; very variable, broad ovate, ovate, elliptic to obovate; usually very coriaceous; glabrous, rarely pubescent; base cuneate, rounded to profound cordate; apex sharp acute to obtuse; lateral veins (8–) 12–14 (–18) pairs, very straight and prominent; intercostals numerous, straight, rigid and prominent, very rarely faint. *Petioles* (4–) 6–10 (–14) cm. long, 0.3–0.6 cm. diam.; periderm splitting into flakes similar to those of twigs; glabrous to pubescent. *Stipules* (1–) 2–4 cm. long, strongly crescentic; glabrous, rarely pubescent; usually persistent. *Male inflorescences* (2–) 4–6 cm. long, 2–5 cm. broad; solitary; branched dichotomously 2–3 times; primary peduncle as long to twice as long as secondary peduncles; tertiary peduncles numerous, at apex of secondary peduncles, always very short, hence the pseudo-umbellate arrangement of the floral capitula; peduncular bracts paired, usually very large, foliaceous, boat-shaped, persistent,

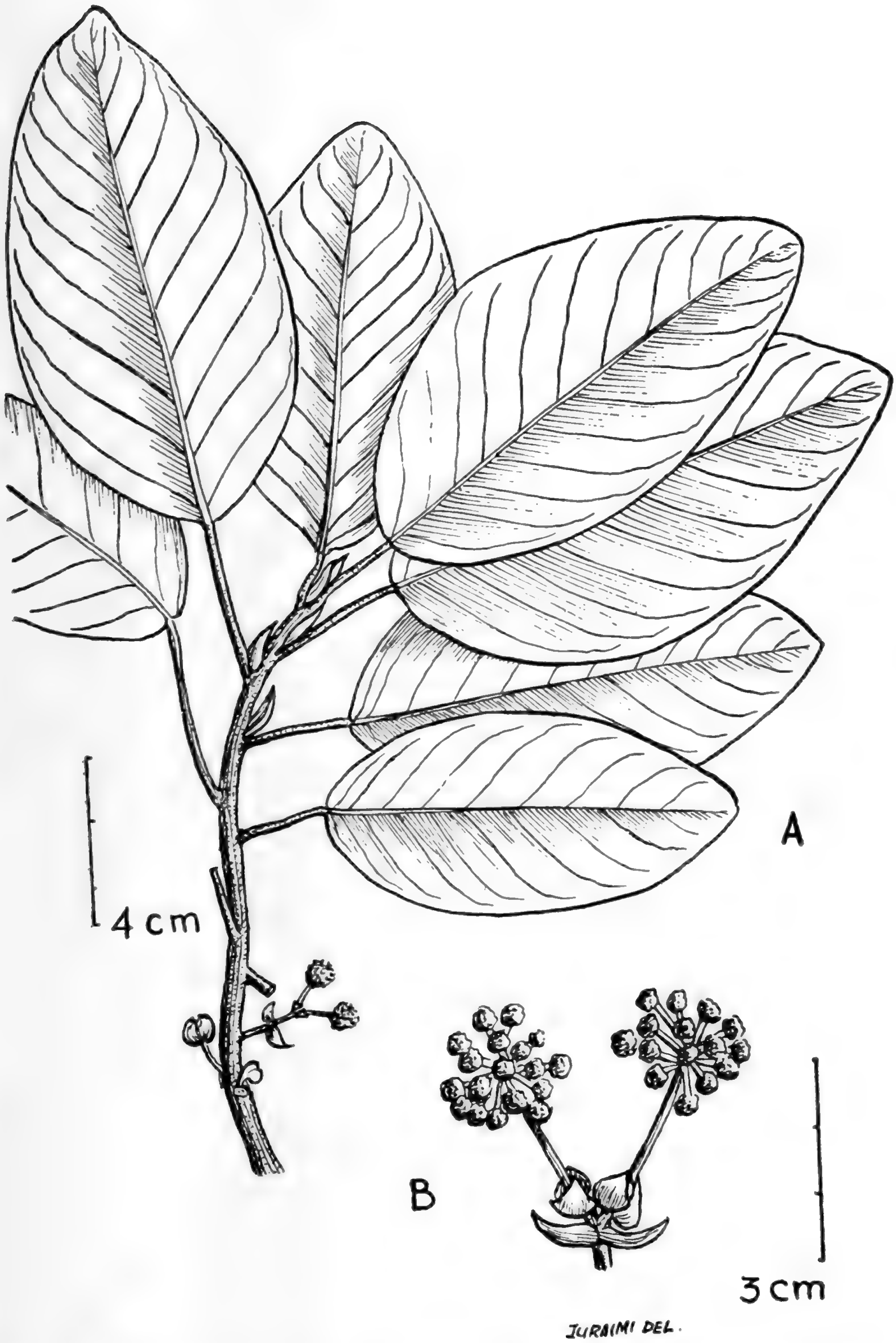


Fig. 23. *Poikilospermum suaveolens*. A, male twig with young inflorescences. B, male inflorescence (matured).

usually 2 pairs at the first dichotomy; floral capitula 0.3–0.5 cm. diam., numerous. *Female inflorescences* 4–6 cm. long, 6–9 cm. broad; solitary; branched once or twice; primary peduncle usually longer than secondary peduncles; peduncular bracts slightly larger than those of the male, otherwise the same; floral capitula 3–5 (–7) cm. diam., 2–4 in each inflorescence. *Male flowers* sessile; 1.5–2 mm. long, as broad; perianth pubescent to rough hairy, rarely glabrous; tepals 4, rarely 2 or 3, strongly incurved at the apex; stamens 4, rarely 2 or 3, ca. 1.5 mm. long, often 2 longer than others; filaments straight, short to long; pistillode ca. 1 mm. long, thin, with capitate stigma; interfloral bracts usually absent. *Female flowers* pedicellate; perianth 2–3.5 mm. long, 1.–2 mm. broad; perianth glabrous, very rarely pubescent; 4-lobed; tepals 2 + 2 decussate-imbricate, the inner part slightly broader than the outer ones, strongly incurved at the apex; ovary 1.–2 mm. long, half as broad; stigma ca. 1 mm. long; pedicels 5–10 mm. long; interfloral bracts usually absent. *Achenes* 3–5 mm. long, 1–1.25 mm. broad; entirely covered by the persistent perianth; pedicels ca. three times the length of achenes.

ECOLOGY: This species occurs more along water courses in the rain forests and seems quite rare in monsoonal forests. It has been found growing from sea-level to as high as 1,500 metres. It does not seem to be able to survive in either very exposed or dark habitats.

ECONOMIC USES: Comercially, this species is not important at all. The bark has often been used as crude ropes by the natives. Cut stems of large sizes have been recorded to yield potable water. Heyne recorded the use of stems for eye diseases in the Celebes. Pounded stems have ben used to destroy hair vermin in many parts of Malaysia while in the Malay Peninsula, the leaves and roots have been used variously as medicine.

VERNACULAR NAMES: Akar murah, Ara jankang, Chentawan, Daun Sentawan, Mentawan, Semelit papan, Sentawan and Tentawan (Malay Peninsula). Besto, Kalas, Kekkegoan aroy and Lesa (Java). Gunatol mukul and Gunatong (Borneo). Anopo, Anopol, Hanopol and Panocol (Philippine Islands). Kari waja (Moluccas).

This is the most wide-spread as well as the most variable species of the whole genus. It is small wonder that a long list of names had been applied to it.

The earliest legitimate specific epithet for this species is that of Blume in 1825. Although his description is not diagnostic enough, his specimens are still well preserved in the herbarium of Leiden and Berlin; besides, he published an excellent drawing of it in 1856 which drawing no botanist has yet referred to.

Blanco (1837) described a species from the Philippines, and named it *Procris violacea;* but his specimen is not extant today. This species was equated with Blume's *suaveolens* by F.-Villar in 1880. Merrill in 1905, on the other hand, disagreed with F.-Villar, but was willing to consider it as belonging to the same genus. Hence he recombined it to *Conocephalus violaceus*. However, in 1918, Merrill changed his mind and confirmed F.-Villar's decision. thereby reducing *C. violaceus* to a synonym of this species. I have seen and compared Merrill's illustrative specimen with Blanco's description; and could find no cause whatsoever to disagree with these two botanists. Hence, Blanco's species is here maintained as being conspecific with this species.

Gaudichaud published a drawing of a species between 1847 and 1848 and he named it *C. blumei*. Bargagli-Petrucci in 1902 maintained it as a distinct species and noted erroneously that it was from the Malay Peninsula. I was fortunate to have come across a specimen collected by Gaudichaud from the Philippines, which is probably the one the author made his drawing from. Having found this specimen to be no different from Blume's *suaveolens*, I have to reduce it to a synonym of Blume's species.

Regarding *C. gratus*, it was Miquel who described this in 1851. Then in 1859, he himself reduced it to Blume's *suaveolens*. Since I have not seen the type specimen and since his description is rather general, I therefore prefer not to disagree with Miquel in his later decision.

The type specimen of *C. borneensis* of Miquel is probably lost. However, I realised from his description that the differences he drew between this species and that of Blume is no greater than the differences between a young and an old plant of the same species. Again, I am forced to reduce this species.

On *C. amoenus*, *B. tonkinense*, *C. sinensis*, *C. piperi*, *C. oblanceolatus* and *C. mollis*, I disagree altogether with Merrill. These are conspecific with *P. suaveolens*.

It must be noted here that this species has hitherto been regarded as including Roxburgh's *naucleiflora* from Continental Asia. This research reveals that these two species are quite distinct (see notes on *P. naucleiflorum*).

This species exhibits three vegetative forms. Specimens of populations occuring in the Malay Peninsula and Continental Asia tend to have robust stems and thick coriaceous leaves. The periderm of petioles and twigs usually split into very large and numerous flakes. Specimens from the Philippine populations differ from the Continental ones in having less coriaceous leaves and more lenticels on the twigs; while those from the Javanese populations have less prominent peridermal flakes which may sometimes be invisible to the unaided eye. However, there are so many intermediates between these forms that it is not possible to divide the species into geographical subspecies.

DISTRIBUTION: India, China, Thailand, Indo-China, Nicobar Islands, Sumatra, Malay Peninsula, Borneo, Philippine Islands, Java, Celebes and Moluccas.

India: *Hooker s.n.,* Mount Khasia, 1861 (G).—*King's Coll. 511,* Chittagong Hill Tracts (G).

China: *Henry 11074,* Mengtze, Yunnan (K).

Thailand: *Gwynne-Vaughan 210,* Koh See Har Island in T.L.S. (CGE).—*Kerr 5707* (BM); *12999,* 22 July 1927 (P).—*Marcan 150 and 816* (BM).—*Pierre 4802,* July 1878 (P).—*Schmidt 646,* 27 Aug. 1901 (C).—*Seidenfaden 2880,* Klong Sabab, 28 Feb. 1935 (SING).

Indo-China: *Balansa 2488,* Tonkin, April 1888 (G & P).—*Bon 2101,* Tonkin, April 1883 (P).*Chevalier 32409,* N. Annam, 7 Feb. 1914 (P).—*Eberhardt 3119,* Thua Thien (P).—*Petelot 5864,* Tonkin, May 1936 (P).—*Pierre 856,* Cochinchine, April 1867 (P); *1221,* Cambodia (BM); *1558,* Feb. 1874 (G); *1558,* Feb. 1874 (P); *3278,* Cochinchine, May 1877 (P); *3279,* Cochinchine, May 1877 (BM, E & P).—*Poilane 1364,* Lang vay pour de Quang-tri, Annam, 8 April 1920 (E & P); *7328,* Annam, 24 July 1923 (P); *7860,* Annam, 9 Sept. 1923 (P); *10475,* Mai Lauh prov., Annam, 21 May 1924 (P).—*Thorel 1111,* 1862/1866, (G & P); *9166,* Me-Kong, 1866/1868 (P).-

Nicobar Island: *Unknown s.n.,* Galathea Exped. 1845–1847 (C).

Sumatra: *Asdat 169,* Kp. Sigleng, Troeman, Atjeh, 29 Aug. 1941 (BO).—*Batten-Pool s.n.,* Wassenar, Atjeh, 1939 (SING).—*Beccari 793,* Padang prov., Western Sumatra, Aug 1878 (BM & FI).—*Buwalda 6531,* Berapit, 13 April, 1939 (L); *6916,* Indragiri Uplands, 17 July 1939 (L); *7001,* Indragiri Uplands, 24 July 1939 (L).—*Forbes 1577A,* 1881/1882 (BM).—*Huitema 33,* Dempo, Palembang, Dec. 1929 (BO).—*Kloss 14714,* Sipora, 12 Oct. 1924 (SING).—*Koch-Reichenall s.n.,* Sumatra, 1927 (M).—*Krukoff 4458,* Asahan, East Coast, Nov.-Dec. 1932 (BO, BR, G, LE & SING).—*Lorzing 12177,* Sibolangit, 17 Oct. 1927 (L).—*Nur SFN. 7387,* Da-to Pulau Siam, 6 Aug. 1921 (SING).—*Teysmann 7299,* Bangka (C).

Malay Peninsula: *Ahmad 5184,* Kuala Lumpur, Selangor, 20 Dec. 1919 (SING).—*Alvins s.n.,* Malacca (SING).—*Burkill SFN. 124,* Kukob, Johore, 10 Aug. 1913 (SING).—*Burkill & Haniff SFN. 12441,* Grik, Perak, 18 June 1924 (SING).—*Chew Wee-Lek CWL. 7,* Bukit Timah, Singapore, 12 Jan. 1957 (CGE & SING); *CWL. 16,* same loc., 25 Jan. 1957 (SING); *CWL. 24 & 25,* Mandai

Road, Singapore, 20 Feb. 1957 (SING); *CWL. 27*, Rifle Range, Nee Soon, Singapore, 21 Feb. 1957 (SING); *CWL. 32*, 47th mile, Ulu Sedili, Johore, 26 Feb. 1957 (SING); *CWL. 34*, Nee Soon Reservoir, Singapore, 5 March 1957 (SING); *CWL. 57*, 31st mile, Jalan Kelantan, Trengganu, 28 March 1957 (CGE, L & SING); *CWL. 61, 78 & 79*, Jerangau F.R., Trengganu, 30 March 1957 (SING); *CWL. 124 & 126*, Baling, Kedah, 9 April 1957 (SING); *CWL. 195*, Bt. Kalong, Kodiang, Kedah, 21 May 1957 (CGE & SING); *CWL. 210*, Bt. Hantu, Kodiang, Kedah, 23 May 1957 (CGE & SING).—*Chew Wee-Lek & Kiah CWL. 97*, Kuala Krai, Kelantan, 2 April 1957 (CGE & SING).—*Clemens 22500*, Botanic Gardens, Singapore, 12 May 1929 (P).—*Corner SFN. 28506*, Sungei Rau Reba, Johore, 12 June 1934 (SING).—*Curtis 1745*, Rest Hill, Penang, March 1892 (SING); *2681*, Langkawi, Kedah, Sept. 1890 (SING).—*Derry 1219*, *Malaka Omdah*, Malacca, June 1892 (BM & SING).—*Gaudichaud 105*, Pulo-Pinang, March 1837 (FI, G & P).—*Henderson SFN. 22584*, Gua Tipus, Pahang, 10 Aug. 1929 (SING).—*King's Coll. 704*, Gopeng, Perak (FI); *4066*, Perak, March 1883 (BM & G).—*Ridley 1152*, Pahang, 4 May 1890 (SING).—*Salvit s.n.*, Penara Bukit, Penang, (SING).—*Spare SFN. 36020*, Sungei Krian Estate, Perak, 12 July 1938 (SING).—*Vesterdal 286*, Johore (C).—*Wray 549*, River Plus, Perak (SING).—*Yakim 7412*, Kuala Lumpur, Selangor, 14 June (SING).

Borneo: *Alston 13244*, Permatang, Indonesian Borneo, 25 Jan. 1954 (BM).—*Anderson 8566*, Saribas, Betong, Sarawak, 14 Aug. 1957 (L & SAR).—*Beccari 320 & 757*, Kuching, Sarawak (FI).—*Brooke 8792*, Kelepu, Sarawak, 11 July 1954 (L).—*Buwalda 7982*, Sampit bloekar, 8 Oct. 1940 (BO & L).—*Elmer 20236*, Sandakan, N. Borneo, 1921 (BM, C, G, M, P & SING); *20703*, Tawao, N. Borneo 1923 (C, G, L, M, P & SING).—*Gibbs 2722*, (BM).—*Kostermans 4486*, Balikpapan, 2 Sept. 1950 (BO & L).—*Purseglove P. 5046*, Bako National Park, Sarawak, 20 May 1956 (L, SAR & SING).—*van Steenis 1243*, G. Ranai Exped. to Anambas & Natoena Islands, 1928 (SING).—*Wood San. A4630*, Kinabatangan, N. Borneo, 22 July 1954 (A, L, MEL, SING & KEP).

Philippine Islands: *Adduru 219 & 275*, Cagayan, Luzon, May-*June* 1917 (P).—*Alcasid & Celestino PNH. 7307*, Tawitawi, June 1940 (PNH).—*Borden 1186*, Bataan, Luzon, June 1904 (BM).—*Britton PNH. 19469*, Calapan, Mindoro, 22 April 1953 (L & PNH).—*Callery 54*, Manille (P).—*Conklin PNH. 17403*, Mt. Yagaw, Mansalay, 17 Feb. 1953 (PNH).—*Cuming 600*, 1841 (BM & FI).—*Edano PNH. 1299*, Davao, Mindanao, 9 Oct. 1946 (PNH). *Edano & Gutierrez PNH. 37720*, Irosin, Sorsogon, Luzon, 11 May 1957 (L).—*Elmer 7469*, Tayabas, Luzon, May 1906 (E, FI & G); *13653*, Agusan, Mindanao, Aug. 1912 (BM, B, FI, G & P).—

Fenix 15871, Davao, Mindanao, Aug. 1912 (SING).—*Fox PNH. 5053*, Baler, Quezon, Luzon, March 1948 (PNH).—*Gaudichaud 144*, Manille, Nov 1836 (G & P).—*Hallier 4442*, Basilan, 18 Jan. 1904 (L); *4528*, Basilan, 24 Jan. 1904 (L).—*Mendoza PNH. 18556*, Albay, Luzon, 18 June 1953 (PNH).—*Merrill, Spec. Blanco, 110*, Luzon, Nov. 1914 (B & P); *Spec. Blanco 111*, Luzon, Nov. 1914 (P).—*Pancho PNH. 33265*, Davao, Mindanao, 1 May 1955 (PNH). —*Quisumbing PNH. 2519*, Baler, Quezon, Luzon, 7 May 1947 (PNH).—*Ramos & Edano 45233*, Tayabbas, Luzon, May 1925 (B & P).—*Ramos & Pascasio 34434*, Surigao, Mindanao, April 1919 (K).—*Sinclair & Edano 9676*, Bulusan, Sorsogon, Luzon, 21 June 1958 (L & SING).—*Sulit PNH. 3639*, Mt. Bulusan, Sorsogon, Luzon, 30 July 1947 (BR & PNH).—*Vidal 924*, Isole, April 1887 (FI).—*Wenzel 337*, Leyte (G); *417*, Leyte (G); *3052*, Surigao, 2 July 1927 (G & M).—*Whitford 13*, Bataan, Luzon, April 1904 (P); *770*, Tayabas, Luzon, Sept. 1904 (P).

Java: *Banks & Solander s.n.*, 1770–1771 (BM).—*Blume s.n.*, Java, 1836 (P); *s.n.*, Java (B & L).—*Bruggeman 38*, Tjibodas, Preanger, 29 March 1924 (BO).—*Commerson s.n.*, (P).—*Durand 6649*, 13 Aug. 1907 (L).—*Forbes 387*, West Java (BM & LE); *485*, West Java, 1879/1880 (BM).—*Franck 219*, East Java (C); *688*, East Java, Dec. 1923 (C).—*La-Haye s.n.*, Java (P).—*Horsfield 524*, Mallang (BM).—*Lanjouw 44*, Java (BO).—*Leschenault s.n.*, (P).—*Martens s.n.*, (BR).—*de Monchy s.n.*, Java (P).—Teysmann s.n., 1868 (B & P).—*de Vriese s.n.* (BR).—*Zollinger 285*, (G, K, LE & P); *329*, (FI); *543*, (B, FI, G & P); *s.n.*, (G). *Unknown (Junghuhn?) s.n.*, (P).

Celebes: *Alston 16174*, Tomohon (BM).—*Beccari s.n.*, Penisola S.E. Kandari, 1874 (FI).—*Bloembergen 4198*, Paloe, Menado, 12 July 1939 (BO & L).—*Elbert 3373*, S.-Celebes, 26 Oct. 1909 (L). —*Eyma 1156*, Mesamba, 19 July 1937 (BO & L).—*Kjellberg 696*, Kendari, Poehara, 6 March 1929 (S); *876*, Wavotobi (S); *1629*, Rante Lemb, 9 June 1929 (S).—*Riedel s.n.*, Minado, 1874 (M).

Moluccas: *Anang (exp. de Haan) 629*, Weda, S. Peninsula, Halmaheira, May 1938 (BO).—*Lam 3620*, Sangi and Talaud Isle. Morotai, 26 June 1926 (BO & L).—*Nedi 155*, Amasing, 12 Sept. 1937 (L); *207*, Sosoepoe, Kp. Taroeba, 1 Oct. 1937 (L); *363*, Djikodjiko Lebengor, Halmaheira, 13 Oct. 1937 (BO).

19. **Poikilospermum subtrinervium** (Miq.) Chew, **comb. nov.**

Conocephalus subtrinervius Miq. Fl. Ind. Bat. **Suppl.** 417 (1861), basionym.

TYPE SPECIMEN: *C. subtrinervius* Miq.: *Junghuhn*, Sumatra bor.

Twigs 0.3–0.75 cm. diam., rarely thicker; periderm splitting into copper-brown flakes; generally glabrous; stipular- and petiolar-scars scarcely to distinctly prominent. *Lamina* 8–14 cm. long, 2–6 cm. broad; elliptic to ovate; glabrous; quite coriaceous; base cuneate to broad cuneate, rarely round; apex sharp or blunt acute to long acuminate; lateral veins fairly straight, very prominent, 7–10 pairs, rarely less, the basal pair usually prominent; intercostals numerous, usually faint. *Petioles* 1–3.5 cm. long, ca. 0.2–0.4 cm. broad; periderm splitting into small brown flakes; light pubescent, soon glabrous. *Stipules* very small, early caducous. *Male inflorescences* 2–4 cm. long and broad; solitary; branched dichotomously 2–3 times; secondary peduncles slightly longer than primary one; tertiary peduncles numerous, very short, at the apex of secondary peduncles, hence the pseudo-umbellate arrangement of the floral capitula; peduncular bracts paired, very small, often early caducous; floral capitula 2–3 mm. diam., very numerous. *Female inflorescences* ca. 6 cm. long, ca. 8 cm. broad; solitary; branched twice; primary peduncle ca. 1.5 cm. long, secondary ones ca. 4.5 cm. long; branches light pubescent, soon glabrous; peduncular bracts paired, ca. 1 cm. long, early caducous; floral capitula ca. 2 cm. diam., usually 4 in each inflorescence. *Male flowers* sessile; ca. 1 mm. long and broad; perianth pubescent to glabrous; tepals 4, slightly gamophyllous at the base, rarely 2 or 3, strongly incurved at the apex; stamens 4, rarely 2 or 3, ca. 1 mm. long; filaments straight, short; pistillode ca. 1 mm. long, thin; interfloral bracts absent. *Female flowers* pedicellate; perianth ca. 2 mm. long, light pubescent, soon glabrous, 4-lobed; tepals 2 + 2 decussate-imbricate; ovary ca. 1 mm. long; stigma 1–1.5 mm. long; pedicel 3–5 mm. long; interfloral bracts absent. *Achenes* ca. 3 mm. long, ca. 1.5 mm. broad; apex slightly exserted from the persistent perianth.

It has already been remarked earlier that Hooker misinterpreted this species in 1888 by equating with it numerous collections of the species *P. microstachys*.

Merrill in 1934, considered this species conspecific with Trecul's *P. lanceolatum*. It has now been found that Merrill was in error and that this species *P. subtrinervium* is in fact distinct.

Although the type specimen has not been examined, the description that Miquel supplied for this species is detailed enough for me to identify the specimens cited below. These are the only Sumatran materials that answer the description.

DISTRIBUTION: Sumatra.

Coert 1634, Banka, 25 Sept. 1941 (L).—*Posthumus 667*, Djambi, 4 Aug. 1925 (SING).—*Robinson & Kloss 210*, Korinchi, 16 April 1914 (BM).—*Rutten-Kooistra 22*, Palembang, Dec. 1938 (BO).—*Yates 1086*, East Coast (BM); *1413*, East Coast (P).

20. **Poikilospermum tangaum** Chew, **spec. nov.**

TYPE SPECIMEN: *Elmer 20724*, Tawao, Elphinstone Prov., North Borneo, Oct. 1922/March 1923 (Holotypus: SING; isotypus: BM, BR, C, G, M & P).—**Fig. 24.**

Ramuli (0.3–) 0.5–1 cm. diam., glabri, novelli cortice levi, mox fisso in scidis, cicatricibus stipularum et petiolarum paullum elevatis. *Laminae* (10–) 11–13 cm. longae, (3–) 4–5 (–6) cm. latae, ellipticae vel oblongae, chartaceae vel coriaceae, glabrae, basi cuneatae, raro rotundatae, apice acuminatae, acumine brevi obtuso; costis lateralibus utrinsecus 7–9, subtus aliquanto elevatis; intercostis obscuris. *Petioli* 2–7 cm. longi, ca. 0.1 cm. lati, cortice levi glabri. *Stipulae* 1–2 cm. longae, gracillimae, lunatae, glabrae, caducae. *Inflorescentiae masc.* 2–3 cm. longae et latae, solitariae; pedunculo pluries dichotomo, pedunculo primario et secondario ca. 0.5–1 cm. longo, aliis brevissimis; paullum pubescentes, mox glabrae; bracteis geminatis ca. 0.5–1 cm. longis, caducis; capitulis 0.3–0.5 cm. diam., numerosis, in capita duo, ca. 1–2 cm. diam. globosa coacervatis, utraque ad pedunculum secundarium. *Inflorescentiae fem.* (4–) 6–9 cm. longae, (4–) 6–8 (–12) cm. latae, solitariae; pedunculo pluries dichotomo; pedunculo primario 1–2.5 cm. longo, secundariis 2–3.5 cm. longis; glabrae, raro paullum pubescentes; bracteis geminatis, ca. 1 cm. longis, caducis; capitulis ca. 1 cm. diam., octo vel pluribus. *Flores masc.* sessiles, ca. 1 mm. longi et lati, paullum vel dense pubescentes; tepalis 2; staminibus 2, filamentis erectis brevibus; pistillodio minuto, interdum absenti. *Flores fem.* subsessiles, vel breve pedicellati; perianthio ca. 2 mm. longo, 1–2 mm. lato, 4-partito; tepalis glabris, apice incurvo; ovario ca. 1.5 mm. longo, ca. 1 mm. lato; stigmate brevi; pedicello ca. 1 mm. longo. *Achaenia* ca. 3 mm. longa, ca. 1.5 mm. lata; piriforma, apice e perianthio persistenti paullum exserto; pedicello ca. 1.5 mm. longo.

ECOLOGY: This species occurs from sea-level to 1,500 metres in altitude in North Borneo and seems to prefer wet habitats.

VERNACULAR NAME: Tangau (Borneo).

Most of the collections of this species had been wrongly identified by Merrill as *micranthum* of Miquel. I have compared these specimens with Miquel's description of *micranthum* very carefully, and found that Miquel was referring to a different species because of the following facts:—

(*a*) The male inflorescences of this species are very congested and not wide-spread, whereas Miquel's species have very divaricate inflorescences.

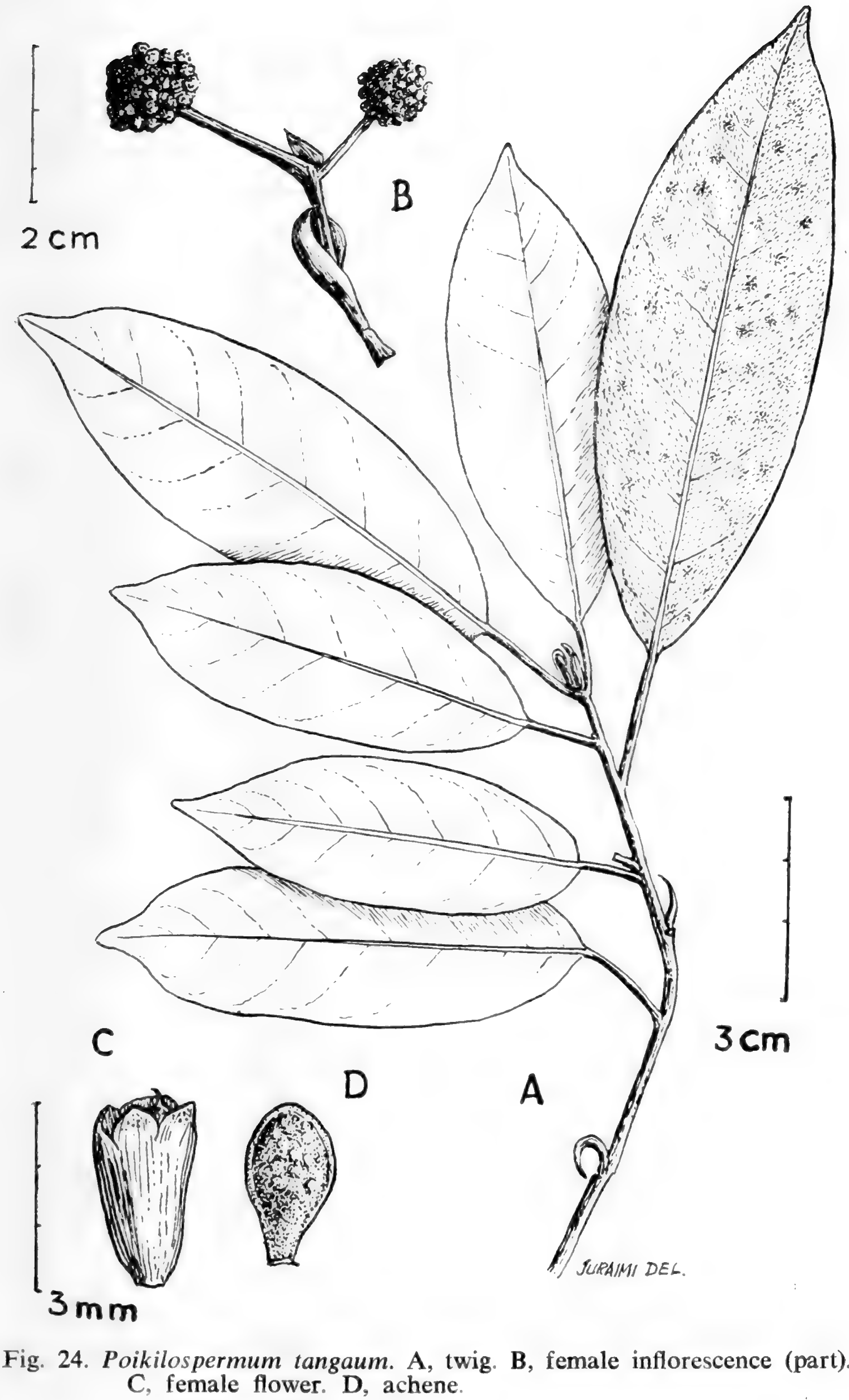


Fig. 24. *Poikilospermum tangaum.* A, twig. B, female inflorescence (part). C, female flower. D, achene.

(*b*) Miquel observed that his plants are trees reaching 30 feet in height, whereas plants of *P. tangaum* are fairly frail scramblers.

(*c*) The lamina of his plants seem to be much broader than those of *P. tangaum*.

This species *P. tangaum* is easily distinguished from the others of subgenus *Ligulistigma* by (*a*) the broad pear-shaped achenes, (*b*) the occasional absence of the pistillode from the male flowers and (*c*) the very congested nature of the male inflorescences.

It is of interest to note that plants of this species that occur in the lowlands have thin, almost chartaceous lamina, whereas those that occur on the hills or highlands above the 1,000 metres contour tend to have more coriaceous lamina.

The specific epithet is derived from the vernacular name "tangau".

DISTRIBUTION: North Borneo.

Clemens 26232, Dallas 3,000 ft., Mt. Kinabalu, 17 Aug. 1931 (K); *29769*, Tenompok, 5,000 ft., Mt. Kinabalu, 26 May 1932 (G, K & M).—*Elmer 20724*, Tawao, Oct. 1922/March 1923 (BM, BR, C, G, M, P & SING).—*Puasa-Angian 4074*, Tambunan, 15 Feb. 1934 (SING).—*Wood San. 15038*, near Sandakan, 31 March 1955 (K, L & SING).

Species Dubiae

1. **Poikilospermum micranthum** (Miq.) Merr. Contr. Arnold Arbor. **8:** 50 (1934).

Conocephalus ? micranthus Miq. Ann. Mus. Bot. Ludge.-Bat. **3:** 210 (1867); Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 217 (1902); Merr. J. Straits Br. Asiat. Soc. **Special:** 229 (1921).

TYPE SPECIMEN: *C. micranthus* Miq.: *Korthals s.n.*, Mantatat, South Borneo (type lost?).

Miquel himself was not sure whether this species belonged to *Conocephalus*. He added, however, that its habit is rather similar to that of *Poikilospermum*.

This species was recognised by Bargagli-Petrucci in 1902; and was noted by him as a distinct one because of its tree habit. As he had neither seen the type specimen nor equated any collection with it, his remark is here not taken seriously. What he actually did, amounts to a re-description of Miquel's species in slightly different words.

In 1921, Merrill also recognised this species. Again like Bargagli-Petrucci, he made no attempt to interpret it. Then sometime in the 1930's Merrill equated a few collections from North Borneo with it.

It has now been found that what Merrill had were specimens of an undescribed Bornean species distinct from *micranthum*.

In the course of this work, I have not yet come across any specimen that could answer the description Miquel supplied for this species; and since I have not been able to trace the type specimen, I prefer to leave it as a doubtful species as Miquel had done himself.

2. *Conocephalus concolor* Dalz. in Dalz. et Gibbs. Bomb. Fl. 239 (1861); Hooker f. Fl. Br. Ind. **5:** 546 (1888); Barg.-Petr. Nuovo G. Bot. Ital. n. ser. **9:** 230 (1902); Cooke, Fl. Bomb. **2:** 660 (1907).

The following description was given by Dalzell for this species which was not typified at all:—

"Shrubby; leaves very large (1 foot), irregularly scattered, 3-nerved, perfectly smooth, oblong-ovate, acute, green on both sides; female flower axillary. At Phoonda Ghant."

It is small wonder that most botanists regarded this a doubtful species. Cooke in 1907 had this to say: "The above is Dalzell's description of the plant, which has not as yet been found by any other collector, and there are no specimens anywhere so far as I know."

Merrill, in 1934, for some reason or other, did not transfer it to *Poikilospermum*. Since this species could mean practically anything, I prefer to leave it as another doubtful one.

Species Excludenda

Conocephalus niveus Wight, Ic. **6:** 7. *t. 1959* (1853); Dalz. et Gibbs. Bomb. Fl. 239 (1861).

! = **Debregeasia velutina** Gaudich. Voy. Bonite, Atlas, *t. 90* (1847–1848). [= D. longifolia (Nic. Burm.) Wedd. (1869).]

Bibliography

AIRY-SHAW, H. K. (1941–1942). *The Biogeographic Division of the Indo-Australian Archipelago: 5. Some General Considerations from the Botanical Standpoint.* Proc. Linn. Soc. **154:** 148–154.

BAILLON, H. (1874). *Natural History of Plants.* 3. London (English translation).

BAILLON, H. (1880). *Natural History of Plants.* 6. London (English translation).

BARGAGLI-PETRUCCI, G. (1902). *Rivista del Genere Conocephalus Bl.* Nuovo G. Bot. Ital. n. ser. **9:** 213–230.

BENTHAM, G. & HOOKER, J. D. (1880). *Genera Plantarum.* **3** (1). London.

BLUME, C. L. (1825). *Bijdragen tot de Flora van Nederlandsch Indie.* 9. Batavia.

BLUME, C. L. (1852–1856). *Stirpium Exoticarum Novarum vel Minus Cognitarum ex vivis aut siccis brevis Exposito et Descriptio.* Mus. Bot. Lugd.-Bat. **2:** 77–78 et 80–81.

BROWN, R. (1818). *Narrative of an Expedition to explore the River Zaire.* London.

BUREAU, E. (1873). *Moraceae* DC. Prodr. **17** (2): 211–279.

BUREAU, E. (1873). *Artocarpaceae.* DC. Prodr. **17** (2): 280–288.

BURKILL, I. H. (1935). *A Dictionary of the Economic Products of the Malay Peninsula.* **2.** London.

DE JUSSIEU, A. L. (1789). *Genera Plantarum.* Paris.

DEWOLF, G. P. (1958). *The American Species of Ficus.* (A Dissertation submitted for the Degree of Doctor of Philosophy at the University of Cambridge).

ENDLICHER, S. (1833). *Prodromus Florae Norfolkicae.* Vienna.

ENDLICHER, S. (1837). *Genera Plantarum.* **1.** Vienna.

ENGLER, A. & PRANTL, K. (1894). *Die Naturlichen Pflanzenfamilien.* **3** (1). *Leipzig.*

GAGNEPAIN, F. (1928–1930) in Lecomte, *Flore Generale de L'Indo-Chine.* **5:** 694–921.

GAUDICHAUD, C. (1826) in Freycinet, *Voyage Autour du Monde, Execute sur les corvettes de S. M. l'Uraine et la Physicienne.* (Botany). Paris.

JARRETT, F. M. (1956). *A Revision of Artocarpus and Allied Genera.* (A Dissertation submitted for the Degree of Doctor of Philosophy at the University of Cambridge; subsequently published in J. Arnold Arbor. **40:** 21–24. 1959).

LAMARCK, J. B. & DECANDOLLE, A. P. (1806). *Synopsis Plantarum in Gallica Descriptarum.* 183–185.

LAMARCK, J. B. & DECANDOLLE, A. P. (1815). *Flore Francaise.* **3.** Paris.

LINDLEY, J. (1830). *Introduction to the Natural System of Botany.* London.

LINDLEY, J. (1846). *The Vegetable Kingdom.* London.

MERRILL, E. D. (1905). *A Review of the Identifications of the Species Described in Blanco's Flora de Filipinas.* Bur. Govt. **27:** 5–132.

MERRILL, E. D. (1926). *An Enumeration of the Philippine Flowering Plants.* **4.** Manila.

MERRILL, E. D. (1934). *An Enumeration of Plants Collected in Sumatra* by *W. N. and C. M. Bangham.* Contr. Arnold Arbor. **8:** 47–52.

METCALFE, C. R. & CHALK, L. (1950). *Anatomy of the Dicotyledons.* **2.** Oxford.

MIRBEL, B. (1815). *Elemens de Physiologie Vegetable et de Botanique.* **2.** Paris.

PLANCHON, J. E. (1873). *Ulmaceae.* DC. Prodr. **17** (2): 151–210.

RENNER, O. (1907). *Beitrage zur Anatomie und Systematik der Artocarpeen und Conocephaleen, insbesondere der Gattung Ficus.* Bot. Jahrb. **39:** 319–448.

STEENIS, C. G. G. J. VAN (1950) in Steenis-Kruseman, *Malaysian Plant Collectors and Collections.* Flora Mal. ser. 1. **1:** lxx–lxxv.

TRECUL, A. (1847). *Memoire Sur La Famille Des Artocarpeae.* Ann. Sci. Nat. ser. 3. **8:** 38–157.

WEDDELL, H. A. (1856–1857). *Monographie de la famille des Urticees.* Arch. Mus. Hist. Nat. Paris. **9:** 1–592.

WEDDELL, H. A. (1857). *Considerations Generales Sur La Famille Des Urticees.* Ann. Sci. Nat. ser. 4. **7:** 307–396.

WINKLER, Hub. (1922). *Die Urticaceen Papuasiens.* Bot. Jahrb. **57:** 595–603.

Notes on Some Malaysian Melastomaceae

By C. X. FURTADO
Singapore.

WHILE ARRANGING the specimens of MELASTOMACEAE from the herbaria of Singapore and Sarawak, certain systematic anomalies or confusions that were noticed, were cleared to form the subjects of these notes. These may be summarised as follows:—

GENERA:

A new genus ANPLECTRELLA has been established for the anomalous species hitherto known as *Anplectrum anomalum*. Reasons have been adduced to conserve MARUMIA Bl. (1831) against MARUMIA Reinwdt. ex Bl. (1825 ?) and ex Reinwdt. (1828) and to reject MACROLENES Naud. ex Miq. (1858), a dubious genus when published and later reduced to MARUMIA Bl. (1831) when discovered to be congeneric.

SPECIES:

(*a*) **Spec. nov:** Dissochaeta **hirsutoidea,** D. **johorensis,** D. **malayana,** D. **marumioides,** D. **stellulata** and D. **tawaensis.**

Excepting *D. marumioides*, all these species are elements that were being confused in herbaria or literature with *D. hirsuta* Hk. f. which has been typified here. In addition *D. densiflora* and *D. porphyrocarpa* were established by Ridley on the material also confused with *D. hirsuta*.

(*b*) **Nom. nov.: Memecylon megacarpum** (*M. pulchrum* Cogn., non Kurz.).

(*c*) **Comb. nov.: Anplectrella anomala** (*Anplectrum anomalum*).

(*d*) **var. nov.:** Diplectria annulata var. **seticarpa.**

(*e*) **Syn. nov.:** *Anplectrum lepidosetosum* and *A. crassinodum* (Diplectria annulata); *Dissochaeta celebica* partim (D. rubiginosa); *Marumia reticulata* Bl. (M. pachgyna), *M. rufolanata* (M. stellulata (Jack) Bl.): *Medinilla polyanthum* and *M. quadrifolia* (M. radicans); *Memecylon elmeri* and *M. heteropleurum* var *olivaceum* (M. maingayi), *M. longifolium* (M. wallichii).

(*f*) **Loc. nov.:** Dissochaeta ramosii; Marumia ciliatiloba; Medinilla pterocaula (*M. crassinervia* partly), M. radicans (*M. crassinervia* partly); Memecylon acuminatum, M. hepaticum, M. multiflorum and M. paniculatum.

Anplectrella Furtado **gen. nov.**

Ab omnibus generibus ad Tribum Dissochaeteae pertinentibus inter alias hoc differt: calyce tubuloso truncato fauce paululo dilatato; staminibus 8, omnibus aequalibus, fertilibus, connectivo dorso breviter hastato producto, ventre in appendices duos longos lineares subulatos exeunte; bacca globosa in vertice in calycis limbo truncato tubuloso angustiore cyncta. *Diflectriae* affinissuma.

1. **Anplectrella anomala** (Stapf et King) Furtado **comb. nov.**

Anplectrum anomalum Stapf et King in King, Mat. Flor. Mal. Pen. III (1900) 467; Ridl., Fl. Mal. Pen. I (1922) 800: basionym.

MALAYA: **Perak,** Gopeng (Kunstler 5,779, syntype). **Johore,** Mawai (Corner 30,876 & s.n.); Layang-Layang at Rengam (H. M. Burkill 1,792); Layang-Layang on Bukit Badak (Hassan & Kadim 13); Sungei Kayu (Kiah 32,061).

SUMATRA: **Indragiri** at Muara Padjanki (Buwalda 6,431).

Field notes by Corner suggest that this is a frequent climber in the swampy forest, but generally grows so high up on trees that its specimens are not easily collected. Kunstler's notes imply that the climber is a saprophyte or semiparasite, growing on the tops of large trees and producing roots that encircle tree branches. Possibly all collections were made when the trees were cut down; Burkill, and Hassan and Kadim note that their collections were from forest felling areas.

Corner notes: "Twigs, undersurface of leaves and inflorescence rusty scurfy. Leaves yellowish green beneath, the sides curved slightly backward i.e. 'subconchate'. Calyx green, brown-scurfy. Petals greenish white, strongly reflexed against pedicel. Filaments white; anthers and appendages pink; anther pores white. Style pink with white stigma."

Corner's unnumbered specimen is sterile and its leaves differ somewhat from the adult ones, in that they are quintuplinerved and almost panduraeform with a broad rotundotruncate base; but there are transitions towards the adult forms which are triplinerved narrowed towards the base.

Diplectria

2. **Diplectria annulata** (Triana) O. Kuntze, Rev. Gen. Plant (1891) 246.

Anplectrum annulatum Triana in Trans. Linn. Soc. XXVIII (1871) 84; Clarke in Hk. f., Fl. Brit. Ind. II (1879) 546; Cogn. in DC., Mon. Phan. VII (1891) 569; **basionym.**

A. lepidosetosum King, Mat. Fl. Mal. Pen. III (1900) 464; Ridl., Fl. Mal. Pen. I (1922) 799 **Syn. nov.**

A. crassinodum Merr. in Univ. Calif. Publ. Bot. XV (1929) 223. **Syn. nov.**

MALAYA: **Penang,** Government Hill alt. 160 m. (Curtis 1078); Government Hill by Old Main Road, alt. 400 m. (Curtis = 1078) Balek Pulau (Ridley & Curtis 7,949; Ridley 9,413). **Perak,** Temango (Ridley in VII–1909). **Pahang,** Bentong (Burkill and Haniff 16,727 as Kayu Mata Hari, sterile). **Selangor,** Kuala Lumpur (Curtis in II–1890); Seminyih (Hume 7,938 & 8,305); Ginting Simpah (Strugnell 13,618); Kepong (Pawanchee & Lela 13,652). **Malacca,** Ayer Panas (Goodenough & Ridley 1574). **Johore,** Batu Pahat on Bukit Patani (Ridley in 1900). **Singapore,** Pulau Ubin (Ridley in 1893).

SUMATRA: **Asahan** at Huta Bagasan (Rahmat 7212).

BORNEO: **North Borneo,** Tawao (Elmer 21,291, typus of *A. crassinodium*). **Sarawak,** Limbang (Haviland c.o.c.h. & c.o.c.k. [544 ?] SAR).

Anplectrum A. Gray is not usable to Malaysian plants cf. Bakhuizen f. in Med. Bot. Mus. Utrecht 91 (1943) 26.

Ridley 12,253 referred by Ridley (Kew Bull., 1946 p. 32) to this species, is *D. cyanocarpa* (Bl.) O.K. In Singapore the material is sterile.

3. **Diplectria annulata** (Triana) O.K. var. **seticarpa** Furtado **var. nov.**

A. varietate typica haec differt baccis setosis.

MALAYA: **Kelantan,** Sungei Terang (Henderson 29,646). **Trengganu,** Dungun (Sinclair & Kiah 40,491); Ulu Brang (Moysey & Kiah 33,853). **Pahang,** Sabai Estate near Bentong (Md. Shah 176—holotypus in SING); Sungei Pertang by Ulu Tembeling (Henderson 22,121).

Dissochaeta

4. **Dissochaeta densiflora** Ridl. in Kew Bull. (1946) 32.

D. hirsuta Hk. f. *sec.* Merr. in Univ. Calif. Publ. Bot. XV (1929) 224 p. parte.

BORNEO: **Sarawak,** Saribas Paku by Sungei Plandok (Haviland 1550, isoholotype in SAR); Sungei Mayeng (Purseglove; calyx pink, corolla white, anthers pink); Sassa by Sungei Tau (calyx and petals pink); Gat, Upper Rejang River (Clemens 21,569 & 21,139 in SAR); Kalaka (Dyak Collector on 10-IV-1893-SAR).

The indumentum in the lower surface is somewhat variable and deciduous, so that some leaves are glabrous below except for a few setae on the thicker parts of the main nerves. Similarly the presence of tomentum and setae on the calyx seem to vary also. In the holotype collection which bears flowers only but no fruit, there are some calyces showing setae in the tubular portion; in other specimens (e.g. Dyak and Purseglove) there are young fruits which are almost non setose, while others are much setose, the setae being pallid at first and blackish later. In Clemens 21,569, the fruit is ripe, much setose, 5 mm. long, campanulate, with reflexed calyx lobes and leaves almost glabrous below, some leaves being obovate. In Clemens 21,139 fruits are as on the previous one but the internodes are quite glabrous in some parts. In every case the petioles are setose and sometimes also the nodes.

The species may be confused easily with some forms of *Diplectria divaricata* (Willd.) O.K. (Anplectrum).

5. **Dissochaeta hirsuta** Triana in Trans. Linn. Soc. XXVIII (1871) 83; Cogn. in DC., Mon. Phan. VII (1891) 556; Merr., Enum. Born. Pl. (1921) 446 et in Univ. Calif. Publ. Bot. XV (1929) 224 pro parte. **Fig. 2–A.**

BORNEO: **Sarawak,** Kuching (Haviland = 2036 on 18-1-1893 and s.n. on 5-V-1893); Mount Singhie (Haviland 2036 in SAR).

There is a good deal of confusion regarding this species so that any *Dissochaeta* sp. from Borneo, Malaya or Sumatra having setae on branchlets, calyx, and the two surfaces of the leaves is referred to it. Ridley (Kew Bull. 1946 p. 32) established *D. porphyrocarpa* on the Kinabalu specimens that were referred to this species by Stapf in Trans. Linn. Soc. Bot. IV (1894) 150.

The type of the species was a specimen in fruit collected in Labuan by Motley. After comparing his specimens with the type, Haviland noted on his sheet No. 2036 (from Mt. Singhie in the Sarawak herbarium) the following: "Leaves typical; type has no flowers, young fruit only." Unfortunately the Sarawak specimen has neither flowers, nor fruit, but the flowering duplicates might have been donated to other herbaria, for Haviland's field notes show that the calyx teeth are red and its petals white, (perhaps those mounted Haviland 1288 (*D. porphyrocarpa* Ridl.) might belong here). However Haviland's specimens collected in Kuching have similar foliage; in addition they bear flowers and young fruit (Haviland = 2036) or more developed fruit (Haviland s.n.). Hence the following notes may be usefully recorded here.

The bristles present on the stem, leaves, petioles, peduncles, bradts and calyces are long (± 3 mm.), soft, tending to be greyish and do not impart rough or asperous characters to parts as do the short, rigid setae in *D. porphyrocarpa* Ridl. *Leaves* long setose on both surfaces, ovate, acuminate, rounded often cordulate at base, 9–15 cm. long, 4–8 cm. broad, 5-nerved, or 7-nerved including the submarginal collective nerves; petiole 10–15 mm. long. *Inflorescence* terminal, primary branches bearing generally 3 pairs of secondary branches, flowers borne on tertiary or quarternary branchlets. *Bracts* and bracteoles similar, variable rarely narrow linear, generally ligulate or spathulate, rounded at apex, narrowed towards the base, fimbricately hirsute along the margins, larger ones about 10 mm. long, 3–4 mm. broad; smaller ones ± 3 mm. long. *Calyx* campanulate, 5–6 mm. in tube, hirsute, (less hirsute in fruit); lobes narrowly ovate or ligulate, rounded at apex, hirsute with long patent setae along the margins, setae absent in the dorsum.

Petals glabrous except a few bristles at the tip, easily noticed in the bud. *Fruit* subglobose, 5–6 mm. long, about 4 mm. in diam., yellowish when dry, constricted below the calyx rim having having persistent, reflexed calyx lobes. *Young twigs*, peduncles, pedicels, bracts and calyx bear dense, deciduous white tomentum of minute stellate-hairs.

Haviland's notes on the Kuching sheets state that bract and calyx are pink.

D. porphyrocarpa has very short, rigid hairs, calyx densely hirsute, lobes narrow, acuminate, petals pink.

6. **Dissochaeta hirsutoidea** Furtado **spec. nov. Fig. 2–C.**

A *D. hirsuta*, quacum facile confusa, differt inter alias: foliis supra parcissime setosis, deciduo minute stellato-pubescentibus, subtus eodemmodo vestitis, supra hirsutioribus; bracteis inconspicuis, brevioribus, linearibus, setosis, premature deciduis; calycibus in lobos angustiores breviores fere lineares divisis, petalis in alabastro singulis 2–5-setosis; bacca vertice annulo calycis minuto et lobis inter se distantibus reflexiusculis, caducis coronata. A *D. stellulata* foliis pro rata angustioribus, lobis calycis angustioribus longioribusque, bracteis citius deciduis sat distincta.

BORNEO: **North Borneo,** Bettotan prope Sandakan (Boden-Kloss 19,156—holotypus in SING.) **Sarawak,** Matang, 250–400 m. alt. (Hullett, 18-VII-1890).

The specimens have been referred to *D. hirsuta*, from which, however, this is distinguished by the presence of minute stellulate, deciduous hairs on both surfaces of the leaf; short, linear bracts which fall off very early in the life of the flower; short, almost linear calyx lobes and more setae on the petals in the bud. From *D. stellulata* this is distinguished by the leaves being proportionately narrower and calyx lobes being narrower and longer. Boden-Kloss notes that the plant is a climber with white flowers and pink-tipped stamens.

7. **Dissochaeta intermedia** Bl. in Flora XIV (1831) 493 et Mus. Bot. Lugd.-Bot. I (1849) 35 fig. 5; Clarke in Hk. f., Fl. Brit. Ind. II (1879) 544 p.p.; King, Mat. Fl. Mal. Pen. III (1900) 462 p.p.; Ridl., Fl. Mal. Pen. I (1922) 788 p.p.

D. pallida Bl. sec. King, op. cit. III (1900) 52 & Ridl., op. cit. I (1922) 797 partim.

D. scortechinii King, op. cit. III (1900) 464; Ridl., op. cit. (1922) 798 **syn. nov.**

MALAYA: **Pahang,** Telom (Ridley 13,680); Cameron Highlands alt. ± 1200 m. (Nur on 3–V–1937); Sungei Bertam alt. ± 1200 m. (Henderson 11,129); Fraser's Hill, alt. 1300–1400 m. (Burkill & Holttum 8,553 & 8,646; Purseglove 4,112; Shah & noor 621). **Perak,** Maxwell Hill, alt. 1200–1500 m. (Ridley & Curtis 5241 and in VI–1893; Ridl. in VI–1893; Sinclair 38,696;

Burkill and Haniff 12,941; Fox 178 as *Akar Sular*); Larut Hill (Curtis on 25-XII-1901); Ulu Batang Padang (Ridley in Nov. 1908); loc. incert. (Scortechini s.n.); Padang Rangas (Curtis 1301, syntype of *D. scortechinii*).

There has been a great deal of confusion about this species. Stapf showed that most of the Malayan specimens referred to this species and Helfer 2,286 from Tenasserim are *D. rubiginosum* Stapf. *D. scortechinii* King was based on specimens bearing young inflorescences. The Pahang specimens are usually more glabrous and have slightly larger fruits.

8. **Dissochaeta johorensis** Furtado **spec. nov. Fig. 2–B.**

D. hirsuta Triana *sensu* King, Mat. Fl. Mal. Pen. III (1900) 51 & Ridl. Fl. Mal. Pen. I (1922) 797; quoad specimina johorensis tantum.

A *D. hirsuta* partibus vegetativis omnino modice vel luteo-brunnescentibus; foliis angustioribus cum nervulis lateralibus inter se remotioribus; bracteis brevissimis inconspicuis premature deciduis; calycibus elongato urceolatis longioribus in tubo 7–9 mm. longis, in lobos 3–4 mm. longos, angustissime triangulares vel fere lineares acutos, dorso setosos, margine haud vel breviter fimbriatos divisis; fructibus urceolatis, majoribus, 8–10 mm. longis, circa 5 mm. in diam., apice cum lobis calycis reflexis

MALAYA: **Johore,** Sungei Kayu (Kiah 32,357—climber, flowers pink); Gunong Muntahak alt. 200 m. (Nur 19,975, climber, flowers pink); Lombong (Burkill 1,822, straggly bush up to 15 ft., flowers pink); near Gunong Panti (Ridley 41,185—flowers pink —holotypus in SING).

The minute, stellate brownish pubescence is present almost in all vegetative parts and on the calyx, it is decicuous though falls very early from the upper surface of the leaves.

9. **Dissochaeta malayana** Furtado **spec. nov. Fig. 2–D & E.**

A D. johorense, *quacum facile confusa, haec species differt: setis ramulis minoribus paucioribusque, saepe atrescentibus; calycibus urceolatis infra faucem validiore cinctis, apice truncatis vel in lobos brevissimos obtuso triangulares divisis; fructibus 8–10 mm. longis urceolatis apice dilatatis margine eversiusculis.*

MALAYA: **Trengganu,** Ulu Brang, alt. 400 m. (Moysey & Kiah 33,858); Dungun (Sinclair & Kiah 40,492). **Kemaman,** Bukit Kajang, alt. 350 m. (Corner 30,381—Holotypus in SING); ibid, alt. 150 m. (Corner s.n.). **Selangor;** Ginting Simpah alt. 600 m. (Hume 9,131 & 9,287).

In leaves and the general shape and size of flowers and fruit, this species is easily mistaken for *D. johorensis*, but calyx is obscurely lobed or almost truncate (cf. Hume 9,131); the hair on the stem and on the upper leaf surface are shorter and fewer and tend to be dark and even to fall off. In both these species the setae are fewer and shorter on the lower leaf surface than in *D. hirsuta* and tend to fall off early or be suppressed. In both, the lateral nerves of the leaves are also more distant than in *D. hirsuta*.

On the field label of the holotype specimen Corner notes as follows: Petals pink. Filaments yellow. Anthers pinkish purple. Style pale pink, white at base. Calyx and pedicels green with purple hairs. An additional bit of information is given on Corner's unnumbered specimen that hairs on stem and inflorescence are purple.

Sinclair and Kiah's field notes are as follows: Climber. Common on roadside in forest. Petals and staminodes pink-purple. Filaments and anthers yellow. Hairs on calyx and ovary pinkish purple.

10. **Dissochaeta marumioides** Furtado **sp. nov. Fig. 1.**

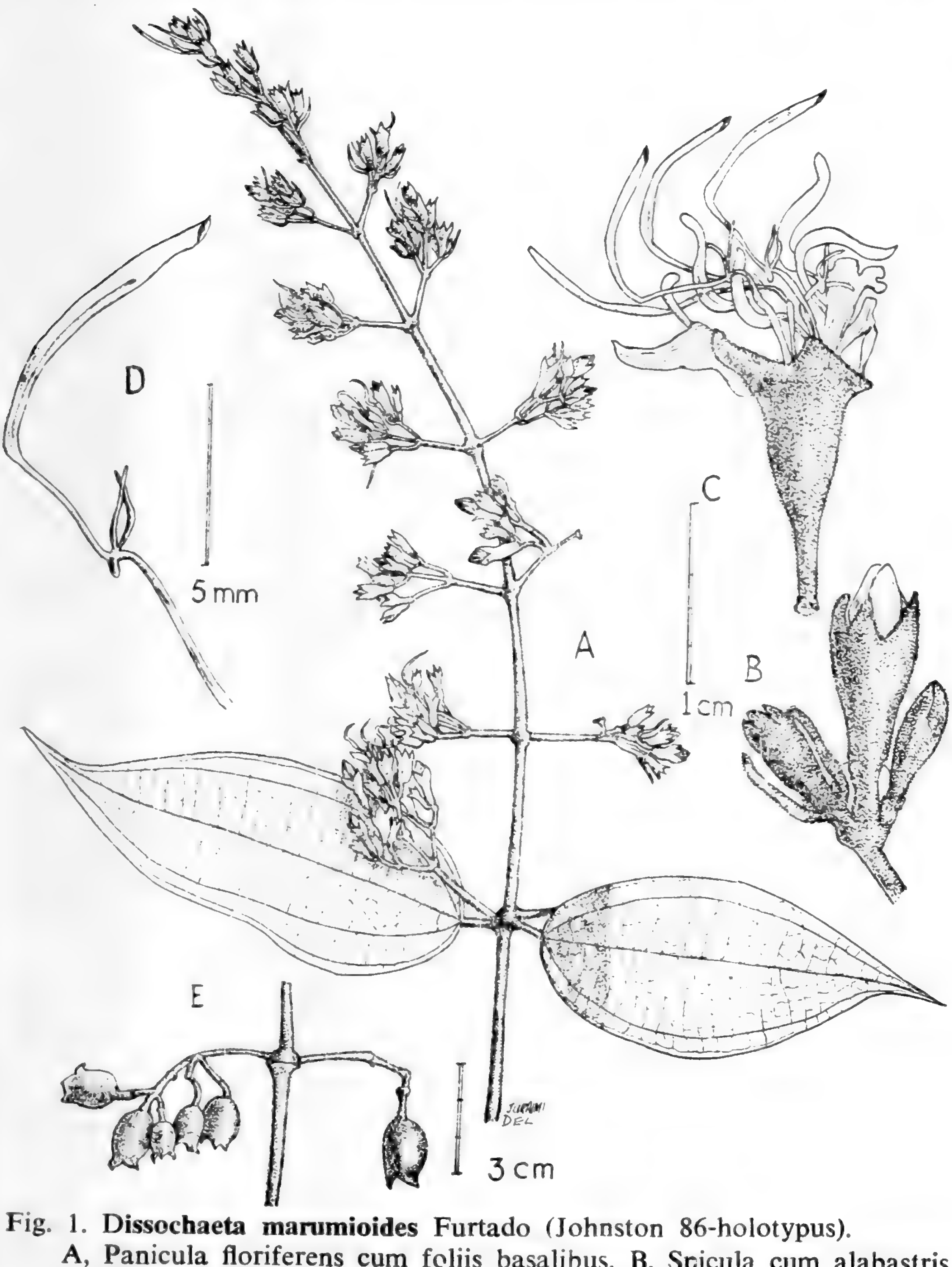


Fig. 1. **Dissochaeta marumioides** Furtado (Johnston 86-holotypus).
A, Panicula floriferens cum foliis basalibus. B, Spicula cum alabastris juvenilibus. C, Flos. D, Stamen fertile. E, Paniculae pars cum fructibus.

A D. pallida *cui affinissima indumento magis rudi densoque griseolo, calycibus longioribus apice valde lobatis, fructibus majoribus vertice limbo calycis lobata cinctis haec species facile distinguenda.*

Frutex erectus vel semi-scandens, bimetralis, ramulis teretibus vel obscure quadrangularibus, dense stellato tomentosis. *Folia* ovato oblonga, 5-nervia, basi rotundata, apice acuminata, 10–15 cm. longa, 5–7 cm. lata, supra glabra olivacea reticulationibus invalidis impressis, subtus omnino dense stellatotomentosa brunneo-albescentia, reticulationibus sicut nervis prominentibus; petiolus circa 1 cm. longus, eodemmodo tomentosus. *Inflorescentia* axillaris ad 10 cm. longa vel terminalis, pedunculis pedicellisque quadrangularibus dense stellato tomentosis. *Bracteae* linearis, 10–15 mm. longae, dense tomentosae. *Calyx* circa 10 mm. longus, obscure quadrangularis vel longitudinaliter rugosus, basin versus attenuatus, in limbo dilatatus, profunde lobatus, lobis circa 4 mm. longis, triangularibus acutiusculis, omnino eodemmodo tomentosus. *Stylus* post anthesin erectus, apicem versus paulo reflexus, glaber, 10–14 mm. longus, vertice truncatus. *Fructus* ellipsoideus, griseo stellato-tomentosus, 10–15 mm. longus, 8–10 mm. in diam., vertice limbo calycis basi annulato apice lobato cinctus.

MALAYA: **Pahang,** Cameron Highlands, 1300–1500 m. alt. Tanah Rata (A & M. Johnston 86-holotypus in SING); Kamunting Road, new Golf Course (A & M. Johnston 22); Robinson Falls (A. M. Burkill 750).

"Thickly sprawling bush to 6 ft. high. Sepals brown, thickly scurfy. Petals pink." (H. M. Burkill). "Large bush with long pendent branches. Fruit black, fleshy." (Johnstons 86).

11. **Dissochaeta ramosii** Merr. in Journ. Roy. Asiat. Soc. Str. Br. 86 (1922) 340 & Univ. Calif. Publ. Bot. XV (1929) 224.

D. annulata Triana sec Stapf in Trans. Linn. Soc. Bot. IV (1894) 159.

MALAYA: **Perak,** Maxwell Hill (Ridley s.n. in VI–1893). **Pahang,** Fraser's Hill (Burkill & Holttum 8,628).

BORNEO: **North Borneo:** Tawaran (Haviland 1,385—SAR): Sabah (Creagh s.n.—SAR); Kabili (Enggoh 7,270), Sandakan (Ridley s.n. in 1897 & Elmer 20,106). **East Borneo,** East Kutei (Kostermans 5,452).

This was not recorded outside British North Borneo.

12. **Dissochaeta rubiginosa** Stapf in Journ. Linn. Soc. XLII (1914) 79.

D. intermedia Bl. sec. Clarke in Hk. f., Fl. Brit. Ind. II (1879) 544; Cogn in DC., Mon. Phan. VII (1891) 562; King, Mat. Fl. Mal. Pen. III (1900) 462: omnino pro parte.

D. celebica Bl. sec. Ridl., Fl. Mal. Pen. 1 (1922) 798 p.p.

MALAYA: **Penang,** Batu Ferengy (Curtis = 2,433); Government Hill (Curtis 2,433: VI–1890: XII–1892; V–1895): Tulloh Bahang (Curtis 2,433).

Since the specific epithet was taken from *Melastoma rubiginosum* Wall. Cat. n. 4052 partim from Penang, the species may have to be typified on Wallich's specimen, though the author included among the syntypes specimens from Burma and Borneo also. Curtis numbered more than one collection as 2,433 instead of " = 2,433".

13. **Dissochaeta stellulata** Furtado **spec. nov. Fig. 2–F.**

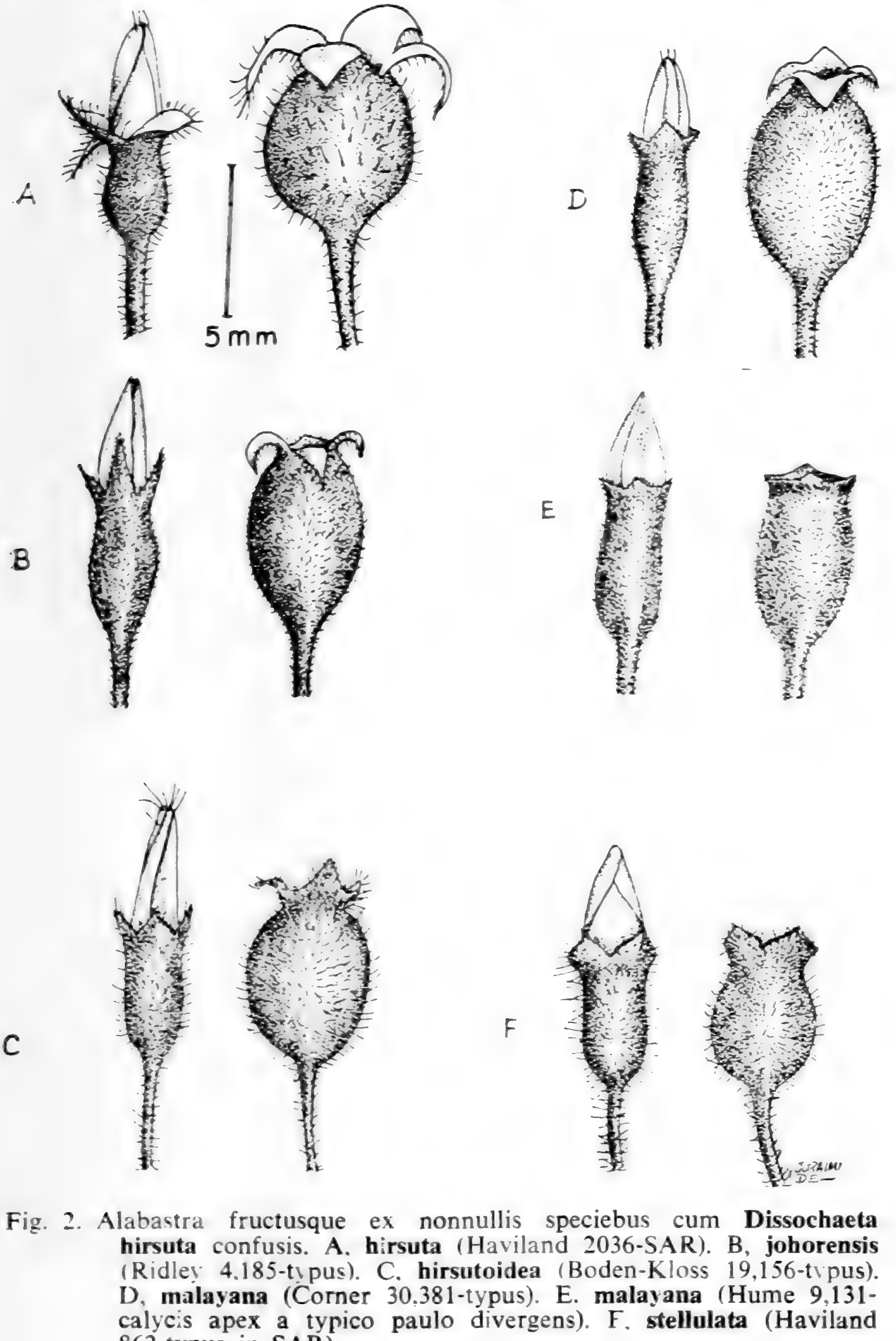


Fig. 2. Alabastra fructusque ex nonnullis speciebus cum **Dissochaeta hirsuta** confusis. A. **hirsuta** (Haviland 2036-SAR). B, **johorensis** (Ridley 4,185-typus). C. **hirsutoidea** (Boden-Kloss 19,156-typus). D, **malayana** (Corner 30,381-typus). E. **malayana** (Hume 9,131-calycis apex a typico paulo divergens). F. **stellulata** (Haviland 862-typus in SAR).

A *D. hirsuta,* cui similima, haec species differt: ramulis, foliis, pedunculis, pedicellis calycibusque omnino setosis et minute brunnescenteque stellulato pubescentibus; foliis paulo minoribus, pro rata latioribus, supra setis paucissimis et pubescentia mox decidua praeditis; calycibus apice in lobos obtusiusculos brevissimos, triangulares divisis; bracteis linearibus, mox deciduis; bacca paulo minore, vertice calycis lobis breviter triangularibus praedita.

BORNEO: **Sarawak,** Sadang (Haviland 862: d: t: m: g:—holotypus in SAR); Santubong (Ridley in IX–1905); Samarahan (Brooke 9,669).

This species is easily mistaken for *D. hirsuta,* but is readily distinguished by the brownish stellulate hairs in between the setae on the lower surface of the leaves and the twigs, peduncles, pedicels and calyces, and also by the obscure triangular lobes of the calyces and the fruit, as well as by the linear deciduous bracts.

14. **Dissochaeta tawaensis** Furtado **spec. nov.**

D. hirsuta Triana sec. Merr. in Univ. Calif. Publ. Bot. XV (1929) 224 quoad specimen infra citata.

D. johorense et *D. malayana,* quibus valde affinis, sed differt: ramulis brevissime setosis; foliis subtus esetosis, punctis minutis brunneis stellulato-puberulis sparse vestitis; supra setosis sicut in *D. johorense,* deciduo minute punctulatis; bracteatis papyraceis, linearibus, esetosis vel margine apiceque paulo setosis, ad 10 mm. usque longis, deciduis; floribus minoribus; calycibus circa 6 mm. longis, campanulatis vel conicis, margine esetosis, in lobos obscurōs apice esetosos vel 1–2 setosos divisis.

BORNEO: **North Borneo,** Tawao (Elmer 21,426—Holotypus in SING).

This might be easily confused with the two Malayan species, *D. johorensis* and *D. malayana,* but the hair are much smaller, the leaves bear no setae in the lower surface, the bracteoles are linear, papery and practically non-setose, flowers with smaller campanulate or conical calyx having obscure lobes which are esetose except at the apices.

Marumia

The genus MARUMIA Reinwardt was a *nomen nudum* when BLUME adopted it in his *Cat. Gew. Buitenz.* (1823) 79 to list some Ternstroemiaceae species for which SAURAUIA Willd. (1801) is the correct generic name and for which REINWARDTIA Bl. was validated by Nees (1824). Apparently two years later, in *Flora* VIII (1825) 103, BLUME himself supplied a valid description of MARUMIA Reinw. In 1828 REINWARDT (Syll. Pl. Ratisb. II p. 10) provided his own description to the genus MARUMIA Reinw. Since MARUMIA Reinw. could not be used as the correct name for the genus, BLUME adopted the same name again for a new Melastomaceous genus he created in 1831 (Flora XIV p. 504), a name that has been widely used since then, even though it was recognized that it was a later homonym.

Its only synonym MACROLENES Naudin (1857) has a peculiar history. Naudin created it as a nomen nudum to a separate Malaysian species that was associated with genera connected with American plants and the identity of which was not easily determined. The plant was first figured and described as *Majeta annulata* Ventenat (1803) and later transferred to a newly created genus HUBERIA DC. (1828) with some doubt as to its precise generic position. NAUDIN (1851) who revised Melastomaceae, maintained MARUMIA as valid genus and though he created the new species *Marumia echinulata* Naud., he did not know where to place Ventenat's species from Java. However, being convinced that it could not be retained in the genera that are exclusively American, he transferred the Javan species to MACROLENES but failed to define the genus.

In 1855 MIQUEL (Fl. Nederl. Ind. I p. 557) who had to give an account of every species found in Indonesia, failed to identify the species, obviously because both the description and the figure given by VENTENAT were defective. Hence not only did he retain *Marumia* Bl. (1831) as the correct generic name for 12 species he described in this work, but provided an incomplete description for MACROLENES, labelling it a doubtful genus accepted by NAUDIN for *Majeta annulata* Vent. and noting that it was probably a species of *Dissochaeta*. In 1865 BENTHAM & HOOKER (Gen. Plant. I, 2, p. 757) recognised VENTENAT's species definitely as a species of MARUMIA and reduced MACROLENES to the synonymy of MARUMIA Bl. (1831) non Reinw. (1828). In 1871 TRIANA in his monographic revision made the new combination *Marumia annulata* (Vent.) Triana. MACROLENES continued to be reduced in all subsequent revisions and floristic works until 1943 when BAKHUIZEN VAN DER BRINK, Jr. rejected *Marumia* Bl. as a later homonym of *Marumia* Reinw. and adopted *Macrolenes* Naudin ex Miq. as the correct name of the genus.

However since his work is not well known and is not monographic, since MARUMIA Bl. has been used for more than a century in several Floras and monographic revisions and since MACROLENES Naud., when validated, was published as a doubtful genus and incompletely described, there is, in my view, a good reason for conserving *Marumia* Bl. (1831) against *Marumia* Reinw.

15. **Marumia ciliatiloba Baker** f. in Journ. Bot. LXII Suppl. 1, (1924) 40.

Macrolenes ciliatiloba (Baker f.) Bakh. f. in Mededeel. Bot. Mus. Utrecht 91 (1943) 215.

MALAYA: **Pahang,** Batu Talam in Raub (Burkill and Haniff 16,998, vern. nom: *Akar Sundok*, the leaves are rubbed for scald in hot water). **Trengganu,** Ulu Brang (Moysey & Kiah 33,835).

This is the first record for Malaya. The Pahang specimen is sterile.

16. **Marumia cf. impressa** Craib in Kew Bull. (1930) 321.

I refer here with some doubt Kunstler 224 from Gunong Panti, Johore. It was cited by King under *Dissochaeta annulata* Hk. f. It has deeply lobed calyx and leaves having impressed nerves and veins above, where the leaves dry greenish yellow. The leaves resemble somewhat those I have doubtfully referred to *M. zeylanica*, but the stellate hairs here are ferrugineous red and calyx and other parts bear no traces of prickles. Its affinity lies with *M. nemorosa*, but is totally different. It must be compared with the type of Craib's species.

17. **Marumia pachygyna** Korth., Verh. Nat. Gesch. Bot. (1839–42) 242 t. 59; Cogn. in DC., Monogr. Phan. VII (1891) 552; Stapf. in Trans. Linn. Soc. Bot. IV (1894) 159.

M. reticulata Bl., Mus. Bot. Lugd.-Bat. I, 2 (1849) 34; Cogn. in op. cit. VII (1891) 551. **Syn. nov.**

M. stellulata Korth. in op. cit. (1839–42) 243, non Bl. (1831).

Macrolenes stellulata (Bl.) Bakh. f. in Mededeel. Bot. Mus. Utrecht 91 (1943) 216 pro parte borneense.

M. reticulata (Bl.) Bakh. f. in op. cit. (1943) 215. **Syn. nov.**

SUMATRA: **Asahan** (Rahmat 7,612).

BORNEO: **East Borneo:** Nunukan (Meijer 2,193). North Borneo: Kinabalu Mt. at Penokok, alt. 1,000 m. (Haviland 1,345); Sandakan: at Elopura (SAN: A.774 & A1,118); Sepilok (Castro 4,502; Keith A1,963); Tawao (Elmer 20,241; 20,548 & 21,540). **Sarawak,** Gat. Upper Rejang river (Clemens 21,594 in SAR); Mt. Matang (Clemens 20,933 in SAR: Haviland s.n. & 146; Ridley s.n.); Sana by Sungei Tau (Purseglove 5,112); loc. incert. (Hullett s.n.). **Brunei:** Bukit Puan (Sinclair & Kadim 10,484); Kuala Ingei (Ashton, BRUN. 151).

Korthals depicts leaves which are clearly biglandulose at the base of their lower surface and shows the calyx hairs with long branches at the top, the two characters which Bakhuizen states to be peculiar of *M. reticulata* and not of *M. stellulata*. Yet he has reduced *M. pachygyna* to *M. stellulata*.

The Brunei specimens quoted above have somewhat smaller flowers with shorter calyx lobes and petals; but they are specifically identical with the other material.

M. reticulata from the Malay Peninsula is different *see* note under this species.

18. **Marumia reticulata** Bl.

Clarke (Hk. f. Fl. Brit. Ind. II, 1879 p. 542). King (Mat. Pl. Mal. Pen. III, 1900 p. 457) and Ridley (Fl. Mal. Pen. 1, 1922 p. 795) describe under this name a species which bears simple prickles on the stem, peduncles and calyx, whereas true *M. reticulata* has non-setose stems and peduncles and the setae on the calyx are branched or stellate at the apex. We have specimens that would agree with this description, viz:

Ridley s.n. from Serom, Johore (Nov. 1900), Henderson 24,057 from Tasek Bera, Pahang, and Strugnell 13,965.

All these bear dense, dirty ferrugineous or ochraceous, more or less deciduous hairs on young branches, petioles, calyx and also on the lower surface of the leaves. The leaves are ovate lanceolate in shape, acuminate at apex, and rounded, cordulate at base and slightly deciduously pubescent above at first. On drying the leaves become greenish yellow above where the nerves, veins and venules all become sunk. Prickles on the young stem and peduncles are very sparse and often weak deciduous; the pubescence and prickles on the calyx are much stronger and persistent. Bracts are linear entire, furfurascent. Flowers are axillary and terminal, usually 3–5 on each lateral peduncle. The specimens seem to be referable to *Marumia zeylanica* Bl. or *M. dimorpha* Craib. Unfortunately I am unable to compare.

19. **Marumia stellulata** (Jack) Bl. in Flora XIV (1831) 503; Cogn. in DC, Monogr. Phan. VII (1891) 552.

M. rufolanata Ridl., Fl. Mal. Pen. V, Suppl. (1925) 310. **Syn. nov.**

Macrolenes stellulata (Jack) Bakh. f. in Mededeel. Bot. Mus. Utrecht 91 (1943) 216 pro parte typica.

Melastoma stellulata Jack in Trans. Linn. Soc. XIV (1825) 6; DC, Prodr. III (1828) 148: **basionym.**

MALAYA: **Kelantan,** Bukit Batu Papan (Henderson 29,504). **Pahang,** Gunong Tahan (Kiah 31,760); Kuala Lipis (Burkill & Haniff 15,661, isoholotype of *M. rufolanata*).

Bracts in this species are oblong or spathulate, almost entire or laciniate, but otherwise agrees with the description of *M. stellulata*. Bakhuizen describes the bracts as linear and entire, but he also states that the species show many transitions in almost all characters. Moreover he had included under this species *M. pachygyna*, which produces linear, non-laciniate bracts, but which, unlike *M. stellulata*, has biglandular leaves. JACK stated that in *M. stellulata*. the bracts were leaf-like.

In interpreting this species I have followed Haviland who had named his collections after comparing his material with Beccari's duplicates of the specimens named by Cogniaux and others, and also Kew's determinations of Haviland's collections.

Medinilla

20. **Medinilla pterocaula** Bl. in Flora XIV (1831) 509 et Rumphia I (1835) 12 t. 7; Cogn. in DC., Phan. VII (1891) 575; Bakh. f. in Med. Bot. Mus. Utrecht 91 (1943) 156.

M. crassinervia Bl. *sensu* Cogn. op. cit. VII (1891) 576; King, Mat. Fl. Mal. Pen. III (1902) 472; Ridl., Fl. Mal. Pen. I (1922) 804: omnino pro parte.

M. macrocarpa Bl. *sensu* Clarke in Hk. f., Fl. Brit. Ind. II (1879) 547 p.p.

MALAYA: **Penang,** Government Hill (Curtis 2,225). **Perak,** Waterfall (Wray 1,821); Batang Padang River (Ridley in Dec. 1908).

BORNEO: **Sarawak,** Kuching (Native collector, 25–IV–1893 —SAR; Haviland 9491 (?): d: h: h: a;—SAR, petals white, and 1,962—SAR, petals white, calyx tube pink).

According to Bakhuizen f. (op. cit. p. 159) who examined the types, *M. crassinervia* Bl. is identical with *M. macrocarpa* Bl., though I do not understand why he reduces the latter which was better described and later even illustrated as the synonym of the former which was imperfectly (and erroneously according to Bakhuizen) described and generally confused with other species. Both the names were published simultaneously in the same periodical and *M. macrocarpa* Bl. has been correctly described as a species having calyx split irregularly into lobes. Clarke apparently considered Malayan specimens referred to this species as exceptional since he recognised "Calyx limb even in the bud truncate entire in Maingay's examples" (Malayan).

Malayan specimens agree well with Blume's description and plate of *M. pterocaula* Bl: it has a truncate calyx and its stem is more or less alate or ridged, in some cases the alae being distinctly undulate in the young branches. The Bornean specimens have slightly broader flowers and the two side nerves diverge almost from the base.

21. **Medinilla radicans** (Bl.) Bl. in Flora XIV (1831) 509 et Rumphia I (1835) 15 t. 3: Cogn. in DC., Mon. Phan. VII (1891) 573; Bakh. f. in Med. Bot. Mus. Utrecht 91 (1943) 153.

M. crassinervia Bl. *sensu* King, Mat. Fl. Mal. Pen. III (1900) 472 partim; Ridl., Fl. Mal. Pen. I (1922) 804 p.p.

M. polyanthium Korth. in Verh. Nat. Gesch. Bot. (1839–42) 245 t. 61. **syn. nov.**

M. quadrifolia (Bl.) Bl. in Flora XIV (1831) 509; Cogn. op. cit. VII (1891) 574; **syn. nov.**

Melastoma quadrifolium Bl., Bijdr. Flor. Ned. Ind. (1826) 1069.

Melastoma radicans Bl., Bijdr. cit. (1826) 1069: **basionym.**

MALAYA: **Pahang,** Fraser's Hill, alt. 900–1200 m. (Burkill and Holttum 7,866; Henderson & Nur 11,101). **Selangor,** Pahang Track (Ridley 8,618); Semangkok Pass (Ridley in VIII–1905). Ginting Simpah (Strugnell 13,006; 13,007 and 27,890). **Singapore,** Bukit Mandai (Goodenough 1,637).

This form with uninerved leaves gradually passes into the one having tri-nerved leaves and so there are no reasons why the two forms should be kept as two species or varieties. Also Blume (1835) mentions that in his *M. radicans* triplinerved leaves occasionally occurs, though in these transversed nerves are not visible. But such leaves have been seen in the specimens which would be referred to *M. radicans*.

Under *M. crassinervia* King referred Ridley, 1637 (= Goodenough 1,637), while Ridley included in addition his Semangkok Pass specimen.

Memecylon

22. **Memecylon acuminatissimum** Bl. Mus. Bot. Lugd. Bot. I (1851) 360: Cogn. in DC., Monogr. Phan. VII (1891) 1144.

MALAYA: **Kemaman,** Sungei Nipa (Corner on 20–XI–1935); Ulu Bendong at Kajang (Corner 30,017). **Pahang,** Ulu Kuantan (Craddock in 1903); Bentong (Md. Shah 233); **Selangor,** Ginting Simpah (Hume 9,159, 8,910 & 8,481). **Negri Sembilan,** Gunong Angsi (Nur 11,679).

23. **Memecylon campanulatum** C. B. Clarke in Hk. f., Fl. Brit. Ind. II (1879) 563; King, Mat. Fl. Mal. Pen. III (1900) 488; Ridl., Fl. Mal. Pen. I (1922) 818 p.p.

MALAYA: **Kemaman,** Bukit Kajang (Corner 30,479). **Malacca,** Bukit Panchor (I. H. Burkill 3,046). **Johore,** Mawai-Jemaluang Road (Corner 29,021 & 29,044); Sungai Kayu (Kiah 32,057); Bukit Badak in Layang-Layang (Hassan & Kadim 92); Sungei Sedili (Corner 31,942); Sungei Kayu Ara (Corner s.n.).

In leaf characters this species is easily confused with *M. minutiflorum* so that Ridley included here some specimens of that species. *M. campanulatum* has sessile or subsessile inflorescences and its fruit is 6–9 mm. in diam., rough, cylindrico-globose, depressed at both the poles, having its areola much reduced and almost sunk. In *M. minutiflorum* the inflorescence is conspicuously pedunculate, and the fruit depressed globular, crowned by a prominent calyx limb.

24. **Memecylon hepaticum** Bl., Mus. Bot. Lugd.-Bat. I (1851) 357; Cogn. in DC., Mon. Phan. VII (1891) 1151; Bakh. f. in Med. Bot. Mus. Utrecht 91 (1943) 354.

MALAYA: **Johore,** Mawai (Corner 30,882); Mawai-Jemaluang Road (Corner on 4 & 9 Feb. 1935); Mawai-Kota Tinggi Road (Corner 30,976): Sungei Kayu Ara (Corner 29,481): Sungei Kayu (Kiah 31,961; Corner 29,251 & 32,467): Sungei Pelapah Kiri (Corner 32,491).

A shrub or treelet up to 5 m. tall, growing usually in or near swampy places. Fruit pink turning bluish purple when ripe.

Inflorescence is a shortly pedunculate, branched umbel, bearing acute flower buds; calyx campanulate, obscurely toothed or truncate; peduncle one or more in a leaf-axil, 2–4 mm. long, slightly longer in fruit. Our specimens were doubtfully referred to *M. oleaefolium, minutiflorum* & *myrsinoides*.

25. **Memecylon maingayi** C. B. Clarke in Hk. f., Fl. Brit. Ind. II (1879) 557; King, Mat. Fl. Mal. Pen. III (1900) 485; Ridl., Fl. Mal. Pen. I (1922) 813.

M. elmeri Merr. in Univ. Calif. Publ. Bot. XV (1929) 230 **syn. nov.**

M. heteropleurum Bl. var. **olivacea** King, Mat. cit. III (1900) 486 p.p.; Ridl., Flor. cit. I (1922) 814: **syn. nov.**

M. heteropleurum Bl. *sensu* Ridl., Kew Bull. (1926) 65; Bakh. f. in Med. Mus. Bot. Utrecht 91 (1943) 349 p.p.

M. Wallichii Ridl. in Journ. Roy. Asiat. Soc. Str. Br. 79 (1918) 75 p.p.

This is a very much confused species and specimens have often been referred either to *M. heteropleurum* or to *M. Wallichii*. The former because of King's var. *olivacea* and the latter obviously because this variety was reduced by Ridley to his *M. Wallichii*. In his Flora I (1922) Ridley restored King's variety back to *M. heteropleurum* without realising that King had cited, under his variety, specimens referable both to *M. maingayi* (e.g. Wray 1310) and to *M. Wallichii* (e.g. Kunstler 500).

The species has large flowers, long, elliptic fruits and leaves which dry often olivaceous green below and vary in shape, from broad, shortly cordate to narrow, elliptic-lanceolate, roundedly cuneate at base. These last could easily be mistaken for the leaves of *M. beccarianum* except that these are subsessile and the inflorescence are short, glomerulate in the leaf axils.

MALAYA: **Perak,** Pondok Tanjong (Salleh Cf. 9,710); Tapah (Wray 1310); Lumut (Ridley 9,474); Gopeng (Kunstler 4,726). **Pahang,** Tahan River (Ridley 2,240); Kota Glanggi (Henderson 22,482). **Trengganu**, Berara (Wood 76,072). **Malacca,** Selandor (Alvins 245 as *Pokoh Kuku Baning*, & 430 as *Pokoh Jambo Baning*). **Johore,** Bukit Tinjau Laut (Ngadiman 36,931); Sungei Kayu (Corner 29,245; 32,311; 32,246; 32,504 & 32,759; Kiah 31,981); Kota Tinggi Road (Corner 28,702); Mersing (Wyatt-Smith 76,278).

BORNEO: **Tawao** (Elmer 21,646).

SUMATRA: **Mentawi Archipelago,** Sipora (Boden-Kloss 14, 743; Iboet 441).

I think we must refer here Krukoff 4,058 from Asahan in Sumatra, cited by Bakhuizen as *M. heteropleurum.*

This species must be compared with the types of *M. excelsum* Bl., which, from the description, comes very close to this.

26. **Memecylon megacarpum** Furtado **nom. nov.**

M. pulchrum Cogn. in DC., Mon. Phan. VII (1891) 1141, non. Kurz. (1872 & 1877): **basionymus.**

BORNEO: **Sarawak,** loc. incert. (Haviland 181: b: z: e: m:); Mount Kalulong, alt. 800 m. (Pickles 3,722).

The syntypes were collected by Beccari in Sarawak.

Pickles 3,722, which is represented in the herbaria of Sarawak and Singapore, shows that the early leaves may be broadly ovate to almost rhomboid, shortly petioled or subsessile, with the olivaceous green in the lower surface when dry; later leaves become narrower, elliptic, longer and sessile and show dark brown lower surface. The main lateral nerves which are prominent below in the early leaves become faint in the later ones. The fruit is large, ovate to globose, 1–2 cm. long, crowned with 1–1.5 mm. long calyx limb. Kurz's species is from the adamans.

27. **Memecylon multiflorum** Bakh. f. in Med. Mus. Bot. Utrecht 91(1943) 343.

MALAYA: **Singapore,** Bukit Timah (Ngadiman 36,139). **Malacca,** Ayer Panas (Derry 1,184 as Kuku Baning).

BORNEO: **Sarawak,** Gunong Sari in Lawas (Omar 97).

SUMATRA: **Indragiri** (Meyer 4,091); Riouw Archipelago, Sungai Dusun (bb. 31,649); Langkap (bb. 31,648).

There is no authentic specimen in herb Singapore, and the identifications are made entirely from the description.

28. **Memecylon paniculatum** Jack in Malay Misc. II (1822) 62; reprint in Hook. Comp. Bot. Mag. I (1835) 219 and in Calc. Journ. Nat. Hist. V (1843) 312; Cogn. in DC., Mon. Phan. VII (1891) 1136.

M. costatum Miq. in Verh. Kon. Ned. Inst. (1850) 29; Bl. Mus. Bot. I (1851) 573; Miq. Fl. Ned. Ind. I (1855) 572. Bakh. f. in Med. Mus. Bot. Utrecht 91 (1943) 345.

M. caloneuron Miq., Fl. Ned. Ind. Suppl. I (1860) 321; King, Mat. Fl. Mal. Pen. III (1900) 76; Ridl. Fl. Mal. Pen. I (1922) 812.

The syntypes of Jack's species were collected in Sumatra and its lengthy description leaves no doubt what this species was meant.

King mistook some specimens of another species having sessile or subsessile flowers as *M. costatum,* Miq., whereas Miquel described his species as having long pedunculate flowers. The only specimens that might agree with King's description of the species are *M. wallichii* Ridl. (cf. also Ridley in J. Roy. Asiat. Soc. Str. Br. 79, 1918 p. 75).

I agree with Bakhuizen in considering *M. costatum, M. caloneuron* and *M. appendiculatum*, as the same species, but he failed to recognise Jack's plant.

29. **Memecylon wallichii** Ridl. in Journ. Roy. Asiat. Soc. Str. Br. 79 (1918) 74 sub *M. amplexicaule*, & Flor. Mal. Pen. I (1922) 813.

M. heteropleurum var. *olivaceum* King, Mat. Fl. Mal. Pen. III (1900) 486 p.p.; Ridl., Flor. cit. I (1922) 814.

M. longifolium Ridl. in Journ. cit. 79 (1918) 72, non Cogn. (1891) **syn. nov.**

MALAYA: **Penang,** Paya Trobong (Curtis = 965); Moniots Road (I. H. Burkill 2,685 & 3,337); Government Hill (Curtis 965, syntype; Burkill 1,532); Waterloo (Curtis 1,294, syntype); loc. incert. (Curtis 457, syntype); Waterfall (I. H. Burkill 6,579); Pantai Achoh (I. H. Burkill 6,146). **Perak,** Gunong Kledang (Ridley 9,628); Kuala Kangsar (Haniff 14,949); Tapah (Ridley 14,102); Taiping (Ridley 14,687); Lumut (Curtis in Dec. 1902); Prah (Jaamat 39,247); Gopeng (Kunstler 500, syntype of *M. heteropleurum* var. *olivaceum*); Larut (Kunstler 3,058, syntype); Bujong Malacca (Ridley 9,526); Waterfall (Wray 3,278, 2,326 & 1964). **Kelantan,** Sungei Keteh (Henderson 19,581). **Trengganu,** Kuala Trengganu-Besut Road (Sinclair & Kiah 40,858); Ulu Bruang (Moysey & Kiah 33,738 & 33,856).

BORNEO: **North Borneo,** Sandakan (Wood, SAN. A. 3,979).

There is a good deal of variation in the leaves of this species so that some are cordulate and sessile while others are rounded and subsessile at base; also some have many prominently developed secondary veins, while in others the secondary veins are few and inconspicuous or faint. A good many specimens of this species were determined by King as *M. amplexicaule*. It is possible that, by *M. costatum* Miq., King intended the larger leafed forms of this species, since he describes the leaves being "thinly coriaceous (drying pale brown with a tinge of yellowish-green), the base rounded or slightly narrowed, not cordate" and the flowers being "crowded in axillary glomeruli" so as to be keyed among the inflorescence that are "sessile or on a very short peduncle." Miquel described the inflorescence of his species as a long, corymbose thyrse shorter than the leaf.

This species must be compared with the type of *M. subtrinervum* Miq., a Sumatran species which, according to cogniaux, also occurs in Sarawak.

Phyllocladus hypophyllus Hook. f.

By HSUAN KENG

Department of Botany, University of Singapore

FROM JUNE to July in 1961, I joined an expedition to Gunong Mulu, Sarawak. During the trip, pickled and herbarium specimens of *Phyllocladus hypophyllus* Hook. f. were collected. As our present knowledge of this interesting species is still more or less limited to the incomplete descriptions prepared by Hooker f. in 1852 and by Pilger in 1903, a comprehensive description of the external morphology and a drawing both made from authentic specimens, are here presented. An anatomical study of the seedling, phylloclade, male and female strobili, and young seed of this species will be published elsewhere.*

Many specimens of this plant from various geographical regions, cited in this paper, are deposited in the herbarium of the Singapore Botanic Gardens. For the facilities provided, I am greatly indebted to Mr. H. M. Burkill, Director of the Gardens.

I wish to express my sincere gratitude to Professor H. B. Gilliland for his encouragement during the progress of this study and for reviewing the manuscript, and to Dr. J. A. R. Anderson, for his distinguished leadership during the expedition.

PHYLLOCLADUS HYPOPHYLLUS Hook. f., Icon. Pl. II, 5 (1852) *t. 889;* Walp. Ann. 5 (1858) 801; Carr. Conif. (1867) 706; Parl. in DC. Prodr. 16, 2 (1868) 499; Stapf. in Trans. Linn. Soc. Bot. 4 (1894) 249; Pilger, in Engl. Pflanzenreich IV, 5 (1903) 99; Ridl. in Journ. Soc. Str. Br. Roy. As. Soc. 63 (1912) 62; Gibbs in Journ. Linn. Soc. Bot. 42 (1914) 195, Contrib. Phytogeo. Fl. Arfak Mt. (1917) 82; Merr. in Journ. Soc. Str. Br. Roy. As. Soc. sp. no. (1921) 32, Enum. Philip. Fl. Pl. 1 (1925) 5; Dallim. & Jacks., Handb. Conif. 4th ed. (1948) 53.

Phyllocladus hypophyllus Hook f. var. *protracta* Warb. Monsun. I (1900) 194.

Phyllocladus protractus (Warb.) Pilger, in Engl. Pflanzenreich IV, 5 (1903) 99; Perk. Frag. Fl. Philip. (1904) 44; Foxw. ex Merr. in Philip. Journ. Sci. 2 (1907) Bot. 259, 6 (1911) Bot. 165, *t. 31.*

Shrub, small or large tree, up to 30 m. high or more; bark brownish to dark brown, flaky; juvenile leaves on seedlings linear, 0.5–0.8 cm. long; scale leaves on seedlings or on the branchlets and phylloclades of mature plants awl-shaped, 0.2–0.3 cm. long, scarious, deciduous; phylloclades on seedlings variable in shape and size, from spatulate to rhomboidal, 2–8 cm. long, 0.5–4 cm.

---

* H. Keng, Aspects of morphology of *Phyllocladus hypophyllus. Ann. Bot.* (n.s. Vol. 26 No. 104, 1962. *in press*).

wide, the apex acute or caudate, the base narrowly attenuate, the margins irregularly serrate, lacerate or pinnatifid; phylloclades on mature plants distichously and pinnately arranged on the lateral branchlets which are born verticillately or subverticillately on branches, each individual phylloclade oblanceolate, obovate to rhomboidal, 1.5–6 cm. long, 1–3 cm. wide, the upper surfaces shining, dark green, the lower surfaces often glaucous when young, becoming grey-purplish or dark and punctate later, the apex acuminate, obtuse or bilobed, the margins coarsely and irregularly serrate or crenate, usually entire and obliquely attenuate towards the base, the venation flabellate, the veins more or less radiating from the base of phylloclade, prominent on both surfaces; strobili unisexual, dioecious; male strobili yellowish brown, often 2–3 or more in clusters on the apices of dwarf branchlets, sometimes mixed with sterile phylloclades or phylloclades bearing reduced female strobili, each individual male strobilus cylindric, 0.8–1.2 cm. long, stalked, the microsporophylls triangular, scarious, with two rounded pollen-sacs, the pollen grains winged; female strobili purplish, solitary or rarely 2 (or 3) together situated in the notches of bilobed phylloclades or occasionally on the tips of reduced phylloclades, each individual female strobilus subglobular or ovoid, consisting of 15 or more coalescent scales, only 2 or 3 of these scales bearing a single erect ovule, generally only 1 ovule in each female strobilus developing into a seed; seeds chestnut brown, ovoid, 5–7 mm. long, flattened at front and back, the upper part protruding from a greyish, papery, cup-like arillus, and the basal part embedded in a fleshy, swollen, yellowish brown receptacle formed by the abortive scales of female strobilus; cotyledons two, linear lanceolate on seedlings, 2–2.5 cm. long, 2–3 mm. wide.

Specimens examined:

Sarawak:

Gunong Mulu, Alt. 1,300 m., path from Sg. Melinau Paku, Baram, *Anderson & Keng 4553*, July 2, 1961 (Tree, 1.1 m. girth, 20 m. high, in submontane forest, sterile); alt. 2,300 m., path to summit, *Anderson & Keng 4544*, July 2, 1961 (Small tree, 3.3 m. high, on exposed ridge near summit).

Brunei:

Lower Mossy forest, Bt. Ulak, alt. 1,400 m. *P. S. Ashton 1033*, no date (23 m. mature tree, bark dull purple, flaky and powdery, slightly dippled in places).

North Borneo:

Mile 39, Penampang-Sensuram, alt. 2,000 m. *Leano-Castro 5992*, July 1936 (26 m. high, 1.8 m. girth, non-resinous); Kumu Rengis, Jesselton, alt. 26 m. *J. W. Sow 71650*, June, 1952 (Rising ground, 15 m. tall, 1 m. girth, bh.).

Mt. Kinabalu: Pakka Cave, 3,400 m. *R. E. Holttum, s.n.*, Nov. 1931, *J. & M. S. Clemens 29328*, March 1932, *C. E. Carr 27632*, June 1933, *J. Wyatt-Smith 80371*, Aug. 1954 (Shrub 2.3 m. tall); 3,300 m. *G. D. Haviland 1092*, 1892 (Shrub dioecious); below Sayat Sayat, alt. 3,800 m., *C. E. Carr 27617*, June 1933; below Kambarangan wireless station, alt. 2,320 m. *J. Sinclair 9053*, June 1957 (Common tree, leaves glossy green at both surfaces, dark above, paler beneath).

Indonesian Borneo:

Top of Mt. Semedoem, *H. Hallier No. 697*, 1893–94; Westerafd. v. Borneo, Bengkajang, Banan, alt. 1,200 m. *Neth. Ind. For. Serv. bb. 24777*, July 1938.

Celebes:

Celebes en Ond. Malili, alt. 1,300 m. *Neth. Ind. For. Serv. bb. 19582*, Apr. 1935.

Philippines:

Bauan, Mt. Tabuan, Cagayan Prov., Luzon, *M. Ramos 77101*, May 1929.

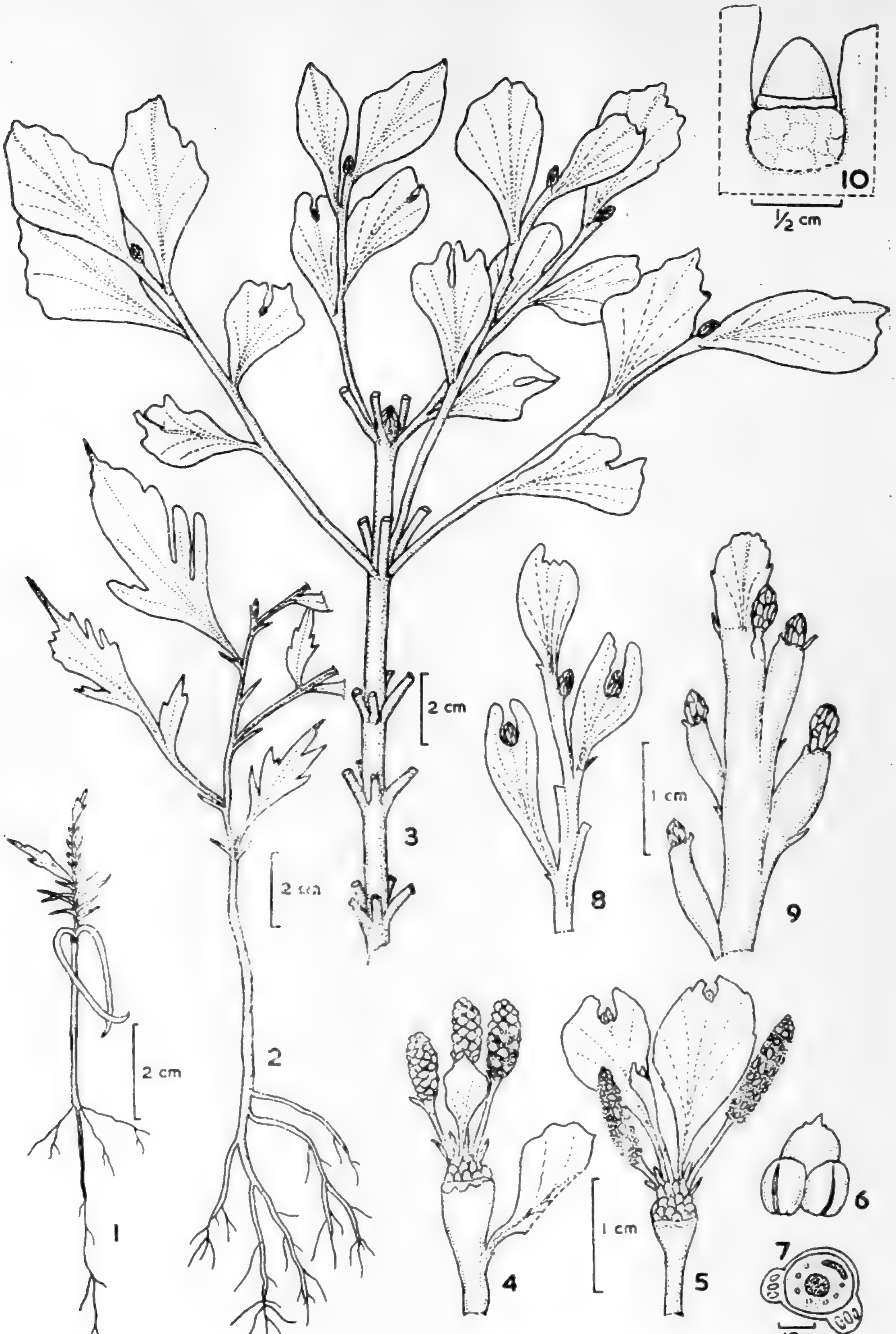
New Guinea:

Al River Mts., Nondugl, West Highlands, alt. 2,300 m. *J. S. Womersley 5351*, Sept. 7, 1953 (Tree 20 m. overall, in *Nothofagus* forest; wood pale to dark straw colour).

Nassau Geb. alt. 2,600 m., *W. M. Docters V. Leeuwen 10906*, Oct. 1926; Wissel Lake region, Tarapadimi, near bivouac, sec. vegetation, *P. J. Eyma 5228*, Sept. 1939; Mt. Digatara, *P. J. Eyma 5371*, Oct. 30, 1939; Tsland and Tage River, alt. 1,750 m., *P. J. Eyma 4954*, Sept. 1939.

This is the only species of *Phyllocladus* reaching the Malaysian region, the rest of 5 species of the genus are confined to New Zealand and Tasmania.

The type specimen of this species was collected by H. Low from Mt. Kinabalu, North Borneo. The plant subsequently found in the Philippines and New Guinea was described by Warburg as a variety, namely, var. *protracta*, of this species. This variety was raised to the specific rank by Pilger. Independently, Gibbs (1917) and Merrill (1925) pointed out that these two species are synonymous. Gibbs made the following notes: "I fail to distinguish any difference between the above species (*Phyllocladus hypophyllus* Hook. f.) and *P. protractus* Pilg. It is a very variable plant like other *Phyllocladus* spp., differing according to the age of the plant and whether the fertile branches occur on the old or the young wood. The series of variations obtained by me on Kinabalu are duplicated in the Arfak material and appear also marked in the large amount of material from the Philippines available at Kew for comparison."



Phyllocladus hypophyllus Hook. f.

1. A young seedling showing the cotyledons, juvenile leaves, scale leaves and phylloclades.
2. A seedling showing the incised and pinnatifid phylloclades.
3. A branch from a mature plant showing the verticillate branchlets bearing two rows of phylloclades.
4. A dwarf shoot bearing 3 young, male strobili.
5. A dwarf shoot bearing dried, male strobili and phylloclades with reduced female strobili.
6. A microsporophyll with two dehiscing pollen-sacs.
7. A winged pollen grain.
8. Portion of a branchlet showing the female strobili situated in the notches of bilobed phylloclades.
9. Portion of a branchlet showing the female strobili seated on the top of reduced phylloclades.
10. Seed with cuplike arillus embedded in swollen receptacle; the whole structure remaining in the notch of a bilobed phylloclade.

Taxonomic position of Phyllocladus and the classification of Conifers

HSUAN KENG*

Department of Botany, University of Singapore.

THE GENUS *Phyllocladus* Louis Claude Marie Richard occupies an equivocal position in the conifers. The opportunity to collect and study material of the hitherto little known species, *Phyllocladus hypophyllus* Hook. f., suggested a review of the perennial taxonomic problem surrounding this genus in the light of new information. The object of this paper is to re-assess the taxonomic position of *Phyllocladus* among the higher categories in the conifers.

The apparently conflicting morphological features of *Phyllocladus* lead to quite diverse taxonomic treatment of the genus, depending on the relative weight assigned to these features. For example, the leafy microsporophyll bearing two microsporangia at the base and the winged microspores resemble those of *Podocarpus* and allied genera; the erect ovules and the peculiar arillus structure appears to be similar to those of *Taxus* and allied genera. For this reason, there are two different ways of classifying this genus. The first is to consider *Phyllocladus* as representing a third taxon intermediate between *Podocarpus* and allies and *Taxus* and allies. The second is to regard *Phyllocladus* as a part of the taxon in which *Podocarpus* and its allies are included. There is also involved the question of the family concept of the Taxaceae. In a broad sense, Taxaceae contain both *Podocarpus* and its allies as well as *Taxus* and its allies; the former constitute the tribe Podocarpineae, and the latter, Taxineae. In a narrow sense, Taxaceae include *Taxus* and allied genera only, whereas *Podocarpus* and allied genera form a separate family, Podocarpaceae.

Thus far, four different ways of classifying the genus *Phyllocladus* have been proposed. These are as follows:—

A. Strasburger (1872); Kildahl (1908A)
    Taxaceae (*sensu lato*)
        a. Podocarpineae (including *Phyllocladus*)
        b. Taxineae

B. Pilger (1903)
    Taxaceae (*sensu lato*)
        a. Podocarpineae
        b. Phyllocladineae (*Phyllocladus*)
        c. Taxineae

* The writer would like to express his thanks to Profs. H. B. Gilliland, E. C. Abbe and H. L. Li for reading the manuscript of this paper and for their constructive criticism. For the conclusions presented here, however, the writer assumes full responsibility.

C. Pilger (1926)
  I. Podocarpaceae
    a. Pherosphaeroideae (*Pherosphaera*)
    b. Phyllocladoideae (*Phyllocladus*)
    c. Podocarpoideae
  II. Taxaceae (*sensu stricto*)

D. Core (1955)
  I. Podocarpaceae
  II. Phyllocladaceae (*Phyllocladus*)
  III. Taxaceae (*sensu stricto*)

Superficially, the genus *Phyllocladus* is somewhat intermediate between *Podocarpus* and allied genera and *Taxus* and allied genera. However, the extensive morphological studies of Robertson (1906), Kildahl (1908), Young (1910) and Sinnott (1913), lead each of these authors independently to the same conclusion, namely, that *Phyllocladus* has far stronger affinities with *Podocarpus* and its allies than with *Taxus* and its allies. A summary of the important morphological characters of *Phyllocladus*, including the work of the previous authors, may be enumerated as follows. Resemblances to *Podocarpus* and allies and to *Taxus* and allies are marked with "P" and "T" respectively.

1. The microsporophyll bears two abaxial sporangia at the base (P).
2. The microspores have two air-filled wings (P).
3. The prothallial cells are present in the mature pollen grain (P).
4. The ovule is erect (T).
5. The arillus originates at the base of the ovule (T).
6. The megaspore membrane is strongly developed and spongy tissue is conspicuous (P).

Thus on morphological grounds, it appears reasonable to include *Phyllocladus* in that taxon which comprises *Podocarpus* and allies rather than with *Taxus* and allies. Nor does it seem reasonable to establish a distinct higher taxon for this genus alone.

A major controversy at the present time revolves around the grouping into higher taxa of the families of conifers. The seven commonly recognized families are: Taxaceae, Podocarpaceae, Araucariaceae, Cephalotaxaceae, Pinaceae, Taxodiaceae and Cupressaceae as originally proposed by Pilger (1926). Chamberlain (1934, p. 434), Janchen (1949) and others, on the one hand, suggest that the Taxaceae, Podocarpaceae and Cephalotaxaceae should be segregated from the manifestly cone-bearing families such as Araucariaceae, Pinaceae, Taxodiaceae and Cupressaceae. The former group is referred as Taxares or Taxales, and the latter, as Pinares (Chamberlain 1934) or Pinales (Janchen 1949). On the other hand, Florin (in Erdtman 1952), Pilger & Melchior (in Melchior & Wedermann 1954) and others emphasize that the ovule structure of Taxaceae is very different from that of the rest of the six families. The ovule in Taxaceae, according to Florin (1951, p. 376, *f. 65*), is always a direct continuation of "flower" axis, while in the other conifers (and Cordaitales), it is essentially terminal on more or less stalk-like lateral appendages of the "flower" axis. Therefore, according to Pilger & Melchior, the Taxaceae alone should be raised to the rank of an independent class, Taxopsida, co-ordinate with Coniferopsida. The latter comprises two orders, Cordaitales (fossil only) and Coniferales, with a number of families including Podocarpaceae.

Certainly some of the characteristics of the ovule of *Phyllocladus*, such as the presence of the arillus, its erect position, and the completely disappearance of the "sterile part of the flower" (Florin 1951, p. 364) are at least superficially similar to those of Taxaceae, although the true homologies are uncertain. Nevertheless, the development of one of the few laterally attached ovules—each representing a "female flower", according to the interpretation of Florin —in a female strobilus into a young seed which eventually assumes a pseudo-terminal position in *Phyllocladus hypophyllus* (Keng 1962 *f. 12* & *f. 14*) is probably significant. It may possibly suggest a similar evolutionary trend from the unknown paleozoic gymnosperms to mesozoic *Taxus jurassica* and *Palaeotaxus rediviva* (cf. Florin 1951, p. 349,*f. 43a*) and to the Taxaceae of to-day. For this reason, Chamberlain's and Janchen's scheme of classification of conifers is perhaps a better approach to the phylogeny of this group than Florin's and Pilger & Melchior's.

In the light of the present writer's morphological observation on *Phyllocladus hypophyllus*, together with information drawn from the literature, it seems appropriate at the present time to:—

1. Retain *Phyllocladus* in the Phyllocladoideae, Podocarpaceae *sensu* Pilger (1926).
2. Assign the Podocarpaceae to the Taxares *sensu* Chamberlain (1934) or preferably Taxales *sensu* Janchen (1949).

References

1. CHAMBERLAIN, C. J. (1934). Gymnosperms, structure and evolution. Chicago Univ. Press.
2. CORE, E. L. (1955). Plant Taxonomy. Englewood: Prentice-Hill.
3. ERDTMAN, H. (1952). Chemistry of some heartwood constituents of Conifers and their physiological and taxonomic significance. *In* Progress in Organic Chemistry, 22–63. London: Butterworths Sci. Publs.
4. FLORIN, R. (1951). Evolution in Cordaitales and Conifers. *Acta Hort. Berg.* **15,** 285–388.
5. JANCHEN, E. (1949). Das System der Koniferen. *Sitzungsber. Oesterr. Akad. Wiss., math.-naturw.* Kl. (div. 1), **158,** 155–262.
6. KENG, H. (1962). Aspects of morphology of *Phyllocladus hypophyllus. Ann. Bot.* (n.s. Vol. 26 No. 104, *in press*).
7. KILDAHL, N. J. (1908). The morphology of *Phyllocladus alpinus. Bot. Gaz.* **46,** 339–248.
8. KILDAHL, N. J. (1908A). Affinities of *Phyllocladus. Bot. Gaz.* **46,** 464–465.
9. MELCHIOR, H. & E. WEDERMANN (1954). A. Engler, Syllabus der Pflanzenfamilien, ed. 12, I. Berlin: Gebruder Bornt.
10. PILGER, R. (1903). Taxaceae. *In* A. Engler, Das Pflanzenreich, IV, 5. Leipzig: Engelmann.
11. PILGER, R. (1926). Gymnospermae. *In* A. Engler & K. Prantl, Die Nat. Pflanzenfamilien, 2nd ed. **13,** 1–447. Leipzig: Engelmann.
12. ROBERTSON, A. (1906). Some points in the morphology of *Phyllocladus alpinus. Ann. Bot.* **20,** 259–265.
13. SINNOTT, E. W. (1913). The morphology of the reproductive structures in the Podocarpineae. *Ann. Bot.* **27:** 39–82.
14. STRASBURGER, E. (1872). Die Coniferen und die Gnetaceen (cited in A. Robertson 1906).
15. YOUNG, M. S. (1910). The morphology of Podocarpineae. *Bot. Gaz.* **50:** 82–100.

OTHER PUBLICATIONS OF THE BOTANIC GARDENS SINGAPORE

1. **Annual Report.**
   Reports from 1909 onward remain available.
   Prices variable.

2. **The Agricultural Bulletin of the Malay Peninsula (Series I).**
   Only Nos. 3, 5, 7, 8 and 9 available at 20 cents each.

3. **The Agricultural Bulletin of the Straits and F.M.S. (Series II).**
   Vols. 1–10, 1901–1911, monthly issues.
   All available except Vols. 1, 2 and 9.
   Price: $5 per volume.

4. **The Gardens' Bulletin, Straits Settlements (Series III).**
   Vols. 1–11, 1912–1947.
   Vols. 1 (1–5) January-May 1912 is issued under title of Agricultural Bulletin of the Straits & F.M.S.
   All parts available, except Vol. 1 No. 10, Vol. 2, Vol. 3 Nos. 1–3 and Vol. 11 pt. 3.
   Prices variable.

5. **The Gardens' Bulletin, Singapore (Series IV).**
   Vols. 12–19.
   All parts available. Prices variable. Issues are irregular.
   Subscription will be entered against deposit.
   Available on exchange.

6. **Materials for a Flora of the Malay Peninsula, Monocotyledons.**
   Parts 1, 2 and 3 remain available.

7. (*a*) **Malayan Orchid Hybrids by M. R. Henderson and G. H. Addison.**
   Price $21.

   (*b*) **Malayan Orchid Hybrids, Supplement I by G. H. Addison.**
   Price $21.

8. **A Revised Flora of Malaya.**
   (*a*) Vol. 1, Orchids, by R. E. Holttum. Price $20.
   (*b*) Vol. 2, Ferns, by R. E. Holttum. Price $20.

9. **Wayside Trees of Malaya by E. J. H. Corner, 2 Vols.**
   Price $25.

Items 1–6 can be obtained from the Director, Botanic Gardens, Singapore.

Items 7–9 can be obtained from the Government Printer, Government Printing Office, Singapore.

Prices quoted are in Malayan Dollars
Overseas postage is extra

3401—550—1/63

THE

GARDENS' BULLETIN

SINGAPORE

Vol. XX, Part II 30th April, 1963

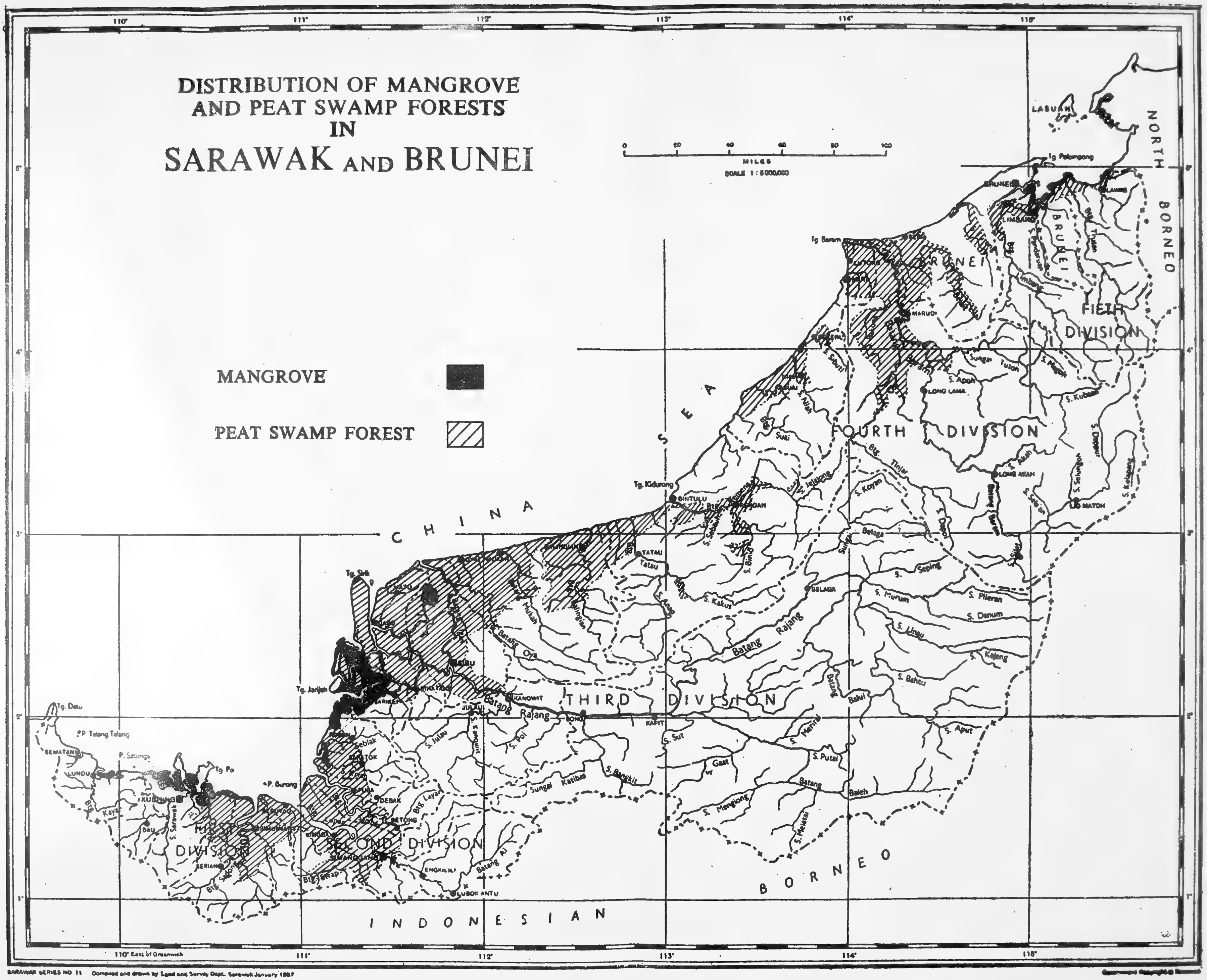
CONTENTS

To be purchased at the Botanic Gardens, Singapore
Price: $8

Published by Authority

PRINTED BY LIM BIAN HAN, ACTING GOVERNMENT PRINTER, SINGAPORE

1963



SARAWAK SERIES NO. 11   Compiled and drawn by Land and Survey Dept. Sarawak January 1957

The Flora of the Peat Swamp Forests of Sarawak and Brunei, including a catalogue of all recorded species of flowering plants, ferns and fern allies

By J. A. R. Anderson

Forest Department, Sarawak

The coastline of sarawak appears to the casual observer monotonous and uninteresting. A coastal fringe of littoral forest or mangrove merges quickly into a flat plain behind which the inland mountain ranges appear in the distance. In south western Sarawak the regularity of the coastline is broken by mountains or low hills that form promontories jutting out into the sea; but from the mouth of the Batang Lupar to Kedurong Point—a distance of 200 miles—there is no high ground in the vicinity of the coast. Apart from the immediate coastal or riparian fringe, subject to regular or occasional inundation, the whole plain has been and still is largely covered in swamp forest growing on peat, recorded depths of which may exceed fifty feet. There is some evidence to show that this coastal plain has developed since the stabilisation of the sea level, about 5,500 years ago, following the last Glacial Period. Alluvium carried down by the rivers draining the interior has been deposited at the mouths of rivers or in bays along the coast and as the coastline has progressed seawards so peat has developed and accumulated under the dense forest on the plain behind. The Rejang, the largest river on the northern coast of Borneo, and to a lesser extent other rivers, has divided to form a complex deltaic system. Each island in the delta forms a distinct and self-contained swamp unit bounded by a fringe of mangrove or riparian forest.

The coastal and deltaic peat swamps cover 5,660 square miles in Sarawak and 380 square miles in Brunei, which amount to 11.9 and 12.5 per cent of the total land surfaces of the two territories respectively. Results of numerous precise level surveys prove that they are entirely of the raised bog type with a stilted water table and surface drainage. The ground water is typically tea-coloured, and the peat soils are oligotrophic and markedly acid. Similar swamps are well known elsewhere in Malaysia. Endert (5) recorded peat swamps in South Sumatra and East Borneo, and other descriptions have been made by Sewandano (11) in Central Sumatra, and by Durgnat (4) and Wyatt-Smith (16) in Malaya. Van Steenis (12–14) shows their distribution on the vegetation map of Malaysia and notes that large areas of southern New Guinea are also peat swamp. Dr. B. Polak (8) undertook fundamental research into the nature and physiognomy of peat swamps in Sumatra and East Borneo. There has been, however, no previous comprehensive study of the ecology or floristic composition of the peat swamp forests in the region.

The catalogue of the flora of the peat swamp forests includes all species of phanerograms, gymnosperms and pteridophytes collected during the course of an ecological survey of these forests. In compiling this catalogue it had been hoped initially to include records of previous collections, especially those by Beccari and by Haviland and Hose. It was found, however, that these collectors only very rarely recorded the habitat of the plant, and consequently there could be no certainty that the specimen originated in peat swamp forest; though frequently the locality of the collection indicates that this is probable. The catalogue, therefore, is confined to recent collections, largely by the author and Forest Department staff, but including a few specimens collected by Miss W. Brooke and Mr. J. Wyatt-Smith.

The species included in the catalogue are those found in the raised bog type of peat swamp forest. The marginal zones, such as the transitional zone from mangrove and near the inland perimeter of swamps, though including numerous true peat swamp species, have in addition a few species that are absent from the extensive coastal and deltaic swamps. The inland fresh-water swamp forests, which are subject to periodic inundation, and high altitude peat swamps require further investigation. These types cover a negligible area in relation to the area covered by the coastal and deltaic peat swamp forests. It is inevitable in an ecological survey of this nature that a good deal of sterile material is collected. However, during the past five years, collecting has been virtually confined to fertile material and about ninety-five per cent of the species is represented by flowering or fruiting specimens, frequently both.

One thousand seven hundred and six numbers are recorded in the catalogue. This total includes 1,528 specimens of dicotyledons, 106 monocotylons, 6 conifers and 66 pteridophytes. The complete collection is housed in separate cabinets in the herbarium of the Sarawak Forest Department at Kuching. Duplicates of early collections (1953–5) were sent to Singapore, and fertile material has in the past five years been distributed to herbaria at Kew, Leiden, Singapore and Bogor, with additional material of certain families to other herbaria. Wood specimens are available for most arboreal species.

The catalogue of phanerograms is arranged by families in accordance with the Bentham and Hooker system of classification with certain generally accepted exceptions. In those families revised for *Flora Malesiana* the nomenclature of the revision has been followed. For the classification of pteridophytes the system adopted by Holttum (6 and 7) has been used. Specimens of each species are recorded by administrative divisions and localities, and notes on the habit, frequence, distribution and occurrence in forest types are included. Furthermore, where species have been matched by the author in the herbarium at Kew, the number of the matching specimen is noted with an indication by the symbols A, B, or C of the degree of reliability of the determination. All recorded vernacular names have not been included as frequently they are very unreliable. The vernacular names shown have been checked and found to have fairly consistent usage.

The completeness of the catalogue varies with the locality and the type of plant. More ecological work has been undertaken in the Rejang Delta than elsewhere and consequently the flora is better known. It also is incidentally the richest. Furthermore, collecting was originally concentrated on the tree flora, though during the past five years collections have been made of herbs, lianes, parasites, epiphytes and ferns. It is considered that for tree and shrub species the catalogue is virtually complete. Visits to peat swamps in the past twelve months have failed to yield any important unrecorded species. It has been found also that the herbaceous and climbing elements of the flora are remarkably uniform. Though the list is not as complete as that for the tree flora the same species tend to be found time and again. Even the epiphytic flora, which might have been expected to be the most variable, appears fairly constant in its distribution in peat swamps and in its occurrence in the forest types. Undoubtedly there are many species yet to be recorded in peat swamps but the most characteristic and abundant species have now been collected.

The names of some species included in the catalogue must be treated with a good deal of caution. The taxonomy of genera such as *Eugenia, Garcinia* and *Lithocarpus* is in a somewhat chaotic state and accurate specific identifications for many species will not be obtainable until the families are revised. Where matching material has not been found the species is designated by the generic name followed by the number in brackets of what is considered to be the most representative specimen.

It is impossible at this stage to say how many species new to science have been collected. This can only be ascertained with certainty when the families are revised for *Flora Malesiana.* In those families that have been revised or are at present in the process of revision the most important discovery has been a new species of *Litsea* (*L. palustris* Kostermans). This tree species is extremely abundant in the central areas of many swamps throughout Sarawak and Brunei; in the Rejang Delta it forms pure stands over many square miles with as many as 120 trees per acre. It is odd that it has never been collected previously. Presumably early collectors did not penetrate into the centres of the swamps. Other new species include *Cephalomappa paludicola* Airy-Shaw, *Pandanus andersonii* H. St. John and *Knema uliginosa* Sinclair, a small tree with a localised distribution in the Loba Kabang Protected

Forest. Mr. J. Sinclair has recently described a new species of *Goniothalamus*. He also considers that *Polyalthia* (*9059*) is undescribed. It is known from only one other previous collection, *p.b. 3919* by Beccari. Mr. E. J. H. Corner has examined all the collections of *Ficus*, and has described three new species: *F. callicarpides* is a small root climber abundant on the buttresses of *Shorea albida; F. spathulifolia* and *F. supperforata* are stranglers or ground rooting epiphytes. In families that have not yet been revised there are a few distinctive species which are unmatched in herbaria at Kew, Leiden, Singapore and Bogor and are therefore probably new to science. These include a *Parishea** (*2697*), a *Xanthophyllum* (*2614*), a *Piper* (*9234*) and a *Cinnamomum* (*4751*). Finally a single collection of a small tree from the Lundu swamps has proved to belong to a new genus (*Jarandersonia*) in the Tiliaceae which has been described by Dr. A. J. G. H. Kostermans.

Two hundred and forty-two tree species have been recorded, including 38 small trees of the understorey which rarely or never exceed twelve inches girth. Some of the latter might be considered as shrubs, but this term has been purposely avoided as few species have a fastigiate form (except in the stunted forest in the centre of certain swamps in the Baram). The arboreal flora is somewhat greater than originally expected. Sewandano (11) estimated that the arboreal flora of the swamps of East Sumatra to be less than a hundred species. In one forest type alone in the peat swamps of Sarawak and Brunei as many as seventy-five species are found to an acre.

Representation of families

The representation, by genera and species, of the families of phanerograms is shown in Table 1. If the arboreal species alone are considered, it will be seen that most of the principal arboreal families that occur in lowland dipterocarp forest are to be found in peat swamp forest. Of the families that have not been recorded mention may be made of the Combretaceae, Lythraceae, Styracaceae, and Proteaceae. A comparison of the arboreal flora in peat swamp forest with that recorded by Wyatt-Smith (15) in two five-acre plots in Malaya shows an obvious similarity in the relative numbers of genera and species recorded. It should be remembered, however, that the comparison is between the total arboreal flora in peat swamp forest and species exceeding twelve inches girth in two small plots. Nevertheless most of those families, i.e. Dipterocarpaceae, Anacardiaceae, Annonaceae, Euphorbiaceae, Guttiferae, Lauraceae, Leguminosae, Myrtaceae, Rubiaceae and Sapotaceae, that predominate in lowland dipterocarp forest also provide

* As result of a recent (1962) collection (S. 15951) this specimen has been identified as *Quassia borneensis* Nooteboom (msc.), the first representative of the Afro-American genus to be found in Asia. A previous collection (*San. 20499*) was made in Borneo.

most species that occur in peat swamp forest. It would appear, therefore, that specialized adaptations, such as pneumatophores, kneed roots and, perhaps, stilt roots, for growing in peat swamps do not tend to be exclusive to or predominate in certain botanical families.

In the herbaceous vegetation there is an absence of the predominantly aquatic families and genera of dicotyledons, e.g. Nymphaceae, *Limnanthemum, Jussiaea,* and *Ludwigia*. A possible cause may be the extremely acidic and anaerobic conditions of peat swamp soils. It is hardly surprising to find an almost complete absence of the calciphylous families such as Balsaminaceae (*Impatiens*), Acanthaceae, Scrophulariaceae, Begoniaceae, and Gesneriaceae. *Aeschynanthus hians,* of the last mentioned family, is the only record. Monocotyledons, and in particular the Araceae and Cyperaceae, preponderate in the herbaceous flora.

The climbing flora is drawn from many families, of which particular mention may be made of the Annonaceae, Rubiaceae and Moraceae. Species of Capparidaceae, Malpighiaceae, Solanaceae and Acanthaceae have not been recorded, and the Convulvulaceae is only represented by two species, neither of which is common.

Floristic composition

Lists of the more important and characteristic peat swamp species are shown in Table 2. These include the more widely distributed and common species. For rarer and localised species reference should be made to the catalogue.

The arboreal flora has been subdivided into four canopy classes based on the average maximum girth attained by a species. This subdivision is somewhat arbitrary and does not presuppose that distinct canopy layers can be recognised or even exist. No consideration is taken here of the ecology of the species or their occurrence in the forest types. This will be briefly discussed later. Furthermore it should be remembered that the average maximum size class of a species varies very considerably in different forest types. For instance *Dactylocladus stenostachys*—the only tree species to occur in all forest types—is a massive dominant, with girths occasionally exceeding twelve feet, on the perimeter of the swamps, whereas in the stunted forest in the centre of certain swamps in the Fourth Division it occurs abundantly as a small tree rarely exceeding twelve inches girth and frequently little more than a shrub.

In the upper storey species of Dipterocarpaceae predominate. Of the six species of *Shorea* commonly found in peat swamps *Shorea albida* forms remarkable pure stands (in the upper canopy) with 40 to 160 trees per acre and covering very extensive areas in the central zones of many swamps from the Sadong river in southern Sarawak to Badas in Brunei. Other important dominants are the timber producing species *Gonystylus bancanus, Dactylocladus stenostachys,* and *Copaifera palustris.* These three species with the *Shoreas* (*S. platycarpa, S. rugosa* var. *uliginosa, S. scabrida,* and *S. teysmanniana*) comprise on the average about 80 per cent of the upper storey (trees with girths exceeding 60 inches) in mixed swamp forest in the peripheral zone of swamps and near the coast. *Litsea palustris,* an associate of *Shorea albida,* occurs in almost pure forests in the centre of some of the larger swamps in the Rejang Delta. In Lawas District in north Sarawak, and in adjacent areas in North Borneo, *Shorea albida* is absent and is replaced by a unique forest dominated by the conifer *Dacrydium beccarii* var. *subelatum* and an undescribed species of *Casuarina,* formerly confused with *C. sumatrana.* Little now remains of this forest after forty years of heavy exploitation.

The middle and lower storeys include many species of the Lauraceae, Euphorbiaceae, Guttiferae, Burseraceae, Ebenaceae, Fagaceae, and Annonaceae. Some of the more abundant species in the middle storey are *Alangium havilandii, Blumeodendron tokbrai, Ctenolophon parvifolius, Diospyros evena, Diospyros pseudomalabarica, Kokoona ovato-lanceolata, Palaquium cochleariifolium, Parastemon spicatum* and *Xylopia coriifolia.* In the lower storey the most widely distributed species in mixed swamp forest are *Neoscortechinia kingii, Cyathocalyx biovulatus,* and *Stemonurus umbellatus. Tetractomia holttumii* and *Cephalomappa paludicola* are abundant in the lower storey of pure *Shorea albida* forest.

In the understorey there are few species that rarely or never attain twelve inches girth, and most of these are rather rare or localised. Mention however may be made of *Ixora pyrantha* which is abundant in *Shorea albida* forest, and *Tarenna fragrans* in mixed swamp forest. Shrubby dicotyledons are rare. Those that do occur are largely confined to the more open forest in the centre of some swamps. Here may be found *Ficus deltoidea* var. *motleyana, Euthemis obtusifolius, Labisia punctata* f. *punctata* and *Medinilla hasseltii.* Some species, such as the *Nepenthes,* may have a scandent or climbing habit, but they are more commonly found on or near to the swamp surface, and may be more correctly considered as shrubs. It would appear that most of the *Nepenthes* in swamp forest only adopt a climbing habit when the canopy is opened. The stemless spiny palm *Zalacca conferta* and the large stemless pandan *Pandanus andersonii* frequently form dense thickets; the former in mixed swamp forest, especially on shallow peat, and the latter in association with *Shorea albida.* Two other pandans are common: *Pandanus brevifolius* in mixed swamp forest, and *Pandanus ridleyi* in stunted forest in the centre of some swamps in the Baram.

Herbaceous dicotyledons are practically absent. *Argostemma psychotrioides* is frequent in mixed swamp forest and the interesting small myrmecophyte *Clerodendron fistulosum* has a wide distribution though is never common. Aroids and sedges predominate, of which the most abundant and widespread species is *Thorachostachyum bancanum*. Many aroids occur in damper localities where the water table is exposed or permanently near the surface. Here may be found *Aglaonema pictum, Homalomena rostrata, Alocasia longiloba* and *Alocasia beccarii*. Near streams or in particularly damp spots in the swamps where the water table is permanently exposed, the aquatic aroid *Cryptocoryne pallidinervia* abounds. Aroids are however almost entirely absent from the drier central areas of swamps. The large herb, *Hanguana malayana,* also favours the damper localities and is frequently found in places where a hole has been torn in the swamp surface by a tree uprooted by wind. A smaller form of this species tends to occur in slightly drier habitats. The two small terrestrial orchids, *Zeuxine violascens* and *Cystorchis variegata,* with attractive variegated foliage, occur on leaf litter in mixed swamp forest.

A simple classification, such as is attempted here, for herbs, epiphytes and climbers may lead to complications. Some species, such as *Ficus* spp., *Pycnarrhena borneensis,* and *Poikilospermum* spp., start life as epiphytes and later, after their roots have reached the swamp surface, develop a climbing habit; whereas others, e.g. *Randia* sp. (*7904*) and *Fagraea litoralis,* are initially epiphytes and later become independent shrubs or small trees. *Bulbophyllum beccarii,* a conspicuous epiphyte on *Shorea albida,* is stated by Beccari(1) to start as a climber from the ground surface, but early stages in its development have not been seen by the author. The species has always been found as an epiphytic climber spiralling round the upper boles of trees. Another complication is that some crown epiphytes, e.g. *Ficus deltoidea* var. *borneensis* and *Dischidia nummularia* may be terrestrial in the more open forest in the centre of some swamps, where presumably the ecological conditions are not dissimilar to those found in the crowns of the upper canopy in dense forest.

Many of the commonest crown epiphytes are confined to mixed swamp forest. They are particularly abundant in the crowns of *Gonystylus bancanus* and *Dactylocladus stenostachys,* both of which have a soft fibrous bark. No attempt, however, has been made to determine host specialisation. The best represented group is the orchids, of which *Bulbophyllum vaginatum, Dendrobium merrillii, Eria pannea* and *Eria* aff. *pulchella* are particularly abundant. Crown epiphytes on *Shorea albida* are scarce. *Dischidia* spp., *Hydnophytum formicarum* and *Myrmecodia tuberosa* are largely confined to stunted forest where conditions are similar to open heath forest in which these species also occur. The two most widely distributed and abundant shade epiphytes are *Medinilla laxiflora* and the orchid *Liparis lacerata*. Both tend to occur as epiphytes on small trees in dense forest at heights of from two to ten feet from the ground.

The liane and climber flora is not so conspicuous as that found in lowland dryland forest. The species are relatively few and do not appear to reach as large a size. In *Shorea albida* forest lianes are rare, and they are almost absent in the central forest types. Rattan palms, though not rare, are small in size and commercially of no value. Of the three species recorded two, *Plectocomiopsis wrayi* and *Korthalsia rigida,* are abundant; the latter frequently in association with *Shorea albida.* The commonest of the larger lianes is *Uncaria ovalifolia,* the sap of which is drunk by the natives to quench their thirst in the forest. This species also tends to form thickets in young secondary forest following exploitation. Other common lianes are *Willughbeia glaucina, Fibraurea chloroleuca,* and *Mitrella dielsii.*

Figs are particularly abundant in peat swamp forest; twenty-four species have been recorded. True strangling figs, that after killing the host develop a trunk of their own, are relatively rare. *Ficus crassiramea* is the most conspicuous example. This species is confined, however, to shallow peat near the coast. Many of the figs start as epiphytes but though adopting a strangling habit rarely, if ever, kill the host tree. They might be considered as partial stranglers, or, as is preferred, ground rooting epiphytes. These are especially abundant in mixed swamp forest on *Gonystylus bancanus* and *Dactylocladus stenostachys.* The most common species are *Ficus acamptophylla, Ficus consociata, Ficus spathulifolia, Ficus xylophylla* and *Ficus sundiaca.* Some tend to be rather localised: *Ficus xylophylla,* for instance, is very abundant on Pulau Bruit in the Rejang Delta but rather rare elsewhere in swamps. Of the small root climbing figs *Ficus callicarpides* is abundant on buttresses of *Shorea albida.*

Of the small climbers, generally confined to the lower storey, though some may reach the crowns of middle storey trees, the most numerous are *Lecananthus erubescens, Lucinaea morinda, Medinilla scandens, Aeschynanthus hians,* and the climbing aroid *Rhaphidophora lobbii. Nepenthes ampullaria* almost invariably has a climbing habit in peat swamps, though in heath forest the whorls of pitchers are not infrequently found embedded in the litter layer. *Gnetum neglectum,* a small twining climber which rarely attains a height of more than fifteen feet has been found throughout the Rejang Delta and Maludam Peninsula but is never common.

The myrmecophytes form an interesting group. They include two trees, *Macaranga caladifolia* and *Macaranga puncticulata.* The former is a primary forest species, whereas the latter has been only rarely recorded in primary forest, though it frequently forms almost pure dense stands in secondary swamp forest, especially along rail lines and on shallow peat cleared for cultivation. Of the other myrmecophytes only the herb *Clerodendron fistulosum* occurs in dense forest, the remainder, which includes the epiphytic climbers *Dischidia nummularia* and *Dischidia rafflesiana* and the two conspicuous epiphytes *Myrmecodia tuberosa* and *Hydnophytum formicarum,* occurs in open stunted forest.

Parasites are not common in peat swamps. *Lepidaria oviceps,* a very conspicuous species, is found as a crown parasite of upper storey trees, whereas *Macrosolen beccarii* occurs as a parasite of lower or middle storey trees in the shade. It can be quite abundant locally. The parasitic shrub *Henslowia varians* is found in open stunted forest.

A list of the common ferns of peat swamp forests is included in Table 3. Terrestrial ferns are limited in number. The most typical species are *Vittaria elongata, Schizoloma coriaceum,* and *Syngramma lobbiana,* all of which occur in mixed swamp forest on roots and pneumatophores above the water table. The stemless tree fern *Cyathea glabra* is locally abundant in *Shorea albida* forest. *Schizaea malaccana,* more usually a montane species, occurs in stunted forest often in association with *Lycopodium cernuum,* which is so common on degraded soils. The interesting and rare *Ophioglossum intermedium* has only been recorded from one locality in the Rejang Delta. *Nephrolepis biserrata* is rare in primary forest but forms dense thickets in completely open secondary forest, especially where the slash has been burnt.

The epiphytic ferns are more difficult to classify into crown and shade epiphytes as they appear to be more tolerant than flowering plants of light and humidity conditions. Many of the common epiphytic ferns of gardens, rubber plantations, etc., such as *Asplenium nidus, Asplenium phyllitidis, Pyrrosia longifolia* and *Paragramma longifolia* are to be frequently found in peat swamp forest. *Humata angustata* and *Humata parvula* may be found as either crown or shade epiphytes and are occasionally even terrestrial in the central forest types. The most consistent shade epiphyte is *Lycopodium phlegmaria* var. *divaricatum* which occupies a similar habitat to *Medinilla laxiflora* and *Liparis lacerata.* Only two climbing ferns have been recorded: *Stenochlaena palustris* which clothes the lower stems of many trees on shallow peat near the coast, but becomes progressively rarer further inland; and *Teratophyllum ludens* which is confined to dense or moderately dense shade in the understorey.

Peat swamp endemics

A far greater knowledge of the flora of Borneo and of the ecology of the species is required before it can be stated with any authority which species are confined to peat swamp forest. There are probably very few. That there are similarities in the floras of heath and peat swamp forest is well known, and has been mentioned by Richards (9 & 10) and Browne (2 & 3). The author has recorded ninety-eight species which occur in both vegetation types and Dr. P. S. Ashton has recently added to the list. A note is included in the catalogue under each species where its occurrence in heath forest has been recorded. Dr. E. F. W. O. Brunig is at present engaged on an ecological study of heath forests and when this is in a more advanced state a comparison of the two floras will be possible. Some typical peat swamp species are also to be found in lowland dipterocarp forest. A recent enumeration of a thirty acre block on a largely clay ridge in the Semengoh Forest Reserve near Kuching showed the presence of *Neoscortechinia kingii, Shorea scabrida, Swintonia glauca, Mangifera havilandii, Koompassia malaccensis, Santiria tomentosa, Bhesa paniculata, Endospermum malaccense, Cratoxylon arborescens, Litsea grandis, Dialium laurinum, Sindora leiocarpa, Carallia brachiata, Mussaendopsis beccariana* and *Pometia pinnata f. acuminata.* All these occur in peat swamp forest and there are probably others in this area which have not yet been definitely identified. It is significant that all these species, without exception, occur and are largely confined to the peripheral zone of mixed swamp forest, where the drainage is better and the peat soil probably more fertile. The species that occur in the forest types in the centre of the swamps are largely those that are also found on poor, frequently podzolic, soils found in heath forest.

Distribution of peat swamp species

The peat swamps form an almost continuous strip along the coast of Sarawak and Brunei from south western Sarawak to the Tutong river in Brunei. The only major breaks in their distribution occur between Bintulu and the Nyalau river, a distance of forty-five miles, and eight miles which separate the swamps in the Sibuti river from those in the Baram river. Conditions of development of peat swamps and the nature of the peat soils themselves are similar over the whole area. It can be expected, therefore, that the flora is relatively uniform. In comparison with the flora of other soil types, where marked discontinuities occur, this is generally so. Nevertheless it has been found that the flora of the Rejang Delta is richer than that of swamps elsewhere in Sarawak or Brunei. Further collecting in less frequented areas will no doubt reveal a more widespread distribution of some species that are at present recorded from only the Rejang Delta. But there are in the Rejang Delta species such as *Lophopetalum rigidum, Blumeodendron subrotundifolium,* and *Stemonurus scorpioides* which occur so frequently that if present elsewhere it is unlikely that they would have been overlooked. Moreover, in ecological sample plots, recording all trees exceeding twelve inches girth, it has been found that the species per acre tend to be consistently more numerous in the

Rejang Delta than elsewhere. The following tree species are known in peat swamp forest only from the Rejang Delta: *Anacalosa frutescens, Blumeodendron subrotundifolium, Ellipanthus tomentosus* spp. *tomentosus, Parishea* sp. (*2697*), *Swintonia glauca, Lophopetalum rigidum, Castanopsis foxworthyi, Cephalomappa beccariana, Mangifera havilandii, Campnosperma montana, Linociera* sp. (*9042*), *Stemonurus scorpioides, Kibatalia* sp. (*9300*), and *Kibessia coriacea.* In contrast there are few species apparently absent from the Rejang Delta yet recorded in other swamps. *Neesia malayana* has a localised distribution in Lawas swamps and has also been recorded from the Setapok Forest Reserve near Kuching. *Tristania maingayi* is abundant in the central forest types in the Baram and in the Maludam Peninsula, but has not been recorded in similar forest in the Rejang Delta. *Ganua curtisii* is known in swamp forest only in the Badas forests of Brunei, where it occurs abundantly in association with *Shorea albida.*

In general it has been found that upper storey species tend to have a more widespread distribution than smaller tree species of the lower storey, and understorey trees are frequently very localised. Typical examples of the latter are *Knema uliginosa* in the Loba Kabang Protected Forest, and *Kibatalia* sp. (*9300*) and *Lophopetalum rigidum* which are confined to the apex of the Rejang Delta. An interesting exception to this generalisation is the distribution of the Dipterocarpaceae which is shown diagramatically in Table 4. Six species occur in peat swamp forest throughout the two territories. *Cotylelobium flavum* has a widespread distribution in heath forests but in peat swamps it has only been recorded from the Rejang Delta and Brunei. *Shorea macrantha* and *Shorea pachyphylla* are also more frequently found in heath forest but both have a limited and localised distribution in heath and peat swamp forests. In peat swamps they are only found near the inland margins of the swamps. *Dipterocarpus coriaceus,* which is only known from localised areas in the Second Division and in the Sekai Forest Reserve in the Mukah river, is confined to peat swamps. It has not definitely been recorded from the Rejang Delta, but seedlings, probably of this species, have been found in the Naman Forest Reserve at the apex of the delta. The distribution of the gregarious species, *Shorea albida,* extends in peat swamps from the Sadong river to the Badas swamps of Brunei. It has also been recorded in heath forest near Lundu. *Shorea inaequilateralis* has a similar, though somewhat narrower, distribution.

There are many factors involved in determining the geographical distribution of peat swamp species. Unpublished pollen evidence indicates that many of the species have been present in peat swamps in Borneo for millions of years. Recent changes in sea level during and immediately after the Glacial Period with consequent erosion and deposition along the coasts may have been an important factor.

Some species confined to peat swamps may have been eliminated from swamps in minor rivers yet retained a foothold in the Rejang river. After the stabilisation of the sea level, some 5,500 years ago, the spread of species may have been obstructed initially until the seaward development of peat swamps on alluvium had progressed sufficiently for the swamps to coalesce along the coast. There are, however, many other factors to be considered. Even if species were eliminated from coastal swamps, they would, no doubt, be preserved in heath forests and in small localised hill and montane peat swamps and thus be able to spread down again to the coast. Moreover, some of the species, such as *Swintonia glauca, Stemonurus scorpioides, Mangifera havilandii* and *Quassia borneensis,* which in peat swamp forest have only been recorded in the Rejang Delta, may be considered more accurately as constituents of dry land forest, and only in the Rejang Delta have they become adapted to growing and regenerating in peat swamps. Further understanding of the distribution of the peat swamp flora is only likely to be achieved after greater knowledge has been gained of the Bornean flora as a whole. Later a comprehensive study of the peat swamp flora in the Malaysian region might yield some interesting and valuable information on the phytogeography of Malaysia.

Ecology of the peats swamp forests

It is not intended to describe in any detail the ecology of the peat swamp forests in this paper. This will be discussed at greater length elsewhere. However, as some details of the occurrence of the species in recognised forest types are included in the catalogue a few remarks by way of explanation are necessary.

The coastal and deltaic peat swamps are all of the raised bog type, each swamp or bog forming a separate unit in the ecosystem. Well developed raised bogs have a structure similar to that found in temperate raised bogs. The vegetation types are found in a catenary sequence from the perimeter to the centre of a raised bog. The term "Phasic Community" has been used to designate a vegetation or forest type. This term is particularly appropriate as a recent pollen analysis indicates that the horizontal pattern of vegetation types found on the ground is also likely to be found in a vertical succession in the centre of the raised bogs. Six phasic communities have been recognised and they are differentiated on floristic composition and structure of the vegetation. Two phasic communities (Nos. 5 and 6) occur only in the most highly developed raised bogs in the Baram river. Brief descriptions of the phasic communities follow:

Phasic Community 1

Gonystylus—Dactylocladus—Neoscortechinia association. (Mixed swamp forest). Occurs on the perimeter of swamps and covers extensive areas of relatively undeveloped coastal bogs. The canopy is uneven, with dominants attaining 130 to 150 feet in height, and the floristic composition of all storeys very mixed. Of the phasic communities it most closely resembles lowland dryland forest. Principal dominants include *Gonystylus bancanus, Dactylocladus stenostachys* and four species of *Shorea* (not *Shorea albida*). Numerous species occur in the middle and lower storeys, of which the most widely distributed and abundant are *Neoscortechinia kingii* and *Alangium havilandii.* Tree species, twelve inches girth and over, recorded in ecological plots average between sixty and seventy per acre. The water table is frequently exposed and aroids and the sedge *Thorachostachyum bancanum* are abundant. *Zalacca conferta* may form dense thickets especially on shallow peat.

Phasic Community 2

Shorea albida—Gonystylus—Stemonurus association. (Locally known *alan* forest). Occurs as a transitional zone, often of considerable depth, between phasic communities 1 and 3. The canopy is uneven, and large trees, frequently exceeding twelve foot girth, of *Shorea albida,* dominate the forest. These are almost invariably hollow and have the appearance of being moribund with large stag-headed crowns. Mid-girth trees and regeneration of *Shorea albida* are almost entirely absent. The moderately dense middle and lower storeys are large composed of species of Phasic Community 1. *Stemonurus umbellatus* is a characteristic species of this community.

Phasic Community 3

Shorea albida consociation (*alan bunga* forest). This community covers very extensive areas in the second and fourth divisions and in the Badas swamps of Brunei, but is largely absent from the Rejang Delta. The upper storey is composed of a pure even canopy, ranging in height between 160 and 190 feet, of *Shorea albida* which averages between thirty-five and fifty trees per acre. The middle storey is largely absent and the moderately dense understorey is frequently dominated by a single species: *Tetractomia holttumii, Cephalomappa paludicola* or *Ganua curtisii.* Herbaceous vegetation is largely absent. *Pandanus andersonii* frequently forms dense thickets in the shrub layer.

Phasic Community 4

Shorea albida—Litsea—Parastemon association (*padang alan* or *padang medang* forest). Occurs in the central area of numerous swamps in all localities, particularly in the Rejang Delta, and as a transitional zone in certain of the Baram swamps. The canopy is unbroken and even at heights ranging from 100 to 120 feet. All trees are relatively small in girth, few exceeding six feet, and the forest has a marked pole-like and xerophytic aspect. Principal dominants are *Shorea albida* (*padang alan*), which may be represented by 180 stem per acre and *Litsea palustris* (*padang medang*). Other characteristic species are *Parastemon spicatum, Combretocarpus rotundatus* and *Calophyllum obliquinervum.*

Phasic Community 5

Tristania—Parastemon—Palaquium association. Occurs as a narrow zone between phasic communities 4 and 6. The canopy is dense and even, with a few emergents, and an average height of between fifty and seventy feet. The forest has between 400 and 500 stems (12 inch girth and over) per acre, all of which are small; few exceeding three feet girth. The most abundant species are *Tristania obovata, Tristania aff. maingayi, Parastemon spicatum, Palaquium cochleariifolium* and *Dactylocladus stenostachys.* Herbaceous flora is largely absent.

Phasic Community 6

Combretocarpus—Dactylocladus association (*padang keruntum*). The last known phase in raised bog development. It covers extensive areas of deep swamps in the middle reaches of the Baram, near and upriver from Marudi. The forest is open and markedly xerophytic. All trees and shrubs tend to have a stunted appearance. *Combretocarpus rotundatus* is the only species that exceeds three feet girth, and it rarely attains a height of more than forty feet. *Dactylocladus stenostachys, Litsea palustris* and *Garcinia rostrata* are abundant, but frequently little more than shrubs. Myrmecophytes and *Nepenthes* spp. are particularly numerous. *Thorachostachyum bancanum* and *Pandanus ridleyi* are abundant on the swamp surface, where sphagnum moss (*Sphagnum junghuhnianum*) also occurs.

Acknowledgements

Difficulties in undertaking this work have been greatly reduced and the value of the work itself enhanced by the generous assistance of many botanists who have helped to identify specimens, frequently from poor and inadequate material. I am particularly indebted to Mr. J. Wyatt-Smith and Professor C. G. G. J. van Steenis for their advice and encouragement, and to Mr. M. R. Henderson and Mr. James Sinclair for many preliminary identifications. I also gratefully acknowledge the assistance of the following botanists for examining and identifying specimens of the mentioned families and genera: Professor H. J. Lam and Dr. P. van Royen (Sapotaceae), Dr. P. W. Leenhouts (Burseraceae), Mr. E. J. H. Corner (Moraceae), Dr. A. J. G. H. Kostermans (Lauraceae), Dr. C. X. Furtado (Palmae), Dr. Chew Wee Lek (*Poikilospermum*), Mr. L. L. Foreman (Menispermaceae), Professor H. C. D. de Wit

(*Phanera* and *Cryptocoryne*) and Dr. R. E. Holttum (ferns). The assistance and co-operation of the Director, Royal Botanic Gardens, Kew, the Director, the Rijkshebarium, Leiden, the Director, Botanic Gardens, Singapore, and the Director, Herbarium Bogoriense, Bogor, in permitting me the use of the facilities of their herbaria are also most gratefully acknowledged. Finally I wish to thank Mr. F. G. Browne for giving me both the opportunity and encouragement to undertake this work.

Literature cited

1. BECCARI, O. (1904): Wanderings in the Great Forests of Borneo. Ed. and transl. by F. H. H. Guillemard. London.
2. BROWNE, F. G. (1952): The Kerangas lands of Sarawak. Malay. Forester, 15, p. 61.
3. BROWNE, F. G. (1955): Forest Trees of Sarawak and Brunei and their Products. Govt. Printing Office, Kuching.
4. DURGNAT, P. A. (1952): Swamp forests in Lower Perak. Malay. Forester, 15 (3).
5. ENDERT, F. H. (1920): De woudbloomflora van Palembang. Tectona, 13.
6. HOLTTUM, R. E. (1954): Ferns of Malaya. Revised Flora of Malaya, Vol. 2.
7. HOLTTUM, R. E. (1959): Pteridophyta (Ferns and Fern Allies), Flora Malesiana, Series II, Vol. 1, Part 1.
8. POLAK, B. (1933): Ueber Torf und Moor in Niederlandisch Indien. Proc. Royal Acad. of Science, Amterdam, 30.
9. RICHARDS, P. W. (1936): Ecological observations on the rain forest of Mount Dulit, Sarawak. Parts I and II. J. Ecol., 24.
10. RICHARDS, P. W. (1952): The Tropical Rain Forest, Cam-Cambridge Univ. Press.
11. SEWANDANO, M. (1938): Peat areas of Bong Kalis, Sumatra. Tectona, 31.
12. STEENIS, C. G. G. J. van (1935): Maleische Vegetatieschetsen. Tijdschr. ned. aardrijksk. Genoot. Reeks 2, 52.
13. STEENIS, C. G. G. J. van (1957): Outline of Vegetation Types in Indonesia and Some Adjacent Regions. Proceedings of the Eighth Pacific Science Congress, 1953.
14. STEENIS, C. G. G. J. van (1958): Vegetation Map of Malaysia, UNESCO Humid Tropics Research Project.
15. WYATT-SMITH, J. (1948): An ecological study of the structure of the natural tropical lowland rain forest in Malaya, (unpub.) B.Sc. Thesis, I.F.I., Oxford.
16. WYATT-SMITH, J. (1959): Peat Swamp Forest in Malaya. **Malay. For., Vol. 22 (1).**

A catalogue of the flora of the peat swamp forests of Sarawak and Brunei including all recorded species of flowering plants, ferns and fern allies

Abbreviations used in the text: Div.: Administrative Division of Sarawak; F.R.: Forest Reserve; g.: girth at 4 ft. 6 ins. from ground; h.: total height; I.: Iban; Kpg.: Kampong (village); L.D.F.: lowland dipterocarp forest; M.: Malay; Mil.: Milanau; P.C.: Phasic Community; P.F.: Protected Forest; Sg.: Sungai (river); Tj.: Tanjong (bend in a river).

ANGIOSPERMAE

I. DICOTYLEDONS

DILLENIACEAE

Dillenia L.

1. **Dillenia pulchella** (Jack) Gilg.

simpor (M.); *beringin* (I.), *jengin perempuan* (Mil.).

II Div.: Triso *3154;* III Div.: *Igan 1590* Pulau Bruit *804, 2664, 2663,* Loba Kabang P.F. *523, 411,* Lepah P.F. *8079;* V Div.: Kayangeran F.R. *1566.*

Large tree, 96–108 ins. g., occasional in P.C. 1 and rather more common in coastal swamps; throughout Sarawak and Brunei.

2. **Dillenia pulchella** (Jack) Gilg var.

simpoh (M.), *beringin* (I.), *jengin laki* (Mil.).

II Div.: Saribas F.R. *8551;* III Div.: Pulau Bruit *7906, 9284,* Singat *9747,* Lassa *12430;* V Div.: Kayangeran F.R. *1781;* Brunei: Anduki *2142.*

Small tree, frequently little more than a shrub, 10 to 20 ft. in height, but may reach 18–24 ins. g.; occasional, locally frequent, in P.C.s 1 and 2 throughout Sarawak and Brunei. This is very similar to 1 above but whereas the latter is a large tree the variant is a small tree of the understorey growing in association with 1, and flowering and fruiting more frequently.

Tetracera L.

1. **Tetracera arborescens Jack.**

II Div.: Triso *12873;* III Div.: Lassa P.F. *12414.*

Small straggling shrub or climber, rare in understorey of P.C. 1, more abundant in secondary swamp forest. Recorded from Maludam Peninsula and Rejang Delta.

MAGNOLIACEAE

Aromadendrum Bl.

1. **Aromadendrum nutans** Dandy.

merabungai (I.), *medang limo* (Mil. Oya), *medang ikan* (Mil.).

II Div.: Simanggang *4806;* III Div.: Loba Kabang P.F. *516, 1577, 867,* Naman F.R. *A 95,* Daro F.R. *5233.*

Medium-sized tree, 48–60 ins. g., occasional in P.C.s 1–2, locally abundant in P.C. 3 in the Sg. Tissak, II Div. Probably occurs throughout Sarawak and Brunei, but not yet recorded from Brunei and V Div. Easily identified in the forest by its thick fibrous bark which gives off a pungent fragrance when initially cut.

Specimen in Kew: *3660* (*Beccari*), Type—A.

ANNONACEAE

Artabotrys R. Br.

1. **Artabotrys suaveolens** (Bl.) Bl.

V Div.: Kuala Lawas *9114.*

Climber to height of 60 ft. in P.C. 2 near coast, and recorded from Meludam Peninsula—Lawas.

Cyathocalyx Champion.

1. **Cyathocalyx biovulatus** Boerl.

eis (Mil. Matu), *selemo* (M.), *mandap* (Kedayan), *eis pendok* (I.).

II Div.: Saribas F.R. *8545, 8561,* Triso *3152,* Lingga *4819;* III Div.: Loba Kabang F.R. *2764, 9709, 693, 79322* (W.-S.), *514,* Sg. Kelepa'an *A 77,* Naman F.R. *A 71,* Pulau Bruit P.F. *8028, 9264, 9210, 8029,* Daro F.R. *5240;* Brunei: Badas, *2836.*

Small tree, 12–24 ins. g., occasionally larger, frequent in lower storey of P.C. 1 throughout Sarawak and Brunei. A characteristic tree of peat swamp forests which flowers and fruits all the year round.

Specimens in Kew: *653* (Beccari), *1869, derc* (*Haviland*)—C.

Disepalum Hk. f.

1. **Disepalum anomalum Hk. f.**

I Div.: Simunjun *11732;* IV Div.: Miri, Sg. Dua *3288;* V. Div.: Kayangeran F.R. *2024;* Brunei: Badas *5960.*

Shrub or small tree of understorey, 6–9 ins. g. and 15–20 ft. high; rare in P.C.s 1 and 2; through Sarawak and Brunei; also known to occur in heath forest.

Fissistigma Griffith.

1. **Fissistigma paniculatum** (Ridley) Merr.

III Div.: Loba Kabang *436*.

Medium-sized climber, rare in P.C. 1, and recorded from only the Rejang Delta.

Goniothalamus Hook. f. et Thoms.

1. **Goniothalamus malayanus** Hook. f. et Th.

serbah (M.), *pudin* (Mil.), *lim panas paya*.

I Div.: Setapok F.R. *4787;* II Div.: Simanggang *9431*, Saribas F.R. *8514, 8512,* Ng. Skrang *9829;* III Div.: Pulau Bruit *8391, 9211,* Lepah P.F. *5202, 8063,* Loba Kabang P.F. *550, 541, 79324* (W.-S.), Lassa *12431;* V Div.: Kayangeran F.R. *4911, 1561;* Brunei: Anduki F.R. *2232.*

Small tree, 12–24 ins. g., frequent and widely distributed in P.C.s 1 and 2 throughout Sarawak and Brunei; also occurs in heath forest.

Specimens in Kew: *borc, dxfc* (*Haviland*)—C.

2. **Goniothalamus andersonii** J. Sinclair.

selukai (I.), *pudin* (Mil.), *serbah semangun* (M.).

III Div.: Naman F.R. *5062,* Daro F.R. *5236,* Batang Igan 689, Sg. Pasir *A 125;* Brunei: Badas *2851.*

Medium-sized tree, 36–48 ins. g., occasional in P.C.s 1 and 2 throughout Sarawak and Brunei. The bark is used as a repellent against mosquitoes.

Mezzettia Beccari.

1. **Mezzettia leptopoda (Hk. f. et Th.)** Oliver. (*Mezzettia havilandii* (Boerl.) Ridley).

buah munau (Mil.), *kepayang babi.*

II Div.: Tj. Keranji *12890;* III Div.: Loba Kabang P.F. *2660, 868, 2719,* Matu Daro P.F. *12264,* Pulau Bruit P.F. *A 173;* IV Div.: Sg. Dua *3254.*

Large tree, 72–84 ins. g., occasional in P.C. I throughout Sarawak and Brunei.

In Kew the specimens collected closely match both the Type, *2335* (*Haviland*), of *M. havilandii,* which is considered to be a synonym of M. *leptopoda,* and also *102* (Herb. Maingay) the Type of *M. leptopoda.*

2. **Mezzettia umbellata Becc.**

karai, selemo.

III Div.: Loba Kabang P.F. *478, 1578;* IV Div.: Miri, Sg. Dua *3256;* Brunei: Anduki *2244.*

Small tree, 12–24 ins. g., rather rare in P.C.s 1 and 2 throughout Sarawak and Brunei; also recorded in heath forest.

Specimens in Kew: *1421* (Beccari) Type—A, and *2104* (*Haviland*).

Mitrella Miq.

1. **Mitrella dielsii** J. Sinclair.

semulun (Mil.).

II Div.: Saribas F.R. *8562;* III Div.: Surong Irit *9708,* Lassa *12428,* Matu Daro P.F. *12319.*

Medium-sized climber with distinctive foliage, rare in P.C. 1. Recorded from Saribas F.R., Batang Lupar, Rejang Delta and Baram.

Polyalthia Bl.

1. **Polyalthia glauca** (Hassk.) Boerl.

dilleh (I. Lassa), *mechang* (I. Igan), *selaut telor* (M.).

II Div.: Tj. Keranji *12401,* Triso P.F. *2342;* III Div.: Loba Kabang P.F. *A 79;* Brunei: Badas *2226.*

Medium-sized tree, 36–48 ins. g., which may be easily identified by its smooth yellow bark and large leaves with glaucous undersurface; occasional in P.C.s 1 and 2. Occurs throughout Sarawak and Brunei, and has also been noted in heath forest (Badas).

2. **Polyalthia hypoleuca Hk. f. et Th.**

selaut (I.), *kayu semut, tatal* (M. Brunei), *udap* (Mil.).

III Div.: Loba Kabang P.F. *2681, 690, 6293;* Brunei: Badas *2837.*

Small to medium-sized tree, 15–36 ins. g., occasional in P.C.s 1 and 2, locally frequent in P.C. 3 (Badas, Brunei); distribution general throughout Sarawak and Brunei.

Specimen in Kew: Herb. Maingay *1516,* Type—A.

3. **Polyalthia sclerophylla** Hk. f. et Th.

karai.

II Div.: Triso *12869, 12851, 14566;* Brunei: Tutong, Kg. Lubok Pulai *5615.*

Medium-sized tree, 36–48 ins. g., locally frequent in P.C. 1, but recorded from only the Maludam Peninsula and Sg. Tutong; probably occurs elsewhere in coastal swamps.

4. **Polyalthia sp. nov.** (*9059*).

II Div.: Saribas F.R. *8513;* III Div.: Pulau Bruit P.F. *9059, 8031, 7942,* Batang Igan *687,* Naman F.R. *677,* Matu Daro P.F. *12274.*

Small tree of the understorey, 6–9 ins. g. 12–18 ft. high; rare and local. Recorded only in the Rejang Delta, Saribas F.R. and Maludam Peninsula. An undescribed species; one matching specimen (*3919*) was collected by Beccari in Sarawak.

Pyramidanthe Miq.

1. **Pyramidanthe prismatica** (Hk. f. et Th.) J. Sinclair.

sebulan (Mil. *Daro*), *handan malam* (I.).

III Div.: Naman F.R. *674*, Pulau Bruit P.F. *9289*. Daro F.R. *9730*.

Large climber reaching 100 ft. or more in height; occasional in P.C. 1. Recorded only from Rejang Delta and Maludam Peninsula, but probably occurs in other swamp forests.

Uvaria L.

1. **Uvaria sp.** (*9749*).

III Div.: Singat *9749*.

Medium-sized climber, rare in P.C. 1 and recorded only from the Rejang Delta.

Xylopia L.

1. **Xylopia coriifolia** Ridley.

akau, bangoh (Brunei M.), *sengkajang paya* (I.).

III Div.: Matu Daro P.F. *12304*, Pulau Bruit P.F. *A. 124, 9201, 2657*, Loba Kabang P.F. *655, 2684*, Naman F.R. *A 13*, Lepah P.F. *8100;* V Div.: Kayangeran F.R. *1565;* Brunei: Badas *2828*.

Medium-sized tree, 48–60 ins. g., with numerous stilt roots; occasional in P.C.s 1 and 2, and also in P.C. 4 in Brunei; occurs throughout Sarawak and Brunei.

Specimen in Kew: *3335* (*Beccari*), Type—A, also *333* (*Beccari*), and *1906* (*Haviland*).

2. **Xylopia fusca** Maingay ex Hk. f. et Th.

akau.

III Div.: Lepah P.F. *8093*, Pulau Bruit *5121*.

Small to medium sized tree, 12–24 ins g., rare and local in P.C. I, preferring coastal margins of swamps. Recorded only from Triso P.F. and the Rejang Delta, but probably occurs throughout Sarawak and Brunei in localised habitats near the coast.

MENISPERMACEAE

Fibraurea Lour.

1. **Fibraurea chloroleuca** Miers.

akar badi.

II Div.: Saribas F.R. *5868;* III Div.: Pulau Bruit *7923*, Matu Daro P.F. *12271*.

Medium-sized to large climber, attaining a height of 100 ft.; frequent in P.C. 1 throughout Sarawak and Brunei. One of the most common climbers in swamp forest. The stem is used by the Malays and Milanaus in the preparation of a stomach medicine.

Pycnarrhena Miers.

1. **Pycnarrhena borneensis** Diels.

III Div.: Daro F.R. *9731, 9066, 5205,* Pulau Bruit *12230,* Matu Daro P.F. *12272.*

Small climbing epiphyte, rare in understorey of P.C. 1. Recorded from the Daro and Naman forest reserves in III Div.

POLYGALACEAE

Trigoniastrum Miq.

1. **Trigoniastrum hypoleucum** Miq.

III Div.: Loba Kabang P.F. *410, 434,* Pulau Bruit *2679.*

Small tree, 12–18 ins. g., rare in P.C.s 2 and 3 in the Rejang Delta.

Xanthophyllum Roxb.

1. **Xanthophyllum amoenum** Chod.

nyalin.

III Div.: Pulau Bruit *2634;* IV Div.: Sg. Dua *4110.*

Small to medium-sized tree, 12–30 ins. g., frequent in P.C.s 1 and 2. Poles and saplings are abundant in the understorey. Occurs throughout Sarawak and Brunei, also in heath forest.

Specimen in Kew: *2112* (*Haviland*), Type—A.

2. **Xanthophyllum** aff. **citrifolium Chod.**

nyalin tikus, mera batu (I.).

III Div.: Lassa *12413,* Pulau Bruit *2636, 8002, 9027, 5111,* Loba Kabang P.F. *525, 2750,* Daro F.R. *5206;* IV Div.: Sg. Dua *4176, 4190.*

Small tree, 9–18 ins. g., occasional, locally frequent, in P.C. 1 from Batang Lupar to Baram. Recorded in L.D.F. in Brunei.

3. **Xanthophyllum** sp. (*2614*).

II Div.: Sg. Tissak *3183;* III Div.: Pulau Bruit *12894,* Loba Kabang P.F. *2614, 500, 2734, 1589;* Brunei: Badas *2830.*

Small tree, 12–30 ins. g., locally frequent in P.C. 4 throughout Sarawak and Brunei, but has not been recorded from V Div. It also occurs in heath forest.

Specimens of this distinctive tree are quite unmatched in Kew, Bogor and Singapore, and the species is probably undescribed.

HYPERICACEAE

Cratoxylon Blume.

1. **Cratoxylon arborescens** (Vahl) Blume.

    geronggang, entimau (I.), *serungan.*

    I Div.: Setapok F.R. *4765;* II Div.: Triso P.F. *3155;* III Div.: Loba Kabang P.F. *536.*

    Large tree, 72–84 ins. g., occasional in P.C. 1, abundant in secondary swamp forest; throughout Sarawak and Brunei.

    Specimen in Kew: *3720* (*Beccari*), *bnpd* (*Haviland*)—B.

2. **Cratoxylon glaucum** Korth.

    geronggang puteh, geronggang padang.

    III Div.: Sungei Assan *A 105,* Loba Kabang P.F. *2721;* V Div.: Kayangeran *1776.*

    Tree, 60–72 ins. g., occasional, locally frequent, in P.C. 4 throughout Sarawak and Brunei.

    Specimens also closely match *Cratoxylon microphyllum* Bl., which is commonly found in heath forest as a small tree or shrub.

    Specimens in Kew: *3176, 3170, 1133, 597* (*Beccari*)—B.

FLACOURTIACEAE

Casearia Jacq.

1. **Casearia elliptifolia** Merr.

    II Div.: Triso *10023;* IV Div.; Lawas *9198.*

    Small tree or shrub, rarely more than 15 ft. h., rare in P.C. 3; recorded from the Rejang Delta, Batang Lupar and Lawas.

Ryparosa Bl.

1. **Ryparosa acuminata** Merr.

    III Div.: Loba Kabang P.F. *888.*

    Small tree, 12–18 ins. g., rare in P.C. 1. Recorded from only the Rejang Delta.

    Specimen in Kew: *501* (Hose), Type—B.

GUTTIFERAE

Calophyllum L.

1. **Calophyllum canum** Hook. f.

    bintangor.

    III Div.: Pulau Bruit *A 137,* Loba Kabang P.F. *1597.*

    Tree, 72–84 ins. g., rare in P.C. 1, and recorded from only the Rejang Delta. It also closely resembles *Calophyllum palustre* Ridley (*3343, Haviland*).

2. **Calophyllum fragrans** Ridley.

bintangor.

III Div.: Loba Kabang P.F. *2698, 480, 2739, 2761.*

Medium-sized tree, 36–48 ins. g., rare and local in P.C.s 1 and 2. Recorded from only the Rejang Delta. One of the two species of *Calophyllum* which have stilt roots.

Specimen in Kew: *1812* (*Haviland*), Type—A.

3. **Calophyllum obliquinervum** Merr. (*Calophyllum benjamina* Ridley).

bintangor kuning.

III Div.: Loba Kabang P.F. *659.*

Medium-sized tree, 36–48 ins. g., locally abundant in P.C. 4 in the centre of certain swamps, also occurs in heath forest; throughout Sarawak and Brunei. Easily identified by its conspicuous bright yellow bark.

Specimen in Kew: *505* (*Haviland*), Type (*C. benjamina*)—A.

4. **Calophyllum retusum** Wall. (*Calophyllum borneense* Vesq.)

bintangor paya.

I Div.: Setapok F.R. *4817*; III Div.: Loba Kabang P.F. *755, 79329* (W.-S.), Daro F.R. *A 126, A 171*, Pulau Bruit *8039.*

Tree, 72–84 ins. g., occasional in P.C. 1 and more rarely in P.C. 2; throughout Sarawak and Brunei.

The specimens closely match the type (*2101, Beccari*) of *C. borneense,* which is considered to be a synonym of *C. retusum.*

5. **Calophyllum scriblitifolium** Hend. & W.-S.

III Div.: Sg. Assan *7361/10*, Loba Kabang P.F. *2740.*

Large tree, 60–72 ins. g., rare in P.C.'s 1 + 2 in the Rejang Delta and Meludam Peninsula.

6. **Calophyllum rhizophorum** Boerl. et Koord.

bintangor kapas (M. Lawas), *bintangor dudok.*

III Div.: Loba Kabang P.F. *654, 756, 79328* (W.-S.), *1598;* V Div.: Kayangeran F.R. *2843.*

Tree, 60–72 ins. g., occasional in P.C.s 2 and 3. Recorded from the Rejang Delta, Baram, Brunei and Lawas, but not yet known to occur south-west of the Rejang Delta.

7. **Calophyllum sclerophyllum** Vesq.

bintangor jangkar.

III Div.: Daro F.R. *A 136.*

Medium-sized tree, 36–48 ins. g., rare or very rare in P.C. 1. Probably occurs throughout Sarawak and Brunei but only recorded from the Rejang, Baram, and Brunei. This species is easily identified by its spreading stilt roots and large coriaceous leaves.

Garcinia L.

1. **Garcinia schizophoroides** Elm. var. **bicolor.**
   kandis.

   Brunei: Anduki F.R. *2249,* Badas *2831;* V Div.: Kayangeran F.R. *2028, 2016, 4910.*
   Small tree, 12–18 ins. g., locally frequent in P.C. 1 in Brunei and V Div., but not yet recorded elsewhere.

2. **Garcinia havilandii** Stapf.

   kandis jangkar.

   III Div.: Loba Kabang P.F. *669.*
   Distinctive medium-sized tree, 36–48 ins. g., with numerous spreading stilt roots. Occasional in P.C. 1 in the Rejang Delta and Batang Lupar.

3. **Garcinia microcarpa** Pierre.

   III Div.: Baram *3284;* Brunei: Badas *2824;* V Div.: Kayangeran F.R. *1558.*
   Small tree, 12–18 ins. g., occasional in P.C.s 2–4 in the Rejang Delta, Baram, Lawas and Brunei.

4. **Garcinia** aff. **rostrata** Hassk ex Hook f.

   II Div.: Triso P.F. *3169;* III Div.: Loba Kabang P.F. *2611;* Brunei: Badas *2817.*
   Small tree, 12–15 ins. g., frequent, locally abundant, in P.C. 4 in Batang Lupar, Rejang Delta, Baram and Brunei, and abundant in P.C. 6; also occurs in heath forest. All collections sterile.

5. **Garcinia tetrandra** Pierre.

   manggis hutan (M.), *kunong* (Mil. Oya), *bua 'babal* (Mil. Rejang), *sakubangan* (I.).

   II Div.: Saribas F.R. *8559,* Triso P.F. *3168;* III Div.: Matu Daro P.F. *12270, 12316,* Pulau Bruit *9208, 2645, 806, 4965.* Loba Kabang P.F. *5053, 669.*
   Very distinctive small to medium-sized tree, 15–30 ins. g., with leaves and fruit which closely resemble the cultivated mangosteen; occasional in P.C.s 1 and 2 throughout Sarawak and Brunei.

6. **Garcinia vidua** Ridley.

   III Div.: Pulau Bruit *8046,* Loba Kabang P.F. *407, 894, 462, 2765;* Brunei: Badas *2839.*
   Medium-sized tree, 36–48 ins. g., occasional in P.C. 1 in the Rejang Delta, also recorded in Brunei.

7. **Garcinia** sp. (*9745*).

   II Div.: Saribas F.R. *8519;* III Div.: Loba Kabang P.F. *865, 2755,* Daro F.R. *9745.*
   Small tree, 12–18 ins. g., occasional in P.C.s 1 and 2 in Batang Lupar and the Rejang Delta.

8. **Garcinia eugenifolia** Wall.

III Div.: Loba Kabang P.F. *2752, 2758;* IV Div.: Sg. Dua *3277, 3259.*

Small tree, 12–18 ins. g., rare in P.C. 2 in the Rejang Delta and Baram.

Kayea Wall.

1. **Kayea** sp. (*9736*).

lupeh (Mil. Oya), *beragasing* (I.).

III Div.: Daro F.R. *5214, 9736,* Loba Kabang P.F. *855, 509.*

Small tree, 12–24 ins. g., rare and local in P.C. 1 in the Rejang Delta and Maludam Peninsula.

TERNSTROEMIACEAE

Ploiarium Korthals.

1. **Ploiarium alternifolium** (Vahl) Melchior.

somah.

III Div.: Loba Kabang P.F. *661;* V Div.: Kayangeran F.R. *2847.*

Small tree, 12–24 ins. g., rare in P.C. 4, but abundant in heath forest and on degraded soils throughout Sarawak and Brunei. In peat swamps it develops numerous stilt roots.

Ternstroemia Mutis ex L. f.

1. **Ternstroemia hosei** Ridley.

II Div.: Triso *8941,* Saribas F.R. *8574;* III Div.: Loba Kabang P.F. *439, 2609;* IV Div.: Sg. Dua *2885,* Lobok Pasir *9874;* Brunei: *2819.*

Small tree, 15–24 ins. g., frequent, locally abundant, in P.C.s 4 and 5 throughout Sarawak and Brunei; also occurs in heath forest.

Specimens in Kew: *235* (*Hose*) Type, *1966, 3102* (Haviland), *2943* (Beccari).

Specimens also closely match *T. citrina* which may be a synonym.

2. **Ternstroemia magnifica** Stapf ex Ridley.

III Div.: Sg. Nangar *12277,* Loba Kabang P.F. *416;* V Div.: Kayangeran F.R. *4908.*

Small tree, 18–30 ins. g., rather rare and localised; has been recorded in P.C.s 1–4. Occurs throughout Sarawak and Brunei, also recorded in L.D.F. in Brunei.

Specimen in Kew: unno. (*Haviland*) Type—**C**.

3. **Ternstroemia** aff. **penangiana** Choisy.

III Div.: Loba Kabang P.F. *899.*

Small tree, 12–24 ins. g., very rare in P.C. 1 and recorded from only the Rejang Delta.

Unmatched in Kew, determined Singapore.

DIPTEROCARPACEAE

Anisoptera Korth.

1. **Anisoptera marginata** Korth. (*Anisoptera grandiflora* Brandis.)

mersawa paya, pelpak.

II Div.: Saribas F.R. *8401,* Nanga Skrang *9827;* III Div.: Pulau Bruit P.F. *9278, 9290, 8038, 8027,* Loba Kabang P.F. *2718, 463, 698.*

Medium-sized to large tree, 48–60 ins. g., though trees of over 96 ins. g. have been recorded; rather rare in P.C. 1. Recorded from only the Rejang Delta, Saribas and Maludam Peninsula, but probably also occurs in northern Sarawak and Brunei.

Cotylelobium Pierre.

1. **Cotylelobium flavum** Pierre.

resak durian.

III Div.: Loba Kabang P.F. *405, A 185, A 147.*

Tree, 24–36 ins. g., rare and local in P.C.s 2–4. Occurs throughout Brunei and Sarawak and is common in some heath forests, but has only been recorded in peat swamps in the Rejang Delta and Brunei.

Dipterocarpus Gaertn. f.

1. **Dipterocarpus coriaceus** V. Sl.

keruing paya.

II Div.: Nanga Skrang *9820;* III Div. Sg. Sekai F.R. *555, 556.*

Medium-sized to large tree, 72–84 ins. g., localised and tending to be gregarious in P.C. 1 near up-river limits of peat swamps. Occurs only in I and II Divs., and the Sg. Sekai F.R. in the III Div.

Dryobalanops Gaertn. f.

1. **Dryobalanops rappa** Becc.

kapur paya.

III Div.: Loba Kabang P.F. *753;* IV Div.: Simalajau *263.*

Large tree, 96–108 ins. g., occasional, locally frequent, in P.C.s 1 and 2. Occurs throughout Sarawak and Brunei in swamp and heath forests.

Hopea Roxb.

1. **Hopea pentanervia** Sym.

chengal paya, mang.

III Div.: Loba Kabang P.F. *2729, A 121;* V Div.: Kayangeran F.R. *1780.*

Medium-sized tree, 24–36 ins. g., occasional in P.C.s 1 and 2. Occurs throughout Sarawak and Brunei and is one of the most sought after swamp species for its heavy durable timber; also a characteristic species of heath forest.

Shorea Roxb.

1. **Shorea albida** Sym.

alan, meraka alan (I, III Divs.), *empenit* (II Div.), *sengawan* (IV Div.), *seringawan* (Brunei).

III Div.: Loba Kabang P.F. *651, 2852, 2805, 2552,* Daro F.R. *12250;* IV Div.: Miri, Sg. Dua *2862, 2900.*

Very large tree, 132–144 ins. g., over-mature trees may exceed 180 ins., very abundant and gregarious; the sole dominant over vast areas in P.C.s 2, 3 and 4. Extensive forests dominated by this species extend from the Sadong river in Sarawak to the Badas swamps in Brunei. One relatively small detached forest occurs in heath forest in the Sedilu F.R., and a few trees have been noted in the Tutong. A common species in certain heath forests.

2. **Shorea inaequilateralis** Sym.

semayor.

III Div.: Loba Kabang P.F. *A30, A 144, 79319* (W.-S.).

Large tree, 96–108 ins. g., occasionally larger; has a rather limited distribution, being confined to a zone overlapping P.C.s 1 and 2, but is generally absent from P.C. 3 and from the coastal type of P.C. 1. Occurs from the Sadong in Sarawak to the Belait swamps in Brunei.

3. **Shorea longiflora** (Brandis) Sym.

lun paya, barun paya (Baram).

III Div.: Loba Kabang P.F. *2749, 9194.*

Medium-sized tree, 48–60 ins. g., rare and local in peat-swamp forest; recorded in P.C. 1 from the Rejang Delta and Baram, but is known to occur elsewhere in L.D.F. and in heath forest.

4. **Shorea macrantha** (Brandis) Sym.

engkabang bungkus, perawan lompong kijang (I. Naman).

III Div.: Naman F.R. *A 14, A 99, 9781.*

Medium-sized to large tree, 60–72 ins. g., occasional and very local in peat-swamp forest. Confined to the inland margins of swamps in P.C. 1 and only recorded from Naman F.R., Setapok F.R. and Lingga. More frequently found as a riparian species and in certain types of heath forest. The fruit is a commercial illipe nut.

5. **Shorea pachyphylla** Ridley ex Sym.

kerukup, urat mata.

Brunei: Badas *1593.*

Large tree up to 144 ins. g., occasional, locally frequent, in P.C. 1 but confined to inland margins of swamps; more common on podsolized soils of heath forests. Occurs in most coastal districts of Sarawak and Brunei, but is absent from the II and III Divs.

6. **Shorea platycarpa** Heim.

meranti paya.

II Div.: Triso *12853;* III Div.: Naman F.R. *A 32,* Pulau Bruit *452.*

Large tree, 108–120 ins. g., occasional in P.C. 1, especially on shallow peat near coast. Seedlings and saplings are liable to be confused with those of *Shorea rugosa* var. *uliginosa;* throughout Sarawak and Brunei, also occurs in heath forest.

7. **Shorea rugosa** Heim. var. **uliginosa** (Foxw.) Sym.

meranti buaya.

III Div.: Loba Kabang P.F. *A145, 2858,* Pulau Bruit *7908.*

Very large tree, girths of over 144 ins. have been recorded, occasional, locally frequent, in P.C. 1. Easily identified by its incurved drooping leaves; throughout western and central Sarawak, but not yet recorded east of the Baram.

8. **Shorea scabrida** Sym.

meranti lop.

II Div.: Tj. *Keranji 12409;* III Div.: Loba Kabang P.F. *752,* Naman F.R. *A 19.*

Large tree, 96–120 ins. g.; occasional but rather local in P.C. 1 throughout Sarawak and Brunei. Occurs more frequently in heath forest and also on ridges in L.D.F.

9. **Shorea teysmanniana** Dyer ex Brandis.

meranti lilin.

III Div.: Pulau Bruit *7907,* Lepah P.F. *8077,* Lassa *12419;* IV Div.: Baram *3280.*

Large tree, 108–132 ins. g., frequent in P.C. 1 in the Rejang Delta and Batang Lupar but rare in swamp forests of Brunei and Lawas; also occurs in heath forest.

Vatica L.

1. **Vatica mangachapoi** Blanco.

resak paya.

II Div.: Tj. Keranji *12878,* Triso P.F. *3159;* III Div.: Loba Kabang P.F. *511,* Daro F.R. *A 42,* Narub F.R. *26;* Brunei: Badas *2820.*

Medium-sized tree, 48–60 ins. g., rather rare and usually confined to P.C. 1 but also recorded in P.C. 4 (Brunei); throughout Sarawak and Brunei in heath and peat swamp forests.

MALVACEAE

Durio Adans.

1. **Durio carinatus** Mast.

durian burong, rian (Mil.).

I Div.: Bako *1387;* III Div.: Pulau Bruit *7920,* Loba Kabang P.F. *425.*

Large tree, 72–84 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei.

Neesia Blume.

1. **Neesia malayana** Bakh.

durian durian (M. Lawas), *bengang.*

I Div.: Setapok F.R. *9853;* V Div.: Kuala Lawas *9111.*

Medium-sized to large tree, 48–60 ins. g., occasionally larger up to 9 ft. g., rare, locally frequent (Kuala Lawas), in P.C. 1. Recorded from only the two mentioned localities.

STERCULIACEAE

Scaphium Endl.

1. **Scaphium macropodum** (Miq.) Beumée.

kembang semangkok.

III Div.: Loba Kabang P.F. *2689.*

Medium-sized tree, 48–60 ins. g., rare and localised in P.C. 1 near riparian fringe, but a common species in heath forest and L.D.F.

Sterculia L.

1. **Sterculia bicolor** Mast.

III Div.: Lepah P.F. *8069, 8078.*

Medium-sized tree, 36–48 ins. g., rare and local in P.C. 1 throughout Sarawak and Brunei.

2. **Sterculia macrophylla** Vent.

II Div.: Sabu F.R. *3207;* III Div.: Loba Kabang P.F. *490.*

Small tree, 18–30 ins. g., very rare in P.C. 2. Recorded from only the two mentioned localities.

3. **Sterculia rhoidifolia** Stapf ex Ridley.

biris.

II Div.: Sg. Tissak *3182;* III Div.: Loba Kabang P.F. *879, 406;* IV Div.: Sg. Dua *4118.*

Small tree, 12–24 ins. g., occasional, locally frequent, in P.C. 4 throughout Sarawak and Brunei. Also occurs in heath forest.

TILIACEAE

Elaeocarpus Burm. ex L.

1. **Elaeocarpus beccarii** A. DC.
   beliban (Mil. Oya).
   I Div.: Setapok F.R. *4703;* II Div.: Triso *3160,* Sg. Tissak *3199;* III Div.: Pulau Bruit *5120, 9265, 9022,* Singat *9064, 9751,* Lepah P.F. *8064;* Brunei: Anduki F.R. *2241.*
   Small tree, 6–12 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei.

2. **Elaeocarpus griffithii** (Wight) Mast.
   II Div.: Triso *4789, 12858,* Saribas F.R. *8501, 9578;* III Div.: Pulau Bruit *9250, 9009, 7905.*
   Small tree, 6–10 ins. g., occasional and localised in P.C. 1 on shallow peat near the coast especially in transitional zones from mangrove. Recorded from only the mentioned localities, but probably occurs throughout Sarawak and Brunei.

3. **Eleocarpus mastersii** King.
   IV Div.: Sg. Dua *4111, 3065.*
   Small tree, 9–15 ins. g., occasional in P.C.s 1–3, frequent in secondary forest following logging; throughout Sarawak and Brunei.

4. **Elaeocarpus obtusifolius** Merr.
   empedu, bangas (Mil. Matu).
   II Div.: Sg. Tissak *3192;* III Div.: Pulau Bruit *9292,* Loba Kabang P.F. *433, 492, 2733, 460, 2616;* IV Div.: Sg. Dua *3058, 2889, 4175;* V. Div.: Kayangeran F.R. *2849, 1557, 2026;* Brunei: Anduki F.R. 2143.
   Small to medium-sized tree, 18–36 ins. g., occasional, locally frequent, in P.C.s 1–4 throughout Sarawak and Brunei. Also occurs in heath forest.

Jarandersonia Kostermans.

1. **Jarandersonia paludosa** Kosterm.
   I Div.: Sg. Snibong, Lundu *6554.*
   Small tree, locally frequent in P.C. 1. Recorded only from this locality.
   A new genus, reference Reinwardtia, Vol. 5, Part 3.

LINACEAE

Ctenolophon Oliv.

1. **Ctenolophon parvifolius** Oliv.
   temana'a (Mil. Oya), *litoh, kriang* (I. Lassa).
   II Div.: Tj. Keranji *12889,* Saribas F.R. *8567, 8527;* III Div.: Pulau Bruit *12897, 2649, 9245, 4969, 9040,* Daro F.R. *9718,* Loba Kabang P.F. *897, A62, 496, 465,* Matu Daro P.F. *12260;* V Div.: Kayangeran F.R. *4904.*

Medium-sized tree, 36–48 ins. g., frequent in P.C. 1 throughout Sarawak and Brunei. In the forest this species is frequently confused with *ngilas paya* (*Parastemon urophyllum*).

Specimen in Kew: Herb. Maingay *382*, Type—A.

Sarcotheca Bl.

1. **Sarcotheca glauca** (Hook. f.) Hallier f.

II Div.: Triso *9798;* III Div.: Pulau Bruit *2654*, Lassa *12436;* IV Div.: Baram *4115;* Brunei: Berakas *2160*.

Small tree, 12–15 ft. h., rare in P.C.s 1 and 2 throughout Sarawak and Brunei, also occurs in heath forest and on degraded soils.

RUTACEAE

Tetractomia Hook. f.

1. **Tetractomia holttumii** Ridley.

rawang.

II Div.: Lingga *9825, 4812*, Triso P.F. *3158;* III Div.: Pulau Bruit *2630*, Daro F.R. *5210;* IV Div.: Sg. Dua *3258, 3272;* Brunei: Badas *2832*.

Medium-sized tree, 24–36 ins. g., locally abundant in P.C. 3 in the Baram and frequent elsewhere; throughout Sarawak and Brunei; occurs in heath forest.

2. **Tetractomia beccarii** Hook f.

rawang.

I Div.: Setapok F.R. *358;* II Div.: Triso *9792*, Saribas F.R. *8504, 9579*, Sg. Tissak *3189;* III Div.: Loba Kabang P.F. *2667*.

Medium-sized tree, 48–60 ins. g., occasional in P.C. 1 and confined to this forest type. Not yet recorded further east than the Rejang Delta.

Both species of *Tetractomia* are readily identified by their smooth yellowish bark and fragrant slash.

Luvunga Buch.—Ham.

1. **Luvunga motleyi** Oliv.

III Div.: Daro F.R. *9063*.

Small tree or erect shrub, 10–15 ft. h., rare in P.C. 1. Recorded from the Daro F.R., Loba Kabang P.F. and Setapok F.R. In Ridley's "Flora of Malaya" this species is stated to be a liane.

SIMARUBACEAE

Samadera Gaertn.

1. **Samadera indica** Gaertn.

kelapahit (M. and Mil.).

II Div.: Triso *12214;* III Div.: Lepah P.F. *8090,* Naman F.R. *9185,* Loba Kabang P.F. *700.*

Small tree, rarely exceeding 12 ins. g., and frequently little more than an erect shrub, rare in P.C. 1. Recorded from Batang Lupar, Rejang Delta and Bintulu but probably occurs throughout Sarawak and Brunei.

The timber is sought after for use as handles for parangs and knives.

Quassia L.

1. **Quassia borneensis** Nooteboom (msc.)

medang pahit, pelai pahit.

III Div.: Loba Kabang P.F. *2697, 413, 891,* Lassa *15951.*

Medium-sized tree, 48–60 ins. g. with very distinctive compound leaves; occasional and local in P.C.'s 1 and 2 in the Rejang Delta. Also occurs in L.D.F. (Semengoh F.R.).

Previous sterile collections were identified as *Parishia,* matching sterile collections *29.570,* and *29.122* (Buwalda), and *25.744* (Mol) from Sumatra. A recent (1962) fertile collection (*15951*) matches SAN 20499 which has been found to be a new species in the Afro-American genus *Quassia.*

OCHNACEAE

Euthemis Jack.

1. **Euthemis obtusifolia** Hook. f.

rumput bintangor.

III Div.: Loba Kabang P.F. *1592, 79332* (W.-S.); IV Div.: Baram *2882.*

Prostrate shrublet with creeping habit, frequent, locally abundant (Rejang Delta), in P.C. 4 throughout Sarawak and Brunei.

Specimen in Kew: Herb. Hook. unno., colld. 1867, Type—A.

2. **Euthemis leucocarpa** Jack.

mata tewop (I.).

II Div.: Triso *10016,* Saribas F.R. *8569, 9014;* III Div.: Pulau Bruit *9014,* Lassa *11713.*

Small erect shrublet, 4–8 ft. h., rare in P.C.s 1, 2 and 3. Recorded in peat swamps from only II Div. and the Rejang Delta. Fruit used in preparation of an eye medicine.

Brackenridgea

1. **Brackenridgea hookeri** Planch.

I Div.: Lundu *9148;* II Div.: Saribas F.R. *8516;* IV Div.: Baram *3054.*

Small tree, 9–18 ins. g., rare in P.C. 1 from Lundu to Baram. Not yet recorded from Brunei or V Div., but probably occurs throughout the two territories.

Tetramerista Miq.

1. **Tetramerista glabra.** Miq.

entuyut, kayu hujan.

I Div.: Satapok F.R. *4780;* III Div.: Pulau Bruit *802, 9038, 9035, 9283, 9233,* Sg. Nangar *12301.*

Large tree, 96–108 ins. g., rare, locally occasional in P.C. 1 throughout Sarawak and Brunei. Also occurs in heath forest and on degraded soils.

Specimens in Kew: *872, 1836* (*Haviland*), Flora of Sarawak *380.*

BURSERACEAE

Dacryodes Vahl.

1. **Dacryodes incurvata** (Engl.) H. J. Lam.

III Div.: Sg. Kelapa'an *A 78,* Pulau Bruit *2650.*

Small to medium-sized tree, 24–36 ins. g., rather rare and localised in P.C. 1. Recorded only from the Batang Lupar and Rejang Delta.

2. **Dacryodes macrocarpa** (King) H. J. Lam var. **macrocarpa**.

kayu tunjang (I. Lupar).

II Div.: Triso *3105, 3111, 3108, 14501;* III Div.: Lepah P.F. *8091,* Sg. Nangar *12327.*

Small tree, 12–24 ins. g., occasional and localised in P.C. 1 on shallow peat near coastal and riparian margins of swamps. Recorded from the Batang Lupar and Rejang Delta.

Santiria Blume.

1. **Santiria laevigata** Bl. forma **laevigata.**

kemayan (I.), *seladah* (Mil.).

III Div.: Loba Kabang P.F. *494,* Pulau Bruit *2625, 9223,* Sg. Nangar *12305;* V Div.: Kayangeran *1564.*

Small to medium-sized tree, 24–36 ins. g., occasional in P.C. 2 throughout Sarawak and Brunei; also occurs in heath forests.

2. **Santiria rubiginosa** Bl. var. **rubiginosa.**

seladah (Mil.).

II Div.: Triso *3102;* III Div.: Loba Kabang P.F. *898, 450, 475, 2703,* Pulau Bruit *9204,* Naman F.R. *676*

Small to medium-sized tree, 24–36 ins. g., occasional, locally frequent, in P.C. 2 throughout Sarawak and Brunei.

3. **Santiria rubiginosa** Bl. var.

II Div.: Triso P.F. *14513;* III Div.: Loba Kabang *869, 2754;* IV Div.: Baram *4177, 3255, 3256;* Brunei: Badas *2040.*

Small tree, 12–24 ins. g., occasional in P.C.s 1–3 throughout Sarawak and Brunei.

This species was previously determined as *S. griffithii* Engl.

4. **Santiria tomentosa** Bl.

seladah, soya bulu.

I Div.: Sedilu F.R. *9566,* Lundu *9776;* II Div.: Triso *3202;* III Div.: Pulau Bruit *9216,* Lepah *8076;* IV Div.: Sg. Dua *3270*

Small tree, 12–24 ins. g., occasional in P.C. 2, especially near coast; throughout Sarawak and Brunei. Also recorded in L.D.F.

MELIACEAE

Amoora Roxb.

1. **Amoora rubiginosa** Hiern (*Aglaia ignea* Valeton ex K. Heyne).

jelungan sasak, bersangai (Mil.), *chenaga dayong* (I.).

II Div.: Triso *9807;* III Div.: Daro F.R. *A 101, A 20,* Pulau Bruit *9807, 9018, 9243, 9734,* Naman F.R. *9177, 9169,* Matu, Daro P.F. *12257, 12308;* IV Div.: Sg. Dua *4185;* V Div.: *4916.*

Very distinctive tree, 48–60 ins. g., occasional in P.C. 1 and rare in P.C. 2 throughout Sarawak and Brunei. This species is easily recognised in the field by its cream coloured pock-marked bark and crown with large compound pinnate leaves.

The specimens are an identical match with the type of *Aglaia ignea,* which is presumed to be a synonym.

Chisocheton Bl.

1. **Chisocheton brachyanthus** Merr.

bua 'pesa kanan (Mil.).

III Div.: Matu Daro P.F. *12258,* Pulau Bruit *9260, 9269, 9003,* Lepah P.F. *8087,* Loba Kabang P.F. *670* IV Div.: Lubok Pasir *4161.*

Small tree of understorey, 6–12 ins. g., occasional in P.C. 1 from Batang Lupar to Baram, but not yet recorded from Brunei or V Div.

Sandoricum Cav.

1. **Sandoricum emarginatum** Hiern.

kelampu, apau (Mil. Rejang).

III Div.: Matu Daro P.F. *12263, 12303,* Lassa *12418,* Daro F.R. *5234, 9711, A 107,* Lepah P.F. *8075,* Loba Kabang P.F. *2665, 2756.*

Large tree, 108–120 ins. g., rare, locally occasional, in P.C. 1 throughout Sarawak and Brunei.

The fruit is edible, though rather tasteless.

OLACACEAE

Anacolosa Blume.

1. **Anacolosa frutescens** Bl. (*Anacolosa arborescens* K. and V.)

III Div.: Lepah P.F. *8065,* Loba Kabang P.F. *2675,* Daro F.R. *5237, 5215,* Naman F.R. *11718, 14585.*

Small tree, 18–24 ins. g., rare in P.C. 1 Recorded in peat swamp forests from only the Rejang Delta, but occurs in L.D.F. in Brunei.

Specimens are an identical match with unnamed specimen *2950* (*Haviland*).

Gomphandra Wall.

1. **Gomphandra** aff. **comosa** King.

II Div.: Triso P.F. *3116, 14502,* Saribas F.R. *8517;* III Div.: Pulau Bruit *7914;* IV Div.: Sg. Dua *4189.*

Small tree, 12–20 ins. g., rare in P.C. 1 from Batang Lupar to Baram.

Platea Bl.

1. **Platea excelsa** Bl.

II Div.: Saribas F.R. *8404,* Triso *9796;* III Div.: Loba Kabang P.F. *2688;* IV Div.: Baram *2894;* V Div.: Kayangeran F.R. *1774.*

Small tree, 12–24 ins. g., occasionally larger, rare in P.C. 1 throughout Sarawak and Brunei. Distinctive features are the fragrant slash and numerous spreading stilt roots.

Stemonurus Bl.

1. **Stemonurus scorpioides** Becc.

jerumit (Mil.), *semburok* (M.), *entaburok* (I.).

III Div.: Pulau Bruit *9020, 7932,* Loba Kabang P.F. *699, 79321* (W.-S.), *2770.*

Medium-sized tree, 48–60 ins. g., occasional, locally frequent in P.C.s 1 and 2 in the Rejang Delta, but absent in peat swamps elsewhere in Sarawak, though recorded on terraces in Brunei.

2. **Stemonurus umbellatus** Becc.

semburok (M.), *jerumit* (Mil.), *entaburok* (I.).

II Div.: Lingga *4810,* Saribas F.R. *8543;* III Div.: Pulau Bruit, *9006, 9259, 9247,* Daro F.R. *9712,* Loba Kabang P.F. *2785, 2786, 518, 539;* IV Div.: Sg. Dua *2868;* Brunei: Badas *2829.*

Small tree, 12–24 ins. g., frequent in P.C.s 1 and 2 throughout Sarawak and Brunei; also of frequent occurrence in heath forest

ILICINACEAE

Ilex (Tourn.) L.

1. **Ilex hypoglauca** (Miq.) Loes.

    mungkulat, kerdam.

    II Div.: Triso *3153, 3161,* Saribas F.R. *8536;* III Div.: Daro F.R. *9760,* Naman F.R. *9178;* IV Div.: Baram, Sg. Dua *3271;* V. Div.: Kayangeran F.R. *2848;* Brunei: Badas *2825.*

    Small tree, 12–20 ins. g., locally frequent in P.C.s 1–3; throughout Sarawak and Brunei, also occurs in heath forest.

2. **Ilex sclerophylloides** Loes.

    mungkulat, kerdam.

    II Div.: Saribas F.R. *8405,* Triso P.F. *14538;* III Div.: Loba Kabang P.F. *2857,* Pulau Bruit P.F. *7919, 9011;* IV Div.: Baram, Sg. Dua *2865, 2896,* Lubok Pasir *8400;* Burnei: Badas *2857.*

    Small tree, 9–15 ins. g.; occasional, locally frequent, in P.C.s 4 and 5; throughout Sarawak and Brunei. These two species may be confused in the field. The larger leaves with glaucous undersurface serve to distinguish *I. hypoglauca.*

CELASTRACEAE

Bhesa Arn.

1. **Bhesa paniculata** Arn. (*Kurrimia minor* Ridl.)

    tekam keladi.

    II Div.: Triso *8942,* Saribas F.R. *8558;* III Div.: Lassa P.F. *A 45,* Loba Kabang P.F. *417,* Pulau Bruit *9041, 9230.*

    Medium-sized tree, 24–36 ins. g., rather rare but widespread in P.C. 1 throughout Sarawak and Brunei; also found in heath forests.

Kokoona Thw.

1. **Kokoona ovato-lanceolata** Ridl.

    bajan tulang (I. Assam), *badang* (M.), *bajan* (Mil.), *masabong* (I. Lassa), *dian* (I. Marudi).

    III Div.: Pulau Bruit *9291, 7910,* Igan A *58,* Loba Kabang P.F. *2699;* IV Div.: Baram *3285,* Marudi F.R. *1485;* V Div.: Kayangeran F.R. *4902.*

    Medium-sized tree, 48–60 ins. g., rare in P.C.s 1 and 2 throughout Sarawak and Brunei; also in heath forest.

Lophopetalum Wight ex Arn.

1. **Lophopetalum multinervium** Ridley.

    perupok, dual (M. Lawas).

    II Div.: Simanggang *9435;* III Div.: Pulau Bruit *803, 12233, 451;* IV Div.: Baram *1264, 934;* V Div.: Lawas *1512.*

Large tree, 84–96 ins. g., occasional and local; generally confined to coastal perimeter of P.C. 1; throughout Sarawak and Brunei.

2. **Lophopetalum rigidum** Ridley.

bajan perupok (I. Naman), *perupok*.

III Div.: Loba Kabang P.F. *2608, 663.*

Medium-sized tree, 36–48 ins. g., very localised; recorded only in the Rejang Delta where it is abundant in P.C.s 2 and 3 and frequent in P.C. 4.

Specimen in Kew: *2236* (*Haviland*)—A.

RHAMNACEAE

Zizyphus Tourn. ex L.

1. **Zizyphus suluensis** Merr.

III Div.: Lepah P.F. *8095.*

Climbing shrub, occasionally with upright habit, rare in primary P.C. 1 but becoming abundant in open secondary swamp forest. Occurs throughout Sarawak and Brunei.

AMPELIDACEAE (VITACEAE)

Ampelocissus Planch.

1. **Ampelocissus thyrsiflora** (Miq.) Planch.

II Div.: Saribas *8509.*

Small climber with attractive mauve foliage, rare but widely distributed in understorey of P.C. 1; through Sarawak and Brunei. Also occurs in heath forest.

Cissus L.

1. **Cissus** sp. (*10013*).

II Div.: Maludam Peninsula *10013.*

Distinctive small climber, rare in understorey of P.C. 1; throughout Sarawak and Brunei. Only sterile collections have been made.

Tetrastigma Planch.

1. **Tetrastigma** sp. (*12420*).

III Div.: Lassa P.F. *12420,* Pulau Bruit *9241, 12899,* Surong Irit *5225;* IV Div.: Baram *3287;* V Div.: Lawas *5225.*

Climber to height of 60 ft., occasional and widely distributed in P.C. 1; throughout Sarawak and Brunei.

SAPINDACEAE

Nephelium L.

1. **Nephelium maingayi** Hiern.

   serait, buah serait.

   II Div.: Triso *12857;* III Div.: Surong Irit *5203, 9710,* Loba Kabang P.F. *2737, 489, 852,* Pulau Bruit *2637;* V Div.: Kayangeran F.R. *1563.*

   Medium-sized tree, 36–48 ins. g., frequent in P.C. 1 throughout Sarawak and Brunei. Also recorded from heath forests.

Pometia Forst.

1. **Pometia pinnata** Forst. forma **acuminata** (Hook f.) Jacobs.

   kasai (M.), *repangah* (Mil. Daro).

   I Div.: Setapok F.R. *2469;* III Div.: Igan *686,* Loba Kabang P.F. *2621, 2672,* Singat *9732.*

   Tree, 24–36 ins. g., frequent and localised on shallow peat in P.C. 1 near coastal margins of swamps. A smaller form, 6–10 ins. g., is found near inland margins of peat swamps where it flowers and fruits as a small tree, 6–10 ins. g., in the understorey.

Xerospermum Blume.

1. **Xerospermum muricatum** (Griff.) Radlk.

   tundum biawak (Mil.), *buah laup.*

   II Div.: Triso P.F. *9801, 3113,* Saribas F.R. *8556, 8521;* III Div.: Sg. Nangar *12255, 12311,* Loba Kabang P.F. *2700,* Pulau Bruit *9240, 2646, 9007,* Lassa P.F. *12435;* IV Div.: Sg. Dua *4116, 4152;* V Div.: Kayangeran F.R. *1554;* Brunei: Badas *2140.*

   Small tree, 12–24 ins. g., frequently smaller, occasional in P.C. 1 throughout Sarawak and Brunei, also recorded in L.D.F. in Brunei.

   Fruit edible, rather similar in taste to the cultivated *rambutan.*

ANACARDIACEAE

Androtium Stapf.

1. **Androtium astylum** Stapf.

   merambang (Iban).

   III Div.: Loba Kabang P.F. *2613, 2735, 443, 2720.*

   Small tree, 12–24 ins. g.; occasional in P.C. 4 in Rejang Delta and Baram.

   The only closely matching specimen seen is *7939* (*Kostermans*) from Borneo.

Buchanania Spreng.

1. **Buchanania arborescens** Bl. var. **florida.**

III Div.: Loba Kabang P.F. *859;* IV Div.: Sungei Dua *4155.*
Small tree, 18–24 ins. g., rare and confined to P.C. 1. As yet only recorded from the Rejang Delta and Baram, but occurs as a riparian tree in Brunei. Only sterile collections have been made.

Campnosperma Thw.

1. **Campnosperma coriacea** (Jack) Hallier f. ex v. Steenis.

terentang.

III Div.: Loba Kabang P.F. *861,* Pulau Bruit P.F. *8011, 9209;* IV Div.: Miri *1413.*
Conspicuous large tree, 72–84 ins. g.; occasional in P.C. 1, locally abundant near coastal margin of peat swamps, also occurs locally in P.C. 4; throughout Sarawak and Brunei.

2. **Campnosperma montana** Lauterbach (*C. squamatum* Ridley et *C. minus* Corn.).

terentang.

III Div.: Loba Kabang P.F. *2686, 667, 691, 2790, 537, 2686;* IV Div.: Sg. Dua *2897.*
Small tree, 12–24 ins. g., occasional and local in P.C.s 1–3 in the Rejang Delta and Baram.
Specimen in Kew: *3196* (*Haviland*) Type—A.

Mangifera L.

1. **Mangifera havilandi** Ridley.

buah raba (M.).

III Div.: Loba Kabang P.F. *2713, 513, 464.*
Small tree, 12–24 ins. g., rare and local in P.C. 1. Recorded in peat swamp forest in only the Loba Kabang P.F., but also noted in heath forest in Setapok F.R. (I Div.) and Brunei.
The exceptionally long petioles are distinctive.
Specimen in Kew: *3368* (*Haviland*), Type—A.

Melanorrhoea Wall.

1. **Melanorrhoea beccarii** Engl.

rengas paya.

III Div.: Loba Kabang P.F. *418, 481, 666, 7289, 495, 499, 885,* Sungei Retus *A 57,* Lassa *12434.*
Large tree, 120–132 ins. g., frequent in all forest types, except P.C.s 5 and 6, near inland margin of peat swamps, but absent or very rare in coastal swamps; throughout Sarawak and Brunei, also occurs in heath forest.
Specimen in Kew: *1484* (*Beccari*), Type—A.

2. **Melanorrhoea tricolor** Ridley.

rengas paya.

II Div.: Lingga *5316;* III Div.: Daro F.R. *9758,* Loba Kabang P.F. *754, 2788, 668, 422,* Lassa *12433,* Naman *9758.*

Large tree, 120–132 ins. g., occasional in all forest types near inland margin of peat swamps, except P.C.s 5 and 6, but absent or very rare in coastal swamps except in Tatau P.F. Distribution is confined to II and III Divs., and Bintulu District of IV Div.

This species is often confused with *Melanorrhoea beccarii.* On field characters they are almost identical but the slightly larger and more coriaceous leaves with more pronounced venation, especially in immature leaves, distinguishes this species.

Specimen in Kew: *2231* (*Haviland*), Type—A.

3. **Melanorrhoea speciosa** Ridley.

rengas bulu.

II Div.: Tj. Keranji *12883;* III Div.: Loba Kabang P.F. *2710, 2787.*

Medium-sized tree, 60–72 ins. g.; rare in P.C.s 1 and 2. Recorded in peat swamps from the Rejang Delta and Saribas and in heath forest in Brunei.

Specimen in Kew: *3247* (*Haviland*), Type—B.

Parishia Hook. f.

1. **Parishia insignis** Hook. f.

upi paya.

II Div.: Triso *9802, 12862, 3117,* Tj. Keranji, *12249, 12885,* Lingga *5315.*

Large tree, up to 96 ins. g., similar in habit and habitat to *P. sericea* but recorded only from the Maludam Peninsula in II Div. It may be easily distinguished by the longer leaflets with more pronounced midrib and venation.

2. **Parishia sericea** Ridley.

upi paya, rengas susu.

III Div.: Loba Kabang P.F. *471, 2751, A 76;* IV Div.: Bintulu *262;* V Div.: *1772.*

Very large tree, 120–132 ins. g., with large ascending buttresses to a height of 12 ft. or more. Occasional, locally frequent, in P.C. 1; throughout Sarawak and Brunei.

Swintonia Griff.

1. **Swintonia glauca** Engl.

petoh, selan petoh, tilong, sikat (Mil.).

III Div.: Loba Kabang P.F. *886, 2607, 665, 421, 660,* Oya Mukah P.F. *A 184,* Lassa *12429.*

Medium-sized tree, 60–72 ins. g., with characteristic, very smooth, pinkish brown bark. Frequent and local in P.C.s 1 and 2 towards the inland margin of swamps. Recorded only from the Rejang Delta and Mukah District in peat swamps, though known to occur elsewhere in heath forests.

Specimens in Kew: *366*, Type, *1085* (*Beccari*)—A.

CONNARACEAE

Connarus L.

1. **Connarus semidecandrus** Jack.

III Div.: Pulau Bruit *7944, 7922;* IV Div.: Sg. Dua *4193.*

Twining climber or scandent shrub frequent in understorey of P.C. 1 throughout Sarawak and Brunei.

Ellipanthus Hook. f.

1. **Ellipanthus tomentosus** Kurz. ssp. **tomentosus.**

kelin (Mil. Matu).

III Div.: Daro F.R. *5238, 9721,* Pulau Bruit *9275, 9294.*

Small tree, 4–12 ins. g., rare and local in P.C. 1. Recorded from only the Rejang Delta.

Rourea Aubl.

1. **Rourea mimosoides** (Vahl) Planch. forma **mimosoides** Leenhouts.

II Div.: Triso *10022.*

Distinctive medium-sized climber, occasionally attaining crowns of dominants, occasional in P.C. 1 throughout Sarawak and Brunei.

No fertile specimens have yet been collected.

LEGUMINOSAE

(Sub-family **Caesalpiniaceae**)

Copaifera

1. **Copaifera palustris** (Sym.) De Wit.

sepetir paya, petir paya, tepih (Mil.).

II Div.: Sg. Tissak *3193,* Saribas F.R. *8565;* III Div.: Pulau Bruit *453, 2624, 501, 454, A 27,* Loba Kabang P.F. *2779,* Daro F.R. *5219;* IV Div.: Miri *1210.*

Large tree, 84–96 ins. g., occasional, locally frequent, in P.C.s 1 and 2 throughout Sarawak and Brunei.

Dialium L.

1. **Dialium laurinum** Baker.

keranji paya (M. and I.), *cham* (Mil. Oya).

II Div.: Triso P.F. *3104;* III Div.: Lepah P.F. *8073,* Daro F.R. *9743,* Loba Kabang P.F. *757, 2725, A 80, 491.*

Medium-sized tree, 48–60 ins. g., rather rare in P.C. 1; throughout Sarawak and Brunei.

Koompassia Maing.

1. **Koompassia malaccensis** Benth.

menggris.

II Div.: Triso P.F. *9804.*

Very large tree, 108–144 ins. g., one of the giants of peat swamp forest, occasional and usually rather localised near coastal perimeter of P.C. 1, throughout Sarawak and Brunei. Also occurs in heath forest and on ridges and terraces.

Phanera Lour.

1. **Phanera moultonii** (Merr.) De Wit var. **moultonii**.

II Div.: Simanggang *14573.*

Medium-sized climber, occasionally reaching upper canopy, rare in P.C.s 1 and 2, throughout Sarawak and Brunei. Occurs more frequently in heath forests.

Sindora Miq.

1. **Sindora leiocarpa** Backer ex K. Heyne.

tapar hantu.

III Div.: Sg. Empawah *A 111,* Loba Kabang P.F. *529, 424,* Pulau Bruit *A 4, 7911.*

Tree, 24–36 ins. g., but individuals up to 50 ins. g., have been recorded, occasional in P.C. 1 throughout Sarawak and Brunei. Also recorded in heath forest.

LEGUMINOSAE

(Sub-family **Mimosaceae**)

Adenanthera Linn.

1. **Adenanthera pavonina** Linn.

saga.

III Div.: Loba Kabang P.F. *900;* V Div.: Kayangeran F.R. *4909.*

Tree, 20–30 ins. g., rare in P.C. 1 throughout Sarawak and Brunei

Parkia R. Br.

1. **Parkia singularis** Miq.

III Div.: Loba Kabang P.F. *8889* (Brooke), *2705,* Pulau Bruit *8051.*

Medium-sized tree, 48–60 ins. g., rare and localised in P.C. 1. Recorded from the Rejang Delta and Batang Lupar in peat swamps but also occurs in heath forest.

Pithecellobium Mart.

1. **Pithecellobium borneense** Benth.

jiring paya, petai belalang.

III Div.: Lepah P.F. *8097,* Pulau Bruit *9008, 9253,* Loba Kabang P.F. *414;* IV Div.: Sg. Dua *4163, 2864;* Brunei: Badas *2838.*

Small tree of the understorey, 9–15 ins. g., occasional, locally frequent, in P.C.s 1–3 throughout Sarawak and Brunei; also occurs in heath forest.

ROSACEAE

Parastemon A. DC.

1. **Parastemon spicatum** Ridley.

ngilas padang.

II Div.: Sg. Tissak *3190, 3151;* III Div.: Pulau Bruit *9056,* Loba Kabang P.F. *440, 658;* IV Div.: Lobok Pasir *9885, 8497,* Sg. Dua *3276, 4169, 2898;* Brunei: Badas *2833, 2816;* V Div.: Lawas *1511.*

Small to medium-sized tree, 24–36 ins. g., occasionally larger, abundant in P.C.s 4–6 throughout Sarawak and Brunei; also one of the commonest small trees of heath forests.

Specimens of this species are frequently confused with *P. urophyllum.*

2. **Parastemon urophyllum** A. DC.

ngilas, mendailas (Brunei).

II Div.: Triso *9803;* III Div.: Sg. Nangar *12306,* Loba Kabang P.F. *423.*

Large tree, 72–84 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei.

Pygeum Gaertn.

1. **Pygeum parviflorum** Teijsm and Binn.

enteli (I.), *akil* (Mil. Rejang).

II Div.: Saribas *12402, 12879;* III Div.: Daro F.R. *12437,* Loba Kabang P.F. *2602, 2731, 2778, 426;* IV Div.: Baram *4173.*

Small tree, 12–18 ins. g., frequent in P.C.s 3 and 4 in the Rejang Delta and rare in Baram; throughout Sarawak and Brunei.

RHIZOPHORACEAE

Carallia Roxb.

1. **Carallia brachiata** (Lour.) Merr.

rabong (Mil.).

III Div.: Sg. Nangar *12256,* Pulau Bruit *9050, 9286, 2640, 8021,* Lepah P.F. *8085;* V Div.: Lawas *9116.*

Small tree, 12–24 ins. g., occasional in P.C. 1, and generally confined to coastal margin; throughout Sarawak and Brunei. Also occurs in heath forest.

Combretocarpus Hook. f.

1. **Combretocarpus rotundatus** (Miq.) Dans.

keruntum, perepat paya.

II Div.: Sabu F.R. *3206;* III Div.: Pasai *A 126,* Lassa P.F. *A 9,* Loba Kabang P.F. *9067.*

Medium-sized to large tree, 72–84 ins. g., frequent, locally abundant, in P.C.s 2–6. It is the dominant species of P.C. 6, where it occurs as a small stunted tree, 12–30 ins. g., and 20 to 40 ft. h. Occurs throughout Sarawak and Brunei, and is also a characteristic species of many heath forests.

Specimen in Kew: Unno. Herb. Hook. Type—A.

MYRTACEAE

Barringtonia Forst.

1. **Barringtonia gitingensis** Elm.

putat paya.

III Div.: Surong Irit *5201,* Naman F.R. *9184.*

Small tree, 6–12 ins. g., rare in understorey of P.C. 1. Recorded in peat swamps from only the Rejang Delta, but occurs in L.D.F. in Brunei.

Eugenia Mich. ex L.

1. **Eugenia cerina** Hend.

III Div.: Loba Kabang P.F. *2612, 2766;* IV Div.: Bakong *3265, 4154;* Brunei: *Badas 2856.*

Small tree, 18–36 ins. g., with distinctive coriaceous glossy foliage, occasional in P.C. 4 in the Rejang Delta, Baram and Brunei.

2. **Eugenia christmannii** Merr. & Perry.

III Div.: Naman F.R. *675,* Surong Irit *9703,* Loba Kabang P.F. *856, 2708, 532, 876,* Pulau Bruit *2623, 9276;* Brunei: Badas *2855.*

Medium-sized tree, 36–48 ins. g., occasional in P.C. 1 and 2; throughout Sarawak and Brunei.

3. **Eugenia** aff. **havilandii** Merr.

II Div.: Triso P.F. *3166, 3103, 12866, 3204,* Saribas F.R. *8555;* III Div.: Pulau Bruit *4966, 3258, 9251, 7902, 4968, 9023, 2659, 9207, 2658, 9274, 5153,* Loba Kabang P.F. *467, 2741,* Matu Daro P.F. *12318, 12253.*

Small to medium-sized tree, occasional in P.C. 1 in Batang Lupar and the Rejang Delta. Recorded in heath forest in Brunei.

4. **Eugenia incarnata** Elm.

II Div.: Triso P.F. *3203,* Sg. Tissak *3191,* Loba Kabang P.F. *2763, 438, 864,* Pulau Bruit *7913;* IV Div.: Sg. Dua *3278, 3170, 2890;* V Div.: Lawas *2017.*

Medium-sized tree, 36–48 ins. g., occasional, locally frequent, in P.C.s 1 and 2; throughout Sarawak and Brunei.

5. **Eugenia lineata** Duthie.

I Div.: Setapok F.R. *9577;* III Div.: Singat *9746,* Pulau Bruit *4972.*

Small to medium-sized tree, 24–36 ins. g., rare in P.C. 1; recorded from Setapok F.R. and Rejang Delta.

6. **Eugenia** aff. **luzonensis** Merr.

II Div.: Saribas F.R. *8502;* III Div.: Pulau Bruit *9004, 8020, 9270.*

Small tree, 12–18 ins. g., occasional in P.C. 1 close to coastal perimeter of swamps, on shallow peat transitional from mangrove. Recorded from the Rejang Delta and Saribas.

7. **Eugenia nemestrina** M. R. Hend.

ubah jankar.

II Div.: Triso P.F. *12860, 3186;* III Div.: Loba Kabang P.F. *2717, 461,* Naman F.R. *682,* Surong Irit *9705;* IV Div.: Sg. Dua *4175.*

Medium-sized tree, 48–60 ins. g., occasional in P.C.s 1 and 2; throughout Sarawak and Brunei. A distinctive species with conspicuous stilt roots.

8. **Eugenia spicata** Lamk. (*Eugenia zeylanica* (L.) Wight).

II Div.: Ng. Skrang, *9821;* III Div.: Loba Kabang P.F. *409, 2727, 1594,* Pulau Bruit *9263;* IV Div.: Bintulu *9891;* V Div.: Kuala Lawas *9115.*

Small to medium-sized tree, 36–48 ins. g., occasional in P.C. 1 especially near the coast, where it flowers and fruits as a small tree 10–15 ft. h. Occurs throughout Sarawak and Brunei.

9. **Eugenia verticilligera** Rid.

II Div.: Triso *9791;* III Div.: Loba Kabang P.F. *2715, 2711.*

Medium-sized tree, 48–60 ins. g., occasional in P.C. 1 in the Rejang Delta.

10. **Eugenia** sp. (*2615*).

ubah padang.

III Div.: Loba Kabang P.F. *2615, 1595.*

Small tree, 12–24 ins. g., with distinctive foliage, occasional in P.C. 4 in the Rejang Delta and Baram. Occurs in heath forest in Brunei.

11. **Eugenia** sp. (*479*).

III Div.: Loba Kabang P.F. *479, 2738, 2732, 883;* V Div.: Kayangeran F.R. *2850.*

Small tree, 18–36 ins. g., rare in P.C. 1 and recorded from only the two mentioned localities.

12. **Eugenia** sp. (*2822*).

kelat jambu (M. Brunei).

V Div.: Kayangeran F.R. *4903;* Brunei: Badas *2822.*

Small tree, 12–24 ins. g., rare in *sempilor* forests of Lawas District and abundant in P.C. 4 at Badas, Brunei. Recorded from only northern Sarawak and Brunei, where it also occurs in heath forest.

Tristania R. Br.

1. **Tristania grandifolia** Ridley.

tekoyong-tekoyong (M. Lawas), *jinggau* (I.).

II Div.: Triso P.F. *14572;* III Div.: Loba Kabang P.F. *2695;* V Div.: Kayangeran F.R. *1555, 1797.*

Medium-sized tree, 24–36 ins. g., occasional in P.C.s 1 and 2, and abundant in Lawas swamps. Occurs throughout Sarawak and Brunei.

Specimen in Kew: *2489* (*Beccari*), Type—A.

2. **Tristania aff. maingayi** Duthie.

selunsor.

II Div.: Triso P.F. *3171, 14561;* IV Div.: *9880, 4161.*

Medium-sized tree, 24–36 ins. g., frequent, locally abundant in P.C.s 4 and 5. Recorded in swamps only from Batang Lupar and Baram; absent from extensive pole forests in the Rejang Delta. A common species in heath forests.

3. **Tristania obovata** R. Br.

selunsor.

II Div.: Triso P.F. *3172;* III Div.: Loba Kabang P.F. *656, 446.*

Medium-sized tree, 48–60 ins. g., frequent, locally abundant, in P.C.s 4 and 5 throughout Sarawak and Brunei; also occurs in heath forest and on degraded soils.

Specimen in Kew: *1955* (*Haviland*)—B.

MELASTOMACEAE

Dactylocladus Oliv.

1. **Dactylocladus stenostachys** Oliv.

jongkong, medang jongkong, merebong (Bintulu), *medang tabak* (Brunei).

II Div.: Saribas F.R. *8541;* III Div.: Lepah P.F. *8074,* Sg. Retus *A 18,* Loba Kabang P.F. *1596,* Naman F.R. *673, A 6, 9174,* Pulau Bruit *9261, 9017,* Matu Daro P.F. *12269;* IV Div.: Sg. Dua *2879, 4191;* V Div.: Kayangeran F.R. *2031.*

Very large tree, girths exceeding 168 ins. have been recorded. One of the most characteristic species of swamp forest. The only species that is represented in all communities; throughout Sarawak and Brunei.

Specimen in Kew: *3272* (*Beccari*) Type, *2916* (*Haviland*)—A.

Kibessia DC.

1. **Kibessia coriacea** Cogn.

III Div.: Loba Kabang P.F. *2606, 2806.*

Small tree, 12–24 ins. g., rare and local in P.C. 2. Recorded from the Loba Kabang P.F. and Naman F.R. in the Rejang Delta.

Specimens in Kew: *3324* (*Beccari*) Type, *dmrc, 972, 1753* (*Haviland*)—A.

Medinilla Gaud.

1. **Medinilla hasseltii** Bl.

III Div.: Loba Kabang P.F. *2814.*

Creeper, locally abundant in P.C. 4 in the Rejang Delta and Baram.

Specimens in Kew: *4167, cllq* (*Haviland*)—B.

2. **Medinilla laxiflora** Ridley.

II Div.: Sg. Tissak *3195,* Saribas F.R. *8535;* III Div.: Naman F.R. *8951,* Pulau Bruit *8025,* Lepah P.F. *8098.*

Epiphyte on small trees or poles, between heights of 3 and 15 ft. from ground, frequent in P.C. 1; throughout Sarawak and Brunei.

3. **Medinilla scandens** King.

III Div.: Loba Kabang P.F. *2810, 79331* (W.-S.).

Small creeper, frequent on pneumatophores, buttresses and protruding roots in P.C. 1. Recorded from the Rejang Delta and Batang Lupar.

4. **Medinilla** sp. (*2029*).

III Div.: Rantau Panjang *9867*, Naman F.R. *12442;* V Div.: Kayangeran F.R. *2029*.

Epiphytic shrub, rare in P.C. 1. Recorded from the Rejang Delta, Brunei and Lawas.

5. **Medinilla** sp. (*9025*).

III Div.: Pulau Bruit *9025*, Daro F.R. *9724;* IV Div.: Sg. Dua *4122*.

Epiphyte or epiphytic shrub in understorey of P.C. 1. Recorded from the Rejang Delta and Baram.

Marumia Bl.

1. **Marumia nemorosa** Bl.

III Div.: Naman F.R. *9765*.

Climber in understorey of P.C. 1. Recorded from only the one locality.

Pogonanthera Bl.

1. **Pogonanthera pulverulenta** Bl.

II Div.: Simanggang *9430*, Triso P.F. *12220;* III Div.: Daro F.R. *9723*, Pulau Bruit *7916*.

Epiphytic shrub at heights of from 3 to 15 ft. in understorey of P.C. 1. Occurs throughout Sarawak and Brunei.

CUCURBITACEAE

Bryonopsis Arn.

1. **Bryonopsis laciniosa** (L.) Naud.

III Div.: Daro F.R. *5241*.

Low climber, very rare in primary peat-swamp forest, but occasional in secondary forest, especially in open areas near rail lines following logging. Occurs throughout Sarawak and Brunei.

ARALIACEAE

Arthrophyllum Blume.

1. **Arthrophyllum diversifolium** Bl.

III Div.: Loba Kabang P.F. *2666;* V Div.: Kayangeran F.R. *2032*.

Small tree of the understorey, 6–8 ins. g., rare. Recorded only from the Rejang Delta and Lawas District; also occurs in heath forest.

2. **Arthrophyllum rubiginosum** Ridley.

III Div.: Loba Kabang P.F. *662, 2622;* IV Div.: Miri, Sungei Dua *4174.*

Small tree, 12–18 ins. g., with conspicuous rufous shoots and young leaves; rare in P.C.s 4 and 5 in Rejang Delta and Baram; also recorded from Saribas F.R.

Specimen in Kew: *591* (*Hose*), Type—A.

Schefflera Forst.

1. **Schefflera ridleyi** (King) Viguier.

III Div.: Pulau Bruit *9046;* V Div.: Kuala Lawas *9113.*

Distinctive sun epiphyte in crowns of large trees, rare and confined to P.C. 1; throughout Sarawak and Brunei.

2. **Schefflera subulata** (Seem) Viguier.

I Div.: Lundu *9144;* II Div.: Sg. Tissak *2143;* III Div.: Surong Irit *5211;* IV Div.: Sg. Dua *9/1956.*

Shrub, or climbing shrub to height of 15 ft., in P.C.s 1–3. Recorded from I to IV Divs.

CORNACEAE

Alangium Lam.

1. **A'angium havilandii** Bloemb.

midong (I.), *jadam* (M.), *dadam* (Mil.).

II Div.: Saribas F.R. *8531;* III Div.: Loba Kabang P.F. *695, 459, 530,* Pulau Bruit P.F. *12868, 9218, 5114, 2629, 8067,* Daro F.R. *9702, 5224,* Sg. Nangar *12302.*

Small to medium-sized tree, 36–48 ins. g., with conspicuous spreading stilt roots; occasional in P.C. 1, throughout Sarawak and Brunei.

Specimen in Kew: *3285, 3019* (*Haviland*), Type—A.

RUBIACEAE

Argostemma Wall.

1. **Argostemma psychotrioides** Ridl.

III Div.: Naman F.R. *8954,* Loba Kabang P.F. *2801.*

Small herb, occasional, locally frequent (Naman F.R.), on pneumatophores and roots above surface of swamp in P.C.s 1 and 2. Recorded from the Batang Lupar and the Rejang Delta, but probably occurs throughout the two territories.

2. **Argostemma psychotrioides** Ridl. var.

III Div.: Singat *9070,* Sg. Kalaparan *8502* (Brooke).

Small herb, rare and localised in P.C. 1 in the Rejang Delta. The status of this species or variant is uncertain. It is distinguished from 1 primarily by its minute size.

Canthium Lam.

1. **Canthium didymum** (Bedd.) Gaertn. f.

janang.

III Div.: Loba Kabang P.F. *880, 485;* V Div.: Kayangeran F.R. *1560, 2025.*

Small tree, 18–24 ins. g., occasional in P.C.s 1 and 2 throughout Sarawak and Brunei; also occurs in heath forest.

2. **Canthium umbellatum** (Benth. & Hook f.) Wight.

tulang ular.

II Div.: Sg. Tissak *2384;* III Div.: Naman F.R. *9761,* Pulau Bruit *9231, 2643, 9016,* Lassa P.F. *12424.*

Small tree of the understorey, 6–12 ins. g., rare in P.C. 1 and recorded from only the Batang Lupar and the Rejang Deta.

Gaertnera Lam.

1. **Gaertnera borneensis** Val. ex Winkler.

III Div.: Loba Kabang P.F. *2794, 435;* Brunei: Badas *5659.*

Small tree, 10–15 ft. h., frequently little more than an erect shrub, occasional in P.C.s 1 and 2 throughout Sarawak and Brunei; also of frequent occurrence in heath forests.

Gardenia Ellis.

1. **Gardenia pterocalyx** Val.

benah (Mil.), *malau, sulong* (M. Lawas).

II Div.: Triso *9797;* III Div.: Pulau Bruit *9026, 9228, 8034, 4976,* Sg. Nangar *12265;* IV Div.: Sg. Dua *2886;* V Div.: Kayangeran F.R. *1562.*

Small to medium-sized tree, 24–30 ins. g., occasional, locally frequent (Sg. Dua, Baram) in P.C. 3, rare in P.C.s 1 and 2; throughout Sarawak and Brunei. Also occurs in heath forest and L.D.F. (Brunei). The sticky excrescence on the buds is used to cement parang handles.

Hedyotis Linn.

1. **Hedyotis tenelliflora** Bl.

III Div.: Loba Kabang P.F. *2795, 2796.*

Slender woody creeper on litter layer and on base of lower boles of trees, occasional in P.C. 4. Recorded from the Batang Lupar and Rejang Delta.

Hydnophytum Jack.

1. **Hydnophytum formicarum** Jack.

II Div.: Triso P.F. *10024.*

Myrmecophilous epiphyte on small trees in understorey of P.C.s 3 and 6.

Ixora Linn.

1. **Ixora pyrantha** Brem.

II Div.: Saribas F.R. *8570;* III Div.: Sg. Nangar *12254,* Lassa P.F. *8846,* Pulau Bruit *9205, 9220, 8035;* IV Div.: Sg. Dua *4179, 3273;* Brunei: Anduki F.R. *4942,* Badas *5660.*

Erect shrub, 5–10 ft. h., occasional in P.C. 1, frequent in P.C.s 2 and 3. Occurs throughout Sarawak and Brunei.

Jackia Wall.

1. **Jackia ornata** Wall.

selumar.

III Div.: Pulau Bruit *9236, 8001, A 41,* Loba Kabang P.F. *2792.*

Small tree, 18–36 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei.

Lecananthus Jack.

1. **Lecananthus erubescens** Jack.

II Div.: Saribas F.R. *8523;* III Div.: Pulau Bruit *8016;* IV Div.: Sg. Dua *2869.*

Small root climber on buttresses, roots and at base of trees, may attain a height of 10–15 ft., frequent in P.C. 1 throughout Sarawak and Brunei.

Lucinaea DC.

1. **Lucinaea morinda** DC.

ngulut (Mil.).

II Div.: Triso *9799;* III Div.: Pulau Bruit *5109;* IV Div.: Sg. Dua *2878.*

Small to medium-sized climber, occasionally attaining 100 ft., occasional in P.C. 1 throughout Sarawak and Brunei.

Mussaendopsis Baill.

1. **Mussaendopsis beccariana** Baill.

III Div.: Loba Kabang P.F. *522, 685, 517.*

Medium-sized tree, 36–48 ins. g., with very localised distribution towards inland margin of swamps; occasional in P.C. 1 in the Loba Kabang P.F. and the Naman F.R., and the species has also been recorded at Ng. Skrang in the II Div. Recorded in L.D.F. from Brunei.

Myrmecodia Jack.

1. **Myrmecodia tuberosa** Jack.

IV Div.: Lobok Pasir *9873.*

Myrmecophilous epiphyte, frequent in crowns of *Combretocarpus rotundatus* in P.C. 6; in peat swamps is known to occur only in the Baram, but is a characteristic epiphyte of certain open heath forests.

Nauclea Linn.

1. **Nauclea parva** (Havil.) Merr.

jengkai (M. Pusa).

II Div.: Saribas F.R. *8508,* Triso P.F. *3167;* III Div.: Lepah F.R. *8061,* Pulau Bruit *7941, 9266,* Loba Kabang P.F. *8051;* IV Div.: Sg. Dua *3253, 3167.*

Small tree, 9–18 ins. g., rather rare but widely distributed throughout P.C. 1, in Sarawak from Batang Lupar to the Baram. Occurs in Brunei in secondary forest on degraded soils.

Psychotria Linn.

1. **Psychotria sarmentosa** Bl.

II Div.: Triso *10007;* III Div.: Naman F.R. *9296,* Pulau Bruit *9031,* Loba Kabang P.F. *2809;* IV Div.: Sg. Dua *9441.*

Small creeper on roots and buttresses, occasionally climbing to height of 10 ft., occasional in P.C. 1 throughout Sarawak and Brunei.

2. **Psychotria** sp. (*5213*).

II Div.: Triso *12213;* III Div.: Surong Irit *5213.*

Small straggling climber in understorey, rare and local in P.C. 1; recorded from Maludam Peninsula and Rejang Delta.

Randia Linn.

1. **Randia auriculata** (Hook. f.) K. Schum.

II Div.: Tj Keranji *12410;* III Div.: Pulau Bruit *9203,* Surong Irit *5216.*

Climber to middle-storey, rare in P.C. 1, and recorded from the Rejang Delta and Maludam Peninsula.

2. **Randia dilleniacea** Baill.

II Div.: Tj Keranji *12405;* III Div.: Singat *9738.*

Slender-stemmed climber to height of 120 ft., rare in P.C. 1; recorded from Saribas and Rejang Delta.

3. **Randia** sp. (*7904*).

III Div.: Pulau Bruit *12952, 9288, 7904, 5113,* Sg. Nangar *12259.*

Small tree or erect shrub, 5–18 ft. h. and 3–6 ins. g., recorded only from Pulau Bruit where it is occasional in the understorey of P.C. 1.

Tarenna Gaertn.

1. **Tarenna fragrans** (Bl.) Koord. and Val.

II Div.: Tj Keranji *12882,* Saribas F.R. *8530;* III Div.: Pulau Bruit *9033, 8009, 9257, 8047;* IV Div.: Sg. Dua *4167, 4198;* V Div.: Kayangeran F.R. *2023, 4912, 2845, 2021.*

Erect shrub, 5–10 ft. h., frequent in P.C. 1 throughout Sarawak and Brunei; also occurs in heath forest.

Timonius DC.

1. **Timonius peduncularis** (Wall.) Ridl.

rentap.

II Div.: Triso *9790;* III Div.: Loba Kabang P.F. *430,* Pulau Bruit *9238, 9029, 9285;* IV Div.: Sg. Dua *2892, 2870;* V Div.: Kayangeran F.R. *2019.*

Small tree, 9–18 ins. g., occasional in P.C. 1 and abundant in P.C. 4 throughout Sarawak and Brunei; also one of the commonest species in heath forest.

Uncaria Schreb.

1. **Uncaria ovalifolia** Roxb.

II Div.: Saribas F.R. *8522;* III Div.: Pulau Bruit *7938, 9053, 9045, 9202,* Loba Kabang P.F. *8810;* IV Div.: Sg. Dua *3063.*

One of the largest climbers in swamp forest and probably the most common; abundant in P.C. 1 and occasional in P.C. 2; particularly common in secondary growth following exploitation. Occurs throughout Sarawak and Brunei.

ERICACEAE

Vaccinium L.

1. **Vaccinium borneënse** W. W. Sm.

III Div.: Loba Kabang P.F. *79331* (W.-S.).

Straggling shrub 3 ft. h. in P.C. 4. In peat swamps only recorded from Rejang Delta, but occurs throughout Sarawak and Brunei in heath forests.

MYRSINACEAE

Ardisia Sw.

1. **Ardisia copelandii** Mez.

merajemah.

II Div.: Triso *14503, 12864;* IV Div.: Sg. Dua *4113.*

Small tree, 9–12 ins. g., rare and local in P.C.s 2 and 3. Recorded from II and IV Divs. and Brunei.

2. **Ardisia polyactis** Mez.

II Div.: Sebuyau F.R. *2462;* III Div.: Pulau Bruit *12951, 9273, 8003,* Lepah P.F. *8071, 8092,* Naman F.R. *9167,* Daro F.R. *9062.*

Small tree, 8–15 ft. h. and 4–8 ins. g., occasional in understorey of P.C. 1 in the Rejang Delta, but with the exception of one record in the Sebuyan F.R. it has not been noted elsewhere.

3. **Ardisia** sp. (*9826*).

II Div.: Lingga *9826*, Sg. Tissak *3194;* III Div.: Loba Kabang P.F. *79333* (W.-S.), *2791*.

Straggling shrub, 5–10 ft. h., occasional, locally frequent, in P.C. 4 in Batang Lupar and the Rejang Delta.

Embelia Burm.

1. **Embelia coriacea** Wall.

III Div.: Sg. Nangar *12326*.

Large climber in P.C. 1, recorded from Rejang Delta and Maludam Peninsula.

2. **Embelia pergamacea** A. DC.

II Div.: Triso *10002, 12407*.

Large climber, rare in P.C. 1. Recorded only from Maludam Peninsula.

Grenacheria Mez.

1. **Grenacheria beccariana** Mez.

II Div.: Saribas F.R. *8505, 8553;* III Div.: Pulau Bruit *7918, 9258, 9239;* IV Div.: Sg. Dua *3289, 3055*.

Slender climber to height of 100 ft. or more, rarely a straggling shrub, occasional in P.C.s 1–3 from Batang Lupar to Baram. Not yet recorded from Brunei or V Div.

Labisia Lindl.

1. **Labisia punctata** (Reinw.) Airy-Shaw f. **pumila** (Bl.) Airy-Shaw.

III Div.: Loba Kabang P.F. *1571*.

Small procumbent shrub, frequent, locally abundant, on litter layer in P.C. 4 from Batang Lupar to Baram.

2. **Labisia punctata** (Reinw.) Airy-Shaw f. **punctata**.

II Div.: Triso *3173;* III Div.: Pulau Bruit *8057*.

Short undershrub, stem less than 12 ins., rare, locally occasional, in P.C. 1 in Batang Lupar, Saribas, and the Rejang Delta.

Rapanea Aubl.

1. **Rapanea avenis** (A. DC.) Mez.

II Div.: Triso P.F. *14522*, Sg. Tissak *2346;* III Div.: Loba Kabang P.F. *2610*.

Small tree, 12–24 ins. g., rare in P.C. 4 in the Rejang Delta and Batang Lupar.

2. **Rapanea philippinensis** Mez.

IV Div.: Sg. Dua *3081, 3073, 2881, 9883*.

Shrub, 5–10 ft. h., occasional in P.C. 4 in the Baram. No fertile material has yet been collected.

3. **Rapanea umbellulata** (A. DC.) Mez.

Brunei: Sg. Ayom Ayom *2181;* V Div.: Kayangeran F.R. *2020.*

Small tree, 9–12 ins. g., occasional in P.C. 1 near coastal margin, and in transitional zone from mangrove swamps. Recorded from only Brunei and Lawas.

SAPOTACEAE

Ganua Pierre ex Dubard.

1. **Ganua coriacea** Pierre ex Dubard.

nyatoh ketiau (M.), *nyatoh chabi* (Mil.).

III Div.: Surong Irit *5232,* Loba Kabang P.F. *2692, 512, 875, 526, 545, 2714, 875, 893.*

Medium-sized tree, 24–48 ins. g., frequent, locally abundant (Rejang Delta) in P.C. 1. Occurs throughout Sarawak and Brunei, but is rare east of the Rejang Delta.

2. **Ganua curtisii** (K. and G.) H. J. Lam.

Brunei: Badas *2815.*

Tree, 18–24 ins. g., abundant in understorey of P.C. 3 in the Badas area of Brunei, but not recorded elsewhere in swamps. Occurs in heath forest.

3. **Ganua motleyana** (de Vriesse) Pierre ex Dubard.

ketiau (M.), *skiew* (Mil. Rejang, Matu, Daro).

II Div.: Saribas F.R. *8402;* III Div.: Singat *9737,* Pulau Bruit, *9037, 9222,* Mubong *671,* Sg. Nangar *12317,* Lassa *12900.*

Medium-sized tree, 36–72 ins. g., locally frequent in P.C. 1 on shallow peat near the coast. Occurs throughout Sarawak and Brunei.

Fruit produces an edible oil and is collected for local use and export.

4. **Ganua pierrei** v.d. Assem.

III Div.: Loba Kabang P.F. *469, 2683 534, 2690, 684, 521, 528, 534,* Singat *9737.*

Small to medium-sized tree, 24–36 ins. g., occasional in understorey of P.C. 1 in the Rejang Delta; also recorded from Batang Lupar and Bintulu. Occurs in heath forest in Brunei.

Palaquium Blanco.

1. **Palaquium cochleariifolium** van Royen.

nyatoh jelutong, nyatoh temiang (M. Lingga).

II Div.: Lingga *4809;* III Div.: Loba Kabang P.F. *A 64, 5647, 653, 657, 1531, 432,* Sg. Pak *A 109;* IV Div.: Sg. Dua *2867.*

Medium-sized tree, 36–48 ins. g., occasional in P.C. 3, frequent in P.C.s 4 and 5, throughout Sarawak and Brunei; also occurs in heath forest.

2. **Palaquium leiocarpum** Boerl.

nyatoh rian, jankar.

III Div.: Igan *A 102;* IV Div.: Baram *1289.*

Small to medium-sized tree, 24–48 ins. g., occasional and localised in P.C. 1, preferring the coastal and riparian margins of peat-swamp forest; throughout Sarawak and Brunei; of more frequent occurrence in heath forests.

One of the species that produces the commercial *getah rian.*

3. **Palaquium pseudocuneatum** H. J. Lam.

nyatoh babi.

II Div.: Saribas F.R. *8542;* III Div.: Pulau Bruit *7917, 4962, 9058, 9246, 9256, 4954,* Singat *9733,* Daro F.R. *2627, A 402,* Loba Kabang, P.F. *497, 1526, 2680, 2685, 2759, 854;* IV Div.: Sg. Dua *3279.*

Tree, 36–48 ins. g., occasional, locally frequent, in P.C. 1 throughout Sarawak and Brunei.

4. **Palaquium pseudorostratum** H. J. Lam.

nyatoh babi.

I Div.: Setapok *9084;* II Div.: Triso *9433, 3112, 3165,* Saribas *12336.* Simanggang *9433;* III Div.: Naman F.R. *A 98, A 106,* Loba Kabang P.F. *2678;* V Div.: Meregang *1542.*

Medium-sized to large tree, 72–84 ins., g., occasional and widely distributed in P.C. 1 throughout Sarawak and Brunei. The largest of the *nyatohs.*

There is frequently confusion in differentiating between this and the previous species in the field or from sterile specimens. The length of the petiole and shape of base of the lamina are diagnostic features.

5. **Palaquium ridleyi** King et Gamble.

nyatoh terong, jerabukor.

II Div.: Tissak *2345;* III Div.: Pulau Bruit *801, 9024, 9013, 7921, 8040,* Loba Kabang P.F. *2619, 1520, 441, 680, 874, 546, 2619, 2605;* IV Div.: Sg. Dua *4192, 4172, 4156,* Lobok Pasir *9895;* V Div.: Lawas *1513,* Sg. Panchanak *9117.*

Medium-sized tree, 36–48 ins. g., occasional in P.C. 1, especially towards inland margins, and in P.C.s 2 and 3; widely distributed throughout Sarawak and Brunei, also occurring in heath forest. This species, especially when immature, is liable to be confused with *Palaquium cochleariifolium.*

6. **Palaquium walsurifolium** Pierre.

nyatoh jangkar.

I Div.: Setapok F.R. *4773, 4776,* Lundu *9775;* II Div.: Sedilu F.R. *4782;* III Div.: Loba Kabang P.F. *872, 877, 696, 508, 882,* Sg. Kelapa'an *751,* Pulau Bruit *9735, A 100,* Oya *5302,* Singat *5002, 5218.*

Medium-sized tree, 36–48 ins. g., occasional, locally frequent near inland margins of swamps, in P.C. 1; throughout Sarawak and Brunei.

A distinctive species with numerous spreading stilt roots.

Payena A. DC.

1. **Payena obscura** Burck.

nyatoh padang.

III Div.: Loba Kabang P.F. *2722, 2768, 2618.*

Small tree, 18–30 ins. g., occasional and localised in P.C. 4 in the Rejang Delta.

Planchonella Van Tiegh.

1. **Planchonella maingayi** (Clarke) van Royen.

II Div.: Triso *3205;* III Div.: Pulau Bruit *A 25, 8049.*

Medium-sized to large tree, 60–84 ins. g., rare in P.C. 1 near the coast. Recorded from the Batang Lupar and the Rejang Delta.

EBENACEAE

Diospyros L.

1. **Diospyros elliptifolia** Merr.

balih (Mil.).

II Div.: Saribas F.R. *8537;* III Div.: Pulau Bruit *8048, 7930, 542,* Loba Kabang P.F. *697, 895.*

Small tree, 12–24 ins. g., occasional in P.C.s 1 and 2, and recorded from Batang Lupar, Saribas, Rejang Delta, and Bintulu.

2. **Diospyros evena** Bakh.

merpinang.

II Div.: Tj Keranji *12887,* Triso *14504, 3164, 12871;* III Div.: Pulau Bruit *4971, 4962, 9244, 9010, 7903, 4953,* Daro F.R. *9716, 5004,* Loba Kabang P.F. *483, A 12,* Sg. Nangar *12315;* Brunei: Anduki F.R. *5552,* Badas *2848.*

Small to medium-sized tree, 24–36 ins. g., frequent and widely distributed, occurring in all forest types except P.C. 6, also in heath forest; throughout Sarawak and Brunei.

3. **Diospyros maingayi** (Hiern.) Bakh.

merpinang.

II Div.: Saribas *8403,* Tj Keranji *12888,* Sg. Tissak *2159, 3196, 3197;* III Div.: Loba Kabang P.F. *5052, 79320* (W.-S.), *890.*

Small to medium-sized tree, 24–36 ins. g., occasional, but very localised, in P.C. 1 in the Rejang Delta and Batang Lupar; also occurs in heath forest.

4. **Diospyros pseudomalabarica** Bakh.

kayu malam.

II Div.: Triso *3176;* III Div.: Sg. Nangar *12307,* Pulau Bruit *4963, 9214, 9032, 4955,* Daro *5001,* Loba Kabang P.F. *5051, 507,* Naman F.R. *A 17.*

Medium-sized tree, 48–60 ins. g., frequent in P.C.s 1 and 2, throughout Sarawak and Brunei, also recorded in L.D.F. in Andulau F.R. (Brunei).

OLEACEAE

Linociera Swartz.

1. **Linociera insignis** Clarke.

IV Div.: Sg. Dua *2887;* V Div.: *4914.*

Small tree, 12–24 ins. g., rare in P.C. 1. Recorded from only the Baram and Lawas, but occurs in heath forest in Brunei.

2. **Linociera racemosa** Merr.

III Div.: Pulau Bruit *9042.*

Medium-sized tree, 24–36 ins. g., rare in P.C. 1, and recorded from only Pulau Bruit.

3. **Linociera** sp. (*3282*).

IV Div.: Sg. Dua *1775, 1777, 3282;* Brunei: Anduki *2041;* V Div.: Kayangeran F.R. *4906.*

Small tree, 12–24 ins. g., occasional in P.C.s 2 and 3 and in *sempilor* forest of V Div.; also occurs in heath forest in Brunei.

Myxopyrum Blume.

1. **Myxopyrum ellipticum** A. W. Hill.

III Div.: Naman F.R. *14586;* IV Div.: Sg. Dua *4171,* Lobok Pasir *9878.*

Small to medium-sized climber, occasional in P.C.s 2 and 3. Recorded from III and IV Divs.

APOCYNACEAE

Alstonia Br.

1. **Alstonia spathulata** Blume.

pelai, pulai (M. Brunei), *tembilak purak* (Dusun).

III Div.: Mukah *551, 552,* Pulau Bruit P.F. *A 62, 12441.*

Forest giant, girths may exceed 156 ins. above buttresses. A very conspicuous and frequent tree of swamp forest on the coastal margins, but rare or absent elsewhere; throughout Sarawak and Brunei.

Dyera Hook. f.

1. **Dyera lowii** Hook. f.

jelutong paya.

III Div.: Daro F.R. *9750.*

Large tree, 108–120 ins. g., with prominent pneumatophores; frequent, locally abundant, in P.C. 1, but also occurs, less commonly, in P.C.s 2–4; throughout Sarawak and Brunei.

This species is the most important local source of the commercial chicle used in the manufacture of chewing gum.

Urceola Roxb.

lukut (Mil.).

1. **Urceola brachysepala** Hk. f.

II Div.: Saribas F.R. *8557;* III Div.: Pulau Bruit P.F. *7909, 9225.*

Medium to large-sized climber which reaches the upper storey; occasional in P.C. 1. So far recorded from only II and III Divs., but distribution is probably more widespread.

Kibatalia G. Don.

1. **Kibatalia** sp. (*9300*).

III Div.: Loba Kabang P.F. *79323* (W.-S.), Naman F.R. *9300, 7945, 9181.*

Shrub, 6–12 ft. h., occasional, locally frequent, but confined to P.C.s 2 and 3. Recorded only from the two localities from which specimens have been collected.

Willughbeia Roxb.

1. **Willughbeia coriacea** Wall.

III Div.: Sg. Semup *5124.*

Medium-sized climber in P.C. 1, and recorded from only the one locality.

2. **Willughbeia glaucina** K. Schum.

III Div.: Naman F.R. *9764*.

Medium-sized to large climber in P.C. 1. This species is only definitely recorded from the Rejang Delta, but its distinctive leaves have also been noted on the swamp surface in the Batang Lupar.

ASCLEPIADACEAE

Dischidia R. Br.

1. **Dischidia hirsuta** (Bl.) Dcne.

II Div.: Triso *12856;* III Div.: Pulau Bruit *5110*.

Small climbing epiphyte in crowns of dominants and middle storey trees in P.C. 1. Probably occurs throughout Sarawak and Brunei but only recorded from II and III Divs.

2. **Dischidia nummularia** R. Br.

IV Div.: Lobok Pasir *9871, 4184*.

Small climbing epiphyte, rare in crowns of dominants in P.C. 1, abundant at a low level on boles and crowns of trees and shrubs in P.C. 6; throughout Sarawak and Brunei.

3. **Dischidia rafflesiana** Wall.

IV Div.: Lobok Pasir *9872*.

Small climbing epiphyte, frequent in crowns and on stems of *Combretocarpus rotundatus* in P.C. 6.

Note: Two further *Dischidia* spp. have been collected. Both occur as small climbing epiphytes in crowns of dominants in P.C. 1; their distribution and occurrence is at present incompletely known.

Hoya R. Br.

1. **Hoya coronaria** Bl.

Brunei: Tutong *4140*.

Small climbing epiphyte in understorey of P.C. 6. Large fruits are used by native people in the preparation of a stomach medicine.

2. **Hoya mitrata** Kerr.

II Div.: Saribas F.R. *8534,* Triso P.F. *10015;* IV Div.: Sg. Dua *3062*.

Small twining climber in understorey of P.C. 3, occasional and rather localised. Not yet recorded from the Rejang Delta. The leaves tend to be in pseudo-whorls, which are inhabited by ants.

3. **Hoya** sp. (*9877*).

IV Div.: Lobok Pasir *9877, 4178*.

Climbing epiphyte in understorey of P.C. 6 in Baram.

LOGANIACEAE

Fagraea Thunb.

1. **Fagraea racemosa** Wall.

III Div.: Naman F.R. *9170, 9179, 9756,* Rantau Panjang *9869,* Pulau Bruit *9267, 9237,* Lepah P.F. *8082.*

Small upright shrub, 6–10 ft. h., rare, locally occasional, in P.C. 1 on shallow peat at margins of swamps. Recorded from only the Rejang Delta.

2. **Fagraea litoralis** Bl.

II Div.: Saribas F.R. *8511;* III Div.: Pulau Bruit *8026, 7943.*

Small epiphytic shrub, rare in P.C. 1. Recorded only from the Rejang Delta and Saribas.

CONVOLVULACEAE

Erycibe Roxb.

1. **Erycibe** c.f. **impressa** Hoogl.

meruyan batu.

II Div.: Triso P.F. *10017,* Saribas F.R. *8560;* III Div.: Pulau Bruit *9280.*

Liane, reaching crowns of dominants, occasional in P.C. 1, rare in P.C.s 2 and 3, throughout Sarawak, but not yet recorded from Brunei.

2. **Erycibe** sp. (*4117*).

IV Div.: Sg. Dua *4117.*

Liane in P.C. 2. Recorded from only the one locality.

GESNERIACEAE

Aeschynanthus Jack.

1. **Aeschynanthus hians** C. B. Clarke.

handan haka (I.).

II Div.: Saribas F.R. *8510;* III Div.: Loba Kabang P.F. *2803,* Naman F.R. *9755, 9183.*

Small creeper or low climber, on litter layer and lower stems and buttresses of large trees, but rarely ascending to a height of more than 6 ft.; occasional in P.C. 1 throughout Sarawak and Brunei.

VERBENACEAE

Clerodendron L.

1. **Clerodendron fistulosum** Becc.

III Div.: Naman F.R. *9171, 7946, 9298;* IV Div.: Sg. Dua *2876, 4188.*

Small myrmecophilous herb, rare, locally occasional, in P.C.s 1 and 2; throughout Sarawak and Brunei. Also recorded in heath forest (Bako National Park).

Premna Linn.

1. **Premna** sp. (*9725*).

III Div.: Singat *9725,* Sg. Nangar *12328.*

Medium-sized to large climber, rare in P.C. 1; recorded from only the Rejang Delta.

Vitex Tourn. ex L.

1. **Vitex secundiflora** H. Hallier.

III Div.: Pulau Bruit *2644.*

Medium-sized tree, 24–36 ins. g., very rare in P.C. 1 and recorded from only the mentioned locality.

NEPENTHACEAE

Nepenthes L.

1. **Nepenthes albo-marginata** Lobb. ex Lindl.

III Div.: Loba Kabang P.F. *1586.*

Slender straggling shrub, rare to very rare in P.C. 4 in the Rejang Delta.

2. **Nepenthes ampullaria** Jack.

tuyud.

III Div.: Pulau Bruit *8059;* IV Div.: Sg. Dua *3061;* V Div.: Kayangeran F.R. *2769.*

Climber, which may attain a height of 60–80 ft., rarely procumbent, occasional in P.C.s 1 and 2 throughout Sarawak and Brunei; also occurs in heath forest.

3. **Nepenthes bicalcarata** Hook. f.

tuyud.

II Div.: Saribas F.R. *8533;* III Div.: Loba Kabang P.F. *2820;* IV Div.: Sg. Dua *3064, 3077.*

Large shrubby pitcher plant, occasionally a low climber to a height of 15–20 ft., frequent, locally abundant in P.C.s 2 and 3 throughout Sarawak and Brunei. The largest pitcher plant and a characteristic associate of *Shorea albida.* Pitchers stated to be used occasionally by Ibans as a vessel for boiling rice.

4. **Nepenthes gracilis** Korth.

II Div.: Saribas F.R. *8575;* III Div.: Loba Kabang P.F. *1585;* IV Div.: Sg. Dua *3053, 4199, 3068, 3274, 3267, 4196, 3075, 4180.*

Slender straggling shrub, or low climber to height of 15–20 ft.; frequent, locally abundant, in P.C.s 4–6; also occurs more rarely in all other forest types; throughout Sarawak and Brunei. The pitchers vary very considerably in shape and especially in size. Plants with smallest pitchers being found in infertile central zone of P.C. 6. Abundant in heath forests.

5. **Nepenthes rafflesiana** Jack.

IV Div.: Lubok Pasir *3080, 3056, 2860,* Sg. Dua *3078, 3076.*
Low shrub or slender climber to 10 ft., rare in P.C.s 3 and 4, but frequent in P.C. 6; throughout Sarawak and Brunei. Also found in open heath forest.

PIPERACEAE

Piper Linn.

1 **Piper arborescens** Roxb.

sireh hutan.

III Div.: Pulau Bruït *8019, 5115;* IV Div.: Sg. Dua *4112.*
Slender climber, occasionally forming a dense mass on lower stems of trees to a height of 30 to 40 ft., occasional in P.C. 1. Recorded from the Batang Lupar to the Baram; probably also occurs in Brunei and the V Div.

2. **Piper muricatum** Bl.

II Div.: Ng. Skrang *9823.*
Herb, locally abundant in P.C. 1 towards inland margin of peat swamps. Recorded from the Batang Lupar and Lawas.

3. **Piper** sp. (*2811*).

II Div.: Triso P.F. *10019;* III Div.: Loba Kabang P.F. *2811.*
Small slender climber on buttresses, pneumatophores and at the base of stems of trees; occasional in P.C. 1 throughout Sarawak and Brunei.
Only sterile specimens have been collected.

4. **Piper** sp. (*9234*).

III Div.: Pulau Bruit *9234, 5116.*
Climber, attaining a height of 100 ft. or more, rare in P.C. 1 and recorded from only the Rejang Delta.

MYRISTICACEAE

Gymnacranthera Warb.

1. **Gymnacranthera eugeniifolia** (A. DC.) Sinclair var. **griffithii** (Warb.) Sinclair.

I Div.: Sedilu *9567;* II Div.: Triso P.F. *9584;* III Div.: Loba Kabang P.F. *1583, 2723, 540;* IV Div.: Sg. Dua *3251.*

Small tree, 12–24 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei.

Specimen in Kew: *Gymnacanthera farquhariana*, Herb. E.I. Coy. *4355*, Type—A.

Horsfieldia Willd.

1. **Horsfieldia crassifolia** (Hk. f. et Th.) Warb.

kumpang ensuliue (I. Assan), *kumpang sadara* (Mil. Rejang), *terada'a* (Mil. Oya), *ta'dara* (Mil.).

II Div.: Sg. Tissak *3188;* III Div.: Singat *9738,* Loba Kabang P.F. *2716, 524,* Naman F.R. *672, 688,* Pulau Bruit *9226, 9279, 9028,* Daro F.R. *A 127, 5204,* Sg. Nangar *12325;* Brunei: Badas *2826*.

Medium-sized tree, 36–48 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei. Also occurs in L.D.F.

Specimens in Kew: *865, 1941* (Haviland), Herb. E.I. Coy. *4350*—A.

2. **Horsfieldia carnosa** Warb.

III Div.: Binatang *9739*, Lassa *15955*.

Small tree, 8–12 ins. g., very rare and localised in P.C. 1; probably confined to swamps near banks of freshwater rivers. Recorded from only the Rejang Delta.

Knema Laur.

1. **Knema intermedia** (Bl.) Warb.

II Div.: Sg. Tissak *3184, 3185;* III Div.: Loba Kabang P.F. *412,* Pulau Bruit *7931, 9055, 9039*.

Small tree, 9–18 ins. g., rare in P.C. 1; recorded from the II and III Divs., also recorded in L.D.F. from Brunei.

Specimens in Kew: *ecqc, 1967 (Haviland)*.

2. **Knema kunstleri** (King) Warb. var. **kunstleri**.

kumpang pinggu (I. Assan).

I Div.: Sarawak Mangrove Reserve *7746;* II Div.: Triso *3178,* Saribas F.R. *8518;* III Div.: Sg. Nangar *12252,* Pulau Bruit *2638, 9249, 9019, 8030;* Brunei: Badas *2853,* Anduki F.R. *5551;* V Div.: Kayangeran F.R. *2027, 2842*.

Small tree, 9–18 ins. g., frequent in understorey of P.C.s 1 and 2 throughout Sarawak and Brunei; also occurs in heath forest.

Specimens in Kew: *1761,* Plants of Sarawak *164*.

3. **Knema uliginosa** Sinclair.

III Div.: Loba Kabang P.F. *447, 9893*.

Small tree, 9–12 ins. g., rare and localised in P.C.s 1 and 2. Known from only the one locality.

Myristica L.

1. **Myristica lowiana** King.

kumpang kiong (I. Assan), *kumpang pendarahan* (M.), *kumpang darah* (I.).

III Div.: Lassa P.F. *A 16,* Pulau Bruit *A 128, 9227.*

Distinctive medium-sized tree, 36–48 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei; also occurs in heath forest. Easily identified by its brittle black bark and numerous spreading stilt roots.

Specimen in Kew: Herb. Calcutta *7258,* Type—A.

LAURACEAE

Actinodaphne Nees.

1. **Actinodaphne** aff. **myriantha** Merr.

II Div.: Loba Kabang P.F. *448, 1583.*

Small tree of the understorey, 9–12 ins. g., and 20–30 ft. h., occasional in P.C. 2 in the Loba Kabang P.F. but recorded from only this locality in peat swamps; occurs in heath forest in Brunei.

Specimens in Kew: *1756* (Haviland), Plants of Borneo *21238, 21809.*

Alseodaphne Nees.

1. **Alseodaphne insignis** Gamble.

III Div.: Loba Kabang P.F. *2762, 476, 2694, 889, 404;* IV Div.: Marudi F.R. *8446.*

Medium-sized tree, 36–48 ins. g., occasional in P.C.s 1 and 2 throughout Sarawak and Brunei.

Specimen in Kew: *251* (*Hose*).

2. **Alseodaphne rigida** Kostermans.

medang lui, medang lendir (M. Bintulu).

III Div.: Loba Kabang P.F. *2691, 2687,* Pulau Bruit *2632, 2635,* Mukah *5101* V Div.: Kayangeran; F.R. *4905.*

Medium-sized tree, 36–48 ins. g., occasional, locally frequent, in P.C. 1 throughout Sarawak and Brunei. The slash has a characteristic greasy feel when freshly cut.

Specimens in Kew: Flora B.N.B. *6727, 6219.*

Beilschmiedia Nees.

1. **Beilschmeidia** aff. **maingayi** Hook. f.

II Div.: Triso P.F. *3101.*

Small tree, 12–18 ins. g., rare and recorded from only the Maludam Peninsula in II Div.

Cinnamomum (Tourn.) L.

1. **Cinnamomum javanicum** Bl.

V Div.: Bukit Bubong Rumah *10028*.

Shrub or small tree, 15 ft. h., in peat-swamp forest, recorded only from V Div. at an altitude of 2,000 ft., but occurs more frequently in heath forest and along river banks (Brunei).

2. **Cinnamomum** sp. (*4751*).

medang tiga.

I Div.: Setapok F.R. *4751*.

Shrub or small tree, 10–15 ft. h., confined to inland margin of peat-swamp forests and more frequently found in heath forest. In swamp forest recorded from only I Div.

Cryptocarya R. Br.

1. **Cryptocarya griffithiana** Wight.

II Div.: Tj. Keranji *12880*, Triso P.F. *3114;* III Div.: Pulau Bruit *9282, 9005*, Lepah P.F. *8062*.

Small tree of the understorey, 12–18 ft. h. and 6–9 ins. g., occasional in P.C.s 1 and 2 from Rejang Delta to Batang Lupar.

Dehaasia Blume.

1. **Dehaasia** sp. (*9252*).

I Div.: Setapok F.R. *357;* II Div.: Saribas F.R. *4770;* III Div.: Pulau Bruit *9252, 9262, 9268, 9030, 8006*, Daro F.R. *9748*, Sg. Nangar *12321*.

Small tree of the understorey, 15–20 ft. h. and 6–12 ins. g., occasional and rather localised in P.C. 1 from I to III Divs.

Endiandra R. Br.

1. **Endiandra** sp. (*3252*).

bejubai (Mil.).

III Div.: Loba Kabang P.F. *2701*, Pulau Bruit *2633, 9221;* IV Div.: Baram *3252, 1554*.

Medium-sized tree, 24–36 ins. g., rare in P.C. 1 in Baram and Rejang Delta. Probably an undescribed species.

Unnamed specimen in Kew: *2199* (*Haviland*).

Litsea Lam.

1. **Litsea cylindrocarpa** Gamble.

medang pasir.

III Div.: Loba Kabang P.F. *858, 1580, 1581, 549, 2844*, Pulau Bruit P.F. *2641, 7915, 4970;* V Div.: Kayangeran F.R. *2030*.

Medium-sized tree, 24–36 ins. g., frequent in P.C.s 1 and 2 and abundant in secondary swamp-forest; throughout Sarawak and Brunei. Occurs in heath forest.

Specimens in Kew: *3143* (Beccari), Flora of North Borneo *2385.*

2. **Litsea gracilipes** Hook f.

medang keli.

II Div.: Triso P.F. *3109;* III Div.: Loba Kabang P.F. *2626, 2704,* Daro F.R. *5003,* Lepah P.F. *8088,* Pulau Bruit *4967, 9287, 5101,* Matu Daro P.F. *12262.*

Medium-sized tree, 24–36 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei.

Specimens in Kew: *3326, 3327, 3329, 3330* (*Haviland*)—A.

3. **Litsea grandis** (Wall.) Hook. f.

medang bulu.

II Div.: Saribas F.R. *8532,* Triso P.F. *14520;* III Div.: Loba Kabang P.F. *531, 2760.*

Medium-sized tree, 36–48 ins. g., rather rare in P.C. 1 from Rejang Delta to Batang Lupar, probably also occurs in northern Sarawak and Brunei. Recorded in heath forest in Brunei. Easily identified in the field by its large leaves with dense pubescence on the lower surface.

Specimen in Kew: *2537* (*Beccari*)—A.

4. **Litsea nidularis** Gamble.

I Div.: Setapok F.R. *7726;* II Div.: Triso P.F. *14543, 3107;* III Div.: Lepah P.F. *8070,* Pulau Bruit *5122,* Sg. Nangar *12310.*

Medium-sized tree, 24–36 ins. g., rare in P.C. 1, locally frequent in coastal swamps, from Kuching to the Rejang Delta.

5. **Litsea palustris** Kostermans.

medang padang (Rejang Delta), *medang lada* (Baram), *medang kuning* (Brunei).

II Div.: Lingga *4811, 9819;* III Div.: Pulau Bruit *8053, 8041, 7912,* Sungei Retus *A 22,* Loba Kabang P.F. *427, 664, 79335* (W.-S.); IV Div.: Sg. Dua *1579, 2880, 2893,* Lubok Pasir *4151, 8050, 9894, 9875*; V Div.: Kayangeran F.R. *9197.*

Medium-sized to large tree, 60–72 ins. g., occasionally larger, abundant to very abundant in P.C.s 4, 5 and 6, also occurring less frequently in P.C.s 2 and 3, but largely absent from P.C. 1. In the centre of swamps in the Rejang Delta it is gregarious forming an almost pure forest (in the upper canopy), known as the *padang medang*. Occurs throughout Sarawak and Brunei and is also found in heath forest.

6. **Litsea resinosa** Bl.

medang engkala (M.), *medang tebulus* (Mil. Rejang).

I Div.: Setapok F.R. *9438, 4760;* II Div.: Sebuyau F.R. *4815;* III Div.: Loba Kabang P.F. *474, 2891, 2895,* Pulau Bruit *9036, 4977,* Daro F.R. *9701, 9060, 9752,* Sg. Nangar *12324;* Brunei: Badas *2835;* V Div.: Kayangeran F.R. *4123.*

Distinctive small tree, 12–18 ins. g., frequent in P.C.s 1 and 2 throughout Sarawak and Brunei; also occurs in heath forest.

7. **Litsea** sp. (8520).

medang sekelat.

II Div.: Lingga *9812,* Saribas F.R. *8520,* Sg. Tissak *2343.*

Small tree, 12–18 ins. g., occasional in P.C.s 1 and 2 from the west bank of the Batang Lupar to east bank of the Saribas, but not yet recorded in peat swamps elsewhere in Sarawak or Brunei. Occurs in fresh-water swamp, subject to periodic inundation, in Brunei. A very distinctive little tree with beautiful foliage.

8. **Litsea** sp. (*4121*).

IV Div.: Sg. Dua *4121.*

Small tree, 12–15 ins. g., rare in P.C. 3 in the Baram.

Phoebe Nees.

1. **Phoebe** sp. (*4959*).

II Div.: Saribas F.R. *8538;* III Div.: Pulau Bruit *4959, 2628.*

Small tree, 12–24 ins. g., locally frequent in P.C. 1 from the Rejang Delta to Batang Lupar. Prefers shallow peat on coastal margins, also recorded from heath forest in Brunei.

THYMELIACEAE

Gonystylus Teys. et Binn.

1. **Gonystylus bancanus** (Miq.) Kurz.

ramin, ramin telur, lunak (Mil).

I Div.: Lundu *9622;* II Div.: Triso P.F. *10001,* Lingga *5317;* III Div.: Pulau Bruit *A 21, 8005, 8044,* Naman F.R. *A 5, 9173,* Daro F.R. *5220.*

Large tree, 108–132 ins. g., frequent, in P.C. 1 where it is the most important dominant; occurs also as a smaller tree in P.C.s 2–4; throughout Sarawak and Brunei. The most important economic timber species in peat swamps.

2. **Gonystylus forbesii** Gilg.

ramin batu paya.

II Div.: Sg. Tissak *2349;* III Div.: Pulau Bruit *A 36, 8054,* Daro F.R. *401,* Lepah P.F. *8084,* Lassa P.F. *A 179,* Loba Kabang P.F. *862, 431, 2724;* V Div.: Kayangeran F.R. *4901, 4913.*

Medium-sized tree, 36–48 ins. g., rare and localised in P.C.s 1 and 2; throughout Sarawak and Brunei. Clearly differentiated in the field from the previous species by fluted bole and darker sooty coloured bark.

3. **Gonystylus maingayi** Hook f.

ramin batu.

II Div.: Triso *12861;* Sungei Mukah *553, A 149.*

Large tree, 72–84 ins. g., with a very localised distribution. Occurs in riverain peat swamp forest where peaty streams flow through the swamps and are liable to overflow and flood the adjacent forest. Not yet recorded from northern Sarawak or Brunei, but probably occurs there in similar habitats.

Linostoma Wall.

1. **Linostoma longiflorum** Hall. f.

II Div: Triso *12874;* III Div.: Pulau Bruit *9047.*

Small climber, rare and localised in P.C. 1. Recorded from the Rejang Delta and Maludam Peninsula.

LORANTHACEAE

Dendrophthoë Mart.

1. **Dendrophthoë falcata** Bl.

III Div: Surong Irit *5217.*

Parasite in crowns of *Gonystylus baneanus* in P.C. 1 Recorded from only the one locality.

Lepidaria Van Tiegh.

1. **Lepidaria oviceps** Dans.

chempaka kijangan (Mil.).

III Div.: Daro F.R. *9729, 9714,* Naman F.R. *9175.*

Very distinctive parasitic shrub of crowns of dominants in P.C. 1. Recorded from the Rejang Delta, Batang Lupar and Lawas and probably occurs throughout Sarawak and Brunei.

Macrosolen Blume.

1. **Macrosolen beccarii** Van Tiegh. ex Beccari.

III Div.: Naman F.R. *9763, 11717.*

Parasitic shrub of small trees in understorey of P.C. 1. Recorded from the Rejang Delta, where it is locally frequent.

SANTALACEAE

Henslowia Blume.

1. **Henslowia varians** Bl.

IV Div.: Lobok Pasir *4158.*

Rare parasite on small trees in understorey of P.C. 1 in the Baram.

2. **Henslowia sp.** (*9884*).

IV Div.: Lobok Pasir *9884, 4159.*

Small straggling parasitic shrub, frequent in P.C. 6, and recorded from only IV Div. Also occurs in certain open heath forests (Bako National Park).

EUPHORBIACEAE

Antidesma Burm. ex L.

1. **Antidesma coriaceum** Tul.

III Div.: Naman F.R. *9762,* Loba Kabang P.F. *449, 1773,* Lassa *12416,* Pulau Bruit *5112;* IV Div.: Sg. Dua *2873, 4162, 3059, 4194, 3281.*

Small tree, 15–30 ft. h. and 12–18 ins. g., locally abundant in P.C.s 1–3. Recorded from the Batang Lupar, Rejang Delta and Baram, but probably occurs throughout Sarawak and Brunei.

2. **Antidesma phanerophlebium** Merr.

I Div.: Lundu *9145;* II Div.: Triso P.F. *4768, 3119,* Simanggang *9432,* Saribas F.R. *8503;* III Div.: Loba Kabang P.F. *2668,* Lepah P.F. *8081,* Naman F.R. *9176,* Daro F.R. *5207,* Lassa *8832* (Brooke).

Shrub or small tree, 10–20 ft. h., occasional in understorey of P.C. 1. Recorded from I, II and III Divs.

Baccaurea Lour.

1. **Baccaurea bracteata** Muell.-Arg.

tampoi paya, perak burong (I. Brunei).

I Div.: Lundu *6552;* II Div.: Lingga *9815;* III Div.: Naman F.R. *9782,* Loba Kabang P.F. *419;* IV Div.: Sg. Dua *2888, 2883;* V Div.: Kayangeran F.R. *1553, 1771.*

Small tree, 12–18 ins. g., frequent in P.C.s 1–3 throughout Sarawak and Brunei.

Specimens in Kew: *3185, 3227* (*Beccari*), *brfs* (*Haviland*)—B.

2. **Baccaurea javanica** Muell.-Arg.

I Div.: Lundu *6553, 6555.*

Small tree or shrub, 10–20 ft. h., frequent but very localised in P.C. 1 and recorded from only the one locality.

Blumeodendron Kurz.

1. **Blumeodendron subrotundifolium** Merr.

lemak manok (M.), *mertawa* (I.).

III Div.: Naman F.R. *681,* Daro F.R. *5228.*

Tree, 24–36 ins. g., frequent in P.C. 1 of Rejang Delta, but absent elsewhere. Recorded in heath forests from the Setapok F.R. (I Div.).

Specimens in Kew: *1648* (*Haviland*), *3849* (*Beccari*)—B.

2. **Blumeodendron tokbrai** (Blume) J. J. Sm.

merahbulan (M.), *teku* (Mil.), *umpungan* (M. Kuching and II Div.).

I Div.: Setapok F.R. *4779;* II Div.: Triso *12863,* Saribas F.R. *8515;* III Div.: Pulau Bruit *9235, 9248, 9043, 2655,* Naman F.R. *683,* Daro F.R. *9717.*

Tree, 24–36 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei. Easily identified by its spreading stilt roots and silvery white bark; the latter appearance is caused by lichen growth, the true bark being a dull greyish colour.

Specimen in Kew: *3670* (*Haviland*)—B.

Bridelia Willd.

1. **Bridelia ovata** Decne.

IV Div.: Sg. Dua *3060.*

Scandent shrub, locally frequent in P.C. 2 in the Baram.

Cephalomappa Baill.

1. **Cephalomappa beccariana** Baill.

ahrau.

III Div.: Loba Kabang P.F. *2859, 870, 484.*

Tree, 12–24 ins. g., occasional in P.C.s 2 and 3 in Rejang Delta, but not recorded from elsewhere.

2. **Cephalomappa paludicola** Airy-Shaw.

ahrau (M.), *kayu pelah* (Mil. Oya), *melasau* (I. Lassa), *bantas arau* (I. Assan).

II Div.: Tj. Keranji *12896,* Sebuyau P.F. *4767,* Triso P.F. *2347,* Saribas F.R. *8540;* III Div.: Naman F.R. *8953, 679, 5123,* Daro F.R. *9713, 5235,* Loba Kabang P.F. *1599, 2677, 1600, 2771, 2772.*

Tree, 12–24 ins. g., locally abundant in P.C.s 2 and 3 in Rejang Delta and Batang Lupar, but absent from northern Sarawak and Brunei. In the field the two species of *Cephalomappa* are difficult to differentiate. The young twigs, inflorescence, and petioles and midribs of the leaves of *C. beccariana* are covered in a stellate tomentum, whereas this species is almost glabrous.

Croton L.

1. **Croton laevifolius** Bl.

III Div.: Loba Kabang P.F. *2673,* Daro F.R. *9744.*

Small tree, 6–12 ins. g. and 20–30 ft. h., rare in P.C. 1. Recorded from only the Rejang Delta.

Endospermum Benth.

1. **Endospermum malaccense** Benth. ex Muell.-Arg.

terbulan.

IV Div.: Sg. Dua *3283.*

Tree, 36–48 ins. g., rare in P.C. 1 near coast, but frequent in secondary forest (not peat swamp) at a low level. Occurs throughout Sarawak and Brunei.

Glochidion Forst.

1. **Glochidion lucidum** Bl.

III Div.: Pulau Bruit *2651,* Loba Kabang P.F. *445, 2773, 2674, 2775;* V Div.: Kayangeran F.R. *4907, 4915, 1556.*

Tree, 12–18 ins. g., occasional, locally frequent, in understorey of P.C. 1 throughout Sarawak and Brunei.

2. **Glochidion obscurum** (Willd.) Bl.

III Div.: Pulau Bruit *9002,* Loba Kabang P.F. *2671,* Lepah P.F. *8068.*

Small tree, 15–30 ft. h. and 6–9 ins. g., rare in understorey of P.C. 1. Recorded from only the Rejang Delta, but probably occurs elsewhere in heath forest.

Longetia Baill.

1. **Longetia malayana** (Benth.) Pax. et K. Hoffm.

ubah banir.

II Div.: Saribas F.R. *8571, 8573,* Tj. Keranji *12889;* III Div.: Lassa *12422,* Loba Kabang P.F. *520, 2720, 871, 2736,* Pulau Bruit *2631, 4974, 12897, 9215, 7928, 9049, 9295;* IV Div.: Sg. Dua *4153;* Brunei: *2840.*

Medium-sized tree, 36–48 ins. g., occasional in P.C.s 1 and 4 throughout Sarawak and Brunei. It appears possible that there are two variants of this species; the trees in P.C. 1 are markedly different in field characters from those found in P.C. 4.

Macaranga Thou.

1. **Macaranga caladifolia** Becc.

benuah hutan (M.), tutup (Mil. Rejang).

III Div.: Pulau Bruit *2639,* Loba Kabang P.F. *9285* (Brooke), Naman F.R. *9168,* Lassa *12415.*

Medium-sized tree, 24–36 ins. g., occasional in P.C.s 1–3. Recorded from Batang Lupar, Saribas and Rejang Delta; also occurs in heath forest.

Specimen in Kew: 464 (*Haviland*) Type—A.

2. **Macaranga puncticulata** Gage.

benuah.

IV Div.: Sungei Dua *2899, 3257.*

Tree, 12–24 ins. g., abundant in open secondary swamp forest after felling, but very rare in primary swamp forest. Probably occurs throughout Sarawak and Brunei, but only recorded from the Rejang Delta and Baram.

Neoscortechinia Pax.

1. **Neoscortechinia kingii** (Hook. f.) Pax et Hoffm.

bantas (M.), *mâras* (M. Btg. Lupar), *bantas ketapong* (I.).

II Div.: Saribas F.R. *8528,* Triso P.F. *3179, 3157;* III Div.: Pulau Bruit *8043, 9254, 2642, 2647, 9213,* Loba Kabang P.F. *692, 892, 510.*

Small tree, 12–24 ins. g., abundant in P.C. 1 throughout Sarawak and Brunei.

Specimen in Kew: *1164* (*Beccari*) Type—A.

2. **Neoscortechinia sumatrensis** S. Moore.

V Div.: Kuala Lawas *9112.*

Distinctive variant which has been recorded in peat swamps from V Div., where it is locally frequent in P.C. 1 near the Coast.

Also recorded at Kuala Bakong in the Baram.

URTICACEAE

Poikilospermum Zipp. ex Miq.

1. **Poikilospermum suaveolens** (Bl.) Merr.

II Div.: Saribas F.R. *8566;* III Div. Lassa R. 13.

Distinctive epiphyte, rare in understorey of P.C. 1. Probably occurs throughout Sarawak but recorded in peat swamp from only the mentioned locality and the Rejang Delta.

2. **Poikilospermum microstachys** (Barg.-Petr.) Merr.

akar labat (Mil.).

II Div.: Kpg. Budu *12333,* Saribas F.R. *8552;* III Div.: Pulau Bruit *9272, 8010,* Lepah P.F. *8083,* Naman F.R. *9182.*

Epiphyte, facultative climber, occasional in understorey of P.C. 1; throughout Sarawak and Brunei.

MORACEAE

Artocarpus Forest.

1. **Artocarpus glaucus** Bl.

III Div.: Serupai *27.*

Large tree 96–108 ins. g., locally abundant in P.C. 1 near large streams flowing through the swamps; throughout Sarawak and Brunei.

2. **Artocarpus rigidus** Bl.

pudau.

III Div.: Sg. Assan *502,* Lepah P.F. *10190,* Bukit Lima F.R. *12902.*

Large tree, 72–84 ins. g., rare and rather localised in P.C.s 1 and 2; throughout Sarawak and Brunei.

Ficus Tourn. ex L.

1. **Ficus acamptophylla** Miq.

ara (generic name for all climbing figs).

II Div.: Triso *3118;* III Div.: Daro F.R. *9722.*

Ground rooting epiphyte in crowns of dominants in P.C. 1; throughout Sarawak and Brunei.

2. **Ficus annulata** Bl.

II Div.: Triso *12872.*

Small tree, 15–20 ft. high, in secondary peat swamp forest near coast. Recorded from Rejang Delta, Maludam Peninsula and Bintulu.

3. **Ficus apiocarpa** Miq.

II Div.: Triso *12854;* III Div.: Naman F.R. *5325.*

Climbing fig, rather rare and confined to wetter localities where streams drain through P.C. 1. Recorded from Rejang Delta and Maludam Peninsula.

4. **Ficus callicarpides** Corner.

II Div.: Triso P.F. *9805,* Saribas F.R. *8539;* IV Div.: Sg. Dua *4120, 9890.*

Root climber, usually at low level but occasionally reaching crowns of dominants, very abundant on buttresses and lower stems of *Shorea albida* in P.C. 3, also occasional and localised in P.C. 1. Recorded from Batang Lupar, Rejang Delta and Baram.

5. **Ficus consociata** Bl.

II Div.: Triso *12210, 12222.*

Large ground rooting epiphyte, locally frequent in P.C. 1 throughout Sarawak and Brunei. Also occurs in heath forest.

6. **Ficus crassiramea** Miq.

II Div.: Triso *10/1959* (J.A.R.A.).

Enormous strangling fig, abundant on shallow peat at coastal margins of P.C. 1, and transitional zone from mangrove; throughout Sarawak and Brunei.

7. **Ficus deltoidea** Jack var. **borneensis** Corn.

II Div.: Sg. Tissak *4807;* III Div.: Singat *9754.*

Epiphytic fig at low levels, occasionally terrestrial, rare in P.C. 4; more frequently found in heath forest. Occurs throughout Sarawak and Brunei.

8. **Ficus deltoidea** Jack var. **deltoidea.**

II Div.: Triso P.F. *141514, 12201, 12204;* III Div.: Pulau Bruit *9048,* Sg. Nangar *12312;* IV Div.: Sg. Dua *2871.*

Epiphytic fig in crowns of dominants and middle storey trees, locally abundant in P.C.s 1 and 2; throughout Sarawak and Brunei. Also occurs in heath forest and is terrestrial on rocky headlands.

9. **Ficus deltoidea** Jack var. **motleyana** (Miq.) Corner.

II Div.: Triso *14515;* III Div.: Lassa P.F. *12901,* Loba Kabang P.F. *79330* (W.-S.), *2784;* IV Div.: Bakong *2872,* Sg. Dua *2884.*

Straggling shrub, rarely more than 4 ft. h., locally frequent in P.C. 4 throughout Sarawak and Brunei; also a characteristic species of heath forest.

10. **Ficus disticha** Bl.

II Div.: Tj. Keranji *12892.*

Root climber to canopy in P.C. 1; rare and recorded in peat swamps from only the one locality. More usually a montane species.

11. **Ficus globosa** Bl.

III Div.: Pulau Bruit *12898.*

Medium-sized climber in P.C. 1. Recorded only from the one locality.

12. **Ficus heteropleura** Bl. var. **hirta** Corner.

I Div.: Lundu *9147.*

Climbing fig to height of 100 ft. in P.C. 1; a single record.

13. **Ficus pellucido-punctata** Griff.

III Div.: Surong Irit *9706.*

Strangling fig of dominants in P.C. 1. Recorded from only the Rejang Delta.

14. **Ficus pisocarpa** Bl.

III Div.: Pulau Bruit *5117,* Oya *5301.*

Epiphytic fig in crowns of dominants in P.C. 1; rare and recorded from only the Rejang Delta.

15. **Ficus recurva** Bl.

II Div.: Triso *12867.*

Small climbing fig in understorey of P.C. 1.

16. **Ficus spathulifolia** Corner.

II Div.: Triso *12203;* III Div.: *7933, 8008, 9044, 9232.*

Ground rooting epiphyte, rarely strangling, locally frequent in P.C. 1. Recorded from II and III Divs.

17. **Ficus sumatrana** Miq.

Brunei: Badas *2841.*

Strangling fig in P.C.s 1 and 2, rare. Recorded from Rejang Delta and Brunei.

18. **Ficus sundaica** Bl.

II Div.: Triso *3163,* Saribas *4771,* Sg. Tissak *4808;* II Div.: Pulau Bruit *9229, 8052, 7934, 8014, 9012.*

Large ground rooting epiphyte, occasionally strangling, frequent in P.C. 1 throughout Sarawak and Brunei.

19. **Ficus sundaica** Bl. var. **beccariana** (King) Corner.

II Div.: Triso *12202;* III Div.: Sg. Nangar *12313,* Pulau Bruit *9051.*

Large ground rooting epiphyte, occasionally strangling, rare in P.C. 1. Recorded from Rejang Delta, Saribas and Batang Lupar.

20. **Ficus supperforata** Corner.

III Div.: Daro P.F. *9061,* Pulau Bruit R3.

Climbing (?) fig in P.C. 1. Single record.

21. **Ficus tristaniifolia** Corner.

III Div.: Pulau Bruit *12232, 12231.*

Ground rooting epiphyte, locally frequent in P.C. 1. Recorded from Pulau Bruit and Maludam Peninsula.

22. **Ficus uniglandulosa** Wall. var. **parvifolia** Miq.

II Div.: Triso *12215.*

Epiphytic fig at height of 80 ft. in P.C. 1; single record.

23. **Ficus villosa** Bl.

II Div.: Kpg. Budu *12334,* Simanggang *12226,* Triso *14546.*

Root climber, occasional in understorey of P.C. 1; throughout Sarawak and Brunei. This species shows remarkable dimorphism in foliage.

24. **Ficus xylophylla** Wall.

III Div.: Pulau Bruit *12228, 5118, 12896, 12895.*

Large ground rooting epiphyte, occasionally strangling, locally frequent (Pulau Bruit) in P.C. 1. Recorded from Rejang Delta and Maludam Peninsula.

Parartocarpus Baill.

1. **Parartocarpus venenosus** (Zoll. and Mor.) Becc. ssp. **forbesii** (King) Jarrett.

minggi, katih (I.), *kelidam* (Murut).

III Div.: Daro F.R. *9715, A 7,* Loba Kabang P.F. *2746,* Naman F.R. *A 122,* Lassa *12432,* Sg. Nangar *12309.*

Medium-sized to large tree, 60–72 ins. g., occasional in P.C. 1 throughout Sarawak and Brunei.

CASUARINACEAE

Casuarina Linn.

1. **Casuarina** sp. nov.

rhu ronang, sempilau (Lawas).

V Div.: Kayangeran F.R. *1569.*

Tree, 60–84 ins. g., abundant in association with *Dacrydium elatum.* Distribution in peat-swamp forest confined to north Sarawak and localised areas of Brunei: throughout Sarawak and Brunei, it is a characteristic species of heath forests.

This undescribed species was formerly confused with *Casuarina sumatrana.*

FAGACEAE

Castanopsis Spach.

1. **Castanopsis foxworthyi** Schottky ex Winkler.

berangan paya.

III Div.: Daro F.R. *9753,* Loba Kabang P.F. *442, 477, 881.*

Small tree, 12–20 ins. g., rare and localised in P.C.s 1 and 2. Recorded from only the Rejang Delta.

Lithocarpus Blume.

1. **Lithocarpus rassa** (Miq.) Rehd.

III Div.: Loba Kabang P.F. *515, 2767, 2783, 444.*

Small to medium-sized trees, 24–30 ins. g., occasional in P.C. 2. Recorded from only the Rejang Delta and Maludam Peninsula in peat swamps, but also occurs in heath forest in Brunei.

2. **Lithocarpus** sp. (*9813*).

II Div.: Nanga Skrang, *9824,* Lingga *9813;* III Div.: Loba Kabang P.F. *878, 428, 519, 2780.*

Small tree, 9–18 ins. g., rare in P.C.s 1 and 2 towards the inland margins of swamp forest in Rejang Delta and Batang Lupar.

3. **Lithocarpus sundaicus** (Bl.) Rehd.

empenit padang.

II Div.: Lingga *9814*, Triso *3201;* III Div.: Naman F.R. *678*, Loba Kabang P.F. *2767, 2730, 492;* Brunei: Anduki F.R. *2043*, Badas *5646*.

Small tree, 12–18 ins. g., abundant to very abundant in understorey of P.C.s 2, 3 and 4. A dominant species in the regrowth following logging. Occurs throughout Sarawak and Brunei.

4. **Lithocarpus wenzigianus** (King) A. Camns.

empenit jangkar, penyibong (Mil. Rejang), *kayu kikai* (Mil. Oya, Mukah).

II Div.: Sabu F.R. *3209;* III Div.: Daro F.R. *9720*, Sg. Kelapa'an *5054*, Pulau Bruit *8013*, Surong Irit *5227, 5229*, Mukah *5102*, Loba Kabang P.F. *2709, 538, 2648, 2682*.

Medium-sized tree, 48–60 ins. g., frequent in P.C. 1 throughout Sarawak and Brunei. The largest oak in swamp forest and readily identified in the field by the presence of numerous spreading stilt roots.

II. MONOCOTYLEDONS

ORCHIDACEAE

Adenoncos Blume.

1. **Adenoncos sumatrana** J. J. S.

III Div.: Pulau Bruit *7936*.

Small epiphytic orchid, occasional in crowns of trees, especially on *Gonystylus bancanus*, in P.C. 1.

Appendicula Blume.

1. **Appendicula pendula** Bl.

II Div.: Triso *9808*.

Small epiphytic orchid, on base of small trees, surface roots and pneumatophores in P.C. 1; frequent and localised. Recorded only from the Rejang Delta and Batang Lupar.

Bulbophyllum Thou.

1. **Bulbophyllum beccarii** Rchb. f.

II Div.: Saribas *13258;* III Div.: Loba Kabang P.F. *9192*.

Distinctive epiphytic orchid which spirals round upper boles of large trees, especially *Shorea albida;* occasional in P.C.s 1 and 2 and frequent in P.C. 3; throughout Sarawak and Brunei.

2. **Bulbophyllum** aff. **concinnum** Hook. f.

II Div.: Triso *9806*.

Small epiphytic orchid at heights of between 3 ft. and 10 ft. in P.C. 1; rare and recorded from only the mentioned locality.

3. **Bulbophyllum vaginatum** (Lindl.) Rchb. f.

III Div.: Pulau Bruit *9217,* Sg. Nangar *12267.*

Epiphytic orchid in crowns of trees in P.C. 1, occasional; throughout Sarawak and Brunei.

Cystorchis Blume.

1. **Cystorchis variegata** Bl. var. **purpurea** Ridl.

III Div.: Pulau Bruit *8033;* IV Div.: Sg. Dua *4181.*

Small terrestrial orchid growing in dense shade and preferring damper localities in P.C.s 1 and 2. Occurs throughout Sarawak, but not recorded from Brunei.

Dendrobium Sw.

1. **Dendrobium cumulatum** Lindl.

III Div.: Lepah P.F. *7901,* Matu—Daro P.F. *12275.*

Epiphytic orchid on small trees at heights from 5 to 12 ft. above swamp surface, rare in P.C. 1. Recorded from only the Rejang Delta.

2. **Dendrobium** aff. **merrillii** Ames.

III Div.: Pulau Bruit *7935, 7937, 10618* (Brooke).

Distinctive epiphytic orchid in crowns of trees in P.C. 1; recorded from the Batang Lupar and Rejang Delta.

Dipodium R. Br.

1. **Dipodium pictum** Rchb. f.

I Div.: Telok Sabang *10198;* II Div.: Saribas F.R. *8572;* III Div.: Rantau Panjang *9868.*

Epiphytic orchid at heights from 3 to 10 ft. above swamp surface, rare in P.C. 1.

Eria Lindl.

1. **Eria aff. obliqua** Lindl.

II Div.: Triso *12207, 10008,* Loba Kabang P.F. *9068,* Surong Irit *5223.*

Small epiphytic orchid in crowns of dominant trees, especially *Gonystylus bancanus,* occasional in P.C. 1; throughout Sarawak and Brunei.

2. **Eria pannea Lindl.**

II Div.: Saribas F.R. *8526;* III Div.: Daro F.R. *5223.*

Epiphytic orchid, frequent in crowns of dominants in P.C. 1. Recorded from the Batang Lupar and Rejang Delta.

3. **Eria aff. pulchella Lindl.**

II Div.: Saribas F.R. *8525;* III Div.: Naman F.R. *8952,* Daro F.R. *9065.*

Epiphytic orchid, frequent in crowns of dominants, especially *Gonystylus bancanus,* in P.C. 1; throughout Sarawak and Brunei.

Eulophia R. Br.

1. **Eulophia squalida** Lindl.

II Div.: Triso *12219;* Brunei: Badas *5648*.

Terrestrial or low epiphytic orchid, rare to very rare in P.C.s 1 and 2; throughout Sarawak and Brunei.

Bromheadia Lindl.

1. **Bromheadia finlaysoniana** (Lindl.) Rchb. f.

IV Div.: Lobok Pasir *3074*.

Terrestrial orchid, frequent in P.C. 6. In peat swamp forest, it is confined to this forest type, though it is a characteristic species in open secondary heath forest and on degraded soils.

Grammatophyllum Bl.

1. **Grammatophyllum speciosum** Bl.

lukut gergasi (Mil. Rejang).

III Div.: Matu-Daro P.F. *12276*.

Large epiphytic orchid in crowns of upper and middle storey trees, rare in P.C. 1; throughout Sarawak and Brunei.

Liparis Rich.

1. **Liparis lacerata** Ridl.

III Div.: Pulau Bruit *9255, 9212, 8024,* Naman F.R. *11720, 8955,* Rantau Panjang *9443*.

Epiphytic orchid on small trees at heights from 5 to 20 ft. above swamp surface, rare but widely distributed in P.C. 1; throughout Sarawak and Brunei.

Zeuxine Lindl.

1. **Zeuxine violascens** (Bl.) Ridl.

IV Div.: Sg. Dua *4187*.

Small terrestrial orchid in dense shade in P.C.s 1 and 2, rare and localised. Recorded from I, III and IV Divs.

ZINGIBERACEAE

Alpinia L.

1. **Alpinia** sp. (*8096*).

III Div.: Lepah P.F. *8096*.

Unidentified species, which is found as a low epiphyte in P.C. 1, rare and localised. Recorded from only the Rejang Delta.

Globba L.

1. **Globba panicoides** Miq.

II Div.: Triso *14548, 3175;* III Div.: *8830* (Brooke).

Herb, rare, locally occasional, in P.C. 1, preferring shallow peat near riparian or coastal margins of forest; throughout Sarawak and Brunei.

DIOSCOREACEAE

Dioscorea Blume.

1. **Dioscorea** sp. (*9001*).

III Div.: Pulau Bruit *9001.*

Unidentified low climber in P.C. 1, rare and only recorded from Pulau Bruit.

LILIACEAE

Pleomele Salsb.

1. **Pleomele cantleyi** (Vand.) N.E. Br.

III Div.: Pulau Bruit *8393;* IV Div.: Sungei Dua *3275.*

Straight stemmed shrub, 9–12 ft. h., rare in P.C.s 1–3; throughout Sarawak and Brunei.

FLAGELLARIACEAE

Flagellaria L.

1. **Flagellaria indica** L.

rotan tikus.

I Div.: Setapok F.R. *4754;* III Div.: Loba Kabang P.F. *1573;* IV Div.: Sg. Dua *3071, 9882.*

Small to medium-sized climber, very rare in P.C.s 1–3, occasional in P.C.s 4 and 5 and frequent in P.C. 6. Occurs throughout Sarawak and Brunei.

Hanguana Blume.

1. **Hanguana malayana** (Jack) Merr.

bakong.

III Div.: Pulau Bruit *8060,* Loba Kabang P.F. *2816, 1570.*

Large herb, occasional and localised in P.C.s 1–3, preferring damper localities where the water table is exposed. A much shorter form is frequently found in a slightly drier habitat. Occurs throughout Sarawak and Brunei.

PALMAE

Calamus Linn.

1. **Calamus** sp. (*4788*).

I Div.: Setapok F.R. *4788*.

Rattan palm, occasional in P.C. 1 throughout Sarawak and Brunei.

Cyrtostachys Blume.

1. **Cyrtostachys lacca** Becc.

pinang raja, pinang laka.

III Div.: Lepah P.F. *8099*.

Conspicuous slender palm, attaining a height of 20 ft., abundant on shallow peat in transitional zone from mangrove, also occasional and localised in P.C. 1, and more rarely in P.C.s 2 and 3; throughout Sarawak and Brunei.

Daemonorops Blume.

1. **Daemonorops longipes** Mart.

III Div.: Loba Kabang P.F. *2823*.

Short stemmed palm, occasional in P.C. 1 but rather localised and preferring wetter localities; throughout Sarawak and Brunei.

Iguanura Bl.

1. **Iguanura** sp. (*12246*).

I Div.: Telok Sabong *12246*.

Slender palm, 3–10 ft. h., locally frequent in P.C. 1, preferring shallow peat near coast, though also found inland on peat near streams subject to periodic inundation. Recorded from I, II and III Divs., and probably occurs throughout Sarawak and Brunei.

Korthalsia Blume.

1. **Korthalsia rigida** Bl.

II Div.: Triso P.F. *10027*.

Rottan palm, frequent in P.C.s 2 and 3 and occasional in P.C. 1; throughout Sarawak and Brunei.

Pinanga Bl.

1. **Pinanga** sp. (*12332*).

II Div.: Tanjong Keranji *12332, 12402*.

Small slender palm, 2–6 ft. h., locally occasional in P.C. 1. Recorded from only the Maludam Peninsula.

Plectocomiopsis Becc.

1. **Plectocomiopsis wrayi** Becc.
III Div: Loba Kabang P.F. *5119*.
Rottam palm, occasional in P.C. 1; recorded from only the Rejang Delta.

Zalacca Rumph.

1. **Zalacca conferta** Griff.
asam paya.
Stemless spiny palm which forms dense thickets on shallow peat near the coast, occasional elsewhere in P.C. 1 especially in wetter localities; throughout Sarawak and Brunei.

PANDANACEAE

Pandanus Rumph.

1. **Pandanus andersonii** H. St. John.
pandan, surong nriit.
III Div.: Loba Kabang P.F. *2815, 1588;* V Div.: Lawas no number (Anderson).
Large stemless pandan which frequently forms dense thickets in P.C.s 2 and 3, and occurs more rarely in P.C.s 1 and 4; throughout Sarawak and Brunei.

2. **Pandanus ridleyi** Martelli.
II Div.: Triso *9817,* III Div.: Loba Kabang P.F. *9069;* IV Div.: Sg. Dua *4119.*
Short stemmed pandan occasionally attaining heights of 6–8 ft., rare in P.C.s 3 and 4, becoming abundant in P.C.s 5 and 6.

3. **Pandanus brevifolius** Martelli.
I Div.: Telok Sabong *10199;* II Div.: Triso *12209;* III Div.: Pulau Bruit *8055.*
Small stemless pandan, locally abundant in damper areas of P.C. 1. Not yet recorded east of the Rejang Delta.

Freycinetia Gaud.

1. **Freycinetia** sp. (*14545*).
II Div.: Triso *14545, 14549.*
Small climbing pandan, occasional in understorey of P.C. 1 throughout Sarawak and Brunei.

ARACEAE

Aglaonema Schott.

1. **Aglaonema pictum** (Roxb.) Kunth.
II Div.: Saribas F.R. *8506;* III Div.: Pulau Bruit *8023, 8056,* Loba Kabang P.F. *2812.*

Herb, 9–18 ins. h., occasional in P.C. 1. Recorded only from II and III Divs.

Alocasia Neck.

1. **Alocasia longiloba** Miq.

birah hutan (Mil.).

II Div.: Triso *12218,* Saribas F.R. *8507;* III Div.: Pulau Bruit *9219, 8018;* IV Div.: Sg. Dua *4195.*

Distinctive herb, rare in P.C. 1, occasional and localised in P.C. 2; throughout Sarawak and Brunei.

2. **Alocasia beccarii** Engl.

II Div.: Triso *3174*, Saribas F.R. *8364;* III Div. Naman F.R. *9299.*

Small herb, occasional in P.C.'s 1 & 2. Recorded from only II & III Divs.

Cryptocoryne Fisch.

1. **Cryptocoryne pallidinervia** Engl.

II Div.: Triso *12212;* III Div.: Pulau Bruit *8022.*

Aquatic herb, occasional, locally frequent, in wetter localities of P.C. 1; throughout Sarawak and Brunei.

Cyrtosperma Griff.

1. **Cyrtosperma lasioides** Griff.

III Div.: Pulau Bruit *9021,* Lepah P.F. *8066.*

Large herb, rare in P.C. 1, more frequent in areas where there has been an opening in the canopy and on shallow peat; throughout Sarawak and Brunei.

Epipremnopsis Engl.

1. **Epipremnopsis media** Engl.

teririp (Mil.).

III Div.: Daro F.R. *9707.*

Climber to height of 15–20 ft., rare in P.C. 1. Recorded in peat swamps from only the Rejang Delta and V Div.

Homalomena Schott.

1. **Homalomena rostrata** Griff.

II Div.: Triso *10020;* III Div.: Pulau Bruit *8012,* Loba Kabang P.F. *2813.*

Herb, occasional and localised in P.C. 1 in wetter localities where the water table is exposed. Occurs throughout Sarawak, but not recorded from Brunei.

Podolasia N. E. Br.

1. **Podolasia stipitata** N.E.Br.

III Div.: Loba Kabang P.F. *2818*.

Spiny aroid, rare in P.C.s 1 and 2, and recorded from only the Rejang Delta and Maludam Peninsula.

Rhaphidophora Schott.

1. **Rhaphidophora lobbii** Schott.

II Div.: Triso *14547, 12216;* III Div.: Pulau Bruit *8007, 8032*.

Small climbing aroid, not exceeding 10 ft. in height, occasional in P.C. 1. Recorded from Maludam Peninsula and Rejang Delta, but probably occurs throughout two territories.

CYPERACEAE

Tetraria Beauv.

1. **Tetraria borneensis** Kern.

IV Div.: Lobok Pasir *9876*.

Tall sedge which is only found in peat swamp forest in the centre of P.C. 6 where it is abundant but localised. Also occurs in open heath forest (Bako National Park).

Thorachostachyum Kurz.

1. **Thorachostachyum bancanum** (Miq.) Kurz.

II Div.: Triso *3177;* III Div.: Loba Kabang P.F. *2802, 1574;* IV Div.: Sg. Dua *3072*.

Sedge, very abundant in P.C.s 1 and 6 but rare in P.C.s 2–5; occurs throughout Sarawak and Brunei.

III. GYMNOSPERMAE

CONIFERAE

Dacrydium Soland.

1. **Dacrydium beccarii** Parl. var. **subelatum** Corner.

V Div.: Kayangeran F.R. *1795, 1568*.

Tree, 72–84 ins. g., forming dense almost pure stands in the Lawas District, the only locality that it occurs in swamp forest, though it is a common component of heath forests.

Podocarpus (L'Hérit.) Pers.

1. **Podocarpus blumei** Endl.

III Div.: Naman F.R. *11716*.

Small tree, 12–24 ins. g., frequent but very localised in P.C. 1 near inland margins of peat swamps. Recorded from only the Rejajng Delta but distribution probably more widespread in localised areas. Occurs more commonly in heath forests.

GNETACEAE

Gnetum L.

1. **Gnetum neglectum** Bl.

II Div.: Ng. Skrang *9828;* III Div.: Naman F.R. *9180,* Surong Irit *5239.*

Small twining climber in understorey of P.C. 1. Rare, recorded from only the Rejang Delta and Batang Lupar.

IV. PTERIDOPHYTA

LYCOPODIACEAE

Lycopodium L.

1. **Lycopodium cernuum** Sw.

IV Div.: Lobok Pasir *4165.*

Terrestrial club moss, abundant in P.C. 6 of the Baram. In swamp forest it occurs only in this one forest type but it is abundant elsewhere in open heath forest and on degraded soils.

2. **Lycopodium phlegmaria** L. var. **divaricatum** Bl.

II Div.: Triso *9900, 10005;* III Div.: Pulau Bruit *9015.*

Epiphytic club moss, rare in P.C. 1 on stems of small trees 4–10 ft. above swamp surface. Recorded from only the Rejang Delta and Batang Lupar.

3. **Lycopodium pinifolium** Bl.

II Div.: Triso *14521.*

Small epiphytic club moss usually found on rotting stumps and fallen trees, rather rare and recorded only from the Batang Lupar.

OPHIOGLOSSACEAE

Ophioglossum L.

1. **Ophioglossum intermedium** Hook.

III Div.: Pulau Bruit *9034.*

Small terrestrial fern on litter layer of P.C. 1, very rare and localised. Recorded from only the one locality.

SCHIZAEACEAE

Schizaea Smith.

1. **Schizaea malaccana** Baker.

IV Div.: Lobok Pasir *3082.*

Small terrestrial fern, rare and confined to P.C. 6, where it is found associated with spaghnum moss (*Spaghnum junghuhnianum.*).

CYATHEACEAE

Cyathea Smith.

1. **Cyathea glabra** (Bl.) Copel.

   IV Div.: Sg. Dua *4160*.

   Stemless tree fern, occasional, locally abundant, in P.C.s 2 and 3 throughout Sarawak and Brunei.

POLYPODIACEAE

Crypsinus Presl.

1. **Crypsinus albidopaleatus** (Bl.) Copel.

   II Div.: Triso *14517;* III Div.: Naman F.R. *9297*.

   Small epiphytic fern near ground level in P.C.s 1 and 2, rare and localised. Recorded from the Rejang Delta and Batang Lupar.

Drynaria J. Sm.

1. **Drynaria involuta** v. A. v. R.

   II Div.: Saribas F.R. *8529;* III Div.: Pulau Bruit *7927*, Naman F.R. *9187, 9188*.

   Nest fern, occasional in understorey of P.C. 1, more rarely in crowns of middle and upper storey trees; throughout Sarawak and Brunei.

Lecanopteris Bl.

1. **Lecanopteris sinuosa** (Wall.) Copel.

   III Div.: *9085;* IV Div.: Lobok Pasir *9879;* V Div.: Lawas *9200*.

   Small epiphytic myrmecophilous fern, rare in crowns of large trees in P.C. 1, also found near ground level in P.C. 6; throughout Sarawak and Brunei.

Paragramma Copel.

1. **Paragramma longifolia** (Bl.) Moore.

   II Div.: Triso *14518;* III Div.: Pulau Bruit *8042, 9052*, Naman F.R. *9787*.

   Epiphytic fern on boles of trees in middle and understoreys, rare in P.C. 1 in the Rejang Delta and Batang Lupar.

Photinopteris Presl.

1. **Photinopteris speciosa** (Bl.) Presl.

   III Div.: Pulau Bruit *12205*.

   Crown epiphyte; rare in P.C. 1 and recorded from only the Rejang Delta.

Phymatodes Presl.

1. **Phymatodes crustacea** (Copel.) Holttum.

   II Div.: Saribas F.R. *8544;* V Div.: Lawas *9199*.

Epiphytic myrmecophilous fern in crowns of dominant trees in P.C. 1, rare; recorded from the Rejang Delta and Batang Lupar, and Lawas.

Platycerium Desvaux.

1. **Platycerium coronarium** (Koenig) Desv.

Large crown epiphyte, rather rare in peat swamps and confined to P.C. 1.

Polypodium L.

1. **Polypodium verrucosum** (Hook.) Wall.

II Div.: Triso P.F. *10006, 12217.*

Large epiphytic fern in middle and understoreys of P.C. 1, rather rare and usually associated with *Asplenium nidus*. Occurs throughout Sarawak and Brunei.

Pyrrosia Mirbel.

1. **Pyrrosia longifolia** (Burm.) Morton.

III Div.: Pulau Bruit *9057, 9054.*

Epiphytic fern on boles of trees in the middle storey, rarely at a lower level, occasional in P.C. 1 throughout Sarawak and Brunei.

Selliguea Bory.

1. **Selliguea heterocarpa** Bl.

II Div.: Triso *14516;* III Div.: Pulau Bruit *7926, 8037, 8036;* V Div.: Kayangeran F.R. *9199.*

Epiphytic fern which occupies a similar habitat to *Pyrrosia longifolia,* rare in P.C. 1; throughout Sarawak and Brunei.

Stenochlaena J. Smith.

1. **Stenochlaena palustris** (Burm.) Bedd.

II Div.: Triso No number (Anderson).

Climbing fern, very abundant on trees in P.C. 1 near coast, less abundant inland and in P.C.s 2 and 3, very rare or absent in P.C.s 4–6; throughout Sarawak and Brunei.

DENNSTAEDTIACEAE (LINDSAYOIDEAE)

Lindsaya Dryand.

1. **Lindsaya scandens** Hk. var. **terrestris** Holttum.

III Div.: Pulau Bruit *8795* (Brooke); IV Div.: Sg. Dua *3085,* Lobok Pasir *9442.*

Terrestrial fern, rather rare in P.C. 1, occasional in P.C.s 2 and 3, throughout Sarawak and Brunei.

Schizoloma Gaudich.

1. **Schizoloma coriaceum** v. A. v. R.

III Div.: Pulau Bruit *8015, 9293,* Loba Kabang P.F. *2804,* V Div.: Sg. Dua *4186.*

Terrestrial fern, abundant on pneumatophores and roots at surface level in P.C. 1; throughout Sarawak and Brunei.

(DAVALLIOIDEAE)

Humata Cav.

1. **Humata angustata** (Wall.) J. Sm.

II Div.: Triso *9809, 10014;* III Div.: Naman F.R. *8599.*

Small epiphytic fern, rather rare in crowns of middle-storey trees in P.C.s 1–3, becoming frequent in P.C. 4 as an epiphyte at ground level; throughout Sarawak and Brunei.

2. **Humata parvula** (Wall.) Mett.

II Div.: Triso *10012, 9811.*

Minute epiphytic fern which occupies a similar habitat to *H. angustata,* but is much rarer. Probably occurs throughout Sarawak and Brunei, but recorded from only the Rejang Delta and Batang Lupar.

(OLEANDROIDEAE)

Nephrolepis Schott.

1. **Nephrolepis biserrata** (Sw.) Schott.

III Div.: Lepah P.F. *8089.*

Terrestrial fern, very rare in primary P.C. 1 but more frequent in transitional zone from mangrove, and very abundant in secondary swamp vegetation following extensive openings of the canopy.

(ASPLENIOIDEAE)

Asplenium L.

1. **Asplenium glaucophyllum** v. A. v. R.

III Div.: Pulau Bruit *7940;* IV Div.: Sg. Dua *3263.*

Epiphytic fern at low level in understorey of P.C. 1, rather rare and localised. Occurs throughout Sarawak but not recorded from Brunei.

2. **Asplenium longissimum** Bl.

II Div.: Triso *10004;* IV Div.: Sg. Dua *3269, 3286.*

Terrestrial fern, or epiphytic on rotten stumps and roots, occasional in P.C. 1, becoming abundant after the opening of the canopy; throughout Sarawak and Brunei.

3. **Asplenium nidus** L.

III Div.: Pulau Bruit *7929.*

Bird's nest fern, frequent in crowns of trees of lower and middle storeys and occasional in crowns of upper storey trees in P.C. 1, becoming less frequent in P.C.s 2 and 3 and rare in P.C.s 4–6.

4. **Asplenium phyllitidis** Don.

III Div.: Pulau Bruit *7939*.

Bird's nest fern, similar in habitat to *A. nidus* but much rarer and more restricted in its distribution; recorded in swamps from only the Rejang Delta.

5. **Asplenium tenerum** Forst.

II Div.: Triso *10018, 9810*.

Small epiphytic fern at base of small trees and on roots and pneumatophores in P.C. 1, occasional and localised. Occurs throughout Sarawak and Brunei.

(LOMARIOPSIDOIDEAE)

Teratophyllum Mett.

1. **Teratophyllum ludens** (Fée) Holttum.

IV Div.: Sg. Dua *3262, 3086*.

Small climbing fern, occasional in P.C. 1 and rare in P.C. 2; throughout Sarawak and Brunei.

ADIANTACEAE

Syngramma J. Smith.

1. **Syngramma lobbiana** (Hook.) Sm.

III Div.: Pulau Bruit *8448*, Loba Kabang P.F. *2807*.

Terrestrial fern, frequent on pneumatophores and surface roots in P.C. 1; throughout Sarawak and Brunei.

Vittaria Smith.

1. **Vittaria elongata** Sw.

II Div.: Saribas F.R. *8563;* III Div.: Pulau Bruit *8017*, Loba Kabang P.F. *2808;* IV Div.: Sg. Dua *3264*.

Small terrestrial fern, abundant on pneumatophores and surface roots in P.C. 1; throughout Sarawak and Brunei.

2. **Vittaria ensiformis** Sw.

III Div.: Pulau Bruit *7925*.

Small epiphytic fern on boles of trees in understorey of P.C. 1, rare and only recorded from the Rejang Delta and Maludam Peninsula.

3. **Vittaria hirta** Fée.

II Div.: Triso *10011*.

Minute epiphytic fern, occasional in crowns of trees in middle storey in P.C.s 1 and 2. Recorded only from the Rejang Delta and Batang Lupar but distribution probably more widespread.

TABLE I

REPRESENTATION OF BOTANICAL FAMILIES OF ANGIOSPERMS AND GYMNOSPERMS

Families	*Total numbers of genera and species (in brackets) represented*	NUMBERS OF GENERA AND SPECIES (IN BRACKETS) REPRESENTED					
		Trees > 12" girth	*Trees <12" girth*	*Shrubs*	*Herbs*	*Climbers and Lianes*	*Epiphytes*
Gymnosperms							
Coniferæ ..	2 (2)	2 (2)					
Gnetaceæ ..	1 (1)					1 (1)	
Angiosperms							
Dicotyledons							
Dilleniaceæ ..	2 (2)	1 (1)				1 (1)	
Magnoliaceæ ..	1 (1)	1 (1)					
Annonaceæ ..	12 (17)	5 (9)	3 (3)			5 (5)	
Menispermaceæ ..	2 (2)					1 (1)	1 (1)
Polygalaceæ ..	2 (4)	2 (4)					
Hypericaceæ ..	1 (2)	1 (2)					
Flacourtiaceæ ..	2 (2)	1 (1)	1 (1)				
Guttiferæ ..	3 (16)	3 (16)					
Ternstrœmiaceæ ..	2 (4)	2 (4)					
Dipterocarpaceæ ..	7 (15)	7 (15)					
Malvaceæ ..	2 (2)	2 (2)					
Sterculiaceæ ..	2 (4)	2 (4)					
Tiliaceæ	2 (5)	1 (2)	2 (3)				
Linaceæ	2 (2)	2 (2)					
Rutaceæ ..	2 (3)	1 (2)	1 (1)				
Simarubaceæ ..	2 (2)	1 (1)	1 (1)				
Ochnaceæ ..	3 (4)	2 (2)		1 (2)			
Burseraceæ ..	2 (6)	2 (6)					
Meliaceæ ..	3 (3)	2 (2)	1 (1)				
Olacaceæ ..	4 (5)	4 (5)					
Ilicinaceæ ..	1 (2)	1 (2)					
Celastraceæ ..	3 (4)	3 (4)					
Rhamnaceæ ..	1 (1)					1 (1)	
Ampelidaceæ ..	3 (3)					3 (3)	
Sapindaceæ ..	3 (4)	3 (3)	1 (1)				
Anacardiaceæ ..	7 (11)	7 (11)					
Connaraceæ ..	3 (3)		1 (1)			2 (2)	
Leguminosæ ..	8 (8)	6 (6)	1 (1)			1 (1)	
Rosaceæ ..	2 (3)	2 (3)					
Rhizophoraceæ ..	2 (2)	2 (2)					
Myrtaceæ ..	3 (16)	3 (15)	1 (1)				
Melastomaceæ ..	4 (8)	2 (2)		1 (1)		1 (2)	1 (3)
Cucurbitaceæ ..	1 (1)					1 (1)	
Araliaceæ ..	2 (4)	1 (1)	1 (1)	1 (1)			1 (1)
Cornaceæ ..	1 (1)	1 (1)					

TABLE 1—*Continued*

REPRESENTATION OF BOTANICAL FAMILIES OF ANGIOSPERMS AND GYMNOSPERMS

Families	*Total numbers of genera and species (in brackets) represented*	NUMBERS OF GENERA AND SPECIES (IN BRACKETS) REPRESENTED — *Trees > 12" girth*	*Trees <12" girth*	*Shrubs*	*Herbs*	*Climbers and Lianes*	*Epiphytes*
Rubiaceæ ..	18 (22)	6 (6)	5 (5)	1 (1)	1 (1)	5 (7)	2 (2)
Ericaceæ ..	1 (1)			1 (1)			
Myrsinaceæ ..	5 (11)	1 (1)	2 (3)	3 (4)		2 (3)	
Sapotaceæ ..	4 (12)	4 (12)					
Ebenaceæ ..	1 (4)	1 (4)					
Oleaceæ	2 (4)	1 (3)				1 (1)	
Apocynaceæ ..	5 (6)	2 (2)	1 (1)			2 (3)	
Asclepiadaceæ ..	2 (6)						2 (6)
Loganiaceæ ..	1 (2)			1 (2)			
Convolvulaceæ ..	1 (2)					1 (2)	
Gesneriaceæ ..	1 (1)					1 (1)	
Verbenaceæ ..	3 (3)	1 (1)			1 (1)	1 (1)	
Nepenthaceæ ..	1 (5)			1 (4)		1 (1)	
Piperaceæ ..	1 (4)				1 (1)	1 (3)	
Myristicaceæ ..	4 (7)	4 (5)	2 (2)				
Lauraceæ ..	9 (18)	6 (14)	3 (4)				
Thymeliaceæ ..	2 (4)	1 (3)				1 (1)	
Loranthaceæ ..	3 (3)						3 (3)
Santalaceæ ..	1 (2)			1 (1)			1 (1)
Euphorbiaceæ ..	11 (17)	7 (12)	4 (4)		1 (1)		
Urticaceæ ..							1 (2)
Moraceæ ..	3 (27)	2 (3)		1 (1)		1 (19)	1 (4)
Casuarinaceæ ..	1 (1)	1 (1)					
Fagaceæ ..	2 (5)	2 (5)					
Monocotyledons							
Orchidaceæ ..	12 (17)				3 (3)		11 (14)
Zingiberaceæ ..	2 (2)				1 (1)		1 (1)
Dioscoreaceæ ..	1 (1)					1 (1)	
Liliaceæ	1 (1)			1 (1)			
Flagellariaceæ ..	2 (2)				1 (1)	1 (1)	
Palmæ	7 (7)		1 (1)	3 (3)		3 (3)	
Pandanaceæ ..	1 (4)			1 (3)		1 (1)	
Araceæ	9 (9)				7(7)	2 (2)	
Cyperaceæ ..	2 (2)				2(2)		

TABLE 2

FLORISTIC COMPOSITION (ANGIOSPERMS AND GYMNOSPERMS) OF PEAT SWAMP FORESTS

Note:—Only the more abundant and widely distributed species are included.

Tree species

(i) Upper storey (60 ins. girth and over):

Alstonia spathulata
Anisoptera marginata
Artocarpus rigidus
Calophyllum retusum
Campnosperma coriacea
Casuarina sp. nov.
Combretocarpus rotundatus
Copaifera palustris
Cratoxylon arborescens
Cratoxylon glaucum
Dacrydium beccarii var. subelatum
Dactylocladus stenostachys
Dillenia pulchella
Dipterocarpus coriaceus
Dryobalanops rappa
Durio carinatus
Dyera lowii
Ganua motleyana
Gonystylus bancanus
Gonystylus maingayi
Koompassia malaccensis
Litsea palustris
Lophopetalum multinervium
Melanorrhoea beccarii
Melanorrhoea tricolor
Mezzettia leptopoda
Parartocarpus venenosus ssp. forbesii
Parastemon urophyllum
Parishia sericea
Planchonella maingayii
Shorea albida
Shorea inaequilateralis
Shorea platycarpa
Shorea rugosa var. uliginosa
Shorea scabrida
Shorea teysmanniana
Swintonia glauca
Tetramerista glabra

(ii) Middle storey (24–60 ins. girth):

Alangium havilandii
Alseodaphne insignis
Alseodaphne rigida
Amoora rubiginosa
Aromadendron nutans
Arthrophyllum rubiginosum
Bhesa paniculata
Blumeodendron subrotundifolium
Blumeodendron tokbrai
Calophyllum fragrans
Calophyllum obliquinervum
Calophyllum sclerophyllum
Cotylelobium fuscum
Ctenolophon parvifolius
Dacryodes incurvata
Dacryodes macrocarpum var. macrocarpum
Dialium laurinum
Diospyros evena
Gonystylus forbesii
Horsfieldia crassifolia
Jackia ornata
Kokoona ovato-lanceolata
Lithocarpus wenzigianus
Litsea cylindrocarpa
Litsea gracilipes
Litsea grandis
Litsea nidularis
Longetia malayana
Macaranga caladifolia
Mussaendopsis beccariana
Nephelium maingayi
Palaquim cochleariifolium
Palaquim pseudocuneatum
Palaquium ridleyi
Palaquium walsurifolium
Parastemon spicatum
Parkia singularis

TABLE 2—*continued*

Diospyros maingayi
Diospyros pseudomalabarica
Elaeocarpus obtusifolius
Eugenia christmannii
Eugenia havilandii
Eugenia incarnata
Eugenia nemestrina
Eugenia spicata
Ganua coriacea
Ganua pierrei
Gardenia pterocalyx
Garcinia havilandii
Garcinia vidua
Goniothalamus andersonii
Platea excelsa
Polyalthia glauca
Pometia pinnata f. acuminata
Santiria laevigata
Santiria rubiginosa var. rubiginosa
Santiria tomentosa
Sindora leiocarpa
Stemonurus scorpioides
Tristania grandifolia
Tristania aff. maingayi
Tristania obovata
Vatica mangachapoi
Xerospermum muricatum
Xylopia coriifolia

(iii) Lower storey (12–24 ins. girth):

Antidesma coriaceum
Baccaurea bracteata
Brackenridgea hookeri
Canthium didymum
Carallia brachiata
Cryptocarya griffithiana
Cyathocalyx biovulatus
Cephalomappa paludicola
Dillenia pulchella var.
Diospyros elliptifolia
Eugenia cerina
Garcinia rostrata
Garcinia tetrandra
Glochidion lucidum
Gomphandra comosa
Goniothalamus malayanus
Gymnacranthera eugeniifolia var. griffithii
Ilex hypoglauca
Ilex sclerophylloides
Knema kunstleri var. kunstleri
Lithocarpus sundaicus
Lithocarpus sp. (9813)
Litsea resinosa
Mezzettia umbellata
Nauclea parva
Neoscortechinia kingii
Pithecellobium borneense
Polyalthia hypoleuca
Pygeum parviflorum
Samadera indica
Stemonurus umbellatus
Sterculia rhoidifolia
Ternstroemia hosei
Ternstroemia magnifica
Tetractomia holttumii
Timonius peduncularis
Xanthophyllum amoenum
Xanthophyllum aff. citrifolium

(iv) Understorey (less than 12 ins. girth):

Antidesma phanerophlebium
Ardisia copelandii
Canthium umbellatum
Chisochetum brachyanthus
Cyrtostachys lacca
Dehaasia sp. (9252)
Disepalum anomalum
Gaertnera borneensis
Ixora pyrantha
Polyalthia sp. (9059)
Tarenna fragrans

Shrubs:

Daemonorops longipes
Euthemis leucocarpa
Euthemis obtusifolius
Labisia punctata f. pumila
Medinilla hasseltii
Nepenthes bicalcarata

TABLE 2—*continued*

Fagraea litoralis
Fagraea racemosa
Ficus deltoidea var. motleyana
Hanguana malayana
Iguanura sp. (12246)
Labisia punctata f. punctata
Nepenthes gracilis
Nepenthes rafflesiana
Pandanus andersonii
Pandanus ridleyi
Pandanus brevifolius
Pinanga sp. (12332)
Pleomele cantleyi
Schefflera subulata
Zalacca conferta

Herbs.

Aglaonema pictum
Alocasia beccarii
Argostemma psychotrioides
Bromheadia finlaysoniana
Clerodendron fistulosum
Cryptocoryne pallidinervia
Cyrtosperma lasiodes
Cystorchis variegata
Globba panicoides
Homalomena rostrata
Piper muricatum
Podolasia stipitata
Thorachostachyum bancanum
Zeuxine violascens

Epiphytes

(i) Sun epiphytes:

Adenoncos sumatrana
Bulbophyllum vaginatum
Dendrobium aff. merrillii
Dischidia hirsuta
Dischidia nummularia
Dischidia rafflesiana
Eria obliqua
Eria pannea
Eria pulchella
Ficus deltoidea var. deltoidea
Grammatophyllum speciosum
Hoya coronaria
Hydophytum formicarum
Myrmecodia tuberosa

(ii) Shade epiphytes:

Appendicula pendula
Bulbophyllum beccarii
Dendrobium cumulatum
Dipodium pictum
Eulophia squalida
Liparis lacerata
Medinilla laxiflora
Pogonanthera pulverulenta
Pycnarrhena borneensis

Climbers

(i) Large climbers, frequently attaining crowns of upper canopy trees, including ground rooting epiphytic and strangling figs:

Calamus sp. (4788)
Erycibe impressa
Fibraurea chloroleuca
Ficus acamptophylla
Ficus consociata
Ficus crassiramea
Ficus spathulifolia
Ficus sundaica
Ficus sundaica var. beccariana
Ficus xylophylla
Grenacharia beccariana
Korthalsia rigida
Mitrella dielsii
Piper arborescens
Plectocomiopsis wrayi
Rourea mimosoides forma mimosoides
Tetrastigma sp. (12420)
Uncaria ovalifolia
Willughbeia glaucina
Zizyphus suluensis

(ii) Small climbers, usually confined to understorey:

Aeschynanthus hians
Ampelocissus thyrsiflora
Connarus semidecandrus
Epipremnopsis media
Flagellaria indica
Ficus callicarpides
Ficus villosa
Gnetum neglectum
Lecananthus erubescens
Lucinaea morinda
Linostoma longiflorum
Medinilla scandens
Nepenthes albomarginata
Nepenthes ampullaria
Pandanus sp. (14545)
Psychotria sarmentosa
Rhaphidophora lobbii

TABLE 3

COMMON FERNS AND FERN ALLIES OF PEAT SWAMP FORESTS

Terrestrial ferns:

Asplenium longissimum	Nephrolepis biserrata
Cyathea glabra	Schizaea malaccana
Lindsaya scandens var. terrestris	Schizoloma coriaceum
Lycopodium cernuum	Syngramma lobbiana
	Vittaria elongata

Epiphytic ferns

(i) Sun epiphytes:

Asplenium nidus	Lecanopteris sinuosa
Asplenium phyllitidis	Photinopteris speciosa
Crypsinus albidopaleatus	Phymatodes crustacea
Drynaria involuta	Platycerium coronarium

(ii) Shade epiphytes:

Asplenium glaucophyllum	Lycopodium pinifolium
Asplenium tenerum	Paragramma longifolia
Crypsinus albidopaleatus	Polypodium verrucosum
Humata angustata	Pyrrosia longifolia
Humata parvula	Selliguea heterocarpa
Lycopodium phlegmaria var. divaricatum	Vittaria ensiformis
	Vittaria hirta

Climbing ferns:

Stenochlaena palustris	Rhaphidophora lobbii

TABLE 4

DISTRIBUTION OF THE SPECIES OF DIPTEROCARPACEAE IN THE PEAT SWAMPS OF SARAWAK AND BRUNEI

	DIVISIONS I		II		III		IV		BRUNEI	V
Species	PRINCIPAL SWAMPS *Lundu*	*Kuching—Semarahan*	*Sadong*	*Maludam Peninsula*	*Rejang Delta*	*Mukah Balingian*	*Tatau*	*Baram*	*Badas Temburong*	*Lawas*
Anisoptera marginata ..		- -	—	—	—	—	- -	- -		
Cotylelobium flavum ..	×	×	×	× —	× —	×	×	×	× - -	×
Dipterocarpus coriaceus		—	—	—	- -	—				
Dryobalanops rappa ..	× —	× —	× —	× —	× —	× —	× —	× —	× —	× —
Hopea pentanervia ..	× —	× —	× —	× —	× —	× —	× —	× —	× —	× —
Shorea albida ..	×		—	—	—	× —	× —	× —	× —	
Shorea inaequilateralis			—	—	—	—	—	—	—	
Shorea longiflora ..				- -			- -	×	×	
Shorea macrantha ..		× —	—	—	—					
Shorea pachyphylla ..		× —					—	× —	× —	
Shorea platycarpa ..	—	—	—	—	—	—	—	—	—	—
Shorea rugosa var. uliginosa	—	—	—	—	—	—	—	—		
Shorea scabrida ..	× —	× —	× —	× —	× —	× —	× —	× —	× —	× —
Shorea teysmanniana ..	—	—	—	—	—	—	—	—	—	—
Vatica mangachapoi ..	× —	× —	× —	× —	× —	× —	× —	× —	× —	× —

Note:—A straight line indicates known distribution of species in peat swamp forest, and a broken line probable distribution but no records yet. Crosses indicate distribution of species in heath forest.

1. Swamp surface in the Gonystylus Dactylocladus Neoscortechinia association, showing the typical groups of pneumatophores covered in bryophytes. The seedling in the right foreground is a *Copaifera palustris* (Sym.) De Wit, at the base of which the fern, *Syngramma lobbiana* J.J. Sm. is to be seen.

2. The somewhat dense understorey in the Gonystylus Dactylocladus Neoscortechinia association. The medium-sized tree to the left of the forester is a *Diospyros maingayi* Hk. f.

3. Two typical pitcher plants of peat swamp forest. On the left is *Nepenthes ampullaria* Jack, which has here adopted a climbing habit, though frequently it is found with the pitchers half imbedded in the litter layer. *Nepenthes bicalcarata* Hk. f. on the right is the largest pitcher plant in the peat swamps.

4. The Shorea albida Litsea Parastemon association, showing the dense understorey but relative absence of a middle storey. The relatively small straight stemmed trees may be noted; *Shorea albida* Sym. is the tree with the fissured bark; and *Litsea palustris* Kost. the smooth barked tree. The sapling to the left of the forester is a *Cotylelobium flavum* Pierre.

5. *Pandanus andersonii* H. St. John in Dacrydium Casuarina forest in the Lawas District. This species is also very abundant in the Shorea albida consociation. *Cyrtostachys lacca* Becc. is the prominent palm and the mottled bark tree is *Diospyros evena* Bakh.

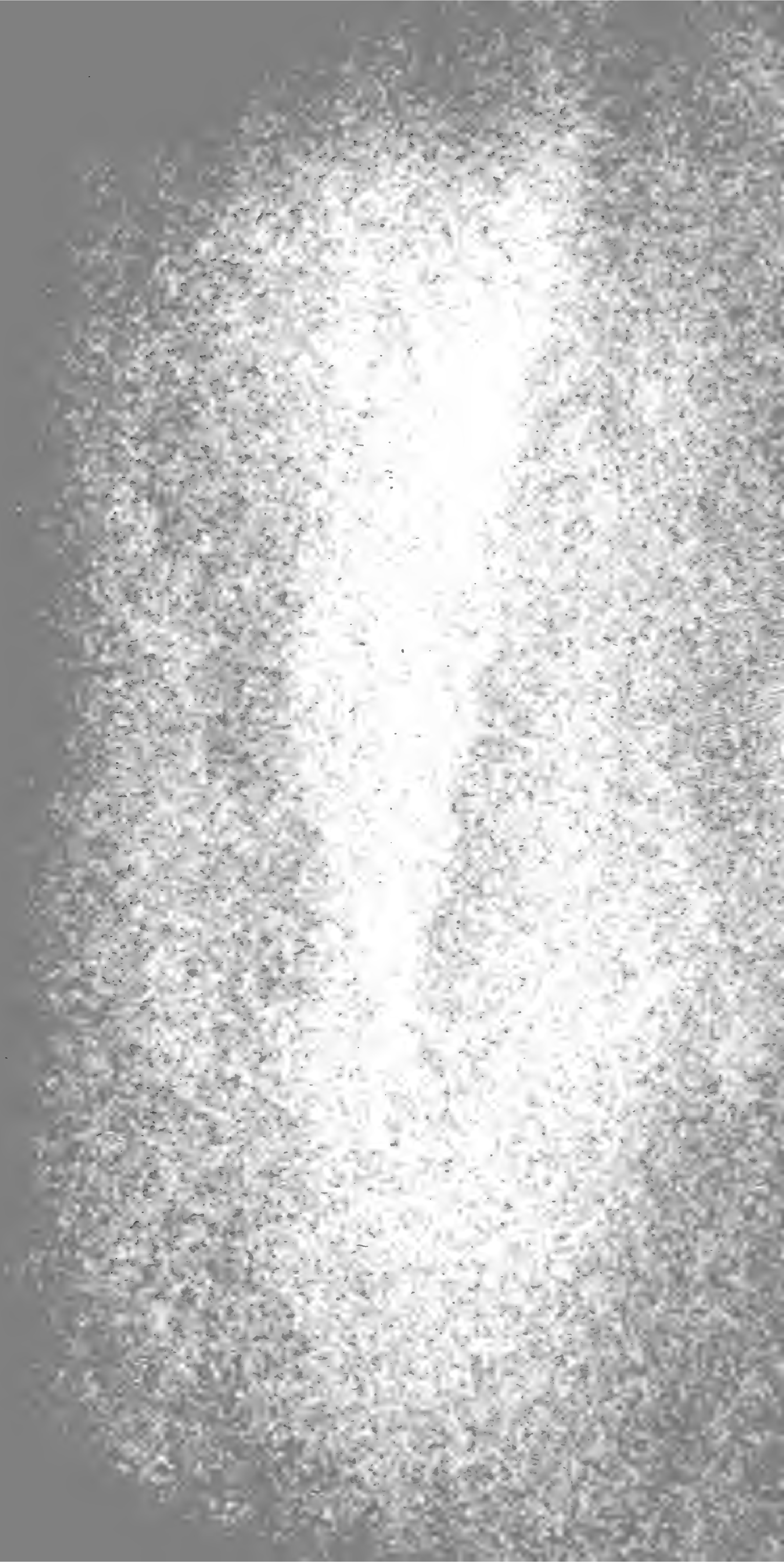
6. Open stunted forest (Combretocarpus Dactylocladus association) in the centre of the Baram peat swamps. The prominent larger trees are all *Combretocarpus rotundatus* (Miq.) Dans.

7. The swamp surface in the Combretocarpus Dactylocladus association. Two pitcher plants, *Nepenthes bicalcarata* Hk. f. and *Nepenthes gracilis* Korth. are growing on a small peat hag.

8. Dacrydium Casuarina forest on deep peat in the Lawas District. This photograph taken in a clearing shows the two principal dominants: *Dacrydium beccarii* Parl. var. *subelatum* Corn. with feathery crowns, and *Casuarina* sp. nov. with small umbrella—shaped crowns.

9. The swamp surface in the Combretocarpus Dactylocladus association showing *Nepenthes bicalcarata* Hk. f. growing amidst *Sphaghnum junghuhnianum* Dz. et Molkenb. The peat depth in this locality was forty feet.

10. The Shorea albida consociation. The height of the pure even canopy of *Shorea albida* Sym. is approximately 170 feet. The almost complete absence of a middle storey may be noted.



OTHER PUBLICATIONS OF THE BOTANIC GARDENS SINGAPORE

1. **Annual Report.**
   Reports from 1909 onward remain available.
   Prices variable.
2. **The Agricultural Bulletin of the Malay Peninsula (Series I).**
   Only Nos. 3, 5, 7, 8 and 9 available at 20 cents each.
3. **The Agricultural Bulletin of the Straits and F.M.S. (Series II).**
   Vols. 1–10, 1901–1911, monthly issues.
   All available except Vols. 1, 2 and 9.
   Price: $5 per volume.
4. **The Gardens' Bulletin, Straits Settlements (Series III).**
   Vols. 1–11, 1912–1947.
   Vols. 1 (1–5) January-May 1912 is issued under title of Agricultural Bulletin of the Straits & F.M.S.
   All parts available, except Vol. 1 No. 10, Vol. 2, Vol. 3 Nos. 1–3 and Vol. 11 pt. 3.
   Prices variable.
5. **The Gardens' Bulletin, Singapore (Series IV).**
   Vols. 12–19.
   All parts available. Prices variable. Issues are irregular.
   Subscription will be entered against deposit.
   Available on exchange.
6. **Materials for a Flora of the Malay Peninsula, Monocotyledons.**
   Parts 1, 2 and 3 remain available.
7. (*a*) **Malayan Orchid Hybrids by M. R. Henderson and G. H. Addison.**
   Price $21.

   (*b*) **Malayan Orchid Hybrids, Supplement I by G. H. Addison.**
   Price $21.
8. **A Revised Flora of Malaya.**
   (*a*) Vol. 1, Orchids, by R. E. Holttum. Price $20.
   (*b*) Vol. 2, Ferns, by R. E. Holttum. Price $20.
9. **Wayside Trees of Malaya by E. J. H. Corner, 2 Vols.**
   Price $25.

Items 1–6 can be obtained from the Director, Botanic Gardens, Singapore.

Items 7–9 can be obtained from the Government Printer, Government Printing Office, Singapore.

Prices quoted are in Malayan Dollars
Overseas postage is extra

0002—400—3/63

THE

GARDENS' BULLETIN

SINGAPORE

Vol. XX, Part III 20th December, 1963

CONTENTS

To be purchased at the Botanic Gardens, Singapore
Price: $5

Published by Authority

PRINTED BY LIM BIAN HAN, ACTING GOVERNMENT PRINTER, SINGAPORE

1963

Taxonomic Notes on Bornean Dipterocarpaceae

By P. S. Ashton

Forest Botanist, Kuching

This is the second precursory paper to the forthcoming publication of a Forester's Manual of the Dipterocarpaceae of Brunei State. Taxonomic and nomenclatural discussion is out of place in the Manual and this paper is therefore presented in order to explain changes that have been made.

The late Dr. D. F. van Slooten and C. F. Symington have between them written much on the infrageneric divisions recognisable within Malaysian dipterocarp genera. Symington (1943 and elsewhere) had crystallised his views on this problem, but never proceeded to a complete revision of the infrageneric classifications or to formal publication of new infrageneric taxa. This gap has remained, and therefore must be filled before further manuals or monographs of the family are completed. I have found it necessary to make nomenclatural changes in most genera where infrageneric divisions are recognised; the present paper explains my reasons for these. With the much more complete herbarium material now available, particularly from Borneo, the subdivision of the large genera Shorea and Hopea, which Symington has already done so much to elucidate, can now be reassessed. Here, though agreeing with Symington on the basis for subdivisions, I have, with the exception of one section, found it unnecessary to create new names; they have already been provided by Brandis (1895), Heim (1892) and other previous monographers, though in many cases a redefinition is necessary.

I wish to thank the Directors of the following herbaria for putting their facilities at my disposal during my visits to study Dipterocarpaceae: Bangkok Forest Herbarium, Bangkok Agricultural Herbarium, Herbarium Bogoriense, the British Museum, the British Pharmaceutical Society, Cambridge, Kepong, Kew, Kuching, Leiden, the Linnean Society, Oxford, Paris, Sandakan, Singapore and Utrecht. I further thank the Directors of the following herbaria for the loan of material to me at Cambridge: Berkeley, Calcutta, Copenhagen, Florence, Kepong, Kuching, Leiden, and Paris.

In order to avoid synonymy when describing new Dipterocarpaceae in my last paper (this journal, 19, 2 (1962) 253), I examined the Type material of all Dipterocarpaceae occuring between Celebes and the Isthmus of Kra. I have been able to discover the true identity of all but two of the species described to date from this area, including species founded on sapling or fallen leaves by Korthals (1841), De Vriese (1861, b) and others. The second purpose of this paper is to explain my reasons for changes in nomenclature and synonymy that I have found necessary.

In addition, I have described one more species, *Shorea crassa,* which was not fully understood by me at the time of completion of my last paper, and have given taxonomic status to the geographical subspecies of some *Dipterocarpus* and *Shorea* species.

As full field and herbarium descriptions are given in my forthcoming Manual, I have excluded them here, though short diagnoses are included with some species in order to clarify my arguments.

I have to thank in particular Mr. E. J. H. Corner, F.R.S., for his continued advice and encouragement, and Mr. B. E. Smythies, who has discussed several of the changes herein explained. With Dr. W. Meijer, who is also completing a manual, on North Borneo Dipterocarpaceae, I have continued to exchange views. Mr. P. D. Sell, of Cambridge Herbarium, has on several occasions offered advice on nomenclatural problems.

The work has been carried out under the auspices of the Government of Brunei, and my thanks are due to them for their financial support.

ANISOPTERA Korth., Kruidk (1841) 65.

Types: *A. costata* Korth., *A. marginata* Korth.

—**Hopea** sensu Roxb., Fl. Ind., ed. 2 (1832) 611, pro parte, quoad *H. scaphula* Roxb.

—**Mocanera** Blanco, Fl. Filip., ed. 1 (1837) 446, pro parte, quoad *M. thurifera* Blanco.

—**Antherotriche** Turcz., Bull. Soc. Nat. Mosc. 2 (1846) 505.

Type. *A. lanceolata* Turcz.

—**Vatica** sensu Dyer, in Hook. f., Fl. Brit. Ind. 1 (1874) 301, pro parte, quoad *V. scaphula.*

—**Scaphula** Parker, Fedde, Rep. 30 (1932) 326.

Type: *Scaphula glabra* (Kurz) Parker.

Korthals described the genus for two species from his Borneon collections.

The two dipterocarp genera appearing in the first edition of Blanco's Flora de Filipinas (1837) are *Vatica* Linn. and *Mocanera,* the latter being a dumping ground for all taxa that could not be placed in *Vatica.* Blume (1852,42) subsequently transferred *M. thurifera,* of which no type exists, to *Anisoptera.* Meanwhile Turczaninow had described a new species and genus from a flowering Cuming collection, no. 882, from Luzon, in the Moscow Herbarium (dupl. in K, PC), referring it to the Tiliaceae. Brandis (1895,44) attributes the reduction of this genus to Walpers (1848,1, 113) but in fact Walpers maintained Turczaninow's name and the reduction was due to Blume (loc. cit.).

Heim (1892, 30–35) recognised three sections:—

I. *Pilosae:* Leaves, twigs, and petioles tomentose; cotyledons foliaceous, radical free; petiole with a single band of vascular bundles at the 'caractéristique' (distal end of petiole in transverse section).

II. *Glabrae:* Parts subglabrous, cotyledons fleshy, with the radical imbedded in them; petiole with two vascular arcs.

III. *Antherotriche:* Anther valves unequal; petiole with complex vascular system.

Brandis (id., 40) ignored Heim's sections, as also did van Slooten (1926,3), partially no doubt because the latter two sections were based on single species and subdivision was certainly premature.

Roxburgh described his *H. scaphula* from flowering material. His brief description, and an unpublished drawing, a copy of which is at Kew, is the basis on which Dyer transferred it to *Vatica;* King (1893,127) and Brandis (1895,132) maintained it in *Vatica*, remarking on its anomalous characters. R. N. Parker demonstrated that Roxburgh's species was identical with *A. glabra* Kurz, the sole member of Heim's section Glabrae. He noted the slender style and disc-shaped stylopodium, in contrast to the cylindrical stylopodium of other species, and proposed a new genus for it.

Symington (1943,199) was left to show that the flower characters were correlated with Heim's sections Glabrae and Pilosae; he emended the section descriptions and reunited *Scaphula*, adding to section Glabrae the recently described *A. laevis* Ridl. In his view the close similarly in fruit, leaf, and wood characters justified reduction of Parker's genus, with which I agree.

The generic types are in Heim's section Pilosae, which should therefore bear the generic name.

I have examined Cuming 882, and find that in flower and leaf characters it belongs to the Type section. The characters of anther and petiole described by Heim vary from species to species and cannot be considered as a basis for section diagnosis.

I therefore follow Symington in recognising only two sections, Anisoptera and Glabrae, defined as follows:—

Section I. ANISOPTERA

—Gen. **Mocanera** Blanco pro parte, **Antherotriche Turcz.**

—Sect. **Pilosae** Heim, Rech. Dipt (1892) 33 (Type: *A. oblonga* Dyer (ut. *A. cochinchinensis* Pierre); **Antherotriche** (Turcz) Heim, id (1892) 34.

Young parts and lamina below tomentose (excl. *A. marginata*). Flower buds lanceolate; anthers linear; appendage to connective short, stout, less than half length of anther; stylopodium cylindrical to ovoid-conical, narrow; style short; stigma minute.

Distribution. 11 species: Burma (2), Thailand (3), Indochina (2), Malaya (4), Sumatra (3), Borneo (3), Philippines (3), Moluccas (2), New Guinea (3).

Section II. GLABRAE Heim, Rech. Dipt (1892) 33.

Type: *A. scaphula* (Roxb) Pierre (ut *A. glabra* Kurz).

—Gen. **Hopea** fide Roxb (1832) pro parte; **Vatica** sensu Dyer (1872) pro parte; **Scaphula** Parker.

Young leaves and twigs epilose. Flower buds globose; anthers broadly oblong; appendage to connective many times longer than anther, slender; stylopodium a flattened disc-shaped platform surmounting the ovary; style filiform, long, with distinct trifid stigma.

Distribution. 2 species: Thailand, Indochina, Burma (1), Malaya (2), Borneo (1).

A. grossivenia V.Sl., Bull. Jard. Bot. Btzg. 3, 16 (1940) 431.

Type: b.b. 29708, fl. and fr., Pepas, Muara Tewe, S.C. Borneo (BO,L).

—*A. curtisii* sensu V.Sl., Bull. Jard. Bot. Btzg. 3,8 (1926) 11, pro parte, quoad spec. Born.

—*A.sp. 'B'*, Wyatt-Smith, Mal. For. 18 (1955) 79.

Van Slooten at first did not distinguish this species from *A. curtisii* Dyer of Sumatra and Malaya, which has 25 stamens (c. 36 in this species), longer tomentum, and more prominent nerves. The closely allied *A. aurea* Foxw. of the Philippines has 25 stamens and larger leaves. In young trees the lamina is grey-green lepidote below; Brunei collections (Kep 30610, 80080, 37115, s.n., Kg. Gana) from young trees were tentatively separated as a new species by Wyatt-Smith, but never named in the absence of fertile material.

A. marginata Korth., Kruidk. (1841) 66.

Holotype: Korthals. s.n., fl., G. Pamaton, S. Borneo (L).

—*A. grandiflora* Brandis, J. Linn. Soc. Bot. 31 (1895) 43.

Type: Haviland (Garai) 959, fl., near Kuching, Sarawak (SAR, SING, K, BM).

—*A. mindanensis* sensu Wyatt-Smith, Mal. For. 18 (1955) 77, pro parte.

Haviland 959 is from a young tree, and the lamina is shortly evenly pubescent below. Van Slooten (1926, 10), who had no field knowledge, attributed it tentatively to *A. costata*. Symington (1934, 13) put it with *A. marginata*, but stated that diagnosis was difficult owing to the similarity in the flowers. The number of nerves is as this species, however, and the tomentum is shorter, more even than *A. costata; A. costata* is not yet known from Sarawak. I have little doubt that Symington's conclusion is correct. Wyatt-Smith cited Brunei collections of this and *A. laevis* under *A. mindanensis* (see under *A. laevis*). The only Brunei collection of *A. marginata* (Kep 30418) is flowering and is very similar to the Type of *A. grandiflora.*

A. laevis Ridl., Fl. Mal. Pen. I (1922) 219.

Type: Ridley 6886, fr., Gardens Jungle, Singapore (SING, K).

—*A glabra* sensu Ridl., Agr. Bull. S.S. and F.M.S., 1, 2 (1901) 60; Str. Br. R. As. Soc. 54 (1910) 25.

—*A. thurifera* sensu Foxw., Philip. J. Sc. Bot. 6 (1911) 257 quoad Spec. Malay.

—*A. mindanensis* sensu Wyatt-Smith, Mal. For. 18, 2 (1955) 77, pro parte.

Symington (1934, 8) has reviewed the synonymy to that date. Wyatt-Smith referred Kep. numbers of this (all sterile) and *A. marginata* from Brunei to *A. mindanenis Foxw.*

The fruit collections (Brun 3053, 3192) now available confirm in their stylopodia that the present determination is the correct one, Foxworthy's species being in the Type section. Symington (unpublished diary, 23-8-1938) records finding *A. laevis* on Bt. Patoi, Brunei; Kep 35455 from there is his collection, and is presumably the basis on which he cites *A. laevis* from Borneo (1943, 205). His determination is now confirmed.

DIPTEROCARPUS Gaertn. f., De Fruct. 3 (1805) 50.

Types: *D. costatus* Gaertn. f.; *D. turbinatus* Gaertn. f.

—**Oleoxylon** Roxb., Trans. Soc. Arts Lond. 23 (1805) 413; Wall. Cat. no. 953; nomen nudum.

—**Pterigium** Correa, Ann. Mus. Par. 8 (1806) 397, pro parte, quoad *P. costatum* (Gaertn. f.) Correa.

—**Mocanera** Blanco, Fl. Filip. I (1837) 446.

Lectotype species: *Mocanera verniciflua* Blanco (*D. gracilis Bl.*).

—**Duvaliella** Heim, Bull. Mens. Soc. Linn. Paris, 2 (1892) 1011.

Type: *Duvaliella problematica* Heim.

The first collections were made by Dr. Buchanan Hamilton near Chittagong, India; he sent what he considered to be four species to Sir Joseph Banks; K. F. Gaertner described two of them, and the Types are now at the British Museum. Later Correa de Serra redescribed Gaertner's species *Dipterocarpus costatus* and *Dryobalanops aromatica* under the generic name *Pterigium;* Steudel (1940, 518, see under *D. aromatica*) transferred both to Dipterocarpus, but no subsequent authors accepted his decision.

Oleoxylon is a nomen nudum used by Roxburgh in an essay on the natural products of India, in which he described the resinous oil of the genus and its potential commercial value; no. 953 in Wallich's Catalogue refers to a specimen of *D. alatus* Roxb.

Dyer (1874b, 97) created five sections, which he himself admitted to be artificial, being based on the shape of the fruit calyx tube alone. He commented 'herbarium specimens of species of *Dipterocarpus* are rarely complete. Generally they consist of examples of the foliage and detached fruits picked up from the ground beneath the lofty trees'. Later authors have maintained Dyer's sections, Symington (1943, 153) again stating that material was still often inadequate, and flowering collections few. I have been able to examine the flowers of most species in Brunei, though in several they are still unknown; they furnish good specific characters in some cases, but I have not been able to correlate flower characters with others in a natural classification. The genus is very isolated, and extremely homogeneous in spite of its size. In some species it is impossible to make more than an arbitrary decision as to whether the lateral processes of the fruit calyx tube are wings or angles or tubercles. Thus the fruit of *D. globosus* Vesque can be angled, spherical, or tubercled, the 3 types sometimes being found together in mature fruits on a single tree; the fruit of *Dipterocarpus exalatus* V. Sl. has prominent apical tubercles, but also thick ribs which could be described according to personal opinion either as angles or stout wings; the fruit of *D. acutangulus* Vesque and some other species are angled when mature but appear narrowly winged before the calyx tube has swollen to its full proportions. I feel that Dyer's divisions have hence lost their usefulness, and as they have never been claimed as natural infrageneric taxa I prefer not to recognise them.

Following Recommendation 75a of the International Rules of Botanical Nomenclature I have treated the generic name as masculine, and not feminine as did van Slooten (1927, 1941, 1961).

In order to eliminate Blanco's dubious genus *Mocanera,* in which he originally put all Philippine Dipterocarpaceae that he could not place in *Vatica,* I have chosen *D. gracilis* Bl. (of which *Mocanera verniciflua* Blanco is a synonym) as Lectotype and reduced the genus to *Dipterocarpus*. No types of any *Mocanera* species exists, and we must depend for their interpretation largely on the evidence of Merrill (1918).

The identity of Dipterocarpus tampurau Korth.

D. tampurau (Korth., 1841, 63) is founded on an unnumbered collection of his with leaves and fallen fruit (at BO, U, L,), from Karaoe, Baritto R., S. of Boentok, Borneo. Burck (1887, 198) reduced *Dipterocarpus crinitus* Dyer to *D. tampurau*, though later authors have maintained Dyer's name. It is clear that the leaves come from a sapling of *D. crinitus;* the fruit, with large globose calyx lobes, can safely be identified as *D. hasseltii* Bl. (1828, 22). I therefore choose the fruit of the Leiden sheet as Lectotype, reducing the name *D. tampurau* to the earlier *D. hasseltii*, and thus eliminate this unsatisfactory name.

D. gracilis Bl., Bijdr. 5 (1825) 224.

Type: Blume 1256, fl., G. Parang, W. Java (L, PC, K, CAM).

—*D. pilosus* Roxb., Fl. Ind. 2 (1832) 615, fide Parker, Ind. For. Rec. 13 (1927) 15.

—*Mocanera verniciflua* Blanco, Fl. Filip., ed. 1 (1837) 450.

—*D. marginatus* Korth., Kruidk (1841) 64.

Type: Korthals s.n., st., G. Bahai, S. Borneo (L).

—*D. vernicifluus* Blanco, id., ed. 2 (1845) 314.

—*D. fulvus* Bl., Mus. Bot. 1, 2 (1852) 37.

Holotype: Perrotet no. 1, fr., Manila (L).

—*?Anisoptera palembanica* Miq., Sum (1862) 485.

Holotype: Teysmann 3694 H.B., st., Ogan Hoeloe, near Batoeradja, Palembang, Sumatra (U).

—*D. velutinus* Vidal, Pl. Vasc. Filip (1886) 59.

Type: Vidal 80, fr., Angat, Prov. Bulacan, Luzon (K).

—*D. bancana* Burck, Ann. Jard. Bot. Btzg. 6 (1887) 196.

Type: Teysmann s.n., Bangka (BO, L).

—*D. skinneri* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 91, var. *hirtus* Ridl. excl.

Type: Curtis 1403, fr. Penang (K, CAL)

—*D. vanderhoevenii* K. et V., Bull. Inst. Bot. Btzg. 2 (1899) 3.

Syntypes: Koorders 11427B–11429B, fr., Soebah, Pekalongan, Sumatra (BO, L).

—*S. mollis* Boerl., Cat Hort. Bog. 2 (1901) 110.

Type: Boerlage s.n., st., from tree no. VIII. D. 53 in Hort. Bog (BO).

—*D. angustialatus* Heim, Bot. Tidsskr. 25 (1903) 43.

Holotype: Schmidt no. 686a, fr., Klong Son, Thailand (CP).

—*D. schmidtii* Heim, loc. cit.

Holotype: Schmidt no. 578a, fr., Lem Dan, Thailand (CP).

The synonymy has already been discussed by van Slooten (1927, 276), and Symington (1938, 321). Smitinand (1958, 32) has reduced *D. angustialatus* Heim here. I have been able to check the authentic material and confirm their conclusions. Van Slooten included *D. lampongus* (Scheff., Nat. Tijd. N.I. 31 (1870) 346) as a synonym. This species is based on two Teysmann collections from S. Sumatra,—Teysmann s.n. fr. Kebang (L, K, not seen by van Slooten) and s.n., fr., Tarabangi (BO, L, K). Van Slooten considered that the fruit of the latter represent this species, while leaves represent *D. trinervis* Bl. He drew this conclusion as the fruit calyx lobes have short lateral nerves, unlike the latter species. The more abundant material now available proves this character to be variable, and I regard both collections as representing *D. hasseltii*, a species whose fruit are indistinguishable from those of *D. gracilis*.

I have further added *D. marginatus* Korth. to the synonymy. This species is described from sterile young saplings collected by Korthals, and which are quite typical of saplings of *D. gracilis*, bearing the same rufous tomentum and nervation as in the mature tree. Dyer (1874b, 105) added unnumbered De Vriese collections from W. Borneo. These consist of sapling leaves and fallen fruit; the leaves are more sparsely tomentose, are considerably larger (28–50 × 11–20 cm.), and with a much longer (4–8 cm.) petiole, than those of Korthals' specimens. De Vriese's specimens should be referred to *D. coriaceus* V. Sl.; the large glabrous fruit with narrow winged calyx tube is unequivocal and quite unlike that of *D. gracilis*. Neither Van Slooten (1927, 329, 331) nor other authors seem to have noticed this. Van Slooten remarks that the Bogor duplicate of the 'authentic specimen' bears a fallen fruit, whereas Korthals states that the fruit were not collected; it is evident from his leaf descriptions that van Slooten only saw De Vriese collections.

D. caudiferus Merr., Philip. J. Sc. 29, 3 (1926) 398.

Holotype: Castro and Melegrito 1709, fallen fruit and leaves, Banguey Island, N. Borneo (UC).

—*D. macrorrhinus* V. Sl., Bull. Jard. Bot. Btzg. 3, 8 (1927) 300.

Lectotype: b.b. 480, fr., Tanahboemboe, S.E. Borneo (BO).

—*D. kutaianus* V. Sl., id. 3, 16 (1940) 437.

Syntypes: b.b. 19458, fl., Semblimbingan, Pulau Laut (BO); b.b. 14965, y. fr., nr. Meridan, Balikpapan, S.E. Borneo (BO); S A 0427, y. fr., Balleh, Ulu Rejang (KEP).

Van Slooten states that his *D. macrorrhinus* is based on b.b. 480, though citing 4 other sterile collections; I cite it as Lectotype therefore. He finally (1961, 459) himself correctly reduced it to *D. caudiferus*.

D. kutaianus is founded on specimens differing from those of the other names in the hispid twigs and buds, and the unconstricted neck of the fruit calyx tube. The first character is typical of immature trees, the second of unripe fruit; I have no doubt that it should be reduced here.

Foxworthy (Philip. J. Sc. 67 (1938) 257) incorrectly reduced this species to *D. warburgii* Brandis, which differs in the larger lamina, long rufous tomentum, and tuberculate fruit calyx tube.

D. humeratus V. Sl., Bull. Jard. Bot. Btzg. 3, 8 (1927) 308.

Syntypes: Forbes 3019, fl., between Soeroeloengoen and Loeboekmas, Palembang, Sumatra (BO, BM); F.R.I. no. E. 946, fl. (BO, K, PC), E 947, fl. (BO), E 1150, fr. (BO, K), Lematang Hilir, Palembang; b.b. 2302, st., S. Redjang, Loeboek Bindjai, W. Sumatra (BO).

—*D. validus* sensu Brandis, J. Linn. Soc. Bot. 31 (1895) 37, pro parte, quoad spec. Forbes.

—*D. gibbosus* V. Sl., id., 311.

Syntypes: Boden Kloss 14452, fr., P. Siberoet, Mentawai (SING) Boden Kloss 14633, fr., P. Pagai (BO, SING, K); Boden Kloss 14719, st. (SING, K), 14749, fr. (SING, K), Iboet 471, fr. (BO), P. Sipora.

Diagnostic Characters. Fruit calyx glabrous; tube –4 cm. diam., subglobose, thickly incrassate, frequently somewhat verrucose, with 5 prominent obtuse apical tubercles. Lamina 20–38 $\times$ 12–33 cm., large, broadly ovate; nerves 20–25 pairs; petiole 4–6 cm. long. Young twigs, petiole, midrib and nerves below persistently shortly cream pubescent; leaf bud and stipule outside densely long fulvous tufted tomentose.

D. gibbosus is based on fallen fruit and leaves; the leaves are identical with those of many Borneo collections, also rarely obtuse as in Van Slooten's syntypes. The calyx tubes of the *D. gibbosus* syntypes are yet more incrassate, and the tubercles are merged together; I do not regard this as outside the expected range of variation for this species and have no doubt that they are conspecific. Boden Kloss 14719 possesses fruit of *D. hassettii* Bl. at Kew .

The Forbes collection was cited as *D. validus* by Brandis (see there).

The identity of D. elongatus Korth.

D. elongatus Korth (Kruidk. 1841, 62) is based on Korthals, s.n., S. Poenin, Baritto, S. Borneo (L,K), being single sheets with large fallen leaves bearing 30–36 pairs of nerves. Of the three species, *D. humeratus* V. Sl., *D. warburgii* Brandis, and *D. apterus*, Foxw., resembling it, only *D. apterus* has so many nerves in the mature tree; as the somewhat attenuate shape suggests that the tree was young, this is not confirmatory; the absence of a short petiolar tomentum excludes *D. humeratus*, and the riverain habitat recorded by Korthals suggests *D. apterus*. Pierre (1891), Heim (1892), and authors contemporary to them used the petiole anatomy, and particularly the arrangement of the vascular bundles as seen in transverse section at the distal end, known as the 'caractéristique', as a guide to classification and species determination. I find that in the large leaved *Dipterocarpus* species under discussion, with their complex petiole anatomy, the 'caractéristique' can provide good characters for specific determination: *D. apterus* has a 'caractéristique' with c. 6 arcs of vascular bundles, the 3rd and 4th coalescing to form bands, shared only with *D. warburgii*. Owing to the scantiness of the Type of *D. elongatus* I have not been able to examine the petiole anatomy. I therefore prefer to leave the name a Nomen Dubium, though it most resembles *D. apterus,* and hence concur with Van Slooten's (1961,474) decision.

The identity of D. validus Bl.

D. validus Bl. (Mus. Bot. 2 (1852) 36) is described from Korthals s.n., G. Sakoembang, S. Borneo (L, K), consisting of leafy twigs. Dyer (1874b, 108) considered it conspecific with *D. lowii,* which differs, *inter alia,* in lamina shape, nervation, and tomentum. Brandis (1895, 37) included a Sumatran collection that later became a syntype of *D. humeratus,* which resembles it in the 22–26 pairs of nerves but differs in the short petiole tomentum; the number of nerves is as *D. warburgii,* the 'caractéristique' (see under *D. elongatus*) as *D. warburgii* and *D. apterus;* I have little doubt that *D. warburgii* should be reduced to *D. validus*. Further confirmation is given in the shorter, denser, darker tomentum and darker lamina colour than *D. apterus,* as in *D. warburgii.*

D. eurynchus Miq., Sum (1862) 485.

Type: Teysmann s.n., st., Bangka (BO, U, L, K).

—*D. eurynchoides* Scheff., Nat. Tijd. N.I. 31 (1870) 346.

Type: Teysmann s.n., st., Batoe Balai, prope Muntok, Bangka (BO, U, L, K).

—*D. appendiculatus* Scheff., id (1870) 347.

Type: Teysmann s.n., fr., Gunong Menoembing, prope Muntok, (BO, L, U).

—*D. micropterus* Dyer ex. V. Sl., Reinwardtia 5, 4 (1961) 428 nomen pro syn.

In the oblique nervation and the narrow caudate-acuminate lamina the Types of *D. eurynchus* and *D. eurynchoides* clearly represent sapling collections. The latter has slightly larger leaves than the former, and it is surprising that Scheffer felt confident enough to consider it specifically distinct. The Type of *D. appendiculatus* is from a mature tree. Dyer (1874b, 104) united *D. acutangulus* Vesque with it; this interpretation was followed by subsequent authors until Van Slooten (1927, 326) correctly pointed out that *D. appendiculatus* has a winged calyx tube as Scheffer, but not Dyer, maintained, unlike the angular tube of *D. acutangulus*. Van Slooten (1961, 458) further mentions the nomen *D. micropterus,* written by Dyer on an unnumbered Beccari fruiting specimen at Florence, as a synonym.

I consider that *D. eurynchus* and *D. eurynchoides* are conspecific and that *D. appendiculatus* should be united with them. Of the known small leaved *Dipterocarpus* species *D. borneensis* V. Sl., *D. palembanicus* V. Sl., and *D. acutangulus* Vesque share the same short obtuse hispid leaf bud, though in D. borneensis the tomentum is shorter and rust-brown. Van Slooten, (1927, 302) considered *D. eurynchus* and *D. eurynchoides* possibly conspecific with his *D. macrorrhinus* (i.e. *D. caudiferus,* in which the bud is linear, very long, and caducous pubescent), but commented on the very short petioles compared with the latter; they share a petiole length with *D. appendiculatus* shorter than any of the other above species, in which the petiole always exceeds 1.5 cm. long. The few (8–10 pairs) of nerves excludes *D. palembanicus* and *D. macrorrhinus;* the dark purplish brown dry lamina of *D. borneensis* further differs from these Bangka collections. The identity receives further confirmation in the petiole vascular configuration at the 'charactéristique' (see under *D. elongatus*); *D. eurynchus, D. eurynchoides,* and *D. appendiculatus* differ from *D. borneensis* and *D. acutangulus* in possessing a united inner arc of fused vascular bundles, and from *D. borneensis* which has very large resin canals.

Thus *D. eurynchus* Miq. is the only small glabrescent leaved *Dipterocarpus* known from Bangka.

D. stellatus Vesque, Compt. Rend. Paris, 78 (Mar. 1874) 626.

Syntypes: Beccari 2555, fr., Matang, Sarawak (PC, K); Beccari 2907, fr., Sarawak (PC, K).

—*D. nobilis* Dyer, J. Bot. 12 (Apr. 1874) 106.

Syntypes: Beccari 2555, 2907 (K, PC).

Dyer (1874c, 153) later admitted the precedence of Vesque's name. I have found no evidence to support Van Slooten's (1961, 465) suggestion that the syntypes may represent a hybrid between *D. grandiflorus* (with identical fruit, but glabrous leaf) and another species; the many and widespread collections confirm that it is a separate distinct species. I recognise two distinct geographical variants; the differences are mainly of size, and I do not, on the material available, consider them to merit specific status, though intermediate forms are not yet known.

ssp. *stellatus.* Lamina 20–25 $\times$ 12–16 cm., basim versus subcordata, ad apicem prominente acuminata; petiolus 4–5 cm. longus; ramuli—7 mm. diam; racemi—20 cm. longi. W. Sarawak.

ssp. *parvus,* ssp. nov. Lamina 10–15 $\times$ 5–7 cm., basim versus obtusa, ad apicem plus minus breviter acuminata. Petiolus c. 2 cm. longus; ramuli c. 2 mm. diam.; racemi—10 cm. longi. Brunei, N. Borneo.

Collections: Brunei: Brun 3176 (Holotypus in Herb. Kew), 3008, 483, S 5799, Bangar; Brun 3138, Bt. Biang; Brun 77, Lamunin, K. Abang. Rd. North Borneo: San 15403, Leila F.R., Sandakan; San 15131, Sipitang.

D. acutangulus Vesque, Compt. Rend. Paris, 78 (1874) 626.

Holotype: Beccari 2913, fr., Sarawak (PC).

—*D. tawaensis* V. Sl., Bull. Jard. Bot. Btzg. 3, 8 (1927) 313.

Type Elmer 21839, fr., Elphinstone Prov., Tawau, North Borneo (BO, K, PC, L, BM).

—*D. helicopteryx* V. Sl., Bull. Jard. Bot. Btzg. 3, 16 (1940) 441.

Lectotype: b.b. 19811, fr., Nunukan, Bulungan, N.E. Kalimantan (BO).

Dyer (1874 c, 152) reduced *D. acutangulus* to *D. appendiculatus* Scheff., with which I do not agree (see under *D. eurynchus*). The slightly different fruit dimensions quoted by Van Slooten for *D. tawaensis* are not sufficient to merit separation, and the material now available shows continuous variation between the two; on other characters they are identical. Under *D. helicopteryx* Van Slooten cites 13 numbers. For facility of citation I choose b.b. 19811 as Lectotype, as many of the other collections are sterile; apart from Kep 35543, which I consider to be *D. globosus,* I regard all the other collections as belonging to Vesque's species. The single character by which Van Slooten's description of *D. helicopteryx* differs from those of the other two is that the longer fruit calyx lobes are twisted like a propellor, a feature found to greater or lesser extent in all dipterocarp fruits, and by itself of no diagnostic value. He states '. . . the present species resembles *D. tawaensis* V. Sl., from which it is manifestly distinct in vegetative and fruit characters, as also is *D. acutangulus* Vesque'. These manifest differences are not enumerated by him.

D. geniculatus Vesque, Compt. Rend. Paris, 78 (Mar. 1874) 626.

Holotype: Beccari 3034, fr., Sarawak (PC).

—*D. angulatus* Dyer, J. Bot. 12 (Apr. 1874) 104.

Holotype: Beccari 3034 (K).

Dyer (1874c, 150) himself recognised precedence of Vesque's name.

There are two well defined geographical forms, differing in the size of all parts but otherwise identical; intermediate forms have not yet been observed, but may well be found when Central Sarawak, where the tree has not been collected, is explored.

ssp. *geniculatus*. Lamina 7–12 × 5–7 cm.; petiolus 3–5 cm. longus; ramuli –7 mm. diam., fructus lobis longioribus 2,—12 × 2.5 cm. W. Borneo, W. Sarawak.

ssp. *grandis*, ssp. nov. Lamina 20–35 × 12–16 cm; petiolus 8–10 cm. longus; ramuli—13 mm. diam.; lobis longioribus 2,—15 × 4 cm. Brunei, North Borneo.

Collections: Brunei: 37088, 80091, 48464, S 2170, Brun 3064, 3269, Andulau F.R.; Kep 30586, S. Tutong; Kep 28658, Bt. Kerita, Ladan Hills; S 1870, Ladan Hills F.R. (Holotypus in Herb. Kep), Brun 74, Mile 8½, K. Abang Rd.; Kep 35666, 48106, Labi Hills F.R. North Borneo: San A4051, 15132, Sipitang.

D. conformis V. Sl., Bull. Jard. Bot. Btzg. 3, 17 (1941) 102.

Holotype: b.b. 29177, fr., Aloer Boeaja, Langsa, Atjeh, Sumatra (BO).

Borneon collections are constantly smaller in all parts, and the tomentum is shorter. I regard them as constituting a separate subspecies.

ssp. *conformis*. Lamina 20–24 × 12–15 cm., nervis lateralibus utrinsecus 14–16. Petiolus 5–6 cm. longus. Tubus calycis in fructu alis 5,—1 cm. latis. Sumatra.

ssp. *borneensis*, ssp. nov. Lamina 9–12 × 5–7 cm., nervis lateralibus utrinsecus 15–18. Petiolus 1.7–2.5 cm. longus. Tubus calycis in fructu alis 5,—3 mm. latis. Borneo.

Collections: *Brunei:* Brun 3130, 2602, Kuala Temburong Machang; Brun 3390, 5673, S 5715, 5741, Kuala Belalong; Brun 738, Kuala Sekurop, Temburong. *North Borneo:* San 15102, Pangi (Holotypus in Herb. Leiden).

CHANGES IN DRYOBALANOPS Gaertn. f.

D. aromatica Gaertn. f., De Fruct. 3 (1805) 49.

Holotype: Charles Miller s.n., leaves and one ripe fruit. Tapanuli, Sumatra (BM).

—*Pterigium teres* Correa, Ann. Mus. Hist. Nat. Paris, 10 (1807) 159.

—*D. camphora* Colebr., As. Res. 12 (1816) 535.

—*Shorea camphorifera* Roxb., Fl. Ind. 2 (1832) 616.

—*Dipterocarpus dryobalanops* Steud., Nomencl. Bot., ed. 2, 1 (1840) 518.

—*Dipterocarpus teres* (Correa) Steud., loc. cit.

—*Dryobalanops junghuhnii* Becc., For. Born (1902) 554.

—*Dryobalanops vriesii* Becc., loc. cit.

No Types of Correa's, Roxburgh's, or Colebrooke's names have been found by me, though Correa's illustration closely resembles the fruit of Gaertner's Type. Beccari's species are based on the illustrations in De Vriese (1861). Van Slooten (1932, 7) has discussed the synonymy. I, unlike him, saw the Holotype. I have checked his conclusions; he cites as a synonym *Shorea costata* Pressl (Rostl. 2 (1846) 66), adding 'fide Index Kew'. Index Kewensis is wrong; this is a synonym of *Dipterocarpus costatus* Gaertn. f.

Gaertner's statement that the Holotype originated from Ceylon is erroneous; Miller gives a detailed note on it's origin and uses on a label attached to the sheet.

D. beccarii Dyer, J. Bot. 12 (1874) 100.

Syntypes: Beccari 2553, fr., Matang, Sarawak (K, PC); Beccari 2944, fr., Sarawak (K, PC).

—*D. oiocarpa* V. Sl. ex Heyne, in Den. Berger et Endert, Med. Proefst. Boschw. 11 (1925) 107; Nutt. Pl. N. I. ed. 2, 2 (1927) 1106, nomen nudum.

—*D. oocarpa* V. Sl., Bull. Jard. Bot. Btzg. 3, 12 (1932) 33.

Lectotype: Endert 5108, y. fr., G. Kombeng, W. Kutei (BO).

Diagnostic Characters. Fruit calyx lobes –6.5 × 0.8 cm., arising from an –8 mm. diam., –5 mm. deep, obconical cup. Nut –1.4 × 1.4 cm., ovoid, subacute. Lamina 5–8 × 1.3 cm., ovate to lanceolate, relatively thin; nerves slender but distinct, pale; with slender but pale, distinct, intramarginal nerve.

Van Slooten (id., 26) has already pointed out that Malayan collections cited by Ridley under the mis-spelling *D. beccariana* should be referred to *D. oblongifolia* Dyer. Van Slooten did not see the Kew syntypes on which Dyer based the species; the Bogor material was apparently poor (not seen by me). A sheet numbered Beccari 2994 at Bogor was considered by Burck (1887, 243) to be an iso-syntype, 2994 being an error for 2944. Van Slooten described the lamina on this specimen as only –5 cm. long and pubescent below, which is not the case with 2944 at Kew; I doubt therefore whether this Bogor sheet is an iso-syntype. It may be this that prevented van Slooten from identifying his *D. oocarpa* with *D. beccarii;* he mentions no diagnostic characters by which the two may be differentiated. All the 33 numbers of *D. oocarpa* cited by van Slooten, and examined by me at Bogor and Leiden, I consider to represent Dyer's species; they all originate from E. Borneo, whereas W. Borneo specimens are cited by him as *D. beccarii.* I have chosen Endert 5108 as Lectotype of *D. oocarpa* for ease of citation.

D. rappa Becc., For. Born. (1902) 572.

Holotype: Beccari s.n., st., plain near Kuching (FI).

—*D. oblongifolia* sensu Wyatt-Smith, Mal. For. 18 (1955) 153.

Wyatt-Smith cites sapling and pole species from Brunei and Western North Borneo as his only records of *D. oblongifolia* Dyer in Borneo, but does not mention the Beccari syntypes of that species from Sarawak. The sapling leaves of *D. rappa* are larger and narrower than those of the mature tree, and are glabrous; they differ notably from those of *D. oblongifolia* however in drying a distinct rust-brown, not olive. *D. oblongifolia* has never been found in peat swamp or Heath forest, to which *D. rappa* is confined.

CHANGES IN COTYLELOBIUM Pierre.

C. burckii (Heim) Heim, Rech. Dipt (1892) 122.

—*Vatica burckii* Heim, Bull. Mens. Soc. Linn. Paris, 2 (July 1891) 956.

Syntypes: Beccari 3260, fr., Sarawak (K, PC); Beccari 3261, fr., loc. cit (K, PC).

—*C. flavum* Pierre, Fl. Coch. 17 (Oct. 1891) tab. 258a.

Syntypes: Beccari 3389, fr., Danau Lamadjang, W. Kalimantan (PC, K); Beccari 3261 (PC, K).

—*C. asperum* V. Sl., Bull. Jard. Bot. Btzg. 3, 10 (1928) 401.

Holotype: Omar 112, fr., S. Rumbungan, Sarawak (KEP).

One of the syntypes of *V. burckii* Heim, later transferred by him to *Cotylelobium,* is also a syntype of Pierre's later species; Brandis (1895, 115) reduced *C. burckii* to *C. flavum.* Van Slooten (1929, 326), without access to the syntypes, applied the name *C. flavum* to material which he later (1932, 43) had to describe as a separate species *C. malayanum,* and at the same time created the name *C. asperum* for the material which should have been referred to *C. flavum.* Later (1932, 43), having seen the authentic material, he corrected his misinterpretations but continued to give precedence to Pierre's name. He had been misled by Ridley (1922, 239) who had erroneously associated Malayan collections of *C. malayanum* with *C. flavum.*

VATICA Linn., Mantissa, 2 (1771) 152.

Type: *V. chinensis* Linn.

—**Seidlia** Kostel., Allg. Med.-Pharm. Fl. 5 (1836) 1945.

Type: *Seidlia lanceaefolia* Kostel.

—**Vateria** sensu Arn., Ann. Nat. Hist. 1, 3 (1839) 155, pro parte, quoad *V. lanceolata* Arn.

—**Retinodendron** Korth., Kruidk (1840) 55.

Types: *R. lanceaefolia* (Kostel) Korth., *R. pauciflora* Korth., *R. rassak* Korth.

—**Isauxis** (Arn) Reichb. Nom (1841) 210.

Types: *I. lanceolata* (W. et A) Reichb., *I. roxburghiana* (W. et A) Reichb.

—**Pteranthera** Bl., Mus. Bot. 2 (1852) 30.

Types: *P. sinensis* (Blanco) Bl., *P. mangachapoi* (Blanco) Bl.

—**Sunaptea** Griff., Notul. 4 (1854) 516.

Type: *S. odorata* Griff.

—**Anisoptera** sensu Hassk., Retzia, 1 (1856) 140, quoad *A. bantamensis* Hassk; Kurz, Flora (1872) 190, quoad *A. odorata* (Griff) Kurz.

—**Synaptea** Kurz, J. As. Soc. Beng. Sc. 39, 2 (1870) 65.

Types: *S. odorata* (Griff) Kurz, *S. grandiflora* Kurz, *S. bantamensis* (Hassk) Kurz.

—**Pachynocarpus** Hook. f., Trans Linn. Soc. 23 (1860) 159.

Type: *P. umbonatus* Hook. f.

—**Eleaogyne** Miq., Sum (1860) 460.

Type: *E. sumatrana* Miq.

The identity of the type

In the Linnean herbarium are two collections, no. 614.1 and no. 614.2, both in the same stage of flowering, and both of which almost undoubtedly were collected simultaneously off the same tree. On the obverse side of 614.1 is a Latin description in Linnaeus' hand that is a modified form of the generic description he published in the Mantissa, presumably the preliminary version. On 614.2 the word India is written, again in his handwriting. 614.1 must represent the Holotype of the species *V. chinensis* Linn (id (1771, 242) and the genus; the specific epithet is presumably a mistake, one that occurs in several genera, as has been pointed out be Stearn (1957, 144).

There has been a controversy as to the identity of Linnaeus' species. Bentham and Hooker (1862, 192) considered *Hopea grandiflora* Wall., a nomen nudum in Wallich's catalogue, as a synonym of *V. chinensis,* the latter being cited as '*Vatica indica* Linn. (species indica nec chinensis)'. Dyer (1874a, 302) considered Linnaeus' species conspecific with *V. roxburghiana* (W. et A) Bl. of Ceylon and S. India, unaccountably maintaining Blume's name against Linnaeus'. Brandis (1895, 117) accepted Dyer's conclusion but reduced Blume's name.

There is a striking similarity when in flower between *V. odorata* (Griff) Sym., with which *H. grandiflora* is synonymous, and *V. roxburghiana,* though the latter possesses subequal partially reflexed fruit calyx lobes that are free to the base, whereas in *V. odorata* the lobes are distinctly unequal, unreflexed, and united at the base into a cup adnate to the ovary. I have examined the Linnean specimens and consider Dyer to be correct; the more coriaceous lamina and (2) 3–4 cm. long petiole in my opinion excludes the possibility of identifying *V. odorata* with *V. chinensis,* and the specimen is in every way typical of *V. roxburghiana.* As shall be seen, the two interpretations have led to considerable nomenclatural confusion.

Generic synonymy

Seidlia lanceaefolia Kostel. is described from the Wallich specimen no. 4405, determined in the latter's Catalogue as *Vateria lanceolata.*

Arnott (1839, 155) described his *Vateria roxburghiana* (synonymous with Linnaeus' Type species) and placed it in a new subgenus Isauxis, at the same time transferring Kosteletsky's genus to it; the subgenus differed from the Type subgenus in the relatively few (15) subglobose, not elongate, stamens. Reichenbach (1841) gave Isauxis generic rank.

In 1840 Korthals described *Retinodendron,* with two new species, *R. rassak* and *R. pauciflora,* described from his Borneon collections; he also transferred *S. lanceaefolia* to his genus, though he did not recognise precedence of Kosteletsky's generic name.

Blume (1852, 31) united *Retinodendron* and *Isauxis* with *Vatica. Vatica sinensis* Blanco and *Vatica mangachapoi* Blanco, described in the first edition of the Flora de Filippinas (1837), of which no Types exist, he placed in a new genus *Pteranthera* on the basis of Blanco's descriptions. He was puzzled by Blanco's allusion to 'antherae . . . 4-alatae', in the description of *V. sinensis. Bentham* and Hooker (1862, 192) suggested that Blume's action was unjustified; De Candolle (1868, 623) retained the binomial *V. mangachapoi,* stating 'antheris vero non alatis (valvis inapertis?)', though he considered it of uncertain affinities. Subsequent authors have interpreted Blanco's antherine wings as dehisced valves, though in the absence of authentic material this is pure speculation (see under *V. mangachapoi*).

In 1854 Griffith described *Sunaptea* from specimens collected by himself at Mergui and named by him *S. odorata.* The fruit differed from *Vatica* as then understood owing to the unequal length of the calyx lobes, which were united at the base forming a cup adnate to the nut. Kurz (1870, 65) maintained that Griffith's name must be a reprint for *Synaptea,* and added two other species. *S. grandiflora* Kurz, based on *H. grandiflora* Wall., nomen nudum, and *S. bantamensis* (Hassk) Kurz, described originally by Hasskarl as an *Anisoptera.* Kurz later (1872, 190) united *S. grandiflora* under *S. odorata* and transferred it to *Anisoptera;* this combination was not accepted by later authors. I retain Griffith's original spelling as Griffith, in explaining the choice of the name, uses the misspelling twice and clearly intended to use it therefore. Unfortunately all subsequent authors except Heim have adopted Kurz's spelling.

J. D. Hooker in 1860 described a plant collected by Motley on Labuan as *Pachynocarpus umbonatus;* he noted the close similarity of the flowers to those of *Vatica,* but considered that the curious fruit with corky pericarp and adnate corky sepals was sufficiently unique to merit separate generic status.

De Candolle (1868, 617) united Thwaites' Ceylonese genus *Stemonoporus* with *Vatica*. Dyer (1874a, 314) created a new section for *Stemonoporus* in *Vateria* Linn., where it has remained in later publications but for a brief period when it was reinstated as a genus by Heim (1892, 112). Dyer also reduced *Sunaptea* to *Vatica*. Burck (1887, 223) argued that *Pachynocarpus* Hook. f., as well as *Sunaptea* Griff. should be united with *Vatica* owing to their similar floral structure and anatomy. In the generic synonymy he further listed *Anisoptera melanoxylon* Hook. f., following Miquel (1867, 85), though he did not describe the species and evidently saw no specimens. Pierre (1889–91, sub tab. 235 and 258) cited *A. melanoxylon* as the Type species of his genus *Cotylelobium*. Pierre (id., tab. 240–2) again separated *Sunaptea* from *Vatica*, on the basis of the presence of endosperm in the ripe fruit and the structure of the embryo.

Heim (1892, 96–117) radically differed from his immediate predecessors, especially Burck, whose work he critically reassessed. Heim, accusing Burck of basing his decisions almost entirely on anatomical evidence, and ignoring external morphology (which accusation was hardly justifiable) divided *Vatica* again into the following series and genera:

Seriées *Vaticées:* Fruit calyx lobes equal. resin canals medium sized, outer arc of petiolar vascular bundles closed.

Genus *Vatica* (including *Isauxis*). Fruit calyx lobes longer than nut.

Genus *Retinodendron* Korth. Fruit calyx lobes shorter than nut.

Genus *Pachynocarpus* Hook. f. Fruit calyx lobes coalescing and adnate to the nut.

Seriées *Sunapteées*. Fruit calyx lobes unequal, resin canals relatively large, outer arc of petiolar bundles open ventrally.

Genus *Sunaptea* Griff.

He tentatively put *Pteranthera* Bl. in his series Vateriées, commenting that Blanco's floral description could well fit *Stemonoporus,* a genus up till the present only definitely known from Ceylon.

Brandis and Gilg (1895, 268) again united these genera with *Vatica,* with the exception of *Pachynocarpus,* though Ridley (1922, 240) continued to maintain *Sunaptea* (as *Synaptea*). *Pachynocarpus* was finally reunited by van Slooten (1927, 72). I am in agreement with van Slooten's and Burck's generic concept; both in the field and in the herbarium it is impossible to subdivide *Vatica* on any other character than that of the fruit calyx; the flowers, the leaf nervation, bark appearance, and wood anatomy are very uniform throughout the genus.

SUMMARY OF THE HISTORY OF THE INFRAGENERIC SUBDIVISIONS OF VATICA

UNEQUAL FRUIT CALYX LOBES.		EQUAL FRUIT CALYX LOBES.			Diagnostic. Characters.
Lobes free to base.	**Lobes united in a shallow cup.**	**Lobes shorter than ripe fruit.**	**Lobes as long as, or exceeding length of ripe fruit.**	**Lobes corky, coalescent, adnate to fruit.**	
			(*Vatica chinensis* Linn., *Type of the genus*.		**Authors.**
Sect. Euvatica. Type: V. chinensis sensu Benth. et Hook. f (=V. odorata (Griff) Sym.)		*Sect. Isauxis (Arn) Benth. et Hook. f.* Type: V. roxburghiana (Arn) Benth. et Hook. f (=V. chinensis Linn).		Genus Pachynocarpus Hook. f. Type: P. umbonatus Hook. f.	**Bentham and Hooker (1862)**
Incertas sedis.		*Sect. Euvatica* (also Sect. Stemonoporus, = Gen. Stemonoporus Thw.) *Division* 1. (incorrectly including V. chinensis Linn.).	*Division* 2.	Genus Pachynocarpus.	**De Candolle (1868)**
Sect. Euvatica. ?Type.		*Sect. Isauxis (Arn) Benth. et Hook. f.* (including here V. chinensis Linn.).		Genus Pachynocarpus.	**Dyer (1874)**
Sect. Euvatica. ? Type.	*Sect. 'Synaptea' (Griff) Burck.* Type: V. odorata (Griff) Sym.	*Sect. Retinodendron* (Korth) *Burck.* Types: R. rassak Korth., R. pauciflora Korth. R. lanceaefolia (Kostel) Korth.	*Sect Isauxis.*	*Sect. Pachynocarpus (Benth. et Hook. f) Burck.*	**Burck (1887)**
Genus Sunaptea Griff.		Genus Retinodendron Korth	*Sect. Isauxis.* (Sect. Euvatica not understood by Heim).	Genus Pachynocarpus.	**Heim (1892)**
Sect. Euvatica.	*Sect. 'Synaptea'.*	Genus Retinodendron.		Genus Pachynocarpus.	**King (1893)**
Subgenus 'Synaptea'.		*Subgenus Retinodendron.* (including V. chinensis Linn).	*Subgenus Isauxis.*	Genus Pachynocarpus.	**Brandis (1895)**
Subgenus 'Synaptea'.		*Subgenus Isauxis.*		*Subgenus Pachynocarpus.*	**Van Slooten (1927)**
Section Sunaptea (Griff) Burck. Type: V. odorata (Griff) Sym.		*Section Vatica.*		*Sect. Pachynocarpus (Hook f.) Burck.* Type: V. umbonata (Hook f.) Burck.	**Present Classification.**

Subgeneric divisions

Bentham and Hooker (loc. cit) recognised that the species in Arnott's *Isauxis* shared with those described under *Retinodendron* Korth. subequal fruit sepals, and united the two under the former name as a section. Their other section, Euvatica, contained the species with unequal fruit calyx lobes,—*Anisoptera bantamensis* Hassk., *A. melanoxylon* Hook. f., and *V. indica* (i.e. *V. chinensis* Linn., which they united with *H. grandiflora* Wall). *Sunaptea odorata* Griff., with which *H. grandiflora* is in fact conspecific, they cited as a species dubium allied to Euvatica, apparently having not at that time seen the excellent specimens of Griffith now at Kew.

De Candolle (id., 618) suggested different subdivisions, though he did not supply names for them. *Stemonoporus* Thw. having been united by him forms one section; the other *Vaticae* were divided again, on whether the fruit calyx was as long as the nut, or shorter and patent. In the first of these subdivisions he included *V. roxburghiana* (hence *Isauxis* Arn.), and in the latter *V. rassak* (hence *Retinodendron* Korth) and *V. chinensis* Linn. Species of Hooker's section Euvatica were excluded from the genus. It is not clear what interpretation De Candolle had of *V. roxburghiana*, in which the fruit calyx is patent and is hardly as long as the fruit. His interpretation of *V. chinensis* is based on the illustration in Smith (1789, 36) in which the Holotype is depicted and hence the calyx of the flower and not the fruit.

Dyer (loc. cit) inexplicably adopted Bentham and Hooker's classification, but as already mentioned, reduced *V. chinensis* to *V. roxburghiana* in section Isauxis, and maintained the name Euvatica for species with unequal fruit calyx lobes, including with them *Sunaptea* Griff (as *Synaptea*). Burck (loc. cit), considering only the East Indian species, recognised 5 sections. He created a new section Pachynocarpus (Hook. f.) Burck, but accepted De Candolle's basis for division and named two sections, Retinodendron (Korth) Burck, with shorter, and Isauxis (Arn) Benth. et Hook. f., with fruit calyx lobes longer than the nut. Isauxis contained the single species *V. venulosa* Bl (as *V. bancana* Scheff); unlike de Candolle, Burck based his classification on accurate information, but would have been forced, had the type species of Isauxis occured in the East Indies, to include it in section Retinodendron. Burck further differentiated between a section Euvatica, with unequal fruit calyx lobes free to the base, and Sunaptea (Griff) Burck, (as Synaptea), with unequal fruit calyx lobes united at the base and adnate to the ovary. In the latter he inaccurately included *V. bantamensis* (Hassk) Burck, in which the calyx is free, and in the former only his two species *V. borneensis* and *V. teysmanniana*, in the second of which the calyx is united and adnate to the ovary at the base. Burck makes no mention of *V. chinensis Linn.*, but we may presume that he accepted Bentham and Hooker's interpretation.

Little remained of *Vatica* after it had been redivided by Pierre and Heim. Heim made a critical reassessment of his two remaining sections, Euvatica sensu Benth. et Hook. f., and Isauxis (Arn) Benth. et Hook. f., properly questioning the true identity of Linnaeus' species in order to decide the correct nomenclature of the sections. He discusses the two interpretations, but reaches no conclusions, having presumably not seen the Type. Isauxis he maintains for *V. roxburghiana,* at the same time correctly stating that if Dyer were correct the name should be changed for Euvatica. In Euvatica sensu Benth. et Hook. f. he only includes *V. scaphula* Roxb (*Anisoptera scaphula* (Roxb) Pierre), *V. maingayi* Dyer, and *V. helferi* Dyer, as anomalous species of uncertain affinities; he at the same time implies that the section might have to be disbanded. *V. bancana* (i.e. *V. venulosa*) he did not see, but judged from the description to probably represent a separate genus.

King (1893, 102), considering only Malayan species, suggested that *Isauxis* should be excluded also as a separate genus, synonymous with *Retinodendron;* he accepted the latter name as it is the earlier used at generic rank. He retained Sunaptea in *Vatica,* and accepted two sections in the genus: Euvatica, with unequal fruit calyx lobes free to base; and 'Synaptea', with unequal lobes united at the base and adnate to the ovary. He accepted Bentham and Hooker's identification of *V. chinensis* Linn., but failed to note that by their interpretation the species had a calyx united at the base and adnate to the ovary. Thus King had accepted a concept of the sections that is the exact antithesis of De Candolle's twenty five years earlier.

Brandis (loc. cit) recognised three subdivisions, treating them as subgenera: Retinodendron, Isauxis, and Synaptea. He accepted Burck's interpretation of Isauxis, including in it *V. kunstleri* Brandis, *V. bancana* Scheff., and *V. schefferi* Brandis, which are in fact conspecific (see under *V. venulosa*). He transferred *V. chinensis* Linn. to section Retinodendron yet correctly reduced *V. roxburghiana* to Linnaeus' species. His retention of both names Retinodendron and Isauxis is unjustifiable; by his interpretation Retinodendron should have borne the generic name, while his Isauxis would require a new name as the Type of Isauxis had been reduced to *V. chinensis,* Type of the genus.

In the most recent classification, of van Slooten (1927, 72), Retinodendron was united with Isauxis, and two other divisions were accepted, Sunaptea (Griff) Burck (as Synaptea) and Pachynocarpus (Hook. f.) Burck; they ranked as subgenera.

Symington (1943, 211) accepted van Slooten's classification, but recommended, owing to the great similarity of all species on floral structure, that these subdivisions merited no higher a rank than sections. I am in agreement with this view; the subdivisions of *Vatica* are no better defined than those of *Shorea,* and I prefer to consider them as sections in both genera.

Accepting *V. roxburghiana* as a synonym of *V. chinensis* Linn., Section Isauxis thus becomes the Type section and must bear the generic name.

The definitions of the sections are as follows:

Section I. PACHYNOCARPUS (Hook. f) Burck, Ann. Jard. Bot Btzg. 6 (1887) 232.

Type: *V. umbonata* (Hook f) Burck.

—Gen. **Pachynocarpus** Hook f.

Calyx lobes thickened, corky, coalescing with each other and with the nut, forming a cup more or less enclosing it.

Distribution. 2 species: Malaya (1), Borneo (1).

Section II. VATICA.

—Gen. **Seidlia** Kostel.; **Vateria** sensu Arn (1839) pro parte, quoad sect. Isauxis Arn.; **Retinodendron** Korth., pro parte; **Isauxis** (Arn) Reichb.; **Eleaogyne** Miq.

—Sect. **Isauxis** (Arn) Benth et Hook. f., Gen. Pl. 1 (1862) 192. (Type: *V. chinensis* L (ut *V. roxburghiana* (Arn) Benth. et Hook. f)); **Retinodendron** (Korth) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 224.

Calyx lobes entirely free, subequal, frequently becoming reflexed.

Distribution. 40 species: Ceylon (3), S. India (1), S. China (1), Burma (7), Thailand (2), Indochina (6), Malaya (9), Sumatra (7), Borneo (15), Philippines (1), Moluccas and Celebes (1), Java (2), New Guinea (1).

Section III. SUNAPTEA (Griff) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 223 (ut Synaptea).

Type: *V. odorata* (Griff) Sym.

—Gen. **Sunaptea** Griff., **Pteranthera** Bl., **Anisoptera** sensu Hassk (1856) 140; **Synaptea** Kurz.

—Sect. **Euvatica** sensu Benth. et Hook. f., Gen. Pl. I (1862) 192; Dyer, in Hook. f., Fl. Brit. Ind. I (1874) 301; Burck, Ann. Jard. Bot. Btzg. 6 (1887) 224; King, J. As. Soc. Beng. Sc. 62, 2 (1893) 102.

Fruit calyx lobes unequal, thin, with 2 lobes longer than the other three, not becoming reflexed.

Distribution. 31 species: Burma (1), S. China (1), Thailand (2), Indochina (1), Malaya (10), Sumatra (3), Java (1), Borneo (17), Philippines (5), Celebes (1), Moluccas (1).

—**V. umbonata** (Hook. f) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 232.

Holotype: Motley s.n., fr., Labuan (K).

—*Pachynocarpus umbonatus* Hook f., Trans. Linn. Soc. 23 (1862) 159.

—*V. verrucosus* (Burck), loc. cit.

Type: Teysmann 11350 HB, fr., S. Landak, W. Borneo (BO, L, K).

—*P. verrucosus* (Burck) Heim, Rech. Dipt (1892) 107.

—*V. cupularis* V. Sl. ex Heyne, Nutt. Pl. ed. 2, 2 (1927) 1129, et Bull. Jard. Bot. Btzg. 3, 9 (1927) 132.

Syntypes: b.b. 364, y. fr., Assem Assem, Pleihari, S.E. Borneo (BO); b.b. 2130, very y. fr., loc. cit (BO).

The Holotype was not seen by either Burck or Van Slooten, though the latter (1927, 131) who cited most of the then extant collections under *V. verrucosa*, alluded to the similarity of the two species. He further described *V. cupularis*, stating that it differed in the 'not furrowed calyx tube and by the nut itself, the diameter of the exserting part of which is c. 2 cm. A striking character by which the leaves may be distinguished is their midrib and lateral nerves, which are hardly prominent on the lower side'. The leaf character is typical of the species as a whole. The fruit characters indicate, and the syntypes confirm, that Van Slooten is describing immature fruit of *V. umbonata*. Recent Brunei collections (Brun 3, 690, 860) bear fruit at all stages and confirm my judgment.

V. venulosa Bl., Mus. Bot. Lugd. Bat. 2 (1852) 32.

Holotype: Muller s.n., st., Pattay, S. Borneo (L).

—*V. bancana* Scheff., Nat. Tijd. N. I. 31 (1870) 348.

Syntypes: Teysmann 12052 HB, fl. and y. fr., Nr. Djeboes, Bangka (BO, U, K); Teysmann 7629 HB, fl., Bangka (BO, L, U, K).

—*V. schouteniana* Scheff., id. 32 (1873) 408.

Type: Teysmann 12053 HB, y. fr., near Koba, Bangka (K).

—*Dryobalanops schefferi* Hance, J. Bot. 14 (1876) 307.

Type: Teysmann s.n., fl. and fr., Lampongs, Sumatra (BM, K).

—*Retinodendron kunstleri* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 129.

Syntypes: Kings Collector 3249, fr. (K, BM, CAL), 4450, y. fr. (CAL), 5335, y. fr. (K, CAL), 6210, y. fr. (K, BM), 6227, y. fr. (BM) Larut, Perak; Wray 1341, fl., Tapah, Perak (K, CAL).

—*V. kunstleri* (King) Brandis, J. Linn. Soc. Bot. 31 (1895) 127.

—*V. schefferi* (Hance) Brandis, id (1895) 128.

The synonymy here quoted is the same as that of Van Slooten (1927, 96) who described and discussed the species under the name *V. bancana* Scheff. I confirm his conclusions. He did not have access to authentic material of *V. schouteniana* and *D. schefferi*, the later of which he reduced only tentatively; I have been able to see the Types of all the synonyms and confirm his conclusions. *Vatica venulosa* Bl. consists of a sterile leafy twig, which in the nervation, shape, texture and length of petiole exactly matches *V. bancana*, which has been collected at Marabahan near the Type locality (b.b. 11026) of Blume's species. In spite of the poor material I am forced to conclude that the two are conspecific, in which case Blume's name antedates *V. bancana*.

V. sarawakensis Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 970.

Holotype: Beccari 3018, fl., Sarawak (K).

—*V. ramiflora* V. Sl., Bull. Jard. Bot. Btzg. 3, 9 (1927) 118.

Lectotype: Elmer 20855, fr., Elphinstone Province, Tawau, North Borneo (SING).

—*V. elmeri* Merr. ex. V. Sl., id. 3, 17 (1942) 240, nomen pro syn.

Under the name *V. ramiflora* Van Slooten originally cited Elmer 20855, fr., 21004, fr., 21065, fl., and 21150, fl. and fr., all from the same locality. Later (1942, 240) he transferred no. 21150 to a separate species, *V. acrocarpa*, at the same time redescribing the fruit from no. 20855 at Singapore, the Bogor specimens being fragmentary; I therefore cite this sheet as lectotype. At the same time he cited Merrill's nomen, which appears on all the duplicates of no. 20855 examined by me (BO, SING, L, PC, K). The leaves, twigs and inflorescences of Van Slooten's specimens differ in no way from the Holotype of *V. sarawakensis*, which he did not see, basing his description of that species (1927, 106) on Haviland 1991, Kuching, which has immature fruit.

V. borneensis Burck, Ann. Jard. Bot. Btzg, 6 (1887) 230.

Holotype: Beccari 2623, y. fr., Matang, Sarawak (BO).

—*V. urbani* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 956.

Holotype: Beccari 2536, fl., Matang, Sarawak (K).

—*V. beccarii* Dyer ex Brandis, J. Linn. Soc. Bot. 31 (1895) 133, nomen pro syn.

Brandis (loc. cit) further cited Beccari 1625, and 1969, flowering collections from Sarawak, under Heim's name but still maintained the fruiting Type of Burck separately; Van Slooten (1927, 77) cited *V. urbani* as an insufficiently known species, having seen none of the cited material. The leaves and twigs are unequivocal and there is no doubt as to the synonymy of the two species. Beccari 2536 at Kew has the name *V. beccarii* written on it in Dyer's handwriting.

V. mangachapoi Blanco, Fl. Filip. ed. 1 (1837) 401.

—*Mocanera mangachapoi* Blanco, id (1837) 450.

—*? V. sinensis* Blanco, id (1837) 401, non V. sinensis Gmel., V. chinensis Linn.

—*V. apteranthera* Blanco, id. ed. 2 (1845) 281.

—*Dipterocarpus mangachapoi* Blanco, id (1845) 313.

—*Shorea mangachapoi* (Blanco) Bl., Mus. Bot. 2 (1852) 34.

—*Pteranthera sinensis* (Blanco) Bl., id (1852) 30.

—*P. mangachapoi* (Blanco) Bl., id (1852) 30.

—*? Anisoptera mangachapoi* (Blanco) A. DC., Prodr. 16, 2 (1868) 616.

—*V. bureavi* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 955.

Holotype: Beccari 3332, fl., Sarawak (K).

—*Cotylelobium philippinense* Heim ex Brandis, J. Linn. Soc. Bot. 31 (1895) 134, nomen pro syn.

—*V. reticulata* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 106; non V. reticulata (Thw.) A. DC.

Type: Kunstler 6969, fl. and y. fr., Perak (PC, K, BM, CAL).

—*Synaptea reticulata* (King) Ridl., Fl. Mal. Pen. 1 (1922) 243.

—*V. patula* Sym., Str. Br. R. As. Soc. 19, 2 (1941) 148.

Merrill (1918, 272) has discussed the difficulty of establishing the true identity of Blanco's *V. mangachapoi;* in order to be consistent I have accepted his interpretation, and base mine on his collection Species Blancoanae no. 866, fr., Bataan Prov., Luzon, at Kew. The first 8 synonyms were cited under *V. mangachapoi* by him; there is no authentic material for any of these names, so that the evidence for their identity is hardly satisfactory. Symington (loc. cit) created the name *V. patula* for the Malayan species previously named *V. reticulata* King, which is a homonym of *V. reticulata* (Thw) A. DC. (Prodr. 16, 2 (1868) 620); he noted the similarity of *V. patula* to Philippine collections identified under this species at Manila, but considered that the latter were too heterogeneous to represent a single species. Having seen the species in the field and examined the Kew sheets, I do not agree, but feel that the Philippine sheets cited by Merrill are without doubt referable to a single species which is conspecific with Merrill's cited collection, and that *V. patula* Sym. in no way differs from it. I further reduce *V. bureavi,* based on a flowering specimen quite typical of this species. Heim's nomen *C. philippinense,* which was written on Vidal 74, a flowering specimen from Bosobosa District, Morong, Luzon at Kew by him has already been reduced to *V. mangachapoi* by Brandis.

HOPEA Roxb., Pl. Corom. 3 (1819) 7.

Type: *H. odorata* Roxb.

—**Hopea** Roxb., Hort. Beng. (1814) 42, nomen nudum.

—**Neisandra** Rafin., Sylva Tellur (1838) 163.

—**Hoppea** Roxb. fide Endl., Gen. Pl (1840) 1014.

—**Petalandra** Hassk., Hort. Bog. Desc (1858) 104.

Type: *P. micrantha* Hassk.

—**Balanocarpus** Bedd., For. Man. Bot (1873) 236 bis.

Types: *B. erosa* Bedd., *B. utilis* Bedd.

—**Doona** sensu Burck, Ann. Jard. Bot. Btzg. 6 (1887) 231, pro parte, quoad *D. javanica* Burck, *D. micrantha* (Hassk) Burck, *D. odorata* (Roxb.) Burck.

—**Hancea** Pierre, Fl. Coch. 16 (1891) sub tab. 244.

Type: *H. pierrei* (Hance) Pierre.

—**Pierrea** Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 958, non Pierrea Hance, J. Bot. 15 (1877) 339.

Type: *P. pachycarpa* Heim.

—**Dioticarpus** Dunn, Kew Bull (1920) 337.

Type: *D. barryi* Dunn.

—**Pierreocarpus** Ridl. ex Sym., Gard. Bull. S.S. 8 (1934) 30, nomen pro syn. sub *H. pachycarpa* (Heim) Sym.

Roxburgh's name, which appeared first as a nomen nudum in 1814, was not published with a description until 1819. It is antedated by *Hopea* Garden ex Linn., Mantissa I (1767) 14, et Systema Naturae ed. 12, 2, 509; (Type: *H. tinctoria* Linn.). *Hopea* Linn. was reduced to *Symplocos* Jacq. by L'Heritier (Trans. Linn. Soc. 1 (1791) 176). Linnaeus' genus has only been maintained separately by C. G. Ortega, who described an *H. ternifolia* (Hort. Matr. Desc. (1800) 131, tab. 17) from Venezuela, and Dalzell and Gibson, who placed *Symplocos spicata* Roxb. and *S. racemosa* Roxb. there (Bomb. Fl. (1861) 140). Other authors have followed L'Heritier's interpretation. Roxburgh himself commented '*Hopea tinctoria* of Linnaeus is now referred to the genus *Symplocos* Linn., Spec. Plant. edit Willdenow, 3, p. 1436.' There are at present 86 species maintained in *Hopea* Roxb., and I have therefore put forward a recommendation for conserving Roxburgh's name against that of Linnaeus. Rafinesque (1838), apparently without access to herbarium material, proposed the new binomial *Neisandra indica* for *Hopea decandra* Ham, a nomen nudum, which was later mentioned by Wight (1840, 88), but never described. Rafinesque argued that the 5-merous perianth and 10 stamens of this species excluded it from *Hopea* L. (a genus with which its author had not intended to associate it) and that a new name was therefore required. *H. decandra* was later reduced to *H. odorata* Roxb., the species having 15 and not 10 stamens as originally described. Rafinesque's genus is therefore based on a myth, but is at present the earliest valid name for the genus under consideration.

Hopea Vahl (Enum. 1 (1805) 3) is a misspelling of *Hoppea* Willdenow (Gentianaceae).

Endlicher (1840) misspelt Roxburgh's genus *Hoppea*.

Korthals (1841, 75) first records the genus in the East Indies, describing two species, *H. sangal*, and *H. balangeran* (*Shorea balangeran* (Korth) Burck). Miquel (1861, 489) added further species, for four of which he designated a separate section, Dryobalanoides, on account of their many indistinct nerves, resembling those of *Dryobalanops*.

Hasskarl (1858) described *Petalandra* from flowering and fruiting collections of Teysmann from Java, differing from *Hopea* Roxb. in having 10, not 15, stamens. Bentham and Hooker (1862, 193) reduced *Petalandra* to *Hopea;* they did not recognise Miquel's sections, nor did De Candolle (1868, 632). The latter nevertheless recognised two divisions, one of which contained only *H. grandiflora* Wall., characterised by the broadly imbricate sepals, longer filament, and trilobed stigma, and retained *Petalandra* as a separate genus; *H. grandiflora* is a synonym of *Vatica odorata* (see there).

Burck (1887, 160) discovered that the petiole and twig anatomy of *H. odorata* Roxb., *P. micrantha* Hassk., and of three further species described by him, was more similar to that of *Shorea*, and yet more to that of *Doona* Thw, (previously considered endemic to Ceylon), than to members of Miquel's section Dryobalanoides. As Miquel's section, unlike *Shorea* and *Doona*, shared with *H. odorata* and its allies two, not three, aliform fruit calyx lobes, he concluded that this character was not of value in delimiting genera and reduced the latter to *Doona*. Heim (1892; 61, 64) is justly critical of Burck, not only for also ignoring the striking differences of the flower and particularly the stamens, which are clavate in *Doona* Thw., but for transferring the Type species of *Hopea* Roxb. to *Doona*, which was only described in 1851, at the same time maintaining Roxburgh's name for a quite separate taxon. Within his *Hopea* Burck still maintained Miquel's subdivisions; in 'Euhopea', with distinct lamina nervation, he included *H. sericea* Bl. and *H. diversifolia* Miq. Both these names are now reduced to *H. sangal* Korth., as also are *P. micrantha* and the three East Indian *Doona* species described by Burck (See under *H. sangal*).

Pierre (1891) separated Miquel's section Dryobalanoides as a separate genus *Hancea*, based on the only Indochinese species, *H. pierrei*, of that section.

Heim (1892, 59–65) re-united *Petalandra* and *Hancea* with *Hopea,* as well as the East Indian species of *Doona* sensu Burck. He placed *H. recopei* Pierre, described a year previously, in a new genus which he never named, separated, according to Heim, by the absence of connectival appendages, and the incompletely septate apically depressed ovary. Subsequent authors have retained this species in *Hopea.* Heim recognised four sections:

I. *Euhopea.* Distinct nervation, 15 stamens.

II. *Dryobalanoides* Miq. Nervation indistinct; 15 stamens; stylopodium distinct; median vascular bundle of the outer arc of petiolar bundles inverted.

III. *Hancea* (Pierre) Heim. As II, but without stylopodium, median bundle not inverted.

IV. *Petalandra* (Hassk) Heim. As I, but with 10 stamens.

King (1893, 123) revised the Malayan species, and maintained the two sections of Miquel; *Petalandra* was not considered. He ignored Heim's work.

Brandis (1895, 53) maintained three sections, following Heim but uniting Hancea with Dryobalanoides. He placed *H. recopei* in section Petalandra.

Heim (1891) further described *Pierrea pachycarpa* from a single Beccari sheet at Kew with young malformed fruit. Ridley identified a flowering collection of Haviland with it at Kew, and wrote on it, but did not publish, a new generic name *Pierreocarpus,* presumably realising that Heim's generic name was preoccupied by *Pierrea* Hance, which was later reduced to *Homalium* Jacq. (Flacourtiaceae). Symington (1934, 30) on the basis of the floral morphology reduced the genus to *Hopea. Pierrea* Heim has been conserved against *Pierrea* Jacq. and is cited in the list of nomina conservanda in the International Rules of Nomenclature.

Beddome (1874) described two species from India which bore flowers typical of *Hopea,* but fruit with short subequal calyx lobes; he described a separate genus *Balanocarpus* for them.

Heim (1892, 74) recognised 4 sections in the genus:

I. *Eubalanocarpus.* With fleshy deeply lobed cotyledons, and morphology of *Hopea,* sect. Euhopea, but for the fruit calyx. *B. erosa* Bedd.

II. *Pachynocarpoides* Heim. Thinner, less deeply divided cotyledons; incrassate fruit calyx and pericarp, and slightly different petiole anatomy. *B. utilis* Bedd.

III. *Microcarpae* Heim. Petiole anatomy at distal end and pericarp as I; petiole anatomy at proximal end as II. Fruit smaller than both. *B. zeylanicus* Trimen.

IV. *Sphaerocarpae* Heim. As section III, but differing in having the largest sepals inside; median vascular bundle of outer petiolar arc inverted as in Hancea. *B. sphaerocarpus* Heim.

Heim further described a genus *Richetia*, with similar floral structure to his section Richetioides of *Shorea*, but with short sub-equal fruit calyx lobes.

It is not surprising that King (id. 130) Brandis and Gilg (1895, 267) and Brandis (1895, 106) do not even take Heim's sections into consideration. It is more surprising however that King describes a *B. penangianus*, from material already described by Heim as *Richetia penangiana*, though King makes no mention of Heim or *Richetia*. He further adds a species *B. hemsleyanus*, which, he states himself, bears flowers identical with several *Shorea* species. Thus *Balanocarpus* became a dumping ground for dipterocarps of wide affinities sharing in common only the characters of the fruit calyx. Brandis (loc. cit.) further added to the confusion by reducing the remains of Heim's *Richetia* to it, yet did not recognise sections in this genus.

Though *B. hemsleyanus* King was transferred to *Shorea* by Foxworthy (1932, 167), it was left to Symington (1934, 26) to point out the heterogeneous nature of the genus. He later (1938, 336) justified Heim's creation of a taxon *Richetia*, and united it with *Shorea*, not giving it a taxonomic rank, but suggesting that at future date, united with Heim's section Richetioides, it might be separated as a genus. He finally (1943) united all remaining *Balanocarpus* from Malaya with *Hopea*, with the exception of *B. heimii* King, which he regarded as an anomalous form no more related to *Balanocarpus* Bedd. sensu stricto than to *Shorea* or *Hopea*. He retained the former name for it as it was commonly known by it in Malaya. The Type species of Beddome should undoubtedly be referred to *Hopea*, following Symington's, in my opinion justifiable, arguments, and a future monographer must find a new generic name for *B. heimii*.

Dioticarpus barryi Dunn was described from Barry s.n., Beddome 27, Barber 3163, and Hayne 2133 at Kew, collected in the Tinnevally Hills of Madras Presidency. Dunn recognised that the flowers were as those of *Balanocarpus* Bedd., but commented that two of the fruit calyx lobes were aliform, and not as closely adpressed to the nut as in *Balanocarpus*. These are, of course, characters typical of *Hopea*, to which genus I reduce it.

Symington did not regard the presence of only 10 stamens in *H. sangal* Korth., to which he had reduced *Petalandra* Hassk., as sufficient to justify a separate section for it. His view has received support from recent collections from Brunei. I have found that the flowers of *H. treubii* and *H. vaccinifolia*, each in different subsections of Section Dryobalanoides, also share this character, and the reduction has thus apparently taken place several times. The infrageneric classification followed here is one suggested, but not given taxonomic expression, by Symington (1943, 108) who recognized Euhopea, Pierrea, Dryobalanoides and Bracteata 'groups'. *Balanocarpus sphaerocarpus* Heim (1892, 77), Type species of

Balanocarpus section Sphaerocarpae Heim, is based on Beccari 3021, fr., from Matang, Sarawak (Holotype: K). This is in fact a *Hopea,* belonging to the Bracteata group of Symington. Sphaerocarpae is therefore the legal name for the Bracteata group.

As Symington himself points out, his Euhopea and Pierrea groups are more closely allied to one another than they are to Dryobalanoides and Sphaerocarpae, and *vice versa.* The primary dichotomy based on the two distinct types of lamina nervation divides the genus into two clearly defined natural groups, and the original classification of Miquel once more should be accepted. The other two divisions are less well defined and I am treating the genus as having two sections, each with a pair of subsections.

Section definitions are therefore as follows:—

Section I. DRYOBALANOIDES Miq., Sum (1861) 489.

Types: *H. dryobalanoides* Miq., *H. myrtifolia* Miq., *H. mengerawan* Miq.

Nervation dryobalanoid or subdryobalanoid (*H. nervosa, H. sublanceolata* excl). Bark smooth, fissured, or cracked, not evenly flaky.

Subsection 1. Dryobalanoides.

—Gen. **Hancea** Pierre; sect. **Hancea** (Pierre) Heim, Rech. Dipt. (1892) 62.

Nervation dryobalanoid, bracts fugaceous; corolla pale; racemes regularly branched, branchlets short; flowers many; ovary and stylopodium ovoid to pyriform, rarely truncate.

Distribution. 23 species: Indochina (1), Thailand (3), Burma (1), Malaya (14), Borneo (15), Sumatra (5), Phillippines (4).

Subsection 2. Sphaerocarpae (Heim) Ashton, comb. nov.

Type: *H. sphaerocarpa* (Heim) Ashton, comb. nov.

—Gen. **Balanocarpus** Bedd., sect. **Sphaerocarpae** Heim, Rech. Dipt. (1892) 77.

Lamina nervation subdryobalanoid (*H. nervosa, H. sublanceolata* excl); bracts subpersistent; racemes irregularly branched, with long branchlets and few flowers (*H. nervosa, H. sublanceolata* excl); corolla dark coloured; ovary and stylopodium truncate; bark smooth or cracked and with small irregular scales.

Distribution. 9 species: Malaya (6); Borneo (6); Sumatra (1).

Section II. HOPEA

Nervation scalariform; bark surface smooth or evenly flaky.

Subsection 1. Hopea

—Gen. **Neisandra** Rafin., **Hoppea** Endl., **Petalandra** Hassk.

—Sect. **Petalandra** (Hassk) Heim, Rech. Dipt. (1892) 63.

(Type: *H. sangal* Korth., ut *H. hasskarliana* Heim).

—Gen. **Balanocarpus** Bedd., sect. **Pachynocarpoides** Heim, id (1892) 75 (Type: *H. utilis* (Bedd) Ashton); sect. **Microcarpa** Heim, id (1892) 76 (Type: *H. zeylanicus* (Trimen) Ashton).

—Gen. **Doona** sensu Burck, pro parte; **Dioticarpus** Dunn.

Lamina base usually equal or subequal; raceme generally tomentose (*H. pentanervia* Sym., *H. dolosa* V. Sl., *H. nodosa* V. Sl. excl). rarely fascicled; ovary and stylopodium more or less ovoid, or if elongate, without median constriction; style evident.

Distribution. 46 species: Ceylon (3), S. India (7), Burma (5), Thailand (8), Indochina (6), S. China (1), Malaya (7), Sumatra (4), Java (1), Borneo (5), Phillippines (2), Celebes and Moluccas (3), New Guinea (10).

Subsection 2. Pierrea (Heim) Ashton, stat. nov.

Type: *H. Pachycarpa* (Heim) Sym.

Gen. **Pierrea** Heim, **Pierreocarpus** Ridl. ex Sym.

Lamina base unequal (*H. glaucescens* Sym., *H. wyattsmithii* Wood ex Ashton excl); racemes glabrescent, fascicled. Ovary and stylopodium hour-glass shaped, elongate; style short, obscure; bark smooth, rarely shallowly patchily flaked (*H. philippinensis*).

Distribution. 7 species; Malaya (3), Borneo (4), Philippines (1).

This is the 'Pierrea group' of Symington (1943, 108–110); it has not previously been given formal taxonomic status.

H. dryobalanoides Miq., Sum (1861) 492.

Syntypes: Teysmann s.n., st., S. Pagu, Sumatra (U); Teysmann s.n., y. fr., Priaman, Padang, Sumatra (U).

—*H. sarawakensis* Heim, Bull. Mens, Soc. Linn. Paris, 2 (1891) 971.

Holotype: Beccari 2987, y. fr., Sarawak (K).

—*H. borneensis* Heim, id (1891) 972.

Holotype: Beccari 2532, fl., Matang, Sarawak (K).

—*H. micrantha* sensu King, J. As. Soc. Beng. Sc. 62, 2 (1893) 126, in nota; Foxw., Mal. For. Rec. 10 (1932) 137. pro parte.

Symington (1939, 345) has reviewed the synonymy; I have examined the authentic material and endorse his conclusions.

I further reduce *H. borneensis* here; it is based on a poor specimen with young fruit; the lamina and acute midrib drying black are unequivocal though.

H. sangal Korth., Kruidk. 3 (1841) 75.

Type: Korthals s.n., st., S.E. Borneo (BO, U, L).

—*Dryobalanops ? sericea* Korth., id (1841) 72.

—*Hopea sericea* (Korth) Bl., Mus. Bot. Lugd.-Bat. 1 (1852) 35.

—*Petalandra micrantha* Hassk., Hort. Bog. Desc. (1852) 105.

Holotype: Teysmann 12043, fl. and fr., Java (BO).

—*H. fagifolia* Miq., Sum (1862) 490.

Type Teysmann 3236, st., Bangka (U, K).

—*H. diversifolia* sensu Scheff., Nat. Tijd. N.I., 31 (1879) 351.

—*H. odorata* sensu Hance, J. Bot. 5 (1876) 308, et auct (1876–1927) pro parte.

—*Doona micrantha* (Hassk) Burck, id (1887) 234.

—*D. javanica* Burck, id (1887) 235.

Type: Burck, s.n. fl., Java (BO, U, K,).

—*Dryobalanops neglectus* Korth. ex Burck, id (1887) 243. nomen pro syn.

—*H. micrantha* Benth. et Hook. f. fide Heim, Rech. Dipt. (1892) 64, in obs.

—*H. hasskarliana* Heim, loc. cit.

—*H. javanica* (Burck) Heim, loc. cit.

—*H. curtisii* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 124.

Syntypes: Curtis 1562, fr., Penang (K, BM, CAL); Kings Collector 8161, fr., Kinta R., Perak (K, BM, CAL).

—*H. globosa* Brandis, J. Linn. Soc. Bot. 31 (1895) 61.

Holotype: Wray 816, fr., Perak (K).

—*D. micrantha* Burck, var. *macrosepala* Boerl. ex Sym., Gard. Bull. S.S. 8. (1934) 18, nomen pro syn.

—*H. fagifolia* Miq., var. *fol. latioribus* Boerl ex Sym., loc. cit., nomen pro syn.

—*H. fagifolia* var. *javanica* Boerl. ex Sym., loc. cit., nomen pro syn.

—*H. macrosepala* Boerl. ex. Sym., loc. cit., nomen pro syn.

—*H. lowii* Dyer ex Brandis, id (1895) 63.

Syntypes: Teysmann s.n., fl., Sumatra (K); Low s.n., st., Borneo (K).

—*H. multiflora* sensu Foxw., Mal. For. Rec. 10 (1932) 119. pro parte.

—*H. albescens* sensu Foxw., id (1932) 122.

Symington (1934, loc. cit.) has already critically discussed the synonymy of this species. I have been able to re-examine the authentic material and confirm his judgments. I also add, however *Hopea sericea* (Korth.) Bl, originally described as *Dryobalanops? sericea* by Korthals. The type, which is sterile and probably comes from a young tree, is a close match of the Holotype of *H. sangal* described in the same work; it is typical of the species. On the holotype is the unpublished name *Dryobalanops neglectus* in Korthals' hand.

SHOREA Roxb. ex Gaertn. f., De Fruct. 3 (1805) 48.

Type: *Shorea robusta* Gaertn. f.

—**Vatica** sensu Wight et Arnott, Prodr. Fl. Pen. Ind. Or. 1 (1834) 84, pro parte, quoad *V. laccifera* W. et. A., *V. tumbugaia* W. et A.

—**Saul** Roxb. ex Wight et Arnott, loc. cit., nomen pro syn.

—**Isoptera** Scheff. ex Burck, Med. Lands Pl. Tuin. 3 (1886) 27.

Type: *I. borneensis* Scheff. ex Burck.

—**Ridleyinda** O.K., Rev. Gen. Pl. 1 (1891) 65.

Type: *R. borneensis* (Scheff. ex Burck) O. K.

—**Richetia** Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 975.

Types: *R. coriacea* Heim, *R. oblongifolia* Heim, *R. latifolia* Heim, *R. acuminata* Heim, *R. penangiana* Heim.

—**Parahopea** Heim, Rech. Dipt (1892) 66.

Type: *P. balangeran* (Korth) Heim.

—**Pachychlamys** (Dyer ex King) Ridl., Fl. Mal. Pen. 1 (1922) 233.

Types: *P. hemsleyanus* (King) Ridl., *P. thistletoni* (King) Ridl.

The generic name *Shorea* was attributed to Roxburgh by Gaertner, who described *Shorea robusta* from a fruiting specimen from India, in the Banksian Herbarium, now in the British Museum. Wight and Arnott (1834, loc. cit) cited *Shorea* as a synonym of *Vatica;* this view was followed by Endlicher (1841, 1014) and Lindley (1846, 394). Blume (1852, 32) reinstated the genus and described the first species from the East Indies. The names *Saul iallarea* and *Saul tumbugaia* were written by Roxburgh on specimens in the East India Company Herbarium, which were described as *Vatica* by Wight and Arnott, who quoted Roxburgh's nomina in the synonymy.

Burck (1886) described *Isoptera* from a specimen named *Isoptera borneensis* in Scheffer's handwriting at Leiden, and differing from *Shorea* as then understood on account of the orbicular subequal coriaceous patent fruit sepals. Kuntze (1891) argued that *Isoptera* was an orthographic variant of *Isopteris*, and was therefore antedated by *Isopteris* Wall (Cat. 1828, 1832). This argument is unjustifiable as Wallich's name is a nomen nudum, synonymous with *Trigoniastrum hypoleucum* Miq (Trigoniaceae). *Isoptera* was reduced to *Shorea* by Symington (1932, 238), who pointed out that except in the fruit calyx the genus differed in no way from the Type section of *Shorea*. He (1943, 5) continued to recognise it as a 'subgroup' of section *Shorea* however. I do not do so here; short subequal fruit calyx lobes occur in most sections in *Shorea* and appear to be specifically diagnostic only.

Parahopea was founded by Heim on Beccari 3461, a flowering specimen that in fact represents *S. balangeran* (Korth) Burck. Heim regarded the specimen as having characters totally intermediate between *Hopea* and *Shorea;* he compared the sepals and receptacle to those of *Shorea*, the petals to *Hopea*, as also the stamens and some aspects of the petiole anatomy; other characters of the stamens and petiole anatomy he compared with *Shorea*. The genus was reunited with *Shorea* and placed in section Anthoshorea Heim by Brandis (1895, 86), with the abrupt comment 'I cannot follow Heim in regard to his genus *Parahopea*'. The species is in every way typical of the section to which Brandis referred it. Heim did not see the fruit of this species which are typical of *Shorea*.

Heim further described a genus *Richetia*, based on 4 species described by him and which are regarded here as synonyms of *S. multiflora* (Burck) Sym. (see there), and also *R. coriacea* Heim. In anatomical characters he compared *Richetia* with his section Richetioides of *Shorea*, but the short subequal fruit sepals, and some minor differences in the embryo and petiole anatomy, led him to consider it generically distinct. Brandis and Gilg (1895, 267) united *Richetia* with *Balanocarpus* Beddome (see under *Hopea*), a heterogeneous genus which came to contain species of wide affinity sharing only the short subequal fruit sepals. King (1893, 134) had already described his *B. hemsleyanus*, which, he rightly indicated, resembled *Shorea* in all but fruit characters. He further described *S. thistletoni* King however, a species again differing from others in the short lobed fruit calyx, creating a new section, Pachychlamys, for it. Ridley (1922) transferred *B. hemsleyanus* to Pachychlamys, and raised it to generic level. Foxworthy (1932, 167) reduced the genus once more to *Shorea*. Symington (1938, 331) transferred the *Balanocarpus* species originally placed by Heim in *Richetia* to *Shorea*, recognising that they represent a distinct natural unit; but he never finally gave them taxonomic status.

Heim (1892) established nine sections in *Shorea*:

I. *Eushorea*. Stamens c. 30; anthers obovoid; appendage pilose; cotyledons large, fleshy; pericarp thin, twigs with long cortical petiolar vascular bundles and very many cortical resin canals;

petiole with very many (14–15 at base, 24–29 at 'caractéristique' (see under *Dipterocarpus elongatus*) resin canals; 'caractéristique' with outer arc of c. 12 bundles, and 3 inner arcs.

II. *Anthoshorea* Heim. Stamens 15–17; anthers oblong; appendage long, setiform; petals oblong, obtuse; albumen usually present in ripe seed; cotyledons thin, an outer enclosing an inner; twig with 1–12 cortical resin canals, small; cortical petiolar bundles short; petiolar vascular bundles in an outer arc of 6–7 and a single central arc with 2 resin canals.

III. *Hopeoides* Heim. Differing from section II in having over 20 stamens, little albumen, the cotyledons fleshy, bifurcated and imbricated, and with one resin canal in the central petiolar vascular arc; petiolar bundles in twig cortex intermediate in length between I and II.

IV. *Pachycarpa* Heim. Stamens 15; anthers short, glabrous; appendage long, setiform; cotyledons large, fleshy, entire; pericarp very thick; twigs with petiolar cortical bundles exceeding an internode in length; petiolar outer vascular bundle arc very disjointed, with many irregularly arranged bundles.

V. *Brachyptera* Heim. Lamina nervation as Eushorea; petals as *S. bakeriana;* stamens as section III; cotyledons fleshy but not imbricate; fruit sepals short; 'caractéristique' with outer arc as Eushorea and single central resin canal of Hopeoides; with parenchymatous gum cells as in *Richetia.*

VI. Unnamed. Stamens 15; style as Section V; style and appendage very long; petiolar 'caractéristique' with outer arc and a complex of bundles within as in Eushorea. The 'Type', *S. bakeriana* Heim, is synonymous with *S. macrophylla* (De Vriese) Ashton, which, under the name *S. gysbertsiana* Burck, was Type also of Section IV.

VII. Unnamed. 'Type': *S. rugosa* Heim. Stamens in number and appearance like *S. bakeriana,* but filaments long and geniculate; embryo as *S. brachyptera* but fruit sepals aliform.

VIII. Unnamed. 'Type': *S. pierriana* Heim (a synonym of *S. scrobiculata* Burck). Ovary, style, anthers, as Eushorea; leaf as Euhopea; petals with hairs on inner face; connectival appendage with single terminal bristle.

IX. *Richetioides* Heim. 15 stamens; anthers short, connectival appendage long, slender, curved; ovary as Eushorea but more shortly tomentose; embryo as Anthoshorea and Hopeoides, but no endosperm; fruit sepals unequal, aliform; cortical parenchyma with gum cells as *Richetia;* petiolar vascular supply as Eushorea.

The last six of Heim's sections are founded on a total of nine species; he in other words had been able to recognise three apparent natural groups within *Shorea,* but had nine species that he could not place in any of them; his decision to found six further sections for them, in view of the very few specimens he had at his disposal, was rash.

Brandis and Gilg (1895, 264) and Brandis (1895, 73) retained some of Heim's sections, but simplified the classification and recognised the following sections based on quite different criteria;

I. *Brachyptera* Heim emend. Brandis. Segments of fruit calyx shorter than twice length of fruit.

II. *Eushorea*. Fruit calyx with 3 long lobes; stamens 20–60, appendage ciliate. Flowers usually in unilateral spikes or racemes.

III. *Anthoshorea* Heim. Fruit calyx with 3 long lobes; stamens generally 15–17, rarely 23–30; anthers oblong, connective terminating in a long, filiform, naked appendage, sometimes scabrous towards the apex; style longer than ovary; stigma generally 3-dentate; no stylopodium.

IV. *Pinanga* Brandis. Fruit calyx with 3 long lobes; anthers short, appendage to connective not ciliate, sometimes scabrous towards apex.

V. *Mutica* Brandis. Fruit calyx with 3 long lobes; anthers of inner stamens or all inappendiculate.

Symington (1943, 4) has suggested that a subdivision of Brandis' concept of the Type section is necessary, and further (id., 58) demonstrated that Malayan species of sections Brachyptera, Pinanga, and Mutica were divisable into three apparently natural groups, based on the characters of the stamen; he did not however give any of these groups taxonomic status. I have been able to examine the flowers and fruit of every species in the genus in which they have been collected, and with the aid of the several new species from Borneo described here have confirmed and elaborated Symington's plan in the present classification.

Symington (id. 58) also pointed out that, in Malaya, groups can be recognised in the field based on bark and slash characters; these can for the most part be equated with botanical divisions recognisable in the herbarium on floral and other characters. Thus the field group 'Balau' (called Selangan Batu' in Borneo) was equivalent to the Type section, 'Meranti Pa'ang' to Anthoshorea Heim, and 'Meranti Damar Hitam' to the 'Richetia group' (Section Richetioides Heim). The 'Red Meranti' field group was, he admitted, heterogeneous botanically, for this field group includes sections Brachyptera, Pinanga and Mutica as interpreted by Brandis and defined above.

Whitmore (1962) has demonstrated that genera, and sometimes infrageneric taxa, in Dipterocarpaceae are characterised by distinct types of bark morphology. Though the number of species examined by him were small, his evidence suggests that each of the sections here proposed is characterised by its bark; I summarise the bark morphology in my section descriptions therefore.

Foresters may be surprised to find that in the classification I have adopted here I have divided the Red Meranti field group into a number of botanical sections, thus placed on an equivalent rank to sections Shorea, Anthoshorea, and Richetioides. The Red Meranti group, in Borneo as elsewhere, is easy with experience to recognise in the field; wood anatomists, though admitting that there is a wealth of anatomic variation within them, find that Red Merantis can always be distinguished from other field groups. Unfortunately not only are the anatomical diagnostic characters of the Red Meranti field group solely negative distinctions, but they are not constant. *Shorea albida* Sym., which to foresters and wood anatomists is a Red Meranti, is botanically typical of section Anthoshorea, whose other members belong to the White Meranti field group. Whitmore (1962) has further confirmed that the bark morphology of *S. albida,* though typical, possesses characters that put it unequivocally in section Anthoshorea. He also recognises that the sections within the Red Meranti field group examined by him can be distinguished by a set of bark characters as distinct as those provided by sections Shorea, Richetioides, and Anthoshorea.

The botanical heterogeneity of the Red Merantis in Borneo is further accentuated by sections Rubella and Pachycarpa, neither of which occur elsewhere; moreover the Balau (Selangan Batu) field group in Borneo comprises not only the Type section but also the monotypic section Neohopea, which is very isolated on flower and fruit characters; the wood anatomy is indistinguishable though from that of section Shorea according to Balan Menon (in correspondence).

The main reason why field workers find the Red Merantis so easily recognisable is owing to the distinctive pink or red colouring of their wood and inner bark. Here the homogeneity seems to end though, and in my opinion it is misleading to consider the Red Merantis as a group of phyletically interallied subsections more closely allied to one another than to the other sections of *Shorea.* I am unable to form a definition of the group on botanical characters that would be watertight.

The sections adopted by me therefore are named and defined as follows:

Section I. SHOREA

Stamens 20–60, in several verticils; filaments broad at base, gradually tapering; anthers with 4 pollen sacs, more or less broadly oblong; appendage to connective shorter than anther, with one or several bristles. Ovary with stylopodium; style shorter than ovary; ovary and stylopodium tomentose. Stipules and bracts fugaceous, small. Midrib raised or depressed above, always evident.

Bark surface flaky or dippled (*S. biawak* Ashton excepted); radially oblique stone cell fingers often present; phelloderm pale, thick, conspicuous; expansion tissue in short fingers, more numerous towards outer surface.

Subsection I. Shorea.

—Gen. **Vatica** sensu Wight et Arnott (1834) 84, pro parte; **Saul** Roxb. ex Wight et Arnott, **Isoptera** Scheff ex Burck, **Ridleyinda** O.K.

Flower buds elongate; petals linear, falling early; appendage to connective with few bristles.

Distribution. 35 species: Ceylon (3), S. and E. India (2), Burma (2), Thailand (4), Indochina (3), Philippines (5), Malaya (12), Borneo (10), Molluccas (1).

Subsection 2. Barbata Sym. ex Ashton, subsect. nov.

Type: *S. maxwelliana* King.

Alabastra subglobosa. Petala breves obtusa, delapsa basi connata. Aristae et apices antherorum exteriorumque conferte setosae.

Distribution. 9 species. Ceylon (2), Burma (1), Thailand (1), Malaya (3), Sumatra (2), Borneo (5).

Section II. NEOHOPEA Ashton, sect. nov.

Type: *S. isoptera* Ashton.

Flores parvi, alabastris globosis. Stamina 15, verticillis 3; filamentis crassis brevibus compressis vix attenuatis; antheris subglobosis, loculis 4; aristis brevissimis crassis glabris. Ovarium stylopodiumque conicum puberulens. Stylum brevissimum. Lobi calycis in fructu aliformes subaequales. Stipulae bracteique minute fugaces. Lamina intercostis scalariformibus, costa media lata supra applanata.

Distribution. 1 species: Borneo.

The bark is similar in appearance to that of the Type section, as also is the lamina nervation and the ovary and stylopodium. The number and character of the stamens are quite different however; moreover the fruit calyx of the single species is unique, and on this account it could be considered to merit separate generic status. G.H.S. Wood had made some preliminary notes on the single species, with intent to later publish it, under the name *Neohopea isoptera*. In view of the fact that the outer 3 calyx lobes in fruit are slightly longer than the inner 2 are, I feel that to create a new genus would obscure its true affinities, which seem certainly to be with section Shorea. The fruit calyx character does further obscure the narrow boundary between the genera *Shorea* and *Hopea*, and indicates the need for a critical re-assessment of the generic distinctions in Brandis's Tribe Shoreae when the family is treated monographically.

Section III. RICHETOIDES Heim, Rech. Dipt. (1892) 48.

Type: *S. faguetiana* Heim.

—Gen. **Richetia** Heim.

Flowers usually small; stamens 15 (rarely 10), in 3 verticils; filaments broad at base, frequently gibbous, tapering more or less abruptly medially, filiform below anther; anthers with 2 pollen sacs, broadly oblong to subglobose; appendage to connective longer than anther, erect, filiform, slender, more or less scabrous towards apex; ovary with stylopodium, shortly tomentose or glabrescent; style shorter than ovary. Stipules and bracts minute, fugaceous; lamina nervation usually more or less scalariform, pellucid; midrib raised or sunken above, evident.

Bark surface scaly (*S. acuminatissima* excepted); phelloderm thin, inconspicuous; expansion tissue in long fingers, becoming wider outwards; outer bark with 1 (2) sheet-like rhytidome layers.

Distribution. 24 species; Southern Thailand (1), Malaya (9), Sumatra (5), Borneo (17), Philippines (1).

Symington (1938, 330; 1943, 44) recognised this section as a natural group under the name 'Richetia group'. Richetioides is the correct name, being the first name published at this status.

Section IV. RUBELLA Ashton, Sect. nov.

Type: *S. rubella* Ashton.

Alabastra fusiformis. Stamina 15, filamentis loratis compressis, sub antheros abrupte attenuatis; antheris anguste oblongis loculis 4; aristis crasse filiformibus brevibus paullum recurvis. Ovarium glabrum stylopodio prominenti glabro; stylo quam ovarium plus quam 2-plo longiori filiformi. Stipulae bracteae bracteolique fugaces. Lamina intercostis scalariformibus; costa media supra lata applanata.

The bark surface appears similar to fissure barked species of section Mutica, but has not been examined morphologically.

Distribution. 1 species: Borneo.

The anthers are similar to *S. ochracea* in section Anthoshorea, though the appendages are atypically short; they are also short however in *S. albida* in that section. The lorate filaments are unique; the lamina with widely spaced nerves and cuneate base is similar to *S. kunstleri* in section Brachyptera, and quite unlike Anthoshorea, in which the lamina shape and nervation has a characteristic appearance with many close nerves; the bark and the pink wood recall section Mutica, as also the raceme with fugaceous bracts, though the flowers are remote as in section Brachyptera; it is on this basis that I have decided to create a separate section for *S. rubella*.

Section V. ANTHOSHOREA Heim, Rech. Dipt. (1892) 41.

Type: *S. harmandii* Lanessan.

—Gen. **Parahopea** Heim.

—Sect. **Hopeoides** Heim, id (1892) 43. Types. *S. hypochra* Hance, *S. henryana* Lanessan, *S. cambodiana* Pierre, *S. maritima* Lanessan.

Flowers usually large. Stamens 15–30, in 3 verticils or irregular; filaments broad at base, gradually tapering; anthers with 4 pollen sacs, narrowly oblong to linear; appendage to connective unreflexed, prominent, usually at least half as long as anther, stout or slender, scabrous or glabrous. Ovary pubescent or glabrous; no distinct stylopodium; style longer than ovary, more or less trifid apically. Stipules caducous; bracts and bracteoles frequently large, subpersistent. Midrib depressed, obscured by lamina above. Bark surface with irregular section fissures, frequently short and anastomosing; inner edge of outer bark ill defined, outer surface rotting off, rarely flaking regularly; periderms undulate or incomplete or absent; inner bark simply laminate.

Distribution. 25 species. Eastern Deccan, India (1) to North East India (2), Burma (6), Thailand (5), Indochina (4), Malaya (10), Sumatra (6), Borneo (9), Philippines (3), Java (1), Celebes (1), Moluccas (2).

I follow Brandis (1895) in uniting Hopeoides with Anthoshorea. The number of species now known confirm that Heim's sections are connected by intermediate forms and are not distinguishable.

Section VI. OVALIS Sym. ex Ashton, sect. nov.

Type: *S. ovalis* (Korth) Bl.

Alabastra late ovoidea obtusa. Stamina 55–67; filamentis longissimis filiformibus, in alabastra plicatis; antheris subglobosis loculis 4; aristis vestigialibus. Ovarium stylopodiumque anguste conicum conferte tomentosum; stylo brevi. Stipulae bracteae bracteolique subpersistentes. Lamina intercostis scalariformibus; costa media supra depressa obscura.

The fissured bark surface and red inner bark appear similar to that of section Mutica, but have not been examined in detail.

Distribution. 1 species: Malaya, Sumatra, Borneo.

This is the 'ovalis group' of Symington (1943, 58).

Section VII. MUTICA Brandis, J. Linn. Soc. Bot. 31 (1895) 100.

Lectotype species: *S. leprosula* Miq.

Buds more or less ovoid. Stamens 15, in 3 verticils; filaments broad at base, tapering gradually to anthers; anthers with 4 pollen sacs, broadly oblong to subglobose; appendage to connective, at least on outer anthers, shorter than anther, becoming reflexed.

Ovary with distinct stylopodium, both more or less densely tomentose; style shorter than ovary, or very slightly longer. Branchlets of raceme short, flowers dense. Stipules, bracts and bracteoles usually caducous, rarely subpersistent. Midrib depressed or raised above, evident.

Bark surface usually V-section fissured, only flaking in very old trees.

Whitmore (1962) separates *S. quadrinervis* V. Sl. and *S. acuminata* Dyer into another subgroup as they only become fissured after attaining a great size and have a unique bark surface pattern; they differ also from others in their persistent stipules and stipular bracts and large spreading inflorescence; I do not feel that these differences alone merit placing them in a separate subsection.

He further places *S. macroptera* in the 'Kawang' group (i.e. Pachycarpa). The bark becomes scaly very early, with a short intermediate fissured stage. This would be true also of the closely related *S. acuta* Ashton, but on other characters they are quite typical of this section. He places *S. macrantha* and *S. singkawang* Miq in the 'Pauciflora Group' (Brachyptera), but on characters other than bark they clearly belong here.

Distribution. 23 species: Penisular Thailand (4), Malaya (15), Sumatra and Bangka (7); Borneo (18).

Brandis included here also *S. ovalis* Korth., *P. malaanonan* (Blanco) Merr (as *S. malaanonan* (Blanco) Bl.), *S. palembanica* Miq (Type of Section Brachyptera), and *S. glauca* King and *S. inappendiculata* Burck of section Shorea. Four of the species quoted by him belong to the section as I here interpret it, and his section description approximates more to this section than to any other. I have therefore chosen *S. leprosula* as lectotype and redefined the section.

Section VIII. PACHYCARPA Heim, Rech. Dipt. (1892) 44.

Lectotype: *S. macrophylla* (De Vriese) Ashton.

—Sect. **Pinanga** Brandis, J. Linn. Soc. Bot. 31 (1895) 90. Lectotype species: *S. pinanga* Scheff.

Buds ovoid to fuseiform; stamens 15, in 3 subequal verticils; filaments lorate, adnate along the margin, forming a tube round the ovary, tapering more or less abruptly below the anthers; anthers subglobose or broadly oblong; appendage to connective filiform, slender, glabrous, erect, 2 to many times length of anther; ovary small, glabrescent or glabrous; style filiform, stylopodium indistinct, or both spindle shaped, tapering distally and basally; 3 outer fruiting calyx lobes broad at base; stipules, bracts, and bracteoles persistent, large; lamina nervation scalariform; midrib above more or less depressed, evident.

Bark surface remaining smooth and hoop-marked longer than in other sections, later becoming more or less flaked, sometimes scroll marked.

Distribution. 6 species: Borneo.

Pachycarpa Heim is the earliest name referable to this section. Heim quoted *S. gysbertsiana* Burck and *S. gysbertsiana* var. *scabra* Burck as syntypes; I choose *S. macrophylla,* to which I reduce *S. gysbertsiana* (see there), as lectotype, as the syntypes of var. *scabra* represent two species.

Brandis (1895) included species from this section in sections Anthoshorea Heim and Pinanga. In the latter he included species which fall into sections Mutica, Brachyptera, and Richetioides as at present defined, as well as Pachycarpa; his section description is too brief and broad to select a lectotype on its basis. I therefore choose *S. pinanga* Scheff. as the section bears its name and thus reduce it here.

Section IX. BRACHYPTERA Heim, Rech. Dipt. (1892) 46.

Type: *S. palembanica* Miq.

Buds more or less ovoid. Filament broad and compressed at base, tapering somewhat abruptly medially and filiform below the anthers; anthers 4-celled, subglobose or broadly oblong; appendage to connective slender, filiform, $1\frac{1}{2}$–$3\frac{1}{2}$ times length of anthers. Ovary with distinct stylopodium, ovary and stylopodium more or less pyriform; or without distinct stylopodium but with style frequently pubescent towards base. Raceme spreading, branchlets long, flowers remote; stipules and bracteoles frequently somewhat persistent; lamina nervation scalariform; midrib raised, applanate or depressed above, not obscured by lamina.

Heim based the section on *S. brachyptera* Heim, later reduced by Symington (1933, 141) to *S. palembanica.* This is the earliest name for the section; the species were dispersed in many sections by Brandis (1895).

Subsection 1. Smithiana Ashton, subsect. nov.

Type: *S. smithiana* Sym.

Stylum brevissimum. Stamina 22—26.

Bark surface with deep V-section fissures, unflaked, as section Mutica; but with sheet like rhytidome layers as in subsect. Brachyptera and other flaky-barked groups.

Distribution. 1 species: Borneo.

Though a reduction of the number of stamens to 10 in sections where the rule is 15 is not rare, an increase is unique, and has prompted me to consider this species as in a separate subsection from the others of section Brachyptera. The bark morphology according to Whitmore is also unique.

Subsection 2. Brachyptera.

—Sect. **Pachychlamys** Dyer ex King, J. As. Soc. Beng. Sc. 62, 2 (1893) 109 (Type: *S. palembanica* Miq).

—Gen **Pachychlamys** (Dyer ex King) Ridl.

Style as long as, or longer than, the ovary; stamens 15.

Bark surface square section fissured, appearing flaky rather than fissured; phloem matrix proliferation tissue with pale stone cells in conspicuous simple laminae; phelloderm thin, inconspicuous.

Distribution. 21 species: Malaya (5), Sumatra (4), Borneo (19), Philippines (3).

In several species the flakes are subpersistent and the appearance of the bark seems to me to be fissured rather than flaky. Further morphological examination of these species is needed before the homogeneity of the bark structure within the subsection is confirmed.

The Type of section Pachychlamys was cited by King as *S. thistletoni* King, a synonym of *S. palembanica* reduced by Symington (1933, 141).

SHOREA CRASSA Ashton sp. nov (Sect Shorea).

S. inappendiculatae Burck affinis, sed stamina 38–46, costis lateralibus utrinsecus 7–11 minus confertis, petiolo longiore, ex integro sparsius tomentosis.

Ramuli, stipulae externe, gemmae petiolique conferte breviter tomentosi; costae subtus sparsium tomentosi. Ramuli apicem versus –5 × 2.5 mm., primo compressi dein teretes glabrescentes, pallide fusci, minute lenticellati, saepe fissuli; internodis 1–2.5 cm. longis; cicatricibus stipularum c. 2 mm. longis, cuneatis pallidis apicem versus directis. Gemma –6 × 6 mm., ovoidea compressa subacuta. Stipula –8 × 4 mm., ovata concava subacuta caduca. Lamina 10–18 × 5–10 cm., elliptica vel ovata; basi cuneata vel anguste obtusa; apice in acumen –1 cm. longum abrupte attenuata; costis lateralibus utrinsecus 7–11 prominentibus remotis angulo 40°–50° exorientibus; intercostis angustis sinuatis conferte scalariformibus; lamina subtus pallide cremeo vel aureo-lepidota. Petiolus 2–5 cm. longus, 2–2.5 mm. diam., crassus, breviter cremeo-tomentosus. Lamina delapsa supra pallide ochraceo-fusca, subtus cremeo-lepidota, ad costam mediam plus minus revoluta. Racemi –13 cm. longi, semel ramosi, stipitis basi in fructu –2 mm. diam., terminales vel axillares, teretes vel paullum compressi, crassi, semper breviter cremeo- vel pallide fusco-tomentosi; ramulis –4.5 cm. longis, floribus distichis –12 gerentibus; bracteolis –3 mm. longis suborbicularibus breviter pubescentibus caducis. Alabastrum –15 × 3.5 mm. anguste lanceolatum. Calyx externe tomentosus, intus glabrescens; lobis late ovatis subacutis; lobis exterioribus quam interioribus paullum longioribus obtusioribus. Corolla cremea basi rosea; petalis linearibus, externe breviter tomentosis, intus glabrescentibus. Stamina 38–46; filamentis basibus latis attenuatis hispidis; antheris anguste oblongis, loculis apicem versus attenuatis, subaequalibus vel externis 2 paullum longioribus; aristis prominentibus sed quam loculis brevioribus, setosis. Ovarium ovoideum, basi glabra, aliter tomentosum; stylopodium quam ovarium longius, cylindricum tomentosum, stylo brevissimo glabro. Pedicellus in fructu 3–5 × 2 mm. Calyx apicem versus puberulus, basim versus confertius pubescens; lobis longioribus 3, –9 × 2.3 cm. late spatulatis coriaceis obtusis, basim versus c. 8 mm. latis attenuatis, partibus basalibus c. 15 × 13 mm. ellipticis tenue saccatis incrassatis; lobis brevioribus 2, –7 × 0.7 cm., lineare oblongis obtusis, basi ut in lobis longioribus. Nux –2.5 × 2 cm., ellipsoidea plane conferte breviter cremeo tomentosa, ad stylopodium –7.5 mm. longum attenuata.

Collections: Sarawak: S 9468, S. Iran, Pelagus; S 11701 (Holotypus in Herb. Kew), 11081, 10035, Semengoh F.R., Kuching; S 20, Lundu; Kep 35527, Pangkalan Ran; Kep 48159, S. Lumut; Kep 48190, Brun 641, 642, Bt. Puan; Kep 48227, S. Badas; Kep 48270, S 5644, 5645, 1911, 1863, Brun 3080, 832, 570, Andulau F.R.; Brun 5156, Berakas F.R.

S. scrobiculata Burck, Med. Lands Pl. Tuin, 3 (1886) 22. Syntypes: Beccari 2538, fl., Matang, Sarawak (BO, K, FIR, PC, BM); Beccari 2917, y. fr., Sarawak (BO, K, PC, BM.).

—*S. pierreana* Heim, Rech. Dipt. (1892) 43.

Holotype: Beccari 2538 (K).

Heim cited *S. pierreana* as 'Type' of his eighth section of *Shorea*. He described the section but did not name it, and cited *S. pierreana* as Type species though he had not previously published it. As the section was monotypic, and Beccari 2538 the only number cited in the section, I conclude that the section description is a valid description of *S. pierreana*, which is thus a valid name; it is founded on the Kew isosyntype of *S. scrobiculata* Burck however.

S. seminis (De Vriese) V. Sl., in Merrill, Pl. Elm. Born (1929) 204.

—*Hopea seminis* De Vriese, Minyak Tengkawang (1861) 32.

Holotype: De Vriese s.n., st., Seminis, Sambas, W. Borneo (L).

—*H. lanceolata* De Vriese, loc. cit.

Holotype: De Vriese s.n., st., Seminis (L).

—*Shorea schefferiana* Hance, J. Bot. 16 (1878) 303.

Holotype: 6526 HB, fl., Sambas, W. Borneo (BM).

—*Isoptera borneensis* Scheff. ex Burck. Med. Lands Pl. Tuin. 3 (1886) 27.

Lectotype: Kater 11157 H.B., fr., W. Borneo (L).

—*Ridleyinda borneensis* (Scheff. ex Burck.) O.K., Rev. Gen. Pl. 1 (1891) 65.

—*H. ovalifolia* sensu Foxw., Philip. J. Sc. Bot. 6 (1911) 263.

Van Slooten (1941, 117) has made a thorough study of this species. I have not found it necessary to differ from his conclusions, but have further reduced here *Shorea schefferiana* Hance, founded on a typical flowering specimen. Burck distributed numerous specimens, both flowering and fruiting, from the cultivated trees at Bogor, under his name *Isoptera borneensis;* I have seen these at BO, L, K, and the Herbarium of the British Pharmaceutical Society. Kater, administrator at Pontianak at the time of Teysmann's visit, sent herbarium specimens and young plants to Bogor, his collections being the earliest to my knowledge collected; I choose Kater 11157 as lectotype of *I. bornensis* Scheff. ex Burck, for brevity of citation, as it is a good fruiting specimen and the original specimen named by Scheffer. *Ridleyinda* has been discussed in the generic introduction.

Van Slooten fails to realise, however, the very close similarity of this species with *S. sumatrana* (V. Sl. apud Endert ex Thorenaar) Sym. of Sumatra and Malaya, stating '*Sh. seminis* is distinguishable from *Sh. sumatrana* by the size and shape of its leaves, the number of its lateral nerves, the number of its stamens and the wider outer lobes of its fruiting calyx'. I found this species to have two distinct habits, as a low overhanging tree with many branches, or as a tall straight-boled tree. This appears to depend on its habitat, either on stable soils on high river levées, or on frequently flooded shifting banks on river bends. The low form retains a juvenile foliage type that apparently was the only form that Van Slooten saw; but in the erect form there is no difference in leaf characters with *S. sumatrana*. The fruit is also found to be identical, but in the many flowers examined by me I could confirm that the number of stamens in *S. sumatrana* is c. 25, whereas in *S. seminis* it is always 30–40; this remains as the only reliable diagnostic character between the two species.

S. laevis Ridl., Fl. Mal. Pen. 1 (1922) 232.

Lectotype: Kep 1905, fl. Serting F.R., K. Pilah, Negri Sembilan, Malaya (KEP, K); Burn Murdoch s.n., y. fr., loc. cit. (K).

—*S. ciliata* sensu Foxw., Mal. Foc. Rec. 1 (1921) 69; id. 3 (1927) 67; id. 8 (1930) 19; Edwards, Mal. For. Rec. 9 (1931) 142.

—*H. laevifolia* Parijs, Fedde, Rep. 33 (1933) 244.

Holotype: b.b. 13894, st. S. Tjoentjoeng, W. Kalimantan (L).

—*S. laevifolia* (Parijs) Endert, Tectona 28 (1935) 292.

Foxworthy and Edwards mistook this species for *S. ciliata* King, which is in subsection Shorea; Foxworthy (1932, 179) corrected his mistake, and chose Kep 1905 as lectotype; Ridley's syntypes were Kep 5502, st., 5506, st., Bentong, Pahang, and Kep 1904, y. fr., and 1905, Serting F.R.; he further added Moorhouse 404, st., a specimen he had originally cited as *S. ciliata* King, but Symington (1933, 146) correctly transferred this specimen to *S. maxwelliana* King (see there). Parijs' sterile Holotype was transferred by Endert correctly to *Shorea*. It consists of a leafy twig from a young tree, the undersurface not being lepidote. From field observations I have made I have no hesitation in reducing it to *S. laevis*, abundant material of which we now have from Brunei in all stages.

S. ovalis (Korth) Bl., Mus. Bot. 1, 2 (1852) 33.

—*Dilleneacea ? nervosa* Wall., Cat (1828–49) 6635, nomen nudum.

—*Vatica ovalis* Korth., Kruidk. 3 (1841) 73.

Type: Korthals s.n., Prarawing, S. Borneo (L, K).

—*V. ? eximia* Miq., Sum (1861) 486.

Type: Teysmann 3596 H.B., st., prope Muara Doea, Palembang (L, K, PC.).

—*V. ? sub-lacunosa* Miq., loc. cit.

Holotype: Teysmann 3233 H.B., st., prope Plangas, Bangka (L).

—*Hopea aspera* De Vriese, Minyak Tengkawang (1861) 31.

Holotype: De Vriese, s.n., st., Sambas, Borneo (L).

—*Shorea sub-lacunosa* (Miq) Scheff., Nat. Tijd. N.I. 31 (1870) 350.

—*var. angustifolia* Scheff., loc. cit.

Syntypes: Teysmann s.n., st., G. Monoembing, Bangka (BO); Teysmann s.n., st., prope Djeboes, Bangka (BO, L).

—*S. eximia* (Miq) Scheff., Nat. Tijd. N.I. 31 (1870) 349.

—*var. angustifolia* (Scheff) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 218.

—*S. sericea* Dyer, in Hook. f., Fl. Brit. Ind. 1 (1874) 306.

Holotype: Maingay 202, fl., Malacca (K).

—*S. fusca* Burck, Ann. Jard. Bot. Btzg. 6 (1887) 207.

Syntypes: s.n., st., Bangka (L); Maingay 202 (L, K).

—*S. rigida* Brandis, in Hook. f., Ic. Pl. (1895) t. 2402.

Type: Ridley 6393, y. fr., Singapore (K, BM).

—*S. furfuracea* sensu Brandis, J. Linn. Soc. Bot. 31 (1895) 98, pro parte; Ridl., Fl. Mal. Pen. I (1922) 232, pro parte, quoad spec. Malay.; V. Sl. ex Heyne, Nutt. Pl. N. I. 1. (1917) 229; non *S. furfuracea* Miq.

I have checked the conclusions of Symington (1933, 143; 1939 370) with the authentic material of all the above synonyms, and differ only in the following respects; He quoted 's.n., ? Sumatra' (Bangka), a sterile specimen at Leiden, as Holotype of *S. fusca* Burck; it is in fact a syntype with the Leiden sheet of Maingay 202, both of which are quoted by Burck. I have further added to the synonymy *Hopea aspera* De Vriese. The Holotype, a seedling collection, bears the characteristic subpersistent subamplexicaul subcordate stipules of this species.

The very numerous collections of this species confirm, as Symington (1939, loc. cit.) suggested, that there are three distinct geographical subspecies. Owing to the very large number of collections examined by me I only quote the Holotypes and indicate the distribution of these forms.

Ssp. *ovalis.* Ramuli lamina subtusque plus minus breviter scabride roseo-fusco-tomentosi. Lamina 10–18 × 3–7 cm., oblonga vel ovata, basi obtusa, applanata vel superficie inferiore concava; costis lateralibus 55°–70° exorientibus.

89 numbers examined; Malaya (E. Pahang, E. Trengganu, Penang); Sumatra (Djambi, Indragiri); Bangka; Billiton; Borneo (E. North Borneo, throughout Kalimantan).

Ssp. *sericea* (Dyer) Ashton, stat. nov.

—*S. sericea* Dyer, *S. fusca* Burck, *S. rigida* Brandis.

Ramuli et lamina subtus plus minus breviter plane roseo-fusco-tomentosi. Lamina 14–22 × 4–10 cm., late oblonga vel obovata, basi cuneata, superficie superiore concava; costis lateralibus angulo 50°–55° exorientibus.

Holotypus: Maingay 202, fl., Malacca (K). 51 other numbers examined; Malaya (east coast, Penang, excl.); Sumatra (Palembang; Sidjundjung, W. Sumatra), Billiton, Bangka.

Ssp. *sarawakensis* Ashton ssp. nov. Ramuli longissime rufo-cristato-tomentosi; cristis-3 mm. longis; lamina costis subtus sparsim scabrido-tomentosis, aliter glabra nitens. Lamina 12–17 × 2–4.5 cm., anguste oblonga, margine revoluto, basi obtusa; lamina deflexa; costis lateralibus 55°–65° exorientibus.

Holotypus: Brun 3281, fl., Andulau F.R., Brunei (K); 24 other numbers examined; Borneo (Sarawak, Brunei, S. W. North Borneo).

Ssp. *sarawakensis* is the only one known from Sarawak and Brunei; no intermediate forms have been collected between this and the other subspecies, and the range does not overlap with them. The other two subspecies are only identifiable when mature, —young trees and saplings are identical; it is therefore not possible from herbarium material to confirm whether intermediate forms exist. The Holotype of *S. ovalis* is from a young sapling; as however there is only one subspecies recorded from S. Borneo, where it originated, I feel that it is justifiable to attach the specific epithet to the S. Borneon subspecies. Similarly it is not possible definitely to determine which subspecies are represented by the types of *V ? eximia, V ? sublacunosa* and *H. aspera,* all of which represent young stages.

S. macroptera Dyer, in Hook. f., Fl. Brit. Ind. 1 (1874) 308.

Holotype: Maingay 1198 (Kew Distrib. no. 208), y. fr., Malacca (K).

—*S. bailloni* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 973.

Holotype: Beccari 2891, fr., Sarawak (K).

—*S. sandakanensis* Sym., Gard. Bull. S.S. 9 (1938) 343.

Holotype: Kep 38730 (San 4354), fl., Kabili F.R., Sandakan (KEP).

Symington (loc. cit) regarded *S. bailloni* and *S. sandakanensis* as specifically distinct from *S. macroptera,* though Brandis (1895, 90) had previously already reduced *S. bailloni.* These forms, with *S. acuta* Ashton, and probably *S. ferruginea* Dyer ex Brandis, constitute a group of closely related taxa sharing in common the auriculate fruit calyx lobes and coriaceous sparsely tomentose to glabrescent lamina with c. 13 pairs of nerves, drying rust-brown. According to Symington *S. sandakanensis* differs from *S. macroptera* in having a longer, thinner lamina, longer, more lax raceme, larger flower, longer fruit calyx, and a tomentose, globose, not ovoid, nut. Of these, only the shape and size of lamina, raceme, and calyx lobes remain good diagnostic characters in the light of more recent collections, and these differences I do not regard as great enough to merit separate specific status. I have on the other hand treated my recently described *S. acuta* as specifically distinct, as the difference in size of all parts is very great, and, unlike *S. sandakanensis,* no intermediate forms have been recorded; I also regard *S. ferruginea* as specifically distinct at present as the flowers have never been collected, and affinities are therefore not definitely known. *S. bailloni,* like *S. sandakanensis,* represents a geographically well defined population which differs only slightly from the Malayan *S. macroptera,* and I prefer to regard it as a geographical subspecies. *S. macroptera,* as it occurs in Brunei, represents yet a further form, which Wyatt-Smith has called *S. macropterafolia* on Herbarium specimens. Intermediate forms have been collected between this and *ssp. bailloni* in C. and N. E. Sarawak, and between it and ssp. *sandakanensis* in W. North Borneo. After the following descriptions I have not been able to cite all collections examined owing to the necessity for brevity, and therefore cite only the Type numbers and geographical distribution, and indicate the number of collections examined.

Ssp. *macroptera.* Ramuli petioli racemique conferte plane breviter alutaceo-tomentosi; lamina 10–15 × 3–5 cm., elliptica vel oblonga, basi late cuneata, in apicem gradatim attenuata; costis lateralibus utrinsecus 12–15 (18), subtus prominentibus nec acutis. Petiolus c. 1.5 cm. longus. Racemi –10 cm. longi, semel ramosi vel basim versus bis ramosi. Lobi longiores calycis in fructu –12 cm. longi. 195 numbers examined; Malaya, Sumatra, Riouw, Karimata.

Ssp. *bailloni* (Heim) Ashton, stat. nov.

Ramuli petioli racemique sparsim cristato-tomentosi vel glabrescentes, sicco nigrescentes. Lamina 12–19 × 3.5–7 cm., anguste elliptica, basi anguste cuneata, in apicem gradatim attenuata; costis lateralibus utrinsecus 11–14 (15), subtus prominentibus nec acutis. Petiolus c. 1.5 cm. longus. Racemi c. 13 cm. longi; semel ramosi vel basim versus bis ramosi; ramulis –2.5 cm. longis. Lobi longiores calycis in fructu –13 cm. longi.

Holotypus; Beccari 1891 (K); 33 other numbers examined; Sarawak: Baram to W. Sarawak.

Ssp. *sandakanensis* (Sym.) Ashton, stat. nov.

—S. *sandakanensis* Sym. (1938) 343 (species).

Tomentum ut in ssp. *macroptera.* Lamina (9) 18–23 × (4) 6.5–9.5 cm., oblonga, tenuis, basi obtusa, in apicem abrupte attenuata; costis lateralibus utrinsecus 13–15, subtus prominentibus angustis acutis. Petiolus –2 cm. longus. Racemi –16 cm. longi, bis ramosi, ramulis –8 cm. longis. Lobi longiores calycis in fructu –14 cm. longi.

Holotypus: Kep 38730 (KEP); 33 other numbers examined; E. North Borneo, S.E. Kalimantan.

Ssp. *macropterifolia* Ashton, ssp. nov.

Tomentum ut in ssp. *macroptera.* Lamina 8–16 × 4–6 cm., ovata, coriacea, basi obtusa, in apicem gradatim attenuata; costis lateralibus 10–14, subtus prominentibus angustis acutis. Petiolus –1.5 cm. longus. Racemi –16 cm. longi, bis ramosi, ramulis –8 cm. longis. Lobi longiores calycis in fructu –14 cm. longi.

Holotypus: San 16255, fr., Sipitang, North Borneo (K); 27 other numbers examined; S. W. North Borneo; Lawas, Sarawak; Brunei.

S. parvifolia Dyer, in Hook. f., Fl. Brit. Ind. 1 (1874) 305.

Syntypes: Maingay 1577, fl., 1197, fl., 2549, fl., Malacca (all sub Kew Distrib. no. 206), (K).

—*S. scutulata* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 110.

Type: Curtis 1396, sapling, Penang (K, CAL).

Symington (1933, 137) has critically discussed this species and reduced *S. scutulata* correctly to it. He further (1943, 85) indicated that 3 geographical variants are distinguishable in Malaya.

Two of these, the 'Selangor' and 'Pahang' forms are well distinguished and occur throughout the range of the species. The third, 'Perak', form has the tomentum characters of the Selangor form, and the leaf shape of the Pahang form; a similar form is also found in the Tawau area of N. E. Borneo which is also an area of overlap between the Pahang and Selangor forms. The Perak form appears to be ill-defined from the other two forms, and may represent either the result of hybridisation or incomplete differentiation. I am giving the 'Pahang' and 'Selangor' forms of Symington the rank of subspecies, but, on the evidence at present available, prefer to treat the 'Perak' form as merely intermediate individuals between the former two.

Ssp. *parvifolia*. Lamina 5–9 × 2.5–5 cm., late ovata, basi obtusa vel cordata; costis lateralibus subtus glabrescentibus, vix elevatis; margine non revoluto. 133 numbers examined; Malaya (Widespread; E. Pahang excl); Sumatra (Riouw, Tapanuli, Djambi, Rawas, Banjuasan, Palembang); Borneo (E., C., and S.E.).

Ssp. *velutinata* Ashton, ssp. nov.

Lamina 6–11 × 3.5–6 cm., ovata vel elliptica, basi obtusa vel cuneata; costis lateralibus subtus crassis prominentibus; margine saepe paullum revoluto.

Holotypus: Kep. 4502, fl., Belingo F.R., Temerloh, Pahang (KEP); 24 other numbers examined. Malaya (E. Pahang, Perak, E. Negri Sembilan); Sumatra; Borneo (Widespread).

This is the only subspecies found in Brunei and Sarawak. 5 Brunei collections differ from ssp. *velutinata* in that a pair of large glabrous domatia seem to remain persistently at the base of the lamina (domatia are usually found only in the young stages in this species). This form occurs on soils with a marked sand content; when more material is available it may be necessary to give it separate taxonomic status, but as the single character of the persistence of the domatia is the only difference I have been able to discern I am unwilling to do so at present.

As the Type of *S. scutulata* King is a sapling it is not possible to refer it to a subspecies; other collections from Penang bear characters intermediate between the two subspecies.

S. macrophylla (De Vriese) Ashton, comb. nov.

—*H. macrophylla* De Vriese, Minyak Tengkawang (1861) 28.

Lectotype: De Vriese s.n., st., 'Borneo' (L, sub. no. 2207, 23).

—*S. gysbertsiana* Burck, Med. Lands Pl. Tuin. 3 (1886) 15.

Syntypes: S.n., fr., cult. in Hort. Bog (K, L); Teysmann 231, fr., W. Borneo (BO, L, U, K).

—*var. scabra* Burck, id (1886) 17, pro parte, quoad. syntypus s.n., fr., cult. in Hort. Bog (K, L).

—*S. bakeriana* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 974.

Holotype: Beccari 3849, fr., Serang R., Sarawak (K).

Closely allied to *S. stenoptera* Burck, of the Heath forests of W. Kalimantan and W. Sarawak, which is a smaller tree, with larger, thickly coriaceous lamina with more prominent nerves, shorter broader stipules, and glabrous young parts. *S. macrophylla,* though varying much in the persistence of the tomentum, is apparently always sparsely or densely tomentose on freshly opened parts; the tomentum is persistent in young trees. The differences between these two species are small, and the fruit are identical, but I hesitate to unite them as I have very little field experience of *S. stenoptera,* which, besides occuring only in a very different habitat from *S. macrophylla,* is said by those who know it to be always easily distinguishable in the field.

De Vriese described *Hopea macrophylla,* and also *H. splendida* (loc. cit) on his return from Indonesia to Leiden, and shortly before his death. I have seen seven collections of De Vriese under these names in his herbarium at Leiden, and two at Utrecht; none exist at Kew, and I have not seen any at Bogor, where there may be duplicates. Of the collections two only are determined in De Vriese's hand, both at Leiden. These are a sterile specimen named *H. macrophylla,* which without doubt represents *S. gysbertsiana* Burck, and a sterile specimen named *H. splendida* which equally unequivocally represents *S. martiniana* Scheff. This latter species is characterised by the relatively small thin lamina, pale twigs with broad amplexicaul stipule scars, and broadly ovate subcordate subpersistent stipules. For both his species De Vriese described flowers and fruit. There is only one fruit specimen at Leiden, with leaves of *S. martiniana* and fragmentary fallen fruit appearing to represent *S. pinanga* Scheff. The three flowering specimens at Leiden, only one of which bears leaves, appear to have originated from the same tree, an immature specimen of *S. stenoptera* Burck. At Utrecht are a sterile duplicate determined as *H. splendida,* and a flowering duplicate determined as *H. macrophylla,* in Boerlage's hand. De Vriese's descriptions are not sufficiently diagnostic to be able to decide which fertile specimens he was describing under each species. but the leaf descriptions are unequivocal. I therefore feel compelled to cite the two specimens determined at Leiden by De Vriese as lectotypes. Thus *S. gysbertsiana* Burck becomes *S. macrophylla* (De Vriese) comb. nov., and *S. martiniana* becomes *S. splendida* (De Vriese) comb. nov.

Burck (1877, 208), following the 'Kew Rule', reduced *H. macrophylla* to *S. martiniana,* and *H. splendida* in part to *S. stenoptera* and in part to *S. martiniana.*

Burck's *S. gysbertsiana* var. *scabra* is founded on two syntypes. One is a fruiting collection from a tree cultivated at Bogor from seed sent by Gysberts from W. Borneo; this differs from the species syntypes only in the tomentose, not puberulent parts, which may well be related to the age of the tree from which it was collected;

the other syntype, Beccari 3077, fr., Sarawak, represents *S. pinanga* Scheff. I therefore do not consider this variety as a distinct taxon. The Holotype of *S. bakeriana* Heim is a typical glabrous fruiting specimen of *S. macrophylla,* and I have no hesitation in reducing it.

S. mecistopteryx Ridl., Kew Bull. (1925) 280.

Holotype: Taha s.n., Fallen leaves and fr., Kinabatangan, North Borneo (K).

—*S. chrysophylla* Ridl., id (1926) 470.

Holotype: Cabiling 1, 6, very y. fr., Pintasan, North Borneo (K).

Ridley, when describing *S. chrysophylla* a year later than his *S. mecistopteryx,* stated that it was a very distinct plant, differing in the gold tomentose lamina undersurface from his former species. The colour of the tomentum alone is hardly a criterion for describing a separate species in section Pachycarpa. The Holotype of *S. mecistopteryx,* with ripe fruit, differs only in that the tomentum is sparser, and brownish; the Holotype of *S. chrysophylla* bears old flowers with fallen corollae and stamens. From field observations I have confirmed that the tomentum is sparser, slightly longer, and brownish in immature trees, an effect exaggerated in the old fallen and slightly decayed leaves of Taha s.n. Van Slooten (1929b, 202) questioned whether the two were distinct, but Symington (1938, 349) considered them so. The present abundant collections confirm the contrary.

S. beccariana Burck, Ann. Jard. Bot. Btzg. 6 (1887) 213.

Lectotype: Beccari 1127, fr., Sarawak (BO).

—*S. franchetiana* Heim Bull. Mens. Soc. Linn. Paris, 2 (1891) 956.

Holotype: Beccari 1126, fl., Sarawak (K).

—*S. beccarii* Dyer ex Brandis, J. Linn. Soc. Bot. 31 (1895) 87, nomen pro syn.

Closely allied to *S. pinanga* and *S. amplexicaulis* Ashton. Burck based this species on the Bogor duplicates of Beccari 1127 and 2912. The latter specimen consists of fragmentary leaves and fallen fruit, with no twig and broken petiole; though the Kew and Florence duplicates are unequivocal, Burck did not see them, and his duplicate is inadequate to distinguish from S. amplexicaulis. to eliminate all ambiguity I therefore choose Beccari 1127 as lectotype.

S. franchetiana Heim is described from a further Beccari collection at Kew, with flowers; Brandis (1895, 87) had already reduced it to *S. beccariana,* at the same time adding Beccari 2480 and 1128, both in fruit. Wyatt-Smith has indicated on Beccari

2480 and 2912 at Kew that he considers them to represent my *S. amplexicaulis*. In this I cannot agree; the leaf and petiole are quite typical of *S. beccariana*, though the stipule scars are rather long, but not amplexicaul. The subterete twigs also resembly *S. amplexicaulis*, but they are clearly old twigs, which would explain these features.

S. pinanga Scheff., Nat. Tijd. Ned. Ind. 31 (1870) 350.

Syntypes: s.n., fl. and fr., cult. in Hort. Bogor (BO, L, U).

—*S. gysbertsiana* Burck, var. *scabra* Burck, Med. Lands Pl. Tuin. 3 (1886) 17, pro parte, quoad syntypus Beccari 3077, fr., Sarawak (BO).

—*S. compressa* Burck, id (1886) 26.

Type: Burck, s.n., fl., cult. in Hort. Bogor (BO, L).

Among the most variable of all dipterocarps as regards density of tomentum, lamina size, and number of nerves. As these characters vary much according to the age of the trees as well as between individuals, I have not been able to discern any discontinuities in the variation upon which I could found infraspecific taxa; much more field knowledge of the population throughout its range is necessary before the nature of the variation can be understood. In Brunei there is a tendency for individuals on ridges to be glabrous, and with c. 18 pairs of nerves, whereas in the valleys the leaves are tomentose below, and with c. 15 pairs of nerves; Brun 124 however is tomentose but bears many nerves, and there is no clear break in the variation between the two forms. The Type of *S. compressa* is an extreme form with unusually large –25 $\times$ 10 cm. lamina, –20 pairs of nerves, and densely tomentose twigs and lamina undersurface; the very stout compressed twigs, as well as the characters mentioned, suggest that it originated from a young tree, and I consider that it falls within the bounds of variation of *S. pinanga* as I am interpreting it. The authentic material of *S. pinanga* bears –18 $\times$ 7 cm. subglabrous laminae with 10–12 pairs of nerves. Beccari 3077, one of the syntypes of *S. gysbertsiana* var *scabra*, bears c. 14 pairs of nerves and a sparsely tomentose lamina undersurface. In all cases the falcate downcurved stipule scar, relatively short petiole, and slender hardly raised nerves, distinguish this species from the others in section Pachycarpa, and it is on this basis that I unite both *S. compressa* and Beccari 3077 with Scheffer's species.

S. ferruginea Dyer ex Brandis, J. Linn. Soc. Bot. 31 (1895) 91.

Holotype: Beccari 2604, fr., Matang, Sarawak (K).

—*S. discolor* Heim, Rech. Dipt. (1892) 67, nomen nudum.

The species appears to belong to the group of closely allied species including *S. macroptera* and *S. acuta*, with which it shares a similar leaf, tomentum, and fruit. The narrow lamina with very slender hardly raised nerves and sparsely tomentose under-surface is sufficiently distinct to allow me always to distinguish it from *S. macroptera* in the field without difficulty. The two sometimes grow together and I saw no evidence of hybridisation. As flowers are unknown its systematic position must remain uncertain.

S. discolor is a nomen, accompanied by a description, written on the Kew sheet of Beccari 2604, in the hand of Heim. He never published this description, but in his 'Recherches' discussed the species, quoting Beccari's number, under his genus *Parahopea*. There he mentions the similarity, a very superficial one in my opinion, in leaf indumentum and shape to *Shorea balangeran* (Korth) Burck, referring to the powdery tomentose undersurface, and remarking on the auriculate fruit calyx. It is quite evident that he did not mean this to be a species description of *S. discolor* however, for he alludes to an already published description by him in the Bulletin Mensuel de la Societé Linnéenne de France of Nov. 1, 1891. This description in fact does not exist in that or any other journal to my knowledge, and I consider Heim's name to be a Nomen Nudum therefore.

Bibliography

BENTHAM, G., and HOOKER, Sir J. D. Genera Plantarum. London (1862) 189.

BLUME, K. E. Descr. sp. in Mus. Bot. Lugd.-Bat. 2 (1852) 28.

BRANDIS, Sir D. An enumeration of the Dipterocarpaceae. J. Linn. Soc. Bot. 31 (Nov. 1895) 1.

BRANDIS, Sir D., and E. GILG. Dipterocarpaceae in Engler, Die Naturliche Pflanzenfamilien, 3, 6 (Feb. 1895) 243.

BURCK, W. Sur les Dipterocarpaceae des Indes Neerlandaises. Ann. Jard. Bot. Btzg. 6 (1887) 145.

CANDOLLE, ALPHONSE P. DE. Dipterocarpaceae in Prodromus 16, 2 (1868) 604.

DYER, Sir W. THISTLETON. a. Dipterocarpaceae, in Hooker, Sir J. D., Flora of British India, 1 (Jan. 1874) 294.

b. A revision of the genera Dryobalanops and Dipterocarpus. J. Bot. 12 (Mar. 1874) 97.

c. Remarks upon M. Vesque's new species. id. 12 (Apr. 1874) 152.

ENDLICHER, S. Genera Plantarum. Vindobonae (1841) 1012.

FOXWORTHY, F. W. Dipterocarpaceae of the Malay Peninsular. Mal. For. Rec. 10, 1932.

HEIM, F. Recherches sur les Dipterocarpacées. Paris, 1892.

KING, Sir GEORGE. Dipterocarpaceae, in Materials for a Flora of the Malay Peninsular. J. As. Soc. Beng. Sc. 62, 2 (1893) 379.

KORTHALS, P. W., Dipterocarpaceae in 'Kruidkunde', in Temminck, Verh. Nat. Gesch. Ned. Overz. Bez. Botanie (1840–1) 45–75.

LINDLEY, J. Dipterocarpaceae in 'The Vegetable Kingdom'. London (1846) 393.

MERRILL, E. D. Species Blancoanae. A critical revision of the Philippine species of plants described by Blanco and Llanos. Phil. Bur. Sci. Publ. 12, 1918.

MIQUEL, F. A. W. Dipterocarpaceae, in Flora Indiae Batavae. Suppl. 1. Prodromus Florae Sumatranae (1861) 190, 485.

Annotationes de Dipterocarpaceis. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 83.

PIERRE, J. B. L. Dipterocarpaceae, in 'Flore Forestiere de la Cochinchine', 14–16, Paris, 1889–91.

RIDLEY, H. N. Dipterocarpaceae, in 'The Flora or the Malay Peninsula'. London, 1 (1922) 209.

SLOOTEN, D. F. VAN The Dipterocarpaceae of the Dutch East Indies. I, Bull. Jard. Bot. Btzg. 3, 8 (1926) 1; II, id., 3, 8 (1927) 263; III, id., 3, 8 (1927) 370; IV, 3, 9 (1927) 67; V, id., 3, 10 (1929) 393; VI, id., 3, 12 (1932) 1.

Dipterocarpaceae, in Merrill, Plantae Elmerianae Borneenses. Univ. Cal. Publ. Bot. 15 (1929 b) 200.

Sertulum Dipterocarpaceum Malayensium. II, Bull. Bot. Gard. Btzg., 3, 17 (1941) 96; III, id. (1942) 220; VII, Reinwardtia, 5 (1961) 457.

SMITH, Sir J. E. Plantarum icones hac tenus ineditae, 2, 1789.

SMITINAND, T. The genus Dipterocarpus Gaertn. f. in Thailand. Bangkok. 1958.

STEARN, W. T., in Linnaeus, C., Species Plantarum, ed. I (1957 facsimile ed.) 1–169.

SYMINGTON, C. F. Notes on Malayan Dipterocarpaceae. I, Gard. Bull. S.S. 7 (1933) 129; II, id., 8 (1934) 1; IV, id., 9 (1938) 319; V, id., 10 (1939) 336.

Forester's Manual of Dipterocarps. Mal. For. Rec. 16, 1943.

VRIESE, W. H. DE. (a). Mem. sur le Camphrier de Sumatra et de Borneo. (b). Minyak Tengkawang. Leiden, 1861.

WALPERS, W. G. Annales botanices systematicae. Lippsiae, 1, 1848.

WHITMORE, T. C. Studies in Sytematic Bark Morphology, III. Bark Taxonomy in Dipterocarpaceae. Gard. Bull. S.S. 19, 2 (1962) 321.

New records of plant diseases in Sarawak for the years 1960 and 1961

G. J. Turner

Department of Agriculture, Sarawak

Very few plant diseases had been recorded from Sarawak until Johnston (1960), carried out a preliminary survey in 1959. The list given below consists of previously unrecorded diseases, together with a number of entomogenous fungi, noted or collected by the writer from the time of his arrival in Sarawak, in August 1960, until the end of 1961. Fifteen of these records appear in the Annual Report of the Department of Agriculture for 1961, but most of them were identified after the Report had been sent to the press.

The causal organisms are listed alphabetically under their individual hosts. The frequency of occurrence is given, together with the Commonwealth Mycological Institute Herbarium serial number, where the identification has been performed by the Institute.

Averrhoa carambola L. (Carambola)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	90670
Calopogonium mucunoides Desv.			
Rust	*Phakopsora pachyrhizi* Syd.	1 record	92366
Chrysanthemum species			
Leaf blight	*Phyllostictina* species	1 record	92381
Citrus aurantifolia (Christm.) Swingle (Lime)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	92360
Citrus aurantium L. (Sour orange)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	92361
Citrus grandis (L.) Osb. (Pomelo)			
On scale insects	*Aschersonia* species	Occasional	—
Citrus nobilis Lour. (Mandarin)			
On scale insects	*Calonectria diploa* (Berk. & Curt.) Wollenw.	1 record	92383
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	—
* Gummosis	*Phytophthora parasitica* Dastur	Occasional	89456
On bark	*Septobasidium* species	1 record	—

Cocos nucifera L. (Coconut)			
Sooty mould	*Aithaloderma setosum* (Zimm.) Boedijn	1 record	92377
Stem disease	*Ganoderma lucidum* (Leyss. ex Fr.) Karst.	Occasional	—
Coffea liberica Bull. ex Hiern (Liberian coffee)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	92379
Coffea robusta Linden (Robusta coffee)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	92363
Cucurbita maxima Duchesne (Squash)			
Powdery mildew	*Oidium* species	1 record	90674
Derris elliptica Benth. (Tuba root)			
Sooty mould	*Asterina* species	Occasional	92384*b*
Leaf spot	*Phyllachora yapensis* (P. Henn.) Syd.	Occasional	92384*a*
Dioscorea alata L. (Yam)			
Rust	*Goplana dioscoreae* Cumm.	Occasional	90675
Durio zibethinus Murr. (Durian)			
Die-back of seedlings	*Botryodiplodia theobromae* Pat.	1 record	—
Leaf rot of seedlings	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Occasional	—
Flemingia congesta Roxb.			
Sooty mould	*Chaetothyrium* species	Occasional	92378
Gardenia augusta Merr.			
Sooty mould	*Balladyna velutina* (Berk. & Curt.) Höhnel	Common	93287
Hevea brasiliensis Muell. Arg. (Rubber)			
Associated with borers	*Botryodiplodia theobromae* Pat.	1 record	—
On bark	*Septobasidium* species	1 record	—
Hibiscus mutabilis L. (Rose of Sharon)			
Sooty mould	*Irenopsis molleriana* (Wint.) Stev.	1 record	92373
Hibiscus sabdariffa L. (Rozelle)			
Sooty mould	*Irenopsis molleriana* (Wint.) Stev.	1 record	92322
Indigofera endecaphylla Jacq.			
Stem disease	*Corticium* species	1 record	92365
Luffa acutangula Roxb. (Angled loofah)			
Sooty mould	*Asteridiella confragosa* (Syd.) Hansf.	Common	92368*a*
Momordica charantia L. (Bitter cucumber)			
Leaf spot	*Mycosphaerella melonis* (Pass.) Chiu & Walker	1 record	92369*b*

Musa sapientum L. (Banana)			
Rust	*Uredo musae* Cumm.	Occasional	90677
Nephelium lappaceum L. (Rambutan)			
Die-back of seedlings	*Botryodiplodia theobromae* Pat.	1 record	—
Leaf scorch	*Botryodiplodia theobromae* Pat.	1 record	92374
Pink disease	*Corticium salmonicolor* Berk. & Br.	1 record	—
On bark	*Septobasidium* species	1 record	—
Oryza sativa L. (Rice)			
False smut	*Ustilaginoidea virens* (Cooke) Tak.	Common	90668
Phaseolus vulgaris L. (French bean)			
Leaf spot	*Phaeoisariopsis griseola* (Sacc.) Ferraris	Common	92370
Piper betle L. (Sireh)			
Leaf spot	*Colletotrichum piperis* Petch	1 record	—
Piper nigrum L. (Pepper)			
Sooty mould	*Aithaloderma* species	1 record	92376
Psophocarpus tetragonolobus DC. (Four-angled bean)			
*Sooty mould	*Meliola erythrinae* Syd. var. *psophocarpi* Hansf.	Occasional	92372
Saccharum officinarum L. (Sugar cane)			
Leaf spot	*Cercospora koepkei* Krüger	1 record	92364
Sauropus androgynus Merr. (Changkok manis)			
Wilt	*Sclerotium rolfsii* Sacc.	Occasional	92380
Sesbania species			
Wilt	*Sclerotium rolfsii* Sacc.	1 record	—
Spondias cytherea Sonn. (Kedondong; Hog plum)			
Sooty mould	*Meliola geniculata* Syd. & Butl.	Occasional	92393
Theobroma cacao L. (Cocoa)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	92367
Thuja orientalis L.			
Thread blight	*Marasmius scandens* Mass.	1 record	93286
Zea mays L. (Maize).			
Tassel mould	*Cochliobolus heterostrophus* (Drechsl.) Drechsl.	1 record	90671

(* Previously collected by P. C. Holliday; private communication Commonwealth Mycological Institute, 1962.)

Acknowledgements

The writer wishes to thank the Director of Agriculture, Sarawak, for permission to publish this list, and the Director and staff of the Commonwealth Mycological Institute, without whose help, in identifying the majority of the species, this list could not have been published.

References

JOHNSTON, A. (1960) "A preliminary plant disease survey in Sarawak". F. A. O. Rome (mimeographed).

Annual Report of the Department of Agriculture, Sarawak, for the year 1961. Government Printer: Kuching, 1962.

OTHER PUBLICATIONS OF THE BOTANIC GARDENS SINGAPORE

1. **Annual Report.**
   Reports from 1909 onward remain available.
   Prices variable.

2. **The Agricultural Bulletin of the Malay Peninsula (Series I).**
   Only Nos. 3, 5, 7, 8 and 9 available at 20 cents each.

3. **The Agricultural Bulletin of the Straits and F.M.S. (Series II).**
   Vols. 1–10, 1901–1911, monthly issues.
   All available except Vols. 1, 2 and 9.
   Price: $5 per volume.

4. **The Gardens' Bulletin, Straits Settlements (Series III).**
   Vols. 1–11, 1912–1947.
   Vols. 1 (1–5) January-May 1912 is issued under title of Agricultural Bulletin of the Straits & F.M.S.
   All parts available, except Vol. 1 No. 10, Vol. 2, Vol. 3 Nos. 1–3 and Vol. 11 pt. 3.
   Prices variable.

5. **The Gardens' Bulletin, Singapore (Series IV).**
   Vols. 12–19.
   All parts available. Prices variable. Issues are irregular.
   Subscription will be entered against deposit.
   Available on exchange.

6. **Materials for a Flora of the Malay Peninsula, Monocotyledons.**
   Parts 1, 2 and 3 remain available.

7. (*a*) **Malayan Orchid Hybrids by M. R. Henderson and G. H. Addison.**
   Price $21.

   (*b*) **Malayan Orchid Hybrids, Supplement I by G. H. Addison.**
   Price $21.

8. **A Revised Flora of Malaya.**
   (*a*) Vol. 1, Orchids, by R. E. Holttum. Price $20.
   (*b*) Vol. 2, Ferns, by R. E. Holttum. Price $20.

9. **Wayside Trees of Malaya by E. J. H. Corner, 2 Vols.**
   Price $25.

Items 1–6 can be obtained from the Director, Botanic Gardens, Singapore.

Items 7–9 can be obtained from the Government Printer, Government Printing Office, Singapore.

Prices quoted are in Malayan Dollars
Overseas postage is extra

0308—400—12/63

THE
GARDENS' BULLETIN
SINGAPORE

Vol. XX, Part IV 1st October, 1964

CONTENTS

To be purchased at the Botanic Gardens, Singapore
Price: $7

Published by Authority

PRINTED BY LIM BIAN HAN, GOVERNMENT PRINTER, SINGAPORE

1964

Stamens and Carpels within the ovary of **Durio zibethinus.** Murr.

by

A. N. RAO and HARDIAL SINGH

(Department of Botany, University of Singapore, Singapore)

Introduction

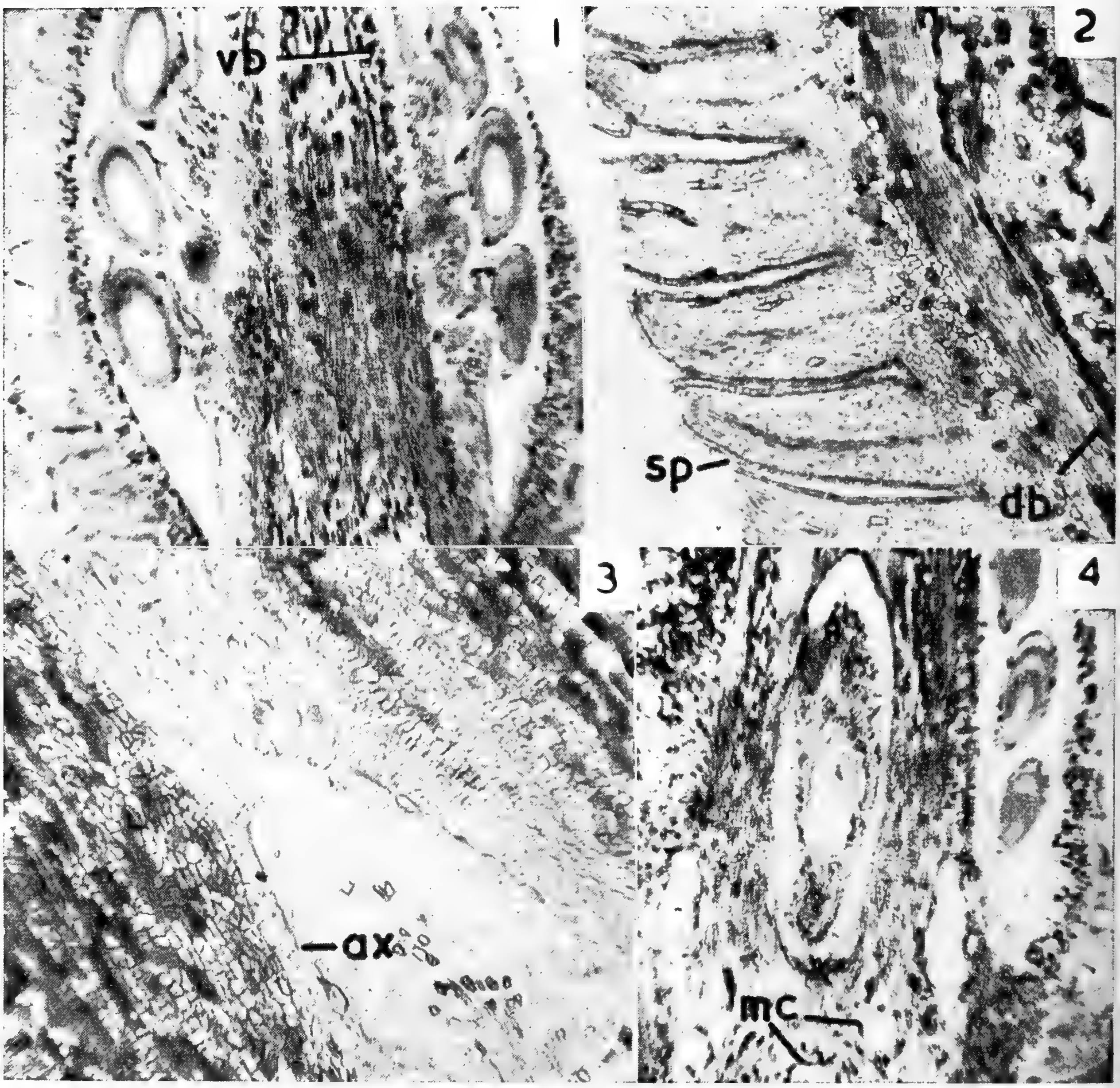
During embryological investigations of the *Durian* plant (*Durio zibethinus*) some abnormal ovaries were seen to have stamens and carpels developing inside the ovary. These abnormal ovaries had normal ovules developing, and in the central region of the ovary, superfluous carpels as well as stamens were in different stages of development.

Previous recorded accounts of such a kind are very few and that too mostly in the family Cruciferae. Masters (1869) describes a few instances of the formation of adventitions flowers and fruits within the ovary. In *Cheiranthus cheirii* (Cruciferae) the development of a small silique within the normal ovary has been illustrated (Masters, p. 182). This small silique developed on the placenta amidst the other ovules. In *Baeckia diosmaefolia* (Myrtaceae) formation of stamens within the cavity of the inferior ovary has been recorded. These abnormal stamens, replaced the ovules and had distinct filaments and anther lobes (Masters, p. 184, Fig. 98). Worsdell (1916) recorded the development of anthers on the inner carpellary margin in *Tulipa gesneriana* (Liliaceae). In *Alamanda grandiflora* (Apocynaceae), Kausik (1938) reported the formation of an elongated axis (gynophore) that replaced the ovary, carrying two leaf-like carpels on its distal end. These carpels formed open ovaries, with ovules present on their adaxial surfaces. Recently Hulbary *et al* (1957) have described the development of flowers within the ovary of *Raphanus sativus* (Cruciferae — Radish).

Young and mature flower buds in different stages of development were collected from Durian plants, growing in Singapore Orchid Gardens, Mandai Road, Singapore. The material was fixed in formalin-acetic-alcohol. After removing a portion of the ovary wall they were dehydrated and embedded in paraffin. Long sections of ovaries were prepared and stained to study the development of female gametophyte and seed.

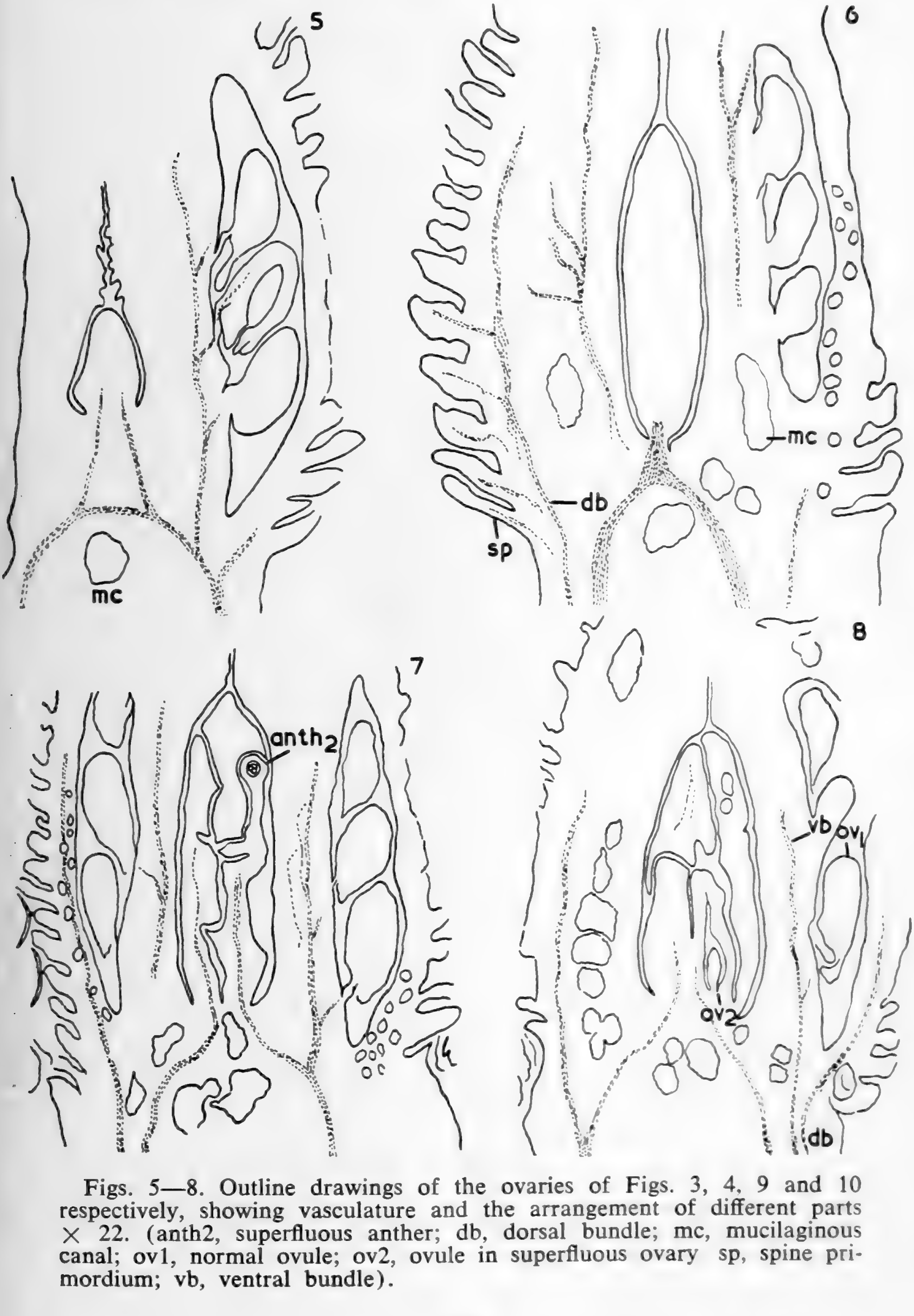
Observations

The normal ovary in *D. zibethinus* consists of 5–6 carpels, syncarpous, with axile placentae that produce 1–4, bitegmic, crassinucellate ovules in each locule. In the median long section of the normal ovary two locules are present on either side of the central placental tissue (Fig. 1). Mucilaginous canals and tannin filled cells are very common in the ovary wall, placental tissues and receptacle. Normally there is no space, or cavity in the central placental tissue, and cells in the receptacle as well as in placentae are compactly arranged (Fig. 1). Vascular strands that enter the ovary, branch in the receptacular region, forming dorsal and ventral bundles of the carpels. The dorsal bundle vascularises the ovary wall and produces a number of lateral branches that enter the spine primordia (Figs. 1, 2, 6). The ventral bundles continue in the central placental region and vascularise the ovules with funicular strands.



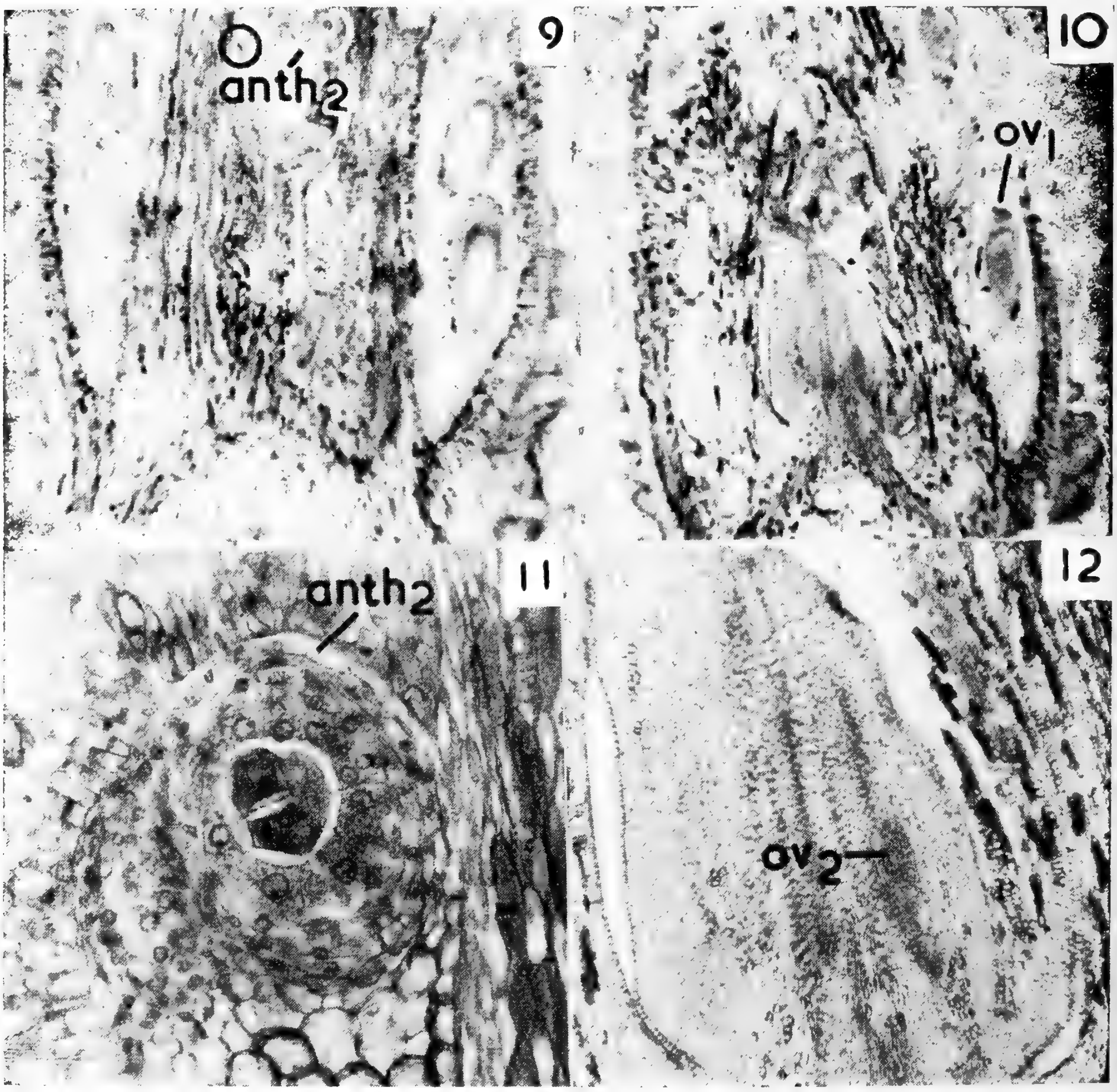
Figs. 1—4. Fig 1. Median L.S. of normal ovary. Note the absence of a central cavity × 51. Fig. 2. A portion of the ovary wall enlarged showing spine primordia and their vasculature × 140. Fig. 3. Central region of an abnormal ovary with the conical axis × 140. Fig. 4. Abnormal ovary with an elongated axis × 56. (ax, central axis; db, dorsal bundle; mc, mucilaginous canal; sp, spine primordia; vb, ventral bundle).

In some of the abnormal ovaries, the cells of the receptacular tissue, show cambial activity. Usually such ovaries can be distinguished from the normal ones, by the presence of a central cavity in the placental tissue (Figs. 5, 8). Cells situated below this cavity are meristematic, and as a result of their division, a small axis is organized (Figs. 3, 5). This axis may elongate and remain without further development (Figs. 4, 6). In some other abnormal ovaries the central axis branches either once or twice,



Figs. 5—8. Outline drawings of the ovaries of Figs. 3, 4, 9 and 10 respectively, showing vasculature and the arrangement of different parts × 22. (anth2, superfluous anther; db, dorsal bundle; mc, mucilaginous canal; ov1, normal ovule; ov2, ovule in superfluous ovary sp, spine primordium; vb, ventral bundle).

carrying the anthers at their tips, recalling the condition of stamen fascicles in normal flowers (Figs. 7, 9). Both transverse as well as long sections of anther lobes were observed. The wall of such anther lobes appear to be normal, with epidermis, middle layers, and uni-binucleate secretory tapetum (Fig. 11). In most of the anther sections, pollen mother cells or rounded uninucleate pollen grains were present. Whether the latter are the products of meiosis and develop into mature pollen grains is hard to say, unless more number of ovaries are examined. There was no distinction between the epidermis and other cell layers that is usually present in the normal anther wall. Tapetal cells were smaller than in the normal anthers.



Figs. 9—12. Fig. 9. Branched central axis in normal ovary with terminal anthers (anthers are circled) × 48. Fig. 10. Another abnormal ovary with superfluous ovary and anthers × 49. Fig. 11. T.S. of superfluous anther enlarged from Fig. 9 showing the anther wall and pollen mother cells × 640. Fig. 12. Superfluous ovary enlarged with the ovule primordia × 180. (anth2, superfluous anther, ov1, normal ovule, ov2, ovule in superfluous ovary).

In some of the other abnormal ovaries, both stamens and carpels had developed (Figs. 8, 12). In such instances, the carpels occupy the central region of the inner cavity, and on either side of them the branched stamens were present. Structure of these anthers was the same as described previously. The carpel initials originate in the same way, as the normal carpels, and show a tendency towards the organization of a second ovary (Figs. 8, 10, 12). The upper region of the second ovary is somewhat flat without any style or stigma. Unlike the normal carpels, the carpels of the second ovary are made up of comparatively thin walled cells and devoid of any mucilaginous canals. In only two instances ovular primordia had developed inside the locule (Fig. 12). Further, there was no recognizable archesporium or megaspore mother cell in them. Some more ovaries have to be studied to conclude whether these would develop into mature ovules with embryo sacs. The growth and formation of superfluous stamens and carpels did not upset the normal development of ovules (Figs. 9, 10). The superfluous stamens and carpels are vascularised by the extensions of the ventral bundles of the normal carpels (Figs. 5—8).

From the external appearance it is difficult to distinguish the abnormal ovaries. Many of them were teased under a dissecting microscope and in a few, the intracarpellary structures appeared as small papillae. More than 120 ovaries were dissected. The frequency of their occurrence was approximately in 5% of the ovaries examined. However, the presence of a central axis was more common in more than 30% of the ovaries studied.

Summary and Conclusions

Two different and extreme points of view have been expressed about the significance of teratological phenomena in plants (Arber, 1931). According to some botanists the teratological examples do not contribute any valid information towards the understanding of phylogeny and classification. Others regard the teratological structures as atavistic and use the data to explain the phylogeny and interrelationships of certain taxa. Views of several botanists of the last century and of the early part of this century have been summarized (Masters, 1869; Worsdell, 1916).

Normally, in *Durian* flower, the floral meristem becomes indistinguishable after the organization of carpels, as it usually happens in other flowers. But in some cases, the floral meristem resumes its activity after the formation of regular floral parts; this meristematic activity leads to the formation of a central axis inside the placental tissue that may or may not branch. The ones that branch, divide twice or thrice, the terminals of which carry anthers. In some others the carpels as well as stamens are organised, the former occupying a central position, and stamens being present outside the carpels. All these are vascularised by extensions of ventral bundles. It is interesting to note that only the stamens and/or carpels are formed, and at least in the cases observed so far, there was no trace of sepal or petal development. The important difference between the present and previous cases reported is, in *Durian* the stamens and carpels develop as superfluous structures, not replacing either ovules or carpels as in *Baeckia*, *Raphanus* or *Alamanda* (Masters, 1869, Hulbary *et al*, 1957, & Kausik, 1938). The formation of a regular axis recalls the condition reported in *Alamanda*.

The present case of abnormality in *Durian* ovary is considered as an anomalous floral structure, because of the small number of such incidences. An examination of a large number of ovaries may help us to understand the regularity of such an occurrence, which may also throw some light on the evolutionary advancement of *Durian* flower.

We are thankful to Messrs. John Ede and Lee Kian Hong, Directors, Singapore Orchids Ltd. who kindly permitted us to collect the material from their garden.

Literature cited.

ARBER, AGNES. 1931—Studies in floral morphology. II. on some normal and abnormal crucifers: with a discussion on teratology and atavism. New Phytol. 30: 172–203.

HULBARY, R. L., A. N. RAO, and B. E. MICHEL. 1957—The development of flowers within the ovary of *Raphanus sativus* L. Proc. Iowa. Acad. Sci. **64:** 127–131.

KAUSIK, S. B. 1938—Morphology of abnormal flowers in some angiosperms. New Phytol. 37: 396–408.

MASTERS, M. T. 1869—Vegetable teratology. Ray Society, London.

WORSDELL, W. C. 1916—The principles of plant teratology. Vol. II. Ray Society, London.

The Origin of the Word "Cocos"

by

C. X. FURTADO

Botanic Gardens, Singapore

There is a good deal of speculation on the etymology of the word *Cocos* and many explanations have been proposed to account for it. According to the most common view, the companions of VASCO DA GAMA used the Portuguese word *coco,* meaning "an ape" or a "bugbear", to denote the coconut (fruit) during their first visit to India and through them it was introduced in the modern languages of Europe. This view is explained by GARCIA DA ORTA (1490–1570) who, after a distinguished career at the Universities of Spain and then in his native Portugal, came as a surgeon to India and during his long stay there (1534–1570), gathered a good deal of information on the medicinal and economic plants, including their vernacular names and uses. In *Coloquios* (first published in Goa in 1563), he deals with the coconut palm in Coloquy 16. The following passage explains the origin of *Coco:*

"It gives so many things necessary to man, that I know no other tree that yields a sixth part. It is well that you should know that we call it palmeira [palm-tree]. However, the ancient Greeks wrote nothing about it that I have seen, and the Arabs have written little. It will be a good thing to tell this in Castille, though this much is probably well-known through those who return from here, since this is at once noticed. Coming to the names I must say that it [the tree] is called [in Goa] *Maro* and the fruit *Narel.* This word Narel is common to all, for it is used also by Persians and Arabs. AVICENNA (Lib. 2, p. 506) calls it *Jauzialindi* [jauz el Hindi] which mean "*Nut of India*". SERAPIO (Cap. 228) and RASIS call the tree *Jaralnare* which means the tree [jara] that yields *coquo* [narel]. The Malabar people call it the *Tengamaram* and the fruit, when ripe, *Tenga.* The Malays call the tree *Tricam,* [Javanese Wit-Krambil ?] and the coco nihor; and we, the Portuguese, because of those three holes, gave it the name *coquo,* for it looks like the face of an ape or another animal."

I was surprised that YULE (1886), *Conde de Ficalho* (1891) and others who knew the Arabic language adopted *jauze-el-Hind* as the correct Arabic name for the coconut and not *gauzoz-Indi* or *geuzoz-Indi* of RUMPHIUS. Hence I consulted, Dr. A. Z. ISKHANDAR, an Arab scholar with an Oxford doctorate. He informed me that the modern Arabic name for the coconut is *jauz-el-Hind* (=the nut of India) and that the same is found in ar-Razi's book called *al-jami* (popularly known as *al-Hawi*) as well as in AVICENNA'S book about a century later. RAZI, he stated, did not visit India but often quoted from the Indian works like *Charaka. Narjil* is used as a synonym of *jauz-el-Hind.* According to Dr. ISHKANDAR, ar-Razi's book *al-Jami,* written at Tabriz in Persia in 669 A. H., is in the MS in the Wellcome Historical Medical Library, London.

It is to be noted here that the Portuguese of the fifteenth and sixteenth centuries often use *qu* for *c* hard or *k*, as in Arequa (Areca) so that *coco* was spelt in the olden times also as *coquo* or *quoquo*, though in modern Portuguese *qu* is employed instead of *c* before *e* and *i* only as in *Coqueiro* (coco-tree) since before these vowels *c* acquires a soft sound of *s*, (*qu* before other vowels retains the *u* sound so as to be pronounced as *cu* e.g. *quarto*, *quadro*). This is probably the reason why CANDOLLE (1855) could not find the word *coquo* in the Portuguese dictionaries of his time, since that old spelling must have been discarded as antiquated.

Newer Views

PISO (1658), obviously confused with the names recorded by FRANCIS PYRARD DE LAVAL (1615) for the different palm fruits in the Maldives, concluded that the *coc, cocoihne* and *care* were Indian words for the coconut. The Portuguese, he maintained, added *co* to the first mentioned name to satisfy the euphony of the Hispanic languages and obtained *cocco*. But, he added, persons like GARCIA [DA ORTA] unjustifiably associated ape with the etymology of the name thus obtained; they, he explained, said that the fruit was called *cocco* because, when husked, the nut with its three "eyes" shows some resemblance to an ape which makes the sound *cocco*, especially when irritated. But, if a monkey itself was not called *cocco*, PISO argued that it was unreasonable to transfer the onomatopoeia to a fruit whatever its resemblance to an ape might be.

If, however, a dignified derivation was needed, PISO suggested to go to the Greek language which more than even Latin is richer in the use of *kokkos* not only as an independent term denoting round and oval grains, but also as a prefix or suffix denoting many other things. The influence of this Greek word has made itself felt in the Spanish and the French languages, explained PISO who also cited GUICCHIARDINO of Italy to show that *coac*, pronounced almost *cac*, is the Hebrew word that means *kokkos*, the grain.

RUMPHIUS (1741) who objected to the use of double *c* in spelling *coco* as applied to the "Nut of India", was apparently convinced by PISO's arguments that the etymology given by the Portuguese was unsustainable. He declared that *Tavarcare* and *Tavarcarze* mentioned by PYRARD DE LAVAL were probably corruptions of other words. He did not discuss *coc* and *cocoihne* obviously because these were the transliterations into the French of 16th and 17th centuries for the Portuguese *coco* and its diminutive (*cocoinho* or) *coquinho* he mentioned (spelt wrongly in one place as *coquinko*). In view of this, after stating that several writers including LINSCHOTEN held to the derivation of the word from the Portuguese *coco* meaning an ape, RUMPHIUS wrote:

"In my judgement, however, a more probably and more correct derivation has to be found elsewhere. Many nations, to whom this fruit is known, call it merely 'the nut'. Thus in Arabic it is called *Gauzoz-Indi* or *Geuzoz-Indi* which means Indian Nut, (which has been corrupted by the translators of AVICENNA, lib. 2, Cap. 298, into *Jausi-Alindi,* and worst still as *Jansi-Alindi*). The Turks call it *Cock-Indi,* signifying the same thing: and from the Turks no doubt the word was taken by the African Moors [=Muslims]* and their neighbours the Spaniards, to the Portuguese to produce *coquo.*

"All these names, however, owe their origin to the Hebrew word *Egoz,* which means the nut, and which . . . becomes *Gauz* in Arabic, yielding in Greek the *kokkos* to mean any large grain." (p. 7)†.

CANDOLLE (1855) took notice of the different explanation given to the origin of the word *coco* or *coquo* from the Portuguese meaning "ape" to the Arabic *gauzoz-indi* as explained by RUMPHIUS but overlooked *cock-indi* mentioned by RUMPHIUS. CANDOLLE also noted that wherever the Arabs went, they used the Arabic word to mean "Indian nut" or the word like *nargil* or its variants from India. But whatever may be the derivation of the word *coquo,* he held it immaterial to the etymology of *Cocos* L. and maintained that the latter was directly taken from the classical Latin *coccus.* In support of this contention, he cited the two following phrases used in describing the coco-palm: "Palma indica coccifera", C. BAUHIN, and "Palma coccos ferens", RECCHI.

Moreover, noting the Mexican name *Coyolli* for coconut, CANDOLLE suggested that it might be either a corruption of the Portuguese *Coqueiro, coco,* or possibly their origin. Later COOK (1901 and 1910) used this word and its derivatives to propound the view that the word *coco* was actually of an American origin brought by the Spaniards to Spain to be adopted later in many European languages.

---

* BURMANN has mistranslated "Africaansche Mooren" of RUMPHIUS into "Aethiopes Africani". Moro, Moiro and its variants meant originally the racial group, Moors, but from the 15th and the 16th centuries it began to be applied to mean "Muslims", so that the Moros of the Philippines refer to Muslims.

† Translation is free.

BARTLETT (1927) who was apparently ignorant of the writers like CANDOLLE, modified the Rumphian theory as follows:

"The origin of the word *coco* in English and other European languages has been considerably discussed. The Oxford Dictionary (MURRAY himself elaborated the letter C) has the following: 'The early writers from COSMAS 545 to the 15th century knew it only as the Indian nut or nut of India; *coquos* (plural) is quoted first from the Roteiro de VASCO DA GAMA (1498–1499); BARBOSA 1516 has (Pg.) *quoquos;* PIGAFETTA 1519 has (It.) *coche* pl. of *coca;* OVIEDO 1526, BARROS 1553, GARCIA 1563, and ACOSTA 1578 have *coco;* CORREA *coquo.* The Portuguese and Spanish authors of the 16th century agree in identifying the word with Pg. and Sp. *coco* "grinning face, grin, grimace", and also "bugbear, scarecrow", cognate with *cocar* "to grin, make a grimace"; the same being said to refer to the face-like appearance of the base of the shell, with its three holes. Historical evidence favours the European origin of the name, for there is nothing similar in any of the language of India, where the Portuguese first found the fruit; and indeed BARBOSA, BARROS and GARCIA, in mentioning the Malayalam *tenga* and Canarese [Concani] *narel* expressly say "we call these fruits *quoquos*", "our people have given it the name of *coco*", "that which we call *coco* and the Malabars *tenga*". To the contrary, the revised *Century Dictionary* says: 'The resemblance of the Sp. Pg. name to the Sp. Pg. *coco,* a word used to frighten children, a bugbear, is probably accidental'.

"By way of comment on the quotations one may point to the existence of words very similar to *coco* in parts of the Indian Archipelago visited by the Portuguese as early as 1511, and, as will be pointed out, not impossible to be established there by Arab traders whose influence and trade extended all the way along the coast of southern Asia and down the east coast of Africa. VASCO DA GAMA may have had the word from the Arabs, whose trade routes he followed. There is, therefore, no reason to suppose the word *coco* to be of Portuguese origin because it fails to appear in Malayalam or Canarese. Now let us quote the PLINY of the Orient, whose old-fashioned Dutch would perhaps be less intelligible than BURMANN's translations: "Fructus autem Latine dicitur *Nux indica,* et *cocus,* male apud Scaligerm . . . *coccus;* Portugallis *coquo,* et *coco* juxta imaginem, uti Linschotenus, et aliis plures putant, faciei Cercopitheci, quam tria superiora putaminis orificia repraesentant; . . ." [Here follows the Rumphian passage in its Latin translation, the same given above by me in its English translation: Rumph., 1741]. "Nothing seems to the writer more likely than that Arab traders might have introduced their own name for the coconut, known to them for centuries before the Portuguese era in the Orient, to the people among whom they went. Furthermore, since the phonetic system of Indonesia does not admit the harsh sounds of Arabic, some such simplification might have taken place as that resulting in *coco.* This the Portuguese might have seized upon, from among many names for *coco* that they certainly heard, because of its coincidence with their name for monkey face. As for the form of *kokoer,* reported for Sumba, it is practically identical with *coker,* an alternative name of *coco* preferred in commercial jargon because of its entire distinctness from *cacao.* That the Indonesian names are not modern adaptations of the Europeanized *coco* is shown by the fact that RUMPHIUS cites *igo* (Ternate), *calucu* (Makassar) and *lalucco* (Boeton). Although the part of his work dealing with the palms was edited and published in 1741 it was composed before 1690 in Amboina".

Some modern writers seem to favour CANDOLLE's view, as modified by BEELER (1960) who stated that though LINNAEUS derived the generic name *Cocos* from the Portuguese and Spanish *coco,* the latter itself was taken from Latin *coccum* and Greek *kokkos.*

Objections to Newer Etymologies

(a) Piso's Views

Apparently PISO was unaware that the inhabitants of the Maldives employed frequently the Portuguese words *coco* and its diminutive *coquinho* (transliterated by PYRARD DE LAVAL as *coc* and *cocoihne*) to denote coconuts so as to mislead LINSCHOTEN (1589 p. 25) that the Maldivians had no vernacular names for the coconut. The etymology given by PISO therefore is not valid since it makes the derived word the root of the original term.

PISO also erred when he stated that *coco* was not used by the Portuguese as a term to denote an ape. As it will be seen later, the word had been used by the Portuguese women to denote ape, bugbear or anything that served to frighten the children, though the word had not become dignified to be included in any contemporaneous glossaries. The three "eyes" of the husked coconut would represent the two eyes and snout of an ape and so would serve to frighten the children — a *coco.* Hence PISO's reason for rejecting GARCIA DA ORTA's explanation is not acceptable.

(b) Rumphian View

The coconut palm cannot thrive well in the interior and in the northern parts of India, the Middle East and the Mediterranean regions. If the Arabs and the Persians of the early centuries knew the coconut, they did so either through the coconut products from India and the Indian medical books, or through their trade in India. The Arabs and the Persians either called it the *Nut of India* in their native languages, or, as stated by GARCIA DA ORTA (1563), they adapted a word used in the Konkan coast of India, (probably introduced via the writings of the Sanskrit medical writers). YULE (1886 and 1902) and CONDE DE FICALHO (1891 p. 248) cannot account for the Turkish word *Cock-Indi*, since their inquiries yielded no clue whatsoever. "One would like to know," writes YULE in his *Hobson-Jobson*, "where RUMPHIUS got the term *Cock-Indi*, of which we can find no trace." CONDE DE FICALHO points out that RUMPHIUS' theory is also untenable because no coconut grows in North Africa for the term to become common among the African Muslims and through them to reach the Iberian Peninsula. In view of this it appears that RUMPHIUS information about the Turkish word *Cock-Indi* was gathered from the Turkish travellers to the East who had become acquainted with the word as made current by the Portuguese.

There are of course *Hyphaene* (perhaps also *Borassus*) spp. which in Egypt, Ethiopia and the neighbouring regions are known as the *kuku* or *kouki*, latinized as *cucas, cucus, coicos* and sometimes erroneously as *cocus* and *coccus*, the tree being known as *Cucioferus* or *Cuciophorus* to the ancient Romans and *Cuciophoron* to the Greeks. But this palm is normally branched (*Borassus* sp. is solitary) and bears fan-shaped leaves; its fruit has a hard, inedible kernel used to make into beads known also as *kuku*. References to this palm in ancient literature or paintings in Egypt have sometimes been mis-translated as coconut by students of archaeology and history of Egypt. And YULE quotes SCHNEIDER to show that SPRENGEL had identified the Egyptian *Kuku* as the coco palm, obviously by mistake. And RUMPHIUS (1741) points out that *Kuku* of THEOPHRASTUS (latinized *coccus* and *cocca* erroneously by BURMANN what RUMPHIUS calls *cocos* meaning a palm tree) may partly be a date-palm, since some of the plants are described as low shrubby palms, growing in groups, with short "branches" and reed-like "leaves".

However the *kuku* palm of Egypt was unknown in Spain and Portugal in the 15th and 16th centuries; nor was the word *coco* adopted for any palm or palm-fruit in the two countries before VASCO DA GAMA's first voyage to India. Subsequently the word *coco* for the coconut and with qualifying words for other palm-nuts became common in these two countries so as to mislead RUMPHIUS who wrote in about 1690 as to the etymology of the word. Nevertheless the Spanish writers did not hesitate to admit that the Portuguese were the first to apply the word *coco* to the fruit of the palm of the East Indies. Thus CHRISTOBAL DA COSTA (1578), dealing with the properties of the coconut oil in his book on the drugs and the simples of the East Indies wrote: "......... the tree is the one that gives the fruit which is brought to Spain and called by the Portuguese *coco* (because of the three holes it has) and the tree is called *palmeira*."

(c) Bartlett's Views

BARTLETT based his arguments actually on the Indonesian word *kokur* which the Dutch found current in east Sumba. Nothing is known about the etymology of this word, whether or not it is of foreign origin. Sumba lies close to the south of Flores where even today there are communities who speak a Portuguese patois, and west of Timor where the Portuguese influence has been widely felt. Since Sumba was famed for its sandalwood and horses, the Portuguese missionaries and traders had contacts with the island, and their influence might have been considerable, though I have not been able to gauge its extent. However, the Dutch scholar HEYLIGERS (1889) maintained that the Portuguese influence on the main languages of Indonesia has been deeply unique, being incomparable to that of any other. The task of tracing etymological roots of some words is rather a complicated matter, though those who are unacquainted with the main Indonesian languages might tend to oversimplify the procedure. However it is significant that, out of the vast Indonesian archipelagos, the only place where *kokur* (spelt by the Dutch as *kokoer*) is found in the vicinity of Flores and Timor where many Portuguese words have been adopted in the vernacular languages. Of course it cannot be denied that there are words like *kokur* and *kukur* in the Indonesian languages, but suspicions arise when they are used to denote *coco* or coconut.

BARTLETT did not mention *kokur* from any other place than Sumba, the only place the Dutch found it previously. However, he assumed that this word and its variants are "not modern adaptations of the Europeanized (sic) *coco*", and to prove his contention he quoted unrelated words like *igo, calucu* and *laluccu* from the linguistic groups of the Celebes and the Moluccas wholly different from those of Sumba. Having declared that *kokur* or its variant does not show any European influence, he assumed with equal facility, and without offering any reason, that it is either a pure Arabic word planted in the island by the Arab traders themselves, or an adaptation of an Arabic word, effected through the peculiar phonetic system of the Indonesians there. Now, on these two alternatives two hypotheses are worked out, but the arguments are so skilfully blended together that a person like BURKILL (1935) failed to notice the basic flaws in them. A brief re-statement of BARTLETT's views is therefore made here in order to examine the validity of his arguments.

(1) If *coco* or *kokur* is a pure Arabic word introduced by the Arabs in Sumba, then the Arab traders must have carried it all along their trade routes in Asia and Africa; and so "VASCO DA GAMA must have had the word from Arabs, whose trade routes he followed".

However, BARTLETT failed to show that any word like *coco* was in fact being used by the Arab traders in India and Africa, or even in Indonesia. Besides these Arabs were not isolated from their homeland, for, before the discovery of the sea-route to India, the whole of Arab maritime trade passed through Arabia to Europe, Egypt and to the different parts of Asia Minor. Hence the *coco* or its variant should have been current even in the native language in Arabia and so easy to find. It is well-known however, that previous to BARTLETT, several workers like GARCIA DA ORTA (1563), RUMPHIUS (1741), CANDOLLE (1855), BALFOUR (1871), YULE (1886), WATT (1889), CONDE DE FICALHO (1891) and DALGADO (1919) had made a careful scrutiny of the problem and found no such Arabic word indigenous in Arabia or current among the Arab traders in Africa and the East. And it must not be imagined that there were no writers among those who visited India before VASCO DA GAMA. Thus COSMAS of Egypt (c. 545), MARCO POLO (1292), MONTE CORVINO (1292), JORDANUS (1328), JOHN DE MARIGNOLI (1350), NICOLO DE CONTI (1444) and JERONYMO DE STO STEPHANO (1499), who had presumably made a part of their voyage or journey with the Arab traders and sailors, did not note any name like *coco*, but were content to call it as the "nut of India" in their own languages, obviously because their guides had said so in Arabic, or adapt a variation of *narel* which became *narigil* in some languages and *nargillus* in Latin. Only VARTHEMA (Italian) who apparently followed the direct monsoon route from Arabia to Malabar, described the coconut under the name *tenga* which he must have learnt in Cochin in 1510. Even the famed Moroccan Arab traveller, generally known as BEN-BATUTA or IBN BATUTA (1330), had no word like *coco* but used the common Arabic word to mean "Nut of India".

Further in RHEEDE's *Hortus Malabaricus* (1679) where the Portuguese *coco* has been latinized as *cocus*, it is implicitly admitted that the plant or fruit had no proper names either in Latin or in Arabic; for in the plates *tenga* has been romanized as the Latin name, while the same name is written in the Arabic script and given as the Arabic name, obviously because the Arab traders consulted had not any proper name for the coconut or its tree.

This means, therefore, that BARTLETT has not brought forth any evidence to justify his assumptions long held as untenable by the previous workers, including RUMPHIUS whom he quoted.

(2) The second hypothesis may be stated as follows: If the *coco* or *kokur* used in Sumba is an adaptation of an Arabic word effected through the local phonetic system, then "this the Portuguese might have seized upon from among many names for *coco* they certainly heard, because of its coincidence with their name for monkey face."

But BARTLETT stated that the Portuguese first visited this archipelago only in 1511, and he quoted evidence to show that *coco* for the coconut was already recorded about 12 years earlier in the *Roteiro* (1498-1499), the Logbook of VASCO DA GAMA's first voyage to India!

Though between 1499 and 1511 many letters and articles were written by Portuguese containing the word *coco*, no reference was made to them in the *Oxford Dictionary* quoted by BARTLETT and perhaps this was the cause why he fell into anachronistic argument. But one quotation may be translated here since it shows that, among the gifts sent by the kings and others to important foreign visitors, coconuts were included and so VASCO DA GAMA might have also received coconuts as gifts from the Sultan of Melinde, Africa, and the Zamorin of Calicut, Malabar. The following is found recorded in *Boletim da Sociedade de Geographia de Lisboa* for the year 1505 (XVII p. 357):

"[The King of Quiloa in East Africa] sent as presents to the Captain-in-chief 5 goats, 1 calf, many *cocos* and fruits .... These *cocos* are as large as the fair-sized melons, and have a thick husk from which ropes are made. Inside there is a fruit of the size of a great pine-cone, which contains about half a pint of water that is pleasant to drink. After removing the water, the *coco* is broken and its kernel which tastes like semi-ripe walnuts, is eaten".

In either case therefore BARTLETT's views are untenable.

(c) Candolle's Explanation

The etymology given by the Portuguese and Spanish writers was accepted widely in Europe and elsewhere for over three centuries, since the Rumphian explanation could not be sustained on the available facts. Unfortunately the early Spanish and Portuguese medical men who collected information about the medicinal and economic plants of Asia or America, wrote their accounts either in Spanish or in Portuguese, languages not easily understood by the scientific men of the period outside the Iberian Peninsula. To make the information available to a wider scientific public in Europe, some foreign authors collated the data in Latin, or issued abridged editions in Latin of the works of the Portuguese and Spanish writers. And so HIERONYMUS CARDANUS (1550), J.C. SCALIGER (1557) and C. CLUSIUS (1574 and 1582) latinized the word *coco* as *coccus* to denote coconut. Due to the influence of these writers, but more especially of CLUSIUS, editors, translators and botanists did not hesitate to adopt *coccus* for the *coco,* and this faulty use of the word *coccus* and its derivatives like *coccifera* is the sole basis why CANDOLLE attributed the classical origin to *Cocos* L. (1753).

In fact LINNAEUS himself had followed these authors and adopted *coccus* for the coconut in his many botanical works issued between 1736 and 1752. However, in 1753, when about to complete his *Species Plantarum,* ed. 1 (1753) LINNAEUS received, as a gift (RICHTER 1840), a copy of RUMPHIUS' *Herbarium Amboinense* (1741–1750). In it LINNAEUS must have found RUMPHIUS condemn the use of *coccus* for *coco* and adopt *cocus* as the correct latinization of the term, as was done also in RHEEDE's *Hortus Malabaricus* I (1679). Unfortunately BURMANN's Latin translation of RUMPHIUS' account in Dutch, did not bring out this objection forcibly, since he employed unjustifiably such words as *coccus, coccorum* and *coccifera* in most unexpected places so as to make one who does not read Dutch, think that it was RUMPHIUS who had employed these terms.

No doubt CLUSIUS, when latinizing *coco* into *coccus,* had not omitted to give, in his abridged translations, the etymology of the term as given by the original writers connecting the Portuguese *coco* with the face of an ape or other animal. Nevertheless *coccus* even with this sense was a homonym of the classical *coccum* and its variant *coccus,* and so was likely to cause a confusion for the general readers do not pause to inquire into the etymology of each term they find.

Classical *coccum* and its variant *coccus*, though derived from the Greek *kokkos* meaning a berry or seed, had a distinctive meaning which modern scientists are apt to ignore. Ordinarily the Romans used *bacca* or *acinus* to indicate special "berry", *semen* "seed" and *granum* "grain"; but *coccum* was adopted to denote scarlet "berries" that produced "scarlet dye" (the dye being also called *coccum*) and which were later identified to be the kermes insects. This term gave rise to the neuter noun *coccinum* which in singular meant "scarlet colour" and in plural *coccina-orum* "scarlet garments". Moreover it produced the adjective *coccineus-a-um* meaning "scarlet" and *cocciferus-a-um* meaning "carrying or bearing kermes insects". Thus *Ilex coccifera* Cam. (1586) meant an Ilex species that bore on it "kermes insects" a meaning that could also be stated by saying "Ilex coccos ferens." The same is true with its isonym *Quercus coccifera* L (1753). But when botanists or medical men described an Indian palm as "coccifera" or "coccos ferens", the palm was in no way to be associated with the kermes insect or even with scarlet dye or colour; for these writers wished merely to say that this palm produced nuts called *coco* in Portuguese, a word that had been commonly latinized as *coccus*.

Evidently LINNAEUS was provoked through the objections raised by RUMPHIUS to reconsider the problem of equivocation. But *cocus*, preferred by RUMPHIUS, was in no way better, since *coco* and *coquo* of the Portuguese had no connection with the Latin *cocus* and *coquus* meaning "a cook". Faced with such difficulties LINNAEUS found a way out to avoid all ambiguities by giving the Portuguese *coco* the Graeco-Latin form as *cocos* and applying the term to the tree and so feminine in gender, with *Cocos nucifera* L. as the type-species. Thus the gender, the meaning and the spelling, all stress the fact that *cocos* has no etymological connection with *coccus, coccum* or *cocus* in Latin or even with *kokkos* in Greek.

Obviously CANDOLLE did not consider adequately the reasons why the early writers had employed phrases like "palma indica coccifera" and "palma coccus ferens" and why LINNAEUS discarded *coccus* which he had long employed, in order to adopt *cocos*. CANDOLLE, therefore, erred in attributing the classical derivation to *Cocos* L (1753), when that etymology cannot be defended even for *coccus* as applied to the coconut.

But did VASCO DA GAMA's sailors themselves adopt the word *coco* from the ancient Latin or Greek root? RUMPHIUS, as we have seen, was not in favour of this view and as also CANDOLLE. To get a clear answer to this question it would be worth while to enquire into the circumstances under which the Portuguese adopted *coco* to denote the palm fruit of India.

When Coco was first adopted

CONDE DE FICALHO shows that the coconut was not growing in Guinea or Congo during VASCO DA GAMA's first voyage (1497–1499) since his *Roteiro* (Log-book) describes the palm for the first time from near Melinde thus:

"The palm of this land yields a fruit as large as a melon; its kernel within is eaten and tastes like a mixture of galanga and hazelnut."* (1498 p. 28).

This, states CONDE DE FICALHO, is a text of great importance. The navigators find a tree which they had no difficulty to recognize as a palm. Their experience with the date and other palms must have helped them in this recognition. But it is quite new to them; hence they note the unusual dimensions of the fruit and the taste of its kernel. They give no name to this palm obviously because they do not know any. This fact too is against the view of RUMPHIUS, for if the Portuguese were already acquainted with the coconut, they would have merely named it as a familiar nut and not described its size and its taste and left it unnamed.

VASCO DA GAMA then proceeded from Melinde to Calicut in India, and then on his return voyage his party seizes a ship from the Moors (Arab-Muslims) near the island of Angediva, off Goa. In the *Roteiro* (p. 94) the entry reads:

"And we who were nearest, boarded the vessel, and found nothing in her but provisions and arms, and the provisions consisted of *coquos* of palm and several cakes of palm sugar in four jars, and there was nothing else but sand for ballast."*

The second half of this sentence is usually translated somewhat differently. YULE, for instance, gives it as follows: "and the provisions consisted of *coquos* and of four jars of certain cake of palm-sugar, and there was nothing else but sand for ballast." But DALGADO points out "de palma" (of palm) refers both to *coquos* (a fruit which the author had already described without any specific name but merely as "The fruit of a palm tree" in Africa) and to *açuquar* (= açucar = sugar).

Since the word *coquo* is used here with a great familarity, CONDE DE FICALHO finds some difficulties in explaining this, for he thinks that the stay of the Portuguese sailors in Mozambique and Calicut was not long enough to make them notice the resemblance of the monkey face or the ogre and to make the word

---

*Translated from the Portuguese.

coquo or *coco* current among them. Besides CONDE DE FICALHO did not find the word *coco* meaning "an ugly and frightening figure" or "bugbear" used by the writers in Spain and Portugal before the 16th century. But he says there is the Spanish word *coco* (shell) (cf. also YULE) whence came the word cocote, meaning "the head". CONDE DE FICALHO, however, adds that the etymology given by ORTA has in its favour the unanimous opinion of the Portuguese and the Spanish writers some of whom, like BARROS and OVIEDO, wrote only a few years after the adoption of the word. The facts that the use of the word *coco* dates from the first visit of VASCO DA GAMA to India and that it was employed in India itself where names current among the peoples of the different linguistic groups (including the Arabs) could not have provided *coco*, seem also to favour this etymology (cf. also DALGADO).

However, it may be said that in olden days, when books were rare, it would not be unusual if such a word as *coco* were not found mentioned in literature especially if this word was current only as an onomatopaeic word among the common women to remind the children of the apes through the sound the latter made. As states COVARRUVIAS in *Tesoro de la Lengua Castellana* (1611), the name *coco* is given to the ape by the common people because when disturbed, it makes guttural sounds *ko-ko*, from which came the name *coco* and the verb *cocar*. DALGADO's inquiry convinced him that the *coco* for bugbear was used before the 16th century in Portugal itself. Besides OVIEDO, BARROS, GARCIA DA ORTA and others who lived during VASCO DA GAMA's time, wrote as if they knew well the usage among the common people even though the word may not have become dignified to be adopted in Portuguese literature and dictionaries. Thus BARROS, explaining in 1553 the adoptation of the word *coco* to mean the coconut (fruit) writes: "This peel . . . is somewhat acute making it look like a nose placed between the two round eyes through which the sprouts come out on germination; because of this semblance of a face, even though it were not a real one, our men gave it the name *coco*, this being a term applied by our women to anything with which they try to frighten children; and this name has stuck, because nobody knew any other, though its proper name is *tenga* among the Malabarese and *narle* among the Canarese [Goans]." (Decades III Liv III Cap. 7 1553, pp. 309–310).*

---

*Translated from the Portuguese.

Further in Malabar the *coco* fruit has many uses. It is husked and sold in shops. Tender coconuts are used for refreshments; ripe ones used in cooking and at religious ceremonies, weddings, and even superstitious rites in sickness, misfortunes, or storms so that any such ceremonies would attract the attention to the nut of a first visit to Malabar in India. Commenting on the Portuguese origin of the word *coco,* DYMOCK, WARDEN and HOOPER remark as follows:

"The resemblance, however, of this nut to a head and face had not escaped the notice of the Hindus; long before the Portuguese had set foot in India, *naral* was used as a cant term in the sense of a head, pate, sconce, etc., and was sometimes used to represent the head of a dummy figure by the relatives of a deceased person whose body could not be found, and who nevertheless were desirous of rendering to it the usual funeral rites. Various superstitious uses to which the coconut is put in India attracted the notice of the early missioners." (1893, p. 512).

DA GAMA's sailors, therefore, must have become well acquainted with the husked fruit in Malabar and with some of its uses. Besides, there are reasons to believe that the Sultan of Melinde, Africa, and the Zamorin of Calicut, India, following the practice of the times, must have included coconuts among the gifts sent in exchange of greetings, to VASCO DA GAMA together with some persons to show how these are husked and used, thus affording an opportunity to the Portuguese sailors to become acquainted with the coconut. Further had not the Portuguese become familiar with the coconut products in the Malabar market, they would not have been able to identify the "palm-sugar" cakes when examining the Arab ship off Angediva, nay, they might not have even suspected that sugar could be obtained from the palm. Obviously, therefore, they had seen husked coconuts in Malabar and astonished at the resemblance to a face of an animal in the nuts, they must have adopted the name first in fun as something to be frightened of — *co-co* — and later as a name in preference to the Malabar *tenga,* which was wholly new to them. As DALGADO writes: "The Portuguese, after adopting the name, would naturally use it every day in Malabar, when, for example, eating the fruit or drinking its water."*

Hence on their return voyage, the word *coco* occurs naturally to DA GAMA's sailors to be recorded in the *Roteiro.*

---

*Translated from the Portuguese.

(d) **COOK's Views**

The reference to the *coco* in VASCO DA GAMA's Roteiro (1498–1499) is the earliest that the philologists have been able to trace. VASCO DA GAMA had taken samples of coconut to Lisbon to enable the Portuguese to be acquainted with the fruit. Soon after, the Portuguese who went to the East began to write letters or accounts about the *coco*. It is only much later that the word *coco* is found in the accounts of the Spaniards. In fact FERNANDO MAGELLAN, the Portuguese who had been in India and the Moluccas, is said to have convinced the King of Spain that, in visiting America, the Spanish discoverers had not reached India because none of them had found the *coco* so common in the East Indies, and which later PIGAFETTA, the amanuensis who wrote the Logbook of MAGELLAN's voyage round the world (1519–1522), recorded for the first time in his voyage from the Ladrone Islands where the party had reached after crossing the wide Pacific.

Unfortunately COOK (1910), who delved intensively into the early accounts of the Spanish navigators, did not pay any attention to the Portuguese writers. Otherwise he would have noticed a remarkable number of references containing the word *coco* much earlier than the earliest credited for the Spaniards and seen the invalidity of his contention that the word is Amerindian in origin, brought first to Spain by the Spaniards to be eventually incorporated in other languages.

(e) **CHIOVENDA's Suggestion**

Here we might refer to CHIOVENDA (1921 & 1923) who, after a careful inquiry into several aspects of the origin and dispersal of the coconut species and also into the history of the word *coco*, refuted COOK's theory that both the name *coco* and the species were American in origin. He showed that the cradle of the species lies in Asia and that the Portuguese were responsible for bringing to Europe the term *coco* from the East Indies as the popular name for the "Nut of India". However noting that the Maldivians from very ancient times had employed *Cuzah, Cusca* or other variations to denote the white coconut kernel used in cooking (ALBIRUHNI in The History of India, *Tarykh-Hind*, 1020 A.D.), suspected that the Portuguese might have adopted it and evolved it through the association with their own *coco* or *coca* meaning an ape, the face of which is suggested by the three "eyes" of the husked coconut.

Unfortunately the earliest Portuguese reference CHIOVENDA had was DUARTE BARBOSA (1516), quite sufficient to refute the claim of COOK that OVIEDO (1526) was the earliest writer to use the word *coco*. Had he seen VASCO DA GAMA's *Roteiro* (Logbook) of the first voyage to India (1497–99) or more modern writers like CONDE DE FICALHO (1891) or DALGADO (1919), he would have noticed that *coco* was adopted by VASCO DA GAMA's party during his first voyage at Anjediva while returning from Cochin and Calicut on the Malabar coast of India, and when they had not gone further south to the Maldives.

(f) BEELER's Views

Disregarding the history of the use of the word *coco* and the traditional etymological explanations given by the contemporaries of those who used the word, it would be easy, CONDE DE FICALHO remarks, to derive the word *coco* from the Latin *coccus* and the Greek *kokkos*. But the fact must not be overlooked that VASCO DA GAMA and his party of sailors, like all the contemporary discoverers, were not called upon to give Portuguese names to new plants and fruits they found in the new countries they visited. They had to record faithfully what they saw and found. The normal procedure, therefore, was to adopt the local names with some variations to suit the Portuguese phonetic system. Thus the Portuguese adopted names like Ananas, Caju and Papaya from America, Manga, Jaca and Areca from Malabar, and Jambo, Duriam and Mangustam from Malaysia. Sometimes the Portuguese imagined to see in the local fruits, particular forms of what was already in Europe, and so they had Figo da India (Indian Fig) for Banana, Pera da India (Indian pear) for Guava of America, and Maça da India (Indian apple) for Jujube.

Hence there were no reasons why VASCO DA GAMA and his party should discard a local name and go in for the Latin or Greek root to create a new name, or adopt a name used by the foreign traders. The circumstances with which a systematist is confronted, when he discovers a new plant, are peculiar to him because he is compelled by the international rulings to follow certain procedures and create a new name for every new taxon he discovers, and this new name must be Latin in form and must consist of one, two or more words according to the circumstances. He therefore frequently discards the local names and goes to the classical languages to find the needed epithets or words to create the new names.

Now, VASCO DA GAMA's party were never under such circumstances and to be faithful to the facts they might be said in a certain sense to have been obliged to adopt the local names for the new plants they met within the locality. Besides, as CONDE DE FICALHO noted, it seems unlikely that, even if they were to create deliberately a new name for a plant, "the rough companions of VASCO DA GAMA" would have gone to the classical languages for a name. But, as said before, if a new name was actually adopted for the coconut in preference to the vernacular name, VASCO DA GAMA's party did so involuntarily first in fun, and then because the name had become common among them, it was retained since it appeared to them more expressive to indicate the nut that had a remarkable likeness to an animal's face.

There is therefore some zest in the etymological inquiry into the word *cocos* and in unravelling the problems connected with the different versions given to explain its origin. But in the following summary, BEELER oversimplifies the whole inquiry:

"The generic name [*Cocos*] was established by LINAEUS as a feminine singular noun, though the term is derived from the Portuguese and Spanish masculine *coco* (coconut palm).* *Coco* is a modern Romance language form of Latin *Coccum* (berry, kernel), which in its turn evolved from the Greek word *kokkos* (berry, seed). The final *s* of *Cocos* reflects the original Greek termination; it is a hellenization which effects correspondence with other Greek generic names ending in *-os;* for example: *Diospyros, Strychnos, Symplocos,* etc. al." (1960 p. 67).

REFERENCES

BALFOUR, E.: Cyclop. Ind. I (1871) 285.

BARBOSA, D.: Libro (1516) quoted by Chiovenda (1923) 420.

BARROS, J.: Decad. Asia III Lib. 3 Cap. 7 (1553) 309–310.

BARTLETT, H. H.: Papers Mich. Acad. Sci. 1926 VI (1927) 15–17.

BEELER, B. H.: Principes 4 (1960) 67.

BEN-BATUTA: (1333–34) Portuguese Translation, Lisbon (1840).

BURKILL, I. H.: Dict. Econ. Prod. Mal. Pen. I (1935) 599.

BURMANN, J.: Edited and translated into Latin Rumph. Herb. Amboin. (1741–1750).

CANDOLE, A. DE: Geogr. Bot. Rais. II (1855) 977.

CARDANUS, H.: De subtil Lib. 8 (1550) quoted by Rumphius.

CHIOVENDA, E.: Webbia V (1921) 199–294 and (1923) 359–449.

CLUSIUS, C.: Arom. et Simpl. Med. Ind. (1574) 107–111.

CLUSIUS, C.: Arom. et Medi. Chi. A Costa (1582) 191.

*It may be noted that even today the Portuguese follow the practice described by GARCIA DA ORTA (1563) and apply the term *coco* to the fruit only, and call the palm *palmeira*, prefering to use the more distinctive term *conqueiro*.

CONDE DE FICALHO: Coloquios of Garcia da Orta (edited with notes) (1891) 235–250.

COOK, O. F.: Contrib. U.S. Nat. Hist. VI, 2 (1901) 256–293.

COOK O. F.: Contrib. U.S. Nat. Hist. XIV, 2 (1910) 271–342.

COSTA, CHRISTOBAL DA: Tract Drog. y Med. Ind. Or. (1578) 98: translated in Latin by Clusius (1582).

COVARRUVIAS, S. DE: Tesoro Leng. Cast. 2 eds. 1611 and 1674.

DALGADO, S. R.: Glossario Luso-Asiat. I (1919) 290–292.

DYMOCK, WARDEN & HOOPER: Pharm. Indica III (1893) 512.

GAMA, VASCO DA: Roteiro 1497–99. (ed. 1838) 28 and 29, written by *Alvaro Velho.*

HEYLIGERS, J. C. Th.: Traces Part. Princ. Lang. Ind. Or. Neerl (1889) 3–12.

LINNAEUS, C.: Species Plantarum II (1753) 995 and 1188.

LINSCHOTEN, J. H.: Hist. Navig. 1596 (ed. 1638) 101.

ORTA, GARCIA DA: Coloq. Simp. Drog. Ind. (1563), (ed. 1574) and ed CONDE DE FICALHO, 2 vols. (1891–1895). Translated and abridged in Latin by Clusius (1574).

PISO, W. Mantissa (1658), 125–130.

RHEEDE, H.: Hortus Malab. I (1679) 1–8 tt. 1–4.

RICHTER, H. E.: Codex Bot. Linn. (1840) x. footnote.

RUMPHIUS, G. E.: Herb. Amb. I (1741) 1–25 tt. 1–3, and IV (1750) 210–220 tt. 81–82.

SCALIGER, J. C.: Exot. Exert. 158 dist. 2 (1557), quoted by Rumphius.

WATT, G.: Dict. Econ. Prod. II (1889) 415.

VASCO DA Gama, see Gama.

YULE, H. & A. C. BURNELL: Hobson-Jobson (Glossary) eds. 1866 and 1902, 244–251.

Further notes on the Grasses of the Malay Peninsula I.

by

H. B. Gilliland
University of Singapore

Study leave from the University of Singapore affording the opportunity, the author has been engaged at the herbarium of the Royal Botanic Gardens, Kew on further study of malayan grasses. The unrivalled collection of types and the fine library have brought to light the need for the changes indicated below. Compare the author's previous "Checklist of Malayan Grasses" Gard. Bull. Sing. *19* 1, 147. 1962.

Acroceras tonkinense (Balansa) C. E. Hubb. ex Bor, Ind. For. Rec. (Bot.) **1, 3,** 78, 1938. Ohwi in Bull. Nat. Sci. Mus. Tokyo. **6,** 119, 1962.

Acroceras zizanioides (H.B.K.) Dandy sensu Gilliland, Gard. Bull. Sing. **19, 1,** *148, 1962. Neohusnotia tonkinense (Balansa) A. Camus Flor. Gen. de l'Indo-Chine, 211, 1920.*

Examination of the Indian material at Kew shows that our Malayan grass has been consistently misidentified. True *A. zizanoides* is a much softer grass with more flaccid leaves and a much stricter panicle with the spikelets more approximate, at once apparent when comparing specimens.

Bambusa montana (Ridley) Holttum in Kew Bull. **2** 206, 1956; Gilliland l.c. 150.

B. klossii Ridley Flor. Mal. Pen. **5,** *259. 1925.* The type material is at Kew and is not specifically distinct. Extends the range to Kedah Peak.

Bothriochloa glabra (Roxb.) A. Camus in Ann. Soc. Linn. Lyon 1930 n.s. **76,** 164. 1931; Bor, l.c. 167, 1960.

Andropogon glaber Roxb. Fl. Ind. **1,** *271. 1820.*

Specimens from Kedah, Selangor and Malacca.

Bothriochloa parviflora (R.Br.) Ohwi in Acta phytotax geobot. **11,** 162, 1942.

Capillipedium parviflorum (R.Br.) Stapf; Bor, l.c. 112, 1960; Gilliland l.c. 152.

Bothriochloa grahamii (Haines) Bor, l.c. 107.

Based on a Singapore plant determined by de Wit.

Brachiaria miliiformis (Presl.) Chase in Contrib. U.S. Nat. Herb. **22:** 35, 1920. Wycherley, Planters' Bull. 218, pl. 31. Nov. 1963.

Panicum miliiformis Presl. Rel. Haenk. **1,** *300 1830 ex Luzon.* This has been recorded from Singapore.

Larger forms of this plant with 4 racemes approach closely to *B. subquadripara* (Trin.) Hitchcock cf. Ohwi l.c. 120, 1962.

Digitaria dispar Henrard in Blumea **1:** 97, 1934.

Digitaria bicornis (Lank) Roem. & Schultz. senusu Gilliland l.c. p. 157. Paspalum heteranthum Hk. f. non Link. nec Nees et Mayen, Ridl. Mat. 3, 136, 1907; Digitaria barbata Willd., Ridl. Flor. Mal. **5,** *215, 1925.*

Digitaria fuscescens (Presl.) Henrard in Medel. Rijks Herb. **61,** 8, 1930. This is recorded from Singapore, Selangor, Pahang and Penang.

Digitaria timorensis (Kunth) Balansa Jour. de Bot. **4:** 138, 1890. This is similar to but more slender than *D. adscendens* (H.B.K.) Henr. and is widespread as a weed.

Digitaria violascens Link. Hort. Berol. **1:** 229, 1827. Specimens from Singapore, Selangor, Perak and Penang.

Hymenachne acutigluma (Steud.) Gilliland comb. nov!

Panicum acutiglumum Steud. Syn. Pl. Gram. 66; 1854. The type Cumings 2287 which is preserved in the Hooker Herbarium at Kew, is from Malacca.

= Hymenachne pseudo-interrupta C. Mueller in Bot. Zeit. 19: 333, 1861. Gilliland l.c. 163, 1962. Based on Griffiths 6471 collected in Malacca.

Isachne globosa (Thunb.) O. Ktze.

Panicum adstans Steud. Syn. Pl. Gram. 94 w. 771, 1854 based on Cuming 2288 Malacca preserved in the Hooker Herbarium at Kew is this grass.

Panicum walense Mez. in Bot. Jahr. **34:** 146, 1904.

Panicum austro-asiaticum Ohwi; Gilliland, l.c. 170, 1962.

Panicum notatum Retz. Obs. Bot. **4:** 18. 1786.

Panicum montanum Roxb.; Gilliland et al. l.c. 170, 1962.

Panicum humidorum Buch.-Ham. ex Hk. f. Fl. Brit. Ind. **7:** 53, 1896.

Panicum perakense (Hk. f.) Merr.; Gilliland et al. l.c. 711, 1962.

Panicum sarmentosum Roxb.

Panicum concinnum Nees in Jour. Bot. 97, 1850 based on Cumings 2284 from Malacca is this species.

Sacciolepis indica (Linn.) Chase var. *turgida* (Ridl.) Gilliland stat. nov! This is a dwarf grass with a much shorter panicle — no longer than 2.5 cms., often much shorter — than *S. indica* var. *indica* and is a consistent member of short turf on Singapore island.

Sacciolepis turgida Ridl. Flor. Mal. **5,** *231, 1925. Lectotype Singapore, Tanglin, Ridley in Herb. Kew.*

An Account of the Malaysian Leucobryaceae ('lumut puteh')

by

ANNE JOHNSON

Department of Botany University of Singapore.

THE MALAY *lumut puteh* ('white moss') refers to members of the Leucobryaceae which are exceedingly common in both terrestrial and epiphytic habitats throughout Malaysia. This family was established by Hampe (1837) under the name Leucophaneae, which was changed to Leucobryaceae by Mueller (1843) to accord with the principal genus, *Leucobryum*. It is but poorly represented in temperate regions of the world but well developed in the tropics. In Malaysia there are at least seven genera comprising about thirty-seven species. The family has been regarded as an isolated one (Cardot, 1899) by virtue of the pronounced cellular dimorphism of the anatomical elements of the leaves; or a highly artificial group (Andrews, 1947). The latter author suggests members should be placed partly in the Dicranceae and partly in the Calymperaceae. In my studies of the Malaysian Leucobryaceae I have inclined to the view that, although related to the Dicranceae, the Leucobryaceae form a distinct natural group with the exception of the last named genus, *Exodictyon*, which is clearly related to the large but poorly known family, Calymperaceae. Further studies on *Exodictyon* may show it is not a true member of the Leucobryaceae.

The very striking plants referred to this family are almost entirely tropical in distribution with the exception of the temperate *Leucobryum glaucum*. Because of its striking white colour, this species was readily recognized by early botanists. Doody (1696) mentions 'muscus trichoides montanus albidus fragilis,' and this plant was figured by Moris (1699). In Dillenius' catalogue (1719) a moss was described as 'bryum trichoides, erectis capitulis, albidum fragile'. Linnaeus placed this plant in the all-embracing genus *Bryum*. Legitimate publication for mosses (except Sphagnaceae) begins with Hedwig's Species Muscorum (1801) where it was placed under *Dicranum*. Other bryologists have referred the same species to *Hypnum, Fuscina, Mnium, Oncophorus* and *Sphagnum*. It was not until 1837 that the Leucobryaceae came into their own as a group apart from other mosses.

Morphology and Anatomy

The Leucobryaceae as defined by Brotherus (1924) includes nine genera, seven of which occur in Malaysia. A tenth genus published by Williams (1931) does not occur in Malaysia.

All the Leucobryaceae are characterized by very pronounced cellular dimorphism in the anatomical elements of their leaves. There are at least two layers of leucocysts, with the chlorocysts arranged in longitudinal series between these layers, often with connecting anastomoses. In *Arthrocormus* and *Exodictyon* the chlorocysts form three layers.

Hedwig, Schwaegrichen and Bridel described *Dicranum glaucum* as lacking a nerve (in Cardot, 1899). This view was followed by many nineteenth century bryologists including Hampe, Mueller, Bruch and Schimper, l'abbé Boulay, Limpricht and Bescherelle. However in other mosses, the lamina of the leaf is only one cell thick and any multi-layered part is regarded as a nerve whether it be sclerified or not. Therefore De Notaris (1869) tentatively put forward the idea that the leaf of the majority of the members of the Leucobryaceae consists almost entirely of a nerve, the lamina being restricted to a small marginal portion which is only one cell thick. This results in two anomalies: (i) the lamina (sensu De Notaris) consists only of leucocysts, dead, colourless cells, while the chlorocysts are confined to the nerve; (ii) in the genus *Leucophanes* there is a central stereid band which runs up the nerve. This must now be called a pseudo-nerve, although in position and function it is more like a true nerve of an ordinary moss. The opinion of De Notaris has been followed by Lindberg, Braithwaite, Dixon, Husnot, Cardot and all other twentieth century bryologists.

In 1899 Cardot published a paper incorporating a very detailed anatomical study of members of the Leucobryaceae. This paper was of such excellence that it seemed to answer all the problems posed by this family, and effectively inhibited research in the first half of the twentieth century. Cardot showed that tribes (and sometimes genera and species) could be separated by the anatomy of the nerve, which he assumed was constant for any one species. He distinguished two basic types of nerve:—(i) *homostrosic* — in which the leucocysts are arranged in two layers at least at the base, (ii) *heterostrosic* — in which the leucocysts were arranged in more than two layers at the base of the nerve. He recognized some intermediate types which he called *sub-homostrosic* (if they more nearly resembled the homostrosic type), and *sub-heterostrosic* (if they more nearly resembled the heterostrosic type). In each case the chlorocysts could be *centric, sub-centric* or *hypercentric*.

Following Cardot, the Leucobryaceae may be divided into the following tribes: —

Tribe Leucobryeae

Nerve without a central stereid band. Chlorocysts quadrangular in section, forming a single layer throughout the whole length of the nerve, and situated at the junction of four leucocysts.

1. *Ochrobryum (homostrosic).*
2. *Schistomitrium (homostrosic, sub-homostrosic or rarely heterostrosic).*
3. *Cladopodanthus (sub-homostrosic).*
4. *Leucobryum (homostrosic or heterostrosic).*

Tribe Leucophaneae

Nerve with a central stereid band. Chlorocysts quadrangular in section, forming a single layer over the whole length of the nerve, and situated at the junction of four leucocysts.

5. *Leucophanes (homostrosic or heterostrosic, distinct border).*

Tribe Octoblephareae

Nerve without a central stereid band. Chlorocysts triangular in the upper part of the leaf, situated at the junction of three leucosysts; at the base often quadrangular; forming a single layer the whole length of the nerve.

6. *Cardotia (heterostrosic or sub-heterostrosic).*
7. *Octoblepharum (heterostrosic).*

*8. *Carinafolium (heterostrosic, keeled).*

Tribe Arthrocormeae

Nerve without a central stereid band. Chlorocysts irregular with 3, 4, 5, 6, or 7 angles and arranged in three layers at least in the upper part of the nerve.

9. *Arthrocormus (heterostrosic* with numerous layers of leucocysts, chlorocysts in a single layer at the base of the leaf, two in the middle part and three above. Border more or less distinct. Chlorocysts never exposed).
10. *Exodictyon (heterostrosic* with numerous layers of leucocysts, chlorocysts nearly always in three layers; a central one consisting of cells with 4, 5, 6, or 7 angles, and a dorsal and a ventral one which are exposed).

Malaysian Leucobryaceae

The following is an account of Malaysian Leucobryaceae which have been studied over the last three years from specimens collected in Malaya and Sarawak, as well as those in the herbaria at the British Museum and Botanic Gardens, Singapore.

---

* The genus Carinafolium was unknown to Cardot.

Leucobryaceae Mueller 1843

Small to large, usually acrocarpous mosses; whitish in appearance due to the presence of a large number of colourless leucocysts. Stem usually branched, bearing rhizoids below. Leaves ascending or secund and made up of two or more layers of leucocysts with small chlorocysts embedded between the layers (exposed in *Exodictyon*). Lamina usually narrow, unistratose and made entirely of leucocysts. Seta erect bearing an upright sub-cylindrical or inclined asymmetrical capsule. Peristome of 8 or 16 teeth, entire or divided half-way into two limbs; or absent (*Ochrobryum*). Operculum rostrate often long-pointed; calyptra cucullate or mitriform.

Key to Genera

1. Leaves with a median band of stereid cells (pseudonerve) ... 5. *Leucophanes*.
1. Nerve without median band of stereid cells ... 2.
2. Leaves arranged in three rows ... 7. *Arthrocormus*.
2. Leaves not arranged in three rows ... 3.
3. Leaves closely imbricate, sometimes bearing a long hispid point. Seta often on short lateral branches ... 3. *Cladopodanthus*.
3. Leaves erect-spreading or falcate, not bearing a long hispid point. Seta terminal ... 4.
4. Leaves very thick and rigid, consisting mainly of the heterostrosic nerve, chlorocysts in one or three layers, often triangular in section above ... 5.
4. Leaves not rigid, chlorocysts always in one layer, quadrangular above ... 6.
5. Teeth eight; leaves thick lingulate, chlorocysts in one layer ... 6. *Octoblepharum*.
5. Teeth sixteen, leaves thinner with hyaline sheathing base, chlorocysts in three layers ... 8. *Exodictyon*.
6. Calyptra mitriform, fringed at the base, capsule erect ... 7.
6. Calyptra cucullate, capsule inclined ... 4. *Leucobryum*.
7. Seta very short, urn hemispherical, no peristome teeth .. 1. *Ochrobryum*.
7. Seta long, cylindrical, peristome of 16 teeth ... 2. *Schistomitrium*.

Tribe **Leucobryeae**

Nerve without a central stereid (pseudo-nerve). Chlorocysts quadrangular in section, forming a single layer throughout the whole length of the nerve, and situated at the junction of four leucocysts.

1. **Ochrobryum** Mitt., Musc. austr. amer. (1869) 108

Slender plants in lowly, thick, whitish-green to white, lustreless tufts. Erect-spreading leaves, rolled above to form a gutter or pipe, with a long ovate basal part, sometimes with a thorn-tip, sometimes cucullate. *Nerve homostrosic, with leucocysts in two layers at the base. True lamina wide, disappearing at the apex or occasionally replaced by a margin of narrow cells (border).* Capsule terminal on the stem, immersed, hemispherical in shape. Peristome absent, operculum conical at base with long acuminate tip. Calyptra narrow, conical awl-shaped with thick lashes (fimbriate) at base.

DISTRIBUTION: Sudan, W. Africa, Madagascar, Nepal, Burma, Siam, Malaysia(?) This genus is included by van der Wijk (1958) in his key to Malaysian moss genera. As far as I know no fertile material has ever been found in Malaysia: and it seems doubtful if it occurs here. It is not possible to identify sterile material with any certainty since members of other genera in this family have a similar morphology and some have homostrosic nerves).

Herzog records *Ochrobryum microphyllum* Card. as collected in Perak by Stresemann no. 86 (Dixon, 1926). *Ochrobryum microphyllum* is a South American species and it seems unlikely that it should occur in Malaya. I have not been able to trace this specimen.

A poor specimen labelled *Ochrobryum mitteni* collected by Motley at Toegoe in Java is in the herbarium at the British Museum. It is not fertile and is most probably a *Schistomitrium*. The apex is sub-cucullate with a short apiculus, and the true lamina is four cells wide at the base. The nerve is homostrosic.

2. **Schistomitrium** Doz. et Molk., Musc. ined. Arch. Ind. (1845–48) 67

Slender to sturdy plants form loose or thick, bluish-green to white, lustreless tufts. Leaves erect-ascending or falcate, lanceolate, either cucullate with a thorn-tip or acuminate. *Nerve homostrosic, sub-homostrosic or rarely sub-heterostrosic* at base. *True lamina wide, never replaced by* a border. Seta terminal on stem, long. Capsule exerted, upright, cylindrical. Peristome teeth sixteen, in a disorderly arrangement, finely papillose. Calyptra conical mitriform, long fimbriate.

DISTRIBUTION: Malaysia.

Key to Species of Schistomitrium

1. Tip acuminate, never cucullate .... 2.
1. Tip sub-cucullate to cucullate with a short thorn-tip .... 3.
2. Leaves folded over entire length to form a narrow gutter-shaped structure .... 7. *Sch. mucronatum*.
2. Leaves somewhat concave, flexuose and bent when dry, not forming a gutter-shaped structure .... 5. *Sch. apiculatum*.
3. Large robust species, leaves at least 5 mm. long .... 8.
3. Smaller species, leaves less than 5 mm. long .... 4.
4. Lamina absent or only one cell wide .... 9. *Sch. sparei*.
4. Lamina at least three cells wide at base .... 5.
5. Leaves falcate .... 6.
5. Leaves not falcate, erect ascending .... 7.
6. Margin entire .... 3. *Sch. lowii*.
6. Margin serrate .... 6. *Sch. mucronifolium*.
7. Leaves more or less triangular/lanceolate, strongly cucullate 4. *Sch. niewenhuisii*.
7. Leaves ovate, subcucullate with a small mucro-tip 8. *Sch. breviapiculatum*.
8. Border of elongate cells narrow, about 4 cells wide 2. *Sch. subrobustum*.
8. Border of elongate cells broad at base, 6 — 12 cells wide 1. *Sch. robustum*.

1. **Schistomitrium robustum** Doz. et Molk., Bryol Jav. 1 (1845) 21.

Large species forming loose untidy tufts 4 — 7 cm. high, stems dichotomously branched and densely covered by over-lapping leaves. Leaves ascending, oblong/ovate to lanceolate, about *7 mm. long × 1.5 – 2.0 mm. wide,* secund, concave, distinctly cucullate with a prominent acumen. *True lamina wide at base* consisting of 6 — 12 rows very narrow prosenchymatous cells, disappearing above. Nerve homostrosic at base of leaf, chlorocysts somewhat hypocentric. Upper leucocyst layer multiplied above to form a bulky sub-trigonal point with chlorocysts strongly hypocentric. Dorsal leucocyst layer not multiplied above. Seta terminal, reddish, 1 cm. high bearing an erect capsule, oblong-cylindrical in shape, striate; operculum subulate-rostrate, about the same length as the capsule. Peristome typical, 16 undivided pale yellow teeth. Calyptra typical, fimbriate, reaching half way down capsule. Spore minutely papillose. (Figure 1; 2 (f)).

PHILIPPINES: Luzon, Infanta, Tayalas; (Robbins 9367).

BORNEO: Liang Gagang; (Verdoorn 17850).

JAVA: ad arb. truncos in Mt. Gegogand near Toegoe 4000; (Burg 489); (Hampe no. loc.); (Bescherelle no. loc.).

2. **Schistomitrium subrobustum** Broth., Leafl. Phil. Bot. 6 (1913) 1976.

Fairly robust plants of whitish green colour, paler or brownish below. Stems 3–6 cm. high, branched. Leaves crowded on the stem, ovate-lanceolate in shape, 5 mm. long×1.3 mm. wide, cucullate at apex and abruptly apiculate; nerve broad flat; *lamina four cells wide consisting of an outer row of narrow cells and three inner rows of more or less rectangular cells,* apex may be somewhat scabrous dorsally. Seta terminal erect smooth. (Figure 2 (c)).

Endemic to Philippines.

PHILIPPINES: Luzon, Tayabas Prov., Lucban (Elmer 7414); Infanta (Robinson 9367); Basilan, Entereon (Reillo 16271); Mindanao, Agusan Province, Cabadaran, Mount Urdaneta (Elmer 14111, type).

3. **Schistomitrium lowii** Mitt., J. Linn. Soc. Bot. 22 (1887) 302.

Small to fairly robust plants of yellow green to brownish colour, about 4 cm. high. Leaves *falcato-secund,* oblong-lanceolate, about 4 × 1 mm., tip tubular in the apical third of leaf with culcullate apex and a small mucrotip. *True lamina about five cells wide* at the base, consisting of three rows of outer prosenchymatous cells and two rows of inner rectangular cells. Seta brownish about 8 mm. long. Capsule shining, brownish, cylindrical, slightly constricted near the stomium. Calyptra acutely pointed, mitriform, golden below red apex with golden fimbriate hairs. (Figure 2 (d)).

Endemic to Borneo.

BORNEO: Kemoel, W. Koetal (Endert 4544): Kamborangah (Holttum 25660).

4. **Schistomitrium niewenhuisii** Fleisch., Musci Fl. Buitenzorg 1 (1900–1902) 161.

Small to fairly robust plants about 3 cm. high. Leaves crowded, erect-spreading, very concave, *never falcate*, cucullate and abruptly apiculate at apex, triangular to lanceolate, about 5 × 1.2 mm., tip with a dark golden colour. Lamina with 1–4 rows of small rectangular cells. Nerve homostrosic below with hypocentric chlorocysts. Seta erect, scabrous; peristome teeth pale brown, papillose; operculum conical-rostrate, not quite as long as capsule; calyptra typical, fringed at base. Spores bearing many papillae. (Figure 2 (a); 4).

PHILIPPINES. Luzon, Abra Province (Ramos 7310); Mindoro, Mt. Halcan Merrill 6209).

NEW GUINEA: Idenburg River, 15 m. S.W. Bernhard Camp, 1800 m. (Brass, July 1939).

BORNEO; fide Bartram; Fleischer, Bukit Milie.

MALAYA: Trengganu, Gunong Sembili near Gunong Padang (Hislop, 1952).

5. **Schistomitrium apiculatum** Doz. et Milk., Musc. frond. ined. Arch. Ind. 68 (1846) 24–25.

Syrrhopodon apiculatus Doz. et Molk., Annal. Sc. Nat. 11 (1844) 315.

Schistomitrium strictifolium Dix., ined.*

Small species forming loose to whitish tufts about 2 cm. high. Stems dichotomously branched with leaves frequently forming apical rosettes. Leaves usually *very falcato-secund, flexuose and bent over when dry*, 2 mm. × 0.6 mm., entire, *tip long acute never cucullate*, somewhat concave, ovate-lanceolate with a wide base. True lamina three to four rows of elongate hyaline cells. Nerve homostrosic at base with median or slightly hypocentric chlorocysts. Ventral layers of leucocysts multiplied above to give thick rounded point with strongly hypocentric chlorocysts. Seta short, 1–3 mm. high, smooth or slightly roughened; capsule upright, cylindrical; operculum conical-subulate; calyptra typical, fimbriate, brownish to golden colour completely enclosing capsule.

**Sch. strictifolium Dix. ined.* This specimen (Spare 3543) has an apex which is in all respects similar to other specimens of *Sch. apiculatum*. The leaves are rather long and thin, about 5 × 0.5 mm. The basal border is three cells wide; the cells being rectangular in shape. The nerve is homostrosic at the base, and heterostrosic near the apex with hypocentric chlorocysts. I see no reason for separating this as a different species. Since the apex is scarcely falcate it could be included below. (Figure 2b).

A very variable species, distinguished from all except *Sch. mucronatum* by its apex which is never cucullate. (Figure 2h, 3).

PHILIPPINES: Luzon, Zambales (Ramos 5152); Rizal, Oriud (Loher 15136) Pangasinan, Umingan (Otanes 18356); Tayabas, Baler (Santos 357); Mindoro, Puerto Galera (Bartlett 13864); Mindanao, Zamboanga Prov. (Merrill 8362).

BORNEO: Bolset, W. Koetai (Endert 2508, 2607a, 4044).

SARAWAK: On fallen tree, Ulu Koyan Oxford Exp. (1932) 2034. On tree in moss forest, Dulit Bridge Oxford Exp. 1932) 1942. Gunong Poe (Beccari (1866)).

SUMATRA: Is. Engano, (Modigliani 787).

JAVA: Mt. Gedah, Tjiburrum, 1700 m. (Fleischer); Pangerango 1700 m. (Kurz); no loc. (Bescherelle).

MALAYA: Pahang, on soil, Sungei Bertam, 1300 m. (Spare 3365); Gunong Jasar (Spare 3543)†; Perak, Lower Camp, Gunong Batu Puteh (Wray 1085); Selangor Border Fraser's Hill, 1300–1450 m. (Burkill et Holttum 8833); Johore, Johore Bahru (Johnson 301).

5 (a) **Sch. apiculatum var. copelandii** (Broth.) Bartram, Phil. J. Sc. 68 63.

Sch. copelandii Broth., Phil. J. Sc. (1908) 13.

Leaves not secund but upright, although flexuose; somewhat longer and more erect-spreading than the type. (Figure 2g).

PHILIPPINES: Luzon, Zambales, Mt. Tapoao, (Ramos 5152). Mindanao, Agusan, (Weber 1297). Zanboanga, 1400 m. (Copeland A.).

SARAWAK: On ground and tree trunk in white sand forest, c. 1000 m., Ulu Koyan, Oxf. Exped. (1932) 1861.

MALAYA: Pahang, Sungei Reriang, Gunong Tahan, on tree in jungle about 1100 m. (Holttum 20847b) (Holttum 20842).

6. **Schistomitrium mucronifolium** (C. Muell.) Fleisch., Musci Fl. Buitenzorg 1 (1900–1902) 161 21.

Leucobryum mucronifolium C. Muell., Syn. (1851), 2536 Bryol Jav. (1855) 1 18.

Medium sized species forming very compact neat pale-green pin-cushion like tufts about 4 cm. high and 5–10 cm. across. Stems branched, thickly clothed with overlapping leaves, often in a semi-rosette form at the top of the stem. Leaves falcato-secund, narrowly ovate-lanceolate to lanceolate, concave, *cucullate with a long golden acuminate tip,* lamina narrow consisting of *3–5 rows rectangular cells.* Leaves about 6×1 mm., margin serrate above. Nerve homostrosic below with strongly hypocentric chlorocysts. Sporogonium pseudolateral. Seta about 1 cm. high, reddish-golden; capsule cylindrical, upright; operculum long drawn out from a cylindrical base, almost as long as the capsule; calyptra typical, attractive shining golden colour. Figure 1; 2 (e)).

Plants similar to *Sch. apiculatum* but larger and with a cucullate apex.

JAVA: Mt. Salak, 1000 m. (Fleischer (1893)).

MALAYA: Kedah, Kedah Peak, 1000 m. (Holttum 14890, 'forma foliis erectis nec falcatis, seta laeviter rugulosa'), Pahang, Gunong Tahan, 1200–1400 m. (Holttum 20922); Cameron Highlands, rotting wood 1700 m. (Spare 3420).

7. **Schistomitrium mucronatum** C. Muell. ex Johnson sp. nov.

Species parva; flavo-viride; caespitosa, circa 5 mm. alta. Folia converta, falcata, toto plicata similis canalis tenuim, pauca deflexa. Margina cellulae 3 ad 4-seriatis, fusiformae, hyalinae. Apex non cucullatus, acutus; cellula termina flava triangularis. Seta flavo-rubra, circa 6 mm. alta; capsula gracile, cylindrica, erecta. Caetera ignota.

A small plant forming pale yellowish green tufts about 5 mm. high. Leaves closely overlapping, falcate, about 3.5 × 0.8 mm., *folded over entire length to form a shallow gutter-shaped structure*, leaf somewhat decurved. Border distinct consisting of three to four rows of narrow prosenchymatous colourless cells. Tip not cucullate but acute, ending in a single yellow triangular shaped cell. Nerve sub-homostrosic below with median chlorocysts; thickened ventrally above. Seta orange about 6 mm. high; capsule slender, cylindrical upright Operculum and calyptra unknown. (Figure 2 (k), 5).

NEW GUINEA: austro-orient. Brit. in montosis Mo-roka, 1300m. (district Moresby) legit Lamberto Loria, Mueller 1629). TYPE IN B.M. (part of Bryotheca E. Levier).

As far as I know this species has not been described before.

8. **Schistomitrium breviapiculatum** Broth., Oefv. af Finska Vet. Akad. Forh. (1898) 160.

Leucobryum brevisetum C. Muell ms., Brotherus, in Engler & Prantl. 2 ed. 10 (1924) 223.

Small species forming dense tufts 1 cm. high. Stems erect, densely covered with erect or slightly secund leaves, basally concave, *long oval, cucullate, obtuse, shortly mucronate,* entire, lamina three cells wide. Nerve heterostrosic throughout the leaf. Chlorocysts hypercentric below, hypocentric above. (Figure 2 (j), 5).

Similar to *Sch. apiculatum* but cucullate and more obtuse.

NEW GUINEA: Guilianetti (1897) (fide Brotherus): Mt. Moroka (Mueller 743).

9. **Schistomitrium sparei** Dix. ex Johnson sp. nov.

Species caespitosa laxa glauco-viride, circa 1.5 cm. alta. Folia lanceolata, falcata, apice caulorum conferta, magna, 5.4 mm. longa, 0.8 mm. lata, plicata (Sch. lowii affinis). Apex cucullatus obtuso-apiculatus. Lamina vera vel mulla vel una cellula seriatia.

Loose whitish-blue tufts about 1.5 cm. high. Leaves lanceolate falcato-secund, forming distinct rosettes at the apex of the stem; large, 5.4×0.8 mm., folded (cf. *Sch. lowii*), cucullate, obtuse with apiculate tip. *True lamina absent or only one cell wide.* Fruit unknown. Nerve strongly sub-heterosic at base towards margine's chlorocysts median below hypocentric above. (Figure 2 (i), (6).

MALAYA: Kedah Peak, leaf mould 750m. (Spare 2920). [TYPE].

This species differs from *Sch. lowii* in the narrower, shorter border (true lamina) and the more obtuse leaves. The basal section shows a single, more or less centric layer of quadratic chlorocysts with an increase in the number of leucocysts both dorsally and ventrally towards the leaf margin; a median section shows little increase in the number of leucocyst layers above two; while the apical section shows considerable ventral multiplication.

As far as I know this species has not been described previously.

3. **Cladopodanthus** Doz. et Molk., Musc. ined. Arch. Ind. (1846) 79.

Vigorous plants forming thick, golden-green, lustreless tufts. Stem upright or creeping. Leaves overlapping, spoon-shaped, usually with a long hair-tip. *Nerve sub-homostrosic. True lamina very wide, never replaced by a border.* Capsule exerted, upright, cylindrical. Peristome teeth sixteen, in a single row, long and thickly lying, finely papillose. Calyptra cucullate, not fimbriate.

DISTRIBUTION: Malaysia.

Key to species of Cladopodanthus.

1. Leaves ending in a terminal hair-point .... 2.
1. Leaves without hair-point .... 3.
2. Leaves narrowing suddenly to hair point at least one quarter length of leaf .... 1. *Cladopodanthus pilifer.*
2. Hair point shorter. Leaves obtuse, strongly concave above 2. *C. speciosus.*
3. Leaves usually truncate when old. Young leaves subtubulose above 3. *C. muticus.*
3. A very small species. Leaves never truncate, usually acuminate to acute 4. *C. microcarpus.*

1. **Cladopodanthus pilifer** Doz. et Molk., Musci Fr. Ined. Arch. Ind. 3 (1846) 80 28.

Leucobryum cladopodanthus C. Muell., Syn. 1 (1849) 78.

L. piliferum Jaeg., Adumbr. 1 (1871–5) 163.

Robust pale golden-green plants, upright or creeping bearing many short branches covered with dense leaves. Leaves rounded oblong to spathulate, cucullate and suddenly piliferous forming a long hair-like tip, equal to one quarter to one third total length of leaf. True lamina narrow, only 1–2 cells wide. Nerve sub-homostrosic with hypocentric chlorocysts throughout the whole length of the leaf. Seta 1 cm. high, a little papillose; capsule upright, long cylindrical, brownish red, shining; peristome deeply inserted, 16 teeth some of which may be split half-way and dicranoid; spores smooth. (Figure 7 (*a*), 8).

BORNEO: Penibukan 1300 and 1500m. (Clemens 5030b and 40531).

JAVA: Herb. Hampe (1881).

MALAYA: Bukit Fraser (Herklots 166a).

1. **(a) var. acuminatus** Doz. et Molk., Musci Fl. Buitenzorg 1 (1904) 156.

Plant more robust with more crowded branches which stand parallel and erect, leaves somewhat larger but narrower above. (Figure 7 (*b*)).

JAVA: Mt. Gedeh (Zippelius).

Depak, Batavia (Halle).

2. **Cladopodanthus speciosus** (Doz. et Molk.) Fleisch., Laubmfl. Java. 1 (1900–1902) 156.

Syrrhopodon speciosus Doz. et Molk., Ann. Sci. Nat. (1844) 315.

Spirula speciosa Doz. et Molk., Musci Frond. Ined. Arch. Ind. 72 (1846) 26.

Schistomitrium speciosum Hamp., Bot. Zeit. (1847) 922.

Leucophanes speciosum C. Muell., Syn. 1 (1849) 84.

Plants to 8 cm. high, mostly upright, dichotomously branched. Leaves densely overlapping, julaceous, concave, oblong, cucullate, rounded, about 2×0.8 mm. with a short hair tip usually bent back. Nerve sub-homostrosic similar to *C. pilifer*. Sporophyte terminal on short branches which become lateral by innovation; seta red, about 1 cm. high; capsule upright, long cylindrical; peristome teeth stumpy, mostly undivided. Calyptra mitriform, split once, lobed at the base; spores rough. (Figure 7 (c), (d), 8).

PHILIPPINES: Luzon; Tayabas Prov., Kabatangan Balu, (Santos 228).

CELEBES: B. Watoewila, 1400m. (Fleischer (1899)).

BORNEO: Penibukan c. 2000m. (Clemens 5080).

SARAWAK: Dulit Ridge, mossforest c. 1300m. (Oxford Exp. (1932)).

JAVA: Tjibodas 1400m. (Fleischer (1899)).

M. Prabakti 800m. (Zollinger 3492); M. Salak (Hampe (1881)).

M. Gedeh (Hampe); no loc. (Zollinger 36291).

3. **Cladopodanthus muticus** Broth., Phil. J. Sc. 31 (1926) 279.

Cladopodanthus truncatus Dix., J. Linn. Soc. (Bot.) 50 (1935) 73.

Very branched upright or creeping plants forming tufts 2–3 cm. high and about 5 cm. diameter. Leaves densely overlapping, appressed, erect, oblong, concave, about 2.5×0.5 mm., subtubulose above with a minute apiculus or squarely truncate with apiculus wanting, with margins forming projecting horns. Lamina consisting of elongate cells, two to four cells wide, narrowing above. Seta short; calyptra golden, mitriform, entire, completely covering capsule. (Figure 7 (*g*)).

PHILIPPINES: Panay, Salibongbong (Martelino et Edano 3578).

BORNEO: (Haviland (1889)).

SARAWAK: Rotten trunk in heath forest under 300m. (Forest Reserve, Marudi (Oxford Exp. (1932)).

4. **Cladopodanthus microcarpus** Dix., J. Linn. Soc. (Bot.) 50 (1935) 74.

A very small species with prostrate or erect branches with densely compacted to somewhat spreading leaves. Leaves erect or slightly secund, rigid, about 2.5×0.5 mm., concave, acute, entire. Capsule small and short, about 0.5 mm. long; calpytra golden, almost entire or slightly notched. (Figure 7 (*c*) (*f*)).

This species resembles *Schistomitrium* far more than *Cladopodanthus* in its external form. The leaves are not tightly packed as in other species of *Cladopodanthus*. However the calyptra is typical of this genus not of *Schistomitrium*.

SARAWAK: On a fallen tree trunk c. 800m., Ulu Koyan (Oxford Exp., (1932)).

4. **Leucobryum** Hampe., Linnaea 13 (1839) 42; Brid., Bryol Univ. 1 (1826) 763.

Slender to sturdy plants in thick, bluish-green, whitish green or white tufts, usually lustreless. Leaves ascending when dry, usually falcate, long ovate or lanceolate. Nerve homostrosic or heterostrosic. *Lamina generally wide, sometimes completely disappearing at the apex. No distinct border.* Seta terminal or lateral, long. Capsule exerted, horizontally inclined, curved, often strumose, longitudinally striated when dry. Peristome teeth 16, each divided half-way to form 32 limbs and dicranoid, transversely barred, thickly papillose. Calyptra cucullate, inflated, entire, never fimbriate.

Distribution: Cosmopolitan but majority of the species are confined to the tropics and sub-tropics.

Key to species of Leucobryum.

1. Leaves auriculate at base; nerve homostrosic throughout leaf ...... 2.
1. Leaves not auriculate; usually heterostrosic .... 3.

2. Leaves falcato-secund; tip scabrous dorsally with serrate margin; true lamina 3–4 rows wide below .... 1. *L. sanctum*.
2. Leaves erect-spreading; sharply apiculate; tip smooth to slightly scabrous dorsally; true lamina 1–2 rows below .... 2. *L. subsanctum*.

3. Plant robust, 5 cm. or more tall; leaves large, at least 9 mm. long .. 4.
3. Plants small to medium sized; leaves less than 8.5 mm. long. ...... 5.

4. Leaves tongue-shaped with wavy sides and broad obtuse tip, about 10 × 1.5 mm.; nerve subhomostrosic with centric chlorocysts 7. *L. cyathifolium*.
4. Leaves lanceolate to ovate with a hollow cucullate to tubular tip .. 6.

5. Silver grey in colour; plant only 4 mm. high; margins of leaf inrolled to base .... 15. *L. byssaceum*.
5. Green to white in colour; plant more than 1 cm. high; margins of leaf not inrolled to base .... 7.

6. Very large attractive plants; leaves shining about 16 × 2.6 mm., base ovate drawn out into a long tubular part above .. 12. *L. pulchrum*.
6. Large loose tufts; leaves dull, lanceolate about 12 × 2 mm., not drawn out into a long tubular part above, falcato-secund .. 11. *L. javense*.

7. Leaves triangular or ovate in shape; abruptly narrowed and drawn out into a long narrow channelled or tubular part above .... 8.
7. Leaves lanceolate to ovate; not abruptly narrowed and drawn out above .... 9.

8. Tip scabrous dorsally .... 10.
8. Tip smooth dorsally .... 11.

9. Plants small, under 1 cm. high; leaves triangular, stiff ascending, about 2.5 × 0.25 mm. .... 14. *L. microleucophanoides*.
9. Medium sized plants more than 1 cm. high, leaves ovate to lanceolate 12.

10. Leaves erect-ascending, about 8 × 1.7 mm. .... 5. *L. scabrum*.
10. Leaves strongly falcate, usually in five rows, about 5 × 1 mm. 13. *L. candidum*.

11. Silky plants with slender flexuose leaves about 6 × 0.5, capsule normal size .... 6. *L. bowringii*.
11. Not silky; leaves rigid and falcate, about 4 × 1 mm., capsule very small .... 8. *L. stenophyllum*.

12. Leaves ovate, about 8 mm. long, rigid with concave base, lamina 12 rows of cells below .... 3. *L. neilgherrense*.
12. Leaves falcate, only 3 mm. long, lamina 7 rows or less .... 13.

13. Leaves strongly iridescent when dry, apiculate ...... 4. *L. aduncum*.
13. Leaves not iridescent, tip keeled or cucullate .... 14.

14. Very rough dorsally with falcate bent over tip, lamina 2–4 rows cells 9. *L. scalare*.
14. Undulate not rough dorsally, tip narrowly keeled, subdenticulate, little falcate; lamina 3–7 rows of cells .... 10. *L. chlorophyllosum*.

1. **Leucobryum sanctum** (Brid.) Hampe., Linnaea 13 (1839) 42.

Dicranum glaucum var. *sanctum* Brid., Bryol. univ. 1 (1826) 811.

Dicranum sanctum Mees., in Schwaegr., Suppl. 11 (1826) 121 186.

Octoblepharum sanctum Mitt., Proc. Roy. Soc. (1879) 99.

Leucobryum auriculatum C. Muell., Bibl. Bot. (1889) 2.

Leucobryum glaucissimum C. Muell. ined., Dix., J. Linn. Soc. Bot. 43 (1916) 295.

Robust plants forming large tufts to 10 cm. high, covered with large, erect-spreading ovate leaves, usually secund, 7×1.2 mm. Lamina cells in 3–4 rows forming distinct hyaline auricles below. Nerve scabrous on back. Tip serrate due to projections of cell corners. Nerve homostrosic to subhomostrosic, hypocentric chlorocysts at the base becoming centric or hypercentric above. Seta reddish, smooth, 2 cm. long; capsule inclined, strongly strumose longitudinally furrowed, asymmetrical about 1.4 mm. long. Fruit rare. (Figure 9 (*d*); 10 (*a*)).

A common species widely recorded from the Philippines, Borneo, Sarawak, Java, Malaya, Singapore, Sumatra, Celebes, Hong Kong, Australia and Samoa.

2. **Leucobryum subsanctum** Broth., Phil. J. Sc. 150 (1907) 339.

Similar to *Leucobryum sanctum* but leaves never secund, always erect-spreading on all sides, sharply apiculate, smooth dorsally. Seta slightly scabrous; capsule suberect, nearly symmetrical or slightly strumose. Figure 9 (*c*).

PHILIPPINES: Luzon, Bataan Prov., Mt. Mariveles (Merrill 3540; 3549); Upper Lamao River (Williams 843); Tayabas Prov., Baler (Santos 238); Mindoro Prov., Halcon (Merrill 6208); Negros Occid. Prov., Fabrica (Chapman 50).

NEW GUINEA: Moresby District, St. Josephi, secus flumen (Loria 702, type).

MALAYA: Pahang, Gunong Tahan, hanging from tree in mossy wood, 2300m. (Holttum 20900).

3. **Leucobryum neilgherrense** C. Muell., Bot. Zeit. (1854) 556.

Leucobryum triviale C. Muell., Linnaea (1869) 30.

Leucobryum hollianum Doz. et Molk., Bryol. jav. 1 (1855) 17.

Leucobryum textori Besch., Bryol Japan. Supple. 1 18.

Medium sized plants, pale green above, buff-coloured below. Stems 2–3 cm. high, branched. Leaves narrow ovate, 8×0.8 mm., concave base, rigid channelled upper part and minute tip. True lamina twelve cells wide below, rectangular with thin straight unpitted walls; nerve heterostrosic above, not scabrous behind. Seta 2 cm. long, red, smooth; capsule inclined, funnel-shaped at stomium, striate when dry; operculum with rounded base and short blunt tip. (Figure 9 (*a*)).

A species distinguished by its rigid leaves.

PHILIPPINES: Benguet subprov., Mt. Santa Tomas, trees in fog area (Hadden 113a) Mt. Data 2000m. (Hadden 113).

JAVA: Mt. Gedeh, Tjibodas, 14–1500m. (Fleischer (1899) (1898)).

SARAWAK: Gunong Wah (O. Beccari 32).

CELEBES: Bua Krang c. 2000m. (Fruhstorfer fide Cardot).

MALAYA: Kedah, Inchong Estate, sandy soil (Spare 3008).

4. **Leucobryum aduncum** Doz. et Molk. Bryol. jav. 1 (1855) 319.

Leucobryum brachyphyllum Wils., Jour. Bot. 9 293.

Small to medium-sized plants forming cushion-like tufts. Stems sparingly branched 1–5 cm. high. Leaves shining, iridescent when dry, falcato-secund, about 3×0.5 mm.; tip very rough dorsally, nerve heterostrosic above, homostrosic at base. Seta 2 cm. long, brown, capsule pendulous, straite strumose. (Figure 9 (*b*); 11).

Widely distributed in the Philippines, Borneo, Sarawak, Java, Sumatra and Malaya. Found also in Ceylon, New Hebrides, Thailand and Hong Kong.

5. **Leucobryum scabrum** Lac., in Miqu., Ann. Musc. bot. Lungdun Batav. 11 292.

A robust species, pale green brown in colour, 2–3 cm. high, forming loose tufts. Leaves large erect ascending, not or very slightly falcate, ovate, upper margins incurved, 8×1.7 mm., lamina five rows, tip very rough dorsally, bent over. Seta 2.5 cm. long, reddish, smooth; capsule pendulous, striate; operculum conical with a long acumen. (Figure 9 (*i*)).

MALAYA: Kedah, Kedah Peak (Spare 2917, 2902, 2373); Pahang, 1300m. Gunong Terbakar (Spare 3330) (3360); Perak, Maxwell's Hill (Spare 2086, 2132).

Distribution: Hong Kong, Formosa, China, Thailand, Japan.

6. **Leucobryum bowringii** Mitt., Musc. Ind. or. (1859) 26.

Leucobryum angustifolium Wils., Jour. Bot. (Kew Gdns.) 9 (1854) 293.

Leucobryum stellatum Dix. ined.

Medium-sized species with a shining silky appearance, forming compact tufts. Leaves with a narrow elliptical base and long tubulose, acute upper part; 6×0.5 mm., lamina six to nine narrow, thick-walled elongated cells at base, becoming wider at widest part of leaf and denticulate towards tip; not auriculate; nerve heterostrosic above, sub-homostrosic below, chlorocysts hypocentric at base. Seta smooth, red shining, to 2 cm. long; capsule short, squat, strumose at base, striate. (Figure 9 (f), 10 (b)).

PHILIPPINES: widely distributed in Batan, Luzon, Sibuyan and Negros.

JAVA: Mt. Gedah, 1500m. (Fleischer 152).

SUMATRA: East Coast (Bartlett 7 La Rue 227).

MALAYA: Kedah, Kedah Peak (Spare 2779); Inchong Estate (Spare 2931); Perak, Hermitage Hill, 1000m. (Spare 2779); Pahang Sungei Bertam (Spare 3349); Malacca, Mt. Ophir (Ridley 724).

CELEBES: Bua Krang c. 2000m. (fide Cardot).

Distribution: China, Formosa, Japan, Ceylon.

6. (a) var. **sericeum** (Broth.) Dix., Annales Bryologicic 5 (1932) 25.

Leucobryum sericeum Broth., Bibl. Bot. (1898) 26.

Leucobryum louisiadum C. Mull. in Micholitz, M. Nov. Guin. no. 139.

Nerve homostrosic above, sub-homostrosic at base. Plant with a very shiny silky appearance. Leaves flexuse, upper half narrow linear, falcate; tip serrate. Lamina 4 cells wide; thin rectangular prosenchymatous cells. (Figure 9 (g)).

PHILIPPINES: widely distributed in Luzon and Bucas Grande Is. and Panay.

NEW GUINEA: Mt. Nok 500–700m., Waigen Is. (Cheesman 106); Tarrara, Warst Kussa River (Brass 8543, fide Bartram, Farlowia 1 (1943) 44); Milne Bay (Micholitz).

MALAYA: Pahang, Gunong Tahan 2000m. (Haniff et Nur 7973 A); Johore, Gunong Blumut (Holttum 10850).

SUMATRA: Slopes of Dolok Si Patsa-patsa, Tapianoeli (Bartlett 7810).

7. **Leucobryum cyathifolium** Dix., Jour. Linn. Soc. Bot. 45 (1922) 499.

A large robust species similar to *L. javense* in habit, 5–6 cm. high and loosely clothed with large spathulate to lingulate leaves. Individual cells iridescent when dry; whole plant pale green and weakly shining. Leaves 10×1.5 mm. or more, broadly obtuse with a conspicuous wide lamina of 4–8 cells wide; laminal cells rhomboid to rectangular, sometimes curved, internal walls with numerous pores. Nerve subhomostrosic; chlorocysts centric throughout whole leaf. (Figure 9 (e); 10 (e)).

NEW GUINEA: Mt. Durigale nr. Boku, Port Moresby District. (Clark no. 9, type).

MALAYA: Pahang, Gunong Jasar, rotting wood c. 2000m. (Spare 3519).

8. **Leucobryum stenophyllum** Besch., Fl. bryol. Nouv. Caled. (1873) 204.

Leucobryum microcarpum C. Muell. in Engl., Bot. Jahr. (1883) 85.

Leucobryum papuense Par., Ind. (1896) 752.

Leucobryum canocladum Besch. ined. (?), Brotherus in Engler & Prantl. 2 ed. 10 (1924) 224.

Small plants forming loose tufts 1–2 cm. high, densely covered with somewhat tufted leaves, thickly clothing stem; brown to pale green. Leaves small, upright to falcate, asymmetrical, ovate at base, 4×1; tip cucullate, somewhat rough, dentate; upper part of leaf tubular. Nerve strongly heterostrosic chlorocysts hypocentric at base, hypercentric above. Lamina 3 cells wide; walls somewhat thickened, smooth, not pitted. Seta 1.3 mm. high; capsule very small, inclined to pendulous, distinct apophysis, striated with an expanded mouth, 0.5—0.8×0.5 mm. (Figure 9 (j); 10 (c)).

9. **Leucobryum scalare** C. Muell., Micholitz, M. Philipp. no. 173.

Large thick cushion-shaped tufts about 15 cm. across and 1–4 cm. high. Stem much-branched, sometimes creeping with side branches (cf. Cladopodanthus), brittle. Leaves extremely falcate, usually all turned the same way, often in indistinct rows; shape long ovate, 3×0.7 mm. or slightly larger, concave; apex sharp, tubulose above, serrate, very rough dorsally, aften bent over. Lamina very narrow with two to four rows of cells. Nerve heterostrosic. Seta dark, 2–3 cm. long; capsule inclined, barely strumose, furrowed when dry. (Figure 9 (k)).

PHILIPPINES: Luzon, Mt. Balatmejan (Edano 79712); Benguet (Micholitz); Bangui (Sanchez 19) ;Camaguin de Mindanao Edano (14887).

JAVA: Tjibodas, 1450m. (Fleischer, Musci Arch. Ind. (1901)); Gedeh (Verdoorn 3153); Mt. Salak 610m. (Schiffner 10379); Tdjen Plateau 2000m. (Fleischer 569); Gedah, Tjibodas (Fleischer 568).

BORNEO: Rundum (Balter 220, 216, 214, 22).

MALAYA: Penang, Crag Hill (Binstead 16 and 18); Perak, Bukit Merak (Spare 1459); Hermitage Hill (Spare 2782); Pahang, Cameron Highlands (Spare 3430); Selangor Klang Gates Ridge 300m. (Johnson 303); Johore, Gunong Panti (Johnson 418).

Distribution: Thailand, Burma, Timor.

Leucobryum scalare var. **marchmeyeri fleisch,** Musci Fl. Buitenzorg ı (1900–1904) 144 and var **tjibodensis fleisch,** ibid 145 are not sufficiently distinct to warrant separation.

10. **Leucobryum chlorophyllosum** C. Muell., Syn. 11 535.

Syrrhopodon rigidum Duby (non Hook et Grev.) in System. Verz. d. Zoll. Pfl. 3370.

Thick compact matted tufts about 10 cm. across and 1–2 cm. high; stem sparingly branched and thickly leafed. Leaves upright, a little falcate, about 3×0.5–0.8 mm., narrow ovate with a narrow keeled tip; apex undulate at back and sub-denticulate at tip. Lamina three to seven rows of elongated cells; nerve heterostrosic with hypercentric chlorocysts. Seta red, 2 cm. long; capsule crooked, bent, striated when dry, with an expanded stomium; operculum with a long thin point. (Figure 9 (e)).

NEW GUINEA: Waigeu Is., 1000m. (Cheesman).

CELEBES: Sumbawa (Zollinger 3370, 3770, Warburg).

BORNEO: Rundum (Butler 221, 218).

SUMATRA: Asakan (Bartlett 7554).

MALAYA: Kedah, Somme Estate (Spare 3082); Gunong Bongsu (Spare 2769); Perak, Hermitage Hill (Spare 2769), Lembok Kluang (Spare 3641); Pahang, Cameron Highlands (Spare 3440); Gunong Tahan 1100m. (Robinson 5420).

11. **Leucobryum javense** (Brid.) Mitt., Musci Ind. or., J. Linn. Soc. 1 (1859) 25.

Sphagnum javanense P. Beauv., Prodom. (1805) 88.

Sphagnum javense Schwaegr. Suppl. 11 1 (1823) 4.

Leucobryum falcatum C. Muell. Syn. 1 79.

Large robust plants growing in loose tufts, 6–12 cm. high. Leaves crowded, falcato-secund, lanceolate, apiculate, wrinkled above, upper part hollow cucullate, 12×2 mm. Apex rough dorsally. Nerve heterostrosic above with centric chlorocysts. Lamina four to six row of narrow rectangular cells, outer row linear. Seta 2.5 cm.; capsule short-oblong, inclined, strumose, wrinkled when dry; operculum conic-rostrate. (Figure 9 (n)).

Widely distributed in Philippines, Borneo, Java, Sumatra and Malaya.

Also found in Laos.

12. **Leucobryum pulchrum** Broth. in Mitt., Int. für allg. Bot. (Hamburg) 11 (1928) 3.

Leucobryum sumatranum Broth. ex Dix., Annales Bryologici 5 (1932) 24.

Robust species, similar in habit to *Leucobryum javense* but often even larger, and much more attractive. Leaves loose, shining pale green, about 16×2.6 mm. with an ovate base and a long drawn out tubular upper part which forms three quarters of the total length. Lamina of about ten rows, eight being of arrow rectangular cells and one or two rows larger endohyalocysts. Nerve heterostrosic with chlorocysts becoming hypercentric near the leaf base. Seta about 3 cm. long. Capsule cylindrical, striate with a distinct red annulus. Operculum sharply pointed. (Figure 9 (q)).

Widely distributed in Sumatra, Borneo and Malaya.

13. **Leucobryum candidum** (Schw.) Hk. f. et Wils., Flora N. Zea. 11 (1855) 64.

Dicranum candidum Schw., Suppl. 187.

Leucobryum brachyphyllum Hampe., Linnaea 17 (1843) 317.

Leucobryum pentastichum Doz. et Molk., Bryol. Jav., (1855) 16.

Medium-sized glossy plants about 4 cm. tall. Leaves secund, usually arranged in five rows; baseovate with tubular upper part about one quarter length of leaf, or whole leaf somewhat triangular in form; lamina 4–5 rows of linear cells; size 5×0.8 mm.; tip blunt, scabrous. Nerve subhomostrosic to heterostrosic below.

Distributed in Philippines, Celebes, Borneo, Sarawak and Java; also in New Zealand and Australia.

13. (a) var. **pentastichum** Dix., N. Zea. Inst. Bull. 3 (1923) 95.

Leaves falcate, more or less triangular in shape with a curved tip; very concave at the base. Lamina four rows of thickened cells with distinct pores present.

Leucbryum pentastichum Doz. et Molk., Bryol. Jav. (1855) 16 1.

Leucobryum speirostichum C.M. ms. et nomen.

Leucobryum strictifolium Broth., Oefv. af Finska Vet. Soc. Foerh. 1 v (1898) 159.

Leucobryum Teysmannianum forma Doz. et Molk., Bryol. Jav. 1 17.

NEW GUINEA: Mt. Durigale, nr. Baku, Port Moresby (Clark 7); Main Range (Barton 839).

BORNEO: Penibukan, 1500m. (Clemens 40713b, fide Bartram).

14. **Leucobryum microleucophanoides** Dix. ex Johnson, sp. nov.

Species parva dense caespitosa circa 1 cm. alta, 3 cm. lata, glaucoviride, vix nitida. Folia erecta, non falcata, fere rigida, minuta, circa 2.5 mm. longa, 0.25 mm. lata, triangulo-ovata; apex acuminatus, multi-capillatus. Lamina angusta; marginis cellulae 2-seriatis; externae sub-rectangularae, inflatae; internae lineari-rectangularae. Costa inferna subhomostrostica; superna homostrosica. Fructus ignota.

Small plant forming tight matted tufts just over 1 cm. high and about 3 cm. across, dull whitish-green colour, not much shining. Leaves upright, not falcate and rather stiff, very small about 2.5×0.25 mm., triangularovate with a point pointed tip which usually bears numerous rhizoids. Lamina narrow, consisting of two rows of cells, outer row sub-rectangular and inflated, inner row linear-rectangular. Walls thin, without pores. Nerve subhomostrosic below, homostrosic above. Fruit unknown. (Figure 9 (m), 12).

MALAYA: Kedah, Inchang Estate (Spare 2941) (TYPE); Gunong Bongsu Forest Reserve (Spare 3048, 3070); Perak, Jungle stump 500 m., Hermitage Hill (Spare 2760, 2716); Lembok Kluang (Spare 3642).

15. **Leucobryum byssaceum** C. Muell. ex Johnson sp. nov.

Species minutissima, argento-glauca; caulis circa 4 mm. altus; Folia anguste-falcata, circa 3 mm. longa, 0.25 mm. lata; marginibus gracilo undulatis involutis ad basin. Marginis cellulae 4-seriatis; 2-externae perlongae angustaeque; 2-internae rectangularae. Costa homostrosica; chlorocystae hypercentricae.

Minute plants about 4 mm. high of a silvery grey colour. Leaves long, falcate, tufted, about 3 × 0.25 mm.; margin slightly undulate and inrolled right to base of leaf. Lamina four cells wide, two outer narrow linear, two inner rectangular. Nerve homostrosic throughout whole leaf with strongly hypercentric chlorocysts. (Figure 8 (c), 9 (h)).

NEW GUINEA: Mt. Mo-roka 1300 m. (Mueller 703) (TYPE in BRITISH MUSEUM).

Tribe Leucophaneae

Nerve with a central stereid band (pseudo-nerve). Chlorocysts quadrangular in section, forming a single layer over whole length of nerve, and situated at the junction of four leucocysts.

5. **Leucophanes** Hampe. in Flora (1837) 282.

Slender plants in thick whitish shining tufts. Leaves erect-spreading, lanceolate to linear with a central pseudo-nerve of thickened stereid cells. Nerve homostrosic or heterostrosic, often papillose at the tip. Lamina variable and often unequal. Border distinct formed of very wide, sclerified and pluristratified cells in the upper part of the leaf. Seta terminal or lateral; capsule upright, cylindrical, shining, longitudinal streaks often present; peristome teeth sixteen, linear-lanceolate, undivided, somewhat papillose; calyptra cucullate, entire.

Distribution: Tropical.

Key to Leucophanes species.

1. Large plants to 6 cm. high .... 2.
1. Small plants less than 3 cm. high .... 3.
2. Leaves keeled, at least in the upper part of the leaf .... 4.
2. Leaves not keeled, flat to slightly concave, falcate
5. *Leucophanes naumannii.*
3. Fine leaved plants; golden yellow-green in colour, leaves drawn out to a long serrate point .... 4. *Leucophanes sordidum.*
3. Leaves linear-lanceolate; whitish green in colour, not drawn out into a long serrate tip, gemmae may be present
3. *Leucophanes octoblepharoides.*
4. Homostrosic; border extends to apex .... 1. *Leucophanes candidum.*
4. Heterostrosic; border only in basal half of leaf
2. *Leucophanes albescens.*

1. **Leucophanes candidum** (Hornsch.) Linb., Oefv Vet. Akad. Forh. (1864) 602.

Syrrhopodon candidus Hornsch., Nov. Act. Acad. Leopold. 14 (1826) 701.

Leucophanes reinwardtianum C. Muell., Syn. 1 (1849) 82.

Octoblepharum squarrosum Mitt., Voyag. of Challeng. Admir. Is. 258.

Large conspicuous brownish-green compact tufts to 18 cm. across and 6 cm. high. Leaves crowded, erect, wide-spreading, ovate-lanceolate, about 3.5 × 0.3 mm., strongly keeled in upper two third of leaf and sharply apiculate; bordered throughout with narrow band of incrassate cells, 3–4 rows wide; nerve homostrosic, with median band of stereid cells, smooth dorsally. Seta 0.8–1 cm. long; slender; capsule erect, cylindrical, warm brown with darker base when ripe; shining; slightly and obliquely striate; operculum rostrate bearing a long hair point, nearly as long as the urn; calyptra cucullate. (Figure 13 (a), 14 (d).

Widely distributed in Philippines, New Guinea, Borneo, Sarawak, Sumatra, Java and Malaya. Also in Ceylon, Thailand, Fiji and Samoa.

1 (a) Var. **densifolium** (Mitt.) Dix., Ann. Bryol. 7 (1934) 23.

Leucophanes densifolium Mitt., Bonplandia (1861) 206.

Octoblepharum densifolium Mitt., Fl. Vit. 387.

Leucobryum candidum var. *aciculare* C. Muell. ined., Dix., Jour. Linn. Soc. Bot. 1 (1935) 76.

Didymodon sphagnoides Hook., C. Muell. im Linnaea 17 (1843) 317, 322.

Didymodon sphagnifolius Hook., Arnott in Nouv. Disp. Meth. (1825) 35.

Arthrocormus hookeri Hpe. Bot. Zeit. (1947) 922.

Syrrhopodon glaucus Schwaeg., Suppl. 2 (1827) 2 tab. 181.

Leucophanes pugioniforme Fleisch. ined., Dixon, Gdns. Bull. 4 (1926) 8.

Leucophanes aciculae C. Muell., ined. Dixon, Gdns. Bull. 4 (1926) 8.

Leucophanes fusculum C. Muell. ined.

Leaves very crowded and adhering together at base. Long excurrent tip. Margin often serrate and sometimes keeled over entire length. (Figure 13 (b)).

Widely distributed in Celebes, Sarawak, Malaya and Indonesian Islands. Also found in Admiralty Islands and Fiji.

2. **Leucophanes albescens** C. Muell., Bot, Zeit. (1864) 347.

Medium sized forming loose tufts to 6 cm. high. Leaves crowded above, erect-spreading, linear-lanceolate, about 2.5–5.0 × 0.2–0.5 mm., keeled over the whole length, undulate when dry; apex serrate, teeth sometimes in pairs; nerve with median stereid cells minutely spinulose, heterostrosic, chlorocysts mainly hypercentric. Border extending to half way up leaf consisting of three to five rows of rectangular cells at base, disappearing above. Figure 13 (c)).

PHILIPPINES: Luzon, Polillo, Mindanao (Phil. J. Sc. 68 (1939) 72).

CELEBES: Herb. Hampe. (1881), Herb. Besch. (1900).

BORNEO: Sekang, decayed wood (Binstead 73, 74); Sandakan, on tree (Binstead 24).

SARAWAK: Mt. Mulu (Hose 3).

MALAYA: Kedah, Pulau Langkawi (Holttum 17478); Trengganu, on bamboo stump in Kampong, Kuala Trengganu (Holttum 15188); Perak, Kampong Tjok (Spare 3216); Sungei Krian Estate (Spare 2524); Singapore, Pulau Ubin (Fleischer, March 1898).

Distribution: Thailand.

3. **Leucophanes octoblepharoides** Brid., Bryol. Univ. 1 (1826) 763.

Syrrohopodon octoblepharoides Nees., Schwaegr., Suppl. 4 t 311a.

Octoblepharum octoblepharoides Mitt., Voy. Chall. Bot. 111 259.

Leucophanes glaucescens C. Muell., Fleisch., Musci Fl. Buitenzorg 1 (1900–1904) 178.

Leucophanes massartii Ren. et Card., Rev. Bryol. (1896) 99.

Leucophanes minutum C. Muell., Geh. Neue Beitr. z. Moosfl. v. Neu Guin. 2.

Slender delicate plants forming short flattened loose tufts to 2.5 cm. high; leaves flat to shallowly concave above, linear-lanceolate, about 5 × 0.5 mm., spreading, sometimes slightly expanded at base; border 4–5 cells wide consisting of short thick-walled rectangular cells about 25u wide, continuing to apex, serrulate above, teeth single; apex usually flat, sometimes rounded and expanded and bearing long gemmae; leaf bases quite separate from one another. Nerve heterostrosic below, homostrosic above, chlorocysts usually hypocentric. Seta 4 cm. long, rough, brown; capsule upright, cylindrical, warm-brown when ripe; operculum conical. (Figure 13 (a), 14).

Widely distributed in Philippines, Celebes, Borneo, Sarawak, Sumatra and Malaya. Also in India, Ceylon and Thailand.

3. (a) var. **korthalsii**, Fl. Musci Buitenzorg 1 (1900–1904) 176.

Leucophanes korthalsii Doz. et Molk., M. Frond. ined Archip. Ind. 1846–65.

Small plants to 1.5 cm. high. Leaves more lanceolate and sharply keeled, hyaline teeth on the dorsal side of the leaf-tip.

JAVA: Buitenzorg (Kurz). Distributed in West Java, Sumatra, New Guinea and Admiralty Islands.

4. **Leucophanes sordidum** C. Muell., in Engler, Bot. Jahrb. (1883) 83.

Fine plants with branched stems about 1.2 cm. high, golden yellow-green in colour. Leaves very fine and densely clothing stem, about 3 × 0.6, upper part long drawn out and serrate; base ovate, lamina almost obsolete; upper part of leaf keeled. Nerve heterostrosic, leucocysts rather thick-walled with conspicuous pores. (Figure 13 (e)).

NEW GUINEA: Poddy Ins. (Karistock 1888); without locality (Naumann 1878).

5. **Leucophanes naumannii** C. Muell., Engler, Bot. Jahrb. (1883) 83.

Large plant similar to *Leucophanes candidum* in habit, 5 cm. high. Leaves erect-spreading, lanceolate, falcate, about 4 × 0.5. Border two cells thick with thickened walls. Nerve heterostrosic with rectangular leucocysts. (Figure 13 (f)).

Confined to New Guinea.

Tribe Octoblephareae

Nerve without central stereid band. Chlorocysts in a single layer throughout the whole length of the nerve; triangular in section in the upper part of the nerve, being placed at the junction of three leucocysts.

6. **Octoblepharum** Hedw., Musc. Frond. 111 (1792) 15.

Sturdy plants forming thick, low, greenish-white to reddish cushions. Leaves erect-ascending with an ovate base and lingulate upper part; very rigid. Nerve heterostrosic with many layers of leucocysts (three to seven at the base; six to eleven in the mid-region and two to four above). True lamina wide at the base, often unequal, disappearing before the tip. Border absent. Seta terminal; capsule upright, regular, oval to cylindrical in shape, peristome teeth eight, each with a median line or sixteen arranged in pairs and without a median line, very rigid; calyptra cucullate, entire.

Distribution: tropical.

1. **Octoblepharum albidum** Hedw., Sp. Musc. (1801) 50.

Octoblepharum cuspidatum C. Muell., Forschunsreise Bot. 57 (nomen), Bartram, Phil. J. Sc. 68 73.

Small to medium sized fragile thick-leaved plants, whitish in colour, slightly iridescent when dry, forming compact cushion-like tufts on soil and on tree trunks. Leaves widely spreading or recurved, oblong to narrow obovate, with rounded apiculate apex. Apical rhizoids may be present. Nerve broad thick, occupying about half the width of the leaf base and three quarters of the upper part, in transverse section showing a single layer of chlorocysts with several layers of leucocysts on dorsal and ventral sides. Lamina cells rectangular, about 30u wide, narrower at the margins. Seta 2–3 mm. high; capsule erect, oblong, ovoid; urn 1.5 mm. long; peristome teeth golden colour, eight in number, well spaced from one another; operculum shorter than the urn.

According to Fleischer (1900–1904) this species exists in three forms: (1) *compactor strictor*, (2) *foliis patentibus, demum recurvatis*, (3) *laxior foliis majoribus violaceis*. In the first form the leaves are longer, upright and very densely packed together; while in the second they tend to be shorter, broader, more rounded at the tip and recurved. Some indication of the distribution of the first two forms is given below. It has not been possible to examine specimens of the third form. (Figure 15).

f. compactor strictor

PHILIPPINES: Prov. Sorsogen, Mt Bulusan (Elmer 16473); Luzon, Trosin (Elmer 6673).

NEW GUINEA: Papua Kariosia, low down on tree trunks, sea level (Carr 11478).

BORNEO: Kaung 325 m. near office, downstream on shady side of huge boulder (Dainton 350).

SUMATRA: Tanang Toloe

JAVA: (Hallier 722); Belanger (Herb. E. Bescherelle); Surinam (Herb. Hampe) Buitenzorg 250 m. (Baung 10417); 260 m. (Schiffner 10424).

MALAYA: Gua Panjang, Gua Ninik.

f. foliis patentibus demum recurvatis

PHILIPPINES: (Cumming 2211); Dumaguete, Prov. Negros, Is. of Negros (Elmer 10035) (further records see Bartram, Phil. J. Sc. 68, 73).

BORNEO: Sekong, decayed log in the shade (Binstead 69).

JAVA: Buitenzorg (Herb. Hampe); Bogor 300 m. (Kurz 90) (Herb. R. J. Shuttleworth).

MALAYA: Perlis, Telor Jambu (Ridley 245); Penang, The Crag 800 m. (Burkill 747); Head of Waterfall Gardens 100 m. (Burkill 6568); Singapore (Wallich in Herb. Musc. W. Wilson).

Distribution: Cosmopolitan at low altitudes in the tropics although it has been found at 2,000 m. at Kurseong, Sikkim, Himalaya and on oak bark, Beninag-Thall, Kumaon 1,100 m. and Arun Valley, Nepal 2,700 m. (Stanton 1448a). Further distributed in Africa, South America, West Indies, Florida, Mexico, Central America, India, Burma, Queensland and Pacific Islands.

Tribe Arthrocormeae

Nerve without a central stereid band. Chlorocysts irregular with 3, 4, 5, 6 or 7 angles and arranged in three layers at least in the upper part of the nerve.

7. **Arthrocormus** Doz. et Molk., Musc. ined. Arch. Ind. (1845–48) 75.

Slender plants forming thick, whitish shining tufts of considerable diameter; or individual plants found mixed in tufts of other mosses. Leaves arranged strictly in three rows which describe loose spiral round the stem; very brittle and rarely found complete. Nerve heterostrosic with numerous layers of leucocysts (three to five at base; seven to ten at tip). Chlorocysts in a single layer at the base of the leaf; in two layers in the middle part; three above; never exposed (cf. Exodictyon). True lamina wide at the base, disappearing towards the tip. Border more or less distinct, forming a unistratified layer of wide cells. Seta terminal or lateral; capsule exerted, upright, long cylindrical; peristome teeth sixteen, very short and stumpy, arranged in pairs, transversely barred and with large warty papillae. Calyptra cucullate, entire.

1. **Arthrocormus schimperi** Doz. et Molk., Musc. fron ined. Arch. Ind. (1845–48) 76.

Miehlichhoferia schimperi Doz. et Molk., Ann. des Sc. Nat. 2 (1844) 312.

Leucophanes trifarum Hampe ms.

Leucophanes squarrosum Brid., Bryol univ. 1764.

Slender rigid fragile plants sometimes found individually mixed with other plants and sometimes forming immense tufts 2–4 cm. high. Leaves crowded, erect-spreading, very rigid, in three distinct rows which may have a spiral twist, linear, concave, hyaline at the base, usually broken off about half-way down, very convex dorsally. Chlorocysts arranged in three rows about but never exposed. Hyaline lamina cells occupying two-third of leaf base. Seta slender, erect; capsule cylindrical, erect; peristome teeth, short, blunt, papillose, arranged in pairs; operculum conical-rostrate; calyptra cucullate, entire at base. (Figure 16).

Widely distributed in Philippines, New Guinea, Borneo, Sarawak, and Malaya. Also in Queensland, Ceylon, Krakatao, Thailand, New Hebrides and Admiralty Islands.

8. **Exodictyon** Card., Rev., Bryol. (1899) 6.

Slender plants forming thick pale green to whitish, lustreless tufts. Stems upright with numerous rhizoids arising from the leaf axils. Leaves erect-ascending with a sheathing base and a long narrow lanceolate or linear upper portion. Nerve heterostrosic with numerous layers of leucocysts (four to eight). Chlorocysts in three layers, the central layer being formed of cells with 4, 5, 6 or 7 angles; the dorsal and ventral layers being exposed. Seta terminal or lateral. Capsule upright, regular, small. Peristome teeth narrow, lanceolate, sixteen, undivided. Calyptra cucullate entire.

Distribution: Ceylon, Malaysia and Pacific Islands.

1. **Exodictyon sullivanti** (Doz. et Molk.) Fleisch.

Syrrhopodon sullivanti Doz. et Molk., Bryol. Jav. 1 (1856) t. 47.

Octoblepharum hispidulum Mitt., J. Linn. Soc. 10 (1869) 178.

Leucophanes hispidulum C. Muell., Musc. Polynes. (1875) 57.

Syrrhopodon hispidulus Card., Annal. Jard. Bot. Buitenzorg 1 Suppl. (1897) 6.

Trachynotus hispidulus Card., in Sched., Fleisch., Fleisch., Musci Fl. Buitenzorg 1 (1900–1904) 192.

Exodictyon hispidulum Card., Revue Bryol. (1899) 7.

Small plants in loose tufts with conspicuous white leaf-bases, very similar to Syrrhopodon in habit. Leaves about 2 mm. long, linear upper portion with clasping base, apiculate apex and spinulose, hispid margins. Hyaline lamina extends nearly to apex. Seta 5 mm. long, slender, orange; capsule upright, cylindrical, orange with a purplish-brown mouth, faintly striate. (Figure 17).

PHILIPPINES: Luzon, Tayabas Prov., Dimasingay, Baler (Santos 355).

JAVA: Mt. Salak 900 m. (Schiffner 39), in forest Tjibodas (Massart (1898)).

MALAYA: Perak, Gunong Semanggol on rotten wood 200–400 m. (Spare 1726, 1729).

2. **Exodictyon blumii** (C. Muell.) Fleisch., Laubfl. Java 1 (1900–1902) 188.

Slender tufted plants with widely spreading leaves which are long and curved, up to 4 × 0.15 mm. and usually folded over entire length when dry. Nerve spinuolose on both sides to half way up leaf. (Figure 18).

Sidely distributed in the Philippines, Borneo, Java and Malaya.

TAXONOMY AND DISTRIBUTION

1. **Ochrobryum**

This genus is probably not found in Malaysia.

2. **Schistomitrium**

Ten species of *Schistomitrium* occur in Malaysia, two of which have not been described before. *Schistomitrium strictifolium* Dix. *ined.* (ms. British Museum) is not a distinct species but simply a longer thinner version of *Sch. apiculatum.* Bartram (1939) considers *Sch. copelandii* is a variety of *Sch. apiculatum.*

—	Philippines	New Guinea	Borneo and Sarawak	Sumatra	Java	Malaya	—
1. Sch. robostum	x	—	x	—	x	—	
2. Sch. subrobustum ...	x	—	—	—	—	—	Endemic to Philippines.
3. Sch. lowii ...	—	—	x	—	—	—	Endemic to Borneo.
4. Sch. niewenhuisii ...	x	x	x	—	—	x	
5. Sch. apiculatum ...	x	—	x	x	x	x	
var. copelandii	x	—	x	—	—	x	
6. Sch. mucronifolium ...	—	—	—	—	x	x	
7. Sch. mucronatum sp. nov.	—	x	—	—	—	—	Endemic to New Guinea.
8. Sch. breviapiculatum ...	—	x	—	—	—	—	Endemic to New Guinea.
9. Sch. sparei sp. nov. ...	—	—	—	—	—	x	Endemic to Malaya.
10. Sch. heterophyllum* ...	—	x	—	—	—	—	Endemic to New Guinea.

*I have been unable to examine this species.

3. Cladopodanthus

There are four species of *Cladopodanthus* in Malaysia, the distribution of which is shown below.

—	Philippines	New Guinea	Borneo and Sarawak	Sumatra	Java	Malaya	Celebes	—
1. C. pilifer ...	—	—	x	—	x	x	—	
var. acuminatus	—	—	—	—	x	—	—	
2. C. speciosus ...	x	—	x	—	x	—	x	
3. C. muticus ...	x	—	x	—	—	—	—	
4. C. microcarpus	—	—	x	—	—	—	—	Endemic to Sarawak.

Cladopodanthus microcarpus resembles *Schistomitrium* in its spreading leaves and external form. But its calyptra is of the typical Cladopodanthus type, cucullate and without fimbriate hairs.

4. **Leucobryum**

There are at least fifteen species of *Leucobryum* in Malaysia. There has been a superfluity of new species proposed for this genus and it has been found necessary to submerge several where the features shown were not sufficiently distinct to warrant specific separation. It has been found necessary to describe two new species used in manuscript by Dixon and Mueller. In the table below nine of the fifteen species found outside Malaysia are indicated(*).

—	Philippines	New Guinea	Borneo and Sarawak	Sumatra	Java	Malaya	Celebes	—
1. L. sanctum* ...	x	x	x	x	x	x	x	Found in from Nepal to Samoa.
2. L. subsanctum	x	x	—	—	—	x	—	
3. L. neilgherrense* ...	x	—	x	—	x	x	x	Found in Ceylon, Tientsin, Japan and Korea.
4. L. aduncum*	x	—	x	x	x	x	—	Found in Ceylon, New Hebrides, Thailand and Hong Kong.
5. L. scabrum* ...	—	—	—	—	—	x	—	Found in Hong Kong, China, Formosa, Thailand and Japan.
6. L. bowringii*	x	—	—	x	x	x	x	Found in China, Formosa, Japan and Ceylon.
(*a*) var sericeum	x	x	—	x	—	x	—	
7. L. cyathifolium	—	x	—	—	—	—	x	
8. L. stenophyllum ...	—	x	x	—	—	—	—	
9. L. scalare* ...	x	—	x	—	x	—	x	Found in Thailand, Burma and Timor.
10. L. chorophyllosum* ...	—	x	x	x	x	x	x	Found in Ceylon, Sumbawa, and Timor.
11. L. javense* ...	x	—	x	x	x	x	x	Found in Laos.
12. L. pulchrum ...	—	—	x	x	—	—	x	
13. L. candidum*	x	—	x	—	x	—	x	Found in New Zealand, and Australia.
var. pentastichum ...	—	x	x	—	—	—	—	
14. L. microleucophanoides sp. nev. ...	—	—	—	—	—	x	—	Endemic to Malaya.
15. L. byssaceum sp. nov. ...	—	x	—	—	—	—	—	Endemic to New Guinea.

5. Leucophanes

The various species described from Malaysia have been reduced to five. *Leucophanes densifolium* Mitt. is regarded as a variety of *Leucophanes candidum* (Hansch.) Linb. This variety has been referred to under many synonyms. It is not considered that *Leucophanes aciculare* C. Muell. and *Leucophanes pugioneforme* Fleisch. are distinct species. Further, no distinction is made of *Leucophanes massattii* and *Leucophanes minutum* which are considered to belong to *Leucophanes octoblepharoides*.

—	Philippines	New Guinea	Borneo and Sarawak	Sumatra	Java	Malaya	Celebes	—
1. Leucophanes candidum* ...	x	x	x	x	x	x	—	Found in Ceylon, Thailand, Fiji and Samoa.
var. densifolium ...	—	—	x	x	x	x	x	
2. Leucophanes albescens ...	x	x	x	—	—	x	x	Found in Thailand.
3. Leucophanes octoblepharoides ...	x	x	x	x	x	x	x	Found in India, Ceylon, Thailand.
4. Leucophanes sordicum ...	—	x	—	—	—	—	—	Endemic to New Guinea.
5. Leucophanes naumanni ...	—	x	—	—	—	—	—	Endemic to New Guinea.

6. Octoblepharum

Octoblepharum albidum is a cosmopolitan species, usually found at low altitudes in the tropics, although it has been found at 2,000m. in the Himalayas and on oak bark in Nepal at 2,500m. It is found throughout Malaysia, in Africa, S. America, West Indies, Central America, Burma, India, Queensland and the Pacific Islands. The soft form, previously called *O. cuspidatum*, is considered by Bartram to be inseparable from *O. albidum*, of which it is probably a shade form.

7. Arthrocormus

Arthrocormus schimperi is widely distributed through Malaysia and is also found in Ceylon, Queensland, Krakatao, Siam, New Hebrides and the Admiralty Islands.

8. **Exodictyon**

Exodictyon sullivantii is found in the Philippines, Java and Malaya; while *Exodictyon blumii* is found in the Philippines, Borneo, Java, Malaya and also in India and Pacific Islands.

Other species recorded from Malaysia include *E. subdentatum* (Broth.) Card.; *E. arthrocromoides* (C. Muell). Card., *E. giulanetti* Broth. and *E. subscabrum* (Broth.) Card. None of these appear to be common.

PHYLOGENY

Owing to the pronounced cellular dimorphism of the anatomical elements of their leaves, the Leucobryaceae were compared with *Sphagnum*. There are, however, several important differences:— (a) the leaves of *Sphagnum* are uniformally one cell thick, the hyaline cells and chlorocysts being arranged in a net-work, not in layers as in the Leucobryaceae; (b) these cells have an entirely different origin in the two groups; (c) the structure of the hyaline cells of *Sphagnum* differs from that of leucocysts in several particulars. In *Sphagnum* the hyaline cells usually have annular or spiral false partitions, and their walls are perforated by specially constructed pores with raised borders. In the Leucobryaceae the leucocysts are simply dead thin-walled cells with simple pores formed by resorption of the cell-wall. A comparison of the mode of branching, the anatomy of the stem and the features of the sporophyte show there is very little true relationship between these two groups of plants.

Leucobryum is the only genus found in Europe and North America. Its manner of growth, branching, falcate leaves and dicranoid peristome is very similar in organization to *Dicranum*. However in the majority of species of *Dicranum* the nerve is devoid of chloroplasts consisting of two layers of stereid cells separated by a median arc of colourless *eurycists*. The cells of the lamina are green. However in three species of *Dicranum* the structure of the nerve has been compared with that of *Leucobryum*. In *Dicranum albicans* the nerve is three-layered consisting of a dorsal and a ventral layer of empty hyaline cells, and between these a layer of green chlorocysts. These chlorocysts are not situated at the points of junction of the empty cells but form a continuous layer. This type of anatomical organisation has also been found at the extreme base of the leaf in some species of Leucobryum. *Dicranum longifolium* and *D. sauteri* have a similar organisation but there is some tangential division of the colourless cells on the dorsal side. The true lamina is also much wider in these species, and like all *Dicranum* spp. is, of course, green.

In other Dicranaceae e.g. *Campylopus leanus* and *Brothera japonica,* there are two layers of empty hyaline cells and between these there is an admixture of non-chlorophyll containing cells plus scattered stereids. The true lamina is green but very narrow.

In many Calymperaceae and Syrrhopodontaceae the lower portion of the lamina (sheath) consists of colourless cells. In *Leucophanella* the lamina is almost entirely formed of hyaline cells the green portion consisting of only two rows of square cells above. It is very difficult to distinguish members of this genus from *Leucophanes* once they have been dried. In *Syrrhopodon tristichus* the nerve has three layers of chlorocysts surrounded by stereids. The lower lamina is colourless. *Syrrhopodon* and *Exodictyon* approach one another in their leaf form.

According to Andrews (1947) the genus *Leucobryum* should be included in the Dicranaceae. Its sporophyte, calyptra, capsule and peristome are typically dicranoid. Its peculiar leaf is regarded as specialisation of the nerve only, further development of the complicated nerve met in *Paraleucobryum, Brothera* and *Gampylopus.*

The tropical Leucobryaceae, apart from *Leucobryum,* are not a bit like *Dicranum.* Their sporophyte, calyptra and peristome are variable, and the latter is not truly dicranoid in any other genus. The Leucobryaceae are very distinct from the Dicranaceae in a number of important particulars, not least of these being that the lamina in the former consists of colourless dead cells, while in the latter they are always green. *Leucophanes* and *Exodictyon* are very similar to the Syrrhopodontaceae. Encroachment of the colourless sheath to include all the lamina would result in a transition from the Syrrhopodon type to the Leucophanes/ Exodictyon type. The single row of papillose peristome teeth are shared by these genera and Syrrhopodon.

References

ANDREWS, A. LEROY (1947) Taxonomic Notes VI. The Leucobryaceae. *Bryologist* 50 319–326.

BROTHERUS, V. F. (1924) in Engler and Prantl, *Nat. Pfl.*

CARDOT, J. (1899) Recherches Anatomiques sur les Leucobryaceae. *Mem. Soc. Nat. Sc. Math.,* Cherbourg, 32, 1–84.

DE NOTARIS, G. (1869) *Epilogo* 285.

DILLENIUS, J. J. (1719) *Cat. Giss.* 225.

DIXON, H. N. (1926) At List of Mosses of the Malay Peninsula. *Gardens Bull.* (Straits Settlements) 4, 1–46.

DOODY, A. (1696) in Ray's *Synops. strip. Brit.* 2 ed. 339.

HAMPE, E. (1837) *Regensb. Bot. Zeit.* 1, 282.

HEDWIG, J. (1801) *Species Muscorum* 135.

LINNAEUS, C. (1753) *Species Plantarum* 2. 1118.

MUELLER. C. (1843) *Linnaea* 687.

WILLIAMS, A. (1931) in Gleason, H. A., *Bull. Torr. Bot. Club* 58, 277–506.

VAN DER WIJK, R. (1958) Precursory studies on Malaysian Mosses II. A Preliminary Key to the Moss Genera. *Blumea* 9, 143–186.

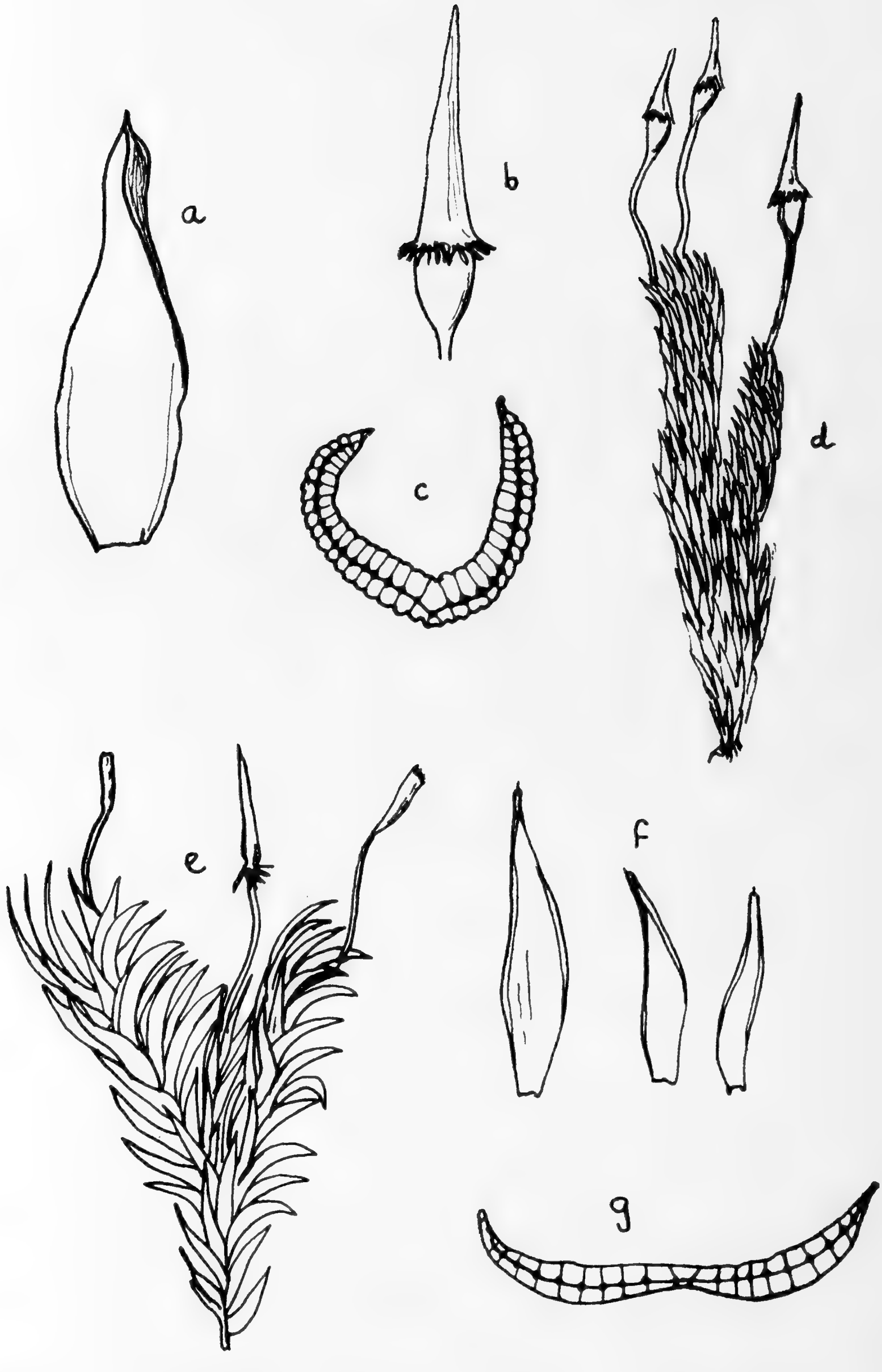


Figure 1. *Schistomitrium robustum* (*a*) *leaf* (x 7) (*b*) capsule (x 5) (*c*) t.s leaf (x 30) (*d*) whole plant (x 1).

Schistomitrium mucronifolium (*e*) whole plant (x 1.5); (*f*) leaves (x 6) (*g*) t.s. leaf (x 50).

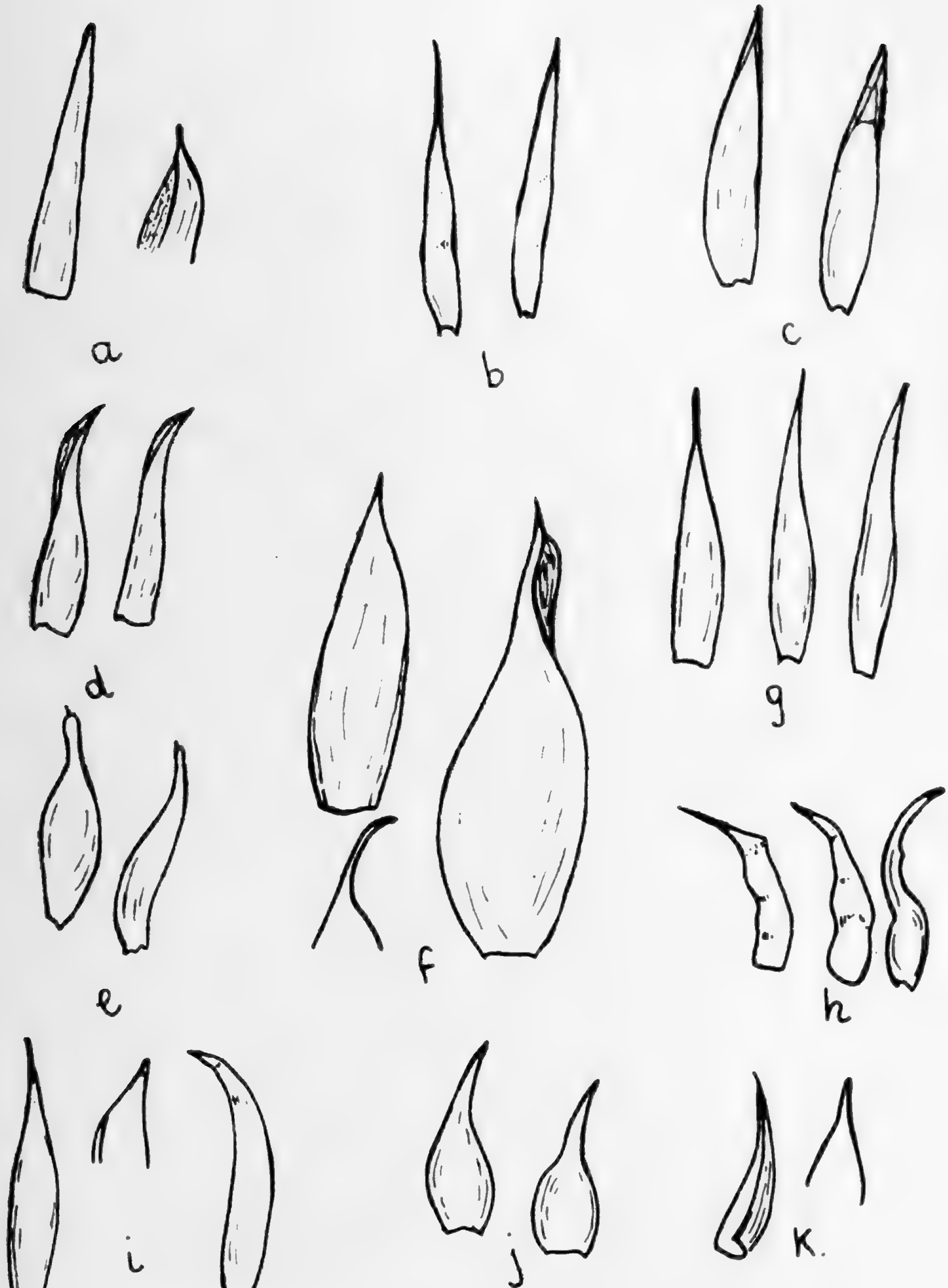


Figure 2. *Schistomitrium species* (x 7).

(*a*) Sch. niewenhuisii.

(*b*) Sch. apiculatum var. copelandii (*f*.).

(*c*) Sch. subrobustum.

(*d*) Sch. lowii.

(*e*) Sch. mucronifolium.

(*f*) Sch. robustum.

(*g*) Sch. apiculatum var. copelandii.

(*h*) Schistomitrium apiculatum.

(*i*) Sch. sparei.

(*j*) Sch. breviapiculatum.

(*k*) Sch. mucronatum.

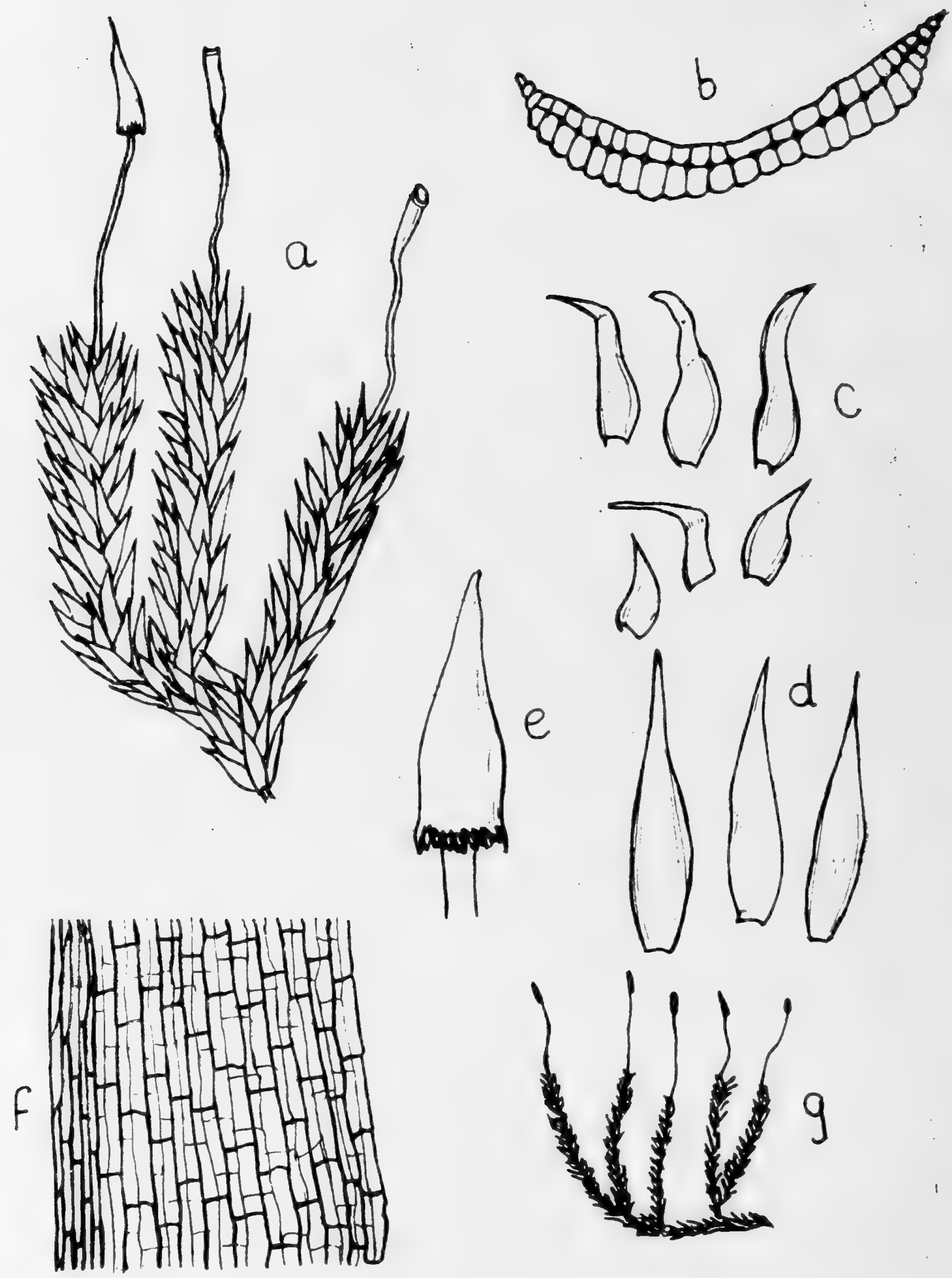


Figure 3. *Schistomitrium apiculatum.*

(*a*) whole plant (x 2.5).
(*b*) transverse section of the leaf (x 100).
(*c*) leaves (x 7).
(*d*) var. copelandii leaves (x 7).
(*e*) capsule (x 7).
(*f*) leaf border (x 100).
(*g*) habit (x 1).

Figure 4. Schistomitrium niewenhuisii, transverse section of leaf (x 100).

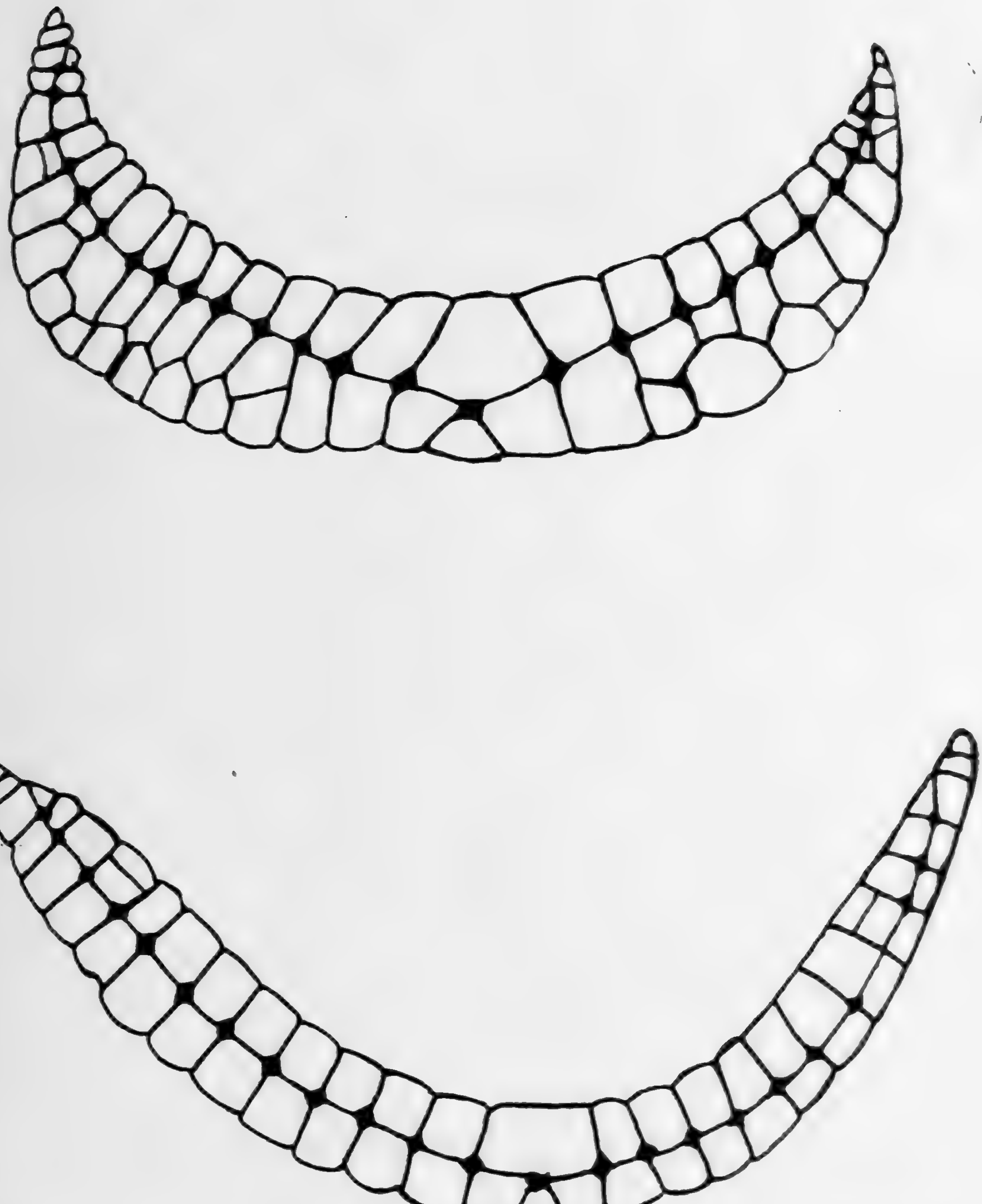


Figure 5. (above) Schistomitrium breviapiculatum; (below) S. mucronatum transverse sections of leaves (x 100).

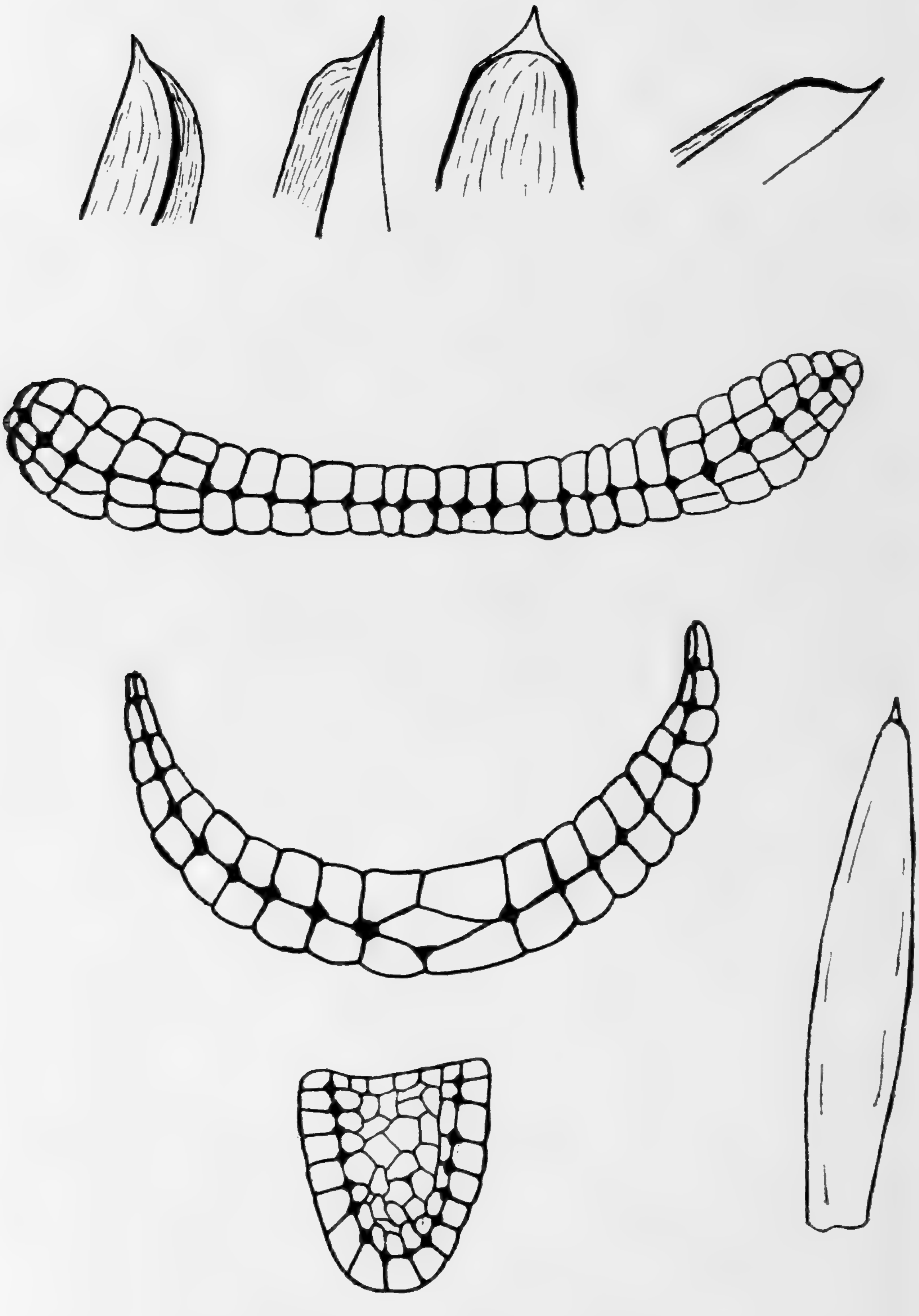


Figure 6. Schistomitrium sparei (above) details of apex (x 20); transverse section of base and of mid-leaf (x 125); (right) whole leaf (x 10).

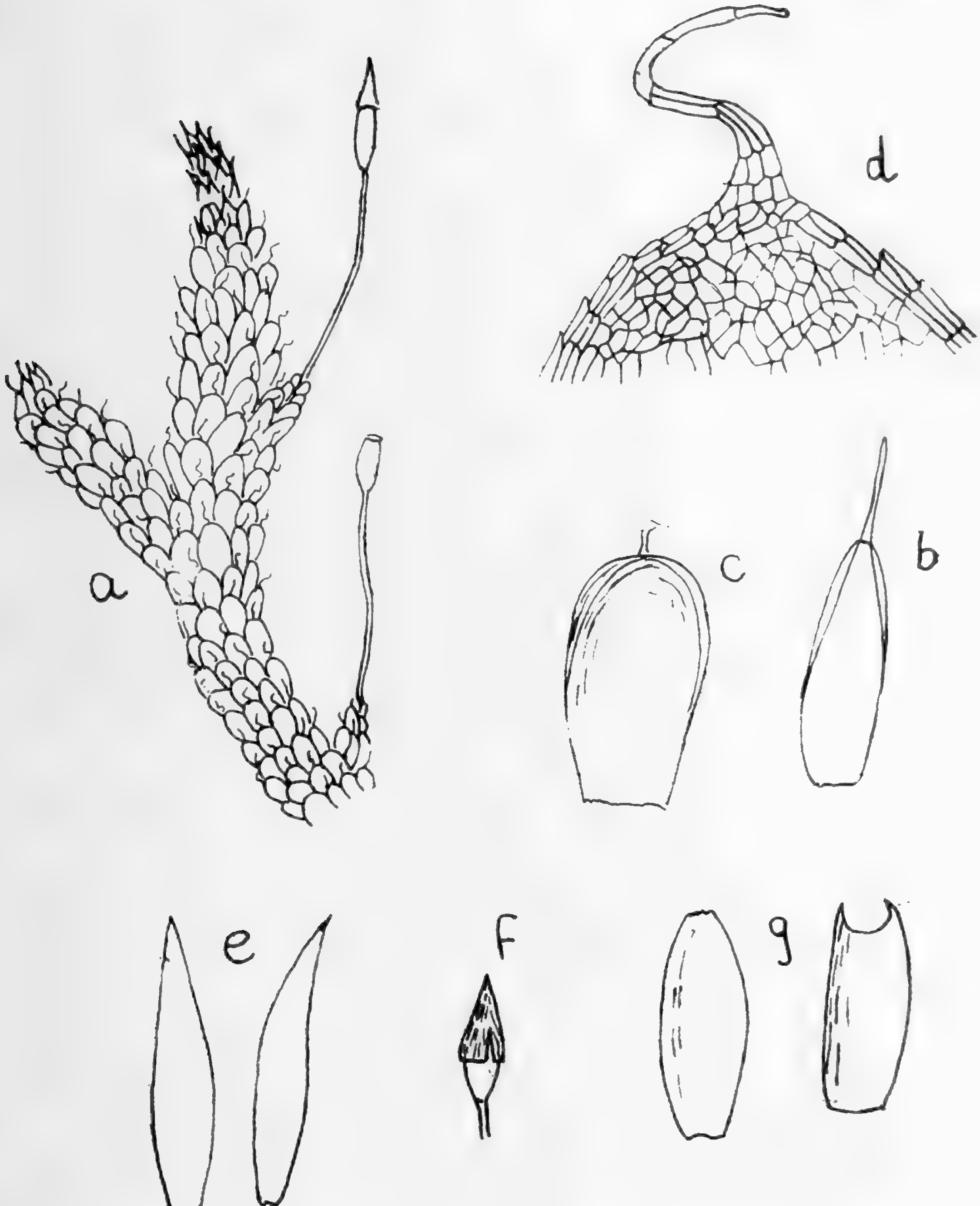


Figure 7. (*a*) Cladopodanthus pilifer branch (x 1.5), (*b*) var. acuminatus leaf (x 12), (*c*) Cladopodanthus speciosus leaf (x 12), (*d*) detail of apex of (*c*) (x 50), (*e*) Cladopodanthus microcarpus leaf (x 12), (*f*) capsule (x 1.5), (*g*) C. muticus (x 12).

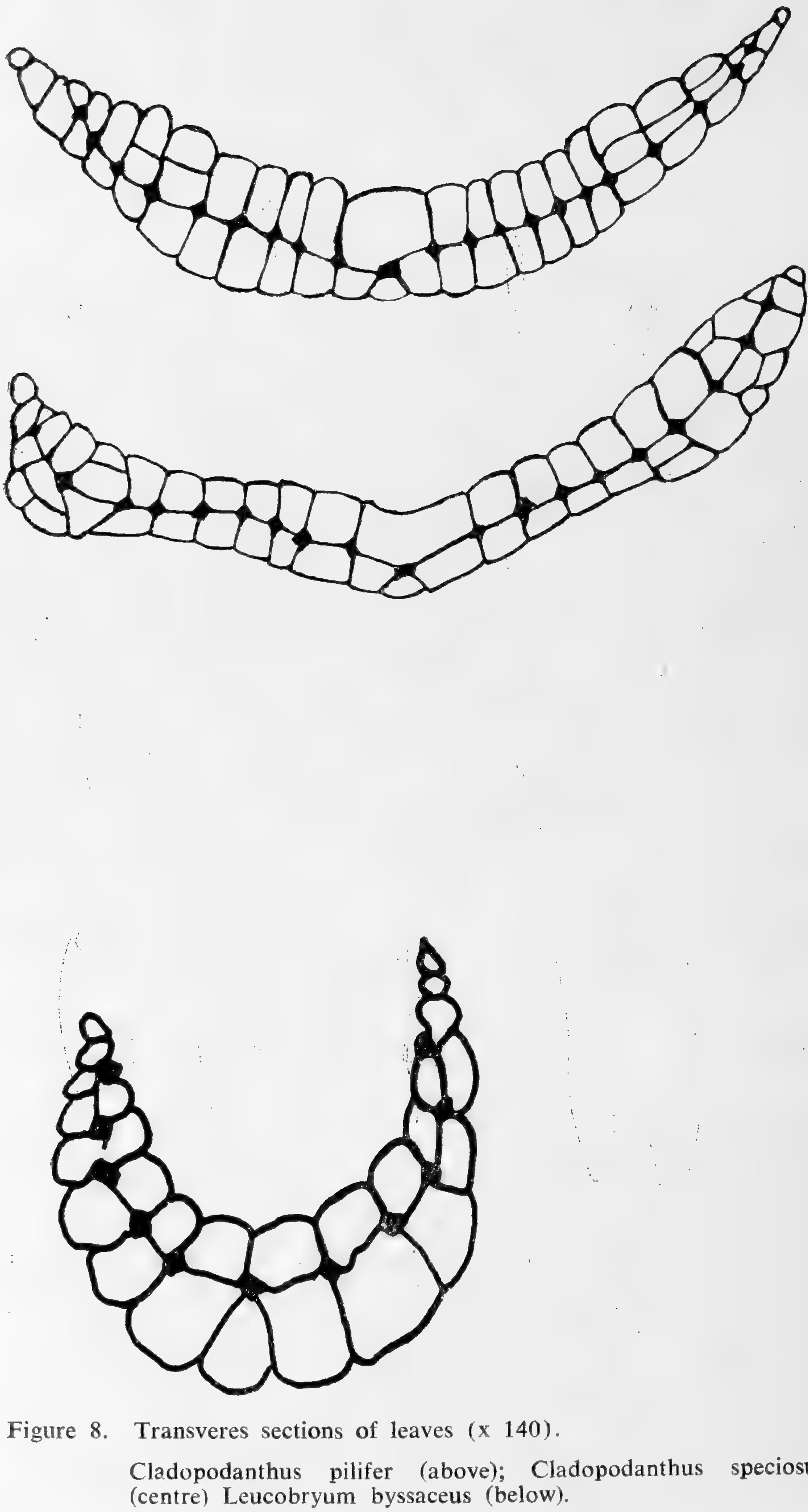


Figure 8. Transveres sections of leaves (x 140).

Cladopodanthus pilifer (above); Cladopodanthus speciosus (centre) Leucobryum byssaceus (below).

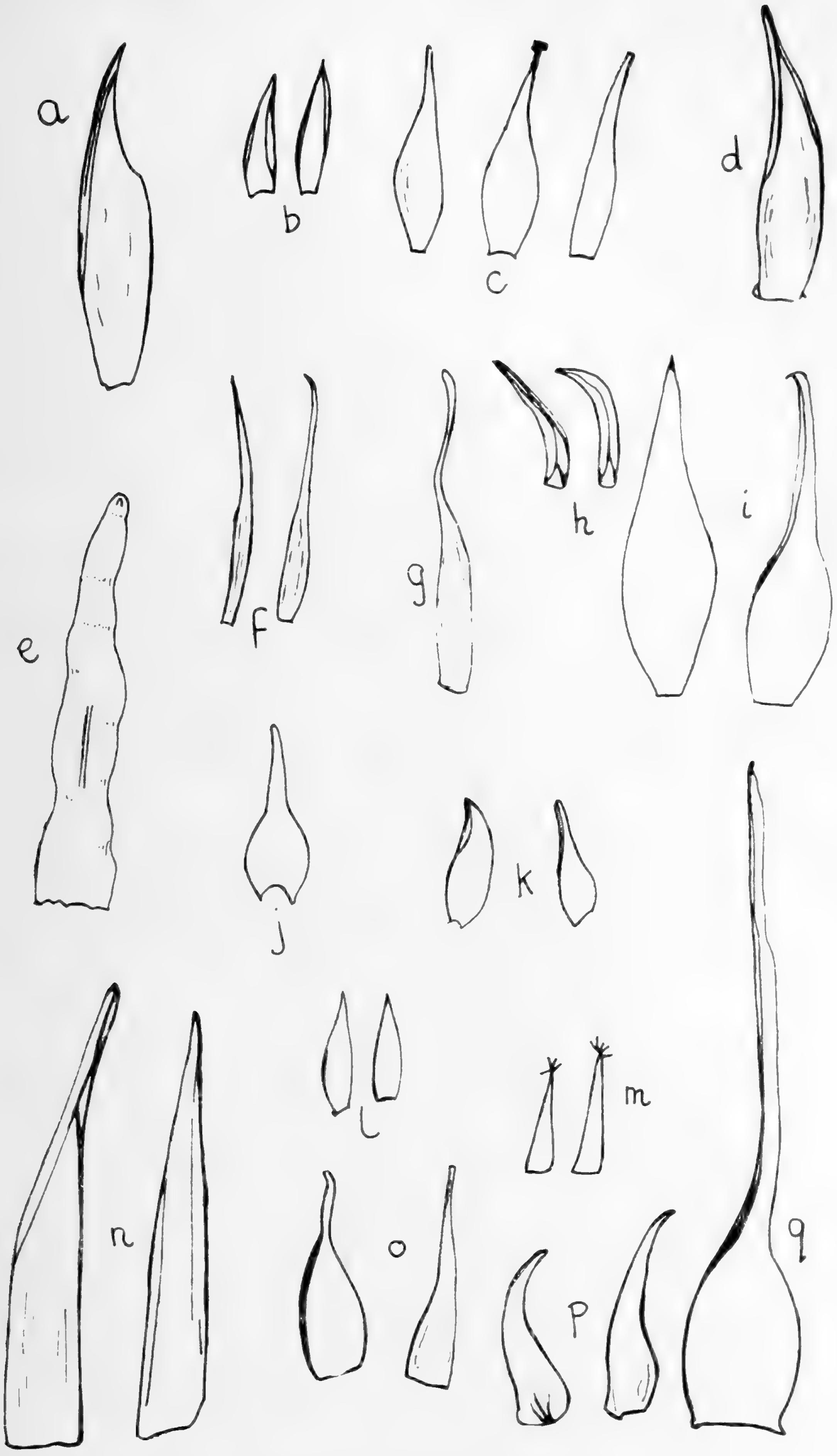


Figure 9. Leaves of Leucobryum species (x 5):—

(*a*) L. neilgherrense.
(*b*) L. aduncum.
(*c*) L. subsanctum.
(*d*) L. sanctum.
(*e*) L. cyathifolium.
(*f*) L. bowringii.
(*g*) L. bowringii ver. sericeum.
(*h*) L. byssaceum.
(*i*) L. scabrum.
(*j*) L. stenophyllum.
(*k*) L. scalare.
(*l*) L. chlorophyllosum.
(*m*) L. microleucophanoides.
(*n*) L. javense.
(*o*) L. candidum.
(*p*) L. candidum var. speiostichum.
(*q*) L. pulchrum.

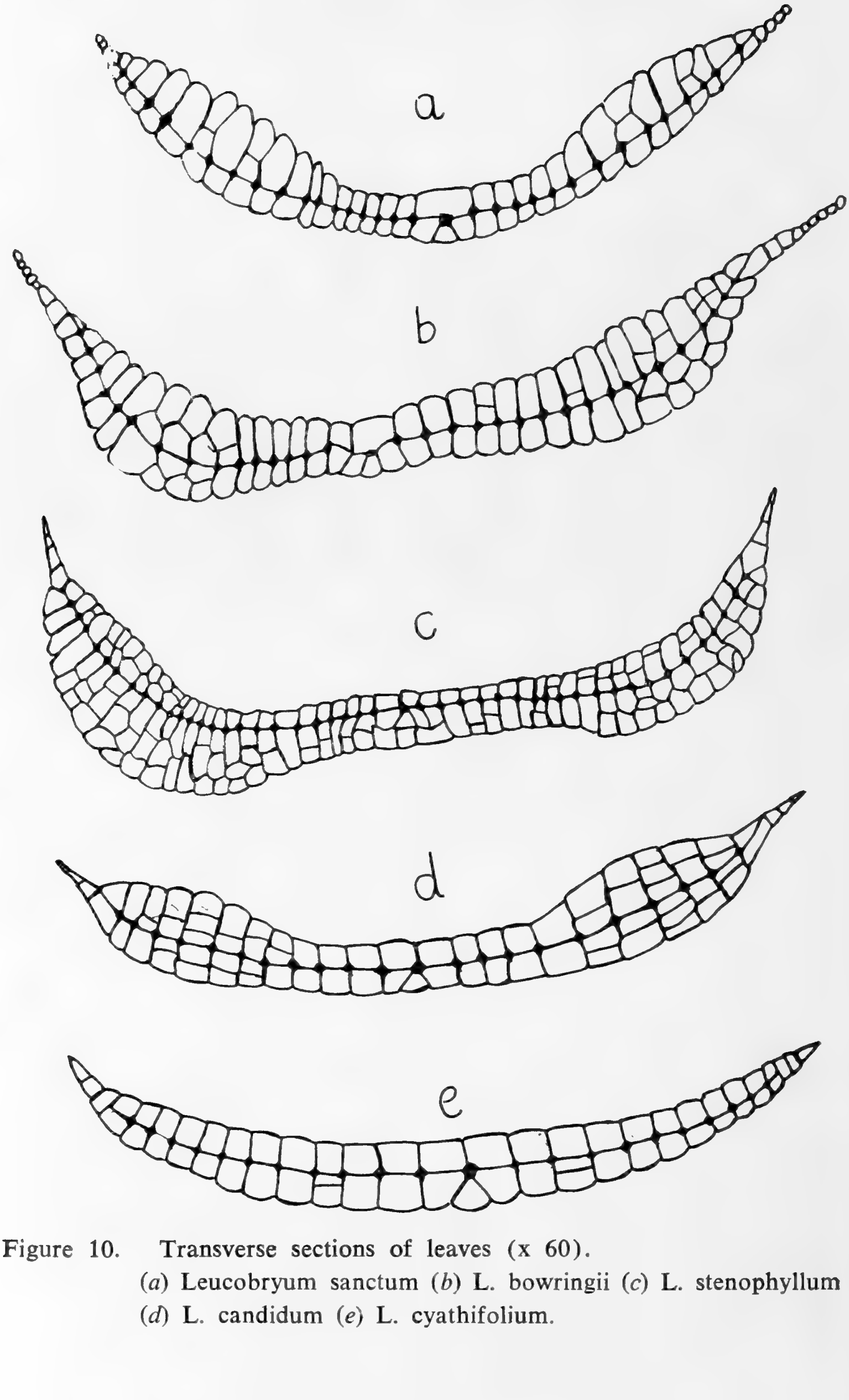


Figure 10. Transverse sections of leaves (x 60).
(*a*) Leucobryum sanctum (*b*) L. bowringii (*c*) L. stenophyllum
(*d*) L. candidum (*e*) L. cyathifolium.

Figure 11. Leucobryum aduncum; whole plant (x 2), capsule (x 6), leaf (x 13), t.s. leaf (x 140).

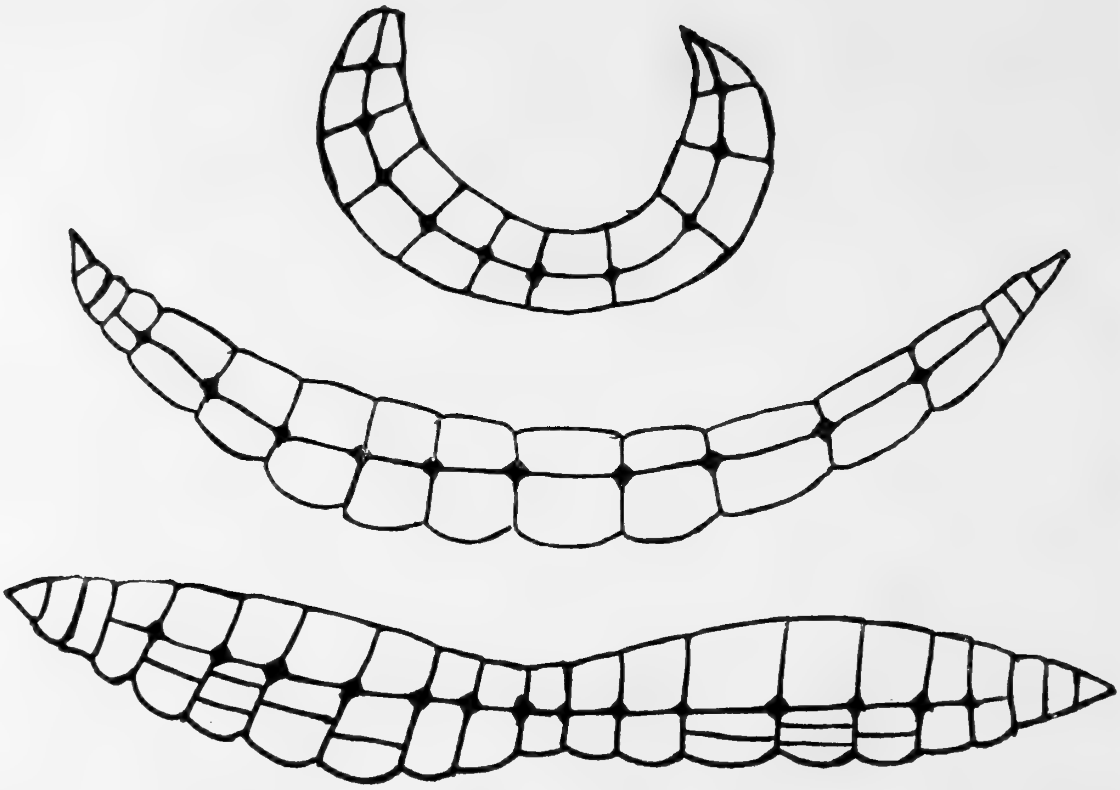


Figure 12. Leucobryum microleucophanoides t.s. leaves towards apex, middle and below (x 400).

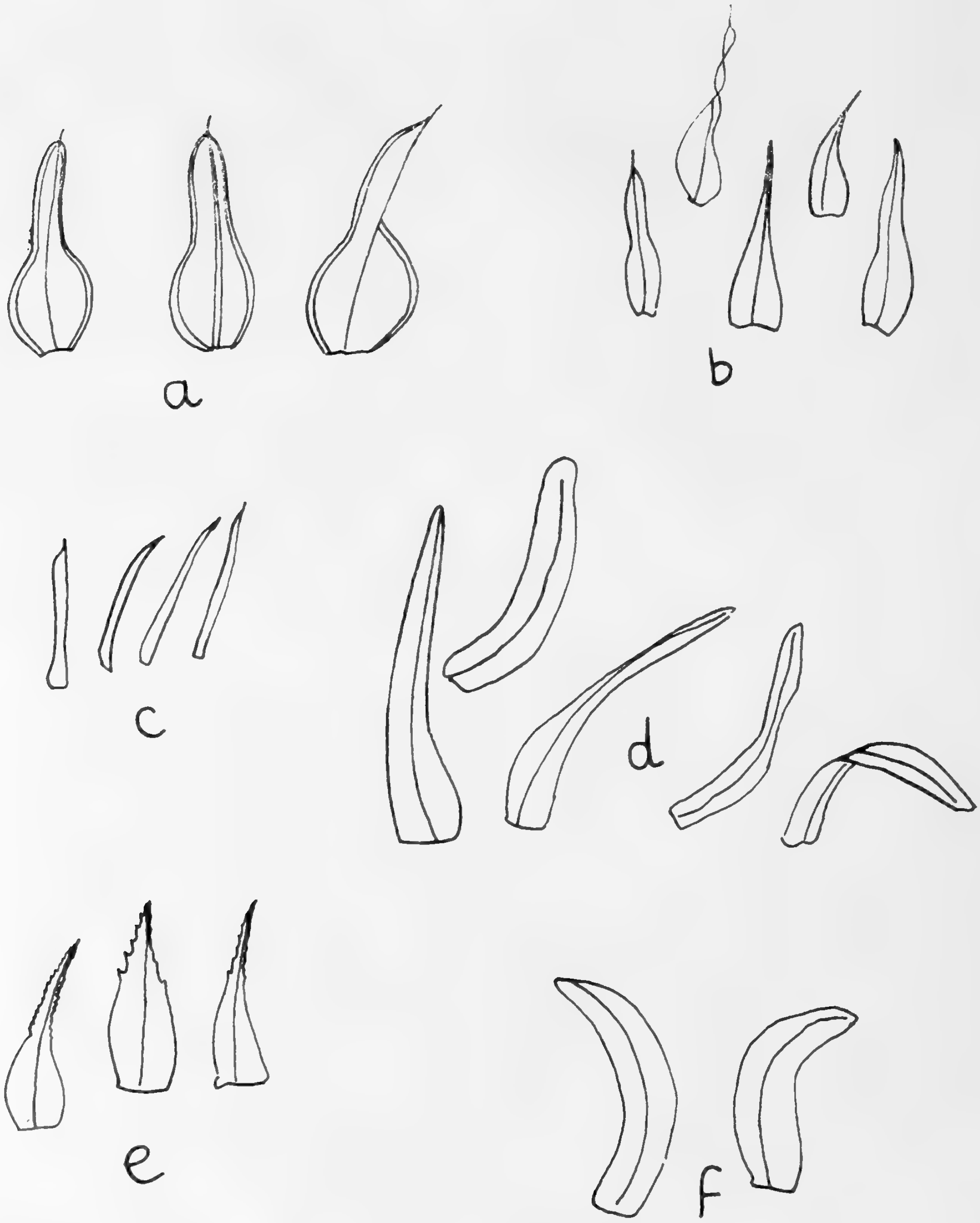


Figure 13. Leaves of species of Leucophanes (x 7).

(*a*) L. candidum.
(*b*) L. candidum var. densifolium.
(*c*) L. albescens.
(*d*) L. octoblepharoides.
(*e*) L. sordidum.
(*f*) L. naumanii.

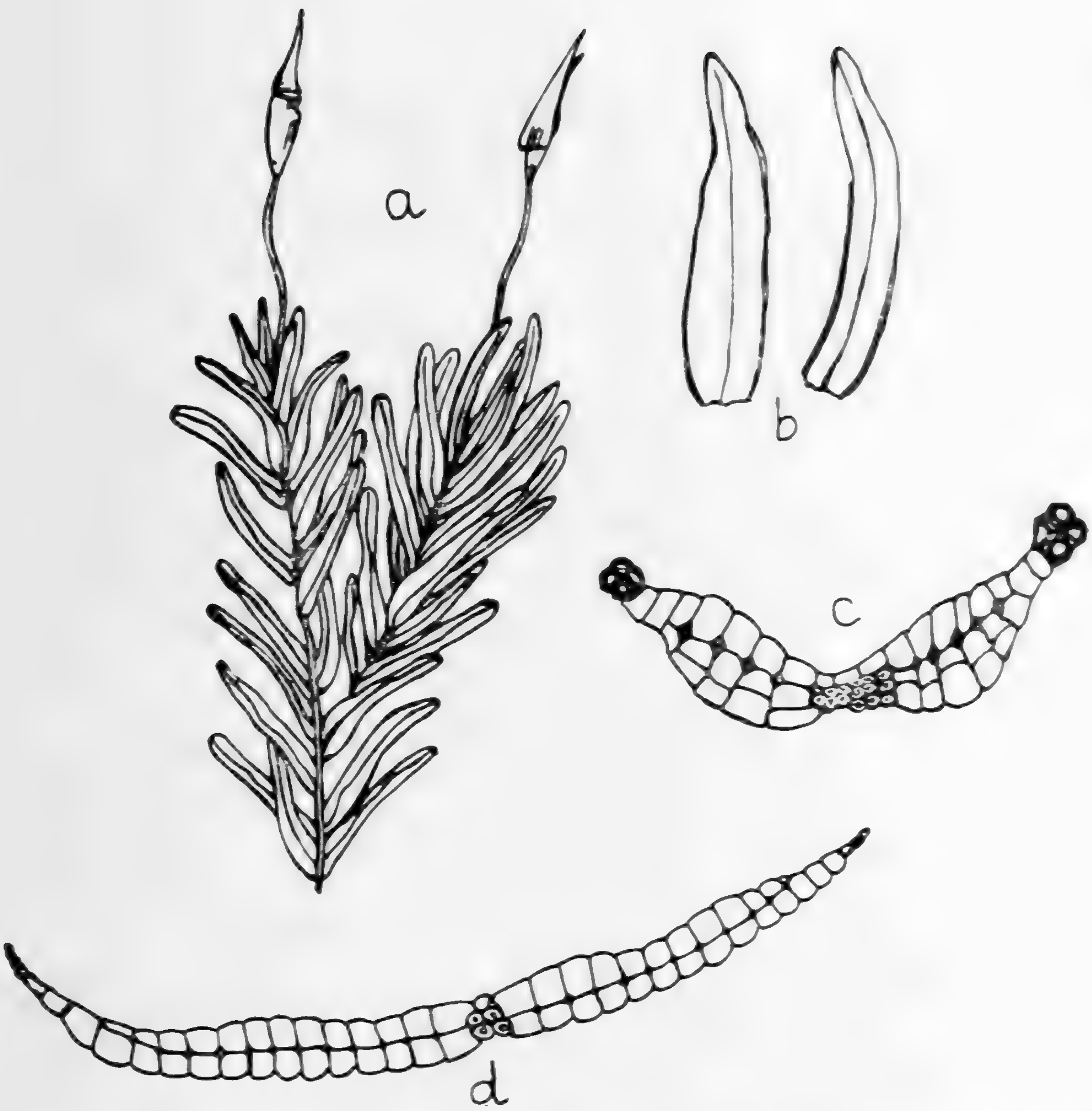


Figure 14. Leucophanes octoblepharoides (*a*) whole plant (x 3). (*b*) leaves (x 7), (*c*) t.s. mid-leaf (x 100), (*d*) Leucophances candidum t.s. base of leaf (x 300).

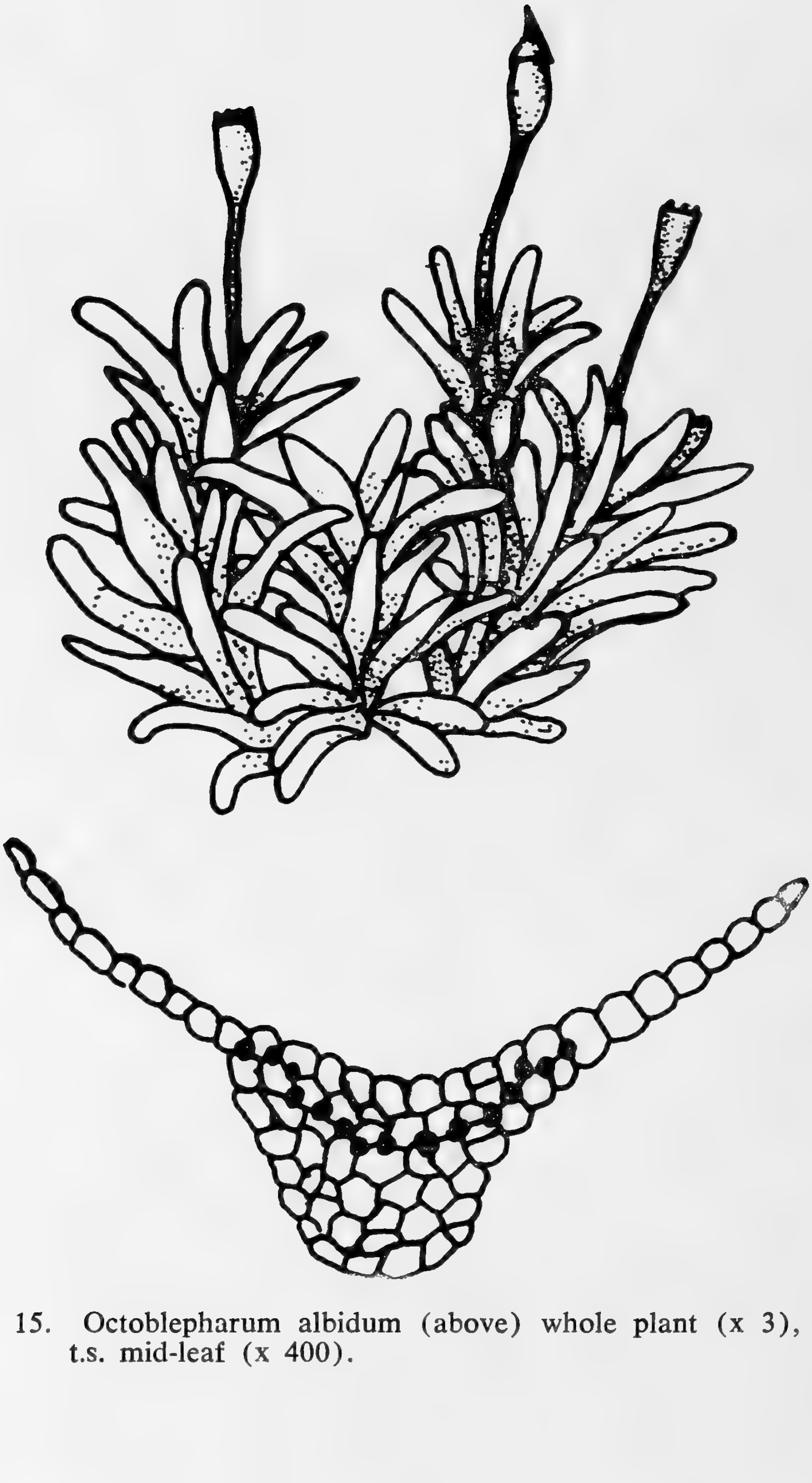


Figure 15. Octoblepharum albidum (above) whole plant (x 3), (below t.s. mid-leaf (x 400).

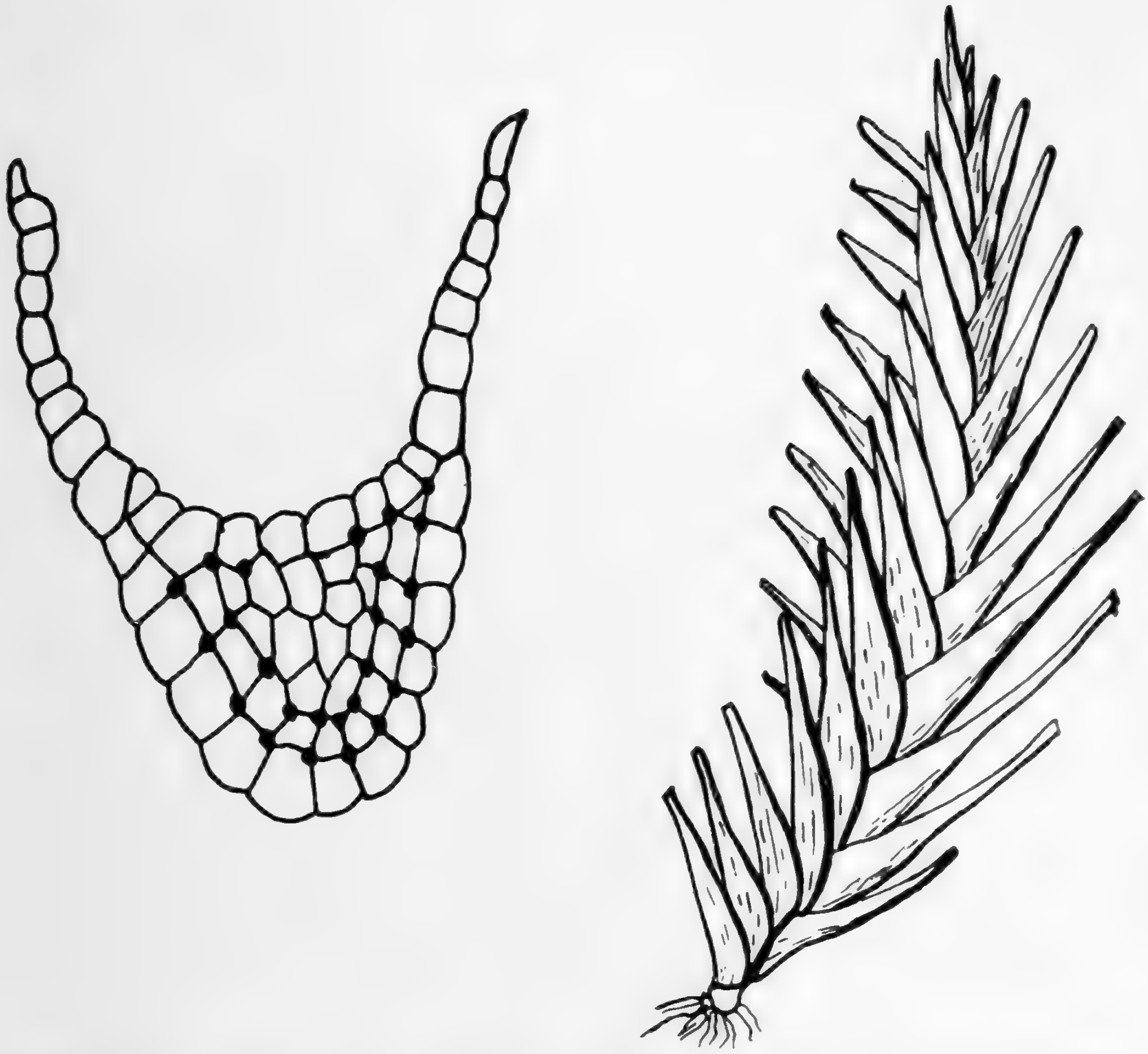


Figure 16. Arthrocormus schimperi (left) T.s. thid-leaf (x 220): (right) single plant (x 3).

Figure 17. Exodictyon sullivanti, t.s. mid-leaf (x 100).

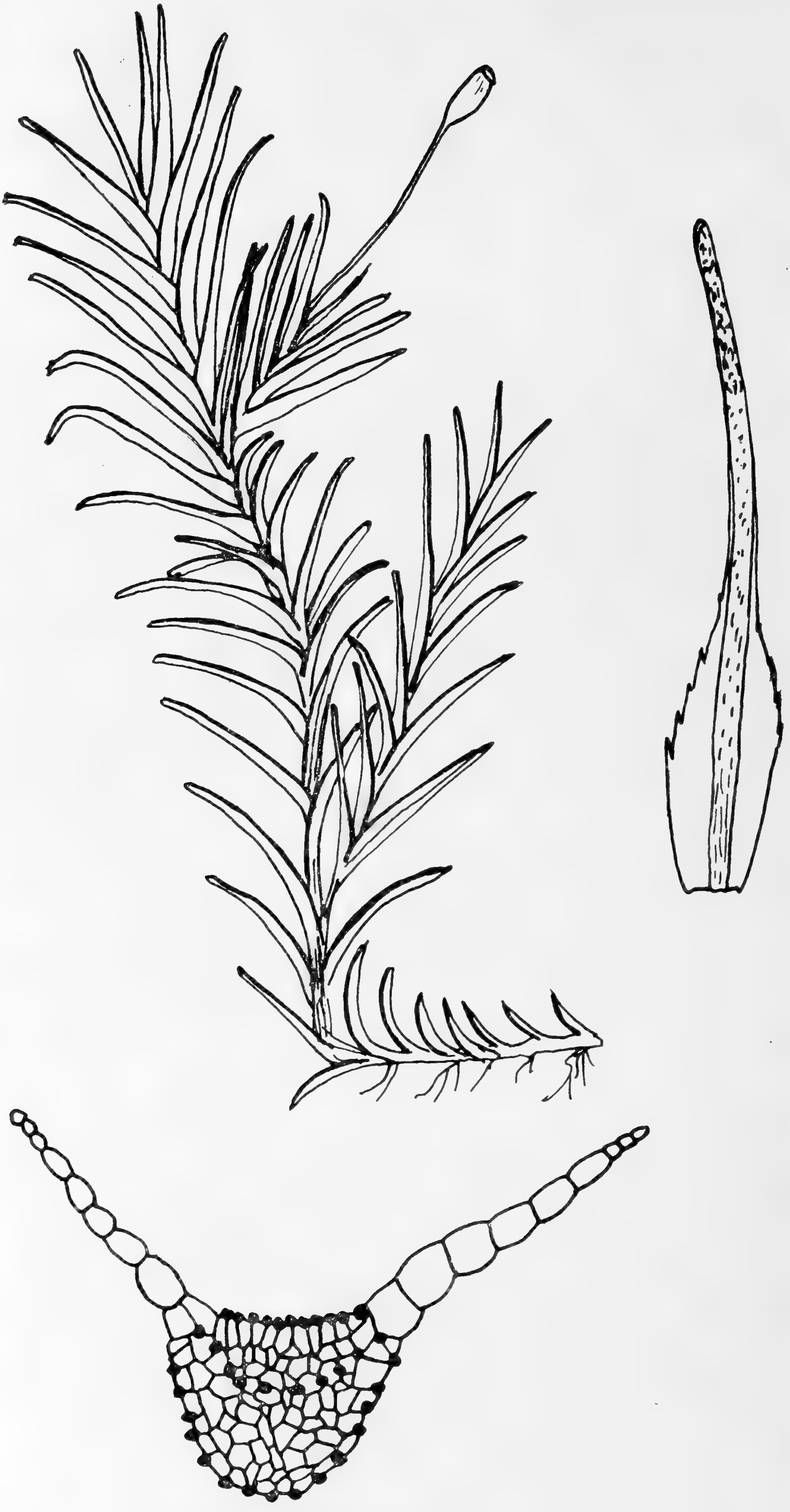


Figure 18. Exodictyon blumii (above) whole plant (x 6) and single leaf (x 20); (below) t.s. mid-leaf (x 200).

Descriptions of the Malayan species of Laportea

by

Betty Molesworth Allen

There are two species of the stinging trees belonging to the genus *Laportea* (Urticaceae) known in Malaya, but the descriptions in Ridleys Flora (1924) are very scanty. Thus, because I have become familiar with both species in the field, it may be of interest to give descriptions of the living plants.

The more familiar species is *L. stimulans* Miq., and it has been stated to be not uncommon in Malaya, but it is undoubtedly absent from wide areas. The second species *L. pustulosa* Ridl., is extremely rare, and until I found some in 1959, it was known perhaps only from Father Scortechini's original collection from somewhere in Perak. Dr. Chew Wee-Lek, who has been studying this genus, now believes that *L. pustulosa* is conspecific with a species that is widespread in Malaysia and India, and will soon be publishing his conclusions, thus nomenclature will not be discussed here.*

LAPORTEA STIMULANS Miq. Malay name: *Jĕlatang.*

Adult tree (when woody), from about 4–8 m. tall, more rarely to 11.5 m. Flowering trees from limestone habitat, commonly 4–5 m. in height, even in shape and sparsely leafy. Trees in jungle habitat (granite), untidy, and largest trees, apparently old, between about 10–11.5 m. in height, nearly always fallen (shallow rooted ?) with the trunk lying at an angle. The trunk may be 30 cm. in diameter, and shoots grow erect from this, later becoming woody and branching, up to 7 m. tall and often flowering. This seems characteristic, and thus the older the tree the more untidy it becomes, and this stage is frequently seen in the jungle.

Bark is smooth, pale and greyish-mottled. Both young and old are marked with very narrow vertical lenticels. *Branches* (of mature trees) are leafy only at the twig ends, and these are always erect for the last 12 cm., the rest being more or less horizontal. Branchlets and twigs are short and the new growth is green and fleshy looking, but becomes pale and woody with maturity, and scarred from fallen leaf-stalks. Wood is brittle; twigs are usually glabrous, but occasionally have a few stinging hairs on very new growth (Rotan Segar specimens).

* Description of the stinging powers, and some observations of the two *Laportea* species are being published in the Malayan Nature Journal.

Leaves in whorls are crowded together at the twig ends, on the erect part. On adult trees, the petioles are about 1.5 cm., apart, or about 3 cm. apart on the same side. Leaves on young plants are usually, but not always, larger than on the mature tree, and again are usually larger on plants growing in granite areas than in limestone. On young plants of one stem (about 130 cm. tall and not woody), the largest leaves measured 38.75 × 13.75 cm. with a petiole length of 6.5 cm., and 36 × 12.25 cm. and petiole of 13 cm. On a new shoot growing from a previously cut tree, many of the leaves measured 51 × 17 cm., but this was not usual. Adult leaves are usually uniform in size on a tree, but again are nearly always larger in granite areas. They are commonly between 15–20 cm. × 5–7 cm., but some (from Gopeng) measured nearly 30 cm. long. Leaves may be green but are more usually flushed with pinkish or purple, especially below on the midrib and main veins. Otherwise they are medium-green above and rather dull, not smooth but with flat, pale scales (?) scattered over the laminae and on the midrib. The under-surface is paler. The texture is thin but looks fleshy. The lamina tapers gradually from base to apex, being widest about the middle; the tip may be short or slightly drawn out, narrow but blunt. The base is narrow, slightly decurrent on the leaf-stalk, sometimes unevenly so. Margins are thickened somewhat, are undulating and sharply crenated rather than toothed. Leaf hairiness is variable, but they are glabrous above, only occasionally are there stinging hairs scattered on laminae. Below, the hairs are usually confined to the veins and underside of the petiole. There are about 10–15, rarely 17, uneven pairs of main veins, these being about 4 mm. apart, and there are often two extra veins on one side. On the upper surface of the leaf these veins are sunk, and are about the same colour as the lamina. Below, they are strongly raised, and together with the midrib are often flushed with pink or purplish, but if green are then lighter than the lamina. There are many smaller and dark interlacing veinlets between the main veins; these often bear scattered hairs which are about 0.5 mm. long, and are very slender, and not appressed, but more or less orientated towards the margin.

The *petiole* is curved so that the leaf faces the sun, but droops rather rapidly if the day is hot and dry. On young plants it is usually between 4–8 cm. long, but occasionally to 13 cm.; on adult plants it may be between 2.75–6 cm. long. On the underside, the stinging hairs are usually fine and about 0.25 mm. long, occasionally stout and then stinging fiercely (Rotan Segar specimens), and very occasionally with no hairs at all (Gopeng). Petioles are green or flushed with pink, are rounded below and channelled above, bearing a few hairs on the edges of the channelling.

The *hairs* present on leaves, petioles and infloresences are stinging hairs. They may vary in size, but all are whitish, translucent and filled with sap, and each has a silica cap.

Trees commence to flower only after they become woody. *Male flowers* are scattered on an open panicle, which is axillary; one arising from the base of a leaf-stalk on the upper side. Panicles, about 10–19 cm. long, are jointed to the twigs and are branched twice or occasionally three times, and are slightly zigzag. They are at first horizontal, then slightly pendulous but are firm yet fleshy in texture, are bright green at first maturing to lilac-pink which is paler at the apex. The panicle is about 3 mm. through at the base tapering upwards; and stinging hairs of two sizes are scattered throughout. There are several flowers together, in tight, almost sessile bunches. There are four pale green pointed sepals enclosing the stamens in bud; they are pubescent and more or less persistent. Stamens, 4–8 with filaments are tightly coiled, and when the flowers reach maturity uncoil with an explosive mechanism in the sun, and then remain in a loose coil showing that the filaments are flat. Anthers are bright green, when immature, then whitish-cream, and the pollen which is the same colour, is ejected into the air for about 15 cm. when the filaments uncoil.

Female flowers: at first the infloresence is about the same length as the male (10–19 cm.) and partly drooping, but elongates after the flowers are fertilised, to almost three times its original length. It then becomes pendulous and, hanging down thus from the erect twig ends, becomes conspicuous. The panicle is green when young but matures to a lilac-pink, and eventually to a vivid cerise-pink when in fruit. When young, the panicle is round, and very slender (about 1.5 mm. through at the thickest part), but thickness with maturity, and may be to about 16 cm. long, to the first branching. Here there are usually 2–3 stalklets from one point, below which is a tiny brownish, persistent convex stipule. Stalklets are from 4–20 mm. long; when short, bearing two receptacles at its apex, or (more commonly) when longer, branched again and culminating in 11–12 receptacles which are often paired on very short (not swollen) pink stalks. In fruit, one of the pair may be mature whilst the other is still very immature. All over the infloresence are short hairs, which are slender but which sting fiercely. The receptacle is fan-shaped, about 2 mm. wide at the widest part, and is pubescent. There are commonly 3–7 flowers on a receptacle, each having 4 green sepals (as in the male flowers), one bright green ovary which is sessile, more or less round and about 0.5 mm. wide; it is capped with a slender white style which glistens although it is pubescent. Flowers are scentless.

The *fruit* is comparatively conspicuous, for the receptacle becomes fleshy and shiny, swelling to about 10 mm., across; it is then of a pale lilac colour, except where the seeds are attached which is bright green. The seeds are dark green in colour and hard.

Fruits ripen gradually, thus few being ripe on a panicle at one time. The fleshy receptacles are quickly eaten by birds at this stage, and in Gopeng sunbirds were seen at the trees, the Purple-naped Sunbird (*Anthrepetes m. macularia*) being the commonest. In the Tapah Hills forest reserve, there were many different kinds of birds eating the fruits, the commonest being The Black-crested Yellow Bulbul (*Pycnonotus dispar caecili*), The Crested Bulbul (*Criniger ochraceus sacculatus*) and the Yellow-throated Flower-pecker (*Anaimos m. maculatus*).* No birds were noted on the limestone plants, but no fruits were found around the bases of the trees.

Male trees appear to flower from about a week to a month ahead of the female. They have been noted in early January, whilst the female trees in the same area were not out until early February (1963). Fruits have been seen from early March to the middle of April. One year which had an unusually long dry season, male flowers (Gopeng) were found in August, September and December, on the same tree. None of the female trees examined at the same time had flowers, nor were any seen on the limestone trees. Apparently trees may not flower every year, for during a very wet January and February, no flowers appeared on Bujang Melaka plants, and although these were watched at intervals during subsequent months, nothing was seen until the following January.

The following are the localities in Perak where I have seen this species. The collecting numbers are mine and the material has been sent to: Royal Botanic Kew; Singapore Herbarium and Sarawak Forest Dept.

Limestone areas in the Kinta Valley: Gunong Ampang; G. Ayer Hangat (4718); G. Idong; G. Lanno; G. Kanthan; G. Merawan (4880); G. Rapat; Rotan Segar (4878). Non-limestone areas: Bukit Gantang Pass; Kledang Range; hills behind Gopeng (4728, 4877); Bujang Melaka Mt., both sides (4888); hills near Chenderiang; Tapah Hills Forest Reserve (off Cameron Highlands Rd.), the latter at 270 m. altitude.

---

* Identified by F.G.H. Allen.

LAPORTEA PUSTULOSA Ridl. Malay name: *Pulutus.*

Adult trees rather open, 3–11 metres high (when flowering). Unless otherwise stated the description is from the largest (11 m.) tree.

Trunk straight, and at 11 cm. from the ground, circumference 53 cm. At about 150 cm. (and just below the first branch) 38 cm. circumference. *Bark* pale, mid-brown and blotched with pale concentric markings (lichens ?), and smooth except for small pimples and a slight ridging running horizontally round the trunk at intervals of about 8–15 cm., the ridge running round all or part of the trunk. The first branch was about 25 cm. circumference at its base, and was flowering; there were no more branches for about another 200 cm. where the main ones started. New twigs, hollow, or filled with a white pith; green and fleshy-looking, with numerous very small white and vertical lenticels on the bark; the twigs becoming ridged with leaf-scars as they mature.

Leaves are bunched together on the green twig ends, for about the last 40 cm. They are loosely whorled, each petiole being about 1 cm. apart, (occuring every 3–4 cm. on the same side). Leaves on young plants, which are usually unbranched, are not always larger than on the adult trees. On the latter they vary in size, 18–44 cm. long by 10–23 cm. wide, but are commonly between 23 × 12 and 27 × 13 cm. Shape of the lamina is constant and texture is thickish and soft. Above, it is smooth, somewhat shiny and rather dark green, but new leaves are very thin and pale green. The underside of the leaf is dull and pale green. There is never any pinkish colour on the lamina or petiole. Leaves are hairless above but are slightly pubescent on the midrib below; the leaf-base is heart-shaped (never tapered), and the short lobes reach over the petiole. The apex is more or less abruptly narrowed and tapered for about 1.5 cm., with a blunt tip. Leaves are obovate and the margins coarsely and unevenly toothed with short teeth; the margin is pale, slightly thickened and narrowly reflexed. The midrib is stout, paler than the lamina and is ridged above for about $\frac{3}{4}$ of its length, and then sunk. Below it is strongly raised (to 5 mm.) at the base, is rounded and covered with stinging hairs which are closely appressed and orientated towards the petiole. The main veins are also stout, about 10, rarely 13 or 14, uneven pairs, which join, or nearly join at about 5 mm. from the leaf margin. They are paler than the lamina, are sunk above but strongly raised below; between these, are several lesser pairs reaching only a short distance from the midrib, these join very small netted veinlets which are also raised below, but are darker than the lamina. There are usually a few (occasionally more) stinging hairs on the main veins; these face the midrib. *Petioles* are jointed to the twigs and are slightly swollen near the join; they are semi-drooping and lighter green than the lamina; are fleshy-looking and narrowly channelled from the apex downwards for about 1.5 cm., otherwise are round. Length varies from about 11–18 cm., or averaging about 13.5 cm., and at the middle of the petiole are 5 mm. through. They are heavily covered on the underside *only* with almost appressed hairs which are comparatively stout and very short (about 0.5 mm. long), but above are glabrous.

The *hairs* present on the lamina, petiole and infloresence are transparent, glistening and are hollow and filled with sap. They all sting fiercely especially those on the petiole and infloresence, causing great pain.

Male flowers seen only when very old and fallen. Apparently on a short axillary panicle (about 10 cm. long), green.

Female flowers on an axillary panicle, one from the upper side of a petiole base, and usually the same number as leaves on a twig end; the oldest being from the lowest leaves. Panicles are erect, not lax, but droop extremely rapidly after being picked. Length varies with leaf length, the longer the leaf the longer the panicle. They are from about 9–18 cm. long and are covered with pale hairs which sting fiercely; these are spreading, not appressed, and panicles vary in their degree of hairiness. On a 12 cm. panicle, the first branch is at about 5 cm. from the base, and from this point there may be up to 5 stalklets. Near the branching the panicle is twisted; it is all green in colour (never pink), and the stalklets are sprinkled with very short (0.5 mm.) hairs. Flowers are 1–6 rarely 7, in a bunch, each being quite separate, sessile, or with a very short stalk which develops as the flower matures. There are 4 green pubescent *sepals* which cover the ovary for about three quarters of its length; they are minutely fringed. Each *ovary* is about 0.5–2 mm. wide, rather round, is green and capped with one curved and comparatively thick style which is about 3–5 mm. long and is white and glistening with translucent dots. On the ultimate stalklets and at the base of a bunch of ovaries, are a few small hairs, most of which are erect. Panicles lengthen with maturity, and in fruit commonly about 20 cm. long.

Fruits are fleshy drupes, but are smooth and flattened when immature, and each is green with a pale edge, and a short curved beak. The fruit-stalk is now about 2 mm. long. Only a few fruits ripen at one time on a panicle; when mature they are fleshy and white with a watery flesh which shows the green seed through it. Each fruit is about 7–10 mm. long by 5–7 mm. across, is slightly flattened and the persistent sepals and curved beak are now sunk in the flesh but are still evident. *Seeds,* one to each fruit, are comparatively large, to about 5 mm. wide, but thin; they are green and minutely pitted. Female trees flowered from early to mid-February; the male had then finished. Fruits ripened in March.

The white fruits fall and lie around the tree base; they do not seem to be eaten by birds as in the previous species, nor were any birds seen at the tree. This may account for its extremely limited distribution within an area.

I have found this species at Gunong Idong (S.E. end of the G. Rapat limestone outcrop) in Perak. (4667, 4879, 4887). In an amphitheatre inside the outcrop; in red earth but completely surrounded by limestone cliffs (35–270 m. tall); in shaded places. I have not found this elsewhere, with the possible exception of a very small plant about 20 cm. high, growing in shade at the base of G. Kanthan, a limestone hill north of Ipoh, which may have been this species (4846).

At Gunong Idong, there were two adult female trees and two male, but there were many young plants growing below the female trees; and at another place, about 100 m. distance, (on the opposite side) there were more immature plants, suggesting another mature female, perhaps above on the cliff, although this was not found. Also there were many plants near the former female trees which had been woody but had been cut back some time previously (at least four years) to within about 30 cm. from the ground. These now (1963) have tall shoots, not yet woody, and not flowering so far.

Plant associates: The floor of the amphitheatre is damp and partly shaded by the tall cliffs and by very old, tall trees of *Hevea brasiliensis*. Where it is slightly open, *Selaginella willdenowii* and *Stenotaphrum helferi* cover the ground, and 'pulutus' is common amongst them. Scattered through this are *Athyrium esculentum*, very large *Amorphophallus campanulatus*, and two gingers, *Achasma* sp. and *Costus* sp. *Lygodium circinnatum* and *L. salicifolium* climb over the shrubs and over a small *Pandanus* sp. (possibly *P. ornatus*). Here also *Cyclosorus truncatus* and *Nephrolepis biserrata* are common together with a few young plants of *Laportea stimulans*. Other plants include *Dracaena* sp. a small species, *Fleuria interrupta, Debregeasia squamata, Certandra pendulosa, Helminthostachys zeylanica* and *Microlepia speluncae* var. *villosissima*. In the darker places where pulutus is most common, near the cliff base (and under tall palms, *Iguanura* sp. and occasional *Taxatrophis ilicifolia*) is a stand of *Justicia* sp. This is where the tall female tree grows and the plants noted include *Heterogonium pinnatum* and *Bolbitis heteroclita* amongst which is a small creeping herb (Acanthaceae) with cream-coloured flowers, and *Monophyllaea horsfieldii*, which were growing in earth amongst the rocks, and on the rock itself were *Pothos macrocephalus*, a *Hoya* sp., two climbing *Piper* spp., *Begonia kingiana, Tectaria amplifolia, Pteridys syrmatica* and *Typhonium fultum*, the latter two being in earth pockets.

REFERENCES

BROWNE, F. G. (1955) Forest Trees of Sarawak and Borneo.

BURKILL, I. H. (1935) The Economic Products of the Malay Peninsula, 2 vols.

CORNER, E. H. J. (1954) Wayside Trees of Malaya.

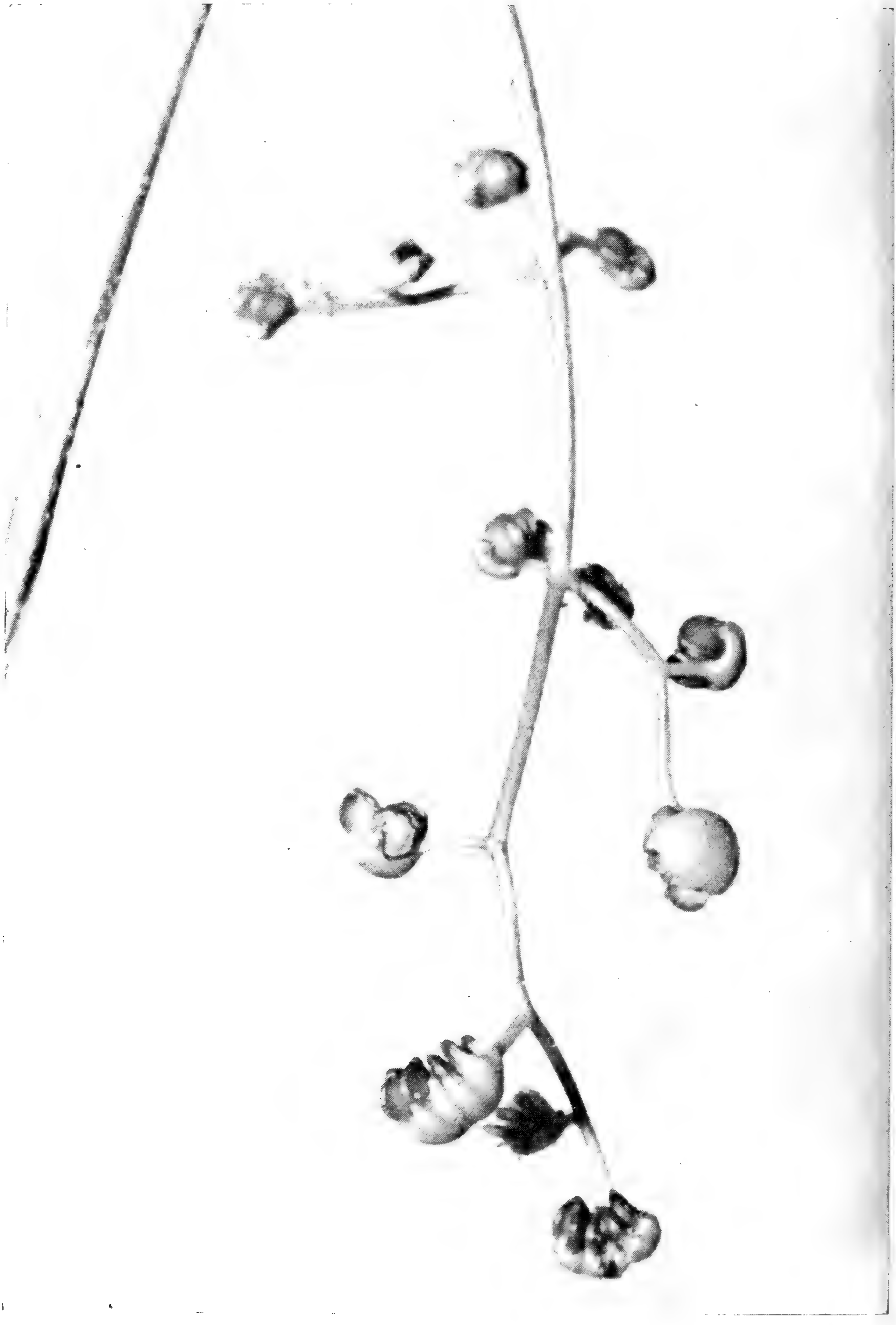
RIDLEY, H. N. (1920) Journ. Straits Br. Roy. As. Soc.

RIDLEY, H. N. (1924) The Flora of the Malay Peninsula, Vol. 3.

WATSON, J. G. (1928) Malayan Plant Names.

(Photo by E. G. H. Allen.)

Laportea stimulans. 'Jelatang'. Fruits, slightly larger than life size.

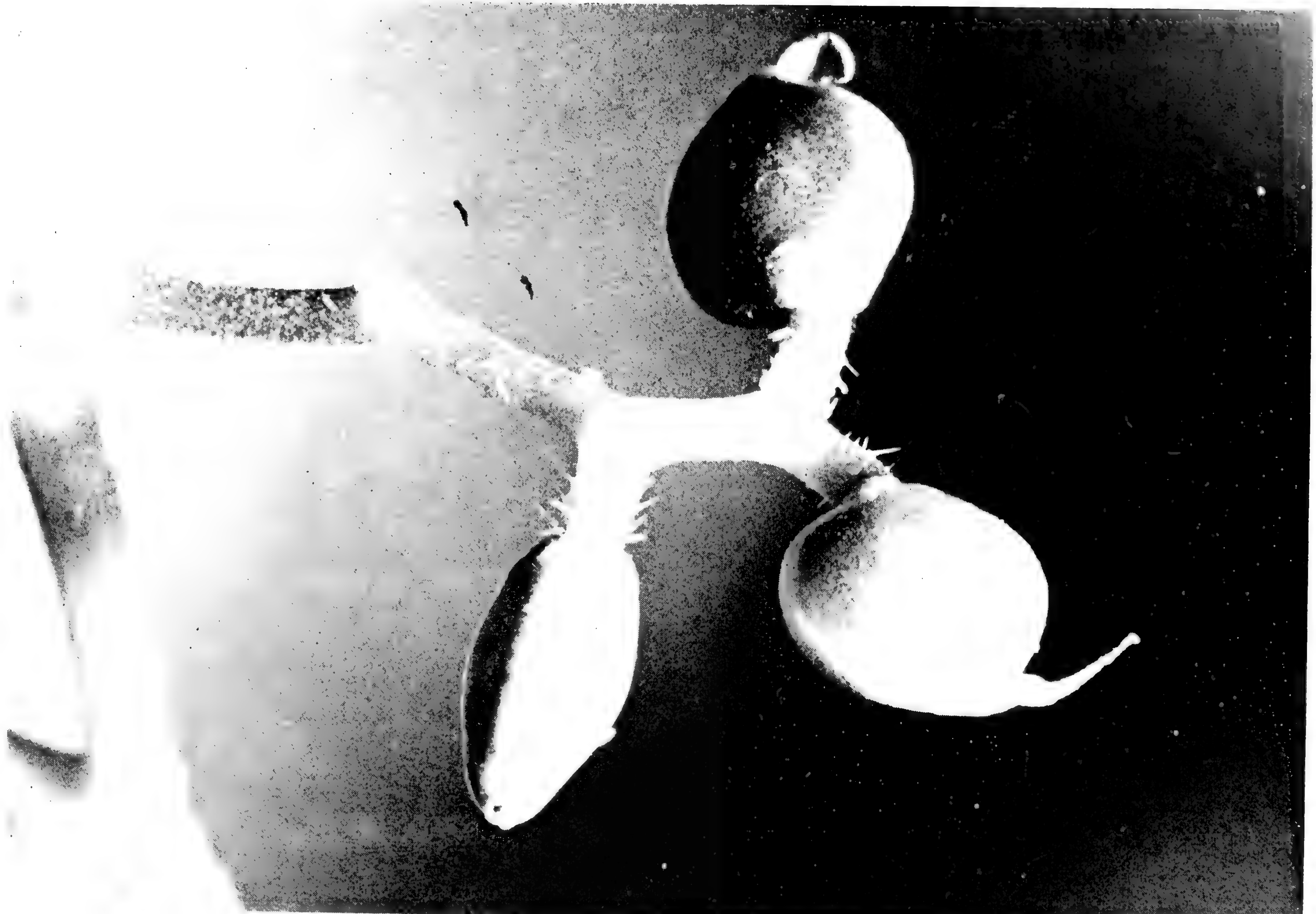


(Photo by F. G. H. Allen.)

Laportea stimulans, 'Jelatang'. Female flowers, C. × 3.

(Photo by F. G. H. Allen.)

Laportea pustulans, 'Pulutus'. Flowers, greatly enlarged.



(*Photo by B. E. Allen.*)

Laportea pustulans, 'Pulutus'. Immature fruits, showing the pale ridge along the edge, and the stinging hairs.

New Records of Plant diseases in Sarawak for the year 1962

by

G. J. Turner

Department of Agriculture, Sarawak

Lists of plant disease records for Sarawak have been given by Johnston (1960) and Turner (1963). The present list consists of previously unrecorded diseases, together with a number of entomogenous fungi, noted or collected in Sarawak during the year 1962.

The causal organisms are arranged alphabetically under their individual hosts. The frequency of occurrence is given, together with the Commonwealth Mycological Institute Herbarium serial number, where the identification has been performed by the Institute.

Achras zapota L. (Sapodilla, Chiku)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	—
Amaranthus gangeticus L. (Bayam)			
White rust	*Albugo bliti* (Biv.–Bern.) O. Kuntze	Occasional	95053
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Occasional	—
Anacardium occidentale L. (Cashew-nut)			
Sooty mould	*Meliola anacardii* Zimm.	Occasional	93295*a*
Annona muricata L. (Soursop)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	1 record	—
Thread blight	*Marasmius scandens* Mass.	1 record	96183
Sooty mould	*Trichopeltis pulchella* Speg.	1 record	93312
Arachis hypogaea L. (Groundnut)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Occasional	—
Leaf spot	*Phyllosticta* species	1 record	96175
Collar rot	*Sclerotium rolfsii* Sacc.	Occasional	—
Artocarpus elastica Reinw. (Terap)			
On leaves	*Cocconia spurcaria* (Berk. & Br.) v. Arx	1 record	93325*c*
Sooty mould	*Irenopsis* species	1 record	93325*a*
Artocarpus integra Merr. (Jack-fruit)			
Thread blight	*Marasmius scandens* Mass.	1 record	96184
Sooty mould	*Meliola artocarpi* Yates	1 record	95050*a*

Averrhoa carambola L. (Carambola)			
Sooty mould	*Asterina venustula* Syd.	Common	93298*a*
Sooty mould	*Stomiopeltella nubecula* (Berk. & Curt.) Theiss.	1 record	93298*b*
Bambusa species (Bamboo)			
Thread blight	*Marasmius scandens* Mass.	1 record	98631
Benincasa cerifera Savi (Wax Gourd)			
Leaf rot	*Corticium solani* (Prill & Delacr.) Bourd. & Galz.	1 record	—
Bougainvillea species			
Thread blight	*Marasmius scandens* Mass.	1 record	98628
Leaf scorch	*Mycosphaerella* species	1 record	96182
Brassica alboglabra Bailey (Kai Lan, Chinese kale)			
Leaf spot	*Cercospora brassicicola* P. Henn.	1 record	93965
Leaf rot	*Corticium solani* (Prill & Delacr.) Bourd. & Galz.	Occasional	—
Brassica chinensis L. (Pak Choy, Chinese cabbage)			
Leaf rot	*Corticium solani* (Prill & Delacr.) Bourd. & Galz.	Occasional	—
Brassica rapa L. (Choy Sam)			
White rust	*Albugo candida* (Pers. ex Hook.) O. Kuntze	1 record	96170
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Occasional	—
Cajanus cajan (L.) Millsp. (Pigeon pea)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	1 record	—
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Sooty mould	*Meliola* species	1 record	93322
Caladium humboldtii Schott			
Wilt	*Sclerotium rolfsii* Sacc.	1 record	—
Calopogonium mucunoides Desv.			
Sooty mould	*Meliola* species	1 record	93303
Camellia sinensis (L.) Kuntze (Tea)			
Thread blight	*Marasmius scandens* Mass.	1 record	93964
Sooty mould	*Tripospermum* species	1 record	98632
Capsicum annuum L. (Chilli)			
Fruit rot	*Colletotrichum capsici* (Syd.) Butler & Bisby	Common	96193
Leaf rot	*Corticium solani* (Prill. & Delacr. Bourd. & Galz.	Occasional	—
White root disease	*Fomes lignosus* (Klotzsch) Bres.	1 record	—
Leaf spot	*Glomerella cingulata* (Stonem.) Spauld. & Schrenk	Common	96172
Wilt	*Sclerotium rolfsii* Sacc.	1 record	—

Citrullus vulgaris L. (Water melon)			
Anthracnose	*Colletotrichum lagenarium* (Pass.) Ell. & Halst.	Common	98643
Citrus aurantifolia (Christm.) Swingle (Lime)			
* Scab	*Elsinoe fawcettii* Bitanc. & Jenk.	Common	—
Sooty mould	*Meliola citricola* Syd.	Common	93953*a*
Citrus aurantium L. (Sour orange)			
Scab	*Elsinoe fawcettii* Bitanc. & Jenk.	1 record	—
Sooty mould	*Meliola citricola* Syd.	Occasional	—
Citrus grandis (L.) Osb. (Pomelo)			
Scab	*Elsinoe fawcettii* Bitanc. & Jenk.	1 record	—
* Root rot	*Sphaerostilbe repens* Berk. & Br.	1 record	—
Citrus limon (L.) Burm. f. (Lemon)			
Scab	*Elsinoe fawcettii* Bitanc. & Jenk.	Occasional	—
Sooty mould	*Meliola citricola* Syd.	Occasional	—
Citrus nobilis Lour. (Mandarin)			
Scab	*Elsinoe fawcettii* Bitanc. & Jenk.	Common	—
Citrus paradisi Macf. (Grapefruit).			
Scab	*Elsinoe fawcettii* Bitanc. & Jenk.	Occasional	—
Sooty mould	*Meliola citricola* Syd.	Occasional	—
Clerodendron paniculatum L. (Pagoda flower)			
Sooty mould	*Meliola clerodendricola* P. Henn.	1 record	96174
Clitoria ternatea L.			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	98629
Coffea arabica L. (Arabian coffee)			
Pink disease	*Corticium salmonicolor* Berk. & Br.	1 record	—
Coffea liberica Bull ex Hiern (Liberian coffee)			
Sooty mould	*Annellophora* species	1 record	96179
Thread blight	*Marasmius scandens* Mass.	Occasional	96178
Coffea robusta Linden (Robusta coffee)			
On fruit and branches	*Aschersonia* species	1 record	93296
Branch die-back	*Irpex flavus* Klotzsch	1 record	93297
Thread blight	*Marasmius scandens* Mass.	Occasional	96176
Coix lacryma-jobi L. (Job's tears)			
Leaf spot	*Cercospora* species	1 record	95041*b*
Leaf spot	*Phyllachora coicis* P. Henn.	Occasional	95041*a*, 95048

(* Previously collected by P. C. Holliday: private communication Commonwealth Mycological Institute, 1962.)

Crotalaria anagyroides H.B. & K.			
Pink disease	*Corticium salmonicolor* Berk. & Br.	Occasional	—
Sooty mould	*Meliola teramni* Syd.	1 record	92389
On stems	*Septobasidium* species	1 record	93308
Crotalaria quinquefolia L.			
Rust	*Maravalia crotalariae* Syd.	1 record	98627
Crotalaria striata DC.			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Crotalaria usaramoensis Baker f.			
Pink disease	*Corticium salmonicolor* Berk. & Br.	1 record	—
Cucumis sativus L. (Cucumber)			
Leaf spot	*Colletotrichum lagenarium* (Pass.) Ell. & Halst.	Common	93951
Leaf disease	*Mycosphaerella melonis* (Pass.) Chiu & Walker	Occasional	93962
Cucurbita pepo DC. (Vegetable marrow)			
Sooty mould	*Asteridiella confragosa* (H. & P. Syd.) Hansf.	Occasional	93955
Powdery mildew	*Oidium* species	Common	93956
Cymbopogon citratus Stapf. (Lemon grass)			
Leaf scorch & tip die-back	*Curvularia andropogonis* (Zimm.) Boedijn	Occasional	95058*b*
Dendrobium crumenatum Swartz (Pigeon orchid)			
Horse hair blight	*Marasmius equicrinus* Müll.	1 record	—
Derris elliptica Benth. (Tuba root)			
Leaf spot	*Colletotrichum* species	1 record	93963
Sooty mould	*Microthyriella* species	1 record	96188*c*
Sooty mould	*Tripospermum* species	1 record	96188*a*
Desmodium species			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Sooty mould	*Meliola* species	1 record	93290
Dioscorea alata L. (Yam)			
Leaf mould	*Cercospora pachyderma* Syd.	1 record	93291*a*
Dioscorea bulbifera L. (Potato yam)			
Rust	*Goplana dioscoreae* Cumm.	1 record	95052
Dolichos lablab L. (Egyptian kidney bean)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Occasional	—

Durio zibethinus Murr. (Durian)			
On leaves	*Aschersonia* species	1 record	—
Leaf scorch	*Botryodiplodia theobromae* Pat.	1 record	95046
Sooty mould	*Capnodium moniliforme* Fraser	1 record	96187
Leaf scorch	*Glomerella cingulata* (Stonem.) Spauld. & Schrenk	1 record	92392
Leaf mould	*Helminthosporium capense* Thuem.	1 record	95051
Thread blight	*Marasmius scandens* Mass.	1 record	95049
Sooty mould	*Meliola durionis* Hansf.	1 record	93305
Seeding die-back	*Perisporium* species	1 record	93301
Euchlaena mexicana Schrad. (Teosinte)			
Leaf scorch	*Cochliobolus heterostrophus* (Drechsl.) Drechsl.	1 record	98641
Eugenia malaccensis L. (Malay apple)			
Sooty mould	*Asterostomula* species	1 record	93954
Eugenia species			
Sooty mould	*Lembosia eugeniae* Rehm	1 record	92385
Flemingia congesta Roxb.			
Leaf blight	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Occasional	93317
White root disease	*Fomes lignosus* (Klotzsch) Bres.	1 record	—
Gardenia augusta Merr.			
Leaf blight	*Corticium ? solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	96181*a*
Thread blight	*Marasmius scandens* Mass.	1 record	96180*a*
Gerbera jamesonii Bolus (Berberton daisy)			
Leaf spot	*Mycosphaerella* species	1 record	92390*b*
Leaf spot	*Septoria gerberae* Syd.	1 record	92390*a*
Gliricidia sepium Steud.			
Leaf spot	*Cercospora gliricidiae* Syd.	Occasional	98640*c*
Sooty mould	*Meliola gliricidiae* Syd.	Occasional	98640*a*
Glycine javanica L.			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Glycine max (L.) Merr. (Soya bean)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Wilt and pod rot	*Sclerotium rolfsii* Sacc.	1 record	96177
Hevea brasiliensis Muell. Arg. (Rubber)			
Leaf disease	*Colletotrichum brachytrichum* Delacr.	1 record	93293
Leaf scorch	*Didymosphaeria* species	1 record	93316
Sooty mould	*Chaetothyrium annonicola* Hansf.	1 record	96186*a*
Hibiscus mutabilis L. (Rose of Sharon)			
On branches	*Septobasidium* species	1 record	—

Impatiens balsamina L. (Balsam)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Indigofera endecaphylla Jacq.			
Stem and leaf rot	*Sclerotium rolfsii* Sacc.	1 record	98642
Ixora species			
Leaf scorch	*Colletotrichum* species	1 record	93319
Sooty mould	*Phaeosaccardinula javanica* (Zimm.) Yamamoto	1 record	93289
Jasminum sambac Ait. (Jasmine)			
Sooty mould	*Meliola jasmini* Hansf. & Stev.	Common	96173
Lactuca indica L. (Indian lettuce)			
Leaf spot	*Cercospora longissima* Cugini ex Traverso	Common	93958
Lagenaria vulgaris Ser. (Bottle gourd)			
Leaf spot	*Colletotrichum lagenarium* (Pass.) Ell. & Halst.	Common	95057
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Leaf spot	*Phyllosticta* species	1 record	96171
Luffa acutangula Roxb. (Angled loofah)			
Stem rot	*Mycosphaerella melonis* (Pass.) Chiu & Walker	Occasional	—
Fruit rot	*Pythium aphanidermatum* (Edson) Fitzpatr.	1 record	—
Mangifera foetida Lour. (Horse mango)			
Sooty mould	*Atichia millardeti* Rac.	1 record	93288*b*
Leaf spot	*Colletotrichum* species	1 record	93961
Sooty mould	*Phaeosaccardinula javanica* (Zimm.) Yamamoto	1 record	93288*a*
Mangifera indica L. (Mango)			
Sooty mould	*Chaetothyrium mangiferae* Bat. & Lima	1 record	93949*a*
Manihot utilissima Pohl. (Cassava)			
Leaf spot	*Corynespora cassiicola* (Berk. & Curt.) Wei	1 record	92386*b*
Leaf spot	*Glomerella cingulata* (Stonem.) Spauld. & Schrenk	1 record	92386*d*
Leaf spot	*Periconia* species	1 record	92386*c*
On stem	*Septobasidium* species	1 record	93318
Maranta arundinacea L. (Arrowroot)			
Wilt	*Sclerotium rolfsii* Sacc.	1 record	—
Myristica fragrans L. (Nutmeg)			
Sooty mould	*Asteridiella* species	1 record	98630*a*
Leaf mould	*Septobasidium* species	1 record	98630*b*
Nephelium lappaceum L. (Rambutan)			
White root disease	*Fomes lignosus* (Klotzsch) Bres.	1 record	—
Nephelium longana Camb. (Longan)			
Sooty mould	*Stomiopeltella nubecula* (Berk. & Curt.) Theiss.	1 record	93313

Nephelium mutabile Blume (Pulasan)			
Thread blight	*Marasmius scandens* Mass.	1 record	93314
Nerium oleander L. (Oleander)			
Thread blight	*Marasmius scandens* Mass.	1 record	96191
Nicotiana tabacum L. (Tobacco)			
Damping-off	*Pythium aphanidermatum* (Edson) Fitzpatr.	1 record	—
Oryza sativa L.			
Leaf spot	*Nigrospora oryzae* (Berk & Br.) Petch	Common	—
Phaseolus aureus Roxb. (Green gram)			
Leaf spot	*Ascochyta phaseolorum* Sacc.	1 record	98633*b*
Leaf spot	*Cercospora canescens* Ell. & Mart.	1 record	98633*a*
Leaf rot	*Corticium solani* (Prill & Delacr.) Bourd. & Galz.	1 record	—
Phaseolus lunatus L. (Lima bean)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Phaseolus vulgaris L. (French bean)			
Rust	*Uromyces appendiculatus* (Pers.) Unger	Common	93957*b*
Piper betle L. (Sireh)			
Sooty mould	*Asterina piperina* Syd.	Occasional	93302 & 93309
Foot rot	*Phytophthora* species	1 record	—
Piper nigrum L. (Pepper)			
Associated with die-back	*Botryodiplodia theobromae* Pat.	1 record	—
Leaf scorch	*Colletotrichum capsici* (Syd.) Butler & Bisby	Common	98636
Leaf blight	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Occasional	95043
Disease of lateral branches	*Irpex flavus* Klotzsch	1 record	93300*b*
Horse hair blight	*Marasmius equicrinus* Müll.	Occasional	93320 & 93321
On lateral branches	*Septobasidium* species	1 record	93299 & 93300*a*
Plumeria rubra L.			
Leaf spot	*Cercospora* species	1 record	95060*b*
Psidium cattleyanum Sabine (Purple guava)			
Horse hair blight	*Marasmius equicrinus* Müll.	1 record	—
Psidium guajava L. (Guava)			
Sooty mould	*Capnodium moniliforme* Fraser	1 record	96190*b*
Sooty mould	*Chaetothyrium annonicola* Hansf.	1 record	96190*a*
Psophocarpus tetragonolobus DC. (Four-angled bean)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Pueraria phaseoloides Benth.			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—

Raphanus sativus L. var. **hortensis** Backer (Chinese radish)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Common	—
Ricinus communis L. (Castor-oil plant)			
Leaf spot	*Cercospora ricinella* Sacc. & Berl.	1 record	95045
Rosa species (Rose)			
Leaf scorch	*Mycosphaerella rosigena* (Ell. & Ev.) Lindau ex McMurran var. *madagascariensis* (Bouriquet) Wallace	1 record	95042
Saccharum officinarum L. (Sugar cane)			
Leaf spot	*Leptosphaeria* species	1 record	93306*b*
Leaf spot	*Phyllachora sacchari* P. Henn.	1 record	93306*a*
Sauropus androgynus Merr. (Changkok manis)			
Sooty mould	*Asteridiella* species	Occasional	93304
Die-back	*Colletotrichum capsici* (Syd.) Butler & Bisby	Occasional	92391*b*
Sesamum indicum L. (Sesame)			
Powdery mildew	*Oidium* species	1 record	93966
Solanum melongena L. (Brinjal)			
Leaf spot	*Myrothecium roridum* Tode ex Fr.	Occasional	98639
Stylosanthes gracilis H.B. & K. (Stylo)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	1 record	—
Tephrosia candida DC.			
Rust	*Ravenelia tephrosiicola* Hirats.	1 record	95054
Thunbergia erecta (Benth.) T. Anders			
Pink disease	*Corticium salmonicolor* Br. & Berk.	1 record	—
Thread blight	*Marasmius scandens* Mass.	1 record	93324
Vigna sinensis Savi (Long bean)			
Leaf rot	*Corticium solani* (Prill. & Delacr.) Bourd. & Galz.	Common	—
Leaf spot	*Corynespora cassiicola* (Berk. & Curt.) Wei	1 record	93950*b*
Wilt	*Sclerotium rolfsii* Sacc.	1 record	—
Zinnia elegans Jacq. (Zinnia)			
Leaf spot	*Cercospora zinniae* Ell. & Mart.	Common	96185

Acknowledgements

The writer wishes to thank the Director of Agriculture, Sarawak, for permission to publish this list, and the Director and staff of the Commonwealth Mycological Institute, without whose help, in identifying the majority of the species, this list could not have been published.

References

Johnston, A., (1960) "A preliminary plant disease survey in Sarawak". F. A. O. Rome, (mimeographed).

Turner, G. J., (1963) "New records of plant diseases in Sarawak for the years 1960 and 1961." Gdns'. Bull. Singapore. (xx 285–288).

POTHOS AUREA, Hort. Linden

by

C. X. FURTADO, *Singapore*

This is an aroid with a long history. In 1880 it was published for the first time under the name given above in *L'Illustration Horticole* Vol. 27 p. 69 Pl. CCCLXXXI. This monthly horticultural review was published at Gand in Belgium under the editorial responsibility of Ed (ouard) Andre, while J (ean) Linden, the horticulturist who owned a commercial garden in the city, was its manager and publisher. The descriptive notes are signed by Andre, although the selection of the material and the accompanying coloured plate might have been made under the direction of Linden. But since the plant was first named in Linden's garden and only later the name published botanically by Andre, many botanists attributed the authorship of the name jointly to Linden and Andre; however, under the modern rules of botanical nomenclature, the credit of the authorship should be given to Andre only, for it is obvious from the publication that Andre alone was responsible for associating the name with its description that is permissible under the rules for giving the name a botanical status. Yet the fact that the name was first adopted in the garden by Linden might be indicated by citing the authorship as "Linden *ex* Andre", not as "Linden *et* Andre" which is used to indicate a joint authorship. The plant was stated to have been introduced in Linden's garden in 1879 from the Solomon islands in the South Pacific.

The aroid forms a very attractive, decorative plant because of its large golden yellow blotches produced on its leaves when the plant is grown in situations exposed to light. It grows luxuriantly as an epiphyte on a variety of conditions, making little demand on water and care, for it will grow as a creeper on rocks, trellis work, on walls and even as a miniature plant indoors and on mantle pieces when placed in small decoration vases containing little water. Further it is easily multiplied from cuttings. All these qualities have helped to make the species spread widely in cultivation to almost all parts of the world. However botanically the species has been insufficiently known, for despite its long history and wide distribution in cultivation, its flowers have not been described, though botanists have been keeping a watchful eye on the plants in several botanical gardens of the world. Judging from its vegetative characters alone A. Engler, who specialized in the Aroids and had opportunities to examine herbaria and living botanical collections in many parts of the world, thought the species should be placed in the genus *Scindapsus* and accordingly he made the transfer of the specific epithet to produce the binomial *Scindapsus aureus* (Linden et Andre) Engler in *Pflanzenreich* Heft 37, 1908, p. 80, though, as said above, it is correct to use *ex* after Linden in place of *et*, or omit the name of Linden altogether. Some are of the opinion that it is an *Epripemnum* species, but according to Bunting (*Baileya* 10: 29. 1962) there is little evidence to justify its transfer to that genus.

In Malaya, too, the plant has been long in cultivation and before the World War II the public utilized it mostly for indoor decoration. But in places like the Botanic Gardens, Singapore, the plant was grown in different positions for the purpose of studying its behaviour and to see whether it would produce any flowers and fruit. According to the notes made by me in June 1928, the plant which climbs and produces very small leaves indoors when placed in small phials containing water, grow into a large plant when planted in the ground outdoors and allowed to climb on trees or on any vertical objects. If grown in situations exposed to sunlight the large leaves retain their yellow markings which vary from yellowish white to orange yellow and yellowish green. If grown in shade, the yellow markings tend to disappear and the plant may produce leaves that are completely green. When grown on short posts or plants, it sends down from the top long pendent stolons which, on reaching the ground, root and trail until they find suitable supports for growing vertically upwards. The trailing stem is very slender and produces very small leaves which are entire and heart-shaped. Later on, when it finds a vertical object to climb up, the stem and the leaves increase in size so that the plant may finally produce huge leaves about 15–20 inches or more long and about 15 inches in width, with a petiole about 12 inches long. The larger leaves are frequently divided into irregular lateral divisions which go deep, about the quarter of the breadth of the leaf-blade. In structure of the leaf this plant seems to be a very close ally of *Epipremnum pinnatum* (L) Engler, a plant also cultivated in the Botanic Gardens, Singapore, and widely distributed in nature throughout Indo-Malaysia from South West Burma to new Guinea, occurring also in Indochina and South China and the monsoon regions of north-east Australia.

However *Pothos aurea* seems to have been never collected again in the wild state, so that all the progeny now spread throughout the world might have derived from the juvenile state originally grown in Linden's garden in Gand. During the recent years many Malayans who now have their own houses with very little vegetation growing around, have started planting this aroid in the open in their compounds or growing in large pots with erect supports. It has come to be known as the 'Money Plant' apparently on the superstitious belief that the person who finds his plant in flower would quickly acquire wealth. One such plant, grown by Mrs. R. R. Sarathee in a kerosene tin in the verandah of her flat on the third floor of a building in Singapore, was fortunate enough to produce flowers, in September 1961, though its owner is yet far from being a wealthy person. And it is through her kindness in allowing me to take a leaf and a spadix from the plant that this note has been possible. The plant had produced three spadices in all, but the other two which were kept on the plant, failed to attain maturity and went bad. Apparently the plant flowered again in December 1961, but I was not able to obtain any specimen.

An analysis of the spadix confirms that the plant is indeed very near to *Epipremnum pinnatum*. However I agree with Mr. D. H. Nicolson of Bailey's Hortorium, Ithaca University, U.S.A., who worked for some time in Singapore and who in his manuscript key sinks the genus *Epipremnum* to unite it with *Raphidophora*, for the distinction between these two is not very marked. Hence when the specific epithet is instated in the latter genus, the new combination *Raphidophora aurea* (Linden ex Andre) comb. nov. is obtained. Bunting (op. cit: 25–29, 1962) argues in favour of retaining *Epipremnum* distinct from *Raphidophora*. The botanical details are given below and in the accompanying figure:

Raphidophora aurea (Linden *ex* Andre) Furtado **comb. nov.** Fig. 1.

Pothos aurea Linden ex Andre in *Ill. Hort*. 27 (1880) 69 pl. 381: **basionym** *Scindapsus aureus* (Linden ex Andre) Engl. in *Pflanzenr*. 37 (1908) 80: **isonym** **Pedunculus** validus, circa 6 cm. longus, 10–15 cm. mm. crassus. **Spatha** crassa, carnosa, albescens, cymbiformis, breviter acuminate, circa 15 cm. longa, 6–7 cm. lata. **Spadix** sessilis, quam apatha paulo longior, cylindricus, apice obtusus, 17–19 cm. longus, 2–3 cm. crassus. **Stamina** 4; filamenta lato linearia, ovario paulo longiora, infra antheras ovales biloculares valde angustata. **Ovarium** hexagonale, biloculare, vertice truncatum, stigmate lineari coronatum; ovula prope basin sita. **Bacca** ignota.

MALAYA: Singapore, (Furtado: 28-ix-1961—SING).

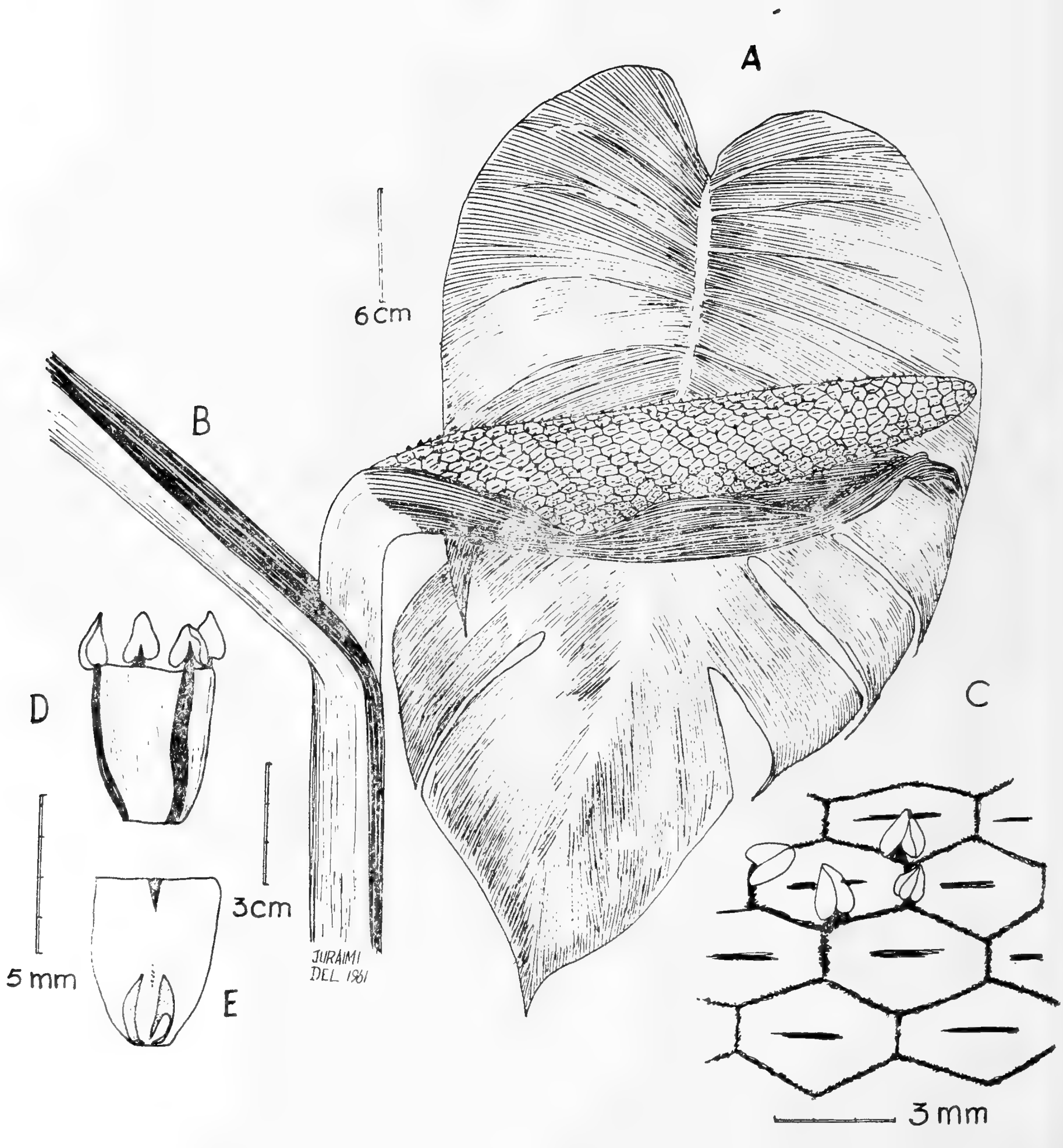


Fig. 1. A. Folium. B. Inflorescentia cum spatha pedunculoque. C. Spadicis pars ut ovaria antheraeque apparent. D. Pistillum a latere visum. E. Pistillum verticalliter sectum.

Mrs. R. Sarathee standing by the side of her "Money Plant" in flower.

Malayan Fern Notes, III

Arthropteris in Malaya

by

Betty Molesworth Allen

ARTHROPTERIS J. Smith in J. D. Hooker, Fl. of N. Z. (1854) 53.

A. PALISOTII (Desv.) Alston in Bol. Soc. Brot. vol. 30(1956) 6. syn. *A. obliterata* sensu C. Chr. Ind. Fil. (non R. Br.).

Tapah Hills Forest Reserve, Cameron Highlands Road, Perak, Malaya. On tree in forest near 23rd milestone, at 2,000 feet altitude. Very rare. Coll. numbers: 4594, 7.7.60; 4649, 2.3.61; 5013, 24.4.63.*

This widespread species (and genus) apparently does not appear to have been found previously in the Malay Peninsula nor in Singapore, although Beddome (4) does record it from here, and Ridley (16), under *Nephrolepis ramosa* lists it as having been collected by Matthews in Selangor (Batu Caves), but Holttum (12) states that the genus has not yet been found in Malaya. I have not seen any Malayan material, apart from my own, in other herbaria.

According to Holttum's classification (11), *Arthropteris* belongs to the Dennstaedtiaceae, in the subfamily Oleandroideae, of which both *Oleandra* and *Nephrolepis* are represented in Malaya. Copeland (9), on the other hand puts these into Davalliaceae, as does Miss Tindale in her treatment of this family for SE. Australia (19), (but she uses the subfamily Oleandroideae).

Description of the species in Malaya

The Malayan material matches quite well the description of the species (under either *A. palisotii* or *A. obliterata*) in various works, and herbarium material was examined by me at Kew, British Museum (Nat. Hist.), Singapore Botanic Gardens, and the Smithsonian Institution and I am most grateful to the Directors of these institutions for their courtesy in allowing me to make use of their libraries and collections.

The following description is taken from the Tapah Hills specimens, and from living material unless otherwise stated.

---

*The numbers refer to my collection and specimens have been sent to: Royal Botanic Gardens, Kew; British Museum; Singapore Botanic Gardens: Smithsonian Inst.; Chicago Natural History Museum; Natural History Museum, Sweden; and Forest Dept. Sarawak.

Rhizome dark, long-creeping, climbing vertically up tree-trunk for about 8 to 10 metres or more. Rhizome diameter 3–5 mm. (1.5–3 mm. when dry) not more; green when young, maturing dark brown (almost straminous when dry). New growth covered with flat, blackish-brown dull scales which have thick cell walls, a central paler patch and a shiny base; scales are about 1×2 mm. and are drawn out to a blunt apex. Except for the basal part they are fugacious, and so old rhizomes are sparsely scaly. Amongst the scales on newer growth are small, thin brown hairs.

Fronds are spaced 4–5 cm. apart on adult rhizomes, but on new growth may be 5.25 to 6 cm. apart. Fronds are simply pinnate, slightly pendulous and the largest sterile frond seen measured 21.5×4.5 cm.; fertile being between about 20 to 51 cm. long, including stipes, and about 6.75 cm. wide, but most commonly about 38 cm. long. Fronds are usually fertile for about two-thirds of the length, but sometimes all the pinnae are fertile except for the basal auricles which always appear to be sterile. The stipes on adult fronds vary enormously in length from a few centimetres to 17 cm.; rachises are dark, dull and on the underside are densely pubescent. *Pinnae:* jointed to the rachis, from about 21 to 43 uneven pairs with a terminal pinna dissimilar in shape and not jointed. Pinnae, largest in the middle of the frond, becoming gradually reduced to the base, the last five pairs being auricles no more than 1 cm. long, but similar in shape to those above which are commonly 2.2–3.5 cm. long by about 1 cm. wide. Pinnae margins are unevenly crenate and the aroscopic base is truncate and auriculate to a length of 7 mm. and this sometimes overlaps the rachis. The basioscopic base is not auriculate and is sharply cut away from the rachis. Apex of pinna, variable in shape but usually drawn out to a fairly blunt, or less commonly, sharp tip. Lamina medium to yellowish-green and dull with indistinct veins, glabrous (but often covered with epiphyllous growth) on the upper side except for the veins, and below sparsely scattered with very short thin scales, which are lost to a certain extent as the frond matures. On young fronds the scales on the veins are light brown with a slightly pale, thickened and shining edge. When dry, fronds are olive-brown, or with a reddish tinge if dried rapidly. Apical pinna not similar in shape to lateral pinnae, but long-triangular, crenate and often with a lobe at the base, and usually about 3×1 cm. *Veins,* midrib raised above and below, more so above; other veins not raised but sunk below, indistinct, free, to about

12 pairs ending in hydathodes or sori; the lowest acroscopic vein forked several times, the next forked twice with both secondary forks nearly meeting the margin. In fertile fronds the third acroscopic vein often forked twice, otherwise all the others (except the lowest basioscopic vein which is simple) usually forked once only, with one long and one short veinlet. Veins of auricle with several forks. *Sori,* round, placed on vein or veinlets ends occasionally on the forks, usually only one sorus to a vein group and always on the acroscopic veinlet, except on the pinna auricle where there are several sori. *Indusium* reniform, dark brown when mature, not always fugacious.

Juvenile fronds on the rhizomes which were at the tree base, were all about 5×1.75 cm., with 4–5 uneven pairs of small pinnae, yet each apex was already the size of the adult (3×1 cm.); margins of pinnae were faintly crenate, the texture thin and the fronds light green and drying olive-green.

General distribution: From China, Hongkong, Formosa to Siam, Ceylon and the Philippine Islands, Borneo, Sumatra, Java, Christmas Id. (Indian Ocean), Australia to the Pacific Is., Tropical West Africa and Uganda.

As the above distribution shows, it is in no way remarkable that this fern should have turned up in Malaya. In 1960 I found several rhizomes which were on one tree trunk, but no more in the surrounding area although I searched for them, in the very tall forest which is on steeply sloping ground. There was not much undergrowth, and the tree, unfortunately not identified, was near a stream. It had scaly bark and at 40 cm. from the ground was 145 cm. in circumferance and was about 20 m. high. Juvenile fronds of *Arthropteris* were quite common at the base of the trunk and none was fertile. The first fertile frond was at 3 m. up the trunk but that was very old. There were no more for at least another two metres, nearly a dozen were counted. In 1963 newly fertile fronds (seen with field-glasses) were 8–10 m. from the ground and none lower, and the young basal fronds had gone, but others were now on the rhizomes on this and another tree trunk both approximately 100 cm. up. Also another patch was seen nearby growing on a small flat rock near and level with. the stream. There were no mature fronds here (5013).

In the field *Arthropteris obliterata* looks rather similar to the common climbing *Trichomanes auriculatum,* which grows fairly near, but it does seem strange that the former should be so rare here. Oddly enough, within this small locality I have found several other very interesting ferns, a new species of *Tectaria,* another *Tectaria* not yet identified but certainly new to Malaya, and

T. melanocaulis, Cyclosorus papilio and several other rare ferns and gingers. This is a narrow ravine and in the past, does seem to have been left quite undisturbed by the aborigines who have destroyed or opened up most of this forest reserve, especially in this immediate area, so that there is little primitive forest left close to the road. Possibly the reason is that there are many stinging trees in this area: young *Antiaris toxicaria, Laportea stimulans,* which is very common, and some large trees of Renghas (*Gluta* spp.).

The Malayan plant agrees well with other specimens of *A. palisotii* I have seen in various herbaria, except that it appears to be more glabrous on the whole, but this character seems to vary a great deal and is probably not of great importance. I have seen *A. palisotii* growing on trees in Christmas Id., where it is very common, and there it looked identical to the Malayan specimens, some being just as glabrous.

Through the kindness of Mr. Morton, Curator of Ferns, I was able to examine the type material of *A. glabra* at the Smithsonian Institution in Washington. It differed in its entirely glabrous laminae which were thicker in texture, and in the rhizome scales. At Kew, however, I saw some material which seemed to be intermediate between the two species.

The colour of the dried specimens varies greatly although Hooker (14) states that the plants turn blackish when dry, but this seems to depend a great deal on the manner of drying and whether the fronds are young or old. Also the indusia is not always fugacious* often remaining on the sori after maturity, and a note on a sheet from Siam, in Eryl Smith's handwritting indicates that she found this was the case also, and Tindale states that it is persistent.

Notes on nomenclature

Previously *Arthroptoris palisotii* was split into two species, this one being confined to Africa, whilst the other, *A. obliterata* (of which many synonyms were used), was spread through Asia to the Pacific (although Hooker includes W. Tropical Africa in its distribution under *Nephrolepis obliterata*).

Alston (1) and Tindale (19) considered that the two species were conspecific, and so the name *A. palisotii* had to stand, for *A. obliterata* as described by Robert Brown, was not a valid name.

In the past there has been a great deal of confusion surrounding the nomenclature of '*A. obliterata* (R. Br.) J. Sm.' and Miss Tindale has added a clarifying note on this.

---

*see Copeland (10) and van Alderwerelt van Rosenburg (20).

When the species was included under *Nephrolepis*, Carruthers (6) under *N. trichomanoides* points out that the type sheet of R. Brown's *Nephrodium obliteratum* (collected by Banks and Solander in Australia) was in fact, a true *Nephrolepis*, and gives the tentative name of *N. obliterata* which Alston (1) has quoted. Carruthers goes on to say that the description of *N. obliterata* in Hooker's Species Filicium (14) is taken from *N. ramosa* T. Moore (i.e. Palisot-Beauvois' description of *Aspidium ramosum* and thus *not* from R. Brown's description).*

Robert Brown's specimen is a sterile (true) *Nephrolepis* species, but he describes the sori in his original description (5). As Alston suggests, the name should be abandoned. Christensen (7) gave a fresh description of *Arthropteris obliterata* excluding R. Br's name as a synonym which had been used in part by Smith, viz. *A. obliterata* (R. Br.) J. Sm. in (17). This should not be used as a synonym.

Synonyms

Aspidium palisoti Desveaux, Ges. Naturf. Berl. Mag. 5 (1811) 320. (Basinym).

A. ramosum Palisot-Beauvois, Fl. d'Oware 2 (1818) 54, tab. 91.

A. obliteratum Spr. Syst. 4 (1827) 99.

A. sublobatum Schum. Kongel Dansk. Vid. Sekle. Naturid. & Math. Arth. 4, (1829) 235.

A. undulatum Sw. (?) (see Hooker Sp. Fil. (1862).

Arthropteris obliterata sensu C. Chr. Ind. Fil. (1906) 62. (Exclud. syn. R. Br.).

A. ramosa (Palisot-Beauvois) Mett. Reise Osterr. Freg. Nov. Bot. 1 (1870), 213.

Nephrodium subpectinatum Blume, En. Pl. Jav. (1828) 143.

N. trichomanoides J. Smith, Hook. Bot. Journ. 3 (1841) 413, (name only).

N. repens Brack. Fil. U.S. Expl. Exped. 209 (see Hooker, Sp. Fil. 1862).

Nephrolepis trichomanoides J. Smith, nomen Presl, Epim. (1849) 44.

N. ramosa (Pal.-Beauv.) T. Moore, (1858); (see Syn. Fil. (W. J. H.) 1874, 301).

N. lepidoneuron Fee, ? 1850–52.

N. obliterata Hk. (see Sp. Fil. 4 (1826) 154, non (R. Br.).

Note:—*Nephrolepis obliterata* (R. Br.) Carr. refers to R. Br.'s specimen and so is not a synonym of *Arthropteris palisotii.*

*the brackets are mine.

Bibliography

1. ALSTON, A. H. G. (1956) New American Ferns: Boletin Sociedade Broteriana Vol. 30, 2A Series, 6.
2. ALSTON, A. H. G. (1959) The Ferns & Fern Allies of W. Tropical Africa, 52.
3. BEAUVOIS, PALISOT DE, (1821) Fl. d'Oware, 2; 54, tab. 91.
4. BEDDOME, R. H. (1892) Handbook of the Ferns of British India; 285, Fig. 145.
5. BROWN, ROBERT (1810) Prodromus Florae Novae Hollandiae et Insulae van Dieman, 1; 148.
6. CARRUTHERS, (1873) (The pteridophyta in Seemen's Flora Vitiensis) 362.
7. CHRISTENSEN, C. (1906) Index Filicum, 62.
8. COPELAND, E. B. (1905) Polypodiaceae of the Philippine Is., 46.
9. COPELAND, E. B. (1947) Genera Filicum, 91.
10. COPELAND, E. B. (1958) Fern Flora of the Philippines, 1; 190.
11. HOLTTUM, R. E. (1949) The Classification of Ferns. Biol. Review, 24; 287.
12. HOLTTUM, R. E. (1954) A Revised Flora of Malaya, Vol. 2, Ferns of Malaya, 372.
13. HOLTTUM, R. E. (1959) Flora Malesiana, Series 11; Pteridophyta, xx.
14. HOOKER, W. J. (1862) Species Fillicum, 4; 154.
15. HOOKER, W. J. (1874) Synopsis Filicum, 301.
16. RIDLEY, H. N. (1926) The Ferns of the Malay Pen.; Mal. Br. R.A.S. Vol. 4; 60.
17. SMITH, J. (1857) Catalogue of Cultivated Ferns, 62.
18. TARDIEU-BLOT, M. L. (1953) Les Pteridophytes de l'Afrique intertropicale Francaise, 28; 158.
19. TINDALE M. D. (1961) Contributions from the N.S.W. National Herb., Flora Series Nos. 208–211; 11.
20. VAN ALDERWERELT VAN ROSENBURGH, C. R. W. K. (1908) Malayan Ferns Vol. 1; 155.
21. VAN ALDERWERELT VAN ROSENBURGH, C. R. W. K. (1916) Mal. Ferns & Fern Allies, Supp. 1; 133.

Plate 2. *Arthropteris palisotii* (Desv.) Alston.
Juvenile frond, older than those in Pl. 1.
Perak: April 1963. (Photo by F. G. H. Allen).

Plate 1. *Arthropteris palisotii* (Desv.) Alston.
Juvenile fronds. Perak: April 1963.
(Photo by F. G. H. Allen).

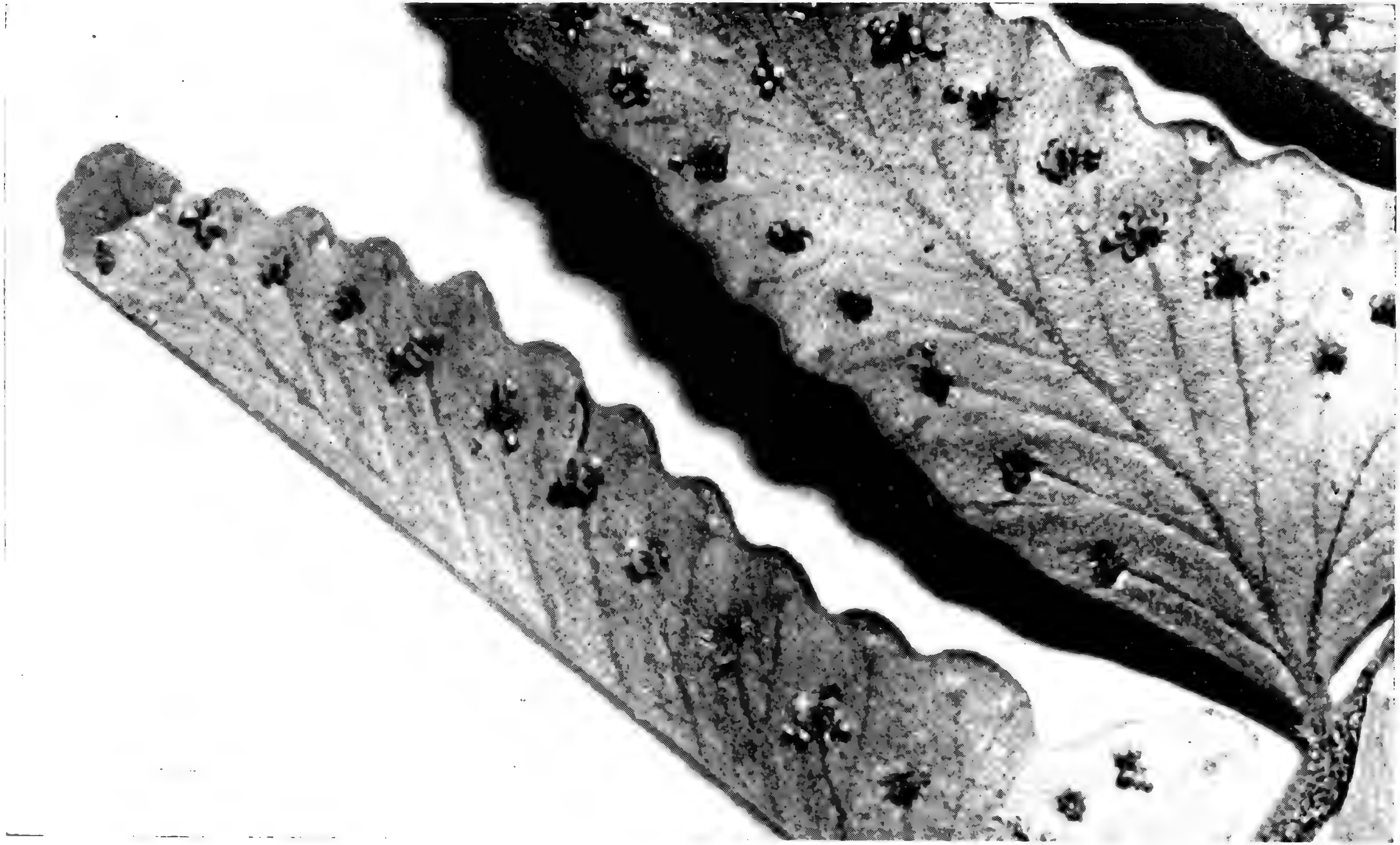


Plate 3. *Arthropteris palisotii* (Desv.) Alston.
Pinnae showing old sori with persistent indusia.
Perak: July 1960. (Photo by B. E. Allen).

INDEX

(*a*) Names of authors of papers in capitals:
(*b*) New taxa and binomials in bold print:
(*c*) Taxonomic synonyms in italics.

OTHER PUBLICATIONS OF THE BOTANIC GARDENS SINGAPORE

1. **Annual Reports.**

    Many from 1909 onward remain available.
    Prices variable.

2. **The Agricultural Bulletin of the Malay Peninsula (Series I).**

    Only Nos. 3, 5, 7, 8 and 9 available at 20 cents each.

3. **The Agricultural Bulletin of the Straits and F.M.S. (Series II).**

    Vols. 1–10, 1901–1911, monthly issues.
    All available except Vols. 1, 2 and 9.
    Price: $5 per volume.

4. **The Gardens' Bulletin, Straits Settlements (Series III).**

    Vols. 1–11, 1912–1947.
    Vols. 1 (1–5) January-May 1912 is issued under title of Agricultural Bulletin of the Straits & F.M.S.
    All parts available, except Vol. 1 No. 10, Vol. 2, Vol. 3 Nos. 1–3 and Vol. 11 pt. 3.
    Prices variable.

5. **The Gardens' Bulletin, Singapore (Series IV).**

    Vols. 12–20, 1949 — *.
    All parts available. Prices variable. Issues are irregular.
    Subscription will be entered against deposit.
    Available on exchange.

6. **Materials for a Flora of the Malay Peninsula, Monocotyledons.**

    Parts 1, 2 and 3 remain available.

7. (*a*) **Malayan Orchid Hybrids by M. R. Henderson and G. H. Addison.**

    Price $21.

    (*b*) **Malayan Orchid Hybrids, Supplement I by G. H. Addison.**

    Price $15 (Photo-lithographic reprint).

8. **A Revised Flora of Malaya.**

    (*a*) Vol. 1, Orchids, by R. E. Holttum. Price $20.
    (*b*) Vol. 2, Ferns, by R. E. Holttum. Price $20.

9. **Wayside Trees of Malaya by E. J. H. Corner, 2 Vols.**

    Price $25.

Items 1–6 can be obtained from the Director, Botanic Gardens, Singapore.

Items 7–9 can be obtained from the Government Printer, Government Printing Office, Singapore.

Prices quoted are in Malayan Dollars
Overseas postage is extra

1084—50:—9/64