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STUDIES IN THE GESNERIACEAE OF THE OLD WORLD XLV: A PRELIMINARY REVISION OF MONOPHYLLAEA

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ABSTRACT. The history and concept of *Monophyllaea* are reviewed and the genus *Moultonia* is reduced to synonymy. Two subgenera are recognised, largely defined by the structure of ovary and fruit. Subgenus *Monophyllaea* now includes 20 species, 14 being described as new; subgenus *Moultonia* (which has a much wider scope than the old genus *Moultonia*) includes 12 species of which 6 are new. The range of the genus is from S Thailand to New Guinea and from Luzon to Java: the numerical headquarters is in Sarawak, but a more easterly origin is thought possible. The ecology and patterns of growth of *Monophyllaea* are considered and there is a key to the species, which are enumerated with descriptions.

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INTRODUCTION

The curious growth-form of *Monophyllaea horsfieldii* is familiar from its illustration in standard text-books (e.g. Wettstein 1911, Goebel 1913). That the single large leaf is a cotyledon was already deduced by Bentham (1876) from analogy with that of the unifoliate species of *Streptocarpus*, which had been investigated by Caspary (1858). However, *Monophyllaea* itself was not introduced to cultivation until about 1897 (Fritsch 1904, p. 50), the first brief account being included with work on *Streptocarpus* by Pischinger (1902).

The additional species of *Monophyllaea* that have been described up till now all have a single foliar organ like that of *M. horsfieldii*. Recently, however, the morphological position has become much more exciting with the discovery of species with elongate "stems" and a succession of "leaves". This recalls the situation in *Streptocarpus*, where the evolution of a more elaborate plant body from the unifoliate forms has been brought about by a new, morphologically integrated unit that we have called a phyllomorph (Jong 1970, Hilliard & Burtt 1971, Jong & Burtt 1975). The growth-patterns of *Monophyllaea*, and their interpretation, are discussed more fully below (p. 15).

Monophyllaea is largely a genus of limestone habitats, but the species demonstrate further ecological diversity in relation to the microhabitats that occur on limestone (p. 8). Plants are frequently encrusted with the excretion of the numerous chalk-glands: as a result they tend to be brittle when dried. In addition the small corollas, unless they are preserved with special care, tend to disappear in the preparation of specimens. Consequently herbarium material is often poor. Perhaps because of this the taxonomy of *Monophyllaea* was for long neglected. My own interest might well have remained marginal had I not had the opportunity to see and collect living plants on the Malay Peninsula and in Sarawak in 1962. Although that experience fired my enthusiasm for the genus, I was able to do little on a return trip to Sarawak in 1967; however in 1975 a third visit to Sarawak was directed almost entirely to limestone areas and proved really rewarding. Thus a major part of this study is based on my own collections, and inevitably the treatment of the genus in Sarawak is more detailed than for other areas; yet even in Sarawak much more work needs to be done.

While my taxonomic studies have been making slow progress, Dr Anton Weber, of the University of Vienna, has revived interest in the general morphology and evolution of the genus, and its allies, in a series of stimulating papers (Weber 1975, 1976a, b). Dr Weber has contributed valuable data on ovary structure to the present revision, which, despite its many deficiencies, will provide a more realistic taxonomic background for an appreciation of his work than is presently available. *Monophyllaea* emerges from revision as a much larger and more highly diversified genus than the literature suggests. It should emerge too, if limitations of the written word permit, as quite one of the most fascinating genera of tropical herbs, and one deserving much more study. This is true not merely of its morphology and ecology but of the variety of its taxonomic problems. To emphasise this I have brought the comments on the better-known species together (p. 13) so that they can be read consecutively. In this way they will give an idea of the taxonomic diversity of the genus, and, complemented by the notes on ecology and growth patterns, will provide an outline sketch of the portrait of *Monophyllaea* that deserves to be painted in meticulous detail.

TAXONOMIC HISTORY

Monophyllaea was described by Robert Brown in 1840, and was based on a plant collected in Sumatra by Horsfield. Twenty years later a second species was added, *M. hirtella* Miq., also from Sumatra. In 1883 the genus was revised by C. B. Clarke in his monograph of the Cyrtandreae, and the number of species was raised to six. It is worth noting that Clarke was working with a total of only nine specimens; *M. horsfieldii* alone was represented by more than one, there being two from Sumatra, one from Java and one from the Malay Peninsula. Later authors have reduced Clarke's *M. pygmaea*, also from Java, to *M. horsfieldii*. Clarke's other three species, *M. glauca*, *M. beccarii* and *M. lowii* were all from Borneo and are here treated as varieties of one (see discussion, p. 14).

Clarke's is the most recent account of the genus as a whole. Since then a further ten species have been described and the known range now extends from southern Thailand, to the Philippines and New Guinea.

An independent genus, *Moultonia*, was proposed in 1915 by Bayley Balfour & Wright Smith for a curious Bornean plant that has the flowers almost sessile up the stalk and along the midrib, not in pedunculate inflorescences arising from the leaf base as in all the species of *Monophyllaea* then known. *Moultonia* has, however, here been reduced to *Monophyllaea*, as suggested by van Steenis (1961); it would be distinguishable only by the peculiar disposition of the flowers: other characters do not hold.

In the present revision 32 species are recognized and 20 are named as new, while one more is left unnamed until better material becomes available. Sarawak is now clearly the headquarters of the genus in numerical terms, but the newly discovered *M. caulescens* and *M. wildeana* show that there is a remarkable range of form on Sumatra. Knowledge of *Monophyllaea* east of Borneo is still rather fragmentary.

PRIMARY SUBDIVISION OF THE GENUS

Discussion of growth-patterns and distribution is more easily undertaken after the primary subdivision of the genus has been established. In the early stages of this study it was noted that the fruit of *M. horsfieldii* breaks up into 4 valves after the style base has fallen. On the other hand in *M. glauca* or *M. merrilliana* the fruit wall was observed to be very thin, not breaking up into valves, and the style base was expanded over the top of the ovary so that when it fell the capsule was effectively porose. It was thought that the whole genus could be split into two using these characters; later, however, some species were found to have very thin fruit walls in which a valvular structure was just detectable, and there was also considerable variation in the behaviour of the style base. The rigid application of these criteria was clearly going to be difficult, despite a tendency for some other minor characters to support the division.

In the next stage of the work, these characters were utilized in the grouping of the species, but the idea of a formal subdivision of the genus receded. In November 1975, however, after examining some of the material from my 1975 collections in Sarawak, Dr Anton Weber acquainted me with his observation that the placental structure of *M. merrilliana*, *M. glauca* and *M. tetrasepala* differed from that of *M. horsfieldii* and *M. hirticalyx* (the two species with which he had previously been working) and some allied species

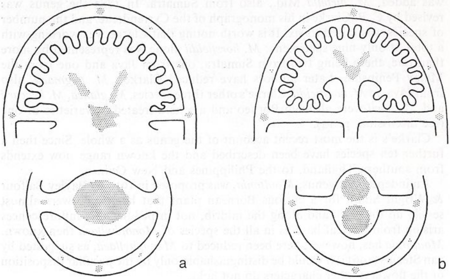

FIG. 1. Diagrams of the two types of ovary: sections of fertile and lower sterile region: a, subgen. *Monophyllaea*; b, subgen. *Moultonia*.

from Sarawak. In brief the placentae of *M. horsfieldii* and similar species have a broad attachment to the septum and there is a single well-marked median vascular strand (fig. 1a, fig. 2); in *M. merrilliana* and its allies the placentae have a thin attachment to the septum and appear anchor-shaped in transverse section, with a vascular strand in each (fig. 1b, fig. 3). Dr Weber offered to follow up these observations to see if they had a consistent taxonomic value. This offer was gladly accepted and a range of material was supplied, sectioning being carried out by his colleague Miss S. Klenner. The results show a clear division of the genus into two groups, similar to the groups I had previously tried to establish on fruit characters.

One exception to this regular pattern must be mentioned. In *M. leuserensis* (*de Wilde* 14990), the attachment of the placenta to the septum is broad-based, as in *M. horsfieldii*, but each placenta contains a vascular strand, as in *M. glauca*. Fortunately, *M. leuserensis* is in every way a close ally of *M. horsfieldii*, and has the pedicels much longer than the calyx. Thus it demonstrates that variation in vasculature does occur; it does not invalidate the distinction of the two groups.

The important progress made by this anatomical study was the demonstration that all the plants I had marked as intermediate, the plants with thin faintly demarcated fruit valves, belong to the placental type of *M. horsfieldii*, where the fruit valves are better developed. Thus a clear-cut underlying morphological criterion is provided. In view of this, and of the presence of minor supporting characters, it has seemed right to revive the idea of a formal subdivision of the genus into two groups.

The next question has been to decide on the taxonomic rank of these groups. Because differences in general appearance are not very great, sectional level might seem appropriate; on the other hand the difference is believed

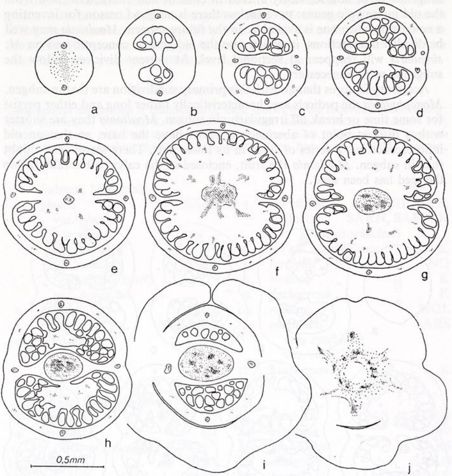

FIG. 2. Transverse sections through the ovary of *M. horsfieldii* (*Jong* s.n., 29 x 1971; cultivated material). a, style; b, transition to the ovary (septum incomplete); c, septum complete; d, beginning of the placenta; e–g, main part of the fertile region, showing the large central bundle; h, lowest part of the fertile zone; i, sterile region; j, opening of the central bundle to a ring.

to be fundamental, because the few species that are in other respects highly distinctive, such as *M. caulescens*, *M. wildeana* and *M. singularis*, nevertheless clearly show one pattern or the other.

It may well be that further grouping of species within these two major units will eventually be found useful: but the first division within the genus should be by these placental and fruit characters. The resultant groups should therefore be ranked at the level next below the genus, that is as subgenera; this leaves sections and series available for minor associations if required.

Monophyllaea is therefore divided into two subgenera. The one including the type species, *M. horsfieldii*, automatically becomes subgenus *Monophyllaea*: for the second the generic name *Moultonia* is retained. The new subgenus is, of course, vastly altered in content and characterization from the old monotypic genus: nevertheless there is no good reason for inventing a new name when one is available. In the future subgen. *Moultonia* may well be divided into sections, in which case the old generic concept based on *M. singularis* will reappear at sectional level. At present divisions below the subgenus seem unnecessary.

Accessory features that go with this primary subdivision are that in subgen. *Monophyllaea* the pedicels are characteristically rather long and either persist for some time or break off irregularly: in subgen. *Moultonia* they are shorter with a distinct point of abscission a little above the base, so that an old inflorescence has a series of stubs in its lower part. There seems little doubt that in subgen. *Moultonia* the fruit, enclosed in the calyx, often falls before the seed has been shed.

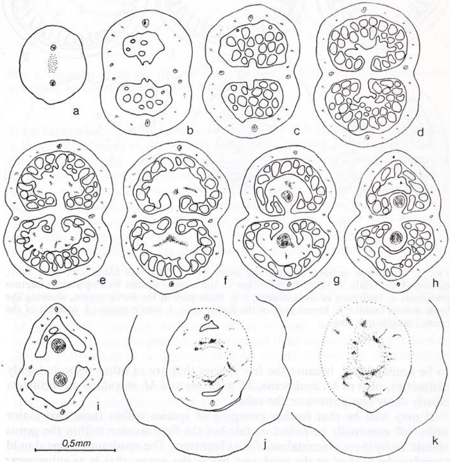

FIG. 3. Transverse sections through the ovary of *M. glauca* var. *versipes* (*Burtt* 8185). a, style; b,c, transition to the ovary showing the complete septum; d, (combination of sections), division of the placentae in the uppermost part of the fertile zone; e–f, anchor-shaped placenta; g, showing the two large median bundles; h,i, sterile region; j,k, formation of a ring.

Other differential features are not found throughout the subgenera, but all plants with branched hairs belong to subgen. *Moultonia*, as do species in which the inflorescences are regularly scattered up the midrib, and those with branched inflorescences (except *M. wildeana* with its distinctive bracteate branching, and perhaps the little-known *M. hirtella*).

SUMMARY OF CLASSIFICATION

Geographical distribution is indicated after each species by the following abbreviations: CEL, Celebes; J, Java; K, Kalimantan (Indonesian Borneo); MOL, Moluccas; MP, Malay Peninsula; NG, New Guinea; PHIL, Philippines; SAB, Sabah; SARN, Sarawak north of the Baram river; SARS, Sarawak south of the Baram river; SUM, Sumatra; T, Thailand.

Subgen. **Moultonia**

1.	*glauca*	SARS
	var. *glauca*	
	var. *hirta*	
	var. *beccarii*	
	var. *versipes* (incl. *M. lowii*)	
	var. *boraginea*	
2.	*eymae*	CEL
3.	*brevipes*	NG, MOL
4.	*tetrasepala*	SARS
5.	*merrilliana* (incl. *johannis-winkleri*)	PHIL, SAB, SARN, SARS, K
6.	*sp.* aff. *merrillianae*	K
7.	*furcipila*	NG
8.	*stellata*	K
9.	*anthocrena*	K
10.	*ramosa*	MOL
11.	*singularis*	SARS
	var. *singularis*	
	var. *semiflorens*	
12.	*kostermansii*	K

Subgen. **Monophyllaea**

13.	*glabra*	T, MP
14.	*hirticalyx* (incl. *M. patens*)	MP
15.	*longipes*	PHIL
16.	*tenuis*	SARS
17.	*selaborensis*	SARS
18.	*sarangica*	SARS
19.	*horsfieldii*	J, MP, SUM
	var. *horsfieldii* (incl. *M. pygmaea*)	
	var. *hendersonii*	
20.	*caulescens*	SUM
21.	*leuserensis*	SUM
22.	*hirtella*	SUM
23.	*pendula*	SARN
24.	*elongata*	MP
25.	*glandulosa*	SARS
26.	*andersonii*	SARN
27.	*hottae*	SARN
28.	*fissilis*	SARN
29.	*cupiflora*	SARN
	var. *cupiflora*	
	var. *aggregata*	
30.	*insignis*	SARN
	var. *insignis*	
	var. *rubriflora*	
31.	*papuana* (incl. *M. finisterrae*)	NG
32.	*wildeana*	SUM

ECOLOGY

Monophyllaea is essentially a genus of the limestone and all species are provided with chalk-glands on leaves, stems and the inside of the sepals (cf. Puff 1975, Weber 1976). However, at least two species are known which are not wholly tied to limestone: *M. horsfieldii* in subgen. *Monophyllaea* and *M. merrilliana* in subgen. *Moultonia*. Each has the widest distribution of its subgenus. Ridley has recorded *M. horsfieldii* from granite in the Malay Peninsula, and *M. merrilliana* has been collected on andesite in Sarawak (*Anderson* S. 28651 from Bukit Tibang, on the Sarawak-Kalimantan border), and also occurs off limestone at least in Sabah. It may be noted also that where these two species occur with others of the genus in limestone areas they are the ones found furthest from the pure rock. Chalk encrustation is less well developed on the leaves of these two species than on those of many others: it is however strongly marked on the inside of the sepals, especially in *M. merrilliana.*

A large outcrop of limestone characteristically provides several microhabitats. These are occupied by different species. For instance in the Mulu National Park *M. pendula* is pendulous on rather soft and sheltered cliff faces, whereas the stiffer and sturdier *M. fissilis* is characteristic of more exposed faces. *M. cupiflora* is frequent at the base of the cliffs, often near the drip-line, and *M. merrilliana* grows further out. In Sarawak First Division *M. tenuis* grows in the sheltered overhangs, *M. glauca* at the drip line or outside. The various varieties of *M. glauca,* however, occupy similar habitats. On the Malay Peninsula the three species *M. elongata*, *M. hirticalyx* and *M. horsfieldii* are all recorded at Kinta, at Gopeng and at Sungei Siput. I have not been to these localities, but I would confidently look for *M. elongata* on cliff faces, *M. hirticalyx* on sheltered ground within the drip line and *M. horsfieldii* further out.

In these habitats where 2 or 3 species occur in close proximity no sign of interaction between them has been noted. They are not in competition and they do not hybridize. All the microhabitats must rank as open: *Monophyllaea* competes very little with other genera.

One of the most remarkable habitats of *Monophyllaea* is deep within Lobang Rusa (Cave of the Deer) in the Mulu National Park. Here one can scarcely see where to walk, yet lines of bright green *Monophyllaea insignis* march along the ridges of rough wet limestone facing a high entrance to the cave, an entrance which is some 30 yards away from the innermost plants.

No experimental data on seed dispersal is available, but it seems certain that it can only take place over short distances. The most likely dispersal agencies are rain-wash and soil adhering to the feet of animals: the cliff-dwelling species presumably depend on updraught to avoid an inexorable migration towards the foot of the cliff. Young plants of *M. pendula* may be found on the ground below a cliff where the species grows, but they are few and I have not noted them in flower. In many species it is very difficult to find dry seed and in *M. glauca* it seems likely that the calyx and capsule often fall together before the seed has been shed. In *M. tenuis* however the dry capsule valves persist on old infructescences: here too wind may play a part in dispersal, the drying stiffening peduncles playing a censer-mechanism role. In damp situations (or wet weather) it is not unusual to find seed already germinating in the capsule.

Geographical Distribution

The present distribution of *Monophyllaea* may be described as doubly archipelagic: a distribution on an archipelago of emergent limestone through an archipelago of islands. The occasional occurrences on rocks other than

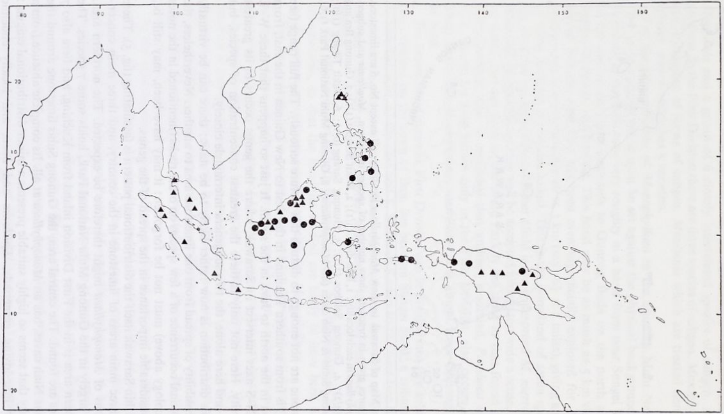

FIG. 4. Map of Malesia to show distribution of *Monophyllaea*. ▲ species of subgen. *Monophyllaea*; ● species of subgen. *Moultonia*.

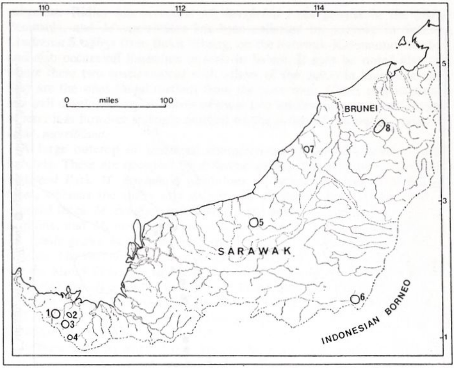

FIG. 5. Map of Sarawak to show *Monophyllaea* localities: all except No. 6 are limestone. The figures given in brackets show number of species in subgen. *Moultonia* and subgen. *Monophyllaea* in each locality: 1, Bau distr. (3/1); 2, Bukit Serapat (1/1); 3, Gunong Bra'ang area (4/2); 4, Gunong Selabor (1/1); 5, Gunong Sarang (0/1); 6, Bukit Tibang (1/0); 7, Gunong Subis & Niah caves (no *Monophyllaea*); 8, Gunong Mulu National Park (1/6).

limestone are not enough to disturb this picture seriously. The full range (see fig. 4) is from southern Thailand in the west to New Guinea in the east, from Luzon in the north to Java in the south. It just so happens that these W–E and N–S axes intersect in Sarawak, where the genus occurs in its greatest diversity. Here not only is there the greatest concentration of species, but here, and here alone, the two subgenera intermingle closely.

This distribution is now rather likely to be static: there can be virtually no possibility of spread from one limestone area to another. Nevertheless, the occasional occurrence of a few species on other rocks (mentioned in the notes on ecology above) must not be forgotten: it may have been, may still be, of considerable importance in the spread of the genus.

Within Sarawak itself the distributional pattern is fascinating (fig. 5). There are three main areas of limestone in the country, and three main concentrations of *Monophyllaea* might therefore be expected. The northern area, now largely in the Gunong Mulu National Park, holds some 7 species. The southern area is in the First Division inland from Kuching, and here also 7 species are found. The central area, the Gunong Subis limestone around the famous Niah caves, has no *Monophyllaea* at all. Its complete absence from a locality that seems so highly suitable presents a minor distributional enigma: other lime-loving gesneriads, *Epithema* and *Boea*, and locally endemic calicolous species of *Cyrtandra* are there, but not *Monophyllaea*.

Another point of interest in Sarawak is the balance of distribution of the subgenera. The Mulu National Park has just one distinctive species of subgen. *Moultonia* and a group of 6 closely interrelated species of subgen. *Monophyllaea*. In the First Division there are three species of subgen. *Monophyllaea*, and a complex of forms of subgen. *Moultonia* which are treated here as 4 species, one of which has 5 varieties.

For the concentration of *Monophyllaea* in the Gunong Mulu National Park to be appreciated, it must be set against the physical background. The limestone in the Park runs very roughly in a band from near Sungei Tutoh in the south-west north-eastwards to Gunong Buda on the north side of Sungei Medalam, and beyond. This band may be as much as 5 km wide in places, but the area that has been even superficially explored for *Monophyllaea* lies in a strip roughly 26 × 3 km (say 16½ × 2 miles), giving an area of 7,800 hectares (33 square miles). This is the homeland of seven species; the only one yet known from further afield is the widespread *M. merrilliana*. Although *M. merrilliana* may well be accepted here in too wide a sense, it can be stated that the form in the Mulu Park is the same as that found in the First Division. One is reminded that another gesneriad, *Paraboea clarkei* B. L. Burtt, for long known only in the First Division, also occurs in the Mulu Park: like *Monophyllaea merrilliana* it is absent from Gunong Subis at Niah.

The limestone of Sarawak First Division can be divided into two subareas. One, centred on the town of Bau, lies between Sungei Staat, a tributary of S. Sarawak Kiri, to the east and S. Sarawak Kanan to the west (see fig. 6); the other subarea lies east of S. Staat and includes the limestone of Gunong Bra'ang (Padawan district), isolated hills nearer Kuching and also Gunong Selabor.

I was able to collect in both subareas in 1975, but the limestone hills are innumerable, so that the localities studied are likely to have been a very small proportion of those actually suitable for *Monophyllaea*.

The Bau subarea is the poorer of the two for *Monophyllaea*: it seemed to be drier and has certainly been more disturbed by man. In this connexion the one record of a small specimen of *M. merrilliana* near Bau may be significant. This species might well tend to disappear where interference with the forest resulted in increased illumination and desiccation: on Gunong Manok, near Padawan in the eastern subarea, it was found in a densely forested wet stream valley. Apart from this record of *M. merrilliana* and the occurrence of *M. singularis*, *Monophyllaea* is represented in the Bau subarea by the five varieties of *M. glauca*.

In the subarea east of Sungei Staat are found not only *M. glauca* (one variety), *M. merrilliana*, *M. singularis* and *M. tenuis*, but also *M. tetrasepala*, *M. glandulosa* and *M. selaborensis*. The last three are endemic to this subarea, and it rivals the Mulu National Park in *Monophyllaea* richness. It is, however, very different physically. The exposed limestone is much more scattered: the most distant hills (Bukit Serapat at 12 miles on the Kuching-Simanggang road, and Gunong Selabor south of Serian) are some 50 km (36 miles) apart, and the limestone hills occur over a wedge-shaped area of some 37,500 hectares (180 sq. miles).

In Sarawak only two records of *Monophyllaea* are yet known outside these two main areas: First Division limestone and Mulu National Park. *M.*

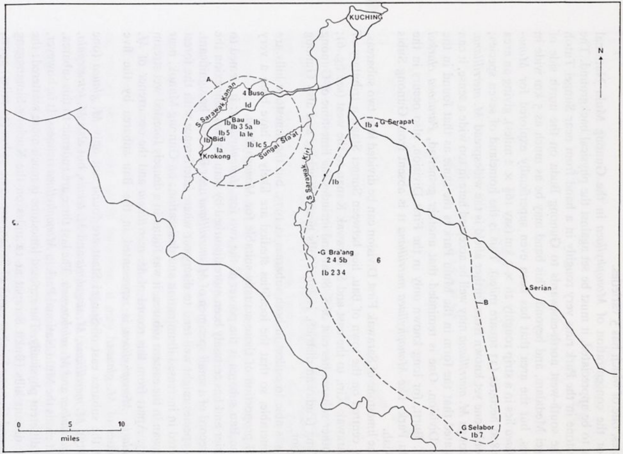

FIG. 6. Part of First Division, Sarawak, to show the two subareas (A & B) for *Monophyllaea*. 1a, *M. glauca* var. *glauca*; 1b, *M. glauca* var. *hirta*; 1c, *M. glauca* var. *beccarii*; 1d, *M. glauca* var. *versipes*; 1e, *M. glauca* var. *boraginea*; 2, *M. tetrasepala*; 3, *M. merrilliana*; 4, *M. tenuis*; 5, 5a, *M. singularis* var. *singularis*; 5b, *M. singularis* var. *semiflorens*; 6, *M. glandulosa*; 7, *M. selaborensis*.

sarangica is known only from Bukit Sarang, a limestone hill inland from Bintulu, while *M. merrilliana* has been collected on andesite in the Balleh headwaters near the Indonesian border. There are a few more small limestone areas shown on the geological maps, but it is not known if they carry *Monophyllaea*.

In the rest of Borneo (Sabah and Kalimantan) all species of *Monophyllaea* belong to subgen. *Moultonia* as does the one species, *M. merrilliana*, of the southern Philippines. Only at the northern tip of Luzon is subgen. *Monophyllaea* represented, by *M. longipes*.

To the south and west of Sarawak (in Java, Sumatra, Malay Peninsula and southern Thailand) only subgen. *Monophyllaea* occurs. Eastwards of Borneo the scanty records in the Archipelago (Celebes and Ceram) are of subgen. *Moultonia*, and this is also found on the mainland of New Guinea. One representative here is *M. furcipila*, a species whose forked hairs suggest its affinity to the Philippine and Bornean *M. merrilliana*, while the other, *M. brevipes*, also occurs on Ceram. The third species on New Guinea, *M. papuana* (incl. *M. finisterrae*) belongs to subgen. *Monophyllaea* where its affinity seems to be with *M. horsfieldii* and related Bornean species, not with the Philippine *M. longipes*.

The occurrence of both subgenera in the Philippines, Sarawak and New Guinea suggests that they were already evolved when the ancestors of the living species laid the foundations of the present geographical distribution. It is always easier to believe that isolated outlying species are relicts rather than recent arrivals, and this is particularly so for *Monophyllaea* in New Guinea because both subgenera are represented. When this is considered along with the present very vigorous populations in Sarawak and with the absence of subgen. *Moultonia* from the Malay Peninsula and Sumatra, it leads to a tentative view that the spread of the genus may well have been westwards from New Guinea rather than radially from its present numerical centre in Sarawak, or eastwards from the Asiatic mainland.

NOTES ON THE NATURE OF THE SPECIES

There are several areas where a number of species of *Monophyllaea* are found, and such distributions have already been looked at in ecological and in geographical terms. Here I want to consider briefly the actual physical closeness of such species. For example, in general terms all the species found in the Mulu National Park are sympatric. But it is necessary to recognize a closer level of association which may be called co-existence. To give an arbitrary definition, co-existence might be defined as occurrence within 50 metres. Within the Mulu National Park such co-existence has been observed between *M. pendula*, *M. cupiflora* and *M. merrilliana:* between *M. pendula*, *M. cupiflora*, *M. insignis* and *M. hottae:* between *M. hottae* and *M. insignis:* between *M. hottae* and *M. cupiflora*. It may be noted that from present knowledge I should not like to assert ecological differences between *M. cupiflora*, *M. hottae* and *M. insignis*, although they may well exist.

Elsewhere co-existence has been noted between *M. selaborensis* and *M. glauca: M. tenuis* and *M. glauca:* and (stretching the 50 metres a little) between *M. glauca*, *M. tetrasepala* and *M. merrilliana*.

So far as has been observed at present, none of these co-existing species have any effect on one another. When the species belong to different subgenera this is not unexpected, but when species as closely related as *M. cupiflora*, *M. insignis* and *M. hottae* grow close together without interaction it looks as though they must be separated by well-marked sterility or pollination barriers, or by a high degree of autogamy. The situation is quite otherwise in the African *Streptocarpus* where co-existence often means an added range of variation due, apparently, to past gene-exchange or the actual presence of first generation hybrids (cf. Hilliard & Burtt 1971, pp. 76–77).

One situation does, however, deserve mention here. Both *M. cupiflora* and *M. insignis* have varieties in which the inflorescence is abbreviated and subumbellate. The species have been found in close co-existence, but not the varieties. However, much of the National Park area remains to be explored. The question whether this variation has been transferred from one species to the other, or whether it results from a parallel mutation is an interesting one.

The major species-problems encountered have been solved by taking a broad concept of the species. Thus the remaining situations to be discussed are at the intraspecific level. The first is exhibited by *M. glauca*. The reasons for regarding this species as a variable one with 5 varieties are given in the enumeration (p. 28). Here, we are concerned with the nature of the species. The whole geographical range is covered by *M. glauca* var. *hirta*: the other four varieties occur at individual points within it. Critical data were provided by *M. glauca* var. *versipes* which grew in a population overlapped by one of *M. glauca* var. *hirta*. The habitat was damp limestone rocks in forest at the foot of a limestone hill: the two varieties grew within a few feet of one another in the area of overlap and there was no ecological differentiation. Away from the overlap the same habitats were occupied, but in one direction the population became pure var. *versipes* in the other pure var. *hirta*. Both varieties were in flower: there was no seasonal separation. A careful search failed to disclose any plants that showed signs of hybridization.

M. glauca var. *glauca* and var. *beccarii* were both found only once and were growing alone, but time did not permit an exhaustive search for var. *hirta* in their localities. *M. glauca* var. *boraginea* was not collected by myself, as the particular hill where it grows was inaccessible for security reasons. However *M. glauca* var. *hirta* has been collected on the same hill at the same altitude.

It is clear that two of these varieties can co-exist with the widespread var. *hirta*. If further field work confirms that this is the general pattern, then their taxonomic rank may have to be re-assessed. Perhaps C. B. Clarke was right to call them species. Thus, *M. glauca* exemplifies a point made elsewhere, that the hierarchy species-subspecies-variety may, biologically, be a false one (Burtt, 1970b, esp. pp. 234–5). The localized variety is more likely to acquire sufficient differences to isolate it from the parent stock, both morphologically and reproductively, than is a widespread 'geographical' subspecies. Even if the rank of subspecies is modified by botanical taxonomists to include purely ecological variants (as I think it must be), these forms of *M. glauca* could not be ranked higher than variety, for they show no obvious differential ecological preferences. Cytological information is obviously needed.

Monophyllaea singularis differs from *M. glauca* in being a species of only two variants, and, to our present knowledge, these do not overlap geographically. The typical form (plate 1) is restricted to the limestone of the

PLATE 1. *Monophyllaea singularis* var. *singularis*. (Gunong Tabai: *Burtt* 8157).

PLATE 2. *Monophyllaea singularis* var. *semiflorens* (Gunong Bra'ang: *Burtt* 8095).

Bau district (A on fig. 6); its flowers are first produced on the stem below the lamina and only subsequently spread to the upper surface of the mid-rib. The other form (plate 2) was found on Gunong Bra'ang, which lies east of S. Sarawak Kiri (B in fig. 6): it was producing flowers only on the mid-rib: there were no flowers at all on the stem. The areas of these two variants are only some 15 miles apart in a direct line; they are thus local, rather than regional, facies of the species; they may be regarded taxonomically as varieties.

The situation in *M. merrilliana* is somewhat different. Its geographical range is much wider, perhaps linked to the fact, already noted, that it is less strongly calcicole than most other species of the genus. It shows a considerable range of variation that is, at least in part, partitioned geographically: there is, as yet, no example of taxonomically significant variants occurring in the same area. Only two points need be made here: first, the plant collected by Anderson (S. 28651) in the Ulu Balleh is exactly matched by the type of the synonym *S. johannis-winkleri* from the upper Kapuas: secondly, the form found in the Mulu National Park is exactly similar to that in the Sarawak First Division. For the rest it must be admitted that any of the local variants may prove to deserve taxonomic recognition when they, and typical *M. merrilliana* from the Philippines, are better known. The broad concept of the species may merely be a reflection of imperfect knowledge.

The parallel varieties of *M. cupiflora* and *M. insignis*, characterized chiefly by their subumbellate inflorescences, have already been mentioned. Both species are endemic to the Mulu National Park, but neither *M. cupiflora* var. *aggregata* nor *M. insignis* var. *rubriflora* is yet known to co-exist with the typical variety of the species; ecological differences, however, have not been detected.

There is nothing unusual in the situations described in this section: they fit standard taxonomic patterns. Their recognition here is important simply in supplementing the data on ecology and growth-patterns to emphasise that *Monophyllaea*, despite its rather stereotyped morphology, is an actively evolving and speciating genus. Also such information, even at this superficial level, is recorded for very few herbs of the tropical rain forest.

Patterns of growth

The most usual growth-form in *Monophyllaea* is that found in *M. horsfieldii*, the species originally investigated by Pischinger (1902), Fritsch (1904), Ridley (1906), Oehlkers (1922). After germination there is a massive enlargement of the hypocotyl, and the development of one cotyledon to form a large ovate cordate leaf, but no new members are formed till the inflorescences develop. The peduncles arise near the base of the leaf-blade on the midrib, either singly or two or three from a short common peduncle; there are small bracts at the base (see Weber 1975, fig. 5).

This form of growth is characteristic of most species that grow erect and of some that are found on steep banks or cliffs, when the hypocotyl grows out from the cliff and the leaf is strong enough to be held at an angle. A variant is found in other cliff plants (e.g. *M. pendula*, *M. elongata*) where the lamina is completely pendulous, oblong in shape with more or less parallel sides: in such a leaf the veins spread almost at right angles to the midrib. In erect species the basal growth of the lamina may eventually be limited, but in these pendulous plants there seems to be a long-persistent basal meristem, and although the tip of the lamina dies back through abrasion and wind damage, there is constant replacement from the base: this probably continues until wind, rain or other accident leads to the detachment and death of the plant.

In *M. glauca* and others the inflorescences, although produced in succession, all seem to be more or less contemporaneous: there are no dead inflorescences on a flowering plant, but flowering can apparently continue for a long time, the fruits falling quickly and new flowers being constantly produced. By contrast a flowering plant of *M. tenuis* may have several dead and dry inflorescence stalks, broken but still hanging on. These two species grow close together and the difference is obvious on a single visit. Until someone on the spot can make regular observations on these plants, we shall remain ignorant of their actual duration and rhythm of flowering. It seems clear that the cliff-dwelling *M. pendula* and *M. elongata* agree with *M. tenuis* in producing more than one crop of inflorescences.

Four arrangements of the inflorescences are possible: in a cluster at the base of the midrib (*M. horsfieldii*, *M. glauca*, etc.); some at the base of the midrib, others, usually smaller, scattered along it (some forms of *M. merrilliana*, *M. tetrasepala*); on the stem just below the lamina (*M. pendula*, *M. elongata*); or, finally, the flowers are borne singly, or 2–3 on a very short common stalk, in a continuous zone up one side of the stem and/or along the midrib (*M. singularis*). In those species where the inflorescences arise below the lamina it seems that the older peduncles are effectively pushed back by intercalary growth, so that the new ones always arise in about the same position relative to the base of the lamina. This position is just where the stem curves over to permit the lamina to be pendulous: no curvature in the peduncle is thus necessary for the inflorescence to be held erect.

It will be noticed that oblong leaves with active basal meristem, inflorescences arising below the lamina, and more than one period of flowering are features that occur together in cliff plants (*M. pendula*, *M. elongata*, *M. horsfieldii* var. *hendersonii*). Probably in this habitat the difficulties of seedling establishment represent the major source of mortality; once establishment has been achieved, longevity is an obvious advantage.

Most commonly small linear bracts are found at the base of the inflorescence and there is no branching higher up. However, one species, *M. wildeana*, has a stout inflorescence strongly branched in the upper part and having large broad bracts at the branchings. *M. stellata*, *M. anthocrena* and *M. ramosa* behave rather differently, producing small rather irregular-looking ebracteate lateral branches below the main flowering region. Finally there is a quite different form of branching in the flowering region. This is found in *M. tetrasepala* and *M. merrilliana* and represents the first dichotomy of the flowering zone, with the first two flowers standing between the branches. Usually this first dichotomy is suppressed and the inflorescence seems to be a simple helicoid cyme of paired flowers. In these two species the first dichotomy persists, but seldom more than the first; thereafter the cymes develop unilaterally.

The plant body of *Monophyllaea* is not always so simple as in the common unifoliate pattern just described. One variation is for a vegetative axis to be produced amongst the peduncles; this then bears another leaf blade which produces inflorescences at its base. This process may be repeated two or three times, so that there is a tiered arrangement of leaves. Such growth is, however, limited, obviously for mechanical reasons.

At one time it seemed that this tiered growth might be a characteristic restricted to one of the undescribed species in the Mulu National Park. Now, however, it is clear that it occurs in several species with some frequency, while in others it is found rarely and in some not at all. The species marked by a strong tendency towards this type of growth are *M. cupiflora* var. *aggregata*, *M. insignis* var. *rubriflora*, and *M. selaborensis*. It has also been noted in *M. furcipila*, and on cultivated specimens of *M. horsfieldii*, though I have not seen it on wild plants of this species.

Much more interesting is the sprawling several-leaved habit of *M. caulescens* in Sumatra and *M. ramosa* in Ceram. It is to be noted that the first belongs to subgen. *Monophyllaea*, the second to subgen. *Moultonia*; the growth pattern is apparently the same in both. The axis is branched below the first leaf so that this has a petiole and at the top of the petiole the inflorescences are borne. The branch develops another leaf and inflores-

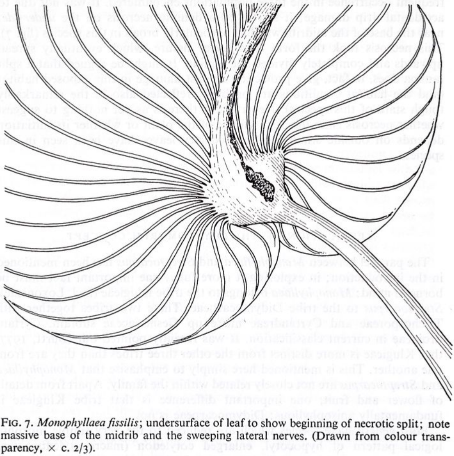

FIG. 7. *Monophyllaea fissilis*; undersurface of leaf to show beginning of necrotic split; note massive base of the midrib and the sweeping lateral nerves. (Drawn from colour transparency, × c. 2/3).

censes and again, some little distance below the second leaf another branch is developed which repeats the same pattern. Thus a straggling stem up to about half a metre long, and producing 5–6 blades and associated inflorescences is produced. The interpretation of this interesting growth pattern is discussed in the next section.

Chifflot (1909) reported that he had a strain of *M. horsfieldii* in cultivation that consistently produced seedlings with both cotyledons enlarged. It was this that led him to propose a new generic name, as he thought that *Monophyllaea* was no longer appropriate. Unfortunately he did not go into details of the form of the adult plant, nor say whether the cotyledons were petiolate. I once had a batch of seedlings of *Streptocarpus compressus* in which both cotyledons enlarged, but I failed to get the strain established. As a casual occurrence the growth of both cotyledons is not infrequent.

There is one other, quite anomalous, growth form to be mentioned, that shown by *M. fissilis*. This species grows on limestone cliff faces much exposed to drip from above. When first collected in 1962 it was noticed that leaves were frequently split to the base and that the two halves grew independently, each producing its own basal inflorescences. This was attributed to mechanical damage of the young leaf by falling water. In 1975 further observations were possible and it was found that the splitting of the leaf was a remarkably frequent occurrence in the three populations encountered. It was not due to accidental drip damage; it started as a definite necrosis on the *underside*, near the base of the midrib, which is particularly broad in this species (fig. 7). This necrosis took the form of a linear fissure, which eventually spread upwards and completely divided the lamina. It might be argued that a split lamina does, in fact, give protection against damage in this exposed habitat (and the habitat conditions are probably reflected also in the remarkably tough stalk of this species). Nevertheless there is as yet nothing to suggest whether necrosis is an inherent feature of the plant or whether its initiation depends on outside stimulus. No accessory leaves have been seen in this species.

APPLICATION OF THE PHYLLOMORPH CONCEPT

The parallel between *Monophyllaea* and *Streptocarpus* has been mentioned in the introduction; in exploring it more fully, one important fact must be borne in mind: *Monophyllaea* belongs to the tribe Klugieae (incl. Loxonieae), *Streptocarpus* to the tribe Didymocarpeae. These two tribes together with Trichosporeae and Cyrtandreae make up Gesneriaceae subfam. Cyrtandroideae in current classification. It was recently pointed out (Burtt, 1977) that Klugieae is more distinct from the other three tribes than they are from one another. This is mentioned here simply to emphasise that *Monophyllaea* and *Streptocarpus* are not closely related within the family. Apart from details of flower and fruit, one important difference is that tribe Klugieae is fundamentally anisophyllous: Didymocarpeae is not.

Both genera have species which are reduced to the very simple morphological pattern of hypocotyl, enlarged cotyledon (macrocotyledon) and inflorescences. Remarkable as is the development of one cotyledon to form the sole, and often very large, foliage leaf of the adult plant, it does not demand any special theoretical interpretation. The possible evolution of this state from the slight anisocotyly that is apparently basic in Gesneriaceae-Cyrtandroideae has been discussed elsewhere (Burtt 1970a). The condition involves the suppression of normal plumular activity and with it the loss of normal foliage leaves.

It seems that after attaining this growth pattern some members of both *Streptocarpus* and *Monophyllaea* have encountered an evolutionary demand, or opportunity, for an enlarged plant body. These unifoliate plants obviously contain the necessary genetic mechanisms for making an axis, a lamina capable of a greater or less degree of continued growth from a basal meristem, and inflorescences. It seems that the easiest way to produce an enlarged plant body from this platform is to repeat the development of these items as an integrated unit. It is this unit that we have called a phyllomorph (Jong & Burtt 1975).

The basis of this interpretation lies in the detailed study of the distribution and behaviour of the meristems of seedlings and adult plants of *Streptocarpus* (Jong 1970). The form of the adult plant of *Monophyllaea caulescens* or *M. ramosa* suggests very strongly that the same sort of evolutionary process has taken place. The additional leaves that are present closely resemble the macrocotyledon and the whole pattern of growth is a repetition of similar units. However it must be emphasised that an ontogenetic investigation is urgently needed.

The tiered structure described above may also be susceptible of interpretation in terms of phyllomorphic units, but because of its irregular occurrence an ontogenetic study may be very difficult.

It has already been mentioned that the tribe Klugieae shows marked anisophylly. Weber (1975) has studied the inflorescence and shoot structure of *Monophyllaea horsfieldii* and has demonstrated its possible derivation from an anisophyllous ancestor. This does not seem to me to be in conflict with the phyllomorph concept. That concept is only essential when dealing with the secondary elaboration of the plant body as in *M. caulescens* or such species as *Streptocarpus fanniniae*, *S. rexii*, *S. polyanthus* and many others. However once it has been developed, it is natural to regard the "unifoliates" such as *Monophyllaea horsfieldii* or *Streptocarpus wendlandii* as consisting of a solitary phyllomorph. The fact that the phyllomorph of *Monophyllaea* has evolved from an anisophyllous stock and that of *Streptocarpus* from an isophyllous one makes no difference when foliage leaves are no longer produced. There are of course other differences: the linear acropetal series of inflorescences in *Streptocarpus* (without bracts at the base of the peduncles) is different from the clustered bracteate and sometimes compound peduncles of *Monophyllaea*, and this difference may well be related to the growth pattern of the very distinct groups from which the two genera are derived.

Although a detailed comparison of *Streptocarpus* and *Monophyllaea* must await an ontogenetic study of the caulescent species of *Monophyllaea*. it does seem safe to say that these two genera show parallel reduction of the plant body to the "unifoliate" condition, and that both show subsequent evolution of a more elaborate architecture with repetition of macrocotyledon-like leaves. This is a remarkable parallelism in two markedly distinct tribes.

GENERIC AFFINITIES

There is little to be added to the brilliant study of the affinities of *Monophyllaea* carried out by Weber (1976b). His findings were twofold: first, that the structural plan of growth to be expected in an ancestor of the highly specialised *Monophyllaea* is to be found in *Whytockia*, a small genus of SE China and Formosa: secondly, that there are good characters that link these two genera more closely than either is linked to any other member of the tribe Klugieae. These characters are: descending imbricate aestivation of calyx and corolla; chalk glands on the inside of the sepals; secretory canals in the sepals, and a bilocular ovary. The evidence is incontravertible; there is no other extant genus that shares these features.

In an earlier paper (Burtt 1963) I regarded Klugieae and Loxonieae (in which I placed *Whytockia*) as separate tribes. This clearly had to be revised, and more recently (Burtt 1977) I have treated the tribes as one, under the earlier name Klugieae. This is preferable to the mere transfer of *Whytockia* from one tribe to the other, for the following reasons. Loxonieae of my earlier paper has already been reduced in size by the transfer of *Cyrtandromoea* to Scrophulariaceae (Burtt 1965): the withdrawal of *Whytockia* would reduce it to *Loxonia* and *Stauranthera*. The tribe Klugieae already has a wide morphological range, and its genera fall into three groups: (i) *Rhynchoglossum* (incl. *Klugia*); (ii) *Epithema*; (iii) *Monophyllaea* and *Whytockia*. *Rhynchoglossum* and *Epithema* have unilocular ovaries, and valvate calyces lacking chalk-glands on the inside of the segments: they differ from one another in inflorescence, habit, androecium, fruit and seeds. The addition of *Loxonia* and *Stauranthera* does no violence to the tenuous features that allow us to hold these genera together. The alternative of splitting the tribe further would, at present, have neither conceptual nor taxonomic advantages. It is important, however, to realize that Klugieae is quite different in taxonomic structure from the other three tribes of Cyrtandroideae. The genera are very easily distinguished, the geographical distribution virtually girdles the earth, (*Rhynchoglossum* is the only genus of Cyrtandroideae represented in the New World), and in Klugieae alone of Cyrtandroideae are there certain features (the form of placenta in *Rhynchoglossum*, the spiral testa markings of *Epithema*) which show hints of an affinity to Gesnerioideae. These distinctive features of Klugieae were discussed more fully in a consideration of the suprageneric categories in Gesneriaceae (Burtt 1977).

The chromosomes of *Monophyllaea* have only been counted in *M. horsfieldii*. The haploid number n=10 was found by Ratter & Prentice (1967), but there is an earlier count of n=16 by Oehlkers (1923). The figure n=10 would be in line with counts for two other members of the tribe, *Rhynchoglossum gardneri* and *R. notonianum*, but n=18, 21, 27 have also been recorded in that genus (cf. Ratter 1975). There are too few counts for any general pattern to be discernible in the tribe as yet.

TAXONOMIC REVISION

Monophyllaea R. Br. in Bennett, Pl. Jav. Rar. 121 (1840); DC., Prodr. 9:274 (1845); Benth. in Benth. & Hook. f., Gen. Pl. 2:1017 (1876); C. B. Clarke in A. DC., Mon. Phan. 5(1):181 (1883); K. Fritsch in Engl. & Prantl, Nat. Pflanzenfam. 4(3B):160 (1895), et Nachtr. 4 zu 2–4:328 (1915).

Syn.: *Horsfieldia* Chifflot in Compt. Rend. Acad. Sc. Paris, 148:941 (1909)– non Willd. Type: *H. javanica* Chifflot = *M. horsfieldii* R. Br.
Moultonia Balf. fil. & W.W. Sm. in Notes R.B.G. Edinb. 8:349 (March 1915) et in Sarawak Mus. Journ. 2:276 (Sept. 1915); Steenis in Blumea 11:133 (1961). Type: *M. singularis* Balf. fil. & W.W. Sm.
Type species: *M. horsfieldii* R. Br.
Distribution: S Thailand, Langkawi Islands, Malay Peninsula, Sumatra, Java, Borneo, Philippines (Luzon, Samar, Bohol and Mindanao), Celebes, Ceram, New Guinea.

Herbs with fleshy stem, usually hypocotylar in origin, with medullary vascular bundles, usually bearing a single leaf (the macrocotyledon), occasionally caulescent with 3–4 petiolate leaves; whole plant provided with chalk glands; leaf lamina with basal meristem, lateral nerves close together near leaf base, becoming more widely spaced higher up and usually about 1–2 cm apart in middle of leaf, usually wide-spreading from midrib, more ascending near leaf margin. *Inflorescences* usually pedunculate arising at or just below the base of the leaf, occasionally also scattered along midrib, with small bracts at base and sometimes 3–4 with a short common peduncle; peduncles simple or branched; flowering axis helicoid, flowers in pairs, pedicellate, ebracteate; more rarely flowers borne singly or 2–3 on a very short peduncle in crowded zone on one side of stem and/or along midrib of leaf. *Calyx* 4–5-partite; segments descending imbricate, the uppermost outside, somewhat broader than the rest and often slightly carinate, one of the anterior laterals wholly inside and narrower than the rest, all concave on the inside, streaked with longitudinal secretory canals, provided with a central patch of chalk glands on the inside. *Corolla* in the range 5–15 mm long, with tube and limb roughly equal; tube usually bearded inside below the filaments with moniliform unicellular hairs; upper lip 2-lobed; lower lip 3-lobed with a patch of erect cylindrical unicellular hairs on the palate; the lobes descending imbricate, often with short 2–3-celled uniseriate papillae. *Stamens* 4 fertile, with or without a short linear posterior staminode: filaments arising about the middle of the tube, the posterior pair often lower than the anterior and shorter than them, so that the anterior are strongly arcuate or even curved back to bring anthers into contact, often with a small tooth at apex; anthers with 2 divergent thecae soon confluent, usually all four cohering by their edges to form a down-facing plate, more rarely didynamous or all free. *Disc* cupular, thick, undulate or lobulate. *Ovary* bilocular with numerous ovules on axile placentae; style simple; stigma capitate, or slightly peltate, or umbilical. *Fruit* capsular, often thin-walled, sometimes breaking up into 4 valves after fall of persistent, often swollen, style, or sometimes without valves, the top of the ovary covered by the expanded style base and the fruit effectively porose when it falls. *Seeds* small, c. 0·5 mm, ellipsoid, dark brown, reticulate, occasionally the reticulate pattern with a spiral twist.

A few notes on the characters given in the descriptions of the species are necessary:—

(i) *Leaf size*: a full grown *Monophyllaea* virtually never has an intact leaf-tip; often the leaf has withered back to the widest part or nearly so, continued growth taking place from the basal meristem. The leaf size given is that actually measured on the specimens: no extrapolation to include an 'intact' tip has been attempted: this would in any case be wrong, for it is likely that such a "reconstructed" lamina would be mechanically unsound. However it should also be remembered that this growth pattern from a basal meristem is very flexible and under optimal conditions the lamina can reach much larger dimensions than those usually found. Some species tend to be large, others small or medium-sized, but actual individual measurements are only a rough guide.

(ii) *Hairs and encrustation*: the encrustation from the chalk glands is usually only mentioned in reference to the undersurface of the leaf: it is present, to a much less extent, on upper surface and on stems and inflorescences. Short hairs may also become encrusted and may then be difficult to detect.

(iii) *Inflorescences.* I refer to these as 'more or less contemporaneous' when they belong to a single series produced in the same period of growth, although the earlier will be going over before the last start to flower. However "not contemporaneous" is used only when the presence of quite dead inflorescences, or of scars of fallen peduncles, clearly indicates that the plant has had more than one flowering period. The length of the flowering axis can only be measured on specimens present on the sheet, inflorescences without young unopened buds have scarcely been seen, so that the ultimate length is always uncertain. Pedicels are measured at their maximum length in fruit: there is continuous elongation from bud stage through to fruit in many species, and to measure during the brief period when a flower is actually open is not practicable. Flowers usually open only 1 or 2 at a time, at the top of the inflorescence curvature in those with a simple helicoid inflorescence.

(iv) *Seeds.* A detailed study of seeds has not been attempted. They are only mentioned in specific descriptions when they do not conform to the usual pattern from the genus. It is likely that good microcharacters will be forthcoming after critical study.

THE SUBGENERA

subgen. **Monophyllaea.**

Pedicels distinctly longer than the calyx. *Ovary* bilocular, the placentae with a broad attachment to the septum which contains a single massive strand (fig. 1a, fig. 2). *Fruit-wall* breaking up into 4 valves, usually after the fall of the style. *Indumentum* (if present) of uniseriate glandular or eglandular hairs.

Type species: *M. horsfieldii*

Content: species 13–32.

subgen. **Moultonia** (Balf. fil. & W.W. Sm.) B. L. Burtt, **stat. nov.**

Syn.: *Moultonia* Balf. fil. & W.W. Sm. in Notes R.B.G. Edinb. 8:349 (1915).

Pedicels equalling or shorter than the calyx. *Ovary* bilocular, the placentae joined to the septum by a narrow bridge (fig. 1b, fig. 3), each placenta with a main central strand. *Fruit-wall* not breaking up into valves, dehiscence porose by fall of style with swollen base. *Indumentum* (if present) of uniseriate glandular or eglandular hairs, or in certain species of forked, dendroid or stellate hairs.

Type species: *M. singularis*

Content: species 1–12.

KEY TO THE SPECIES

1a. Flowers arising in a continuous zone up one side of the stem and/or on the midrib; singly pedicellate or 2–3 with very short common peduncle . . . 2
1b. Flowers in pedunculate inflorescences from base of leaf or just below it on the stem, sometimes with smaller ones scattered up the midrib 3

2a. Plant heavily encrusted; leaf ovate-oblong; calyx 4–5-partite 11. *singularis*
2b. Plant lightly encrusted; leaf ovate; calyx 5-partite 12. *kostermansii*

3a. Inflorescence branched above naked peduncle . . . 4
3b. Inflorescence not branched above naked peduncle . . . 10

4a. Branches of inflorescence conspicuously bracteate 32. *wildeana*
4b. Branches of inflorescence ebracteate . . . 5

5a. Hairs branched 6
5b. Hairs simple 7

6a. Hairs forked or dendroid; inflorescence forked immediately below first flowers . . . 5. *merrilliana*
6b. Hairs stellate; inflorescence with lateral branches . . 8. *stellata*

7a. Plant producing more than one leaf; leaves petiolate and separated by internodes . . . 10. *ramosa*
7b. Plant producing only one leaf . . . 8

8a. Calyx densely hairy; inflorescence congested . . . 22. *hirtella*
8b. Calyx glabrous; inflorescence not congested . . . 9

9a. Inflorescence with lateral branches; pedicels 10–12 mm; calyx 5-partite . . . . 9. *anthocrena*
9b. Inflorescence forked immediately below first flowers; pedicels 5–6 mm; calyx 4(–5)-partite 4. *tetrasepala*

10a. Plant producing more than one leaf; leaves petiolate and separated by internodes . . . 11
10b. Plant producing only a single leaf, or if a secondary one is produced it is borne on an axis arising among the peduncles at the base of the primary leaf, and perhaps itself bearing a tertiary leaf in the same way 12

11a. Pedicels 5–7 mm, hairy; fruit wall not valvular . 10. *ramosa*
11b. Pedicels 15–20 mm, glabrous; fruit wall valvular 20. *caulescens*

12a. Pedicels shorter than or equalling calyx, eventually disarticulating just above base and leaving regular row of stubs; fruit wall not valvular 13
12b. Pedicels longer than calyx, not usually disarticulating regularly; fruit wall valvular 18

13a. Hairs forked or dendroid 14
13b. Hairs simple or absent 16

14a. Hairs forked at tip . . . . 7. *furcipila*
14b. Hairs dendroid 15

15a. Larger inflorescences at least forked below first flowers; dorsal segment of calyx c. 5 mm . . . . . . 5. *merrilliana*
15b. Inflorescence simple; dorsal segment of calyx c. 7 mm . . 6. sp. aff. *merrilliana*

16a. Peduncle at first with stiff brown hairs: dorsal calyx-segment exceeding laterals, down-curved and beak-like at tip in fruit . 3. *brevipes*
16b. Peduncle glabrous or shortly pilose; dorsal calyx-segment if exceeding laterals not beak-like 17

17a. Style exserted from fruiting calyx, 5 mm long . 2. *eymae*
17b. Style not exserted from fruiting calyx, 3 mm long 1. *glauca*

18a. Inflorescences arising from top of stem distinctly below the leaf-base 19
18b. Inflorescences arising from mid-rib at or above the leaf-base . 22

19a. Pedicels filiform, flexuous, up to 4 cm; leaf-blade attenuate at base . . . . . . 24. *elongata*
19b. Pedicels up to 12 mm; leaf-blade cordate or truncate at base . 20

20a. Peduncles with long spreading brown setae near base, the old ones drying on the plant and often long persistent . 23. *pendula*
20b. Peduncles glabrous or with a few scattered hairs, the old ones falling, sometimes leaving well marked stubs 21

21a. Leaf deeply cordate at base; inflorescences straggly, up to 23 cm . . . . 19. *horsfieldii* var. *hendersonii*
21b. Leaf shallowly cordate or truncate at the base; inflorescences up to 15 cm . . . . . . 31. *papuana*

22a. Upper corolla-lobes very oblique at base 23
22b. Upper corolla-lobes straight or slightly oblique at base 24

23a. Hairs eglandular; corolla pure white 26. *andersonii*
23b. Hairs glandular; corolla white with yellow palate . 25. *glandulosa*

24a. Upper corolla-lobes small, barely 1 mm, recurved 25
24b. Upper corolla-lobes more than 1·5 mm, erect or porrect . 26

25a. Corolla-tube equalling calyx; corolla green or whitish 29. *cupiflora*
25b. Corolla-tube exceeding calyx; corolla with red and yellow marks on lower lip, background white or red . 30. *insignis*

26a. Inflorescence hairy 27
26b. Inflorescence glabrous 32

27a. Hairs glandular 28
27b. Hairs eglandular 30

28a. Corolla more than 1 cm long . . . . . 27. *hottae*
28b. Corolla less than 1 cm long 29

29a. Corolla lobes with recurved margins, appearing acute; glandular hairs coarse; tips of calyx segments erose . . . 17. *selaborensis*
29b. Corolla lobes flat, rounded; glandular hairs slender; tips of calyx segments entire . . . 16. *tenuis*

30a. Corolla more than 1 cm; stem stout . . . . . 28. *fissilis*
30b. Corolla less than 1 cm; stem slender 31

31a. Calyx with short hairs outside, or glabrous . . . 15. *longipes*
31b. Calyx with long slender hairs outside . . . 14. *hirticalyx*

32a. One pedicel of a pair curved downwards around the other in fruit . . . 13. *glabra*
32b. Pedicels ascending in fruit 33

33a. Calyx with a few brown curled hairs on outside, margins slightly undulate . . . 21. *leuserensis*
33b. Calyx glabrous, not undulate at margin . . . 34

34a. Corolla more than 1 cm long; leaf at first glandular-pilose 27. *hottae*
34b. Corolla less than 1 cm long; leaf glabrous . . . 35

35a. Filaments bearded . . . . 19. *horsfieldii*
35b. Filaments glabrous 36

36a. Leaf deeply cordate, broadly ovate; corolla tube bearded within; style swollen at base in fruit . . . 18. *sarangica*
36b. Leaf more or less truncate, narrowly ovate, ovate-oblong or ovate-lanceolate; corolla tube subglabrous within; style swollen above base in fruit, contracted at attachment to ovary . 31. *papuana*

1. Monophyllaea glauca C.B.Cl. in DC., Mon. Phan. 5:183, tab. 20 (1883). Type: Sarawak, *Lobb* (K).

Stem 15–60 cm. *Leaf* 15–32 × 10–36 cm, broadly ovate, deeply cordate at base, glabrous or shortly pilose. *Inflorescences* arising at base of lamina, 1–20, more or less contemporaneous; peduncle c. 15–25 cm high, glabrous or shortly pilose, flowering part 2–5 cm; pedicel c. 3–5 mm. *Calyx* 5–6 mm; tube 1–1·75 mm; segments 5 (very rarely 4), 4–4·5 mm, oblong, blunt, the dorsal one more or less carinate on the back and slightly larger. *Corolla* c. 1 cm; tube broadly cylindric, 4·5 mm, bearded inside c. 1·5 cm above base; upper lobes translucent, erect, 3 × 2 mm; lower lip 5 mm, densely papillose, with central yellow patch with a red bar below it, lateral lobes c. 3 × 3 mm, median 3 × 3 mm, orbicular-spatulate. *Stamens* with posterior filaments arising 2·5 mm above base of tube, 2 mm, hairy at top; anterior arising 3 mm above base of tube, 3 mm, strongly arcuate, connective with distinct apical tooth, hairy; anthers 0·75 mm diam. *Disc* c. 0·75 mm. *Ovary* c. 1·5 mm; style c. 2·5 mm, both glabrous. *Capsule* c. 3 × 2·5 mm, surmounted by strongly thickened style 3 mm long.

Key to varieties:

1a. Leaf and inflorescence glabrous . . . . . . var. *glauca*
1b. Leaf or inflorescence hairy 2
2a. Leaf glabrous above, or slightly hairy on basal lobes, or with a very few scattered hairs on upper surface; pedicels and usually calyx with indumentum of stiff brown hairs . . . var. *hirta*
2b. Leaf with erect hairs all over upper surface . . . 3
3a. Pedicels and calyx with rather dense indumentum of brown hairs; young fruiting pedicels deflexed . . . . var. *versipes*
3b. Pedicels and calyx glabrous or with short white hairs; young fruiting pedicels erect 4
4a. Hairs on leaf soft, from slender base; base of peduncle glabrous var. *beccarii*
4b. Hairs on leaf harsh, from thick swollen persistent base; base of peduncle with scattered stiff spreading hairs . . var. *boraginea*

var. **glauca**

Leaf subglabrous; a few scattered short sharp peripheral hairs merge into the marginal asperities. Fruit with shallowly dome-shaped (rather than conical) persistent style base (B.8177).

Type: Sarawak, sine loc., *Lobb* (K).

SARAWAK. First Div., Bau distr., Gunong Tongga, NE of Krokong, 21 v 1975, *Burtt* 8177 (E, SAR).

var. **hirta** B. L. Burtt, **var. nov.** a var. *glauca* pedicellis et plerumque calycibus pilis rigidis brunneis (interdum breviter dendroideis) indutis distinguenda. *Fig. 8A.*

Leaves glabrous or with brown hairs on and near the margins of the basal lobes, rarely with a few short very scattered hairs all over the upper surface (B.1876). Pedicels and usually calyces with a dense indumentum of stiff brown hairs, sometimes with short dendroid branching (B.1826,1876,8191, S 25627, *Purseglove* 4470).

Type. Sarawak, First Div., Bukit Serapat, 13 miles from Kuching on Simanggang road, 25 vii 1967, *Burtt & Martin* B.4743 (holo. E, iso. SAR).

Selected specimens:—

SARAWAK. First Div.: Area West of S Sarawak Kiri (Bau distr.): Seburan, 100 m, 2 v 1957, *Anderson* S.7766 (L, SAR); S side Bukit Krian, 26 iii 1966, *Anderson* S.23498 (SAR); Bukit Kapor, 22 v 1962, *Burtt & Woods* B 1876 (E, SAR); Bukit Numpang, Tai Ton, 17 xii 1965, *Chai & Seng* S.22887 (L, SAR); S end Gunong Doya, above Kampong Seromah, 23 v 1975, *Burtt* B.8191; Bukit Jebong, 100 m, 29 iv 1967, *Paul & Ilias* S.25627 (E, L, SAR); Bau, 30 m, 15 ix 1955, *Purseglove* 4470 (E, SAR, SING). Area East of S Sarawak Kiri; Bukit Serapat, 13 miles from Kuching on Simanggang road, 7 v 1972, *Anderson* S.31638 (SAR); 16th mile, Penrissen road, 21 iv 1962, *Anderson* S.15271 (SAR); Gunong Segu, path to Kampong Segu, 6 iii 1949, *Sinclair* 5657 (E, SING); Bukit Manok, Padawan, 5 xii 1973, *Mamit* S.33452 (SAR); Upper Sadong distr., Gunong Selabor, 120 m, 29 ix 1964, *Anderson* S.20820 (E, SAR); *ibidem*, 28 v 1975, *Burtt* 8205 (E, SAR).

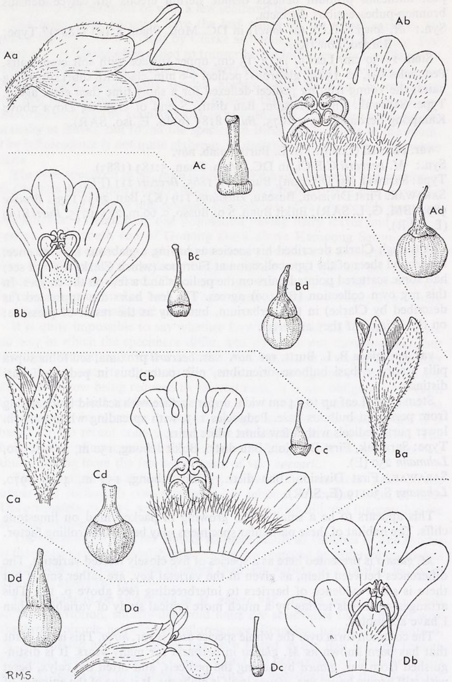

FIG. 8. A, *Monophyllaea glauca* v. *hirta* (*Burtt* 1826); B, *M. tetrasepala* (*Burtt* 8119). C, *M. merrilliana* (*Burtt* 8244); D, *M. singularis* var. *singularis* (*Burtt* 8157); a, flower or calyx; b, corolla, dissected; c, gynoecium; d, capsule. All × 4.

var. **versipes** B. L. Burtt **var. nov.**, foliis superne pilis erectis indutis, pedicellis post anthesim primum deflexis deinde iterum erectis uti calyce densius brunneo-pubescentibus distincta.
Syn.: *M. lowii* C.B.Cl. (as *lowei*) in DC. Mon. Phan. 5:183 (1883)? Type: Borneo, *Low* (K).

Stem 15–30 cm. Leaf c. 15 × 15 cm, upper surface with soft erect hairs. Peduncles 1–4, 10–15 cm, glabrous; pedicel 5–6 mm, clad with short spreading hairs; the young fruiting pedicel deflexed for a short time then erect again. Type. Sarawak. First Division, Bau distr., S end of Gunong Doya above Kampong Seromah, 23 v 1975, *Burtt* 8185 (holo. E, iso. SAR).

var. **beccarii** (C.B.Cl.) B. L. Burtt, **comb. nov.**
Syn.: *M. beccarii* C.B.Cl. in DC., Mon. Phan. 5:183 (1883).
Type: Sarawak [Ist Division], Busso, vii 1865, *Beccari* 211 (FI).
SARAWAK. First Division, Buseau, *Haviland* 119 (K); Bau, 26 iv 1955, *Brooke* 9890 (BM, G, L, SAR); Bukit Buan, S of Busso, c. 60 m, 27 v 1975, *Burtt* 8199 (E, SAR).

Although Clarke described his species as having a glabrous inflorescence, the second sheet of the type collection at Florence (which Clarke did not see) had some scattered pointed hairs on the pedicels and a few on the calyces. In this my own collection (B 8199) agrees. The leaf hairs are appressed (as described by Clarke) in the herbarium, but only as the result of pressure: on the living leaf they are erect.

var. **boraginea** B. L. Burtt, **var. nov.** var. *beccarii* proxima, sed foliis supra pilis scabris e basi bulboso orientibus, pilis patentibus in pedunculi basi distincta.

Stem 2 cm. Leaf up to 14 cm wide, upper surface with scabrid hairs arising from persistent bulbous base. Peduncles 1–3, with spreading white hairs in lower part. Pedicels with a few short white hairs.
Type: Sarawak, First Division, Bau distr., Bukit Jebong, 150 m, 24 vii 1970, *Lehmann* 250 (E).
SARAWAK. First Division, Bau distr., Bukit Jebong, 150 m, 4 vii 1970, *Lehmann* S.30119 (E, SAR).

This appears to be a small plant, growing in packed mud on limestone cliffs. The habitat of these particular specimens may be the controlling factor.

M. glauca is presented here as a species of five closely related varieties. The differences between them, as given in the varietal key, are rather small; but there is some evidence of barriers to interbreeding (see above p. 14). This arrangement needs testing by a much more critical study of variability than I have attempted.

The common form over the whole species area is var. *hirta*. This is the plant that has been known as *M. glauca* in herbaria for many years. It is distinguished from var. *glauca* by having the pedicels, and often the calyx, beset with stiff brown hairs: var. *glauca* itself is glabrous. It is one of the enigmas of *Monophyllaea* that none of the three specimens from near Kuching that Clarke described as species represented *glauca* var. *hirta*, for it is by far the commonest and most widespread form. The typical var. *glauca*, with glabrous inflorescence, is known to me only from the type specimen and the one collection I made near Krokong (B. 8177).Both var. *glauca* and var. *hirta* have the leaves glabrous or with a few scattered hairs.

The other three varieties have the leaf pilose on the upper surface. *M. glauca* var. *beccarii* was cited by Clarke as coming from near Kuching. For some reason Clarke often failed to transcribe the localities given on Beccari's labels; the type of *M. beccarii* is clearly labelled 'Busso', a village on the Sarawak river. Incidentally Beccari always wrote Kuching in italianized spelling, Kutcin, and Clarke always misread this as Kutein. The species has been collected also by Haviland and by Miss Brooke. I could see no limestone actually at Busso, but found the species on Bukit Buan a little to the south. The inflorescence is not quite glabrous, as described; it has a few short white hairs.

The type specimen of *M. lowii* is unlocalized and it is a very bad specimen. In Clarke's description it differs from *M. glauca* var. *beccarii* in one particular only: in having a pilose inflorescence whereas that of var. *beccarii* is described as glabrous. I found only one population having hairy leaves and inflorescence: at the south end of Gunong Doya above Kampong Seromah. The plants in this population had, however, a very curious and distinctive feature. Just after flowering the pedicels became deflexed, but quickly became erect again as the fruit ripened. This meant that the usually smooth curve of the inflorescence was broken by a gap where the pedicels were bent down: only 2 or 3 flowers were affected at a time.

It is quite impossible to say whether Low's plant had this character. I see no way in which the specimens differ, and therefore put them together, but the imperfect material dictates an indication of doubt. It is very unsatisfactory to have such uncertainty about the features of the type of a taxon. Because *M. lowii* is now being reduced to varietal rank, it is not obligatory to retain the same type and epithet. This variety is accordingly redescribed above as var. *versipes*, in reference to the changing posture of the pedicel, and it is based on the recent collection in which alone this character is visible. The hairs in the inflorescence of var. *versipes* are fairly dense, short and brown: thus differing from the few white hairs of var. *beccarii*.

The fifth variety is distinguished by the harsh bulbous-based hairs on the upper leaf surface. It comes from Bukit Jebong, somewhat south of Bau. Unfortunately in 1975, when I was in the area, this hill was inaccessible for security reasons.

The dominant reason for uniting all these plants as varieties of one species is that their morphological differences are not matched by different ecological preferences. The occurrence of more than one variety in a locality has been discussed above (p. 14).

One comment on variability in *M. glauca* var. *hirta* is necessary. As noted in the description, shortly dendroid hairs are sometimes found mixed with the brown simple hairs in the inflorescence. Branched hairs are a feature of *M. merrilliana* and this species has been found in the Bau district, though seemingly very rare there. It could be that the occurrence of branched hairs in *M. glauca* is due to contamination with *M. merrilliana*; on the other hand it may be simply variation within the species. On the island of Ceram in the Moluccas a specimen referable to *M. brevipes* (a New Guinea species) also has one or two branched hairs in the inflorescence. This again could be normal variation, or another New Guinea species that has branched hairs (*M. furcipila*) could eventually be found on Ceram. At present this variation in indumentum is scarcely strong enough evidence to suggest that hybridization has been of importance in the genus.

M. glauca is undoubtedly the species in which a critical study of variation could most easily be undertaken. Its whole area is accessible from Kuching and it occurs with sufficient frequency and in sufficient numbers for limited sampling to be possible without endangering its existence. The complex pattern of variation, here somewhat superficially subsumed under five varieties, is a guarantee that results would be of value. Its suitability for study holds as an example of a rainforest herb and does not depend on its eccentric unifoliate habit.

2. Monophyllaea eymae B. L. Burtt, **species nova**; a *M. glauca* habitu graciliore, folio angustiore, pedicellis longioribus, stylo longiore e calyce fructus exserta distinguenda.

Stem 4–12 cm. *Leaf* up to 20 × 6·5 cm, ovate-lanceolate, glabrous, slightly cordate and perhaps unequal-sided at base. *Inflorescences* 2–4, arising just below leaf-base; peduncles up to 5 cm, glabrous; pedicel 5 mm, glabrous; flowers dense. *Calyx* tube 1 mm; lateral and anterior segments 2·5 × 1·25 mm, glabrous; the dorsal one 4 × 1·75 mm, the midvein ending 0·5 mm below tip and hairy here on the outside, the tip a membranous appendage decurrent at sides. *Corolla* 10 mm; tube nearly 7 mm; upper lobes 1 × 1·5 mm, lateral 1·5 × 1·75 mm, median 2·5 × 1·5 mm. *Stamens*: posterior filaments arising 3·5 mm above corolla base, 1 mm; anterior arising 4 mm above corolla base, 1·5 mm; all glabrous; anthers 0·5 mm diam. *Disc* barely 0·5 mm. *Ovary* 0·75 mm; style 3·25 mm; both glabrous. *Capsule* 2·5 × 1·75 mm, thin walled, crowned by conically thickened persistent style 5 mm long.

Type. E Celebes: Res. Menado, subdiv. Loewoek, between Pinapoeng and G. Loloa, G. Beabis, limestone rocks, 27 ix 1938, *Eyma* 3875 (holo. L, iso. K).

The collector noted the flowers of this species as 'pale lilac', and the plant as smelling of coumarin. The affinity is perhaps closer with *M. anthocrena* from S Celebes than with *M. glauca*, but it is a much smaller plant with narrower leaf and, when both species are so little known, the obvious differences can only be taken at face value.

3. Monophyllaea brevipes S. Moore in Trans. Linn. Soc. Bot. 9:127 (1916).

Stem c. 8 cm. *Leaf* 12–15 × 6–9 cm, ovate-cordate, more or less glabrous above except for simple bristly hairs towards base and margin. *Peduncles* arising at base of lamina, 5–15 mm, at first beset with stiff brown hairs, at length glabrous; pedicels 3–4 mm, with brown hairs. *Calyx* 6·5 mm to tip of upper lobe, with short stiff brown simple hairs; tube 2 mm; lobes acuminate, the 4 lower 3 mm, the dorsal one 4 mm. *Corolla* tube 4 mm, papillose inside in upper part; upper lip 3 mm, lower 2 mm; lobes suborbicular. *Filaments* not toothed. *Ovary* 1 mm; style 2 mm; both puberulous.

Type. New Guinea [Irian Jaya], Mt Carstenz, Camp III, c. 650 m, *Wollaston Exped.* (holo. BM).

The following specimen also probably belongs here:—
MOLUCCAS. Ceram, east, Gunong Selagar near Kampong Selagar, 300 m, calyx yellow green, corolla white, 26 viii 1938, *Buwalda* 5749 (K, L).

The tendency for the dorsal sepal to be longer than the remainder is well-marked in *M. brevipes*, where it can appear almost beak-like. *Buwalda* 5749 from Ceram agrees with the type except that the calyx is slightly shorter (5 mm overall) and a few of the hairs on it are forked. With only one specimen available for comparison from each area one cannot be dogmatic about their specific identity. However there are no significant differences to suggest separation at present.

The description given above is partly based on that of S. Moore, as the material is inadequate for further floral dissection. In order to avoid possible confusion nothing has been added to it from the Ceram specimen, *Buwalda* 5749; this too is somewhat incomplete, but the following details were ascertained: Calyx 5 mm, thinly pilose, a few of the hairs forked and a few hooked; tube 1·5 mm, lower lobes 3 mm, the dorsal 3·5 mm: corolla c. 8 mm, tube bearded below insertion of stamens: anterior filaments arising 2·5 mm above corolla-base, posterior 2 mm, all c. 1 mm long: style 2 mm.

4. Monophyllaea tetrasepala B. L. Burtt, **species nova** habitu magno, inflorescentiis rubicundis, primariis sub flore primo furcatis, secundariis secus costam dispersis, calyce saepius quadripartito, corolla labio inferiore subrubro insignis. A *M. merrilliana*, cui magnitudine approximat, colore et calyce circum capsulam clauso distinguitur. *Fig. 8B.*

Stem 30 cm or more. *Leaf* up to 35 × 35 cm, broadly ovate, cordate at base, shining, glabrous except for asperities on and near margin; nerves 3 cm apart, ascending. *Inflorescences* spread interruptedly up the midrib, the larger near the base up to 30 cm, forked below the first flowers and, more rarely, one of the laterals forked again, the smallest higher up the midrib only 3 cm, glabrous; pedicels 5–6 mm with short somewhat crisped hairs. *Calyx* c. 7 mm, shortly hairy outside, tube 1–1·5 mm; segments 4–5, 6 mm, the dorsal one keeled on the back. *Corolla* 10 mm; tube 5 mm, densely bearded inside about 2·5 mm above base; upper lobes pale greenish 3 × 3 mm; lower lip pink except for yellow patch at base of middle lobe and overlapping onto laterals, papillose, laterals 4 × 2·5 mm oblong, median 4 × 3 mm spatulate. *Stamens*: anterior filaments arising 4 mm above base, 3 mm long; posterior arising 3 mm above base, 2·5 mm long; all glandular towards top; anthers 1·25 mm diam. *Disc* 0·5 mm. *Ovary* 1 mm, glabrous; style 3 mm, with some scattered short hairs in upper half; stigma bifid. *Fruit* 2 mm, surmounted by broad minaret-shaped style-base.
Type. Sarawak, First Div., Padawan distr., Gunong Manok, 13 v 1975, *Burtt* 8119 (holo. E, iso. SAR).
SARAWAK. First Div., Padawan distr., Gunong Bra'ang, 7 v 1975, *Burtt* 8096 (E, SAR).

This is a spectacular species with large shining leaves and reddish inflorescences. When cut for pressing the inside of the stem was also found to be red. It was growing on loose limestone slopes in forest gaps. The forking of the inflorescence and the way the later inflorescences arise scattered up the midrib of the leaf emphasise the affinity with *M. merrilliana*; but the closed fruiting calyx and the lack of branched hairs show that there is also a close relationship with *M. glauca*. On Gunong Manok all three species grew in the same stream valley.

5. Monophyllaea merrilliana Kraenzlin in Philipp. Journ. Sc. 8:168 (1913); Merrill, Enum. Philipp. Fl. Pl. 3:456 (1923).

Syn.: *M. johannis-winkleri* Kraenzlin in Mitt. Inst. Bot. Hamburg, 7:91 (1927). Syntypes: [Kalimantan], W Borneo, Bukit Mehipit, *Winkler* 674; Bukit Raja, *Winkler* 930 (HBG).

Very variable in size: stem 5–30 cm, encrusted. *Leaf* 12–45 × 10–40 cm, usually broadly ovate occasionally oblong, base cordate; upper surface covered all over, or only near the base, with brown branched hairs or glabrous, lower surface more or less encrusted. *Inflorescences* arising at the base of the midrib, with or without additional ones scattered along it; primary peduncles up to 30 cm, branching below first flowers, more rarely twice branched, secondary ones sometimes only 1 cm, not branched; glabrous or thinly pilose; flowering axis and pedicels rather densely clad with brown branched hairs; pedicels c. 4 mm. *Calyx* 7–8 mm, with branched hairs on the outside; tube 2·5–3 mm; anterior and lateral lobes 4·5–5 × 1·75–2·5 mm, dorsal 4·5–5 × 3·5 mm, all acute. *Corolla* 12–13 mm, white with yellow patch in centre of palate; tube 6–7 mm, bearded inside below the filaments; upper lobes 2 × 4 mm, laterals 2·5–3 × 3–4 mm oblong, median similar but broadly spatulate, papillose. *Stamens* with red filaments (? always): posterior arising 4 mm above base, 1·5–2 mm long, anterior 4·5 mm above base, 2–3 mm, arcuate, all verrucose-glandular near top and back of connective; anthers 0·75–1·25 mm diam. *Disc* 0·5–1 mm. *Ovary* 1·5 mm, glabrous; style 2–3 mm, sometimes with a few glandular hairs in upper part. *Fruit* 2 × 2·5 mm, thin-walled crowned by persistent conical style with swollen base; fruiting calyx open. *Fig. 8C.*

Type. Philippines: Mindanao, distr. Zamboanga, Sax River mts, *Merrill* 8110 (BM, K).

PHILIPPINES. Samar, ii-iii 1916, *Ramos* BS 24343 (BM, K); Mt Malingan, Wright, iv-v 1948, *Sulit* PNH 6188 (L, SING); Mt Purug, 460 m, xii 1951, *Edano* PNH 15438 (L, SING). Bohol, viii-x 1923, *Ramos* BS 43315 (BM, HBG, K). Mindanao, prov. Agusan, Cadadbaran (Mt Urdaneta), ix 1912, *Elmer* 13781 (BM, E, HBG, K, L); prov. Surigao, Mt Kabatuan, iii 1948, *Mendoza & Convocar* PNH 10518 (L); Surigao, 18 v 1928, *Wenzel* 3360 (K); *ibidem*, iv 1929, *Ramos & Pascasio* BS 34351 (K).

SABAH. Mt Kinabalu, Dallas to Kiau Forest, 900 m, 22–24 viii 1931, *Clemens* 26197 (BM, K, L); *ibidem*, Dallas, 900–1200 m, 11 viii 1931, *Clemens* 26438 (BM); Nankatan, by Kalim R., 450 m, 2 viii 1955, *S. Collenette* 55 (BM). Mt Trusmadi, 5° 37′ N, 116° 30′ E, 1000 m, 20 iii 1969, *Nooteboom* 1419 (L).

KALIMANTAN. West Borneo, Bukit Mehipit, 750 m, 9 xii 1924, *Winkler* 674 (HBG); Bukit Raja, 1250 m, 17 xii 1974, *Winkler* 930 (HBG). East Borneo, Loa Haur, west of Samarinda, 40 m, 13 v 1952, *Kostermans* 6908 (K, L); Berau, Mt Njapa on Kelai river, 1000 m, 25 x 1963, *Kostermans* 21493 (L); Peloe Pjihan, 11 xii 1898, *Amdjah* 328 (Exped. Nieuwenhius, L); Bukit Liang

Karing, 1896–7, *Jaheri* 1199 (L); Peak of Balikpapan (G. Beratus), sandstone, 640 m, *Kostermans* 7562 (L); Sangkulirang distr., Mt Medadam, limestone, 450 m, 8 viii 1957, *Kostermans* 13384 (L); *ibidem*, 100 m, 13 viii 1957, *Kostermans* 13496A (L).

SARAWAK. First Div.; Bau distr., Gunong Krian to Seburan mine, 23 v 1962, *Burtt & Woods* B 1899 (E); Padawan distr., Gunong Regu, 6 v 1975, *Burtt* 8087 (E, SAR); 16th mile, Penrissen road, 150 m, 21 iv 1962, *Anderson* S 15282 (SAR). Third Div.; Kapit distr., western slopes of Bukit Tibang, extreme headwaters of Balleh R., 1° 35′ N, 114° 33′ E, 960 m, on igneous (andesitic) rocks, 11 vii 1969, *Anderson* S 28651 (E, SAR). Fourth Div.; Gunong Mulu National Park, Melinau gorge 90 m, 11 vii 1961, *Anderson & Keng* K42, K43 (SAR); *ibidem*, 22 vi 1962, *Burtt & Woods* B 2231 (E, SAR); Gunong Api, c. 900 m, 5 ix 1970, *Chai* S. 30067 (E, L, SAR); *ibidem*, 660 m, 29 xi 1971, *Anderson* S. 30811 (E, SAR, SING); *ibidem*, 855 m, 12 vi 1975, *Burtt* 8244 (E, SAR).

M. merrilliana, in the sense that the name is used here, covers a considerable amount of variation and a wide distributional range. Like the other widespread species, *M. horsfieldii*, it is not restricted to limestone; where it does occur on limestone, it is often on the limestone-derived soil rather than on the rock itself. Unfortunately the kind of rock was not recorded for the type specimen: Merrill merely noted "on damp cliffs in deep shaded ravines".

Monophyllaea leaves often seem to vary in shape according to where they grow: pendulous leaves tend to be oblong, those on an erect stem to be ovate. *M. merrilliana* is certainly variable in this respect, the type specimen having oblong leaves, most of the Bornean material ovate. There is also much variation in the indumentum. The type of *M. johannis-winkleri* (exactly matched by S 28651) has a broadly ovate leaf, glabrous above. Other plants (including those from the Gunong Mulu National Park) have similar leaf shape, but a well-developed indumentum of brown branched hairs, at least on the younger parts of the upper surface. The Philippine (type) plant has an oblong leaf but it is hairy above.

Inflorescences also vary. It is usually only the larger ones that are forked below the first flowers: the smaller ones are unbranched. In *M. johannis-winkleri* and in some other specimens they arise at the base of the midrib only. Sometimes smaller inflorescences arise at intervals up the midrib. Sometimes again the large primary inflorescences are suppressed and all are of secondary stature, starting at the base of the midrib and then scattered up it: this condition is found in much of the material from east Kalimantan (e.g. *Kostermans* 6908, 7562, 13384, 13496A, *Jaheri* 1199, *Amdjah* 328).

Thus there is a considerable range of variation to study. The more obvious aspects, mentioned above, do not seem to me to break the species up into clearly definable subunits. What is needed is more adequate flowering and fruiting material (or field studies) to see if there may be characters of flower or fruit which will indicate more clearly how subdivision should be attempted.

I have separated the following species (no. 6) with some doubt, but it does seem to extend the variability of *M. merrilliana* unduly; especially in respect of the calyx. However too little is yet known for me to feel confident enough to assign it a name.

6. Monophyllaea sp. aff. *M. merrilliana* Kraenzlin

Stem 8–12 cm, with a few branched hairs near top. *Leaf* up to 25 × 14 cm, more or less oblong, slightly cordate at base, thinly pilose with branched hairs on both surfaces (densely so on young parts near base of leaf), lightly encrusted below. *Inflorescences* arising just above or just below leaf base, up to 25 cm high, unbranched, covered with branched brown hairs when young, these eventually persisting only towards base and apex; pedicels c. 4 mm, with branched hairs. *Calyx* with branched hairs on outside; tube 1 mm, dorsal segment 7 mm, acuminate, others 5 mm acute.

KALIMANTAN. E Borneo, Berouw, top of Mt Ilas Mapulu, 800 m, limestone, 23 ix 1957, *Kostermans* 14048 (L); Mt Ilas Bungao, 300 m, ix 1957, *Kostermans* s.n. (L).

Even with a broad concept of *M. merrilliana* I have little doubt that these specimens represent a distinct species, but it is advisable to await fuller material before giving it a name. The outstanding feature is the very long dorsal calyx segment: in no other *Monophyllaea* is the difference between the dorsal segment and the remainder so marked.

7. Monophyllaea furcipila Ohwi apud Kanehira & Hatusima in Bot. Mag. Tokyo, 57:127 (1943).

Syn.: *M. furcipila* Ohwi var. *pustulata* Ohwi, l.c. 128. Type: as for type of species, *Kanehira & Hatusima* 12436/A (n.v.).

Stem c. 30 cm. *Leaf* c. 20 × 12 cm, oblong-ovate, cordate at base, glabrous or pilose with simple hairs on upper surface (especially towards base), subglabrous below. *Inflorescences* c. 3, from base of leaf; peduncle 5–8 cm, with scattered forked hairs, simple or forked below the inflorescence; pedicel 5 mm, densely pilose with forked hairs. *Calyx* 4–5 mm, pilose like the pedicel; tube c. 2 mm; segments 2–3 mm, acute. *Corolla* 8 mm; tube 2 mm, bearded within the throat; upper lip half as long as the lower; the lower 4 mm long flabellate in the middle, very shortly puberulous, trifid; lobes all orbicular, 2 × 2 mm, ciliolate. *Stamens* glabrous; filaments without appendages. *Ovary* subglobose, glabrous; style rather thick, glabrous, nearly 2 mm long. *Capsule* 3 mm, ovate-conical.

Type: New Guinea [Irian Jaya, SE corner of Geelvink Bay], Patema, 40 km inward of Nabire, 300 m, 6 iii 1940, *Kanehira & Hatusima* 12436 (n.v.).

PAPUA NEW GUINEA. Sepik distr., Aitape subdistr., along Bliri R. near Kaiye village, c. 75 m, 13 vii 1961, *Darbyshire & Hoogland* 8136 (E, K).

The above description is condensed from the one published by Ohwi, and includes his var. *pustulata*. As I have not seen his type specimen, and have had only one other for examination, it has seemed better not to mix characters. The var. *pustulata* was apparently growing with the type and the differential characters supplied do not suggest that it deserves recognition. Elsewhere I have used varietal rank for definite populations.

Darbyshire & Hoogland 8136 supplies the following deviating or additional characters: *Leaf* up to 28 × 19 cm, hairs on upper surface usually simple very rarely forked, those on lower surface usually simple sometimes forked, thinly encrusted below. *Corolla* tube 4·75 mm, bearded below filaments.

Stamens: anterior filaments arising 3·75 mm above base, 2 mm long; posterior arising 2·75 mm above base, barely 1 mm long, distinctly decurrent half-way to base; all glabrous; anthers 1 mm diam. *Ovary* 1·5 mm, glabrous: style nearly 2 mm, with a few scattered hairs in the upper half.

This specimen also shows that there may be a stem bearing 2 further leaves above the main one: unfortunately the connexion is not preserved. Ohwi comments on, and illustrates, the production of adventitious plantlets near the base of the stem. This has already been noted in *M. merrilliana*, with which *M. furcipila* certainly has its closest affinity, a fact emphasised both by the branched hairs (forked at the tip in *M. furcipila*, but dendroid in *M. merrilliana*) and by the tendency of the inflorescence to fork below the first flowers. No observations are available on the fruiting calyx, but it certainly looks as though it may be open, as in *M. merrilliana*.

8. Monophyllaea stellata B. L. Burtt, **species nova** indumento e pilis stellatis pedicellatis composito et inflorescentia infra floribus ramosa ab speciebus aliis borneensibus facile distinguitur. Ob ramificationem inflorescentiae *M. anthocrenae* affinis sed ab hac ut ab omnibus indumento stellato distincta.

Stem to 36 cm, encrusted. *Leaf* 36 × 36 cm, rounded, cordate at base, glabrous above, stellate-hairy and encrusted below; veins 1·5–2·5 cm apart in middle of lamina. *Inflorescences* all arising at base of lamina, clustered, 3–4 primaries then smaller secondaries; main inflorescence broken but bare peduncle 15 cm, at first stellate then (apart from incrustation) more or less glabrous; basal bracts small, 2·0 × 0·5 mm; inflorescence with 2–3 ebracteate side branches; pedicels 6 mm, shortly stellate. *Calyx* shortly stellate outside, margins and inside of tips of lobes with short stiff simple hairs, 5 mm; tube 1 mm; lobes 5, 4 lower 4 × 2 mm, oblong-elliptic, rounded at tips, uppermost 4·5 × 3 mm acute. *Corolla* and stamens not seen. *Fruit* 3 mm, 3 mm wide at top, 1·5 mm at base, persistent style 2·5 mm very shortly pubescent.

Type. Kalimantan, Sangkulirang distr., Mt Medadam, N of Sangkulirang, 450 m, limestone, flowers white, inside pinkish, lip with yellow spot inside, 8 viii 1957, *Kostermans* 13393 (holo. L, iso. K).

KALIMANTAN. Sangkulirang distr., Mt Medadam, 200 m, *Kostermans* 13401 A (L).

The stellate indumentum of this species is unique in the genus. In the branching of the inflorescences it is allied to the following species, *M. anthocrena*. Both *M. stellata* and *M. merrilliana* have been found on Mt Medadam in the Sangkulirang district of E Borneo, while *M. kostermansii* comes from the same district.

9. Monophyllaea anthocrena B. L. Burtt, **species nova** ex affinitate *M. stellatae*, sed foliis incrustatis glabris et inflorescentiis glabris, sepalo dorsali porcato differt.

Stem 30–50 cm. *Leaf* 25–35 × 20–35 cm, ovate-oblong, deeply cordate, glabrous above, encrusted below, asperous on margin. *Inflorescences* arising at base of leaf, up to 30 cm; peduncle to 25 cm; upper part with 2–3 lateral branches that terminate in typical curved flowering part; pedicel 10–12 mm.

Calyx tube c. 2 mm; segments 5–7 × 2–2·5 mm, the dorsal one always slightly the largest and distinctly ridged on the back, oblong-oblanceolate, narrowed to a bluntish tip. *Corolla* not seen. *Fruit* 2 × 2 mm, thin-walled, persistent style base expanded over top of capsule, the persistent part of style 2–5 mm.

Type: S Celebes, Bantimoeroeng, between Makassar and Marcos, 20 m, 25 vi 1937, *van Steenis* 10445 (holo. L).

S CELEBES. Bantimoeroeng and vicinity, limestone near the caves, 50 m, 20 ii 1938, *Buwalda* 3720 (L).

CERAM. SE Ceram, Kotta, c. 100–200 m, 14 ii 1918, *Kornassi* (Exped. Rutten) 1011 (L, U).

The specific epithet is derived from ’άυθος (flower) and κρήνη (fountain) in reference to the branching of the inflorescence. It produces, below the main plume, side shoots with the same apical curvature, so that the whole may be likened to the spray of a fountain. I have latinized the ending for convenience.

Although related to *M. stellata* in the structure of the inflorescence, *M. anthocrena* is quite distinct in having no trace of the characteristic stellate indumentum. The texture of the leaf is much thinner.

10. Monophyllaea ramosa B. L. Burtt, **species nova** habitu *M. caulescentem* (infra No. 20) revocans sed indumento, calyce longiore et praecipue fructus parietibus tenuibus non in valvas frangentibus et inflorescentiis ramosis distinguitur. *M. brevipedi* S. Moore artius affinis a qua caule et inflorescentia ramosa recedit.

Stem branched, probably straggling; c. 15–18 cm to first branch. *Leaves* 15–25 × 12–18 cm, oblong ovate, cordate at base, glabrous, slightly asperous at the margin, thinly encrusted below. *Inflorescences* arising at or just below the base of the lamina; peduncles up to c. 5–15 cm, the larger ones branched, sometimes subumbellately, near the top, subglabrous; pedicel 5–7 mm, with short spreading hairs, or longer slightly curly hairs. *Calyx* 5 mm; tube 2 mm, sometimes hairy outside; lobes 3 × 1·5 mm, dorsal slightly larger. *Corolla* 11 mm; tube 7 mm; thinly bearded within below the insertion of stamens; dorsal lobes 3 × 2 mm, lateral 3 × 1·75 mm, median? *Stamens*: posterior filaments arising 3 mm above base, anterior 4 mm; filaments 2 mm, slender, glabrous, the anterior with short blunt apical tooth; anther 1 mm diam. *Disc* 0·5 mm. *Ovary* 1·5 mm; style 2 mm, glabrous. *Fruit* thin-walled, 2 × 2 mm, style persistent, thickened; fruiting pedicel leaving stub 1·5 mm long when it falls.

Type. Moluccas, Central Ceram, Pileana-Biv., Wae Pileana, 680 m, fl. white, 28 x 1937, *P. J. Eyma* 1839 (holo. L, iso. K).

MOLUCCAS. Ceram (East), from Kampong Roemoga to the Wae Tasikmi, few m alt., fl. white, 2–4 ix 1938, *Buwalda* 5949 (L).

It is not possible to give an adequate description of the growth form of *M. ramosa* from the available herbarium specimens. In one plant the stem is 18 cm, then at the first branching the leaf has a "petiole" of 6 cm; the next section of the stem is 8 cm, the second leaf has a petiole of 1 cm; the final section of stem to the base of the final leaf is 16 cm and the leaf-blade 12 × 9 cm.

The name *M. ramosa* was proposed in the herbarium by J. Ohwi, when working at Bognor in 1945, and has been used on the labels of distributed duplicates.

11. Monophyllaea singularis (Balf. fil. & W.W. Sm.) B. L. Burtt, **comb. nov.**
Syn.: *Moultonia singularis* Balf. fil. & W.W. Sm. in Notes R.B.G. Edinb. 8:349 (1915) et in Sarawak Mus. Journ. 2:278 (1915); Steenis in Blumea, 11:533 (1961), excl. spec.

Stem up to 60 cm when erect, but as little as 15 cm when growing from cliff face, with or without flowers. *Leaf* at flowering stage 30 × 20–90 × 60 cm, oblong or ovate-oblong, glabrous, thickly encrusted below; nerves wide-spreading from midrib, ascending near margin, c. 1·5 cm apart. *Flowers* in a double ranked line up the stem and on to the midrib of the leaf, or on stem or midrib only; arising in groups of 2–3 with very short common stalk, the younger still in very small bud when oldest opens; pedicel 4 mm. *Calyx* 4–5 partite glabrous, the parts exposed in bud thick and encrusted, the covered parts submembranous; tube 0·5 mm; 3 anterior segments 3 × 2 mm, posterior 4 × 3 mm, strongly keeled. *Corolla* 9 mm, white, with yellow mark on palate; tube 4·5 mm, bearded below insertion of filaments; posterior lobes 3 × 2 mm, more or less erect, laterals 3 × 2·5 mm oblong-obovate, median 3 × 2·5 mm orbicular-spatulate; palate papillose. *Stamens*: anterior filaments arising 3·5 mm above base, 3 mm long, very arcuate, posterior 3 mm above base, 1·5 mm long, all glabrous; anthers 0·5 mm diam. *Disc* 0·75 mm, cupular. *Ovary* 1·5 mm, gradually narrowed to thick style 2 mm long tapering a little upwards. *Capsule* 2 × 1·5 mm, truncate at top, surmounted by the thickened persistent conical style 1 mm wide at base.
Type: Sarawak, Sudan, *native collector* D53 (E).

var. **singularis**
Flowers appearing first on the stem, later spreading to the midrib of the lamina. *Plate 1, fig. 8D.*
Type: as for species.
SARAWAK. First Division, Bau distr.: Bidi Caves, 1916, *Trench* s.n. (E); Seburan, c. 45 m, 21 x 1958, *Anderson* S. 11092 (SAR); *ibidem*, 60 m, 6 xii 1959, *Anderson* S. 14575 (SAR); gulley W of Gunong Tabai, 24 x 1962, *Burtt & Woods* B 1916 (E); Gunong Tabai, E of Bidi, 18 v 1975, *Burtt* 8157 (E, SAR); S end of Gunong Doya above Kampong Seromah, 23 v 1975, *Burtt* 8184 (E, SAR).

var. **semiflorens** B. L. Burtt **var. nov.** a var. *singulari* floribus in laminae costa tantum productis (caule sine floribus) differt. *Plate 2.*
Type: Sarawak, First Division, Padawan distr., Gunong Bra'ang, 7 v 1975, *Burtt* 8095 (holo. E, iso. SAR).

The variety takes its name from the fact that the inflorescence represents only half of that of var. *singularis*, flowers on the stem being wholly absent. In var. *singularis* flowering commences on the stem and only spreads to the midrib later. These varieties have been discussed above (p. 14).

Shortly after this species was first described, Mr C. Trench of Kuching wrote to Sir Isaac Bayley Balfour offering a few observations on the plant, which he had observed at Bidi. One point is of particular interest: "the seedlings appear to germinate on the parent stalk . . . [which] gradually withers away and falls on the ground when the young plants take root in the soil." This cannot be a general feature, as many of the early fruits have fallen while the plant is still growing and producing flowers, but it is an interesting observation on the ultimate fate of the plant. Nothing is known about the life-span, and I have never noticed dead plants in the populations examined.

12. Monophyllaea kostermansii B. L. Burtt, **species nova** *M. singulari* affinis, sed caule tenuiore, folio proportione latiore tenuiore subtus minus incrustato, calyce segmentis constanter 5 facile distinguitur.

Stem c. 25 cm long, rather slender, bearing flowers in the upper two thirds. *Leaf* c. 20 × 17 cm, roughly ovate, cordate at the base, glabrous above, thinly encrusted below, rather thin when dried, with arcuate-ascending lateral nerves. *Flowers* arising direct from the upper two thirds of the stem in a (probably double) line up one side; pedicels 5 mm long. *Calyx* tube 0·5 mm; segments 4 × 2 mm, blunt. *Corolla* tube 5 mm, bearded about the middle; lobes? *Stamens*: the lower pair arising 3·5 mm above the base of corolla tube, the upper pair 3 mm; anthers? *Disc* 0·5 mm. *Ovary* barely 1·25 mm, glabrous; style 4 mm, glabrous.
Type. Kalimantan. Sangkulirang distr., Karangan River, sandstone, corolla green, lip white with yellow spot flashed by tiny purple stripes, 24 viii 1957, *Kostermans* 13556 (holo. L, iso. K).

This specimen was referred to *M.* (*Moultonia*) *singularis* by van Steenis (in *Blumea* 11:533. 1961), but though it is a close ally of that species there can be little doubt that they must be distinguished. *M. singularis* is always on limestone and is more heavily encrusted than any other species: *M. kostermansii* is said to grow on sandstone and even if this proves to be a calcareous sandstone the light encrustation of the leaf is distinctive. Furthermore the constant possession of 5, rather than 4, calyx segments is distinctive, so that the description of the species is justified even though some floral characters have yet to be ascertained.

In the material seen so far, flowers are produced only on the stem, not on the midrib: *M. singularis* flowers either on the stem and midrib, or on the midrib only (see under that species).

13. Monophyllaea glabra Ridley in Journ. As. Soc. Str. Br. 44:82 (1905), et Mat. Fl. Mal. Pen., Gamopet. [in Journ. As. Soc. Bengal, 74(2) extra no] 785 (1908); Fl. Mal. Penin. 2:540 (1923); Henderson in J. Mal. Br. R. As. Soc. 17:61 (1939); Barnett in Fl. Siam. Enum. 3(3):208 (1962).

Stem 12–35 cm. *Leaf* 10–17 × 12–17 cm, ovate-cordate, glabrous on both surfaces, thin, very slightly encrusted. *Inflorescences* c. 9, arising at base of leaf, all more or less contemporaneous; peduncles c. 7–12 cm, flowering axes 10–15 cm; pedicels c. 1 cm. *Calyx* c. 4 mm, glabrous; tube 1 mm; segments lanceolate, acute, 3 mm. *Corolla* (shrivelled) 3 mm. *Stamens*: filaments all rising c. 2 mm above base of tube, c. 0·5 mm long, slender, glabrous; anther

0·75 mm diam. *Style* 1 mm, persistent. *Fruit* 2·5 mm, valvular; fruiting pedicels deflexed, one twisted round the other.

Type: Thailand, Kasum, limestone rock, xi 1896, *Curtis* 3219 (holo. SING, iso. K).

THAILAND. Peninsular region: Kao Talu, Ranaung, 50 m, 3 ii 1927, *Kerr* 11791 (BM, K); Pungah, 6 xii 1918, *Haniff & Nur* 3870 (K, SING); Nai Cheng, Kap Thong Thai, *Hansen & Smitinand* 11998 (C).

MALAYA. Langkawi Islands: Selat Panchor, 60 m, 22 xi 1934, *Henderson* SFN 29061 (SING); *ibidem*, 30 m, 23 xi 1934, *Henderson* SFN 29072 (BM, K, SING); Dayong Bunting, *Robinson* 6209 (K); *ibidem*, 17 xi 1941, *Corner* s.n. (K, SING); *ibidem*, 14 xii 1969, *Whitmore* FRI 15069 (K).

M. glabra is the northernmost of the Malay species and lives in a definitely seasonal climate. In April I saw only young seedlings on Langkawi Island and the citations show that all the fertile specimens were collected late in the year. None of the herbarium specimens show any sign of separate crops of inflorescences and there is no doubt that *M. glabra* is an annual.

14. Monophyllaea hirticalyx Franch. in Bull. Soc. Linn. Paris, n.s. 1:125 (1899); Burtt in Notes R.B.G. Edinb. 31:50 (1971).

Syn.: *M. patens* Ridl. in Journ. Roy. As. Soc. Str. Br. 44:82 (1905), et Fl. Mal. Penins. 2:540 (1923). Henderson in J. Mal. Br. R. As. Soc. 17: 61 (1939). Syntypes: Selangor, Kuala Lumpur caves, *Ridley* 8222, *King's Coll.* 7052; Perak, Kinta, *Curtis* 3136, Sungei Siput, *Curtis* 3135, Batu Kurau, *Scortechini* 1574, 1579, Gopeng *Kunstler* 449.

Stem c. 5–20 cm, pilose. *Leaf* 3·5 × 2·5 cm to about 15 × 20 cm, thin and fragile when dry, ovate or oblong-ovate, cordate at base, pilose above, sparingly pilose to glabrous and encrusted below. *Inflorescences* arising in a close cluster at leaf base (solitary and few flowered on smallest plants), up to 12 cm; peduncles 7 cm, pilose at first; flowering axis c. 5 cm; pedicels 5–8 mm, pilose, glabrescent. *Calyx* 2·5 mm long, usually at first pilose, becoming glabrous (? sometimes glabrous throughout); tube 0·5 mm; lobes 2 × 1·5 mm. *Corolla* 7 mm; tube 3 × 1·5 mm, bearded inside below filaments; upper lobes 1·5 × 1·5 mm, laterals 2·75 × 2·75 mm broadly oblong, median 3 × 3 mm broadly spatulate; palate bearded, 2 mm. *Stamens*: filaments all arising c. 1·5 mm above base, posterior 1 mm bearded at top, anterior 2 mm bearded at top and on apical tooth; anthers 0·5 mm diam. *Disc* less than 0·5 mm. *Ovary* 0·5 mm; style 1·5 mm, glabrous, slightly expanded to notched stigma. *Fruit* 1·5 mm, firm-walled, persistent style 2 mm; fruiting pedicels deflexed, one twisted round the other at the base. *Fig. 9A*.

Type. Malaya, Perak, near Ipoh, "in speluncae Boukit Tcheura dicta", *de Morgan* (P).

MALAYA. Perak: Kwala Depong, ix 1901, *Ridley* s.n. (SING); Gopeng, viii 1880, *King's collector* 449 (SING); Kinta, xii 1895, *Curtis* 3136 (SING); *ibidem*, v 1946, *Allen* (SING); Ipoh, ii 1904, *Ridley* s.n. (SING); *ibidem*, Ayer Hangat, 21 iv 1962, *Burtt & Woods* B 1695 (E); *ibidem*, Gunong Panjang, 19 iv 1962, *Burtt & Woods* B 1658 (E). Kelantan: Gua Lambok, Sungei Betis, 16 vii 1935, *Henderson* SFN 29709 (K, SING). Pahang: Gua Tipus, Chegar Perah, 14 x 1927, *Henderson* SFN 19380 (K, SING); *ibidem*, 15 x 1927, *Henderson* 19404 (SING); *ibidem*, 10 viii 1929, *Henderson* SFN 22578

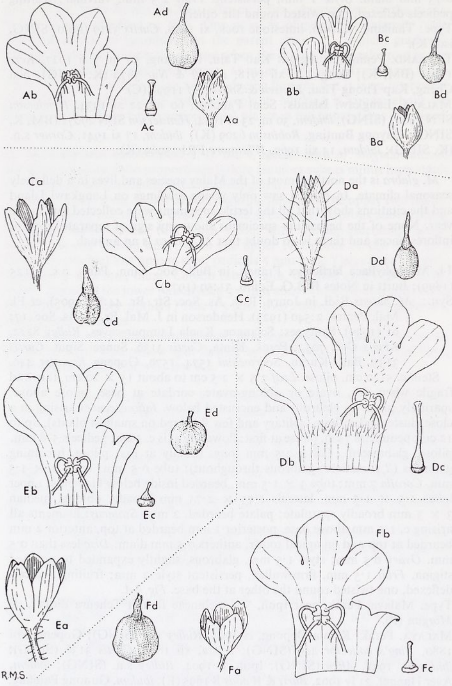

FIG. 9. A, *Monophyllaea hirticalyx* (*Burtt & Woods* B 1658); B, *M. tenuis* (*Burtt* 8145); C, *M. selaborensis* (*Burtt* 8206); D, *M. pendula* (*Burtt & Woods* B 2210); E, *M. glandulosa* (*Burtt* 8113); F, *M. andersonii* (*Burtt* 8243). a, calyx; b, corolla, dissected; c, gynoecium; d, capsule. All × 4.

(SING). Selangor: Kuala Lumpur, ii 1889, *Curtis* s.n. (SING); *ibidem*, Gua Batu, xii 1896, *Ridley* 8222 (K, SING).

M. hirticalyx is the delicate *Monophyllaea* of central Malaya where it is often accompanied, in the slightly more exposed habitats, by the more robust *M. horsfieldii*: they seem to have the same ecological relation to one another as do *M. tenuis* and *M. glauca* in Sarawak. *M. hirticalyx* and *M. tenuis* are closely allied and form a compact group with *M. selaborensis* and *M. longipes*: *M. glabra* is, in its lack of hairs, slightly more distinct.

15. Monophyllaea longipes Kraenzlin in Philipp. Journ. Sc., Bot. 8:168 (1913); Merrill, Enum. Phil. Fl. Pl. 3:455 (1923).

Stem 12–34 cm. *Leaf* up to 30 × 20 cm, ovate-cordate, hairy on the upper surface near the base, glabrescent in upper part. *Inflorescences* 2–7 arising at base of leaf, all contemporaneous; peduncles up to 20 cm, thinly pilose; rhachis and pedicels (c. 10 mm) setose-pilose. *Calyx* divided almost to base into 5 segments, 3·5 × 1·5–2 mm, obtuse. *Corolla* said to be blue, not seen.

Lectotype: Philippines, Luzon, Prov. Cagayon, subprov. Apayao, i 1912, *Curran* For. Bur. 19600 (BM, K, L). [Kränzlin also quotes For. Bur. 13869, this I have not seen].

PHILIPPINES. Luzon, Prov. Cagayon, subprov. Apayao, May 1917, *Fenix* Bur. Sci. 28091 (K).

I have seen no recent material; the description is largely adapted from Kränzlin.

16. Monophyllaea tenuis B. L. Burtt, **species nova** ex affinitate *M. longipedis*, speciei philippensis male cognitae, sed inflorescentia pilis glandulosis tenuibus pubescente, floribus laxioribus, calyce minore satis recedit. *Fig. 9B*.

Stem 8–15 cm, pilose. *Leaf* often c. 15 × 10 cm but up to 30 × 25 cm, ovate, deeply cordate at base, rather thin, thinly pilose on upper surface, ciliate on margins, glabrous and thinly encrusted below. *Inflorescences* not all contemporaneous, old withered peduncles often present when a fresh crop is flowering; peduncles 6–12 cm long, thinly pilose; flowering axis up to 10 cm with flower-pairs up to 1 cm apart; pedicels 6–10 mm, with delicate glandular hairs. *Calyx* divided almost to the base into segments 2 × 1 mm, glabrous. *Corolla* 5 mm long, greenish-white; tube 3 mm long, nearly 3 mm wide at mouth, pilose inside between the filaments; upper lobes 1 × 1·5 mm, lateral 1·5 × 1·5 mm, median 2 × 1·5 mm, all at first ciliolate, palate shortly hairy. *Stamens*: posterior filaments arising 1·5 mm above base, 1 mm long, anterior 2 mm above base, 2 mm long, all glabrous or with an occasional hair near base; anthers 0·75 mm diam. *Disc* 0·25 mm. *Ovary* 0·5 mm; style 0·5 mm. *Fruit* 1 mm, surmounted by 1 mm conic style; fruiting pedicels ascending.

Type. Sarawak, First Division, Padawan distr., Gunong Bewan, 14 v 1975, *Burtt* 8145 (holo. E, iso. SAR).

SARAWAK. First Division, Bukit Serapah, 13 miles from Kuching on Simanggang road, 23 vi 1967, *Burtt & Martin* 4751 (E, SAR); *ibidem*, 7 v 1972, *Anderson* S. 31639 (E, K, SAR). Padawan distr., Gunong Regu, c. 300 m, 6 v 1975, *Burtt* 8086 (E, SAR); *ibidem*, 8 v 1975, *Burtt* 8103 (E, SAR). Bau distr., Buseau, *Haviland* 588 (K, SING); Jambusan, ix 1903, *Ridley* (SING).

At first I tentatively included *M. tenuis* in the Philippine *M. longipes*, but that course seemed likely to lead to future confusion. There are small but distinct differences and there is no precedent for such a discontinuity of distribution in *Monophyllaea*. *M. longipes*, like *M. glabra*, may well be an annual, for the inflorescences on the available material are all more or less contemporaneous. In *M. tenuis* all except the youngest plants show old dry broken peduncles as well as young flowering ones, indicating that the plant goes through more than one flowering period.

17. Monophyllaea selaborensis B. L. Burtt, **species nova** *M. tenui* peraffinis, sed differt habitu robustiore magis carnosulo, calycis segmentis apice obtuse erosulis, corollae majoris lobis ob margines recurvatos primo conspectu acutis. *Fig. 9C*.

Stem c. 15–20 cm long, at first somewhat pilose with rather thick hairs; one or two secondary stems not infrequently arising among inflorescences on leaf base and themselves bearing a leaf and inflorescences. *Leaf* up to 30 × 20 cm, more usually c. 15–20 × 12–15 cm, ovate-oblong, deeply cordate at base, at first very thinly pilose above, very soon glabrescent except for the ciliate margins, hairy on the nerves below, the hairs becoming encrusted like the rest of the lower surface. *Inflorescences* arising from base of leaf, in various stages on one plant but perhaps not produced in definite crops; peduncles c. 8 cm long, pilose with thick spreading hairs; flowering axis up to 10 cm; pedicels c. 10 mm long. *Calyx* tube 0·5 mm; segments 2·7 mm, blunt, slightly erose around the apex, the dorsal one carinate and tending to be notched at the tip. *Corolla* 6·5 mm long, white; tube 2·5 mm, bearded all round inside below the filaments; upper lobes 2·5 × 2·5 mm, lateral 2·5 × 2 mm, median 3 × 2 mm, all spreading and with the margins somewhat revolute so that the lobes appear acute. *Stamens*: posterior filaments arising 1·5 mm above base of corolla tube, 1·5 mm long, anterior 2 mm above base, 2·25 mm long with an apical tooth, all thick and slightly hairy; anther 0·75 mm. diam. *Disc* 0·5 mm. *Ovary* 0·5 mm; style 0·5 mm. *Fruit* 2 mm, persistent style 2 mm, little swollen at base; fruiting pedicels ascending.

Type: Sarawak, First Division, Upper Sadong distr., Gunong Selabor, c. 0° 98′ N, 110° 29′ E, c. 120 m, 28 v 1975, *Burtt* 8206 (holo. E, iso. SAR).

SARAWAK. First Division, Gunong Selabor, 29 ix 1964, *Anderson* S 20830 (E, K, SAR).

This species was discovered by Dr J. A. R. Anderson on soft limestone at the mouth of caves on Gunong Selabor, an isolated limestone hill of Permian/Carboniferous age (contrasting with the Cretaceous and Upper Jurassic age of most of the First Division limestone). *M. glauca* var. *hirta* also occurs on G. Selabor, growing further away from the cliffs than *M. selaborensis*, which here takes over the role of *M. tenuis* at Bukit Serapat. In fact *M. selaborensis* is very closely allied to *M. tenuis*, and it might be thought that subspecific rank would be more appropriate. But then *M. hirticalyx* and *M. longipes* might also have to be brought into the enlarged concept, and I am unwilling to introduce such name changes until the situation has been much more thoroughly investigated.

18. Monophyllaea sarangica B. L. Burtt, **species nova** *M. horsfieldii* affinis, floribus minoribus (corollae tubo 2 mm tantum), filamentis glabris, parietibus fructus tenuibus recedit.

Stem 17 cm. *Leaf* 25 × 25 cm, ovate-oblong, cordate at base, glabrous, lightly encrusted below. *Inflorescences* arising from base of leaf, about 5; peduncle 13–18 cm, glabrous; flowering axis 4–12 cm; pedicel c. 10 mm. *Calyx* 2 mm, divided almost to base, segments elliptic-oblong, blunt. *Corolla* (damaged) 5 mm; tube 2 mm, bearded inside about 1 mm above base; upper lobes 2 × 2·5 mm. *Stamens*: posterior filaments arising 1 mm above base of corolla tube, 1 mm long, anterior 1·5 mm above base, 1·5 mm long, with very small apical tooth, all glabrous. *Ovary* 0·75 mm; style 0·75 mm, glabrous. *Fruit* 1·5 mm, thin-walled but breaking up into valves; persistent style conical, swollen at base, 1 mm.

Type. Sarawak, Fourth Div., Bintulu, Tatau, Bukit Sarang, 14 iii 1965, *Anderson* S. 20953 (holo. SAR, iso. K).

This species is at present known only from the type locality. There is other limestone, near the headwaters of Sungei Kakus, some 50 miles to the north east, from which I have not yet seen any *Monophyllaea*.

19. Monophyllaea horsfieldii R. Br. in Benn., Pl. Jav. Rar. 115, 121 (1840); DC, Prodr. 9:274 (1845); C.B.Cl. in DC. Mon. Phan. 5:182 (1883) et in Hook. fil., Fl. Brit. Ind. 4:370 (1884); Ridley in Journ. Linn. Soc. Bot. 32:523 (1896) et in J. Fed. Mal. St. Mus. 4:52 (1909) et in Fl. Mal. Penins. 2:590 (1923); Henderson in Journ. Mal. Br. R. As. Soc. 17:61 (1939); Steenis in Fl. Males. ser. 1, 4 (1): xxii fig. 6 (1948); Bakh. f. in Blumea 6:394 (1950); Henderson, Malayan Wild Flowers, Dicots. 356 (1959); Backer & Bakh. f., Fl. Java, 527 (1965).

Type: Sumatra, *Horsfield* (BM).

Syn.: *Monophyllaea pygmaea* C.B.Cl. in DC. Mon. Phan. 5:183 (1883). Type: Java, *Zollinger* 3203 (BM).
Horsfieldia javanica Chifflot in Compt. Rend. Acad. Sc. Paris, 148: 941 (1909). Type as for *M. horsfieldii*.

Key to varieties
Stem erect; leaf ovate or ovate-orbicular; inflorescences erect, arising on leaf-base, all more or less contemporaneous, pedicels glabrous . . . . . . var. *horsfieldii*
Stems probably pendulous from cliff; leaf broadly oblong; inflorescences long and straggly, arising from top of stem distinctly below leaf, old plants with scars of earlier peduncles below the flowering ones; pedicels sparingly glandular-pilose . . var. *hendersonii*

var. **horsfieldii**

Stem 9–37 cm, erect, not usually heavily encrusted. *Leaf* ovate or ovate-orbicular, 17–30 × 19–34 cm, cordate at base, glabrous, lightly encrusted below. *Inflorescences* arising from leaf-base, up to c. 12, all more or less contemporaneous; peduncle 8–14 cm, glabrous; flowering axis 7–18 cm; pedicels 6–8 mm. *Calyx* tube 1 mm; segments 3 mm, rounded at the tips, glabrous. *Corolla* 8 mm; tube 5 mm, bearded above the stamens; upper lobes 1·5 × 1 mm, lateral and median 2·5 × 2 mm, orbicular-spatulate, papillose on both sides, palate bearded. *Stamens*: posterior filaments arising 2 mm above base of corolla tube, 0·75 mm long, glabrous, upper arising 2·5 mm above base, 1·25 mm long, densely hairy, toothed at apex, tooth pilose on inner face; anthers 0·75 mm. *Disc* 0·5 mm. *Ovary* 1 mm; style 1 mm, glabrous. *Fruit* 2·5–3 × 2 mm, crowned by 1 mm thickened conical style, splitting into 4 hard clean-edged valves when ripe, placenta 1·5 mm on stipe 0·75 mm, often persisting when valves have fallen.

Type: Sumatra, *Horsfield* (BM).

MALAYA. Perlis: Kaki Bukit, 14 iv 1938, *Kiah* SFN 35287 (SING). Kelantan: Ulu Kelantan, Bertam, 27 vii 1962, *Unesco* 10 (SING); *ibidem*, non-limestone area, 27 vii 1962, *Unesco* 1001 (SING); Gua Ranjang, 9 viii 1962, *Unesco* 533 (SING); *ibidem*, 27 vii 1962, *Unesco* 21 (SING); Gua Musang, 6 viii 1962, *Unesco* 396 (SING); Batu Bow, 11 ii 1924, *Nur & Foxworthy* s.n. (SING); Gua Lamok, Sungei Betis, 16 vii 1935, *Henderson* SFN 29714 (SING). Perak: Jor, Batang Padang, 1 iv 1923, *Henderson* SFN 10879 (SING); Ulu Batang Padang, 1908, *Ridley* 13661 (SING); Kuraw, *Wray* 597 (SING); Gunong Kerbau, v 1909, *Haniff* 3999 (SING); Gopeng, viii 1880, *King's collector* 515 (SING); Padang Rengas, 15 vi 1924, *Burkill* 13562 (SING); Tong temple, Chemor, near Ipoh, 23 x 1958, *Sinclair* 9848 (E, SING); Ipoh, ii 1904, *Ridley* 11929 (SING); hills S of Ipoh, 4 x 1966, *Ng* FRI 1594 (KEP, SING); Batu Kurow, *Scortechini* 1579 (SING); Gunong Temparan, Ipoh, 13 viii 1959, *Allen & Kadim* 498 (SING); Ipoh, Ayer Hangat, 21 iv 1962, *Burtt & Woods* B 1694 (E); Ipoh, Rapat, 21 iv 1962, *Burtt & Woods* B 1698 (E); Ipoh, Gunong Panjang, 19 iv 1962, *Burtt & Woods* B 1655 (E). Pahang: Sungei Merapoh, 2 iii 1924, *Nur & Foxworthy* 11927 (SING); Gunong Senyum, 30 vii 1929, *Henderson* SFN 22394 (SING). Selangor: Batu Caves, 3 xi 1953, *Sinclair* SFN 40061 (E, KEP, SING); *ibidem*, 23 i 1966, *Hardial & Sidek* 472 (L, SING); Ulu Gombak, 450 m, 3 x 1921, *Hume* 8714 (SING); Ginting Simpah, 600 m, 29 x 1937, *Nur* SFN 34293 (SING); Bukit Tahun, Templer Park, 150 m, 29 vi 1975, *Balgooy* 2716 (E, L).

SUMATRA. East Coast: Sibolangit, E of Bandarbaroe, c. 350 m, 18 vi 1918, *Lörzing* 5765 (L); *ibidem*, c. 800 m, 11 vii 1918, *Lörzing* 5838 (L); Lau Rahit, S of Medan, c. 300 m, *Lörzing* 6536 (L); NW Simelungen, c. 350 m, 16 iii 1925, *Lörzing* 11496 (L); Simelungen, *Yates* 2152 (L, SING); Tinggi Radja, 400 m, *Surbeck* 210 (L). West coast: Gunong Malintang, c. 1250 m, 22 vii 1918, *Bunnemeijer* 3832 (L); between Alai and Paripandang, Lake Manindjau, 500 m, 20 ii 1954, *Alston* 13751 (BM); sine loc. 1881–2, *Forbes* 1830 (BM). Palembang: Gunong Pebarang NW of Ranau, c. 550 m, 31 x 1929, *van Steenis* 3475 (L). Lampung: Mt Tanggamus, 5° 26′ S, 104° 41′ E, 1100–1200 m, 25 iv 1968, *Jacobs* 8040 (K, L).

JAVA. Sine loc., *Lobb* (K); Bolang, near Buitenzorg, 1912, *Backer* 4045 (K, L); Klappa-Noenggel, 1912, *Backer* 5847 (L).

M. horsfieldii var. *horsfieldii* is not confined to limestone, for both Ridley and Henderson report its occurrence on acid rocks: nevertheless limestone is certainly its most frequent habitat. As the citations show it is one of the widest ranging species, and its variability, especially in Sumatra, deserves more critical study.

This species has been frequently seen in European Botanic Gardens and has been the main subject for morphological and anatomical investigations in the genus (e.g. Oehlkers 1922, Ridley 1906, Weber 1975, 1976b).

var. **hendersonii** B. L. Burtt, **var. nov.** a var. *horsfieldii* lamina oblonga venis lateralibus prope basin fere recte patentibus, inflorescentibus effusis ad 23 cm longis, pedicellis parce glanduloso-pilosis, cicatricibus pedunculorum vetustiorum infra inflorescentiis florentibus e suprema parte caulis orientibus differt.

Probably a plant of cliff-faces. *Stem* 22–25 cm, heavily encrusted. Leaf up to 32 × 28 cm, broadly oblong, cordate at base, glabrous, heavily encrusted below, lateral nerves spreading almost at right angles near the base. *Inflorescences* numerous, arising near top of stem distinctly below lamina, up to 23 cm long, straggly; stubs of old inflorescences visible down stem to 3 cm from lamina; pedicels 6 mm, with a few glandular hairs.
Type: Malay Peninsula: Pahang, Bukit Cheras [NW of Kuantan], c. 150 m, 11 x 1931, *Henderson* SFN 25067 (holo. SING, iso. BM).

This plant stands out from *M. horsfieldii* in the herbarium because of its long lax straggly inflorescences arising below the lamina, and large heavily encrusted leaf with wide spreading lateral nerves and tendency to a broadly oblong outline. These are characters one would expect from a plant growing on a vertical cliff-face, and I feel sure that is the habitat of var. *hendersonii* although there are no collector's notes. Henderson (1939, p. 16) reported that his partial exploration of Bukit Cheras in 1931 was the only time the mountain has been botanized. The situation may well remain the same today; certainly Chin (1973) does not record any other material of *Monophyllaea* from there. Henderson's specimen was determined by himself as *M. horsfieldii* and has been so accepted since. I was tempted to regard it as a distinct species, but the one flower I have been able to dissect agrees well with *M. horsfieldii* in dimensions, in the pattern of hairs on palate and below the filament and in the well-developed tooth on the anterior filaments. If *M. horsfieldii* is capable of growing on vertical faces, it is odd that it does not do so more often. However, while only a single specimen is known it is wisest to accord it no more than varietal rank. The presence of inflorescence scars lower on the hypocotyl than the current peduncles suggests that the plant is a long-lived one.

20. Monophyllaea caulescens B. L. Burtt, **species nova** in genere caule longe diffuso foliis pluribus internodiis c. 10 cm longis separatis distinctissima. Ceterum corollae palato barbato *M. horsfieldii* R. Br. revocans, sed filamentis gracilibus 2 mm longis glabris, antheris ut videtur inter se liberis facile distinguitur.

Straggling glabrous herb, some of the stem-branching apparently dichotomous, the branches running either directly to the base of a lamina or branching again; apparent internodes c. 10 cm; main stem c. 1·5 cm diam. at base when dry; leaves and stems lightly encrusted. *Leaf* up to 15 × 10 cm, oblong or oblong-lanceolate, truncate or cordate at base; petiole of 2nd and later leaves 2–12 cm. *Inflorescences* 3–12, arising on uppermost 1 cm of leaf-stalk; peduncle up to 15 cm; flowering axis 3–4 cm; pedicels more or less congested, 1·5–2 cm long, slender. *Calyx* 3–3·75 mm, divided almost to base; segments c. 3 mm wide, broadly elliptic, obtuse, the dorsal slightly keeled. *Corolla* 8–9 mm; tube 3·75–4 mm, bearded inside below filaments; dorsal lobes 2 × 2·5 mm, laterals and median 3 × 2·5 mm, palate 2 mm bearded. *Stamens*: posterior filaments arising 2·75 mm above base, 1·75 mm long, anterior 3·5 mm above base, 2 mm long, all slender, glabrous or slightly verrucose below anthers; anthers 0·75 mm, at time of dissection all free. *Ovary* narrowly conical, 1 mm; style 2 mm, down-curved at tip, glabrous. *Fruit* 2 mm, valvular, persistent style base 1·5 mm, thickly conical.

Type. Sumatra. Atjeh, Gunong Leuser Nature Reserve, Gunong Ketambe and vicinity, 8–15 km SW from mouth of Lau Ketambe, c. 30 km NW of Kutatjane, camp 3–4, 1700–1850 m, 5 viii 1972, *de Wilde & de Wilde-Duyfjes* 14010 (holo. L).

SUMATRA. Atjeh, Gunong Leuser Nature Reserve, Gunong Ketambe and vicinity, Camp 3, 1700–1900 m, 19 vii 1972, *de Wilde & de Wilde-Duyfjes* 13820 (L); *ibidem*, Camp 2–3 climbing Gunong Mamas, c. 12 km SW from mouth of Lau Ketambe, 1500–1800 m, 7 v 1975, *de Wilde & de Wilde-Duyfjes* 16680(L).

This remarkable species merits a field study so that the details of its branching patterns and range of size can be elucidated. It is also desirable to check that the anthers are really free in the living plant.

21. Monophyllaea leuserensis B. L. Burtt, **species nova** *M. horsfieldii* affinis, a qua indumento calycis, et marginibus segmentorum demum recurvis, et corolla fauce purpureo-notata vel omnino pallide lilacina, capsulae parietibus tenuibus distinguenda. A *M. hirtella* Miq., specie male cognita, foliis glabris, calyce minus piloso, parte inflorescentiae florifera elongata haud congesta recedit.

Stem up to 35 cm. *Leaf* up to 30 × 28 cm, ovate cordate at base, glabrous, very lightly encrusted below. *Inflorescences* 5–15, arising at the base of the leaf; peduncles c. 10 cm, glabrous; flowering axis c. 10 cm; pedicel 5–6 mm. *Calyx* c. 5 mm, divided almost to base; segments broadly elliptic, obtuse, margins tending to become recurved and undulate. *Corolla* 9–10 mm, whitish with purple-brown throat or pale lilac (ex coll.); tube 3–5 mm, bearded within between the anterior filaments, glabrous outside; dorsal lobes 2 × 1·5 mm, laterals 3 × 2 mm, median 3·5 × 2 mm, lobes roughly papillose outside. *Stamens*: posterior filaments arising 1·5–2 mm above base, 1–1·5 mm long, anterior rising 2·5 mm above base, 1·5 mm long, with short anterior tooth, all glabrous; anthers 0·5 mm diam. *Disc* irregularly 5-lobed. *Ovary* 1 mm; style 1 mm. *Fruit* 1·5–2 × 1·5–2 mm, more or less truncate, crowned by thickly cylindric to conical style base 1–1·5 mm, thin-walled splitting into 4 valves with thin irregular edges.

Type: N Sumatra. Atjeh, Gunong Leuser Nature Reserve, Ketambe, valley of Lau Ketambe, c. 35 km NW Kutatjane, 200–400 m, 16 v 1972, *de Wilde & de Wilde-Duyfjes* 12018 (holo. L).

SUMATRA. Atjeh, Gunong Leuser Nature Reserve, Ketambe, valley of Lau Ketambe, c. 35 km NW of Kutatjane, 200–400 m, 22 v 1972, *de Wilde & de Wilde-Duyfjes* 12275 (L); *ibidem*, 4 ii 1975, *de Wilde & de Wilde-Duyfjes* 14990 (L).

M. leuserensis differs from *M. horsfieldii* in too many details to permit its inclusion in that species, although that is certainly where the affinity lies. Characteristic of this species are the coarse curled hairs on the outside of the calyx; the corolla lobes being roughly papillose on the outside and the flower colour. The margins of the calyx lobes seem to recurve after flowering: this needs confirmation on living plants. The walls of the capsule are thinner than in *M. horsfieldii* and the edges of the valves are irregular, not hard and clean cut.

22. Monophyllaea hirtella Miq., Fl. Ind. Bat. Suppl. 564 (1860), et Sumatra 564 (1864); C.B.Cl. in DC., Mon. Phan. 5:183 (1883).

Leaf c. 30 × 25 cm, ovate-cordate, with thin indumentum of stiff setose-pilose hairs on both surfaces, tending to disappear in centre of upperside, dense around sinus. *Inflorescences* arising at leaf-base; peduncles [main one broken off on specimen seen] densely and shortly pubescent, shortly branched at the top and on account of contracted branchlets and crowded pedicels pseudo-umbellate [ex Miquel]; secondary peduncle not branched, 8 cm long, flowers c. 10 congested, pedicels 12 mm. *Calyx* 5 mm long, with spreading hairs, segments ovate.

Type: Sumatra, West Coast, Lolo, *Teysmann* (holo. U).

Teysmann was at Lolo on 6 December 1855; the previous day he had been at Alahanpandjang, which is at 1° 03′ S, 100° 48′ E. I have seen only the imperfect type specimen: unfortunately there are no corollas or fruits: it has only old calyces, which at least tells us that they do not fall early as in *M. glauca* and its allies. This, together with the long pedicels, make it reasonable to assign this species very tentatively to subgen. *Monophyllaea*. I have preferred to deal with it as best I can, rather than assign it to *species non satis notae*. Miquel's description of a branched inflorescence is most interesting, and is the one feature that suggests subgen. *Moultonia*. We can only await further material. A critical study of *Monophyllaea* on Sumatra is badly needed.

23. Monophyllaea pendula B. L. Burtt, **species nova** habitu pendulo *M. elongatae* et *M. glandulosae* similis, ab ambabus pilis longis subsetosis circa pendunculi basim distinguitur. A *M. elongata* folio basi cordato a *M. glandulosa* lobis corollae superioribus erectis basi haud obliquis etiam distincta. *Fig. 9D.*

Stem 10–12 cm. *Leaf* 30–42 × 12–17 cm, oblong, cordate at base, thin, younger parts clad with long slender brown hairs above, becoming glabrous later, underside very sparingly pilose near the base, encrusted. *Inflorescences* arising at top of stem just below the lamina, numerous, the old dry bases of the dead ones persisting while new ones arise nearer the leaf-base; peduncle c. 8–10 cm, pilose with long eglandular hairs at base and some shorter glandular ones intermixed higher up; flowering axis 7–10 cm; pedicel 12 mm, with short glandular and long eglandular setae. *Calyx* 3 mm, shortly hairy, some of the hairs glandular; tube 0·5 mm; segments 2·5 × 1 mm, subacute. *Corolla* c. 9 mm, white, marked yellow and red at base of palate; tube 4–5 mm, bearded inside below the anthers; upper lobes 1·5 × 2 mm, erect, laterals 1·5 × 1·75 mm, median 2 × 2·5 mm, palate 2·5 mm. *Stamens*: filaments all

arising c. 4 mm above base, posterior 1·5 mm, anterior 2·5 mm with an apical tooth; anthers nearly 1 mm diam. *Disc* 0·5 mm. *Ovary* 1 mm, glabrous; style 2 mm, not reaching to anthers, glabrous. *Fruit* 1·5 mm, hard-walled, valvular, with persistent style 3 mm, slightly swollen at base.
Type. Sarawak. Fourth Division, Gunong Mulu National Park, Melinau gorge camp, c. 120 m, 11 vi 1975, *Burtt* 8231 (holo. E, iso. SAR).
SARAWAK. Fourth Division, Gunong Mulu National Park, Melinau gorge: *Burtt & Woods* 2210 (E, SAR), *Lehmann* S. 29436 (E, SAR), *Anderson* S 30755 (E, SAR), *Argent* 634 (E, SAR). Fifth Division, north of S. Medalam, cliffs at foot of G. Buda, 210 m, 21 vi 1975, *Burtt* 8337 (E, SAR).

Monophyllaea pendula is the species that grows on the stalactites overhanging the Melinau gorge camp-site in the Gunong Mulu National Park. The camp site stands back some 50 yards from the river: when in constant use the intervening undergrowth has been cut down, which lets in more light and air for the benefit of the campers and to the detriment of the *Monophyllaea*. It gets too much wind, the leaves get more battered even than usual, and persisting leaf-blades are noticeably shorter, and it dries out more easily. Fortunately the species is not infrequent on other sheltered cliffs in the gorge area and across the Park on Gunong Buda, north of Sungei Medalam.

The corolla-tube is greenish, the limb white, yellow on the centre of the palate and pink-flushed at its base with two red lines in the throat. The species is obviously long-lived, there being a number of dead inflorescence bases below the current ones.

24. Monophyllaea elongata B. L. Burtt, **species nova** adhuc pro *M. hirticalyce* (*M. patente*) habita, sed folio longiore oblongo basi in petiolum angustato nec cordato, nervis numerosis a costa recte patentibus, inflorescentiis et pedicellis elongatis facile distinguitur. Melius prope *M. pendulam*, speciem sarawakensem, ponenda et ea congruit habitu pendulo, sed recedit floribus flavis nec albis, folio basi in petiolum angustato nec cordato, et pedicellis longioribus.

Stem to 12 cm, pilose. *Leaf* c. 25 × 15–18 cm (one younger leaf seen 50 × 15 cm with a single inflorescence), narrowed at base into a distinct petiole up to 5 cm long between base of lamina and inflorescences, both surfaces thinly brown pilose-pubescent becoming glabrous, some hairs persisting on nerves and midrib. *Inflorescences* up to about 8, arising near top of stem; peduncle c. 7 cm, densely hairy at base; flowering axis up to 18 cm long, straggly, thinly hairy; pedicels filiform, up to 4 cm long, interval between flower pairs c. 1 cm on older parts. *Calyx* divided almost to base; segments 3 mm long, ovate. *Corolla* 5·5 mm, yellow (ex coll.); tube 3·5 mm. *Anthers* 1 mm diam. *Capsule* c. 2·5 mm, hard-walled, valvular, one valve often carrying at its tip the persistent 1·5 mm long style. *Seeds* ellipsoid, 3 mm, with irregular raised somewhat spiral ridges with irregular cross-connexions.
Type. Malay Peninsula, Perak, Sungei Siput, xii 1895, *Curtis* 3135 (holo. E, iso. SING).
MALAY PENINSULA. Perak, Gopeng, on limestone, flowers light yellow, ix 1880, *King's collector*, 674 (SING). Kinta, near G.M. [Gunong Bujong Malaka], 90–150 m, in shady moist spots amongst limestone rocks, fl. light yellow, viii 1885, *King's collector* 7052 (SING).

The sheet of *King's collector* 7052 has pencilled alongside the G.M. of the label "Gunong Magua?". However Narayanaswami tells us that Kunstler (who was the "King's collector" of these labels) used G.M. as an abbreviation for Gunong Bujong Malaka, and indeed so lists this specimen (under *M. patens* Ridl.; Narayanaswami 1933, p. 540).

M. elongata has hitherto been confused with *M. hirticalyx* (*M. patens*), from which the leaf shape and venation is alone sufficient to distinguish it. The long lamina with wide-spreading veins and the long straggly inflorescences clearly indicate that it is a pendulous species, not erect like *M. hirticalyx*. Indeed it is the Peninsula counterpart of the Sarawak *M. pendula*, another species of cliff faces.

As can be seen from the citations, *M. elongata* is known only from old collections made by Curtis and by Kunstler. Not unexpectedly the material is not ideal for description, and I have preserved the solitary flower undissected in case it is needed for critical comparison later on. Specific characters are quite adequate. Not only the habit and the light yellow flower are distinctive. The style is found persisting on one of the fruit valves: it is evidently not swollen at the base as in most other species and it plays no part in dehiscence of the valvular capsule. The seeds have a well-developed raised pattern of more or less spiral ridges with irregular cross-connexions.

New material of this species should be carefully sought wherever shaded limestone cliffs afford a suitable habitat.

25. Monophyllaea glandulosa B. L. Burtt, **species nova** nulli arcte affinis. Corolla alba ore perobliqua flava et pilosa, labio superiore profunde diviso lobis basi obliquis reflexis distincta. Fortasse *M. pendulae* affinis, floribus et insuper pilis pedunculi glandulosis (setis longis absentibus) facile distinguitur. *Fig. 9E.*

Stem 7–17 cm. *Leaf* up to 35 × 20 cm, younger parts with a few scattered hairs above, otherwise glabrous, underside with a few hairs and encrusted. *Inflorescences* 2–3 arising from leaf base, glandular-pilose throughout; peduncle c. 1–6 cm; flowering axis c. 15 cm, flower pairs c. 2–3 mm apart; pedicels c. 7 mm. *Calyx* 3–3·5 mm, glandular hairy outside; tube 0·5 mm: segments 2·5–3 mm, striate (showing the lines of the secretory canals) when dry. *Corolla* c. 9 mm, white, mouth yellow very oblique; tube 5 mm to lateral sinus, only 3 mm to dorsal sinus, slightly bearded inside below the stamens; upper lobes 1 × 3 mm, very oblique at base, reflexed, laterals 3·5 × 5 mm, median 3 × 4 mm orbicular-spatulate, all ciliolate. *Stamens*: posterior filaments arising 1·5 mm above base, 0·5 mm long, anterior nearly 3 mm above base, 1 mm long; anthers 1 mm diam. *Disc* 0·5 mm. *Ovary* 1 mm; style 1·5 mm. *Fruit* 2 mm, persistent style 1·5 mm, thickened at base.
Type. Sarawak, First Division, Padawan distr., Gunong Maja, near Teng Bukap, 11 v 1975, *Burtt* 8113 (holo. E, iso. SAR).

M. glandulosa is very distinct amongst the Sarawak species on account of the very oblique corolla mouth, the upper lobes being oblique at the base and reflexed. It was growing on the mossy vertical wall of a 20 ft hollow on a forested limestone ridge. No doubt it will be found in due course on other hills in the area, but so far they have not been intensively explored by botanists.

26. Monophyllaea andersonii B. L. Burtt, **species nova** *M. insigni* fortasse maxime affinis sed habitu minore, foliis supra in toto pilis brevibus acutis erectis eglandulosis praeditis, corollis albis lobis superioribus obliquis facile distinguitur. *Fig. 9F.*

Stem up to 10 cm, heavily encrusted. *Leaf* up to 12 × 12 cm, base cordate, covered all over upper surface with short stiff acute erect hairs, heavily encrusted below, mid-leaf nerves ascending. *Inflorescences* arising at base of midrib, peduncle 6–10 cm long, often encrusted in lower part; flowering axis up to 5 cm; pedicels eventually up to 12 mm. *Calyx* 5-partite to base; segments 3 × c. 2 mm, elliptic, obtuse, glabrous. *Corolla* 8 mm to lip of mid-lobe, pure white; tube 3 mm to dorsal, 4·5 mm to lateral sinus, slightly swollen, glabrous inside below filaments, palate slightly hairy 2 mm; lower lip 7·5 mm diam., lateral lobes 3·5 × 4 mm, median 3·5 × 4 mm; upper lobes 2 × 1 mm, oblique. *Stamens*: upper filaments arising 1·25 mm above base of tube, 1 mm long, lower arising 2 mm above base of tube, 2 mm long, all glabrous; anthers 1 mm diam. *Disc* 0·5 mm. *Ovary* 1 mm; style 1·5 mm, cylindric, with bifid stigma. *Fruit* 2·5 mm with thin but distinct valves, style-base only slightly swollen. *Seed* ellipsoid, reticulate, 0·5 mm.

Type. Sarawak, Fourth Div., Gunong Mulu National Park, Gunong Api, c. 855 m, 12 vi 1975, *Burtt* 8243 (holo. E, iso. SAR).

SARAWAK. Fourth Div., Gunong Mulu National Park, Gunong Api, c. 1110 m, 12 vii 1961, *Anderson* 4715 (K, SAR); *ibidem*, 906 m, 2 x 1971, *Anderson* S 30916 (E, SAR); *ibidem*, 900 m, 7 ix 1970, *Lehmann* S. 29450 (E); *ibidem*, 600 m, 1 xi 1977, *Argent* 635 (E, SAR).

M. andersonii has as yet only been collected on Gunong Api, the large limestone mountain in the Gunong Mulu National Park, Sarawak. It will probably be found elsewhere on the higher limestone in that area, but so far this route up G. Api, pioneered by Dr J. A. R. Anderson, is the only point where sufficient altitude has been reached. It seems likely that *M. andersonii* grows only near or above 1900 m, although the two other species found nearby both occur also on the limestone at the foot of the mountain in the Melinau gorge (120–150 m).

The oblique upper corolla-lobes have only been noted elsewhere in *M. glandulosa*, but there they are more marked and, in association with a long lower lip, they give a much more oblique look to the whole corolla than is found in *M. andersonii*.

27. Monophyllaea hottae B. L. Burtt, **species nova** ex affinitate *M. fissilis* et *M. horsfieldii*. Ab *M. fissili* inflorescentia glabra, caule griseo (haud nigro) plus minusve erecto, ab *M. horsfieldii* folio primum glanduloso-piloso floribus majoribus labio inferiore rubro et flavo-notato filamentis anticis magis arcuatis processu apicali minuto obtuso (haud conspicuo acuto) praeditis. *Fig. 10A.*

Stem c. 10 cm. *Leaf* c. 30–60 × 25–40 cm, oblong to ovate in outline, deeply cordate at base, sometimes split into two halves, each bearing inflorescences; upper surface with scattered erect glandular hairs when

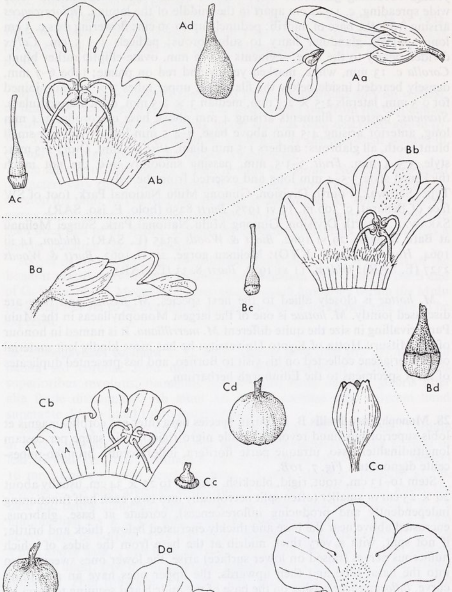

FIG. 10. A, *Monophyllaea hottae* (*Burtt* 8256); B. *M. fissilis* (*Burtt & Woods* B 2261); C, *M. cupularis* v. *aggregata* (*Argent* 811); D, *M. insignis* (*Burtt* 8277). a, flower or calyx; b, corolla, dissected; c, gynoecium; d, capsule. All × 4.

young, becoming glabrous; lower surface densely encrusted; lateral veins wide spreading, c. 1·5–2 cm apart in the middle of the lamina. *Inflorescences* arising from the base of midrib; peduncle up to 30 cm; flowering axis c. 5 cm long sparsely glandular hairy to subglabrous; pedicels 1–1·5 cm. *Calyx* divided nearly to the base; segments 3 × 2 mm, ovate-elliptic rather blunt. *Corolla* c. 13 mm, white, marked yellow and red on palate; tube 6–7 mm, densely bearded inside below the filaments; upper lobes 3 × 4·5 mm joined for 0·5 mm, laterals 2·5 × 2·5 mm, median 3 × 2·5 mm, orbicular-spatulate. *Stamens*: posterior filaments arising 4 mm above base of corolla, 3–4 mm long, anterior arising 4·5 mm above base, 4–4·5 mm long, with very small blunt tooth, all glabrous: anthers 1·5 mm diam. *Disc* 0·5 mm. *Ovary* 1·5 mm; style 3·5–4 mm. *Fruit* 3–3·5 mm, passing smoothly into the not much thickened style 3·5–4 mm long and exserted from the calyx.

Type. Sarawak, Fourth Division, Gunong Mulu National Park, foot of SW face of Benarat, c. 300 m, 13 vi 1975, *Burtt* 8256 (holo. E, iso. SAR).

SARAWAK. Fourth Division, Gunong Mulu National Park, Sungei Melinau at Batu Bungan, 29 vi 1962, *Burtt & Woods* 2345 (E, SAR); *ibidem*, 14 iii 1964, *Hotta* 14382 (E, KYO); Melinau gorge, 27 vi 1962, *Burtt & Woods* 2327 (E, SAR); *ibidem*, 11 vi 1975, *Burtt* 8233 (E, SAR).

M. hottae is closely allied to the next species, *M. fissilis*, and they are discussed jointly. *M. hottae* is one of the largest Monophyllaeas in the Mulu Park, rivalling in size the quite different *M. merrilliana*. It is named in honour of Dr Mitsuru Hotta of Kyoto University: he has most kindly lent material of Gesneriaceae collected on his visit to Borneo, and has presented duplicates of most specimens to the Edinburgh herbarium.

28. Monophyllaea fissilis B. L. Burtt, **species nova** inter eas corollis magnis et lobis superioribus haud revolutis, caule nigro rigido, folio saepe per costam longitudinaliter fisso, utraque parte florifera, inflorescentia brunneo-pubescente dignoscitur. *Fig. 7, 10B.*

Stem 10–13 cm, stout, rigid, blackish. *Leaf* up to 25 × 34 cm, usually about 20 × 25 cm or smaller (often split necrotically into two, each half functioning independently and producing inflorescences), cordate at base, glabrous, encrusted above near the base and thickly encrusted below, thick and brittle; if not split, with a very thick midrib at the base from the sides of which numerous nerves (raised on lower surface) arise, the lower ones sweep down into the basal lobe and then upwards, the upper ones have an ascending curve. *Inflorescences* arising on the base of the midrib and seeming to form an acropetal series, the stumps of old ones persisting, shortly spreading pubescent throughout; peduncles 10–12 cm; flowering axis c. 5 cm: pedicels c. 7 mm. *Calyx* 4 mm long, glabrous except at the very base, divided almost to base; segments 2 mm broad, obtuse. *Corolla* c. 11 mm; tube 6 mm, bearded inside below the filaments; upper lobes 2 × 3 mm, porrect, laterals 3·5 × 3 mm, median 4·5 × 4 mm spatulate. *Stamens*: filaments arising 3 mm above base of corolla, posterior 1·5 mm, anterior 2·5 mm with apical tooth, all glandular-papillose near top; anthers 1·5 mm diam. *Disc* 0·5 mm. *Ovary* 1 mm; style thick, tapering, 1·5 mm. *Fruit* 2·5 mm, thin-walled, valvular, truncate at top, persistent style 4 mm much thickened at base.

Type. Sarawak, Gunong Mulu National Park, S flank of G. Benarat, 24 vi 1962, *Burtt & Woods* 2261 (holo. E, iso. SAR).
SARAWAK. Gunong Mulu National Park, S flank G. Benarat, 24 vi 1962, *Burtt & Woods* 2280 (E, SAR); *ibidem*, 150–225 m, 13 vi 1975, *Burtt* 8255 (E, SAR); below G. Buda, N of Sungei Medalam, 20 vi 1975, *Burtt* 8335 (E, SAR).

M. fissilis is an ecologically specialized plant, being found only on vertical, or nearly vertical, damp cliff faces. The stem is held out from the cliff almost horizontally. The frequent splitting of the leaf has been described above (p. 18). The succession of inflorescences, evidenced by the persistent stumps of the old ones suggests that this species is long-lived.

The affinity of this species is clearly with *M. hottae*. Not only are floral characters very close, but furthermore *M. hottae* shows a slight tendency to develop the same sort of necrotic splitting of the lamina. *M. hottae*, however, grows on the ground with erect stem and the leaf reaches a much greater size than does that of *M. fissilis*. Judging by collected specimens *M. hottae* has a shorter duration than *M. fissilis*.

As yet *M. fissilis* has only been found along the SW to NW cliffs of the Benarat massif, between the Melinau and Medalam rivers, and at the S end of G. Buda, N of S Medalam. There remains much limestone within the Mulu park that has yet to be examined, and extensions of its known area are to be expected.

29. Monophyllaea cupiflora B. L. Burtt, **species nova** olim pro *M. horsfieldii* habita sed corollae tubo inflato intus glabro calycem aequante, lobis superioribus revolutis, filamentis anticis apice haud dentatis glabris inter alia facile distinguitur. Ab affini *M. insigni* corollae tubo calycem haud superante, limbo haud rubro-notato recedit.

Stem c. 8–15 cm. *Leaf* up to 35 × 35 cm, ovate-orbicular, deeply cordate at base, glabrous, lightly encrusted below. *Inflorescences* arising at base of leaf, several, glabrous; peduncle 6–20 cm; flowering axis 0·5–15 cm; pedicel 10 mm. *Calyx* divided nearly to base, 2·5 mm; segments rounded at tip. *Corolla* c. 5·5 mm, greenish-white; tube 2·5–3 mm, papillose just above the base and below filaments; upper lobes 1 × 2 mm, recurved, laterals 2 × 2·5 mm, median 2·5 × 2·5–3 mm. *Stamens:* posterior filaments arising 1·5 mm above base of corolla, 2·25 mm long, thickened upwards; anterior arising 2 mm above base, 3 mm long, curved, with a very small blunt tooth; anthers 0·75 mm diam. *Disc* 0·5 mm, bluntly lobed. *Ovary* 1 mm; style 1 mm, stigma umbilical. *Fruit* spherical, 1·25 mm, with short thick persistent style 1 mm long.

var. **cupiflora**

Flowering axis elongate, c. 9 cm long, flower-pairs about 2–5 mm apart. Very seldom producing more than one leaf.
Type: Sarawak, Fourth Division, Gunong Mulu National Park, S Melinau gorge, c. 120 m, 11 vi 1975, *Burtt* 8230 (holo. E, iso. SAR).
SARAWAK. Fourth-Fifth Div., Gunong Mulu National Park, Melinau gorge, 23 vi 1962, *Burtt & Woods* 2257 (E, SAR); *ibidem*, 26 ix 1971, *Anderson* S. 30742 (E, SAR); *ibidem*, 130 m, 2 xi 1977, *Argent* 648 (E, SAR); *ibidem*,

below Benarat, 14 vi 1975, *Burtt* 8262 (E, SAR); SW side Benarat, 13 vi 1975, 150–300 m, *Burtt* 8254 (E, SAR); N of S Medalam, below G. Buda, 21 vi 1975, *Burtt* 8330 (E, SAR); Lobang Angin on S Melinau, 29 vi 1962, *Burtt & Woods* 2346 (E, SAR); *ibidem*, 5 xi 1977, *Argent* 670 (E, SAR); S Melinau, Lobang Bungan, 14 iii 1964, *Hotta* 14385 (E, KYO).

var. **aggregata** B. L. Burtt **var. nov.** a var. *cupiflora* axi florenti brevi 5 mm longo, flores 8–12 gerente recedit. Planta saepe foliis additis 1–3 supra primario emittens. *Fig. 10C.*

Plant often producing a secondary stem amongst the inflorescences, this bearing a secondary leaf that bears inflorescences and may bear a tertiary stem and leaf with inflorescences. *Flowering axis* very short, c. 5 mm long, bearing about 8–12 flowers.

Type: Sarawak, Fourth Division, Gunong Mulu National Park, Lobang Rusa, c. 30 m, 9 vi 1975, *Burtt* 8221 (holo. E, iso. SAR).

SARAWAK. Fourth Division, Gunong Mulu National Park, Lobang Rusa, 7 ix 1971, *Anderson* S.31815 (E, SAR); *ibidem*, 30 x 1977, *Argent* 626 (E, SAR); *ibidem*, 19 xi 1977, *Argent* 811 (E, SAR).

In *M. cupiflora*, as in *M. insignis*, two varieties are distinguished on the basis of the development of the inflorescence. The cases are quite parallel: *M. cupiflora* var. *aggregata* and *M. insignis* var. *rubriflora* both have inflorescences in which flower production is limited to about 10–15 flowers. In the typical varieties, as in other species of *Monophyllaea*, the inflorescence continues to elongate for a considerable time and new flowers are being produced long after the first fruits have dehisced and fallen.

There seems no doubt that this curtailment of flowering is genetically controlled: it is a feature of populations, not individuals. At Lobang Rusa, near the foot of Gunong Mulu, only var. *aggregata* is found: in the Melinau gorge it is all var. *cupiflora*. Around the southern end of Gunong Buda, N of the Sungei Medalam, both varieties were at first thought to occur (B. 8330, 8330/A), but further examination showed that the plants attributed to var. *aggregata* were in fact var. *cupiflora* with very young inflorescences.

It is an interesting fact that in both *M. cupiflora* and in *M. insignis* the variety with congested inflorescence also tends to produce accessory leaves.

M. cupiflora and *M. insignis* are a pair of closely related species distinguished from others by the very small recurved upper corolla lobes and by the very short style. The small greenish-white corolla makes *M. cupiflora* easy to recognise in the field, that of *M. insignis* being larger and more colourful.

30. Monophyllaea insignis B. L. Burtt, **species nova** *M. cupiflorae* ob lobos superiores corollae semilunatos recurvos et tubum paulo inflatum valde affinis, sed floribus majoribus, corollae tubo calycem distincte excedente, limbo colorato distinguitur. Ut in *M. cupiflora*, inflorescentia aut elongata aut subumbellatim congesta varietates dignoscit.

Stem 10–16 cm. *Leaf* up to 40 × 40 cm, often c. 25 × 20 cm, ovate-orbicular, glabrous. *Inflorescences* arising near leaf base, often numerous; peduncle 10–20 cm; flowering axis 0·5–12 cm; pedicel 8–14 mm. *Calyx* divided almost to the base, glabrous; segments 2·5–4 × 1·5–2·5 mm, blun.

Corolla 7–9 mm; tube 4–5 mm, bearded below the filaments; upper lobes semilunate, 1–1·5 × 1·5–2 mm, recurved, lateral lobes 2·5–3 × 3–3·5 mm, median 3 × 4 mm. *Stamens*: posterior filaments arising 1–1·5 mm above base, 1·5–2 mm long, anterior arising 2–2·5 mm above base, 1·75–2·5 mm long, all glabrous except for an occasional hair near the base, thickened upwards. *Disc* 0·5 mm. *Ovary* 0·75–1 mm, narrowed sharply into 0·5–0·75 mm style thickening upwards; stigma oblique, umbilical. *Capsule* spherical 2·5 × 2·5 mm, valvular; persistent style 1 mm, just exserted from calyx.
Type. Sarawak, Gunong Mulu National Park, Gua Rusa (SW side), c. 100 m, 19 xi 1977, *Argent & Kerby* 810 (holo. E, iso. SAR).

Key to varieties
Flowering axis 8–12 cm; ground colour of lower lip of corolla white or cream . . . . var. *insignis*
Flowering axis 2–4 mm; ground colour of lower lip of corolla dull red or pink . . . . . . var. *rubriflora*

var. **insignis**

Flowering axis 8–12 cm; corolla with lower lip with usually white ground, yellow palate and red marks on either side of yellow. *Fig. 10D*.
Type: as above for species.
SARAWAK. Fourth-Fifth Divisions, Gunong Mulu National Park: Benarat cliffs just S of Sungei Trekan, 18 vi 1975, *Burtt* 8304 (E, SAR); between S Trekan and S Medalam, 15 vi 1975, *Burtt* 8277 (E, SAR); Lobang Rusa, 7 ix 1971, *Anderson* S. 31812 (E, SAR); *ibidem*, 9 vi 1975, *Burtt* 8275 (E, SAR); *ibidem*, 19 xi 1977, *Argent* 796 (E, SAR); N of Gua Angin, S Melinau, 17 xi 1977, *Argent* 777 (E, SAR).

var. **rubriflora** B. L. Burtt, **var. nov.** a var. *insigni* parte inflorescentiae florifera brevi, labio corollae inferiore rubro in palato flavo-notato differt.

Floral axis short, 2–4 mm, bearing up to 15 flowers on pedicels 10–15 mm long. *Corolla* with lower lip dull red marked yellow in centre of palate.
Type: Sarawak, Gunong Mulu National Park, Gunong Api, 4° 7′ N, 114° 53′ E, c. 600 m, 12 vi 1975, *Burtt* 8240 (holo. E, iso. SAR).
SARAWAK. Fourth Division, Gunong Mulu National Park, Gunong Api, c. 540 m, 29 ix 1971, *Anderson* S. 30809 (E, SAR); *ibidem*, c. 600 m, 1970, *Lehmann* 517, 553 (E, SAR); *ibidem*, c. 900 m, *Chai* S. 30082 (E, SAR); *ibidem*, c. 400 m, 1 xi 1977, *Argent & Kerby* 636 (E, SAR); Melinau gorge, 27 vi 1962, *Burtt & Woods* 2328 (E, SAR); *ibidem*, 23 vi 1962, *Burtt & Woods* 2229 (E, SAR); *ibidem*, c. 150 m, 12 vi 1961, *Anderson & Keng* K60 (SAR).

One anomalous population needs special mention:—Gunong Mulu National Park, Bukit Sungei Pala, near Park base camp, 12 vi 1962, *Burtt & Woods* 2050 (E, SAR); *ibidem*, 18 xi 1977, *Argent* 787 (E, SAR).

This is distinguished by having the flower colour of var. *insignis*, but a much abbreviated flowering axis 10–20 mm long (and thus longer than in var. *rubriflora*) and carrying up to 20 flowers with pedicels 7–8 mm.

The concept of *M. insignis* presented here, of a species with two varieties differing in inflorescence and flower colour, is one that has developed in the herbarium: in the field these two entities were regarded as distinct species.

The factors that have led to their subordination under one species have been, firstly, the absence of clear-cut floral differences and secondly the difficulty of placing the population at Bukit Sungei Pala. The broader species concept therefore seems desirable at the present juncture. As in *M. cupiflora*, the varieties are not randomly distributed and have not been found growing together.

31. Monophyllaea papuana Lauterb. in Lorentz, Nova Guinea 8:326 (1910); Schlechter in Bot. Jahrb. 58:301 (1923).
Syn.: *M. finisterrae* Schlechter in Bot. Jahrb. 58:301–302, fig. 5 (1923). Type: New Guinea, Finisterre Range, c. 800 m, vii 1908, *Schlechter* 1793 (n.v.).

Stem 2·5–19 cm. *Leaf* 12–20 × 6–10 cm, ovate-oblong, more or less truncate or shallowly cordate at base, glabrous or with a few hairs on younger parts near base. *Inflorescences* arising at or just below leaf-base; peduncle 4–12 cm, glabrous or sparsely pilose towards the base; flowering axis 2–7 cm, glabrous or with scattered glandular hairs; pedicels 5–15 mm, glabrous or shortly hairy. *Calyx* 3–4 mm, glabrous, divided almost to base, segments obovate elliptic, the dorsal one broader. *Corolla* tube 3·5–4·5 mm, papillose within except basal 1·5 mm; upper lobes 1 mm, more or less erect, lower lip 2 mm, mid-lobe papillose and deflexed. *Stamens*: posterior filaments arising 2 mm above base, anterior 3 mm above base, all 1·5 mm long; anthers 0·5 mm diam. *Disc* 0·5–0·75 mm. *Ovary* 0·75 mm; style 1·25 mm. *Fruit* 1·5–2 mm, subglobose, thin-walled, valvular; persistent style c. 2 mm, swollen in lower half but narrowed where it joins ovary.
Type: New Guinea: [Irian Jaya] Resitop, Noord Rivier [=Lorentz R.], 800 m, ix 1907, *Versteeg* 1688 (L, U, K).
NEW GUINEA. Irian Jaya: Perameles Mts, 1000 m, 25 xi 1912, *Pulle* 448 (L, U, K); Hellwig Mts, 2000 m, xi 1909, *Römer* 1211 (L); Star Mts, Sibil Valley, Oemboek, 1200–1300 m, 15 v 1959, *Kalkman* 4049 (L). Papua-New Guinea: Sepik distr., Telefomin [5° 05′ S, 141° 30′ E], 1800 m, 15 i 1965, *Henty* NGF 20941 (E, L); Gulf distr., Kukipi subdistr., Titamunga [7° 22′ S, 146° 03′ E], 1800 m, 13 v 1968, *Streiman & Kairo* NGF 35977; Morobe distr., Aseki patrol area, near Wangia [c. 7° 20′ S, 146° 10′ E], 480 m, 28 iv 1966, *Craven & Schodde* 1496 (K, LAE); Huon Peninsula, E slope Mt Rawlinson, along Gang Creek, c. 1290 m, 8 vi 1964, *Hoogland* 9095 (E, K, L).

Schlechter distinguished his *M. finisterrae* by the presence of glandular hairs in the inflorescence, whereas in the type of *M. papuana* the glands (chalk glands) are sessile. I have not seen an isotype of Schlechter's species, but other specimens from the Huon Peninsula certainly have a few chalk-encrusted hairs in the inflorescence. However, indumentum and geography are not consistently associated: some specimens from Irian Jaya have hairs on leaf and inflorescence (*Römer* 1211, *Kalkman* 4049), whereas glabrous plants may be found as far east as Gulf district (NGF 35977). More than one species may well prove to be involved here; indeed Schlechter suggested that *Römer* 1211 represented a distinct species. Nevertheless until more carefully collected material is available a critical study cannot be made and it seems best to place all this material under one name.

One aspect of variation that needs study is the habit. *Hoogland* 9095 and *Henty* NGF 20941 are described as pendulous from cliff faces: in these, as we should expect (cf. p. 16), the inflorescences arise just below the leaf base. Other specimens (e.g. *Craven & Schodde* 1496, *Streimann & Kairo* 35977) are erect, and, as Schlechter illustrates for *M. finisterrae*, the inflorescences arise on the base of the leaf. We still have everything to learn about *Monophyllaea* in New Guinea.

32. Monophyllaea wildeana B. L. Burtt, **species nova** ab omnibus aliis ob ramulos inflorescentiae bracteis late ovatis c. 12 × 6 mm suffultos distincta.

Stem robust, c. 30 cm high, up to 5 cm diam. when alive (fide coll.; when dry c. 1·5 cm diam. at base). *Leaf* up to 75(–100) cm long (fide coll.) cordate at base, at first thinly pilose above, becoming glabrous, more persistently thinly pilose and encrusted below. *Inflorescences* arising just below the base of the leaf; peduncle up to 15 cm, glabrous: flowering axis branched, the branches subtended by broadly ovate ciliate bracts c. 12 × 6 mm; flowers congested; pedicels c. 7 mm. *Calyx* 5 mm long, divided almost to base; segments 4 × 2·5 mm, the dorsal one 5 × 4 mm when flattened, with a few marginal hairs near the base. *Corolla* yellow, purple at base (fide coll.). *Disc* 0·5 mm. *Fruit* 3 mm, thin-valved, style 2·5–3 mm, not swollen at base.

Type. Sumatra: Atjeh, Gunong Leuser Nature Reserve, Gunong Ketambe and vicinity, 8–15 km SW from mouth of Lau Ketambe, 1700–1900 m, Camp 3, montane rain forest, on vertical limestone rocks, in crevices, half-shaded; stem thick, juicy, to 5 cm diam., leaves to 75(–100) cm long, calyx brown-purple, corolla yellow, purple at base; 19 vii 1972, *de Wilde & de Wilde-Duyfjes* 13811 (holo. L).

This is the only *Monophyllaea* with well-developed bracts in the fertile part of the inflorescence. In *M. horsfieldii* and others, there is often a short common peduncle that bears the individual peduncles subtended by small lanceolate bracts. In *M. wildeana* it is as though the common peduncle has been greatly developed while the individual peduncles, now much reduced and appearing as branches of the inflorescence, have been carried up and are subtended by large concave bracts.

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BOOK REVIEW

Angiosperm classification and evolution. It is perhaps appropriate that this symposium volume* which is devoted to the evolution and classification of the higher categories of flowering plants should begin and end with contributions by two sceptics. Professor Heywood introduces the proceedings by spelling out with renewed force and clarity his well-known reservations to the whole concept of phylogenetic classification. Likewise, Professor Merxmüller, in his concluding lecture, holds "a truly evolutionary system or a generally acceptable classification to be an unatainable aim in our time", although from his admirably fair summary it is clear that he has in fact a more moderate stand in any phenetic *versus* phylogenetic polarisation. The problem is that although much cool logic lies with the pheneticists, for those who are imbued with the central role of evolutionary processes in biology it is well nigh impossible to resist giving an evolutionary interpretation to the existence of similarity and difference between organisms. I suspect that it is the evolutionary implications, however vague and shadowy these may be, which make the distribution patterns of betacyanins or sieve element plastids of great interest. But certainly the array of differing and often contradictory interpretations of evolutionary affinities presented at this symposium will do little to encourage the faithful. Some years ago, in a different context, Mr B. L. Burtt wrote: "We are seeking not merely to classify plants but to learn about them. The classification is both an end product and a tool. We need stable classifications against which the distribution of other characters (not used in their construction) can be studied. It is just from the tension between a classification and characters discordant with it that we learn about plants" (*Notes R.B.G. Edinb.* 30, p. 143, 1970). I have found this idea very helpful, particularly in discussions with students, and it is certainly a view which will do much to fortify the reader of the present volume.

The twenty-one papers which were delivered at the symposium reflect a wide array of opinion and content. As always, there are contributions where one or two ideas have been expanded to produce a conference paper, such as Dr Cronquist's speculative attempt to interpret overall distribution patterns of secondary metabolites as successive waves of adaptive responses against predators, and Dr Gottsberger's views on the catalytic role of cantharophily in the evolution of polystemony in diverse angiosperm lines, and Professor Ehrendorfer's concept of the Hamamelidales as the remnants of an anemophilous transition group between the originally entomophilous Magnoliidae and subsequent Dilleniidae–Rosidae evolution. Other largely theoretical contributions are provided by Professor Kubitzki, on the need to understand the function of characters, Dr Clifford, with a numerical taxonomy of the Monocotyledons, and Dr Sporne, with an up-to-date restatement of his character-correlation approach to the primitive angiosperms. Another group of papers is by specialists who have studied a character complex across a broad sweep of families. These include contributions by Dr Gottwald, on secondary xylem in the Magnoliales *s.l.*, Professor Philipson, with a reassessment of the taxonomic value of the unitegmic ovule, Dr Krach, on seed characters in the Saxifragales *s.l.*, Professor Behnke, with a statement of the current position with regard to the occurrence of sieve element plastid types, and Professor

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