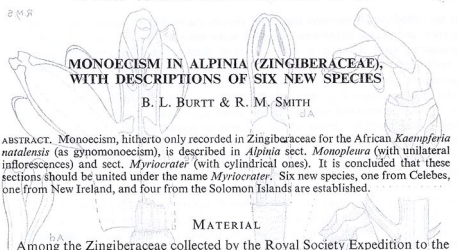


NOTES FROM THE ROYAL BOTANIC GARDEN  
30



## MONOECISM IN ALPINIA (ZINGIBERACEAE), WITH DESCRIPTIONS OF SIX NEW SPECIES

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**ABSTRACT.** Monoecism, hitherto only recorded in Zingiberaceae for the African *Kaempferia natalensis* (as gynomonoeism), is described in *Alpinia* sect. *Monopleura* (with unilateral inflorescences) and sect. *Myriocrater* (with cylindrical ones). It is concluded that these sections should be united under the name *Myriocrater*. Six new species, one from Celebes, one from New Ireland, and four from the Solomon Islands are established.

### MATERIAL

Among the Zingiberaceae collected by the Royal Society Expedition to the Solomon Islands in 1965 were four giant species of *Alpinia*, reminiscent in habit of the Fijian *A. boia* Seem. The stems may be as much as 10 metres tall, terminating in an inflorescence, either pendulous or erect and up to three-quarters of a metre long. Leaf-blades of well over a metre in length have been recorded. Two of these species had secund inflorescences and were thus clearly referable to sect. *Monopleura* K. Schum., which is so characterized. The other two were evidently allied, but these had the cincinni evenly distributed around the inflorescence axis. In 1970 M. J. S. Sands collected two further specimens: one in Celebes, also with evenly distributed cincinni, the other from New Ireland with a secund inflorescence. We are indebted to the authorities at Kew, to Professor E. J. H. Corner, F.R.S. and to Mr Sands for making herbarium specimens and spirit material available for study. We are also indebted to the authorities at the British Museum (Natural History) for the loan of a specimen collected by the late A. H. G. Alston in Celebes.

### SEXUAL DIFFERENTIATION

There is only one well-attested instance of the flowers of Zingiberaceae being other than hermaphrodite. K. Schumann (Pflanzenreich, Zing. p. 72) suggested that because his imperfect specimen of *Kaempferia natalensis* had no stamens, it might be dioecious. Subsequently Wood & Franks (in Wood, Ill. Natal Pl. 6: 560, 1911) described this plant as a distinct genus, *Siphonochilus*, and said that the flowers were female and hermaphrodite on the same plant (i.e. gynomonoeious). However no fruits have yet been found. The new material of *Alpinia* from the Solomon Islands, New Ireland and Celebes all belongs to a single group of species (their position in the genus will be discussed below) and all these show sexual differentiation between flowers on the same plant.

In each cincinnus (partial inflorescence) it is only the first (lowermost) and, occasionally, the second flower that is female and produces fruits. All the remaining flowers are functionally male and it seems that completely male cincinni and inflorescences may sometimes be produced. The position in the various specimens examined is given in detail as this is the first such information available for the family.

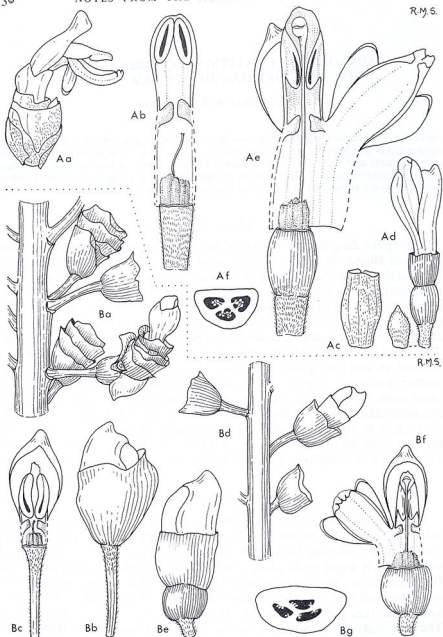


FIG. 1. A. *Alpina unilateralis* Burt & Smith. Ae, single cincinnus, showing male flower emerging from 4th bracteole  $\times 1$ ; Ab, L.S. of male flower showing stamen, lateral staminodes, epigynous glands and aborted style  $\times 2$ ; Ac, bracteole from first flower of young cincinnus  $\times 1$ ; Ad, female flower showing position of 2nd bracteole which encloses remainder of cincinnus  $\times 1$ ; Ae, female flower, dissected  $\times 2$ ; Af, ovary in T.S.  $\times 3$  (from spirit material).

B. *Alpina laxiseconda* Burt & Smith. Ba, part of inflorescence showing laxly arranged secund cinnini  $\times 1$ ; Bb, male flower showing unilaterally swollen calyx  $\times 2$ ; Bc, male flower in L.S.  $\times 2$ ; Bd, part of different, fewer flowered inflorescence  $\times 1$ ; Be, female flower  $\times 2$ ; Bf, female flower, dissected  $\times 2$ ; Bg, ovary in T.S.  $\times 3$  (from spirit and dried material).

In *A. unilateralis*, which bears closely arranged cincinni of probably up to 7 flowers, 4 out of the 7 inflorescence branches examined show that, except for the lowermost flower which develops into a 2-3 cm long persistent capsule, all the flowers of each cincinnus are male (fig. 1A). In the other 3 branches neither flowers nor fruits remain within the lowermost bracteole, which is rather shorter than that associated with female flowers, and the later flowers are staminate. Had fruit been formed by the lowermost flower one might reasonably expect some to remain on the plant. Although the field note indicates that *A. unilateralis* has a branched inflorescence one cannot tell, from the dried material, whether or not these entirely male branches (if such they be) have come from the same plant, but the possibility of a completely male inflorescence cannot be disregarded.

Examination of the lowermost flower of the cincinnus (fig. 1, Ae) shows that the inferior ovary, style and stigma are well-developed, but that the anther-thecae are greatly reduced in size. A small amount of pollen is produced, but the relative position of stigma and anther quite prevents self-pollination and it seems certain that the flower is functionally female. It is interesting to note that although the anther-thecae are much reduced the anther-crest is well-formed and over-arches the stigma, for which it presumably provides some protection. Exactly the reverse is found in the male flowers (fig. 1, Ab); the anther-thecae are well-formed but the crest is virtually absent; the style is rudimentary and does not reach to the level of the anthers, the stigma does not develop and the somewhat flattened, broadly triangular pedicel expands smoothly to the flower-base and is not swollen by the subglabrous apical ovary. Transverse sections of the upper part of the pedicel give no indication of even a rudimentary ovary. The calyx of the male flower is longer than that of the female and is markedly swollen on one side.

The situation in regard to the pollen is interesting. The small amount of pollen from the female flowers showed no stainability when tested with acetocarmine. This was expected. The male flowers of *A. unilateralis* had completely shed their pollen (which in itself perhaps suggests that the retention of pollen in the anthers of the female flowers is an indication that it is not functional). Pollen was, however, found in male flowers of *A. aenea*. This also completely failed to stain. Next, a presumably normal hermaphrodite flower from a herbarium specimen of *A. allughas* was tested and no pollen was found to stain. However pollen from fresh flowers of *A. zerumbet* showed nearly 100% stainability. Pollen was then removed from a 6 year-old herbarium specimen of the same cultivated stock, and stainability was found to be down to about 50%. Erdtman has noted that the pollen of Zingiberaceae has a very thin exine and is not resistant to acetolysis. Whether these two phenomena are connected remains to be seen, but it certainly seems that the failure of old pollen to stain with acetocarmine cannot be taken to show beyond doubt that it was originally inviable.

Turning to the other species we find considerable agreement. The inflorescence structure of *A. monopoleura* is very similar to that of *A. unilateralis*. In *A. laxiseconda* the inflorescence is unbranched and here, with the exception of a single plant, which will be discussed later, the cincinni contain up to 9 flowers. No first flowers remain on the material, neither are there any attached fruit and it is by no means certain that the loose capsules included with this

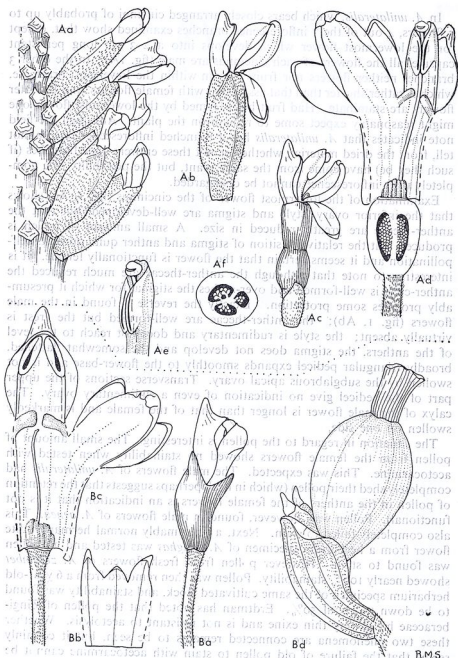


FIG. 2. A. *Alpinia conferta* Burt & Smith. Aa, part of inflorescence  $\times 1$ ; Ab, single cincinnus showing first flower  $\times 1$ ; Ac, first flower, bracteole removed showing position of second bracteole which encloses remainder of cincinnus  $\times 1$ ; Ad, female flower (no later and presumably male flowers seen) dissected  $\times 2$ ; Ae, anther  $\times 3$ ; Af, ovary in T.S.  $\times 2$  (from spirit material).  
 B. *A. salomonensis* Burt & Smith. Ba, male flower  $\times 2$ ; Bb, calyx, dissected  $\times 2$ ; Bc, male flower, dissected  $\times 2$ ; Bd, cincinnus with capsule emerging from lowermost bracteole  $\times 1$  (from spirit material).

gathering have come from these particular inflorescences. The later flowers of each cincinnus are staminate (fig. 1, Bb, c). The branched or unbranched inflorescence of *A. novae-hiberniae* is exactly similar. A single plant of *A. laxiseconda* with much reduced cincinni of 2-3 flowers and a shorter inflorescence has female first flowers (fig. 1, Be, f), but the inflorescence is in a young state and the structure of the later flowers cannot be determined. The structure of the female and male flowers is very similar to that described for *A. unilateralis*, but in *A. laxiseconda* the anther of the male flowers has a small central appendage: this is much narrower than the anther-crest of the female flower.

In *A. conferta* (fig. 2A) all the inflorescences examined probably have cincinni with not more than 3 flowers, and again, although the first flower is female we cannot be certain of the state of those that follow. In *A. salomonensis* (fig. 2B) the cincinni are several-flowered and at least one has produced fruit from both first and second flowers. This is also the case in *A. aenea*. Thereafter only male flowers are to be found. No female flowers remain in *A. salomonensis* and the fruiting cincinni are not attached to the inflorescence and could have come from a different plant.

It is clear that no satisfactory account of sexual differentiation in plants of this size can be made in the herbarium. Field observations are needed. These should be made not merely on individual plants but on populations, to see if all the plants behave in the same way. The temporal relations of female and male flowering in different parts of the inflorescence also need study in the field. Despite the inadequacy of herbarium studies the evidence strongly suggests that these species are all monoecious.

#### GENERAL MORPHOLOGY AND TAXONOMY

Of the species under discussion six have inflorescences in which the cincinni are borne on only one side of the main axis. Here are included *A. monopoleura*, *A. celebica*, and *A. eremochlamys*, all described from Celebes by K. Schumann, and the sum total of his *Alpinia* subgen. *Dieramalpinia* sect. *Monopoleura*. No types have been seen but we have examined good material of what is undoubtedly *A. monopoleura* from the type locality and it is clear that *A. unilateralis* and particularly *A. laxiseconda*, both from the Solomon Islands, together with *A. novae-hiberniae* (from New Ireland), are closely allied. The remaining four species, *A. conferta*, *A. salomonensis* (Solomon Islands), *A. aenea* (Celebes) and *A. myriocratera* (Moluccas) have cincinni disposed all round the axis; but in no other respect can they be separated from the plants with unilateral inflorescences. On the contrary they show just the same sort of sexual differentiation, which is at present unknown elsewhere in the genus.

All are tall-growing herbs of up to 10 m high, the stout stems characteristically bladeless in the lower half, with usually pendulous, branched or unbranched inflorescences. Branching has been regarded as of some importance within the classification of *Alpinia* but should be viewed with caution here, for there is evidence from the field notes to *A. novae-hiberniae* that branched inflorescences are not necessarily constant throughout a species. When branching occurs it is in the form of 2 or 3 strong lateral shoots arising at the base of the inflorescence, quite unlike the paniculate arrangement found in

sect. *Pycnanthus* K. Schum. (sect. *Hellwigia* (Warb.) Loesen.) and exemplified by *A. pulchra* (Warb.) K. Schum. and the Fijian *A. boia* Seem.\*

Primary bracts are, with 2 exceptions, small and quickly deciduous and each inflorescence bears numerous cincinni of few to many tubular-bracteolate flowers. The flowers of all species are green and white; with the exception of *A. aenea* which is salmon-bronze in the bud and has bronze petals and a cream labellum. The short corolla tube is not usually exerted from the calyx and there is a shortly cucullate dorsal lobe. The more or less ovate labellum has incurved margins with an irregularly though probably shortly 4-lobed apex and the fleshy truncate lateral staminodes lie at the base of the short and broad fleshy filament. The most useful characters for distinguishing the species are found in the indumentum of leaves, bracteoles and calyx and in the length of the cincinnus-stalk; these are set out in the key below.

While the species with unilateral inflorescences clearly belong to sect. *Monopleura* K. Schum., those which lack this key character can scarcely be so placed without comment. Study of the alternatives leads to sect. *Myriocrater* K. Schum. as their most appropriate position.

*A. myriocratera* K. Schum., as represented by *Moseley* s.n. from Ternate, Moluccas, has been examined at Kew. A cincinnus has at least eight flowers: no fruit or open flowers remain, but a flower bud from the seventh bracteole is clearly that of a male flower. The inference is, therefore, that *A. myriocratera*, the type species of sect. *Myriocrater* K. Schum., is monoecious like the other species discussed. Or, put another way, the monoecious species with the cincinni distributed evenly around the inflorescence axis should be placed in sect. *Myriocrater*.

The positioning of the cincinni on the axis is scarcely an adequate character to distinguish two sections. The species that do not have one-sided inflorescences would clearly be ill-placed under the sectional name *Monopleura* and it therefore seems appropriate to maintain the sectional name *Myriocrater*, which refers to the numerous tubular bracteoles and is appropriate to all species.

It should be noted that Loesener reduced sect. *Myriocrater* to sect. *Strobidia* (Miq.) K. Schum.; the type of which is *A. sumatrana* (Miq.) K. Schum. There is, however, no indication of monoecism in the species of this section at present and we prefer to leave it on one side. Similarly the second species that K. Schumann placed in sect. *Myriocrater*, *A. stenostachys* K. Schum. from New Guinea (redescribed at some length by Valetton in Bot. Jahrb. 52: 67, 1914), has a flower structure similar to sect. *Pleuranthodium* or sect. *Psychanthus* and need not further concern us here.

**Alpinia** sect. *Myriocrater* K. Schum. in Pflanzenr., Zing. 356 (1904).

Syn.: *Alpinia* sect. *Monopleura* K. Schum. in Pflanzenr., Zing. 361 (1904).

Type species: *A. myriocratera* K. Schum. in Bot. Jahrb. 27: 290, t. 3 fig. K (1899) & in Pflanzenr., Zing. 356 (1904).

Emended diagnosis. Inflorescence usually pendulous, more rarely erect, simple or branched at the base; cincinni secund or distributed round the

\* In flower structure *A. pulchra* and *A. boia* are very dissimilar. *A. pulchra* agrees, save for the fact that the cincinni are many flowered, with sect. *Monanthocrater* Val. in which the lip is narrowly strap shaped and there is an elongated, usually dentate, filament. In *A. boia* the labellum is more or less obovate and the filament short and edentate.



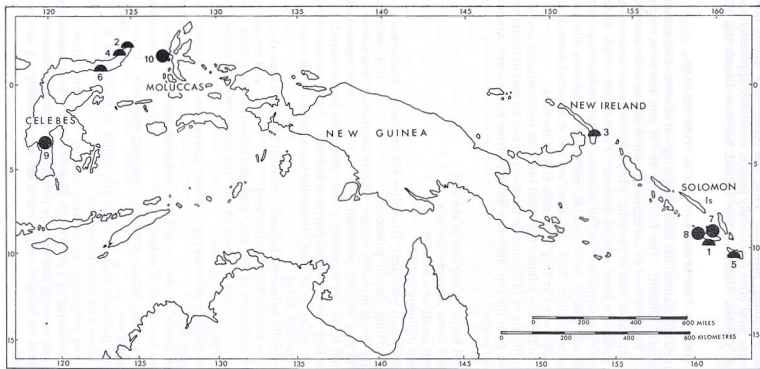


FIG. 3 Distribution of *Alpinia* sect. *Myriocrater* K. Schum. Species 1-6 have unilateral inflorescences and are represented by half circles: 1, *A. unilateralis*; 2, *A. eremochlamys*; 3, *A. novae-hiberniae*; 4, *A. monopleura*; 5, *A. laxiseconda*; 6, *A. celebica*. Species 7-10 have cylindrical inflorescences and are represented by circles: 7, *A. conferta*; 8, *A. salomonensis*; 9, *A. aenea*; 10, *A. myriocratera*.

axis; bracteoles tubular, persistent. First, and occasionally second, flower in the cincinnus most often functionally female, remainder apparently male. Distribution. Celebes, Moluccas, New Ireland, Solomon Islands (fig. 3).

# KEY TO THE SPECIES OF SECT. MYRIOCRATER

Lack of authentic material has made the keying-out of some of Schumann's species extremely difficult. The following key is not, therefore, entirely satisfactory. We have tried to use characters which can be easily seen from herbarium material or used in the field. Floral differences are described but need confirmation on more copious material. Furthermore, it will be seen from the ensuing descriptions that full accounts of the size and shape of the leaves have not always been possible, particularly regarding the easily damaged apical portion. Such omissions are not unexpected, since dealing with leaf blades over 1 m long is no easy task in the field.

Throughout this key primary bract and bracteole measurements are taken from the first bracteole of cincinni in the lower or middle part of the inflorescence. Those from the top, and their accompanying flowers, are invariably much reduced in size.

- |  |                              |
|--|------------------------------|
| 1a. Cincinni borne on one side of the axis . . . . .   | 2                            |
| 1b. Cincinni borne all round the axis . . . . .  | 7                            |
| 2a. Cincinni sessile or subsessile . . . . .   | 3                            |
| 2b. Cincinni distinctly stalked . . . . .  | 4                            |
| 3a. Primary bracts persistent, lanceolate 2-4 cm long; bracteoles to 1.5 cm long, densely pubescent . . . . .  | 1. <i>A. unilateralis</i>    |
| 3b. Primary bracts probably minute, quickly deciduous; bracteoles to 1 cm long, sparsely pubescent . . . . .   | 2. <i>A. eremochlamys</i>    |
| 4a. Cincinni stalks not exceeding 1 cm; bracteoles funnel-shaped c. 1 cm long, 0.6 cm wide at top (New Ireland) . . . . .  | 3. <i>A. novae-hiberniae</i> |
| 4b. Cincinni stalks up to 3 cm; bracteoles cup-shaped 1.5 cm long, 1-1.5 cm wide at top . . . . .  | 5                            |
| 5a. Leaves softly pubescent beneath; cincinni laxly arranged, 2-3 arising at more or less the same level . . . . .   | 4. <i>A. monopleuria</i>     |
| 5b. Leaves pubescent at margins, glabrous below; cincinni laxly arranged, 4 arising at more or less the same level, or dense towards the top of the axis . . . . . | 6                            |
| 6a. Leaves distinctly petiolate (up to 6 cm); cincinni lax throughout (Solomon Is.) . . . . .  | 5. <i>A. laxiseconda</i>     |
| 6b. Leaves sessile or shortly petiolate; cincinni densely arranged towards top of axis (Celebes) . . . . .   | 6. <i>A. celebica</i>        |
| 7a. Cincinni sessile, densely arranged, obscuring main axis; leaves quite glabrous . . . . .   | 7. <i>A. conferta</i>        |
| 7b. Cincinni distinctly stalked, main axis visible in lower part at least; leaves with some pubescence . . . . .   | 8                            |
| 8a. Main axis velutinous, leaves hairy at least on midrib below; bracteoles averaging 3 cm in length (Solomon Is.) . . . . .                                       | 8. <i>A. salomonensis</i>    |
| 8b. Main axis minutely and sparsely pubescent or glabrous; leaves pubescent on margins only; bracteoles not exceeding 1.5 cm in length . . . . .                   | 9                            |



- 9a. Flowers bronze and cream; fruit spherical c. 1-1.3 cm in diameter (Celebes) . . . . . 9. *A. aenea*  
 9b. Flowers white; fruit ovoid-ellipsoid 2.7 cm long (Moluccas) . . . . . 10. *A. myriocratera*

1. *Alpinia unilateralis* Burtt & Smith, *species nova* *A. laxisecondae* affinis, cincinnis densis sessilibus et bracteolis pubescentibus recedens.

*Herba* ad 10 m usque, basi bulbosa 15-25 cm crassa, lamina prima 4-6.5 m supra basin oriente. *Folia* in quaque fronde 10-14; vagina? ligula? petiolus? lamina 125-200 cm longa et 25-30 cm lata, marginibus pubescentibus cetera glabra. *Inflorescentia* terminalis, basi ramosa, ramis 2-3 ad 45 cm usque longis triente inferiore nudis, rhachide glabra; cincinni sessiles approximati in rhachide unilaterales; bracteae primariae lanceolatae majores (9-)  $4 \times 1$  cm, minores c.  $1 \times 0.3$  cm, ad apicem iterum minores, marginibus pubescentibus, pagina superiore parcius pubescente; flores in quoque cinnino 3-7, primus femineus, ceteri masculi, vel fortasse flores omnes interdum masculi; bracteolae tubulares ad 1.5 cm usque longae (eae florum masculorum minores) pubescentes, demum unilateraliter fissae. *Flos femineus* breviter pedicellatus; calyx, ovario glabro incluso, 1-1.8 cm, obscure trilobus fere glaber; corolla pallide viridis, glabra, tubo 1 cm longo e calyce vix exserto, lobo dorsali c.  $1.5 \times 1$  cm ad apicem breviter cucullatum angustato, lobis lateralibus  $1.2 \times 0.7$  cm apice rotundato incrassatis et leviter cucullatis; labellum album, ad  $1.8 \times 0.8$  cm usque, marginibus involutis, lobulis apicalibus quattuor praeditum; staminodia truncata, 4 mm longa, carnosa; stamen glabrum, ad 2 cm longum usque; filamentum  $9 \times 6$  mm, marginibus leviter involutis, sulco mediano carente; antherae thecae 1 cm longae connectivo prolongato cristam undulatam 2 mm longam formante; stylus glaber; stigma ore ciliatum; glandes epigynae basem styli paene circumcingentes, c. 2-2.5 mm altae, carnosae; ovarium glabrum, triloculare, multi-ovulatum. *Fructus* plus minusve 2-3 cm longus, costatus, calyce persistente coronatus. *Flos masculus* a femineo differt bracteola breviori, pedicello longiore et calyce majore validius trilobato et unilateraliter ampliato, filamento latiore et connectivo antherae vix prolongato et emarginato.

BRITISH SOLOMON ISLANDS PROTECTORATE. Guadalcanal, Popomanasiu, upper camp, 1750 m, 24 x 1965, Royal Society Expedition to the Solomon Islands, Corner 106 (holo. K; iso. E).

Collector's note:—Tufted. Stem 10 m high 15-25 cm thick at bulbous base, 4-6.5 m to first leaf; 5-7 leaves on each side; lamina 1.2-2 m long, 25-30 cm wide; inflorescence one-sided with 2-3 branches 30 cm long on stalks 15 cm long; stamen lip and style white, sepals green, petals pale green, inflorescence erect, slight citronella scent in flowers.

This is a very distinct species readily distinguishable by the lanceolate more or less persistent primary bracts which may be as much as 9 cm long at the base of the inflorescence and by the densely pubescent bracteoles.

2. *Alpinia eremochlamys* K. Schum. [in Bot. Jahrb. 27: 288, t. 3 f. 9 (1899) nomen tantum] Pflanzenr., Zing. 362, f. 40, o (1904).

CELEBES: Tomohon, 6 vi 1894, Sarasin 412; Tondano, v 1871, Meyer s.n. (syntypes n.v.).

There is at Edinburgh a specimen labelled *Warburg* 15733 collected from Bojong (Mt. Lollem-Bulan) in Celebes. This number is cited by Schumann under *A. monopleura* v. *minor* but in the Edinburgh duplicate this determination applies only to the material in the capsule which consists of a few long stalked cincinni. The mounted specimen which is made up of a single unbranched inflorescence and two leaves should be referred to *A. eremochlamys*. The cincinni are very shortly stalked and much more densely arranged than in *A. monopleura*, the bracteoles do not exceed 1 cm in length and the leaves are entirely glabrous. The material is too inadequate to allow accurate examination of flower structure.

3. *Alpinia novae-hiberniae* Burt & Smith, *species nova* *A. eremochlamydis* similis sed foliorum marginibus pubescentibus et pedunculo cincinnati longiore (1 cm usque) differt.

*Herba* 8 m usque; vaginae  $\pm$  glabrae; ligula c. 1 cm longa, rotundata, dense pubescens; lamina subsessilis, basi attenuata, usque ad 1 m  $\times$  0.2 m (interdum multo angustior), marginibus conspicue pubescentibus exceptis glabra. *Inflorescentia* plerumque eramosa, ad 40 cm? longa, rhachide  $\pm$  glabra; cincinni densi, unilaterales; bractae primariae usque ad 0.5 cm longae, triangulares, caducae; cincinni pedunculo usque ad 1 cm longo, flores bracteolatos saltem 10 gerentes; bracteolae tubulares, infundibuliformes, 1-1.5 cm longae (ad apicem inflorescentiae multo minores), truncatae, unilateraliter fissae, parce pubescentes. *Flores* infimi (et fructus) delapsi, ceteri masculi; pedicellus 0.5 cm longus (1 cm usque floris infimi) ad apicem pubescens; calyx fulvo-viridis, usque ad 1.2 cm longus, obscure trilobus, unilateraliter ampliatus et sub apice carinatus, glaber; corolla alba, c. 1.5 cm longa, tubo 0.3 cm, lobo dorsali 1.2  $\times$  0.7 cm incurvato et plus minusve cucullato, lobis lateralibus c. 1  $\times$  0.5 cm, cucullatis; labellum oblongum, 0.9  $\times$  0.5 cm, marginibus involutis, apice minute 4-lobulatum; staminodia minus quam 1 mm, truncata, carnosa; stamen 8 mm; filamentum paulo minus quam 1 mm; thecae 7 mm connectivo emarginato; glandes epigynae c. 2 mm, stylum abortivum minutum circumcingentes.

NEW IRELAND. Namatani sub.-distr., Hans Meyer Range, Danfu river valley c. 8 km west and upstream of Danfu bridge near Manga, steep gulley on west side of a ridge c. 3 km south of the river, mixed forest apparently dominated by *Podocarpus* and *Eugenia* spp., deep clay loam and rough limestone outcrops, 925 m, 14 ii 1970, *M. J. S. Sands* 857 (holo. K; iso. E).

Collector's note:—Extremely large plant to 8 m; stems very stout, erect; leaves each c. 1 m long, bluish mid-green above, paler beneath, inflorescence terminal (branched in one case) flowers more or less on one side, emergent from a series of brown scarious sheathing bracts; sepals yellowish-green; corolla white, fragrant with a mild sweet ginger odour.

With the exception of *A. unilateralis* which has sessile cincinni and densely pubescent bracteoles *A. novae-hiberniae* may be distinguished from other species with unilateral inflorescences by the rather elongated more or less funnel-shaped bracteoles. The cincinni are only shortly stalked, unlike those of *A. monopleura*, *A. celebica* and *A. laxiseconda* but not as shortly so as in *A. eremochlamys* from which it is further distinguished by the subsessile

leaves with pubescent margins. Such leaf margins also occur in *A. celebica*, *A. laxiseconda*, *A. aenea* and *A. myriocratera*.

No female flowers remain on our material nor was fruit collected. The flowers from the upper bracteoles are male and there is no anther crest.

**4. *Alpinia monopleura*** K. Schum. [in Bot. Jahrb. 27: 287 (1899) nomen tantum] Pflanzenr., Zing. 361 (1904).

CELEBES: Tomohon, 22 iv 1894, *Sarasin* 219 (holo. n.v.); Tomohon, 700 m, stem about 2 m, green, lower half bare, fruits green, flowers white with green outside, 4 vi 1954, *Alston* 15656 (BM).

Alston's collection fits Schumann's description reasonably well. It also shows the occurrence of separate male and female flowers in exactly the same manner as its New Ireland and Solomon Island counterparts. No female flowers remain on the material but ripe capsules are exerted from the lowermost bracteole of almost every cincinnus.

As Sarasin's type is no longer at Berlin and we have been unable to trace any duplicates we cannot comment on Schumann's use of the word linear to describe the labellum. In Alston's plant it is clearly oblong but this is the only serious difference. The description also refers to a 3 mm acute anther crest. We have already remarked that while, as far as we know within this section, female flowers produced a crest, it may be quite absent from the male flowers and these of the recent gathering are indeed crestless. Schumann's unawareness of these sex forms has been discussed and we have no idea which type of flower he examined.

var. **minor** K. Schum. [in Bot. Jahrb. 27: 287 (1899) nomen] in Pflanzenr., Zing. 362 (1904).

CELEBES. Bojong, *Warburg* 15733 (iso. E. p.p. min.).

Differing from the species in the smaller bracteoles and flowers. For note on *Warburg* 15733 see under *A. eremochlamys*.

**5. *Alpinia laxiseconda*** Burt & Smith, *species nova* ab affini *A. celebica* foliorum laminis distincte petiolatis et cincinnis per inflorescentiam laxè distributis differt.

*Herba* 8 m usque alta; vaginae minute pubescentes vel plus minusve glabrae; ligula usque ad 2.5 cm longa, acuta, breviter pubescens; petiolus 6 cm usque longus; lamina usque ad 1 m  $\times$  0.33 m, sed interdum multo minor, glabra. Inflorescentia eramosa, 40–75 cm longa, triente basali nuda, rhachide glabra; cincinni in rhachide unilaterales; bracteae primariae mox caducae; inflorescentia duae diversae visae: (1) 40 cm longae; cincinni pedunculis 1–1.3 cm longis, 2–3 (?) flori; bracteolae cupuliformes, ad 1 cm usque longae; flos primus breviter pedicellatus femineus, ceteris masculis (?); calyx 1–1.3 cm longus ovario glabro incluso, truncatus, glaber; corollae tubus 0.3–0.4 cm longus, e calyce haud exsertus; lobus dorsalis 1.1–1.2  $\times$  1 cm, breviter cucullatus; lobi laterales 0.8–1  $\times$  0.5 cm apice rotundato cucullato; labellum oblongum, c. 1  $\times$  0.6 cm marginibus plus minusve incurvis, lobulis apicalibus 4 praeditum; staminodia truncata vix plus quam

1 mm, carnosa; stamen 0.8–1 cm longum; filamentum 1 mm; thecae c. 5 mm; connectivum in cristam undulatam vel obscure dentatam 2–3 mm longam abeuns; stylus glaber stigmate ore ciliato praeditus; glandes epigynae 1–1.25 mm longae, stylum fere circumcingentes, carnosae; ovarium superne uniloculare multiovulatum; fructus globosus 2 cm usque diametro calyce persistente coronatus. (2) *Inflorescentia altera* ad 75 cm usque longa; cincinni pedunculis 2 cm usque longis, flores 9 usque gerentes; nec infimi feminei nec fructus visi; flores superiores masculi pedicellis 1–1.5 cm longis, calyce 1.3–1.5 cm longo obscure trilobo unilateraliter ampliato, corollae tubus 0.2 cm longus lobo dorsali 1.5 × 1.3 cm, antherae connectivo in cristam 1–1.5 mm longam prolongato.

BRITISH SOLOMON ISLANDS PROTECTORATE. San Cristobal, ridge east of Pegato, 600 m, stem 8 m, flowers pale greenish-white, 3 viii 65, Royal Society Expedition to the Solomon Islands, *Sore* 2316 (holo. K; iso. E).

The different inflorescence types found in this species have been discussed in some detail above. That it is very closely allied to *A. monopleura* and *A. celebica* is without question. From the former it may be distinguished by the glabrous leaf undersurface and usually 4-ranked, more numerous cincinni; from the latter by the distinctly petiolate leaves and entirely lax inflorescence. It will be seen that the male flowers differ from the female in several ways. They are long pedicellate, the larger calyx has a conspicuous unilateral swelling (this was also observed in *A. unilateralis*), and the corolla lobes are longer and wider. The corolla tube, however, is barely two-thirds the length of that of the female flowers and although an anther-crest is produced it is reduced to a 1–1.5 mm long central projection.

**6. *Alpinia celebica*** K. Schum. in Pflanzenr., Zing. 362 (1904).

CELEBES. Gorontalo, *Riedel* s.n. (holo., n.v.).

Schumann distinguished this species from *A. monopleura* by the cincinni being densely borne at the top of the inflorescence and by the crestless anther. It has become apparent that the latter character is a dangerous one unless the sex-forms of the flowers are understood, as it may be present in female flowers, absent in the male.

**7. *Alpinia conferta*** Burt & Smith, *species nova* *A. salomonensi* similis sed cincinnis sessilibus densis differt.

*Herba* 6 m usque alta, caulibus caespitosis; vaginae inter costas parce vel dense pubescentes; ligula 3 cm usque longa, velutina, acuta, integra; lamina sessilis, glabra, magna, basi anguste attenuata. *Inflorescentia* eramosa, cylindrica, saltem 15 cm usque longa, c. 5 cm diametro, basi per 1–1.5 cm nuda, velutina, superne rhachide cincinnis spiraliter ordinatis occulta; bracteae primariae lanceolatae acutae 2.5 × 1 cm, sursum decrescentes, dense pubescentes; cincinni sessiles 2–3–(vel pluri-?)flori; flos primus femineus, ceteri?; bracteolae 2.25–3 cm longae, dense pubescentes, undulatae vel obscure trilobae, lateraliter paulo complanatae; flores (sursum decrescentes) pedicellis 0.6 cm longis pubescentibus; calyx ovario glabro

incluso c. 1.8 cm longus, glaber, irregulariter trilobus; corolla pallide viridis, tubo 1 cm longo calycem vix excedente, lobo dorsali c.  $1.2 \times 1$  cm ad apicem breviter cucullatum angustato, lobis lateralibus  $1 \times 0.6$  cm apice rotundatis; labellum album  $1.4 \times 0.7$  cm usque, marginibus involutis, lobulis 4 apicalibus praeditum; staminodia c. 4 mm longa, carnosae, truncata; stamen glabrum, c. 1.2 cm longum; filamentum  $6 \times 4$  mm sulco medio carente; thecae 4–5 mm longae connectivo in cristam brevem emarginatam prolongato; stylus glaber, stigmatibus ore ciliato; glandes epigynae stylum plus minusve omnino circumcingentes, carnosae; ovarium glabrum, triloculare, ovulis numerosis.

BRITISH SOLOMON ISLANDS PROTECTORATE. Guadalcanal, Popomanasiu, upper camp, 1680 m, 24 x 1965, Royal Society Expedition to the Solomon Islands, Corner 107 (holo. K; iso. E).

Collector's note:—As no. 106 (*A. unilateralis*) but more tufted, stem not so tall, 6 m; inflorescence solitary, unbranched, flowers spirally arranged all round. Flowers same colour and scent, but bracts and calyx seem different from 106.

*A. conferta* is readily distinguished by the closely arranged sessile cincinni which hide the main axis completely. The primary bracts are up to 2.5 cm and more or less persistent, a feature only otherwise observed in *A. unilateralis* with which it shares similarly velutinous, although much longer, bracteoles and inflorescence axis. Both species were collected from the same locality and Professor Corner recorded in his excellent field notes that while *A. unilateralis* has a one-sided branched inflorescence both have similar flower colouring and a slight smell of citronella.

**8. *Alpinia salomonensis* Burt & Smith, species nova** ab affini *A. conferta* cincinnis laxioribus pedunculatis differt.

*Herba* grandis; vaginae, ligula et lamina parce, costa densius, pubescens. *Inflorescentia* simplex c. 100 cm longa, rhachide velutina; cincinni breviter (ad 0.5 cm) pedunculati, subverticillati; bractae primariae mox caducae, haud visae; flores ad 9, infimus et interdum secundus femineus (fructu tantum viso), ceteri masculi; bracteolae tubulares 3 cm usque longae, pubescentes, demum lateraliter alte fissae; calyx (floris masculi) 2.5 cm longus, glaber, trilobus, lobis lateralibus 1 cm longis plus minusve triangularibus carnosis, dorsali 0.5 cm plus minusve rotundato vel subacuto; corolla viridis tubo calycem haud excedente; lobus dorsalis  $1.5\text{--}1.8 \times 1.2$  cm, breviter cucullatus; lobi laterales  $1.5 \times 1$  cm, apice carnosus et cucullatus; labellum album, oblongum  $2 \times 1$  cm, marginibus involutis, lobulis 4 apicalibus praeditum; staminodia lateralia 4 mm longa, truncata, carnosae; stamen c. 1.5 cm longum; filamentum  $7 \times 6$  mm, carnosum; thecae 7 mm connectivo incrassato sed haud prolongato; stylus abortivus interdum ad medias thecas attingens plerumque brevior; glandes epigynae c. 2 mm stylum circumcingentes, carnosae. *Fructus* plus minusve ampulliformis, 4 cm usque longus, glaber, polyspermus.

BRITISH SOLOMON ISLANDS PROTECTORATE. Guadalcanal, Popomanasiu, 1000–1300 m, 30 x 1965, Royal Society Expedition to the Solomon Islands, Corner 143 (holo. K; iso. E).

Collector's note:—Habit of no. 106 (*A. unilateralis*) but inflorescence decurved vertically, simple, 1 m long. Flowers arranged all round, but well spaced. Stamen and lip white, petals greenish; the large one from Gallego?

The long, up to 4 cm, more or less funnel-shaped bracteoles and the densely pubescent inflorescence with well spaced subverticillate cincinni are the distinguishing features of *A. salomonensis*. The leaves are sparsely pubescent below, much more densely so on the midrib. In this species it was observed that occasionally the second flower of a cincinnus may produce a fruit, thereafter the flowers are male.

The collection from Mt. Gallego referred to in the above field note differs from the type in the longer (up to 1.5 cm) stalked cincinni; smaller bracteoles, densely pubescent leaf surface and in the branched inflorescence. Branching is not constant throughout a species (cf. *A. novae-hiberniae*) and flower size may also vary considerably. Until more observations are made we do not feel that the more important differences of cincinni stalk length and indumentum justify according name or rank to this plant the details of which are: British Solomon Islands Protectorate. Guadalcanal, eastern slopes of Mt. Gallego, moss forest, 1000 m, 7 vii 1965, Royal Society Expedition to the Solomon Islands, T. Whitmore 2056 (K, E).

Collector's note:—5 m tree, leaves up to  $3.5 \times 0.3$  m; terminal pendulous flowering spike; outer perianth segments pale green; inner segments pure white.

**9. *Alpinia aenea* Burt & Smith, species nova ab affini *A. myriocratera* floribus aeniis et fructibus globosis differt.**

*Herba* 6 m usque; vaginae glabrae; ligula 2.5 cm usque, rotundata, pubescens; lamina sessilis  $100 \times 11$  cm usque, marginibus pubescentibus exceptis glabra. *Inflorescentia* eramosa, 75 cm usque longa; rhachis minute et parce pubescens; cincinni densi; bracteae primariae haud visae, ut videtur mox caducae; cincinni pedunculo minute pubescente 1 cm usque longo sursum decrescente, saltem 6-florus; bracteolae tubulares ad 0.8 cm usque longae, ore c. 0.5 cm diametro, ad apicem cincinni diminuentes, plus minusve truncatae, unilateraliter fissae, glabrae; flos primus cincinni haud visus, fructifer et probabiliter femineus, ceteri masculi; pedicellus c. 0.3 cm longus, pubescens praesertim apicem versus; calyx c. 0.8 cm longus, plus minusve truncatus, glaber; corolla 1.3–1.5 cm longa, tubo 0.3 cm; lobi aenei, dorsalis c.  $1 \times 0.6$  cm breviter cucullatus, laterales paulo breviores, 0.5 cm lati, cucullati; labellum ochroleucum, c. 0.8–1 cm longum, c. 0.5 cm latum, sursum paulo angustatum, apice minute 4-lobulato praeditum, marginibus incurvis; staminodia vix 1 mm longa, carnosa, truncata; stamen c. 6 mm longum, filamentum 1 mm; thecae 5 mm, connectivo crista minuta  $1 \times 1$  mm bilobulata dorsali praedito; glandes epigynae c. 2 mm, stylum abortivum plus minusve circumcingentes et excedentes. *Fructus* globosus 1.5 cm usque diametro, cyano-viridis, in siccitate conspicue costatus, minute et parce pubescens, calyce persistente coronatus.

CELEBES. Enrekang District, Latimojong Mts., flat area on shoulder of slopes c. 4.5 km west of Bunte Tjejeng and c. 3 km south east of Rantelemo village, secondary grass cover on old abandoned rice fields, open, damp



ground near old irrigation pool, 1500 m, 26 xi 1969, *M. J. S. Sands* 595 (holo. K; iso. E).

Collector's note:—Very stout plant to 6 m; c. 20 leaves out at once, yellowish-green undulate; inflorescence terminal to 75 cm long; flowers salmon bronze in bud with bronze outer petals [corolla lobes], cream labellum and pink-flushed pollinia, fruits blue-green.

*A. aenea* is probably most closely allied to *A. myriocratera* but we have seen no good material of that species. In flower colouring *A. aenea* is unique, the usual green and white giving way to salmon bronze buds, bronze petals, cream labellum and pink flushed anther. The corolla, whose overall length does not exceed 1.5 cm, is much the smallest of the section. This is the only known species from Celebes without a unilateral inflorescence, but like *A. celebica* it has distinctly pubescent leaf margins. Fruit emerging from the first and sometimes second bracteole and the presence of male flowers in the remainder of each cincinnus indicate the consistency of monoecism throughout this group.

**10. *Alpinia myriocratera*** K. Schum. in Bot. Jahrb. 27: 290 (1899) & Pflanzenr., Zing. 356 (1904).

MOLUCCAS: Ternate, Acqui Conora, xi 1874, *Beccari* s.n. (holo. n.v.); without locality, x 1874, *Mosely* s.n. (K).

*A. myriocratera* resembles *A. aenea* in the cylindric inflorescence and pubescent leaf margins but may be distinguished by the ovoid-elliptic fruit and white flowers. This statement is made largely on the basis of Schumann's description for we have not seen the type specimen of *A. myriocratera* and the Moseley collection, which was cited by Schumann in 1904, retains no fruit and colour notes are not given. All the lowermost flowers are gone but a young bud near the top of a cincinnus could be clearly distinguished as male.