A MONOGRAPH OF THE GENUS BARRINGTONIA (LECYTHIDACEAE)

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CONTENTS

SUMMARY

A brief history is given on the circumscription and subdivision of *Lecythidaceae* and the position of *Barringtonia*. All aspects, also of auxiliary disciplines point to affinity with *Myrtaceae* but warrant separate family status. The conviction is that only one family is concerned, not two, or even three, as Knuth proposed.

The subdivision of *Lecythidaceae* appears to meet with great difficulty. It does not seem to be possible to divide the family in tribes which would be restricted to the New and Old Worlds respectively, affinities running transoceanic.

In the present revision of the genus *Barringtonia* 39 species are distinguished, 3 of which have one or a few new subspecies, varieties, or forms; three species are newly described. A survey is given of the morphological characters, their variation, and systematical value.

Great attention is given to the seed structure and blastogeny which could be studied in two species. Various dubious or erroneous former statements on the peculiar embryo could be straightened out. The mature embryo is almost unique among Angiosperms because it is a solid body, provided with a spiral of small scales, but without cotyledons as usually understood. After germination this spiral is continued, first with cataphylls and finally with normal leaves.

A similar structure is possibly found in other genera of *Lecythidaceae*; it appears highly desirable that embryogeny of all genera be studied, to ascertain its systematical importance.

Two sections based on the calyx structure can be distinguished. This coincides with former generic distinction. *Barringtonia sens. str.* has initially a closed calyx which later disrupts into pseudolobes or opens circumscissile and *Stravadium* has a calyx which is open from the beginning. Within these sections eleven smaller groups of mutually allied species are present but they can only vaguely be defined and do not represent taxa.

All species were examined palynologically and appeared to belong to eight pollen types, each comprising one or more species. These types can be arranged into two main types which do not coincide with the two taxonomical sections. On the whole it appeared that at the species level the groups are satisfactorily in accord with the pollen types.

INTRODUCTION AND ACKNOWLEDGEMENTS

Barringtonia is the largest genus of the Old World *Lecythidaceae*. In the past it has been revised twice, first by Miers in 1875 and later by Knuth in 1939. Both monographs were unsatisfactory, largely because they were based on a very limited number of collections. Another essential point is that the herbarium material of the genus is by its inadequacy difficult to study by the shrunken condition of the fleshy flowers and fruit and the size of the leaves. Besides, hardly any collections contain both buds, flowers, mature fruit, and good field notes. Especially fruit is lamentably scarce, even in the collections now at hand; of six species fruit is lacking or incompletely known. The ample collections brought together, mostly by forest services, in the past half century, remained unidentified and in the herbaria their number far exceeded that of named specimens.

During the preparation of this thesis I have examined *c.* 2000 collections from 29 herbaria and I have been able to check almost all literature; Knuth cited only *c.* 500 collections.

The number of species has drastically been reduced, partly because through the abundant material a more critical view could be obtained about the variability of the characters and of the species. Knuth recognized 109 species; in the present revision there are only 39, among which 3 are newly described. I hope to have provided a useful key; every specimen has been tested with it.

In the course of the study it became clear that, if the pollen had sufficient distinctive characters, a palynological investigation might be helpful. I am very much indebted indeed to Mr. J. Muller, who prepared and described the pollen slides, and who generously agreed to make use of his results. His work will be published in full in the near future.

It was also clear to me that the incomplete statements on the peculiar embryo and its blastogenic development needed clarification. I am very grateful for all the trouble that has been taken by Mr. G. F. C. Dennis (Honiara), Dr. Ding Hou (Leyden), Mr. J. van Niel (Seria), Dr. T. C. Whitmore (Kuala Lumpur), as well as by personnel at the Botanic Garden in Trinidad who repeatedly collected fruit and/or flowers for germination tests or histological investigation respectively. The latter was carried out by Dr. W. A. van Heel to whom I feel much obliged for kind assistance.

I am indebted to Dr. Ding Hou for the proper disposition of *B. sphaerocarpa* C. A. Gardn. which could be excluded from the genus, thereby exposing the remarkable fact that no Lecythidaceous representative is native in West Australia.

Valuable collaboration or help was obtained from Mr. F. Murray, Australian Embassy, The Hague, for putting several maps at my disposal; from Dr. P. S. Ashton, Dr. A. J. G. H. Kostermans, Dr. W. Meijer, and Dr. T. C. Whitmore for keeping a close look-out for *Barringtonia* in the field and collecting many valuable specimens; from Dr. H. Sleumer

and Dr. P. van Royen for photographs of the opening of the flowers of *B. asiatica*.

I express sincere thanks to Miss Emmy van Nieuwkoop for the careful typing of the manuscript. For the excellent species drawings thanks are due to Miss Ruth van Crevel and for the drawings of the maps and seedlings to Mr. E. Vijsma.

I feel very much obliged to the directors and curators of the many herbaria from which material was sent on loan for a much longer period than usual; the work proceeded only slowly as it could only be achieved in my spare time; I thank them kindly for their patience.

I am thankful to Professor Dr. R. Hegnauer and Dr. R. C. Bakhuizen van den Brink for their suggestions after having critically read the complete MS, for redactional remarks to Dr. P. W. Leenhouts, and for advising of the English text to Mr. R. Topliss, M.Sc.

Professor Dr. C. G. G. J. van Steenis, who enabled me to work on *Barringtonia* for so many years, I respectfully would like to thank for his assistance and supervision, and even more so for encouragement and patience shown to me as a part time botanist.

LIST OF HERBARIA FROM WHICH MATERIAL IS EXAMINED

The herbaria I visited personally are marked with an asterisk. *

A	Arnold Arboretum, Cambridge, Massachusetts, U.S.A.
B	Botanisches Museum, Berlin-Dahlem, Germany.
BKF	The Forest Herbarium, Bangkok, Thailand.
BM	British Museum (Natural History), London, United Kingdom. *
BO	Herbarium Bogoriense, Bogor, Java, Indonesia.
BRI	The Botanic Museum & Herbarium, Brisbane, Queensland, Australia.
BRUN	State Forest Office, Brunei.
BSIP	Forestry Department, Honiara, British Solomon Islands Protectorate.
C	Botanical Museum & Herbarium, Copenhagen, Denmark.
CGE	Botany School, University of Cambridge, Cambridge, United Kingdom. *
DD	Forest Research Institute & Colleges, Dehra Dun, India.
E	The Royal Botanic Garden, Edinburgh, Scotland, United Kingdom.
GH	Gray Herbarium of Harvard University, Cambridge, Massachusetts, U.S.A.
HBG	Staatsinstitut für Allgemeine Botanik und Botanischer Garten, Hamburg, Germany.
K	The Herbarium of the Royal Botanic Gardens, Kew, Richmond, United Kingdom. *
L	Het Rijksherbarium, Leyden, Netherlands. *
LAE	Division of Botany, Department of Forest, Lae, Territory of New Guinea.
P	Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie, Paris, France. *
PERTH	Western Australian Herbarium, Perth, West Australia.
S	Botaniska Avdelningen, Naturhistoriska Riksmuseet, Stockholm, Sweden.
SAN	Forest Department, Sandakan, Sabah.
SAR	Sarawak Museum, Kuching, Sarawak.
SING	The Herbarium of the Botanic Gardens, Singapore.
TAI	The herbarium, Department of Botany, National Taiwan University, Taipei, Taiwan.
U	Het Botanisch Museum & Herbarium, Utrecht, Netherlands. *
US	The National Museum, Smithonian Institution, Washington D.C., U.S.A.
W	Naturhistorisches Museum, Vienna, Austria.
WRSL	Instytut Botaniczy, Universytetu Wroclawskiego, Wroclaw, Poland.
ZT	Institut für Spezielle Botanik, Zürich, Switzerland.

FAMILY CONCEPT OF LECYTHIDACEAE AND THE POSITION OCCUPIED BY BARRINGTONIA

Taxonomic History.

Already Linnaeus 1753 classified *Barringtonia* in its proper affinity with the *Myrtaceae*, recognizing two species under *Eugenia*. In his Familles des Plantes Jussieu 1789 inserted *Barringtonia* Forst. 1776 as *Butonica* Lamk in his second section of the *Myrtales*, along

with *Stravadium*, *Gustavia*, *Couroupita*, and *Lecythis*, excluding *Foetidia* which he had in his first section alongside true *Myrtaceae*.

In 1825, in his Mémoire sur les Lécythidées (Mém. Mus. Hist. Nat. 13: 141) Poiteau established the family *Lecythidaceae* comprising the genera *Couroupita*, *Bertholletia*, *Gustavia*, *Couratari*, and *Lecythis* to which he added that possibly *Barringtonia* might also be joined in this if the structure of the stamens were better known.

This disposition was not accepted by De Candolle (1828) who divided the *Myrtaceae* into 5 tribes, one of them being *Barringtonieae* with the genera *Barringtonia*, *Stravadium*, and *Gustavia*. This was followed by Meisner (1838). Endlicher (1839) had the same taxa as subfamilies; in *Barringtonioideae* he included *Barringtonia*, *Careya*, and *Gustavia*.

In 1830, in his Systema Orbis Vegetabilium, F. C. L. Rudolphi (*op. cit.* 56) accepted the tribe *Barringtonieae* DC. as a family next to *Lecythideae* (Rich. *ex*) Poit.

Lindley, Veg. Kingd. (1846) 716, 739, accepted the *Lecythidaceae* of Poiteau, but without the genera *Barringtonia*, *Stravadium*, *Careya*, *Gustavia*, and *Foetidia* which he united in the family *Barringtoniaceae* (*op. cit.* 749, 754). He kept *Lecythidaceae*, comprising *Lecythis*, *Eschweilera*, *Bertholletia*, *Couroupita*, *Couratari*, and *Cariniana*, in the *Myrtales*, while *Barringtoniaceae*, comprising *Barringtonia*, *Careya*, *Gustavia*, *Foetidia*, *etc.* were placed in the *Grossales* between *Escalloniaceae* and *Philadelphaceae*. He thought *Barringtoniaceae* were quite different from *Lecythidaceae*, as the former have no stipules and the singular hooded plate of sterile or additional stamens is most remarkable in the latter.

Bentham & Hooker (1865) did not follow Lindley, but divided the *Myrtaceae* in 4 tribes. One of them, the *Lecythideae*, was subdivided into 3 subtribes, *viz.* (i) *Barringtonieae* with the genera *Barringtonia*, *Careya*, *Planchonia*, *Gustavia*, and *Grias*, (ii) *Eulecythideae* with only the American genera, and (iii) *Napoleoneae* with *Napoleona* and *Asteranthos*.

Miers (1875) followed Lindley in having two families: *Barringtoniaceae* have flowers with an epigynous disk, on the outer margin of which the staminal tube is inserted with stamens in many dense whorls; in *Lecythidaceae* the disk is perigynous, bearing the filaments of the stamens separately. He included in the *Barringtoniaceae* the genera *Barringtonia*, *Butonica*, *Stravadium*, *Planchonia*, *Careya*, and *Petersia*. New genera described by Miers were *Agasta*, *Doxomma*, *Megadendron*, and *Chydenanthus*. Miers supported his division of the families, and the genera belonging to them, also with plant geographical arguments by saying that *Barringtoniaceae* are all Old World species and *Lecythidaceae* all New World species. He did not believe in any relationship with the *Myrtaceae* but saw a strong relationship with *Rhizophoraceae* because of fruit characters of the *Barringtoniaceae*.

Niedenzu (1892) united the 2 families again in *Lecythidaceae* and also accepted their affinity to *Rhizophoraceae*. He divided the family into 4 subfamilies: *Foetidioideae* (*Foetidia*), *Planchonioideae* (*Barringtonia*, *Planchonia*, *Petersia*, *Careya*, and *Chydenanthus*), *Napoleonoideae* (*Napoleona*, *Asteranthos*), and *Lecythidoideae* (the rest). The division into subfamilies was mainly based on the structure of the stamens and fruit.

Hutchinson, Fam. Fl. Pl. 2 (1926) 182 and also 1 (1959) 303, followed Niedenzu, keeping *Barringtonia* within the *Lecythidaceae*.

In his morphological study of *Lecythidaceae*, J. MacLean Thompson (1927) did not make it entirely clear whether he accepted this as a family, naming it tribe, but adding 'a tribe of Myrtaceous affinity'. This enigmatic addition anyway indicates that he did want to keep them as one whole. By comparative study he framed four tribes (called by him 'series'), but again certain genera were shifted from one tribe to another if his tribes are compared with those of his predecessors. *Barringtonieae* comprise with him

both Old and New World genera, *viz. Barringtonia, Careya, Gustavia, Planchonia,* and *Grias*; *Napoleoneae*: *Asteranthos, Crateranthus, Napoleona,* all African; *Couratarieae*: *Couratari, Lecythopsis,* all American; *Bertholletieae*: *Couroupita, Lecythis,* and *Bertholletia,* all American.

Knuth (1939a, p. 12), however, followed Lindley and Miers by putting all the Old World genera in the *Barringtoniaceae* and all the New World genera in the *Lecythidaceae.* The neotropical genus *Asteranthos* he accommodated in a separate third family. He subdivided *Barringtoniaceae* into 5 tribes. To the first one, *Barringtonieae,* belong the genera *Barringtonia* (subdivided into 4 sections, see p. 178), *Careya, Planchonia,* and *Chydenanthus.*

Pichon (1945) distinguished within *Lecythidaceae* three subfamilies: (i) *Planchonioideae,* with three tribes, all Old World genera; (ii) *Lecythidoideae,* with five tribes, all New World genera; and (iii) *Napoleonoideae,* with three tribes, two genera in Africa, one in America. He disagreed with Knuth's more or less geographical argument for grouping the genera into taxa of higher rank which led Knuth to place *Napoleona* close to *Barringtonia.* These genera are, according to Pichon, morphologically and anatomically very different. According to him *Napoleona* is related to *Asteranthos,* though the first is African, the latter American.

Melchior (1964) in the 12th edition of Engler's Syllabus, distinguished one family *Lecythidaceae* with 3 subfamilies agreeing with Bentham & Hooker's division; the first subfamily, *Planchonioideae,* has 4 tribes with 6 genera, which are then all Old World because *Gustavia* is placed in *Lecythideae.*

Discussion.

Following Linnaeus *Lecythidaceae* have been associated with *Myrtaceae* up to and including Bentham & Hooker 1865, but always as two infrafamilial taxa.

Poiteau and Rudolphi, and later Lindley recognized them on family rank on the same level as the *Myrtaceae.* Since Miers 1875 this was generally accepted, but it depends of course on the scope one gives to the family *Myrtaceae.*

In the present century it is universally agreed to keep *Lecythidaceae* separate from *Myrtaceae,* as the latter have no stipules [1]) but possess oil glands.

From the historical review it appears that there is no unanimity of opinion about the subdivision, but it is clear that Knuth's distinction of more than one family seems untenable and is followed by no other authoritive treatment.

From De Candolle's subdivision onwards the idea stuck with all important authors that there are 2 taxa, whether tribes, subfamilies, or families concerned, with Bentham & Hooker, and later Pichon, even 3 (now revived in Engler's Syllabus, ed. 12, by Melchior) and with Niedenzu and Thompson 4, the supernumerary taxa often being segregates of (American) *Lecythidoideae.*

However, these taxa were not very well defined, and some genera, notably the Asiatic *Careya,* the Madagascan *Foetidia,* and the American *Gustavia,* changed places with different authors. This shows the uncertainty of the differential characters.

The argument of Miers, followed by Knuth, about the insertion of the stamens, in connate whorls outside the disk (*Barringtoniaceae*) or on the disk margin (*Lecythidaceae*) I cannot follow; the situation in *Gustavia* is not at all different from that in *Barringtonia, Foetidia, etc.* Whether the floral parts are epigynous or perigynous is a mere matter of

[1]) Lindley's argument that *Barringtoniaceae* had no stipules and *Lecythidaceae* had, has appeared to be erroneous (see p. 162).

small size differences of the receptacle. The family shows an interesting display of such characters which are good for generic distinction, but not for classification at higher rank.

A secondary argument of which several authors were feebly aware, was raised by Knuth, who combined in *Barringtoniaceae* all Old World and in *Lecythidaceae* all New World genera although the American *Gustavia* shows distinct affinity to the Old World *Barringtonia*-allied genera. Clearly taxonomic affinities are transoceanic in this family. Thompson has probably provided the best picture of mutual affinity on a morphological basis. But his 4 series (tribes) are vaguely defined in a sort of phylogenetical order based on morphological advancement; they cannot be accepted as a truly taxonomical division. Provisionally it seems to me that a satisfactory taxonomical subdivision of the family is still wanting, and may not even be possible.

Conclusion.

Whatever subdivision to the *Lecythidaceae* should be given, there is in my opinion no argument to recognize more than one family, as the members are too intricately, and partly reticulately, knit together and furthermore have too much intrinsic structural characters in common.

MORPHOLOGICAL CHARACTERS

1. Habit. Trees or shrubs, easily recognizable in the field because of the bare branchlets with the leaves tufted at the end of the twigs and the predominantly sympodial branching. Rarely, like in *B. macrocarpa*, the twigs of herbarium size carry more than one tuft of leaves. Three species have a cycadoid habit bound up with cauliflory: *B. calyptrocalyx*, *B. papeh*, and *B. papuana*.

Buttresses are reported from *B. asiatica*, *B. lanceolata*, *B. lauterbachii*, and *B. racemosa* (§ *Barringtonia*) and *B. reticulata* and *B. scortechinii* (§ *Stravadium*). *B. racemosa* can also develop looping pneumatophores.

2. Leaves. For specific delimitation the leaf structure is, with a few exceptions, of secondary importance (size, leaf-index, texture, number of nerves, margin). Some species develop rather coriaceous leaves with an entire margin (*B. asiatica*, *B. longisepala*, *B. reticulata*, *B. sarcostachys*), but generally the margin is distinctly serrate with small crenules on the apices of the serration (*B. acutangula*, *B. macrocarpa*, *B. macrostachya*, *B. racemosa*). The greatest width always lies above the middle, except in *B. papuana* where the leaf is distinctly lanceolate.

3. Hairs. Only in some specimens of *B. acutangula* and its ssp. *spicata*, and in all specimens of *B. calyptrocalyx* var. *mollis* and *B. fusiformis* (fig. 17b) the blade is hairy underneath. The hairs are very short, white, yellowish, or brown and are usually restricted to the midrib and nerves, sometimes also found on the veins.

4. Petiole. Always thickened at the insertion, usually very variable in length within a species, but some species have always distinctly petioled leaves, in others they are almost sessile (fig. 5). In a few species the situation is arbitrary, the decurrent, narrow-cuneate base of the blade being difficult to demarcate against the petiole (fig. 12).

5. Stipules. All species have distinct stipules, only visible at the base of very young leaves, the largest being only *c.* 1 mm. They are mostly conical or triangular, in a few cases like little trichomes. I also found stipules in some New Guinea specimens at the

base of the sessile bracts and bracteoles. The seedlings of *B. asiatica* and *B. procera* I raised in the hothouse of the Botanical Gardens at Leyden had cataphylls with red or white triangular stipules, see fig. 1. See also F. Weberling (1957).

6. Cataphylls. Seedlings at first develop several cataphylls (fig. 1); later the normal leaves appear flushwise and between each flush a series of cataphylls develops, their scars remaining visible (fig. 21). Cataphylls are also found as a dense tuft at the base of the inflorescence in species like *B. integrifolia*, *B. gigantostachya*, *B. procera*, *B. pterita*, and *B. sarcostachys* in § *Barringtonia*, or *B. augusta*, *B. curranii*, *B. fusiformis*, *B. macrocarpa*, and *B. reticulata* in § *Stravadium* (fig. 11, 22).

7. Inflorescences. Racemes or spikes are pendulous, except in *B. asiatica* which has an erect, nearly always terminal inflorescence with very large, showy flowers. *B. lanceolata* has an extremely reduced rachis neither pendulous nor erect, very densely flowered as if the flowers are clustered on the bare branchlet (fig. 21). All other species have a distinctly pendulous rachis, either terminal at the end of a leafy twig (fig. 7) or lateral (ramiflorous) (fig. 5b), or both. Only *B. calyptrocalyx*, *B. papeh*, and *B. papuana* have cauliflorous rachi (§ *Barringtonia* only). The rachis can be glabrous or pulverulently pubescent. Position, length, and diameter of the rachis, sometimes its pubescence, provide valuable characters for distinguishing the species.

8. Bracts and bracteoles. These do not provide useful characters for specific delimitation. It is noteworthy that species of the § *Barringtonia* in Melanesia show larger and less caducous bracts and bracteoles than usual. In one collection from Borneo very large bracts were found in *37. B. curranii*.

9. Flowers. In § *Barringtonia* 8 species have sessile flowers (fig. 12), 3 have sessile as well as pedicelled ones, and 12 have pedicelled flowers only (fig. 5—7). Articulated pedicels occur occasionally in *B. calyptrocalyx* and *B. apiculata*. In § *Stravadium* 9 species have sessile flowers (fig. 15, 19, 21, 22), 2 have sessile as well as pedicelled ones, and 5 have pedicelled flowers only (fig. 17). Articulated flowers have been observed in *B. acutangula* (only once), in *B. macrocarpa* (a few times), and in all flowers of *B. niedenzuana*. *B. calyptrocalyx*, *B. pterita*, and *B. racemosa* (§ *Barringtonia*) have sessile as well as pedicelled flowers; some species have sometimes inflorescences with both sessile and pedicelled flowers on one rachis, and sometimes a specimen has either sessile or pedicelled flowers only. In *B. acutangula* (§ *Stravadium*) the situation is different in that sessile flowers occur regionally, inducing me to distinguish a ssp. *spicata*. In *B. niedenzuana* flowers in young stages can be sessile.

In several species the size of the flower has a distinct taxonomical value; there are about three sizes prevailing.

10. Calyx. The structure of the calyx I have accepted to be of high importance and this is easiest to observe in mature buds. In § *Barringtonia* it is completely connate (fig. 5c, 11b). In some species, *e.g. B. gigantostachya*, *B. integrifolia*, *B. novae-hiberniae* (fig. 11g), *B. longisepala*, and *B. samoensis* (fig. 11f) the calyx has an apical pore. In *B. longisepala* this is not always very distinct, and in *B. novae-hiberniae* and *B. gigantostachya* the pore is often, already in a young stage, rather large. The margin of the apical pore is thin and may be ± fimbriate similar to the edge of the free sepals in § *Stravadium* (fig. 11g).

The completely closed calyx of the other species has two different ways of dehiscence: either circumscissile, as in *B. apiculata*, *B. calyptrata* (fig. 12c), *B. calyptrocalyx*, *B. lauterbachii*, and *B. papeh*, or by splitting into 2—5 irregular lobes (fig. 5b) which never have a thin, fimbriate edge. Some species in which the calyx is circumsciss can have a few calyces on the same rachis dividing into lobes.

In § *Stravadium* the calyx is lobed from the beginning and its lobes have a scarious and often distinctly fimbriate margin (fig. 17c).

In § *Barringtonia* about 10 species have a mucronate calyx in bud. This is not found in § *Stravadium*.

11. Petals. They are membranous; their parallel venation is finely anastomosing (fig. 12d); at their wide base they are just adnate with the staminal tube and fall off together.

According to Thompson (1927) *op. cit.* 34, 36, it is a true corolla, not from staminodial origin as no intermediate forms have been found. Except for size the petals do not provide good taxonomic characters; their colour is almost nowhere constant according to the field data on the labels, varying from white to pink and red in various shades.

12. Stamens. All species have whorls of stamens which are connate at the base in a short tube, the number of whorls varying from 3 to 8, the number in some cases being important to distinguish between different species. In *B. filirachis* and *B. pterita* (§ *Barringtonia*) and in *B. acutangula* (§ *Stravadium*) only 3 whorls develop. In *B. samoensis* and *B. ashtonii* (§ *Barringtonia*) and *B. havilandii*, *B. macrocarpa*, and *B. niedenzuana* (§ *Stravadium*) 3—4 whorls develop (in *B. niedenzuana* up to 6 whorls are found). In *B. apiculata*, *B. novae-hiberniae*, *B. papeh*, and *B. seaturae* (§ *Barringtonia*) the number of whorls varies from 5 to 8; in *B. pauciflora* (§ *Stravadium*) from 4—8. All other species have 4—6 whorls and are less variable.

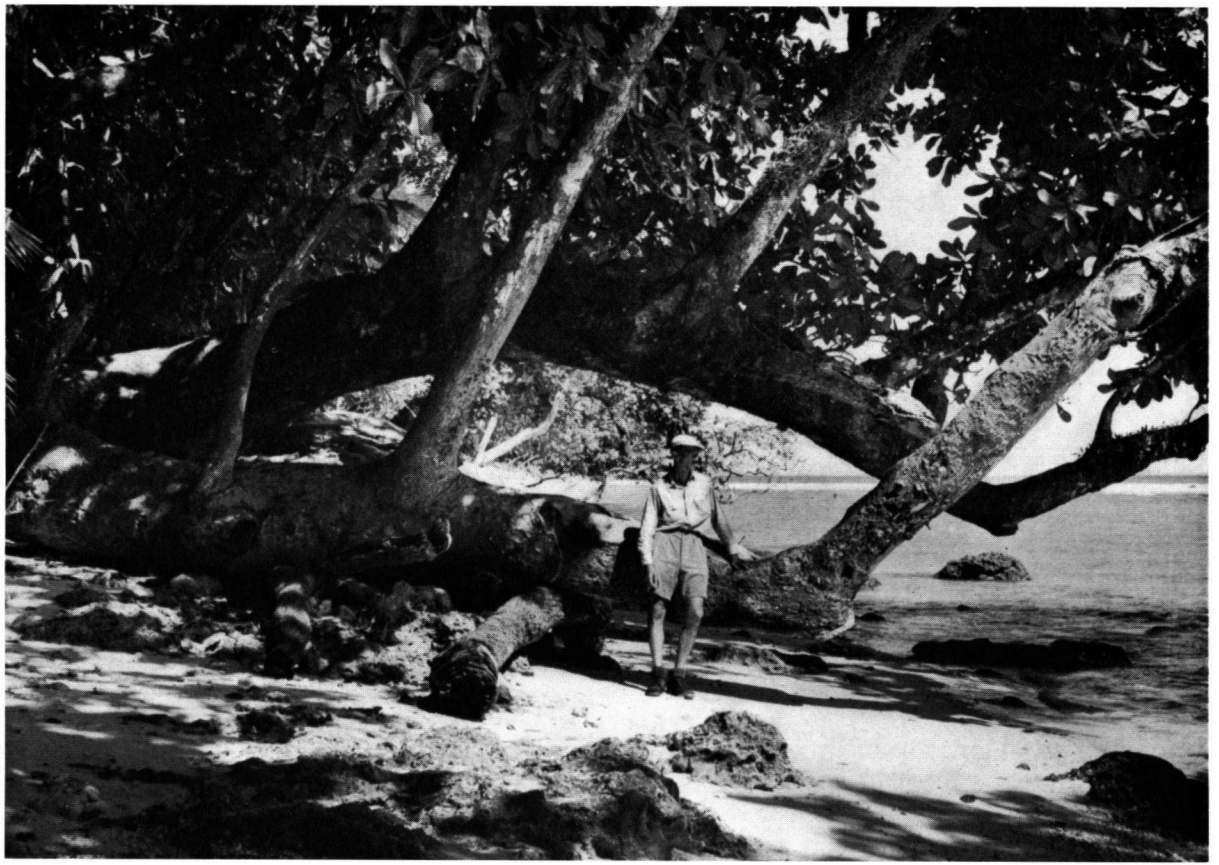
All species have a staminodial inner whorl and in a few (*B. apiculata*, *B. calyptrocalyx*, *B. neo-caledonica*, and *B. papeh*) a second or even third staminodial whorl occurs. This may vary on one rachis, and occurs only in species with a high number of staminal whorls. According to Thompson (1927) this sterility of the inner whorl is due to retardation and suppression in ontogeny. Staminodia are always much shorter than fertile stamens. Thompson also mentioned sterile outer whorls, but in my material I have not observed this.

Another important character for specific delimitation is the height of the connation of the inner staminodial whorl as compared with the other whorls. In *B. apiculata*, *B. calyptrata* (fig. 12e), *B. calyptrocalyx*, *B. edulis*, *B. lauterbachii*, *B. novae-hiberniae*, *B. papeh*, *B. papuana*, and *B. petiolata* in § *Barringtonia* and *B. niedenzuana* in § *Stravadium* the inner whorl is highly connate, the other fertile whorls are connate with this high tube to various degree from high to low going from inside outwards. This high connation may be caused by 'gigantism of cells' as Thompson (1927) proved for the development of the hood or ligule in other Lecythidaceous genera. Only in one collection of *B. neo-caledonica* I found a higher connation of the outside staminal whorl.

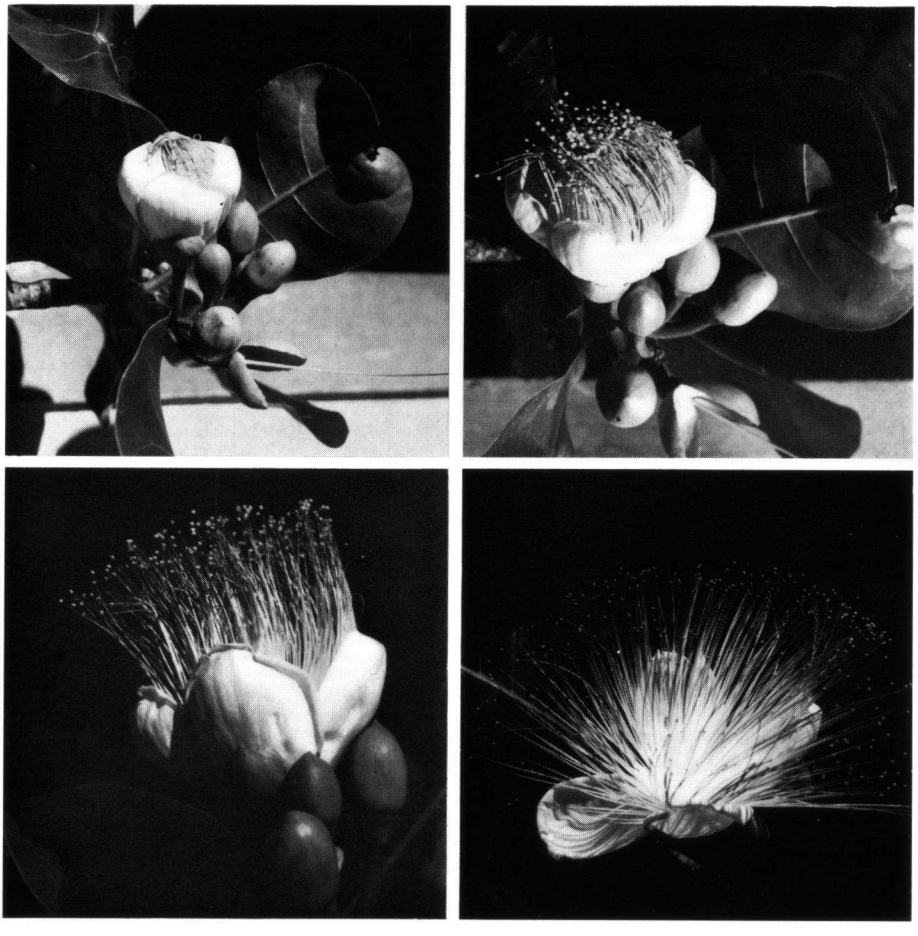
Davis (1966, p. 9) stated that the anther wall formation of *Lecythidaceae* belongs to the basic type, of archaic nature, found in several families of old stock.

13. Disk. A distinct ring around the style, separate from the staminal tube. According to Thompson (1927) the disk develops independently and later than the stamens during ontogeny, hence its development may be retarded. In several species the disk is minute, in others it may be a *c.* 2 mm high tube. For specific delimitation it is of no value.

14. Ovary. The number of cells is in many species rather variable due to late disintegration of septa or by inequalities of growth. See Thompson (1927) *op. cit.* 7. On one and the same rachis 2-, 3-, and 4-celled ovaries may be found. In many species the septa are not complete at the top. The variability in the number of cells is mainly found in the 4-celled species. A few species are dominantly 2-celled, *e.g. B. acutangula* and *B. filirachis*. Predominantly 3-celled are: *B. ashtonii*, *B. revoluta*, *B. samoensis* (§ *Barringtonia*), and *B. havilandii* and *B. macrocarpa* (§ *Stravadium*); all others are mainly 4-celled. Several species have a glabrous ovary while others have a pubescent one; this



Photogr. 1. A characteristic habit of *Barringtonia asiatica* (L.) Kurz on abrasive beach, with big branches sagging seaward. Sunda Straits, Legundi, Aug. 1952 (F. Huysmans).



Photogr. 2. Four stages of opening flower of *Barringtonia asiatica* (L.) Kurz, the closed calyx disrupting into two pseudo-sepals. New Guinea (P. van Royen & H. Sleumer).

Photogr. 3 (left). Fruiting branch of *Barringtonia sarcostachys* (Bl.) Miq. Sabah, Sepilok For. Res., *SAN 22575* (W. Meijer, Dec. 1962).

Photogr. 4 (right). *Barringtonia scortechinii* King. Sabah, Sepilok For. Res., *SAN 21703*. Note scarcity of fruit on multiflowered rachis (W. Meijer, Aug. 1966).

Photogr. 5. *Barringtonia acutangula* (L.) Gaertn. ssp. *spicata* (Bl.) Payens. In muddy, tidal creek with low tide, east coast of Pahang, Malaya. Note characteristic tufted habit with stems conically thickened; undergrowth of the sedge *Fimbristylis pauciflora* R. Br. round the stem bases and numerous epiphytes (E. J. H. Corner).

may vary within one species. Eight wing-like appendages, as in *B. conoidea* (fig. 5c), winged corners on a tetragonous ovary as in *B. integrifolia* and *B. pterita* (§ *Barringtonia*), and *B. augusta* and *B. scortechinii* (§ *Stravadium*) (fig. 15b), or four grooves on the corners, as in *B. pendula*, are good specific characters.

15. Ovules. The number of ovules per cell as well as the total number per ovary varies considerably. As an average there are 4 per cell, up to 12—16 in all; *B. hallierii* and *B. pauciflora* can have a total number of ovules far over 30, up to 60. They are inserted either apically or slightly lower down.

16. Style. Mostly as long as, or slightly longer than the filaments, *B. longifolia* excepted in which the style is half their length.

17. Fruits. For many species the fruit is characteristic. In § *Barringtonia* the following have a big fruit (up to 15 cm long): *B. gigantostachya*, *B. integrifolia*, *B. longisepala*, *B. sarcostachys*. The fruit of *B. integrifolia* has wings up to 2½ cm wide.

Other remarkable fruits are those of *B. asiatica*: large ovate, with spongy pericarp *c.* 2—2½ cm ∅; *B. conoidea*: conoid with 8 wings at the base (fig. 5f); *B. pterita* and *B. filirachis* with 4 distinct wings *c.* 2—7 mm wide; *B. petiolata*: winged in upper half *c.* 3—4 mm wide; *B. papeh* and *B. racemosa*: more or less winged when young; rugose are the fruits of *B. papeh* and *B. samoensis*; very distinctly pedicelled *B. lauterbachii*, *B. fusiformis* and *B. revoluta* (fig. 7c, 17d); 7—8-ribbed are *B. novae-hiberniae* and *B. procera*, the latter with hooks on alternate ribs (fig. 1d).

In § *Stravadium* big fruits are found in *B. curranii*, *B. lanceolata*, *B. pendula*, and *B. scortechinii*. The pericarp of *B. lanceolata* has very characteristic thick fibres. Distinctly winged are the fruit of *B. augusta*: *c.* 3—5 mm wide, and *B. acutangula* ssp. *spicata*: either 4-winged or 4—8-ribbed; winged when young are *B. acutangula*, *B. macrostachya*, and *B. scortechinii* (fig. 15d); sharply 4-angled is the fruit in *B. reticulata*, outside shiny (fig. 22c); distinctly pedicelled in *B. fusiformis* (fig. 17d), and irregularly winged with 4 hooks near the base in *B. niedenzuana*.

The fruit is not or incompletely known in *B. papuana* and *B. seaturae* (§ *Barringtonia*), and *B. hallieri*, *B. havilandii*, *B. longifolia*, and *B. macrocarpa* (§ *Stravadium*).

18. Seed and embryo. In each fruit only one seed develops. On the outer side of its apex the aborted ovules can be observed. The testa is always brown. The seed is mostly spindle-shaped, rarely trigonous, in the herbarium often fissured (fig. 21g). On the solid embryo tiny scales are arranged in a spiral on the apical part (fig. 2B). In a section of the embryo two layers can be distinguished (fig. 2B). There is no trace of either 'true' cotyledons or a plumule. Thomson (1858), but more so Treub (1884), have given a detailed account on the embryo structure of *B. racemosa*, *Careya arborea* Roxb., and *Chydenanthus excelsus* (Bl.) Miers. Their publications and others are discussed below. Thomson (1858) summarized earlier interpretations as follows:

(i) An undivided exalbuminous embryo (Blume, Miquel, Endlicher, and Meisner).
(ii) An embryo in the axis of copious albumen (Gaertner, Hamilton, Roxburgh, Wight, and Lindley).
(iii) An exalbuminous embryo in two layers (Wight & Arnott, doubtfully adopted by Griffith).

Thomson's own opinion is as follows:

'1. The embryo is exalbuminous (in *Barringtonia* as well as in *Careya*).
2. The cotyledons are rudimentary.
3. The embryo is an axial organ, consisting of pith, a woody layer, and a bark.
4. The plumule, at best almost without scales, is developed into a stem, while the opposite extremity elongates into a root.'

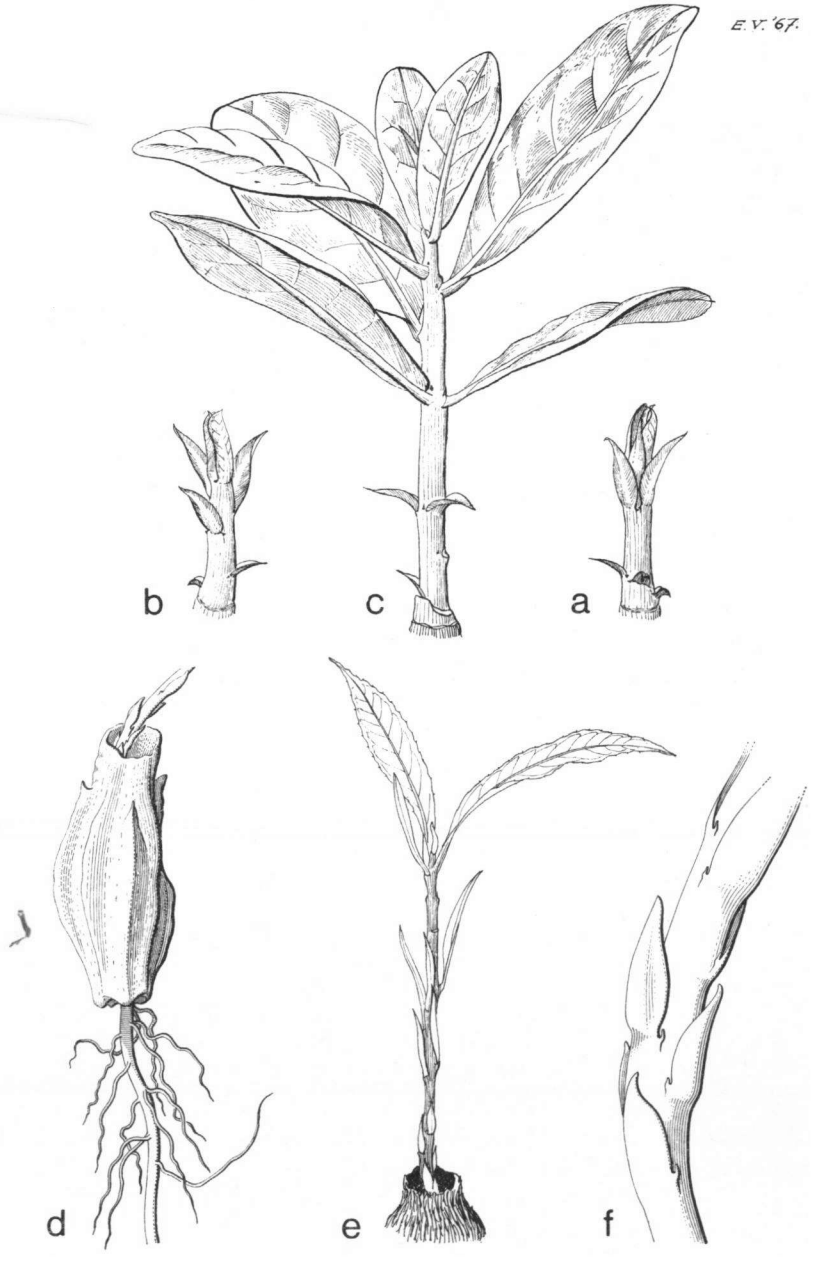


Fig. 1. Germination stages. — *Barringtonia asiatica* (L.) Kurz. a—c. Stages of shoot development, the ring at base is the disrupted testa (a—b. × ¼, c. × ⅓). — *B. procera* (Miers) Knuth. d. Seed germinating in the fruit, the shoot pushing through its base, the roots appearing between the calyx lobes, e. young seedling with cataphylls, followed by small leaves, f. shoot of fig. d. enlarged, showing the stipulate cataphylls (d. × ½, e. × ½, f. × 2½).

According to him in *Careya* the primary apex often dies off on germination, and the stem is continued by a bud springing from the axil of one of the minute scales. 'In one instance this took place so close to the embryo as to be apparently in the axil of one of the first pair of scales, or rudimentary cotyledons'. In his fig. 3 he drew the 'woody layer' as elongated into the stele of the root and stem of the very young seedling.

Treub (1884) investigated the embryo of *Chydenanthus excelsus* (Bl.) Miers (as *B. vriesii*). The situation here is identical with that of *Barringtonia* and *Careya*. He observed also the small scales on the outside of the embryo near the apex and found no trace of certain scales standing opposite which could be interpreted as cotyledons. All scales are spirally placed. Treub also gave an accurate account of his microscopic slides made of the germinating seed. In section he has also seen the two layers, separated by a different coloured layer. The latter layer he described as the part of the embryo in which vascular tissue is formed; at the apex he found, however, no vascular contact of this layer with the foliar scales. At the base roots develop from this layer, growing through the 'cortex' of the embryo.

Goebel (1901) did not add any new facts to the observations of Thomson and Treub, but added a description of the embryo of *Bertholletia*: see below.

Troup (1921) studied *B. acutangula*. He supported the exalbuminous nature of the seed and described the embryo as thick and fleshy with rudimentary scale-like cotyledons. 'The fleshy portion resembles a tuber, and if cut across shows a ring of vascular tissue like that of a carrot.'

The statement of Goebel that the whole embryo is a hypocotyl has been proved to be erroneous by Rauh (1937) who said that a hypocotyl has never leaves or scales, not even in the case of ectogene budding.

For my investigation I have used at first fresh seeds of *B. asiatica*, *B. procera*, and *B. racemosa*. They germinated very slowly and erratically in the hothouse. All seeds of *B. racemosa* decayed. Later I received well-preserved pickled material.

It is noteworthy that the many dozens of pickled flowers, sent for ontogenetic morphology, contained no embryo save one or two, corresponding with the extremely scanty fruit setting (see p. 172).

Fortunately some stages of the ontogenetic development could be studied in microscopical slides of *B. asiatica* and *B. racemosa*.

This is as follows: The young seed is filled with nuclear endosperm. Fig. 2A shows the young embryo near the micropyle. The embryo is formed from the basal end of a pro-embryo, gradually absorbing the nuclear endosperm and ultimately occupying the whole seed cavity.

The mature embryo is solid, surrounded by the seedcoat, which is provided with many strong vascular bundles. It is not differentiated in a hypocotyl, cotyledons, and plumule. In section it shows only a cortical layer and a central core, separated by a small-celled sheeth of vascular tissue (fig. 2B). Apically on the outside there are a number of tiny scales, derived from a meristematic apical region, which are more or less spirally arranged (fig. 2B). From these scales vascular traces run inwards, joining the vascular cylinder with normal endarch vascular bundles (fig. 2Bb). This is contrary to the observation of Treub. In the axils of these scales axillary meristems have been observed. This is in agreement with the observation of Thomson that a bud may develop here. In *B. racemosa* the number and the development of the scales is far less than in *B. asiatica*. Further growth takes place lengthwise by means of the apical meristem, piercing the testa (fig. 1a—c), then the (morphological) base of the pericarp, developing cataphylls obviously continuing the scale spiral (fig. 1d). At the base of the embryo adventitious

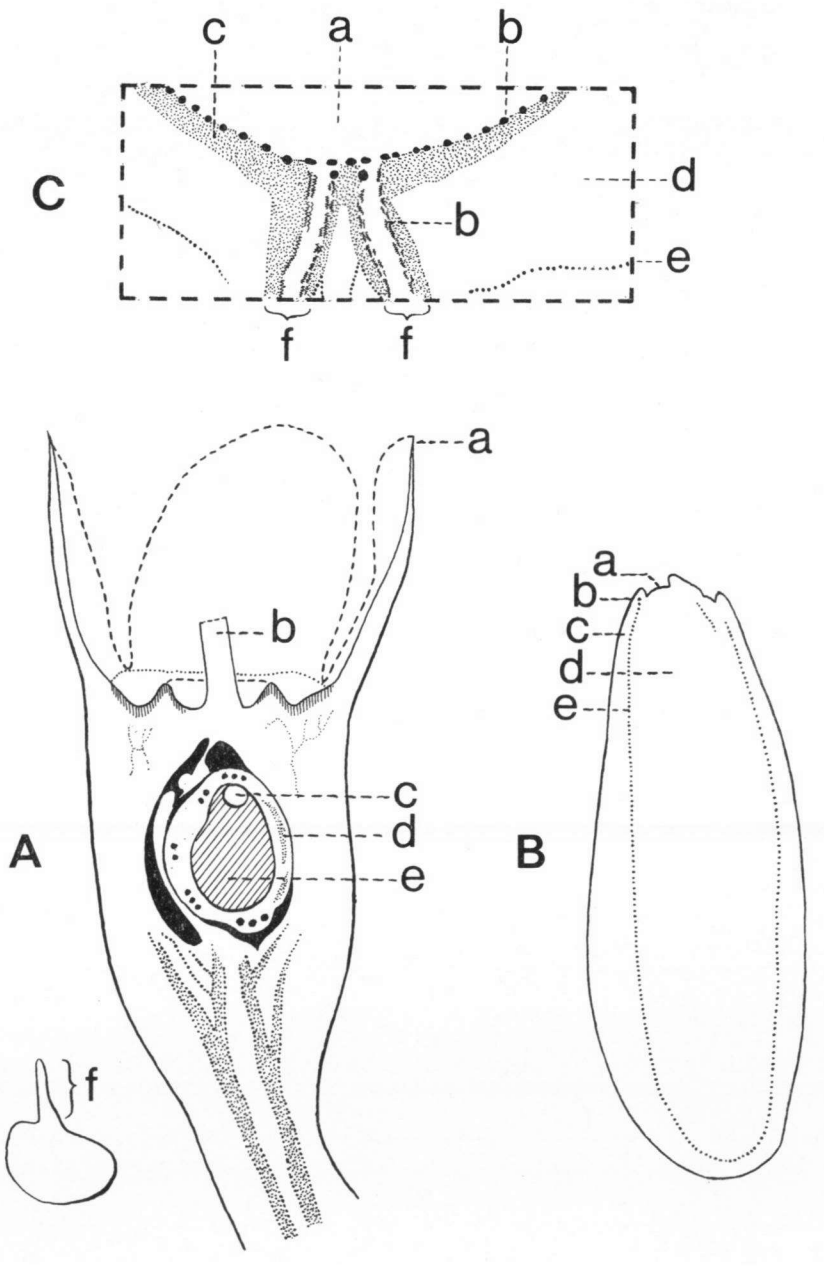


Fig. 2. A: Section of very young fruit of *Barringtonia racemosa* (L.) Spreng. a. Sepal, b. style, c. embryo, d. young testa, e. nuclear endosperm, f. pro-embryo. — B: Section of embryo of *B. asiatica* (L.) Kurz. a. Apex (apical meristem), b. scale, c. cortex, d. core, e. vascular traces. — C: Section of base of developing embryo. a. Core, b. xylem, c. vascular tissue, d. cortex, e. periderm ?, f. adventitious roots.

roots develop, piercing the testa, then the (morphological) apex of the pericarp, protruding between the remains of the calyx (fig. 1d). These adventitious roots develop endogenously from the vascular cylinder (fig. 2Cf). This cylinder is and remains completely closed at the root pole, contrary to the situation at the shoot pole (fig. 2B—C).

The situation is thus very different from that in *Rhizophoraceae*. I do not agree with Miers (1875: 52—54) who suggested a close relationship between *Barringtoniaceae* and *Rhizophoraceae*.

The solid, undifferentiated (*'ungegliedert'*) embryo is of course in Angiosperms extremely rare. It is certainly not common to all genera of *Lecythidaceae*. From the Trinidad Botanical Gardens I received fresh seeds of *Couroupita guianensis* Aubl. and *Cariniana exigua* Miers which upon germination in the hothouse showed two distinctly opposite, large cotyledons, lobed in the latter. Poiteau (1825) gave some meticulous attention and beautiful illustrations for several genera. In *Gustavia* he found 2(—3?) flat cotyledons; in *Couratari* and *Couroupita* he found 2 plicate cotyledons, the embryo in the first being, besides, double-folded. For *Lecythis* and *Bertholletia* he mentioned an undivided embryo without cotyledons. This latter observation is erroneous. Goebel (1901) correctly described the embryo of *Bertholletia* as a big solid structure, having, however, 2 minute cotyledons at the tip, which I could check in fresh material. The peculiar thing is that the latter are not transversely attached as would be expected from true cotyledons. It may be that they are the two uppermost scales of a potential spiral similar to the situation in *Barringtonia*.

According to Knuth (1939) the embryo in *Grias* is *'ungegliedert'*. For *Combretodendron*, Pichon (1945) recorded two cotyledons.

Knuth (1939) and Kartawinata (1965) are unanimous about the embryo of *Planchonia*. According to the latter it 'consists of a terete, spirally coiled radicle with foliaceous, plicate cotyledons'. Knuth used the type of embryo to differentiate *Planchonia* from *Careya* as the latter has only an *'embryo indivisus'*, obviously like in *Barringtonia*.

Summarizing: The structure of the embryo in *Lecythidaceae* seems to be extremely varied and is worthy of a thorough morphological investigation.

I find it remarkable that Davis (1966) in her handbook on the embryology of Angiosperms does not comment on the astonishing variety in embryo types of the *Lecythidaceae*. If the above mentioned data are correctly interpreted, embryo structure must be an important taxonomical feature, at least for generic rank, and, besides, for affinity. Tentatively we may conclude that presence or absence of cotyledons in *Lecythidaceae* does not coincide with distribution in the New and Old Worlds respectively.

POLLEN TYPES IN THE GENUS BARRINGTONIA

A pollen morphological investigation was carried out by Mr. J. Muller (in litt., June 1967) which resulted in the distinction of a number of pollen types.

It should be stressed that Mr. Muller received from me pollen samples which were unnamed, in order to guarantee an objective approach.

He has found that the pollen of *Barringtonia* falls apart into 2 main types, each of which comprises a number of subordinate types. The latter are generally well separated but between some of them no sharp boundaries can be drawn.

It is interesting to note that the pollen is diversified and is not of one type on the generic level. There is a lack of correlation between taxonomy and palynology in the main division and in a number of specific cases. These observations led me to distinguish

between *B. procera* and *B. edulis*, which I had tentatively merged but which could be separated on closer examination. There is unanimity of opinion between taxonomy and palynology about the specific distinction for the rest of the species with the exception of some pollen samples of *B. apiculata* (B3) and of *B. lauterbachii* (B5) which belong to different pollen types. In this case closer examination did not lead to changing taxonomic identification.

Furthermore, in *B. apiculata* sterile anthers have been found in a few specimens.

A. Calyptrocalyx Main Type: A groove surrounding the intercolpate area is absent.

1. *Papeh type.* The intercolpate area is foveolate-perforate. A unique pollen type, only found in *22. B. papeh.*
2. *Calyptrata type.* Outer surface smooth; the intercolpate area has a more or less developed intra-areolate structure. *21. B. calyptrata, 38. B. neo-caledonica,* and *39. B. longifolia* are rather similar, but *23. B. procera* has a somewhat different wall structure.

B. Asiatica Main Type: A continuous or interrupted groove surrounds the intercolpate area.

1. *Asiatica type.* Characterized by a thick massive and structureless intercolpate wall area. *1. B. asiatica, 2. B. conoidea,* and *3. B. longisepala* have a similar pollen type, while *25. B. scortechinii* has a lobate edge of the intercolpate area.
2. *Revoluta type.* The intercolpate area has a fine and rather widely spaced areolate structure. *6. B. revoluta, 7. B. samoensis, 28. B. fusiformis, 29. B. hallieri, 30. B. havilandii, 31. B. pauciflora, 32. B. macrostachya, 33. B. pendula,* and *34. B. lanceolata* form one large group of very similar pollen. *8. B. seaturae* and *27. B. macrocarpa* are both slightly different, and *35. B. reticulata* is transitional to the next pollen type.
3. *Calyptrocalyx type.* The intercolpate area has a rather coarse, but not dense areolate structure. *16. B. calyptrocalyx, 19. B. sarcostachys,* and *20. B. ashtonii* are very similar. *36. B. augusta* is slightly different. *17. B. apiculata* has some similarity to *16. B. calyptrocalyx* but has rows of verrucae on the colpi membranes.
4. *Petiolata type.* The intercolpate area has a dense, angular, and coarse areolate structure. *9. B. petiolata, 11. B. gigantostachya,* and *37. B. curranii* are very similar and still show some resemblance to the calyptrocalyx pollen type. *10. B. novae-hiberniae, 12. B. integrifolia, 13. B. edulis, 14. B. papuana,* and *15. B. pterita* are all more or less different from each other and from the other types of this main type.
5. *Niedenzuana type.* Characterized by a rather dense structure of convoluted twisted, elongated areolae and a strongly convoluted edge of the intercolpate area. Both *26. B. niedenzuana* and *18. B. lauterbachii* are rather similar to each other.
6. *Racemosa type.* Rather well distinct by a reticulate border around the intercolpate area. *4. B. racemosa, 5. B. filirachis,* and *24. B. acutangula* are similar and show only minor differences.

Discussion. To start with the conclusion: my sections *Barringtonia* and *Stravadium* do not in the least coincide with pollen main types A and B. This follows from the following summary: Of pollen type A1 the single species belongs to § *Barringtonia*; of A2 2 species belong to § *Barringtonia* and 2 to § *Stravadium*; of B1 the proportion is 3: 1, of B2 3: 9, of B3 4: 1, of B4 7: 1, of B5 1: 1, of B6 2: 1.

On the other hand my taxonomic groups (see pp. 182 and 225 respectively) show in many cases a distinct agreement between palynological and taxonomic affinity.

The detailed account of the comparisons is as follows:

A1—A2. Papeh and Calyptrata types. B. papeh is as to pollen a unique species, but

together with *B. calyptrata* and *B. procera* from the A2 Calyptrata type it belongs to my calyptrata group of § *Barringtonia*. The two endemic species from New Caledonia belonging to his A2 Calyptrata type form a separate group in my § *Stravadium*.

B1. Asiatica type. B. scortechinii stands palynologically slightly apart from *B. asiatica*, *B. conoidea*, and *B. longisepala*. The latter three species are a separate group in my § *Barringtonia*, whilst *B. scortechinii* belongs in § *Stravadium* along with *B. acutangula* from the Racemosa type and *B. niedenzuana* from the Niedenzuana type.

B2. Revoluta type. B. revoluta, B. samoensis, and *B. seaturae* from § *Barringtonia* belong to the Revoluta type (agreeing with my revoluta group) along with a large number of species from § *Stravadium*. In this section they form taxonomically two related groups (macrocarpa and macrostachya respectively).

B3. Calyptrocalyx type. B. augusta from the Calyptrocalyx type and *B. curranii* from the palynologically related Petiolata type belong morphologically to one group in § *Stravadium*. The other species form two groups in § *Barringtonia*, but *B. lauterbachii* from the Niedenzuana type is included in the calyptrocalyx group.

B4. Petiolata type. Except *B. curranii* the pollen type agrees with my petiolata group.

B5. Niedenzuana type. This type (2 species) does not agree with any of my groups.

B6. Racemosa type. B. racemosa and *B. filirachis* are a group in § *Barringtonia* but for *B. acutangula*.

Erdtman (1952) has been the first to investigate *Barringtonia* pollen. He placed them in his Planchonia (super)type, standing against a Lecythis (super)type. This conclusion is fully confirmed. Mr. Muller has also examined the pollen of two species of *Planchonia* and one species of *Careya*, both allied to *Barringtonia*, though this is insufficient for a final conclusion, their pollentypes appear different from those of *Barringtonia* on a generic level.

WOOD ANATOMY

Diehl's study is the most comprehensive. He concluded that there are sufficient wood-anatomical arguments to make a distinction between *Lecythidaceae* and *Myrtaceae*. Furthermore, he maintained that *Asteranthos* and *Napoleona* should be included in the first; hence not be treated as a separate family as Knuth proposed for *Asteranthos*. Finally, he concluded that there are two groups in *Lecythidaceae*, by the presence or absence of crystal strands. 'These structures are a unique and distinctive character and show a striking correlation with geographical distribution, being absent in the Old World genera, except (African) *Foetidia*, and constantly present in those of the New World.' Metcalfe and Chalk added little comment, finding only that a minor feature in the parenchyma distinction with *Myrtaceae* is not as clear as Diehl implies, of which they gave examples.

See Balfour (1862), Brandis (1874), Desch (1941), Diehl (1935), Foxworthy (1909), Moll & Janssonius (1918), Metcalfe & Chalk (1950).

POLLINATION AND FERTILISATION

Flowers are nocturnal and the following morning one finds the fallen corollas with adnate staminal tube on the ground or floating on the surface of the water. In a high number of cases fruit develops well, but is seedless. This was also found in the F.A.A.-preserved material. In three species I found an occasional, obviously anomalous,

elongation of the seedless fruit (*B. macrocarpa*, *B. pendula*, and *B. racemosa*). Fruit setting is, generally speaking, curiously rare. Of 6 species I have seen no fruit and in collections usually only few fruits are found on one rachis though it must have borne fifty odd flowers (photogr. 3—4). Cross-pollination by insects is most likely; cauliflorous species may be visited by bats. On long racemes with many flowers only *c.* 5—15 flowers are found open at a time. Buds start swelling during the day and open early in the evening reaching full expansion near midnight (photogr. 2). See Ridley (1904) 125.

CYTOGENETICS

Very little is known about the chromosome numbers in *Lecythidaceae*. Only one species of *Barringtonia* has been investigated by Roy & Jha (1965). They found for *B. acutangula* n = 13, the same number as found by them in *Careya arborea* Roxb. In *Couroupita guianensis* Aubl. the number n = 18 was recorded by Banerji (1950).

In passing attention is pointed to the possibility of occasional hybridisation, see under 17. *B. apiculata*.

CHEMOTAXONOMY

Van den Driessen Mareeuw (1903) was the first author who published a chemical analysis of *B. asiatica*. He extracted seeds and isolated two characteristic compounds: barringtogenitin and barringtonin. The latter is a saponin. Hegnauer (1964) stated that the triterpene sapogenin barringtogenol has hitherto only been observed in *Lecythidaceae* (*Barringtonia*) and *Combretaceae* (*Terminalia tomentosa*). Saponins as well as polyphenols are widespread in *Lecythidaceae*. Hegnauer (1966) concluded that phytochemistry corroborates the position of *Lecythidaceae* near *Myrtaceae*, but in order to gain more taxonomically valuable information further detailed chemical data are necessary.

FOSSIL RECORDS

Fossil records of *Lecythidaceae* are very scarce. In the uppermost Cretaceous to early Eocene Deccan Intertrappean beds of Mahurzari (India) fossil wood has been found. Shallom (1960) and Prakash & Dayal (1965) described two species found in this area as *Barringtonioxylon deccanense* Shallom and *Barringtonioxylon eopterocarpum* Prakash & Dayal. The wood structure of the latter species shows some similarity to that of *B. augusta* (under the synonym *B. pterocarpa* Kurz).

REVIEW OF THE SYSTEMATIC AFFINITIES WITHIN THE GENUS BARRINGTONIA

This is to summarize a view on the genus *Barringtonia*, blending morphological characters, their taxonomic evaluation, and plant-geographical array, to which is added the flavour of a personal opinion about the genesis of *Barringtonia* in time.

Unfortunately I cannot correlate this view with the palynological characters, unearthed by Mr. J. Muller, as pollen 'affinity' runs often across my system of affinities, even across the sectional subdivision (see p. 170), though admittedly in a good number of cases it

runs parallel with taxonomic affinity on the group level. Furthermore, almost all specimens of one species are characterized by one pollen type.

As usual there are not many factual arguments to evaluate taxonomical characters and groupings phylogenetically. This is especially true when, as is the case here, there is a fairly large number of interrelated species for which only two sections can be distinguished by one character, *viz.* the open calyx of § *Stravadium* and the closed one in § *Barringtonia* but that character is, of course, an important one.

Although there are in the inflorescence various types, from erect and short to long and pendulous, and from terminal to cauliflorous, there are intermediary stages which make this character useless for subdivision. A similar thing can be said about the androecium, the number of staminal whorls, and the degree of their connation. Such characters are good for specific distinction, not for a generic subdivision.

As in all genera related to *Barringtonia* the calyx consists of free lobes, this is likely to be considered an ancient character in *Barringtonia*, leading to the view that § *Stravadium* is the oldest and § *Barringtonia*, with closed calyces, whether provided with a pore or not, is derived.

The forking of the genus must, however, have taken place at an early stage, as both sections contain two very widely spread, and therefore probably ancient species, *viz.* in § *Stravadium*: *B. acutangula* and *B. macrostachya*, and in § *Barringtonia*: *B. asiatica* and *B. racemosa*.

In both sections I have assigned the species to groups (see pp. 182 and 225) which in themselves hang together as small webbed affinities; these groups have been arranged as well as possible from species with a complex of more primitive characters to those with derived ones.

As primitive I regard, for example, a short erect pauciflorous inflorescence, as found in *B. asiatica*; that stage is characteristic for the ground plan ('*Bauplan*') of all other genera of the *Barringtonia*-alliance.

Furthermore, pedicelled flowers I consider primitive and sessile ones derived, large flowers primitive (as in the family) and small ones derived. In the same way are contrasted inflorescences on the twig-ends and ramiflory, and finally cauliflory derived; large trees primitive and small ones with cycadoid habit derived. Within § *Barringtonia* I assume that circumscissile calyces are derived from closed ones.

In this way I have come to the personal, tentative view that the genus *Barringtonia* must have made part of an ancient, possibly Cretaceous, Lecythidaceous stock in Malesia. That two sections were formed at an early stage, with probably few species; that these spread both eastward and westward; and that the insular conditions eastward stimulated speciation, especially in § *Barringtonia*, which accounts for the fairly high number of derived species with restricted ranges in the Solomons, New Caledonia, and Fiji.

REFERENCES

BALFOUR, E. 1862. The Timbertrees, Timber and Fancywoods, as also, the Forests of India and of Eastern and Southern Asia: 44.

BANERJI, I. 1950. Development of Female Gametophyte in Couroupita guianensis Aublet. Curr. Sci. 19: 347.

BENTHAM, G., & J. D. HOOKER, 1865. Genera Plantarum I: 695.

BRANDIS, D. 1874. The Forest Flora of North-West and Central India: 235.

CANDOLLE, A. P. DE. 1828. Prodromus Systematis Naturalis Regni Vegetabilis 3: 288—290, 295.

DAVIS, G. 1966. Systematical Embryology of the Angiosperms: 9, 154.

DESCH, H. E. 1941. Manual of Malayan Timbers. Mal. For. Rec. 15: 251—252, pl. 60, fig. 1.

DIEHL, G. A. 1935. A Study of the Lecythidaceae. Trop. Woods 43: 1—15.

DRIESSEN MAREEUW, W. P. H. VAN DEN. 1903. Ueber die Samen von Barringtonia speciosa (Gaertn.).

ENDLICHER, S. L. 1839. Genera Plantarum: 1233.
ERDTMAN, G. 1952. Pollenmorphology and Plant Taxonomy: 222, fig. 133 & 134.
FORSTER, J. R. & G. 1776. Characteres Generum Plantarum: 75—76, tab. 38.
FOXWORTHY, F. W. 1909. Indo-Malayan Woods. Philip. J. Sc. 4, Bot.: 525.
GOEBEL, K. 1901. Organographie der Pflanzen 2: 463, fig. 308.
HEGNAUER, R. 1964. Chemotaxonomie der Pflanzen 3: 444, 447.
—— 1966. Ibidem 4: 381—385.
HUTCHINSON, J. 1926. The Families of Flowering Plants 2: 182.
—— 1959. Ibidem ed. 2, 1: 303.
JUSSIEU, A. L. DE. 1789. Genera Plantarum: 326, 327.
KARTAWINATA, E. KUSWATA. 1965. The Genus Planchonia Blume (Lecythidaceae). Bull. Bot. Surv. India 7: 162—187.
KNUTH, R. 1939. Barringtoniaceae. Pfl. R. Heft 105: 1—82.
—— 1939. Lecythidaceae. Pfl. R. Heft 105a: 1—146.
—— 1939. Asteranthaceae. Pfl. R. Heft 105b: 1—3.
LINDLEY, J. 1846. The Vegetable Kingdom: 716, 734, 739, 749, 754.
LINNAEUS, C. 1753. Species Plantarum: 471.
MEISNER, C. F. 1838. Plantarum Vascularium Genera: 109.
MELCHIOR, H. 1964. Lecythidaceae, in Engler's Syllabus der Pflanzenfamilien ed. 12, 2: 353—355.
METCALFE, C. R., & L. CHALK. 1950. Anatomy of the Dicotyledons 1: 632.
MIERS, J. 1875. On the Barringtoniaceae. Trans. Linn. Soc. Bot. 1: 47—118, t. 10—18.
MOLL, J. W., & H. H. JANSSONIUS. 1918. Mikrographie des Holzes der auf Java vorkommenden Baumarten 3: 489—501.
NIEDENZU, F. 1892. Lecythidaceae, in Engler & Prantl, Die Natürlichen Pflanzenfamilien 3, 7: 26—41.
PICHON, M. 1945. Le genre Combretodendron et les Lécythidacées. Not. Syst. 12: 192—197.
POITEAU, A. 1825. Mémoire sur les Lécythidées. Mém. Mus. Hist. Nat. 13: 141—165, tab. 1—7.
PRAKASH, U., & R. DAYAL. 1965. Barringtonioxylon eopterocarpum sp. nov., a fossil wood of Lecythidaceae from the Deccan Intertrappean beds of Mahurzari. The Paleobotanist 13: 25, pl. 1.
RAUH, W. 1937. Die Bildung von Hypocotyl- und Wurzelsprossen und ihre Bedeutung für die Wuchsformen der Pflanzen. Nova Acta Leopoldina N.F. 4: 395—553.
RIDLEY, H. N. 1904. On the Flowering of Barringtonia racemosa. J. Str. Br. Roy. As. Soc. 41: 125.
ROY, R. P., & R. P. JHA. 1965. Cytological Studies in Lecythidaceae II. J. Ind. Bot. Soc. 44: 211—217, fig. 1—3, pl. I.
RUDOLPHI, F. C. L. 1830. Systema Orbis Vegetabilium: 56.
SHALLOM, L. J. 1960. Fossil Dicotyledonous Wood of Lecythidaceae from the Deccan Intertrappean Beds of Mahurzari. J. Ind. Bot. Soc. 39: 198.
THOMPSON, J. MCLEAN. 1927. A Study in Advancing Gigantism with Staminal Sterility with Special Reference to the Lecythideae. Publ. Hartley Bot. Lab. 4: 5—44, fig. 1—64.
THOMSON, TH. 1858. On the Structure of the Seeds of Barringtonia and Careya. J. Proc. Linn. Soc. Bot. 2: 47—53, pl. I, A fig. 1—3.
TREUB, M. 1884. Notes sur l'embryon, le sac embryonnaire et l'ovule. Ann. Jard. Bot. Btzg 4: 101—106,pl.8.
TROUP, R. S. 1921. The Silviculture of Indian Trees 2: 590—592, fig. 222.
WEBERLING, F. 1957. Ueber das Vorkommen Rudimentaerer Stipeln bei den Lecythidaceae (s.l.) und Sonneratiaceae. Flora 145: 72—77, 1 fig.

PRESENTATION OF DATA

Synonymy has been given in full. Names occasionally found on herbarium sheets have been omitted but *nomina nuda* and erroneous identifications are evaluated. All names and references belonging to the same type are combined in one paragraph.

References have been recorded as far as they appeared of value.

Type specimens are all cited and I have also mentioned the herbaria in which such type specimens are preserved, and these I have actually seen unless otherwise stated.

Abbreviations of the herbaria are in accordance with the Index Herbariorum ed. 5 (1964).

Specimens other than type specimens have not been cited unless a collection was in some way noteworthy. All the material examined is or will be adequately labelled by me. A separate Identification List of all numbered collections will appear in due course.

Distribution is based on identified collections of reliable provenance. Countries and islands are arranged from west to east and where necessary from north to south.

The ecology of each species has been mostly compiled from field labels. The same applies to notes on the shape of the tree, the height of the bole, texture and colour of the bark, colour of flower parts, fruit and the like. Notes on galls, germination, and dispersal are often supported by literature. Vernaculars have been selected from field labels; their reliability is restricted.

Uses are either compiled from field notes and/or from literature.

To rule out any misunderstanding on the measurements of plant parts in the species descriptions the following remarks may be useful: The diameter of the twigs has been measured at the apex between the leaves. The size of the leaf is without the petiole. The pairs of nerves are those lateral nerves that reach the margin, omitting the very small ones near apex and base. The calyx tube has been measured from receptacle to the base of the segments or sepals. The length of the filaments is that of their free part; the height of the staminal tube is given separately. The length of the ovary is measured from receptacle to apex of pedicel or to rachis (in case of sessile flowers). The length of the fruit is measured without the calyx lobes.

Throughout the paper the abbreviation *B.* stands exclusively for *Barringtonia.*

BARRINGTONIA, *nom. cons.*

J. R. & G. Forster, Char. Gen. (1776) 75; Thunb., Nov. Gen. Pl. 2 (1782) 46 ('*Barringtona*'); Murr., Syst. Veg. ed. 14 (1784) 620; Schreber, Gen. Pl. 2 (1791) 473; Gmelin, Syst. Nat. 2 (1791) 1000, 1039; Willd., Sp. Pl. 3 (1800) 845; J. St. Hil., Exp. Fam. Nat. 2 (1805) 166; Pers., Syn. Pl. 2 (1807) 30; Presl, Rostlin. 2 (1825) 401; Spreng., Syst. Veg. 3 (1826) 127; Sweet, Hort. Brit. ed. 1 (1826) 159; Blume, Bijdr. (1826) 1096; DC., Prod. 3 (1828) 288; Kosteletzky, Allg. Med. Pharm. Fl. 4 (1835) 1534; Meisn., Pl. Vasc. Gen. (1838) Tabl. 109, Comm. 77; Endl., Gen. Pl. (1840) 1233; Steud., Nomencl. ed. 2, 1 (1841) 402; Lindley, Veg. Kingd. (1846) 755; Blume, in Fl. Serr. 4 (1848) 409; ibid. 7 (1851) 22; Walp., Ann. 2 (1852) 641; Miq., Fl. Ind. Bat. 1, 1 (1855) 483; C. Mueller in Walp., Ann. 4 (1857) 850; Benth. & Hook., Gen. Pl. 1 (1865) 695, 720; Miers, Trans. Linn. Soc. Bot. 1 (1875) 55; Kurz, J. As. Soc. Beng. 46, ii (1877) 69; Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 506; Durand, Ind. Gen. Phan. (1888) 129; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 31; Koord. & Val., Bijdr. Booms. Java 6 (1900) 2; King, J. As. Soc. Beng. 70, ii (1901) 134; Koord., Exk. Fl. Java 2 (1912) 664; Ridl., Fl. Mal. Pen. 1 (1922) 712, 756; Knuth, Pfl. R. Heft 105 (1939) 10.

Huttum Adans., Fam. Pl. 2 (1763) 88, *nom. gen. rejic.*; Britten, J. Bot. 39 (1901) 67.

Commerçona Sonner., Voy. Guin. 1 (1776) 14; Salisbury, Prod. Stirp. (1796) 355 ('*Commersona*'). — *Butonica* sect. *Commersonia* Post & O.K., Lex. Phan. (1903) 85.

Menichea Sonner., Voy. Guin. 1 (1776) 133; Gmelin, Syst. Nat. 1 (1791) 770, 799.

Butonica Lamk, Enc. Méth. Bot. 1, 2 (1785) 521; Juss., Gen. Pl. (1789) 326; Kosteletzky, Allg. Med. Pharm. Fl. 4 (1835) 1535 (*pro subgen.*); Endl., Gen. Pl. (1840) 1233 (*pro subgen.*); Miq., Fl. Ind. Bat. 1, 1 (1855) 485 (*pro sect.*); C. Mueller in Walp., Ann. 4 (1857) 850 (*pro sect.*); Miers, Trans. Linn. Soc. Bot. 1 (1875) 65; Kurz, J. As. Soc. Beng. 46, ii (1877) 69 (*pro subgen.*); Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 507 (*pro sect.*); Durand, Ind. Gen. Phan. (1888) 129 (*pro sect.*); Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 32 (*pro subgen.*); Koord. & Val., Bijdr. Booms. Java 6 (1900) 3 (*pro subgen.*); King, J. As. Soc. Beng. 70, ii (1901) 134 (*pro sect.*); Post & O.K., Lex. Phan. (1903) 85; Koord.,

Exk. Fl. Java 2 (1912) 665 (*pro sect.*); Ridl., Fl. Mal. Pen. 1 (1922) 756 (*pro sect.*); Knuth, Pfl. R. Heft 105 (1939) 12 (*pro sect.*).

Stravadium Juss., Gen. Pl. (1789) 326; J. St. Hil., Exp. Fam. Nat. 2 (1805) 166; Persoon, Syn. Pl. 2 (1807) 30 ('*Stravadia*'); Presl, Rostlin. 2 (1825) 400; Sweet, Hort. Brit. (1826) 159; DC., Prod. 3 (1828) 289; Kosteletzky, Allg. Med. Pharm. Fl. 4 (1835) 1535 (*pro subgen. Stravadia*); Meisner, Pl. Vasc. Gen. (1838) Tabl. 109, Comm. 77 (*pro subgen.*); Endl., Gen. Pl. (1840) 1233 (*pro subgen.*); Steud., Nomencl. Bot. ed. 2, 2 (1841) 645; Lindley, Veg. Kingd. (1846) 755; Blume, in Fl. Serr. 7 (1851) 23; Miq., Fl. Ind. Bat. 1, 1 (1855) 488 (*pro sect.*); C. Mueller in Walp., Ann. 4 (1857) 850 (*pro sect.*); Miers, Trans. Linn. Soc. Bot. 1 (1875) 80; Kurz, J. As. Soc. Beng. 46, ii (1877) 69 (*pro subgen.*); Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 508 (*pro sect.*); Durand, Ind. Gen. Phan. (1888) 129 (*pro sect.*); Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33 (*pro subgen.*); Koord. & Val., Bijdr. Booms. Java 6 (1900) 3 (*pro subgen.*); King, J. As. Soc. Beng. 70, ii (1901) 134 (*pro sect.*); Koord., Exk. Fl. Java 2 (1912) 665 (*pro sect.*); Ridl., Fl. Mal. Pen. 1 (1922) 756 (*pro sect.*). — *Butonica* sect. *Stravadium* Post & O.K., Lex. Phan. (1903) 85.

Meteorus Lour., Fl. Cochin. 2 (1790) 410; ed. Willd. 2 (1793) 498; Sprengel, Syst. Veg. 3 (1826) 127.

Mitraria Gmelin, Syst. Nat. 1 (1791) 771, 799, *non* Cav. 1801, *nom. cons.*

Botryoropis Presl, Epim. Bot. (1851) 220; Walp., Ann. 2 (1852) 641.

Agasta Miers, Trans. Linn. Soc. Bot. 1 (1875) 59; Durand, Ind. Gen. Phan. (1888) 129 (*pro sect.*); Knuth, Pfl. R. Heft 105 (1939) 10 (*pro sect.*).

Doxomma Miers, Trans. Linn. Soc. Bot. 1 (1875) 98; Durand, Ind. Gen. Phan. (1888) 129 (*pro sect.*); Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33 (*pro sect.*); Koord. & Val., Bijdr. Booms. Java 6 (1900) 3 (*pro sect.*); Koord., Exk. Fl. Java 2 (1912) 665 (*pro subsect.*); Knuth, Pfl. R. Heft 105 (1939) 26 (*pro sect.*).

Megadendron Miers, Trans. Linn. Soc. Bot. 1 (1875) 109; Durand, Ind. Gen. Phan. (1888) 129 (*pro sect.*).

Michelia O. Kuntze, Rev. Gen. Pl. 1 (1891) 240, *non* L. 1753.

Barringtonia sect. *Eustravadium* Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; Koord. & Val., Bijdr. Booms. Java 6 (1900) 3; Knuth, Pfl. R. Heft 105 (1939) 42.

Careya sect. *Barringtoniopsis* Niedenzu in K. Sch., Notizbl. Bot. Gart. Berl. 2 (1898) 137.

Shrubs or trees seldom buttressed; bark fissured. Growth flushwise, with an open terminal bud, each flush often provided with reduced leaves (cataphylls) in the basal part; leaf-scars distinct, often enlarged on the often proportionally thickish pithy twigs. *Leaves* spirally arranged, ± tufted at the end of the twigs, rarely also persistent on 1—2 lower flushes, obovate to linear-oblanceolate (in 1 sp. lanceolate), always cuneate towards the base; apex mostly acute or acuminate; margin serrate-crenulate or entire; midrib prominent on both sides, penninerved, nerves curved upwards, arching, nerves and veins prominent underneath; petiole flat above, semi-terete beneath, rarely absent, mostly not distinctly demarcated against the decurrent leaf-base, thickened at the insertion. Stipules very small, triangular, acute, caducous. *Racemes* (*cq. spikes*) terminal or lateral on the twigs, or cauliflorous, generally pendulous and long, very rarely erect and short, mostly dense-flowered, glabrous or pulverulent; peduncle often with a tuft of cataphylls at the base. *Bracts* small, sessile, caducous. *Pedicels* sometimes 0. *Bracteoles* very small, caducous. *Flower-buds* globular. *Calyx tube* (ovary) obconical, mostly 4-angular, sometimes 4-winged, glabrous or pulverulent; receptacle ± convex. *Calyx* chartaceous, parallel-veined, convex, in bud either connate (and closed or provided with a circular, apical pore) and towards anthesis rupturing into 2—4(—5) persistent segments (pseudo-lobes) or rather clearly circumscissile rupturing above the base, leaving

a cup-shaped ring (calyptra entire or rarely lobed), or calyx lobes 4(—5) free from the beginning and inserted on a ring-shaped tube slightly elevated above the torus, in bud imbricate, persistent; rupturing segments unequal and rupturing line only becoming visible at the last moment, their margins ± thickened, never fimbriate; calyptra not rupturing along a visibly predestined line; free sepals always fimbriate, with a thin, ± membranous or scarious margin; margin of apical pore similar in structure to that of free sepals. *Petals* (3—)4(—5), free, cochlear-imbricate, convex, alternate with the free sepals, adnate to the staminal tube, the outer ones mostly smaller than the inner ones. *Stamens* very numerous, connate at the base, in 3—8 whorls of which the inner 1(—3) are reduced to shorter mere sterile filaments, strongly folded in bud; anthers basifix, 2-celled, latrorse, dehiscing already in bud (herb. material). *Disk* a thin or thick, undulating ring surrounding the style-base. *Style* 1, long, terete, filiform, folded in bud, persistent; stigma slightly knob-like, sometimes with an apical pore. *Ovary* inferior, mostly tapering into the pedicel, 2—(3—)4-celled but the septs sometimes incomplete at apex, ovules 2—6 in each cell, attached apically and axially, pendent, anatropous, apotropous. *Fruit* obovoid or ellipsoid to fusiform, terete or angled to winged, fleshy-fibrous; exocarp thin; mesocarp fibrous or rarely spongy with few fibres; endocarp thin or a thin layer of fibres. *Seed* 1, large; testa brownish, membranous, from 2 integuments; embryo developing from a pro-embryo, originally with abundant nuclear endosperm which later distintegrates; in later stages embryo solid, spindle-shaped, without cotyledons, but with a spiral of minute scales towards the apex, in section consisting of a core and a cortical layer, separated by a small-celled vascular cylinder, composed of traces running down from the scales; stele closed at base, emanating endogenous, adventitious roots in germination; apex lengthening upward producing cataphylls and finally leaves, obviously continuing the scale spiral upon germination.

Holotypus: *Barringtonia speciosa* J. R. & G. Forster (= *B. asiatica* (L.) Kurz).

Distribution: About 40 species, in tropical and subtropical regions of E. Africa (with one species), the Madagascan area (2 spp.), S. Asia, Malesia, Australia, and the Pacific Islands, between lat. *c.* 30° S—35° N, long. *c.* 30° E—150° W; seeds may be found in drift eastwards to 140° W. One species has been introduced in cultivation in Hawaii, the West Indies, and the tropical islands of the Atlantic Ocean. Fig. 3, 4, 14.

Ecology: Generally in fresh-water swamps, near rivers and lakes, or in areas subject to high yearly rain-fall, where inundation occurs for several weeks. *B. asiatica* is purely littoral and is so characteristic of the coastal forest fringe that this has been called the *Barringtonia*-formation. A few species grow on dry land in the tropical rain-forest. Altitudes from 1500—2000 m are reached by only very few species.

Subdivision of the genus: The first author to subdivide the genus *Barringtonia* into two subgenera, *viz. Butonica* and *Stravadia* was Kosteletzky (1835) *op. cit.* Three years later Meisner (1838) *op. cit.* had the same entities as subgenera under the names *Barringtonia* and *Stravadium*. He was followed by Miquel (1855) *op. cit.* who divided the genus into two sections equivalent to Meisner's subgenera, but he used *Butonica* (Lamk) for the one section and *Stravadium* (Juss.) for the other. Miers (1875) *op. cit.* recognized these two taxa as separate genera next to *Barringtonia*, adding three new ones besides. Durand (1888) *op. cit.* reduced five of Miers' genera to sectional rank. Niedenzu (1892) *op. cit.* recognized only two subgenera, as Meisner did (*Butonica* and *Stravadium*), but subdivided subg. *Stravadium* into two sections, one of which was Miers' genus *Doxomma*, while the other sect. *Eustravadium* was new, including only *B. acutangula*. In 1898, in a paper by K. Schumann on *Careya*, Niedenzu placed one species, *Careya niedenzuana* K. Sch., in a separate, monotypic section, *Careya* sect. *Barringtoniopsis*. This was later correctly

reduced by Knuth to *Barringtonia* sect. *Doxomma*. Knuth recognized (1939) four sections, *Agasta* (Miers), *Butonica* (Lamk), *Doxomma* (Miers), and *Eustravadium* (Niedenzu).

The only important character by which the genus *Barringtonia* can be subdivided is found in the calyx, *viz.* whether this is in bud closed or provided with an apical pore without showing a trace of lobing, or, whether it consists of free lobes from the beginning. Compare fig. 5b—c, 11b, f, g, 12c, 17c.

This may seem a difficult matter to decide in practice, because the closed or apical-pored calyx frequently does not or insufficiently enlarge and is subsequently ruptured by the growing corolla by which process 2 or more pseudocalyx lobes appear (fig. 5b, 11b & d); in a few cases no pseudo-lobes originate but the calyx is rupturing more or less circumscissile (fig. 12c).

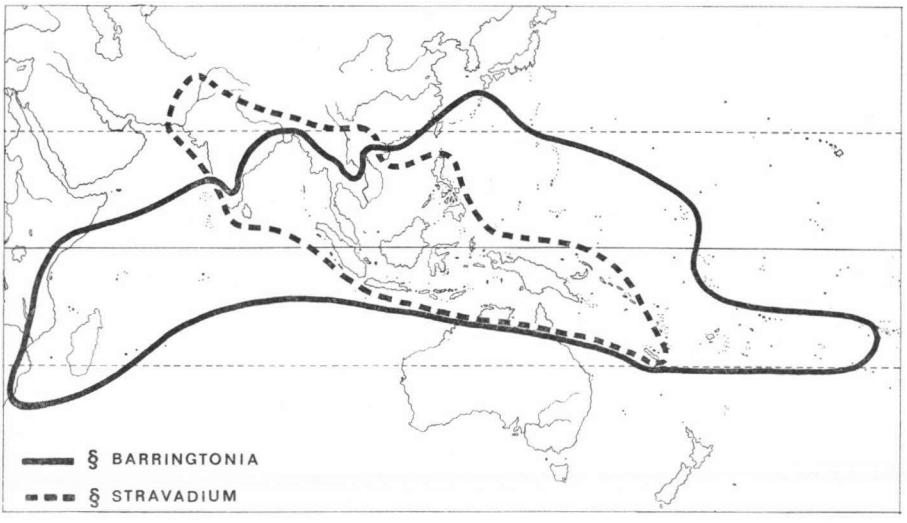


Fig. 3. Range of *Barringtonia* § *Barringtonia* and § *Stravadium*.

However, the distinction between the structures of the calyx is very clear, because true calyx lobes have always a thin and scarious, mostly fimbriate margin (fig. 17c) and are almost equal in size, while the pseudo-lobes have a thickish, not scarious and never fimbriate margin, the lobes being often irregular in size and shape.

This distinction was observed long ago and has been maintained in various ranks up till the present day. It has been accepted for the delimitation of two sections in this monograph.

Knuth, *l.c.* 10, kept *B. asiatica* (L.) Kurz in a separate section *Agasta* because of its two large pseudocalyx lobes and 4 ovary cells. Though this species stands also apart by its very short, not pendent raceme I do not feel this sufficient for infrageneric distinction. The number of ovary cells, which Knuth also uses for defining other sections, 4- *versus* 2-celled, does not hold, as the number of cells may vary within the species from 2—4. The distinction by Knuth *l.c.* between sessile and petioled leaved species is an impossible proposition and is of no value whatsoever.

Concluding, in my opinion there are two distinct sections, § *Barringtonia* and § *Stravadium*. In mapping them it appeared also that they occupy a range of their own which seems to sustain this opinion (fig. 3).

KEY TO THE SPECIES [1])

1. Flowers sessile.
  2. Calyx in bud closed (fig. 5b) or with an apical pore [2]) (fig. 11f—g).
    3. Calyx, and mostly also rachis, densely short-hairy.
      4. Connation of inner staminodial whorl not exceeding the staminal tube. Calyx never calyptrately rupturing (circumscissile), always in segments.
        5. Stamens in 3 whorls. Ovary winged. Fruit winged when mature. Leaf-index (3½—) 4—5(—10) . . . . . **15. B. pterita**
        5. Stamens in 5—8 whorls. Ovary not winged. Fruit not winged when mature. Leaf-index 2—3½.
          6. Stamens in 5—6 whorls. Ovary globular, *c.* 1½—3½ by 1½—3½ mm. Twigs *c.* 3—6 mm ∅. **4. B. racemosa**
          6. Stamens in 7—8 whorls. Ovary *c.* 10 by 5 mm, subtetragonous. Twigs *c.* 8—10 mm ∅. **8. B. seaturae**
      4. Connation of inner staminodial whorl exceeding the staminal tube (fig. 12e). Calyx calyptrately rupturing (circumscissile) or disrupting into segments.
        7. Nerves 25—65 pairs. Stamens in 8 whorls, the 3 inner staminodial. Leaves 50—160 cm, leaf-index 3—4. Ovary obpyramidal smooth. Fruit ovoid, 4-gonous, apex ± truncate, base tapering. Calyx rupturing into a caducous cap and a persistent ring. . **22. B. papeh**
        7. Nerves 8—23 pairs. Stamens in 4—6(—7) whorls, the inner 1 (2) staminodial. Leaf-index 2—3½. Ovary grooved.
          8. Calyx disrupting into 4 lobes, *c.* 12—17 by 10—15 mm. Fruit cylindrical, 8-ribbed, truncate at both ends, hooked near the base on alternate ribs, 6—7½ by 3—4 cm (fig. 1). Leaves 29—62 cm; leaf-index 2½—3½; nerves 17—23 pairs . . . . **23. B. procera**
          8. Calyx rupturing either into 4 lobes 5—6 by 5—10 mm or rupturing into a caducous cap and persistent ring (in one inflorescence). Fruit ovoid to spindle-shaped; apex truncate, smooth, *c.* 5—9½ by 1½—2½ cm. Leaves 10—35 cm; leaf-index 2—3; nerves 8—20 pairs (fig. 12) . . . . . **21. B. calyptrata**
    3. Calyx and rachis glabrous.
      9. Twigs 7—20 mm ∅. Nerves 15—50 pairs.
        10. Calyx in bud with apical pore. Fruit ovoid, ± spindle-shaped, 8½—10 cm. Connation of staminodial whorl not exceeding the staminal tube. . . . . **11. B. gigantostachya**
        10. Calyx in bud completely closed.
          11. Fruit ovoid to subglobular, 5—11 cm (photogr. 3). Connation of staminodia not exceeding staminal tube. Leaf margin revolute (fig. 11). . . **19. B. sarcostachys**
          11. Fruit cylindrical, 8-ribbed, hooked near the base on alternate ribs, 6—7½ cm (fig. 1d). Connation of staminodia exceeding staminal tube. Leaf margin flat. **23. B. procera**
      9. Twigs 2—4 mm ∅. Nerves 8—12 pairs.
        12. Flower-buds *c.* ½ cm ∅ with distinct mucro 1—2 mm long. Connation of staminodia not exceeding staminal tube. Ovary tetragonous with distinct ribs. Fruit ovoid or spindle-shaped, tapering at both ends, *c.* 4½—5 cm. . . . . **20. B. ashtonii**
        12. Flower-buds *c.* 1 cm ∅, without mucro. Connation of staminodes exceeding staminal tube. Ovary subtetragonous, without ribs. Fruit tetragonous or trigonous, truncate at both ends, *c.* 3½—7 cm. . . . . **9. B. petiolata**
  2. Calyx already in bud with free sepals [2]).
    13(a) Ovary tetragonous, angled, manifestly winged on the corners.

[1]) Al l measurements are taken from herbarium material.

[2]) In anthesis such calyces may split circumscissile (fig. 12c), or into lobes, or are irregularly ruptured, often to the base. Such segments (pseudo-lobes) never show a true, free, thin, always scarious and fine-fimbriate edge, as is found in calyces which are lobed from the beginning, and on the margin of apical pores.

14. Twigs (under the leaves) ¾—1½ cm ∅. Nerves 16—30 pairs; leaf-index 2½—4; petiole ½—2 cm. Stamens in 6 whorls. Fruit tetragonous or trigonous, *c.* 5—7 cm long. **36. B. augusta**

14. Twigs (under the leaves) ¼—½ cm ∅. Nerves 7—10 pairs; leaf-index 1½—3; petiole (½—)1½—5 cm. Stamens in 4—5 whorls. Fruit ovoid, rarely tetragonous, *c.* 10—12 cm long (fig. 15) . . . . . **25. B. scortechinii**

13(b) Ovary teretish, with 4 distinct grooves . . . . . **33. B. pendula**

13(c) Ovary tetragonous, terete or angled but neither winged nor grooved.

15. Ovary 2-celled. Stamens in 3 whorls. Fruit *c.* 1½—3½ by 1—1½ cm; rachis *c.* 3 mm ∅. **24b. B. acutangula** ssp. **spicata**

15. Ovary (3—)4-celled. Stamens in 4—7 whorls.

16. Ovary distinctly very densely puberulous. Petiole 0.3—1(—3½) cm, in the exceptional case the blade very narrowly decurrent and the sulcate petiole difficult to demarcate from the blade.

17. Rachis *c.* 9—27 cm. Stamens in 7 whorls. Leaf-index 2¾—3½. Petiole 0.3—1 cm. **38. B. neo-caledonica**

17. Rachis *c.* 40—110 cm. Stamens in 4—6 whorls. Leaf-index 3½—5. Petiole 1—3½ cm.

18. Style 4—7 cm. Stamens in 5—6 whorls. Petiole 1—2½ cm. . **37. B. curranii**

18. Style 1 cm. Stamens in 4 whorls. Petiole 2½—3½ cm . . **39. B. longifolia**

16. Ovary glabrous. Petiole distinct, (1—)2½—10(—17) cm long.

19. Racemes (even in fruit) up to only 4(—10) cm, distinctly ramiflorous far below the ± entire, flat-margined leaves. Fruits ovoid, 6½—10½ by 3—7 cm. Leaves 9—20 by 3—8 cm. Nerves 8—11 pairs (fig. 21). . . . . **34. B. lanceolata**

19. Racemes with the leaves *c.* 20—75 cm long. Leaves 11—45 by 3—15 cm. Nerves 9—21 pairs.

20. Fruit dull, teretish, at most with 4 ribs, mostly with convex sides, 5½—9 by 2—4 cm. Leaves 15—45 by 6—15 cm, in upper half shallowly serrate-crenulate, mostly chartaceous and with flattish margin (fig. 19) **32. B. macrostachya**

20. Fruit rather or fully smooth and mostly shining, conspicuously tetragonous, with clear angles and flat or depressed sides, 3½—5 by 1—2 cm. Leaves 11—20 by 3—8 cm, entire or almost so, coriaceous and with recurved margin (fig. 22). **35. B. reticulata**

1. Flowers pedicelled.

21(a) Calyx in bud closed or with a small apical pore [1]).

22. Connation of inner staminodial whorl exceeding the staminal tube. Inflorescence cauliflorous. Bud completely closed.

23. Leaf-index 3½—31; nerves 14—95 pairs.

24. Leaf-index 3½—7; nerves 14—65 pairs. Flowers pink or red. . **16. B. calyptrocalyx**

24. Leaf-index 12—31; nerves 70—95 pairs. Flowers white. . . . . **14. B. papuana**

23. Leaf-index 1¾—3¼; nerves 7—20 pairs.

25. Calyx disrupting into a caducous cap leaving a persistent ring. Stamens in 5—8 whorls.

26. Rachis up to 9 cm; pedicels not articulated. Fruit cylindrical, distinctly pedicelled, base truncate. One whorl of staminodes. . . . . **18. B. lauterbachii**

26. Rachis up to 45 cm; pedicels often articulated. Fruit ovoid, base tapering into the pedicel. Often two whorls of staminodes . . . . . **17. B. apiculata**

25. Calyx disrupting into 2—3 lobes. Stamens in 4—5 whorls . . . . . **13. B. edulis**

22. Connation of inner staminodial whorl not exceeding the staminal tube. Inflorescence terminal or cauliflorous. Bud completely closed or with an apical pore.

27. Rachis erect. Flowers very large (in anthesis: calyx lobes 3—4 cm, filaments 8—15 cm). Fruit large, with thick spongy mesocarp. Calyx in bud completely closed (photogr. 2). **1. B. asiatica**

27. Rachis pendulous. Flowers smaller (in anthesis: sepals shorter than 2 cm, filaments to 6 cm). Fruit not with thick, spongy mesocarp. Calyx in bud closed or with apical pore.

28. Calyx in bud with apical pore.

29. Leaves subsessile. Fruit with 4 distinct, undulating, wide but not thick wings, tetragonous, its base tapering into the pedicel . . . . . **12. B. integrifolia**

29. Leaves distinctly petioled (1—8 cm). Fruit not winged, subtetragonous or ovoid, its base more or less truncate.

30. Fruit 4½—7 by 2½—5 cm, tapering into 6 ribs at the base. Stamens in 3—4 whorls.

[1]) See note 2 on page 179.

Sepals in anthesis ½—¾ by 0.3—1 cm, not accrescent. Leaves chartaceous. **7. B. samoensis**

30. Fruit 13—14 by 4½—5½ cm, truncate at the base. Stamens in 6—7 whorls. Sepals in anthesis 1—2 by 1—2 cm, in fruit enlarged tot 3 cm. Leaves coriaceous. **3. B. longisepala**

28. Calyx in bud completely closed.

31. Mature fruit winged.

32. Fruit conoid, with 8 wings at the emarginate base; apex tapering. Leaf-index 2½—3½. Inflorescence mostly ramiflorous. Stamens in 5—6 whorls. Ovary 8-winged (fig. 5) . . . . . **2. B. conoidea**

32. Fruit tetragonous, 4 wings running from the truncate apex to the emarginate base. Leaf-index 1½—5(—10). Inflorescence terminal, lateral or cauliflorous. Stamens in 3 whorls. Ovary slightly or not 4-winged.

33. Nerves 8—10 pairs. Leaf-index 1½—3. Ovary 2-celled, not winged. Buds 5 mm. Fruit 2½ by ½—1 cm, 4-winged. . . . **5. B. filirachis**

33. Nerves 15—28 pairs. Leaf-index (3½—)4—5(—10). Ovary 3—4-celled, 4-winged. Buds 10 mm. Fruit 4—6 by 1—2½ cm, 4-winged. **15. B. pterita**

31. Mature fruit not winged [1]).

34. Leaf margin serrate-crenulate, flat. Stamens in 5—6 whorls. Fruit 5—9 by 2—5½ cm, ovoid, subtetragonous, truncate at apex, base tapering with depressed sides when immature, often sessile. . . . . **4. B. racemosa**

34. Leaves entire, with revolute edge. Stamens in 4 whorls. Fruit 4½—6 by 1—1½ cm, 3—4-gonous, at apex truncate, at base tapering, distinctly pedicelled (fig. 7) . . . . . **6. B. revoluta**

21(b) Calyx in bud with large apical pore or wide open circular hole, sometimes disrupting into lobes (fig. 11g) . . . . . **10. B. novae-hiberniae**

21(c) Calyx in bud with free sepals from the beginning [2]).

35. Leaves sessile or subsessile.

36. Leaves *c.* 30—70 by 6—18 cm, glabrous underneath. Twigs *c.* 7—15 mm ∅. Fruit 3—4-gonous, slightly winged . . . . . **27. B. macrocarpa**

36. Leaves *c.* 9—28 by 2½—8½ cm, underneath pulverulent on nerves and veins. Twigs *c.* 2—5 mm ∅. Fruit fusiform or ovoid, not winged (fig. 17) . . . . **28. B. fusiformis**

35. Leaves distinctly petioled.

37. Nerves 35—45 pairs; petiole 9—14 cm. Pedicels 2—6 cm. Buds *c.* 1½ cm. . **29. B. hallieri**

37. Nerves 7—30 pairs; petiole ½—10 cm. Pedicels ½—2 cm. Buds *c.* ½—1 cm.

38. Ovary 2-celled; ovules 4—10. Nerves 7—12 pairs. Fruit 4-gonous, slightly 4-winged when young . . . . . **24a. B. acutangula** ssp. **acutangula**

38. Ovary 3—4-celled; ovules 8—60. Nerves 13—30 pairs. Fruit ovoid or spindle-shaped, not winged.

39. Stamens in 3—4 whorls, 25—35 mm. Fruit unknown . . . . **30. B. havilandii**

39. Stamens in 4—8 whorls, 17—20 mm.

40. Fruit ovoid, tapering to the base, 3½—4½ by 2—3 cm, glabrous. Bud 7 mm. Pedicels not articulating . . . . . **31. B. pauciflora**

40. Fruit 4-gonous, tapering at both ends, 4½—6½ by 1—1½ cm, with 4 hooked appendages on the corners near the base. Bud 5—7 mm. Pedicels articulating. **26. B. niedenzuana**

1. Sect. **Barringtonia**

Barringtonia J. R. & G. Forst., 1776.
Commerçona Sonnerat, 1776.
Menichea Sonnerat, 1776.
Butonica Lamk, 1785. — Niedenzu, 1892 (*pro subg.*). — Endl., Gen. Pl. (1840) 1233 (*pro subg.*); C. Muell. in Walp., 1857; Clarke, 1879; Knuth, 1939.

[1]) In *B. racemosa* immature fruits may appear ± winged in the herbarium; in the eastern part of Malesia and the W. Pacific fairly mature fruits may carry thickish prominences on the edges of part of the ribs.
[2]) See note 2 on page 179.

Mitraria Gmel., 1791.

Agasta Miers, 1875. — Durand, 1888 and Knuth, 1939 (*pro sect.*).

See for full references under the genus.

Calyx in bud closed or with an apical pore, often disrupting subsequently into 2—4, mostly irregular pseudo-lobes, or circumscissile.

Taxonomic relationships within § Barringtonia.

The section contains 23 species, 2 of which are very widely distributed, *viz. B. asiatica* and *B. racemosa*, occurring from the Madagascan area and eastern tropical Africa respectively, eastward far into the W. Pacific. Fig. 3. The first is a common species of the sandy beach and a supposed easy sea-borne dispersal might well account for this wide distribution and by diffusionists assumed not to point to high antiquity. But this cannot be held for *B. racemosa* which, though a rather coastal lowland species, is not dispersed

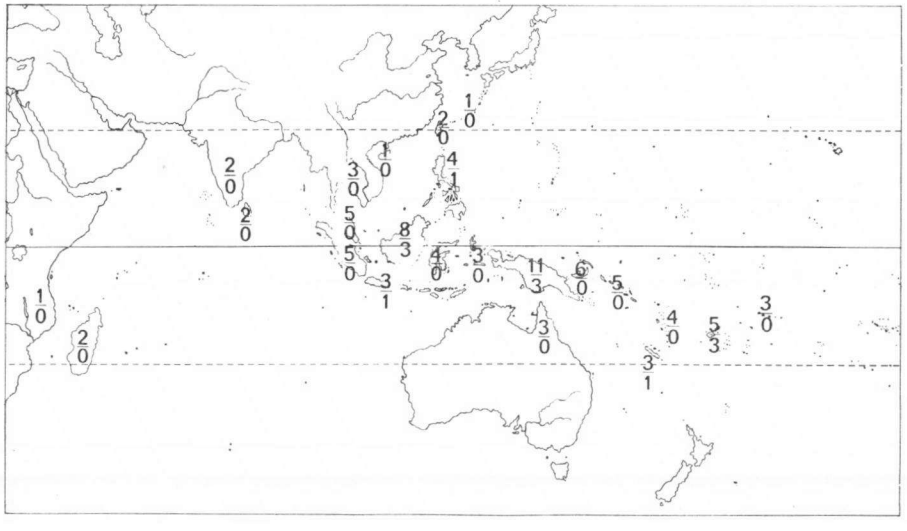


Fig. 4. Species density in § *Barringtonia*, above the hyphen the total number of species for each area, island or island group, below it the number of endemic species.

by seawater, inhabiting the fresh-water swamp forest and banks of rivers and lakes.

The majority of the species occurs in East Malesia and Melanesia, and among the six affinity groups, distinguished below, there is none which solely consists of species of West Malesia. Fig. 4.

Six groups of species which mutually show a greater affinity to one another than to those of other groups can be distinguished. They cannot be keyed out and have no taxonomical status. Their sequence reflects my ideas about their derivation, the most primitive group being first, derived ones following.

I. Asiatica Group. Fig. 6.

1. *B. asiatica* — from the Madagascan area to the W. Pacific.
2. *B. conoidea* — Tenasserim, Malaya, S. Sumatra, Banka, Borneo.
3. *B. longisepala* — N. Borneo.

Though *B. asiatica* has a short, erect inflorescence, *B. conoidea* and *B. longisepala* with racemes are closely related to it in leaf, flower, and fruit characters. All have a calyx closed in bud. As to pollen very homogeneous, belonging to one pollen type. Obviously as to pollen *B. scortechinii* from § *Stravadium* approaches this group!

II. Racemosa Group.

4. *B. racemosa* — from E. Africa to the W. Pacific.
5. *B. filirachis* — E. Sumatra, Malaya.

Like *B. asiatica*, *B. racemosa* has a very wide distribution which must be ancient and it is quite feasible that it is one of the ancestral species from which for example *B. seaturae* (Fiji) and *B. filirachis* (W. Malesia) are derived. The latter is a sort of dwarf with small leaves, thin rachis, half the number of staminal whorls and ovary cells, and a distinctly winged small fruit: the fruit of *B. racemosa* is only slightly winged in a very young stage. These two are palynologically identical, but also with *B. acutangula* belonging to § *Stravadium*!

III. Revoluta Group. Fig. 8.

6. *B. revoluta* — Malaya, S. Sumatra, N. Borneo, Palawan.
7. *B. samoensis* — SE. Celebes, Moluccas, New Guinea, Guam, Palau, Samoa.
8. *B. seaturae* — Fiji.

As remarked above *B. seaturae* is a link with Group II through its affinity with *B. racemosa*. The E. Malesian-Polynesian *B. samoensis* can be considered a link between *B. revoluta* and *B. seaturae*, also in flower and leaf characters: the calyx of *B. samoensis* differs from that of *B. revoluta* in having an apical pore when in bud; its leaves are very similar to those of *B. seaturae*. All 3 species belong to one pollen type.

IV. Petiolata Group. Fig. 9.

9. *B. petiolata* — Fiji.
10. *B. novae-hiberniae* — NE. New Guinea, Bismarcks, Solomons, New Hebrides.
11. *B. gigantostachya* — Java, a variety in NE. Borneo.
12. *B. integrifolia* — New Caledonia.
13. *B. edulis* — Fiji.
14. *B. papuana* — New Guinea.
15. *B. pterita* — Philippines.

In this group are also relationships with three Malesian species in Java, Borneo and Philippines, and New Guinea, the latter all being endemic. It is characterised by the many species with an apical pore in the bud stage and a more or less distinctly winged fruit. Only 2 species have sessile flowers (one has both sessile and pedicelled ones). In leaf and flower characters *B. petiolata* is related to *B. novae-hiberniae*. *B. gigantostachya* from Java and its var. *megistophylla* from Borneo are linking *B. petiolata* and *B. integrifolia*, because of the distinct apical pore in the closed calyx, the high number of staminal whorls and the 4-celled ovary. *B. edulis* and *B. integrifolia* differ in as much that the latter species has an apical pore. *B. edulis* and *B. novae-hiberniae* are mutually related, as well as to *B. papuana* and *B. petiolata*, because of the high connation of the staminodial whorl. *B. pterita* belongs to this group because of its leaf characters being similar to those of *B. papuana* and its winged fruit like that in *B. petiolata*. All belong to one pollen type in which *B. petiolata* and *B. gigantostachya* form a link with Group V.

V. Calyptrocalyx Group. Fig. 10.

16. *B. calyptrocalyx* — Aru Is., New Guinea, New Britain.
17. *B. apiculata* — SE. Celebes, Misool, Waigeo, New Guinea, Rossel I.
18. *B. lauterbachii* — Adi, Japen and Rossel Is., New Guinea.
19. *B. sarcostachys* — S. Sumatra, Borneo.
20. *B. ashtonii* — Borneo.

This group is largely New Guinean but reflects again affinities with West Malesian species, *B. apiculata* in SE. Celebes filling the gap.

B. calyptrocalyx, *B. apiculata*, and *B. lauterbachii* have many flower characters in common such as the high connate staminodial whorl, the calyx dehiscing circumscissile, and the flowers mostly pedicelled. *B. sarcostachys* is linked with *B. calyptrocalyx* because of the same number of staminal whorls, but more distinctly so by the leaf characters of *B. calyptrocalyx* and *B. sarcostachys* f. *dolichophylla* from Borneo. *B. sarcostachys* is related to *B. apiculata* by its coriaceous leaves and *B. ashtonii* is related to *B. lauterbachii* also because of leaf characters as well as the mucronate calyx. All species have one pollen type in common.

VI. Calyptrata Group. Fig. 13.

21. *B. calyptrata* — Aru Is., New Guinea, N. Australia.
22. *B. papeh* — SE. New Guinea, Bismarck Arch., Solomons.
23. *B. procera* — New Guinea, Bismarck Arch., Solomons, New Hebrides.

This group can be considered as centering in Melanesia, except for *B. calyptrata* reaching N. Australia and some islands along the Australian coast. It is characterised by cycadoid habit, *B. procera* excepted, by sessile flowers, and a high connation of the staminodial inner whorl. The calyx of *B. procera* disrupts into 4 segments, the calyx of *B. papeh* and *B. calyptrata* is circumscissile, and so the latter two species are closely related.

The pollen type of *B. papeh* is unique. That of the 2 other species fit, but their pollen type links this group with the Neocaledonica Group of § *Stravadium*.

1. **B. asiatica** (L.) Kurz, Rep. Pegu (1875) App. A, lxv, App. B, 52 *in clavi*; J. As. Soc. Beng. 45, ii (1876) 131; *op. cit.* 46, ii (1877) 70; Druce, Rep. Bot. Exch. Cl. & Soc. Br. Isl. 3 (1914) 414; Merr., Int. Rumph. (1917) 384; Setchell, Dep. Mar. Biol. Carn. Inst. Wash. 20 (1924) 63; Merr., Philip. J. Sc. 29 (1926) 405; Booberg, Bot. Jahrb. 66 (1933) 18; Wilder, Bull. Bern. P. Bish. Mus. 120 (1934) 35; Burkill, Dict. Ec. Prod. 1 (1935) 304; Christophersen, Bull. Bern. P. Bish. Mus. 128 (1935) 154; Brown, Bull. Bern. P. Bish. Mus. 130 (1935) 203; Kanehira, En. Micron. 4 (1935) 376; Henderson, J. Mal. Br. R. As. Soc. 17 (1939) 45; Guillaumin, Bull. Soc. Bot. Fr. 86 (1939) 174; Knuth, Pfl. R. Heft 105 (1939) 10, fig. 3 J—K; Corner, Ways. Trees (1940) 353, pl. 72; Yuncker, Bull. Bern. P. Bish. Mus. 178 (1943) 88; *op. cit.* 184 (1945) 53; Walker, For. Br. Solomon Is. (1948) 130; Guillaumin, Ann. Mus. Col. Marseille 55/56 (1948) 38; Fl. Nouv. Caléd. (1948) 226; Meijer Drees, Comm. For. Res. Inst. 33 (1951) 63; Glassmann, Bull. Bern. P. Bish. Mus. 209 (1952) 62; Borssum Waalkes, Trop. Nat. 32 (1952) 37, fig. 1; Merr., Chron. Bot. 14 (1954) 348, 351; Browne, For. Trees Sarawak (1955) 217; Yuncker, Bull. Bern. P. Bish. Mus. 220 (1959) 196; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 106; Fosberg & Sachet, Atoll Res. Bull. 92 (1962) 28; Backer & Bakh. *f.*, Flora of Java 1 (1963) 352; Parham, Pl. Fiji Isl. (1964) 143; Neal, In Gardens of Hawaii (1965) 622, fig. 241. — *Mammea asiatica* Linné, Sp. Pl. 1 (1753) 512; Osbeck, Dagbok Ostindisk Resa (1757) 278; Murr., Syst. Veg. ed. 13 (1774) 409. — *B. littorea* Oken, Allg. Naturgesch. 3, (3) (1841) 1925; *cf.* Merr., J. Arn. Arb. 31 (1950) 271. — *Agasta asiatica* Miers, Trans. Linn. Soc. Bot. 1 (1875) 61, t. 12,

fig. 10—16. — *Michelia asiatica* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240. — **Photogr. 1—2, fig. 1a—c, 2 B—C.**

Fructus peregrinus tetragonus Clusius, Exot. lib. 2 (1605) cap. 5, 26; Bauhin, Hist. 1, lib. 3 (1650) 397.

Butonica Rumphius, Herb. Amb. 3 (1743) 179, t. 114; Lamk, Enc. 1 (1785) 521; Ill. 3 (1797) t. 590, 591 f. 1. — *Butonica rumphiana* Miers, Trans. Linn. Soc. Bot. 1 (1875) 68, t. 13, fig. 23, *pro parte, pro syn. Rumph.*

B. speciosa J. R. & G. Forster, Char. Gen. (1776) 76, t. 38; [G. Forster, Icon. Ined. 2 (1776) t. 191; J. F. Miller, Icon. Ined. 2 (1776) t. 7, in BM ~ Linn. *f.*, Suppl. (1781) 312; Thunb., Nov. Gen. Plant. 2 (1782) 47; Murr., Syst. Veg. 14 (1784) 620; Cook's Voy. 1 (1784) t. 24; G. Forster, Prodr. Fl. Austr. (1786) 47; Gaertn., Fruct. 2 (1791) 96, tab. 101; Gmelin, Syst. Nat. 2 (1791) 1000, 1039; Kerner, Hort. Semp. 1 (1796) t. 28; Willd., Sp. Pl. 3, 1 (1800) 845; Roxb., Hort. Beng. (1814) 52; Spreng., Syst. Veg. 3 (1826) 127; Bl., Bijdr. (1826) 1096; DC., Prod. 3 (1828) 288; Gaudich., Voy. Freyc. (1830) 483; W. & A., Prod. (1834) 333; Kostel., Allg. Med. Pharm. Fl. 4 (1835) 1535; Guillem., Zeph. Tait. Ann. Sc. Nat. II, 7 (1837) 358; Blanco, Fl. Filip. (1837) 533; Span., Linnaea 15 (1841) 204; Paxton, Mag. Bot. 10 (1843) 241, *ic. col.*; Wight, Icon. 2 (1843) 3, t. 547; Hassk., Flora 27 (1844) 594; Cat. Hort. Bog. (1844) 262; Voigt, Hort. Calc. (1845) 51; Lindley, Veg. Kingdom (1846) 755, t. 503; Miq., Anal. Bot. Ind. 1 (1850) 28; Bl., in Fl. Serr. 4 (1848) 409, *ic. col.*; *op. cit.* 7 (1851) 23; Walp., Ann. 2 (1852) 641; A. Gray, U.S. Expl. Exped. 1 (1854) 508; Miq., Fl. Ind. Bat. 1, 1 (1855) 485, 492, 1087; Pl. Jungh. (1855) 413; De Vriese, Pl. Ind. Bat. Or. (1856) 78; Walp., Ann. 4 (1857) 850; Thwaites, En. Zeyl. (1859) 119; Pancher in Cuzent, Iles de la Soc. Tahiti (1860) 232; Montrouzier, Mém. Acad. Lyon 10 (1860) 209; Seem., A mission to Viti (1862) 436; Kurz, Nat. Tijd. Ned. Ind. 27 (1864) 164; Seem., Fl. Vit. 1 (1866) 82; Bedd., Fl. Sylv. Madr. 3 (1869) 112; F. v. M. in Campbell, A Year in New Hebr., App. (1873) 11; Nadeaud, En. Pl. Tahiti (1873) 79; F. v. M., Fragm. 9 (1875) 118, 190; Miers, Trans. Linn. Soc. Bot. 1 (1875) 56, t. 10; Kurz, J. As. Soc. Beng. 45, ii (1876) 131; Fl. Burma 1 (1877) 496; Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 507; Bisschop Grevelink, Pl. Ned. Ind. (1883) 158; K. Sch., Bot. Jahrb. 9 (1887) 213; K. Sch. & Hollr., Fl. Kais. Wilh. Land (1889) 91; Warb., Bot. Jahrb. 13 (1891) 388; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33, fig. 13; Drake del Castillo, Fl. Polyn. Franç. (1893) 68; Engl., Notizbl. Berlin 1 (1897) 225; K. Sch., Notizbl. Berlin 2 (1898) 136; Reinecke, Bot. Jahrb. 25 (1898) 660; Bailey, Queensl. Fl. 2 (1900) 666; K. Sch. & Laut., Fl. Schutzgeb. (1900) 463; King, J. As. Soc. Beng. 70, ii (1901) 135; Merr., Dep. Int. Bur. Gov. Lab. 27 (1905) 46; Safford, Contr. U.S. Nat. Herb. 9 (1905) 196, pl. 38; Usteri, Vierteljahrschr. Naturf. Ges. Zürich 50 (1906) 440; Brandis, Ind. Trees (1906) 330; Matsamura & Hayata, J. Coll. Sci. Imp. Univ. Tokyo 22 (1906) 145; Val., Bull. Dép. Agr. Ind. Néerl. 10 (1907) 37; Rechinger, Denkschr. Wien. Akad. Wiss. 85 (1910) 320; Guillaumin, Ann. Mus. Col. Marseille 19 (1911) 155; Backer, Schoolfl. (1911) 529; Hayata, Ic. Plant. Form. 2 (1912) 21; Bailey, Cat. Queensl. Pl. (1913) 209; C. T. White, Proc. Linn. Soc. N.S.W. 44 (1919) 822; Gagn. in Fl. Gén. I.-C. 2 (1921) 854; Laut., Bot. Jahrb. 56 (1921) 528; *op. cit.* 57 (1922) 350; Ridl., Fl. Mal. Pen. 1 (1922) 756; C. T. White, Proc. R. Soc. Queensl. 38 (1927) 248; J. Arn. Arb. 10 (1929) 246; Watson, Mal. For. Rec. 6 (1928) 94; Malm in Fedde, Rep. 34 (1933) 283; Lloyd & Aiken, Bull. Lloyd Libr. & Mus. 33 (1934) 79, fig. 79, 80; Parham, Dep. Agr. Fiji Bull. 21A (1942) 42, 70; Peekel, Ill. Fl. Bism. Arch. (1945) 1285, fig. 1284 (*ined.*); Tang-shui Liu, Ill. Lign. Pl. Taiwan 1 (1960) 280, tab. 232, photogr. — *Commersona speciosa* Salisbury, Prod. (1796) 355. — *Butonica speciosa* J. St. Hil., Exp. Fam. Nat. 2 (1805) 166. — *B. butonica* Forster *ex* Cuzent, Iles de la Soc. Tahiti

(1860) 213, *nomen invalid.*; Drake del Castillo, Ill Fl. Ins. Pac. (1890) 171; Cheeseman, Trans. Linn. Soc. II, Bot. 6 (1903) 280; Wilder, Bull. Bern. P. Bish. Mus. 86 (1931) 79; Perrier de la Bâthie, Fl. de Madag. 149 (1954) 2. — *Huttum speciosum* Britten, Journ. Bot. 39 (1901) 67.

Commerçona Sonnerat, Voy. Guin. 1 (1776) 14, t. 8—9. — *Mitraria commersonia* Gmelin, Syst. Nat. 1 (1791) 799.

B. lévequii Jardin, Mém. Soc. Imp. Sc. Nat. Cherb. 5 (1857) 296, 311, *nomen.* — *B. senequei* Jardin, Bull. Soc. Linn. Normand. sér. 2, 9 (1875) 305; Guillaumin, Bull. Soc. Bot. Fr. 86 (1939) 174. — *B. senequli* Jardin, *ex* Ind. Kew. 1 (1895) 276. — *B. seneguli* Jardin, *ex* Knuth, Pfl. R. Heft 105 (1939) 50. — *B. senequili* Jardin, *ex* Guillaumin, Bull. Soc. Bot. Fr. 86 (1939) 174.

Agasta indica Miers, Trans. Linn. Soc. Bot. 1 (1875) 63, t. 12, fig. 1—9.

Agasta splendida Miers, Trans. Linn. Soc. Bot. 1 (1875) 60, t. 11. — *Butonica splendida* Solander, Prim. Flor. Ins. Oc. Pac. (1769) 281 (*ined.*); Parkinson, Illustr. 1, t. 54—58 (*ined.*); in BM.

Tree, 7—20(—30) m; dbh *c.* 25—100 cm; twigs thick, 6—10 mm ∅, with large leaf-scars. *Leaves* obovate or obovate-oblong, glabrous, *c.* (15—)20—38(—52) by (7—)10—18(—21) cm (leaf-index 1½—2½), subcoriaceous, entire, emarginate to mucronate, base cuneate, nerves 6—10 pairs, marginal vein distinct; petiole very short, *c.* ½ cm. Cataphylls 1½—3 by ¾—1 cm. *Raceme* terminal, more rarely some near the top of the branch lateral, erect, *c.* 2—15(—20) cm with (3—)7(—20) flowers. Bracts sessile, oval *c.* 8—15(—20) by 4—10(—15) mm, papyraceous, rounded. Bracteoles triangular, *c.* 1½—5 by ½—1½ mm. Pedicels *c.* 4—6(—8) cm. Opening buds 2—4 cm. *Calyx* tube *c.* 3 mm high, not accrescent, closed in bud, rupturing into 2 unequal segments almost circular or acuminate *c.* 3—4 by 2—3 cm, persistent, accrescent, chartaceous. *Petals* 4, elliptic, convex, *c.* 5½—8½ by 2½—4½ cm, obtuse, sometimes emarginate, insertion *c.* 6—9(—12) mm wide. *Staminal tube c.* 1½—6 mm high; stamens in 6 whorls, inner one staminodial, *c.* (8—)12(—15) cm, staminodia *c.* 2—3½ cm, anthers *c.* 1—2 by 1 mm. *Ovary* 4(—5)-celled, tetragonous to subglobular, *c.* 5—9 by 4—7 mm; ovules 4(—5) per cell (total number 16—23); septa not always complete; style *c.* 9—13½ cm, accrescent to *c.* 15 cm. Disk a thick glabrous ring *c.* 1 mm high. *Fruit* ovate *c.* 8½—11 by 8½—10 cm, tapering to apex, sharply tetragonous to the emarginate base; pedicel ± square, *c.* 7 mm ∅; exocarp thin with glandular dots and a shiny cuticle, mesocarp 2—2½ cm thick, spongy, with a layer of longitudinal fibres closely arranged against the exocarp and some dispersed in the parenchyma, endocarp a thick layer of longitudinal anastomosing fibres between 2 thin membranes. *Seed* oblong, *c.* 4—5 by 2½—4 cm, subtetragonous, tapering to the emarginate apex.

Typification: *B. asiatica* Kurz, *Mammea asiatica* L., *B. littorea* Oken, *Agasta asiatica* Miers, *Michelia asiatica* O. Kuntze: *Osbeck s.n.* (Prinsen l., off W. Java), holotype in LINN., isotype in S.

Butonica rumphiana Miers: Fig. in Rumphius, Herb. Amb. 3 (1743) 179, t. 114.

B. speciosa J. R. & G. Forster, *Commersona speciosa* Salisbury, *Butonica speciosa* J. St. Hil., *Huttum speciosum* Britten, *B. butonica* J. R. & G. Forster *ex* Cuzent: *Forster s.n.* (Tahiti), holotype in BM.

Commerçona Sonnerat, *Mitraria commersonia* Gmelin: t. 8—9 in Sonnerat, Voy. Guin. 1 (1776).

Agasta indica Miers: Hermann icon. tab. 241, in BM.

Agasta splendida Miers, *Butonica splendida* Solander: *Banks & Solander s.n.* (Tahiti), holotype in BM, isotype in P.

Distribution: Comores, Madagascar, Seychelles, Mauritius, Coromandel Coast of India, Ceylon, Andaman Is., Thailand, Cambodia, S. Vietnam, throughout Malesia, Formosa, Marianas, Carolines, N. Australia (Queensland), Bismarcks and Solomons, Marshall Is., New Hebrides, New Caledonia, Fiji, Tonga, Samoa, Cook I., Society Is. (Tahiti). Introduced in Hawaii, the West Indies (Jamaica, Haiti, Martinique, Trinidad, and British Guiana) as well as in St. Helena.

Ecology: Almost exclusively a littoral species belonging to the characteristic coastal forest belt, the so-called *Barringtonia* formation. Photogr. 1. In some localities trees are also growing further inland on higher ground, out of reach of the surf, even on high calcareous hills or cliffs near the coast (*viz.* Celebes and Tonga Is.). In the Seychelles it has been found in forest relics at an altitude of 350 m. Generally growing on predominantly abrasive sandy beaches, coral-sand flats or open spaces, presumably sandy ridges of former beaches, along river-banks (Ambon), and in mangrove-swamps (Solomons and Samoa). Often associated with *Hernandia*, *Calophyllum*, *Guettarda*, *Scaevola*, coconuts, *etc.* and breadfruit (Carolines). Altitude: mostly at sea-level, occasionally higher, up to 350 m. Fl., fr. Jan.—Dec., but in full bloom generally in May and Aug.—Sept. See Schimper, Indo-Mal. Strandflora (1891) 68, 172; Booberg (1933) *op. cit.*; Papy, Trav. Lab. For. Toulouse 5 (1955) 2e section, vol. 1, art. 3.

Compilation of field-notes: Tree spreading, often crooked, in a few localities with thick buttresses, spreading to 1.20 m wide (Solomon Is.). Bark brown or grey, slightly grooved and longitudinally fissured, thick, lenticells often distinctly diamond-shaped. Sapwood and heartwood not clearly defined, white, cream, or pale yellow. Fresh wood floats. Leaves reported to be fleshy, very smooth, shiny bright green above, pale green beneath. Petiole reddish coloured. Flowers with a fragrant smell, once mentioned to be like that of roses (Sumatra); opening between 6.30 and 7.30 p.m. or later in the evening. Petals white. In 8 cases petals reported to have pink veins or margin, twice as greenish white and once as pale yellow (Solomon Is.). Sepals green. Stamens white at the base and pink, red, or purple at apex. Anthers yellow. Style basal part white, apex red, stigma white. Fruit green, shiny.

Galls: Leaf-galls caused by a gall-midge are reported from the underside of the leaves from a plant collected in Ambon. See Docters van Leeuwen-Reynvaan, Ned. Kruidk. Arch. 51 (1941) 196.

Germination: From seeds sent to me by Mr. Dennis (Honiara, Solomon Is.) I made a detailed study. In the tropical hothouse at Leyden the seeds germinated slowly. From the central part of the seed first several lateral roots developed. At the apex a thick axis with bright red cataphylls developed *c.* 1 cm ∅. See fig. 1 a—c. As soon as the stem was *c.* 12 cm three leaves appeared which at first were enveloping the growing apex. The sequence of development was as follows: 31/3 seed sown; 12/5 stem 5 cm high, with 7 cataphylls; 16/5 stem 9½ cm high; 18/5 stem 12 cm high, first 3 leaves appear, first erect then assuming a horizontal position; 31/5 stem 15 cm, 8 leaves developed; 5/7 stem 19½ cm, 8 leaves, 3 more cataphylls and more leaves appearing, all original cataphylls fallen off; 13/7 stem 23½ cm, 6 new leaves have developed; 9/8 stem 27 cm; 23/9 stem 31½ cm, 10 new leaves have developed.

Dispersal: Mature fruits have a very good buoyancy through the thick layer of spongy, fibrous pericarp. Dispersal by sea currents is thus very likely and, considering the distribution pattern, all islands with sandy coasts are the most likely sites for germination and development of the seeds. Local dispersal by squirrels has been mentioned by Papy from Tahiti. See Ridley, Disp. (1930) 291, 292; Papy, Trav. Lab. For. Toulouse 5 (1955) 2e section, vol. 1, art. 3, p. 297.

Vernaculars: In the Andaman Is. it is *Kyee-bin*, in Malaya *Putat-laut*. From Sumatra, Java, Lingga, Borneo, and Sulu Is. the name *Butun*, also *Butun alas*, *Pôkok butun*, *Boó-tun* and other variants are reported. From Java the name *Kěběn* is mentioned 5 times. From the Pacific *Vutu* or *Futu* is the most commonly used name with the following variants: *Tetu*, *Utu*, *Hutu*, *Vutu nganga*. On the Carolines *Gul* or *Kul* has been mentioned 5 times.

Uses: Wood. Balfour, Timbertrees ed. 2 (1862) 44 gave a survey of the different uses made of the wood. Bisschop Grevelink (1883) *op. cit.* stated that it is not very durable, hence not very suitable for construction work. On the field label of a Caroline specimen is noted that it is used for construction work and the making of bowls. On Rurutu I. canoes are made of it and in Tonga it is used for various handwork.

The Forest Research Institute, Bogor, tested wood collected in Billiton and reported: trees easy to cut down and easy to shave, but difficult to split or saw. Resistance against decay, termites, burrowing worms, and insects is rather poor. On durability see also references given below.

Wood-anatomy: Good surveys on the wood-anatomy are found in: Schneider, Bur. For. Bull. 14 (1916) 178; Moll & Janssonius, Mikrographie 3 (1918) 489, fig. 196; Kanehira, Anat. Char. Formosan Woods (1921) 11, pl. 22, fig. 128, 129; Desch, Mal. For. Rec. 15 (1941) 252; Walker, For. Br. Solomon Isl. Protect. (1948) 130.

Fish-poison: Fruit, bark, and mostly pounded fresh seeds are used as a fish-poison. Also some chemical analytical work has been done by Van den Driessen-Mareeuw (1903) in his thesis 'Ueber die Samen von B. speciosa (Gärtn.)', and Boorsma, Pharm. Mitt. IV in Bull. Dep. Agr. Ind. Néerl. 16 (1908) 17. See further: Greshoff, Meded. 's Lands Pl. Tuin 10 (1893) 82; Nutt. Ind. Pl. 1 (1896) 11, fig. 27; Meded. 's Lands Pl. Tuin 29 (1900) 75, 176; Duyster, Gift. Ind. Pl. (1927) 114; Tattersfield, Martin & Howes, Kew Bull. (1940) 170; Quisumbing, Philip. J. Sc. 77 (1948) 165.

Medicinal uses: On field labels from Mauritius, Carolines, Marshalls, and Antigua (Br. W. Indies) the use of bark, fruit, and leaves is reported for alleviating headache, treating sores or bad dreams. Young shoots are said to be eaten by dwarf deer (Pelanduk) on Pulau Sebangka (Lingga).

Remarks: *B. asiatica* is the oldest known species of *Barringtonia*. It was described by Clusius in 1605 in his Exoticorum, he gave also a figure of the fruit; the name *Peregrinus fructus tetragonus* is written in Greek characters, the long description is in Latin. Rumphius (1743) *op. cit.* referred to Clusius and gives a more detailed drawing of a twig with leaves as well as flowers. Miers (1875) *op. cit.* in his description of *B. rumphiana* referred to Rumphius' drawing (as well as to Clusius), but the material cited and the drawings on tab. 13 are discordant. The Schomburgk material from Siam I have seen at BM belongs to *B. racemosa* (L.) Spreng. The figures 18—22 on tab. 13 do not represent flowers of *B. asiatica*, the fruit on fig. 23, however, is a typical fruit of *B. asiatica*. I have therefore referred *Butonica rumphiana* as a synonym to *B. asiatica pro parte, pro syn. Rumph.*

Linnaeus based *Mammea asiatica* on an Osbeck specimen collected in Java (Prinsen I.); this specimen is preserved.

The most commonly used name for the species is *B. speciosa* J. R. & G. Forster, based on material from Tahiti. The Forsters are also the authors of the generic name *Barringtonia* in honour of Sir Daines Barrington (1727—1800).

A *nomen nudum* spelled in 5 different ways has been found in literature. Jardin proposed the name *B. lévequii* to a plant from an island near 'Ile de la Madelaine' in the 'Marquises' and said to be different from *B. asiatica*, but as far as I could judge from his statement it is only a young fruit from this species.

2. B. conoidea Griff., Notul. 4 (1854) 656; Ic. Pl. As. 4 (1854) t. 635, 636, fig. 1; Kurz, Rep. Pegu (1875) App. A, lXV, App. B, 52 *in clavi*; J. As. Soc. Beng. 46, ii (1877) 70; Fl. Burma 1 (1877) 497; Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 508; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; King, J. As. Soc. Beng. 70, ii (1901) 136; Brandis, Ind. Trees (1906) 330; Merr., J. Str. Br. R. As. Soc. 77 (1917) 204; Gagn. in Fl. Gén. I.-C. 2 (1921) 854; Merr., En. Born. (1921) 419; Ridl., Fl. Mal. Pen. 1 (1922) 757; Corner, Ways. Trees 1 (1940) 354 fig. 122; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 106. — *Michelia conoidea* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240.

Butonica alata (Wall.) Miers, Trans. Linn. Soc. Bot. 1 (1875) 70, t. 14 fig. 10—15. — *B. alata* Wall. [Cat. (1831) 3633, *nomen*] *ex* Knuth, Pfl. R. Heft 105 (1939) 15; Masamune, En. Phan. Born. (1942) 513. — **Fig. 5.**

Small tree or shrub *c.* 3—15 m; dbh *c.* 10—15 cm; twigs 4—9 mm ∅. *Leaves* obovate-oblong, glabrous, *c.* 12—28 by (4—)7—10 cm (leaf-index 2½—3½), chartaceous, serrate-crenulate, rounded, sometimes emarginate, rarely acute, base auriculate or emarginate, midrib prominent at both sides, nerves 10—15 pairs, less prominent above than beneath, venation very distinct underneath; petiole sometimes slightly winged, *c.* 1—4(—7) mm. Cataphylls triangular-lanceolate, *c.* 5—10 by 3—4½ mm. *Racemes* terminal or ramiflorous, pendulous, *c.* (2—)5—10(—60) cm (up to 12 flowers on a raceme of 10 cm), rachis longitudinally fissured, finely puberulous. Bracts triangular, *c.* 5 by 2 mm, acute. Pedicels *c.* 5—9 mm, accrescent to 15—20 by ½ mm. Opening buds *c.* 4—8 by 5—8 mm, mucronate. *Calyx* connate in bud; tube *c.* 2 mm high; limb rupturing into 2 equal, ovate or almost circular segments *c.* 8—13 by 7—10 mm, ± accrescent, chartaceous. *Petals* 4, elliptic, obtuse, convex, *c.* 1½—1¾ by ¾—1 cm, membranous, fimbriate; insertion *c.* 4—5 mm wide. *Staminal tube c.* 3 mm high; stamens in 5(—6) whorls, inner one staminodial; filaments *c.* 25 mm; staminodia *c.* 4 mm; anthers *c.* ¾ by ¾ by ⅓ mm. Disk a thin ring, ¾—2 mm high. *Ovary* 4-celled, ± cylindrical, *c.* 2½—5 by 2½—3½ mm, with 8 wing-like appendages at the base; ovules 1—3 per cell (total number *c.* 8—10 per ovary); septa complete; style *c.* 2½—3¼ cm. *Fruit* conoid, *c.* 3—5 by 2½—4½ cm, distinctly 8-winged, wings *c.* 12—17 by 6—13 mm; fruit pedicel *c.* 15—20 by 1½ mm; pericarp *c.* 4 mm thick, exocarp thin, mesocarp with very little spongy parenchyma and mainly consisting of anastomosing fibres, endocarp a thick brown membrane. *Seed* ovoid, *c.* 3 by 1½ by 1 cm, fissured, pointed, rounded at base.

Typification: *B. conoidea* Griffith, *Michelia conoidea* O. Kuntze: *Griffith KD 2423* (Malaya), holotype in K, isotype in P.

Butonica alata Miers, *B. alata* Wall. *ex* Knuth: *Wallich 3633* (Moulmein), holotype in K, isotypes in BM (loose flowers only) and CGE.

Distribution: Burma (Tenasserim), Sumatra (Palembang area only), Malaya, Banka, Borneo. Fig. 6.

Ecology: Growing in water or in regularly inundated areas near the limit of saline influence; also along the tidal part of rivers above the *Nypa*-zone. Locally common, at sea-level. Fl., fr. Jan.—Dec.

Compilation of field-notes: Petals white; fruit red and green.

Vernaculars: In Malaya it is called *Putat napi* or *nasik*, in Banka *Putat sungei* and in W. Borneo *Kaju putat.*

Remarks: In the Leyden Herbarium are 2 sheets said to have been collected by Mr. Ploem, stamped at Leyden as coming from 'Java, Preanger', but this is certainly erroneous. It is more likely to be a collection from Banka, where Ploem also collected. See Fl. Mal. I, 1 (1950) xxviii, 409. *B. conoidea* does not occur in Java.

Miers (1875) *op. cit.* 66, cited amongst his specimens for *Butonica alba* a Griffith col-

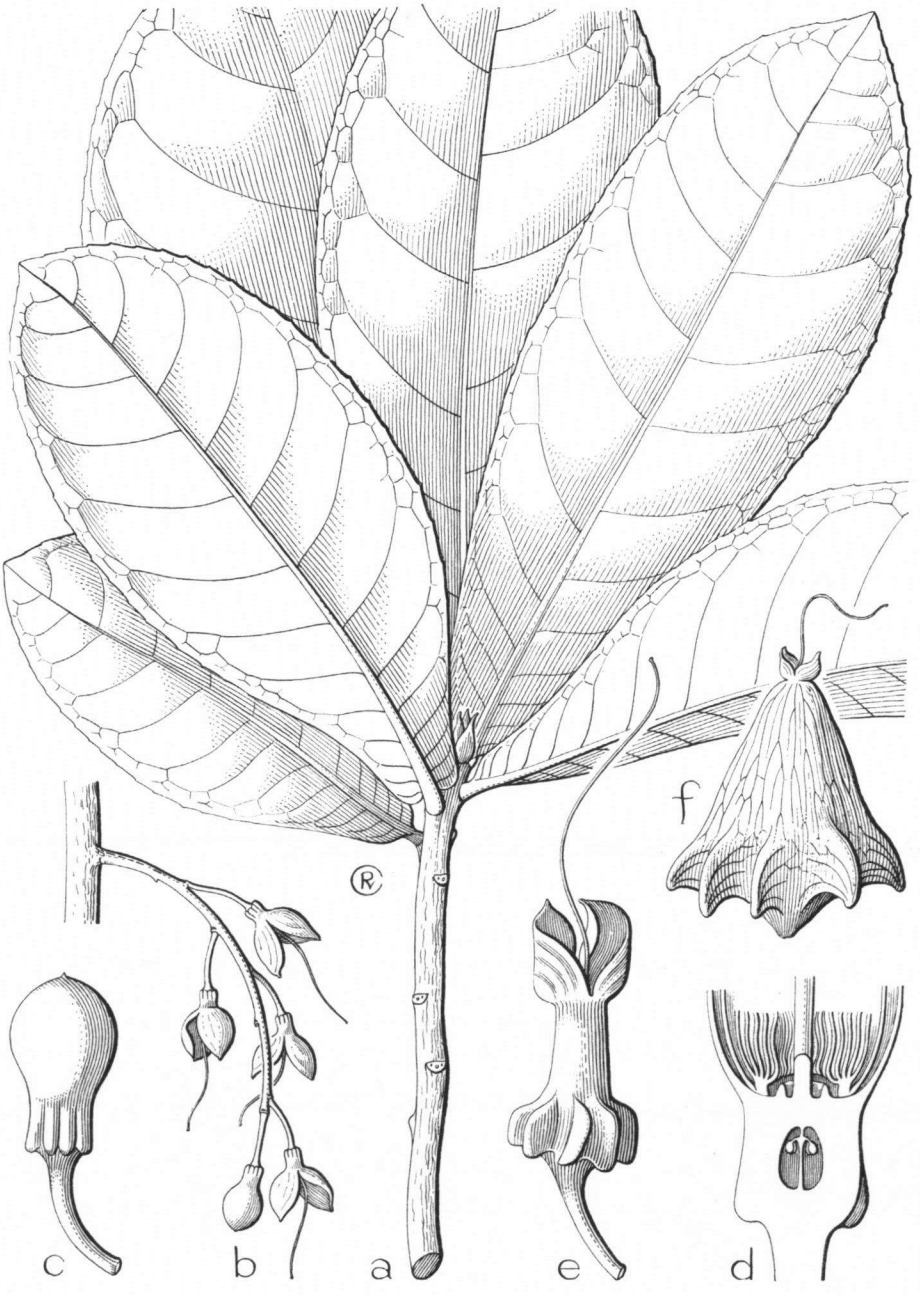


Fig. 5. *Barringtonia conoidea* Griff. a—b. Habit, × $\frac{2}{3}$, c. bud, × 2, d. ditto, in section, × 4, e. very young fruit, × 2, f. fruit, × $\frac{2}{3}$ (a—b. *J. S. Goodenough s.n.*, 15-III-90, c—d., f. *BRUN 5382* (*Corner*), e. *SFN 36739* (*G. H. Spare*)).

lection from Mergui. This specimen I have seen at Kew and belongs to *B. conoidea*. Miers's drawing of *Butonica alba* on tab. 13 is a mixture of flowers of *B. conoidea* (fig. 1—7) and fruit of *B. racemosa* (fig. 8—9).

Miers (1875) *op. cit.* 70 and 71 stated that tab. 636 fig. 1—6 of Griffith's Ic. Pl. As. 4 (1854) do not represent good drawings of the fruit of *B. conoidea*. This statement is not to the mark: they fit the *Wallich 3633* material as well as the drawing of Miers tab. 14 depicting his *Butonica alata*.

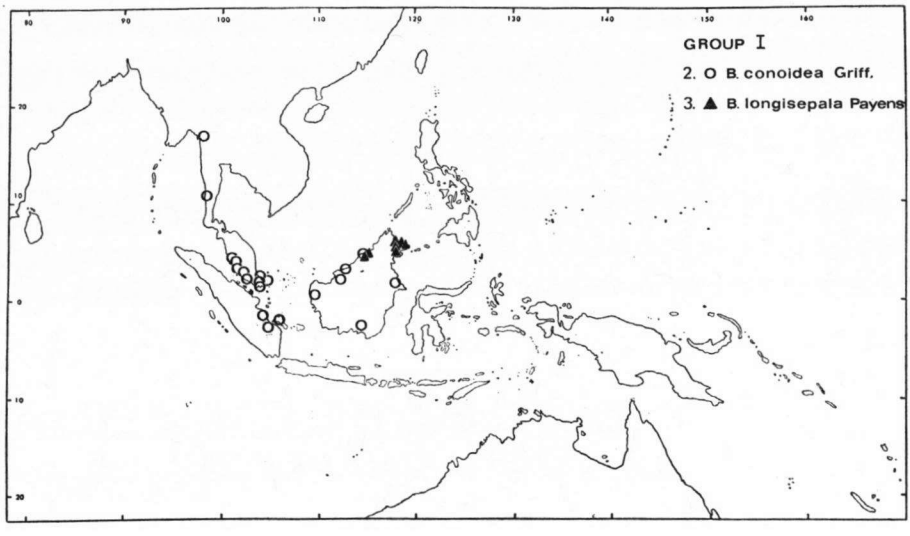


Fig. 6. Localities of the species of Group I.

3. B. longisepala Payens, *sp. nov.*

Folia oblonga, obovata vel obovato-oblonga usque -lanceolata, distincte petiolata, coriacea, glabra, supra nitentia, integra, nervis lateralibus 11—15(—18)-paribus. Racemi terminales, rachis crassa. Flores magni, calyce in gemma clauso, parte libero in segmenta 3 vel 4 accrescentia rumpente. Stamina exteriora bene evoluta 5—6-seriata, interiora uniseriata staminoidea. Ovarium 4-loculare, tetragonum, puberulum. Drupa oblonga, truncata.

Tree, *c.* 10—21 m; dbh *c.* (9—)17—35 cm; twigs *c.* 4—6(—8) mm ∅. *Leaves* oblong, obovate, or obovate-oblong to obovate-lanceolate, coriaceous, glabrous, glossy above, *c.* (10—)15—20(—23) by (3—)4—7(—8) cm (leaf-index (2½—)3—4), entire, acuminate (sometimes acute or rounded), base cuneate, midrib and nerves prominent at both sides; nerves *c.* 11—15(—18) pairs; petiole *c.* 2—5 cm. *Racemes* terminal, *c.* 25—86 cm, up to 30 flowers, rachis *c.* 3—4 mm ∅, accrescent to 6—8 mm, yellowish puberulous. Cataphylls *c.* 6 by 1½ mm. Bracts lanceolate, *c.* 5—11 by 1—3 mm. Opening buds *c.* 12—20 mm. Pedicel *c.* ½—1½ cm, slightly puberulous. *Calyx* closed in bud, sometimes with an apical pore when young, the limb rupturing into 3—4 ± equal segments, tube *c.* 2—5 mm high; segments elliptic, convex, *c.* 1—1¾ by 1—2 cm accrescent to *c.* 2½—3¼ by 1—2 cm, chartaceous, entire, acute, sometimes fimbriate. *Petals* 4, obovate to elliptic, convex,

c. 3½—4½ by 2—2½ cm, herbaceous, fimbriate, at apex rounded or obtuse, insertion *c.* 7—11 mm wide. *Staminal tube c.* 2—3 mm; stamens in 6(—7) whorls, inner one staminodial; filaments *c.* 4—6 cm, staminodia *c.* 1¼ cm, anthers *c.* ¾—1 by ¾ by ½ mm. Disk a ring *c.* 1—1½ mm high. *Ovary* 4-celled, tetragonous, ± puberulous, *c.* 7—10 by 4—7 by 4—6 mm; ovules 3—5 per cell (total number up to 11—18); septa incomplete; style *c.* 4—5½ cm, accrescent to 6½ cm. *Fruit* oblong, tetragonous, *c.* 13—14 by 5—5½ by 4½ cm, truncate; pericarp *c.* 5—11 mm thick, exocarp thin, ½ mm, mesocarp spongy with dispersed large and small fibres, *c.* 4—9 mm, endocarp thin, fibrous, *c.* 1—¾ mm. *Seed* ovoid, deeply fissured, *c.* 7 by 2½ by 1¾ cm.

Typification: *Sam SAN 26364 NT 198*, holotype in L, isotypes in SAN (not seen) and K (flowering material). Paratype: *Anderson S 5558*, in SAR, dupl. in BRUN (fruiting material).

Distribution: N. Borneo (Brunei and Sabah). Fig. 6.

Ecology: In primary and secondary forest on sandstone hills; once in a mixed peat-swamp on edge of a *Shorea albida* swamp, at low altitude up to 130 m. Fl. Febr.—Aug., fr. Jan., Sept.

Compilation of field-notes: Bark fissured, dark grey or grey-brown, with distinct lenticells. Sapwood white. Flowers red or white with red margin, young buds reddish green. Stamens white with red or pink apex and base. Fruit pink.

Vernaculars: *Putat* is mentioned 5 times. From Brunei *Rengas binjai* and *Rengas putat* (Iban) are also mentioned.

Remarks. In leaf, flower, and fruit characters, as well as to the pollen type, it is related to *B. asiatica* and *B. conoidea*.

4. B. racemosa (L.) Spreng., Syst. Veg. 3 (1826) 127; Bl. *ex* DC., Prod. 3 (1828) 288; Roxb. [Hort. Beng. (1814) 52, *nomen*], Fl. Ind. ed. Carey 2 (1832) 634; W. & A., Prod. 1 (1834) 333; Kostel., Allg. Med. Pharm. Fl. 4 (1835) 1535; Wight, Ic. Pl. Ind. Or. 1 (1839) t. 152; Hook. in Curtis, Bot. Mag. 67 (1841) 3831, fig. in col.; Hassk., Flora 27 (1844) 594; Voigt, Hort. Calc. (1845) 51; Korth., Ned. Kruidk. Arch. 1 (1846) 205; Miq., Analecta Bot. Ind. 1 (1850) 28; Bl., in Fl. Serr. 7 (1851) 23, *incl.* var. *minor* Bl., var. *elongata* (Korth.) Bl. *et* var. *procera* Bl.; Griff., Not. Pl. As. 4 (1854) 659; Ic. Pl. As. 4 (1854) 636, fig. II, 1—6; Miq., Pl. Jungh. (1855) 413; Fl. Ind. Bat. 1, 1 (1855) 486, *incl.* var. *subcuneata* Miq.; De Vriese, Pl. Ind. Bat. Or. (1856) 78; Thw., En. Zeyl. (1859) 119, *incl.* var. *α* and *β*; Dalz. & Gibs., Bomb. Fl. (1861) 94; Cleghorn, For. & Gard. S. India (1861) 251; Sonder, Fl. Cap. 2 (1862) 523; Balfour, Timber Trees ed. 2 (1862) 44; Vieill., Bull. Soc. Linn. Norm. 10 (1866) 98; Seem., Fl. Vit. (1866) 83, *excl. syn.* Forster; Bedd., Fl. Sylv. Madr. 3 (1869) 112; Lawson, Fl. Trop. Afr. 2 (1871) 438; F. v. M. in Campbell, A Year in New Hebr. (1873) app. 10; Kurz, Rep. Pegu (1875) App. A, lXVi, App. B, 52; J. As. Soc. Beng. 45, ii (1876) 131; Fl. Burma 1 (1877) 496; J. As. Soc. Beng. 46, ii (1877) 70; Baill., Hist. Pl. 6 (1877) 323, fig. 315, 316; Villar & Naves in Blanco, Fl. Filip. ed. 3, 2 (1878) 325, t. 240; Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 507; Villar, Nov. App. (1880) 86; Bisschop Grevelink, Pl. Ned. Ind. (1883) 157; Hemsley, Bot. Chall. Exp. 3 (1884) 152, 238; Vidal, Rev. Pl. Vasc. Filip. (1886) 133; Drake del Castillo, Ill. Fl. Ins. Pac. (1890) 171; Warb., Bot. Jahrb. 13 (1891) 388; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; Nairne, Flow. Pl. W. Ind. (1894) 115; Reinecke, Bot. Jahrb. 25 (1898) 660; Koord. & Val., Bijdr. 6 (1900) 6; Andrews, Mon. Christmas Is. (1900) 178; King, J. As. Soc. Beng. 70, ii (1901) 136; Volkens, Bot. Jahrb. 31 (1901) 470; Merr., Philip. Bur. For. Bull. 1 (1903) 42; Safford, Contr. U.S. Nat. Herb. 9 (1905) 195; Merr., Dep. Int. Bur. Gov. Lab. 27 (1905) 46; Matsumura & Hayata, En. Pl. Form.

in J. Coll. Sci. Imp. Univ. Tokyo 22 (1906) 144; Brandis, Ind. Trees ed. 1 (1906) 330; Usteri, Vierteljahrschr. Naturf. Ges. Zürich 50 (1906) 440; Guppy, Pl. Disp. 2 (1906) 573; Sim, For. Fl. Port. E. Afr. (1909) 68, t. 68; Merr., Philip. J. Sc. 3 (1909) Bot. 422; Rechinger, Denkschr. Wien. Akad. Wiss. 85 (1910) 320; Guillaumin, Ann. Mus. Col. Marseille 19 (1911) 155; Backer, Schoolfl. (1911) 530; Talbot, For. Fl. Bombay 2 (1911) 47; Koord., Exk. Fl. Java 2 (1912) 665; Laut., Nova Guinea 8 (1912) 845; Hayata, Ic. Pl. Form. 2 (1912) 21; Merr., Fl. Manila (1912) 345; Int. Rumph. (1917) 385; Kirtikar & Basu, Ind. Med. Pl. 1 (1918) 557, t. 426; Gamble, Fl. Pres. Madras 1 (1919) 487; Engl., Pflanzenwelt Afrikas 3, 2 (1921) 658, fig. 290; Troup, Silv. Ind. Tr. 2 (1921) 591; Laut., Bot. Jahrb. 56 (1921) 527; Merr., En. Born. (1921) 419; En. Philip. 3 (1923) 142; Gagn., Fl. Gén. I.-C. 2 (1921) 855; Laut., Bot. Jahrb. 57 (1922) 349, 353; Ridl., Fl. Mal. Pen. 1 (1922) 757; Hochreutiner, Candollea 2 (1925) 445; Marloth, Fl. S. Afr. 2 (1925) 218, fig. 140; Craib, Enum. 1 (1931) 672; Guillaumin, J. Arn. Arb. 12 (1931) 258; Steen., Arch. Hydrobiol. Suppl. 11 (1932) 310, fig. 65, 66, 68; Benthall, Trees Calc. (1933) 251; Booberg, Bot. Jahrb. 66 (1933) 19; Lloyd & Aiken, Bull. Lloyd Libr. Mus. 33 (1934) 78; Burkill, Dict. Ec. Prod. 1 (1935) 305; Merr., Trans. Am. Phil. Soc. 24, ii (1935) 281; Kanehira, J. Dep. Agr. Kyushu Imp. Univ. 4 (1935) 376; Form. Trees rev. ed. (1936) 491; Knuth, Pfl. R. Heft 105 (1939) 17; Merr. & Chun, Sunyatsenia 5 (1940) 142; Corner, Ways. Trees (1940) 355, fig. 123; Holthuis & Lam, Blumea 5 (1942) 134, 217; Parham, Dep. Agr. Fiji Bull. 21 A (1942) 42, 70; Peekel, Ill. Fl. Bism. Arch. (1945) 1290, fig. 1290 (*ined*); Guillaumin, Ann. Mus. Col. Marseilles 55/56 (1948) 38; Glassmann, Bull. Bern. P. Bish. Mus. 209 (1952) 62; Walker, Important Trees Ryukyu Isl. (1954) 230, fig. 143; Perrier de la Bâthie, Fl. Madag. 149 (1954) 4, fig. 2; Cufodontis, Bull. Jard. Bot. Brux. 29, Suppl. (1959) 613; Tang-Shui Liu, Ill. Lign. Pl. Taiwan 1 (1960) 281, t. 233 (in Chinese); Hundley & U Chit Ko Ko, List Trees Burma ed. 3 (1961) 107; Dale & Greenw., Kenya Trees & Shrubs (1961) 243, fig. 48; Backer & Bakh. *f.*, Fl. Java 1 (1963) 353; Parham, Pl. Fiji Isl. (1964) 143; Balgooy & Payens, Blumea, Suppl. 5 (1966) 27, 292, map 164. — *Eugenia racemosa* Linné, Sp. Pl. 1 (1753) 471; Lamk, Enc. Bot. 3 (1789) 197. — *Butonica racemosa* Miers, Trans. Linn. Soc. Bot. 1 (1875) 66, t. 13, fig. 11—17. — *Stravadium racemosum* Sweet, Hort. Brit. ed. 1 (1826) 159. — *Michelia racemosa* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240. — *Huttum racemosum* Britten, Journ. Bot. 39 (1901) 67.

Menichea rosata Sonnerat, Voy. Guin. 1 (1776) 133, t. 92—93. — *Butonica rosata* Miers, Trans. Linn. Soc. Bot. 1 (1875) 72, t. 14, fig. 16—18. — *Michelia rosata* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241. — *B. rosata* Knuth, Pfl. R. Heft 105 (1939) 19.

Stravadia alba Persoon, Syn. 2 (1807) 30, *nom. illeg., pro descr. Rumph., excl.* t. 116; DC. Prod. 3 (1828) 289, *ditto.*

B. stravadium Blanco, Fl. Filip. ed. 1 (1837) 533, *ex descr., sine typo*; *cf.* Merr., Dep. Int. Bur. Gov. Lab. 27 (1905) 46; Sp. Blanc. (1918) 282.

B. rosaria Oken, Allg. Naturgesch. 3, (3) (1841) 1926; *cf.* Merr., J. Arn. Arb. 31 (1950) 272.

B. elongata Korth., Ned. Kruidk. Arch. 1 (1846) 206; Walp., Ann. 2 (1852) 641. — *B. racemosa* var. *elongata* Bl., in Fl. Serr. 7 (1851) 23.

B. timorensis Bl., in Fl. Serr. 7 (1851) 23; Miq., Fl. Ind. Bat. 1, 1 (1855) 486; Walp., Ann. 4 (1857) 850; Britten in Forbes, Nat. Wand. (1885) 505; Knuth, Pfl. R. Heft 105 (1939) 19. — *Megadendron ? ambiguum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 110. — *Michelia timorensis* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241.

Stravadium obtusangulum Bl., in Fl. Serr. 7 (1851) 24, *excl. syn.*; Miers, Trans. Linn. Soc. Bot. 1 (1875) 81. — *B. obtusangula* Knuth, Pfl. R. Heft 105 (1939) 46.

B. excelsa (*non* Bl.) A. Gray, U.S. Expl. Exped. 1 (1854) 508.

Butonica rumphiana Miers, Trans. Linn. Soc. Bot. 1 (1875) 68, t. 13, fig. 18—24, *pro specim. typ., excl. syn. Rumph.* — *B. rumphiana* Knuth, Pfl. R. Heft 105 (1939) 19.

Butonica terrestris Miers, Trans. Linn. Soc. Bot. 1 (1875) 69, t. 14, fig. 4—9, *nomen illeg., excl. syn. Rumph. & Miq.* — *B. terrestris* Knuth, Pfl. R. Heft 105 (1939) 19, *excl. syn. Rumph. & Miq.*

Butonica inclyta Miers, Trans. Linn. Soc. Bot. 1 (1875) 71, t. 14, fig. 19. — *B. inclyta* Miers *ex* Jacks., Ind. Kew. 1 (1895) 276, *in synon.*

Butonica ceylanica Miers, Trans. Linn. Soc. Bot. 1 (1875) 77. — *B. ceylanica* Gardner *ex* Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 508; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; Knuth, Pfl. R. Heft 105 (1939) 15. — *Michelia zeylanica* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241.

Butonica apiculata Miers, Trans. Linn. Soc. Bot. 1 (1875) 78. — *Michelia apiculata* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240. — *B. apiculata* Knuth, Pfl. R. Heft 105 (1939) 18, *non* Laut. 1922.

Butonica caffra Miers, Trans. Linn. Soc. Bot. 1 (1875) 78. — *B. caffra* E. Mey. *ex* [Drège, Flora 26, ii (1843) Besondere Beigabe 157, 168, *nomen*] Knuth, Pfl. R. Heft 105 (1939) 19.

Megadendron pallidum Miers, Trans. Linn. Soc. Bot. 1 (1875) 110, *pro parte, quoad flores.* — *B. pallida* Koord. & Val., Bijdr. Booms. 6 (1900) 12; Koord., Exk. Fl. Java 2 (1912) 665; Knuth, Pfl. R. Heft 105 (1939) 22.

B. ? *costata* [*non* (Bl.) Miq.] Laut., Nova Guinea 8 (1910) 315.

B. salomonensis Rech. in Fedde, Rep. 11 (1912) 183; Denkschr. Kais. Akad. Wiss. Wien 89 (1914) 581, t. 5, fig. 9a; Knuth, Pfl. R. Heft 105 (1939) 26; Walker, For. Br. Solomon Isl. Protect. (1948) 131; repr. (1962) 131; C. T. White, J. Arn. Arb. 31 (1950) 99.

B. longiracemosa C. T. White, Proc. Linn. Soc. N.S.W. 44 (1919) 823, pl. 44; Contr. Arn. Arb. 4 (1933) 75.

B. celebesensis Knuth, Pfl. R. Heft 105 (1939) 17.

B. lageniformis Merr. & Perry, J. Arn. Arb. 21 (1940) 294, fig. 1A.

Shrub or small to medium-sized tree, 2—20(—27) m; dbh *c.* 10—50 cm; twigs *c.* 3—6 mm ∅. *Leaves* tufted, obovate-oblong or -lanceolate, glabrous, *c.* 14—36(—42) by 4—14(—16) cm (leaf-index 2—3½), papyraceous, serrate-crenulate, acute or acuminate, base cuneate, midrib and nerves less prominent above than beneath, nerves (10—)13—18 (—20) pairs; petiole slightly winged, ¼—1(—1½) cm. Cataphylls triangular, *c.* 5—11 by 2—8 mm. *Racemes* or *spikes* pendulous, mostly terminal, sometimes ramiflorous, *c.* 20—70(—100) cm; rachis glabrous or pulverulent, *c.* 2—3 mm ∅. Pedicels *c.* 3—16 (—25) mm, flattened, insertion a thick ring. Bracts triangular, *c.* 5—6 by 1½—2 mm. Bracteoles triangular, acute, *c.* 1½—2 by ½ mm. Opening buds *c.* 6—9 by 6—10 mm, often mucronate. *Calyx* closed in bud, rupturing into 2—4(—5) equal or unequal lobes; tube *c.* 2—5 mm high, accrescent; lobes elliptic, *c.* ¾—1½ by ½—1¼ cm, accrescent. *Petals* 4, elliptic, obtuse, convex, *c.* 1½—2½ by ½—1½ cm; insertion *c.* 2—5 mm wide. *Staminal tube c.* 3½—6 mm high; stamens in (5—)6 whorls, inner one staminodial; filaments *c.* 2½—3¾ cm, staminodia *c.* 1—1¼ cm; anthers *c.* ¾ by ¾ mm. Disk a thick, grooved ring. *Ovary* (2—)3—4-celled, ± globular, *c.* 1½—3½ mm; ovules 2—3 per cell (total number 8—9); septa complete; style *c.* (2—)3—5½ cm. *Fruit* ovoid, *c.* 5—7(—9) by 2—4(—5½) by 2—4(—5½) cm, truncate, tapering at base, subtetragonous, slightly winged when young; pericarp *c.* 3—12 mm thick; exocarp rather fleshy with dispersed fibres and a wrinkled, reticulate or fissured outer layer; endocarp a strong layer of longitudinal anastomosing fibres covered inside by a thin brown membrane. *Seed* ovoid, *c.* 2—4 by 1—2½ cm, subtetragonous, tapering towards the apex, rather flat at the base.

Typification: *B. racemosa* (L.) Spreng., *Eugenia racemosa* Linné, *Butonica racemosa* Miers, *Stravadium racemosum* Sweet, *Michelia racemosa* O. Kuntze, *Huttum racemosum* Britten: *Herb. Hermann fig. 212, 213 & 339*, syntypes in BM.

B. racemosa (L.) Spreng. var. *minor* Bl.: *Forsten 318*, holotype in L.

B. racemosa (L.) Spreng. var. *procera* Bl.: *Hasskarl 532* (W. Java), holotype in L.

B. racemosa (L.) Spreng. var. *subcuneata* Miq.: *Horsfield s.n.* (Java), holotype in K.

Menichea rosata Sonnerat, *Butonica rosata* Miers, *Michelia rosata* O. Kuntze, *B. rosata* Knuth: *Sonnerat op. cit. tab. 92—93.*

Stravadia alba Persoon: *Rumphius descr.*

B. stravadium Blanco: *Blanco descr.*

B. rosaria Oken: *Rheede et Rumph. descr.*

B. elongata Korth., *B. racemosa* (L.) Spreng. var. *elongata* Bl.: *Korthals s.n.* (Borneo), *Herb. Lugd. Bat. 898.204.202*, holotype in L.

B. timorensis Bl., *Megadendron ? ambiguum* Miers, *Michelia timorensis* O. Kuntze: *Zippelius s.n.* (Timor), *Herb. Lugd. Bat. 898.204. 236—238*, holotype in L, isotype in U.

Stravadium obtusangulum Bl., *B. obtusangula* Knuth: *Van Royen s.n.* (Ceylon), *Herb. Lugd. Bat. 898.204.144*, holotype in L.

Butonica rumphiana Miers, *B. rumphiana* Knuth: *Schomburgk s.n.* (Siam), holotype in BM, isotype in K.

Butonica terrestris Miers, *B. terrestris* Knuth: *Horsfield s.n.* (Banka), holotype in BM, isotype in K.

Butonica inclyta Miers, *B. inclyta* Jacks: *Griffith s.n.* (Malacca), holotype in K.

Butonica ceylanica Miers, *B. ceylanica* Gardner *ex* Clarke, *Michelia zeylanica* O. Kuntze: *Thwaites 2682* (Ceylon), syntype in K, isosyntype in BM; *Rottler s.n.* (India), syntype in K, isosyntypes in BM, BO, P, W.

Butonica apiculata Miers, *Michelia apiculata* O. Kuntze, *B. apiculata* Knuth, *non* Laut.: *Perville 517* (Madagascar), holotype in P, isotype in BM.

Butonica caffra Miers, *B. caffra* E. Mey. *ex* Knuth: *Drège 5369* (S. Africa), holotype in B (lost), isotypes in BM, K, L.

Megadendron pallidum Miers, *B. pallida* Koord. & Val.: *Horsfield s.n.* (Java, Patjitan), holotype in BM, isotypes in CGE, K, U.

B. salomonensis Rech.: *Rechinger 4787* (Bougainville), holotype in W.

B. longiracemosa C. T. White: *Bancroft s.n.* (Queensland) *Herb. BRI 38832*, holotype in BRI.

B. celebesensis Knuth: *Warburg 15129* (N. Celebes), holotype in B (lost), isotype in WRSL (only fl.).

B. lageniformis Merr. & Perry: *Brass 5776* (New Guinea), holotype in A, isotypes in BO, BRI.

Typification of pre-Linnean names by Rheede and Rumphius.

Rheede, Hort. Mal. 4, t. 6 and 7, had under the name *samstravadi* two entities, and Rumphius, Herb. Amb. 3, t. 114, 115, and 116, had under *butonica* three.

Lamarck, Encycl. 1 (1785) 521, used the Rumphian name *Butonica* t. 114 for this new genus. As he referred to it the earlier *Barringtonia* J. R. & G. Forst. in the synonymy, the name *Butonica* is accordingly superfluous and hence illegitimate.

Jussieu, Gen. Pl. (1789) 326, arranged both Rheede's and Rumphius's pre-Linnean names in his ordo vii. *Myrti*, using *Butonica*. He added to it a second genus *Stravadium*, obviously based on Rheede's plates, but also referring to it *Butonica alba* Rumph. t. 116. As a segregate from *Eugenia* L. (*pro E. racemosa* L.) this is a legitimate name.

Persoon, Syn. Pl. 2 (1807) 30, did not recognize *Butonica* but distributed the Rumphius

and Rheede records among two species under the generic name *Stravadia* as *S. alba* and *S. rubra*. Both specific names are superfluous, hence illegitimate, as under *S. alba* he refers as a synonym *Eugenia racemosa* L. and under *S. rubra* he refers *Eugenia acutangula* L. as a synonym.

Later authors, De Candolle, Blume, Miers, Merrill, and Lütjeharms & Van Ooststroom, have tried to interpret these pre-Linnean names but their records were of course mostly actually based on material which they tried to identify with the Rheede and Rumphian plates. As the interpretation of the Rumphian plates 115 and 116 has varied considerably, and I do not precisely agree with any of these interpretations, a full citation of all of these would be an extremely complicated matter; it would mean an endless number of references, almost all *pro parte* and excluding certain synonyms or parts of plates. As none of them would add to the botanical value of this revision I have concluded this to be a useless procedure and refrained to cite them. I simply suffice to give here my interpretation of the 5 original pre-Linnean plates:

(i) *Samstravadi* Rheede, 4, 11, t. 6 = *B. racemosa* (L.) Spreng.
(ii) *Tsjeria samstravadi* Rheede, 4, 15, t. 7 = *B. acutangula* (L.) Gaertn.
(iii) *Butonica* Rumphius, 3, 179, t. 114 = *B. asiatica* (L.) Kurz.
(iv) *Butonica terrestris rubra* Rumphius, 3, 181, t. 115 = *B. acutangula* (L.) Gaertn. The confusion about this name has probably come through the fact that Rumphius described and pictured the fruits as pedicelled, but the plate shows sessile flowers. This cannot occur in one specimen, but it can occur within the species of which one form has pedicelled flowers and fruit (ssp. *acutangula*) and the other has sessile flowers and fruit (ssp. *spicata*).
(v) *Butonica terrestris* (*silvestris*) *alba* Rumphius, 3, 181, t. 116 = *B. acutangula* (L.) Gaertn. The plate shows sessile fruits, pedicelled flowers, but one loose sessile flower. However, the description does not apply to *B. acutangula*, but in my opinion refers to *B. racemosa* (L.) Spreng.! Besides, the flower colours which gave rise to the Rumphian 'epithets' are confusing, as white and red flowers may occur in both *B. racemosa* and *B. acutangula*!

Distribution: E. & S. Africa (Kenya, Tanzania, Mozambique, Natal), Zanzibar, Mafia I., Comores, Madagascar, Seychelles, Malabar and Coromandel Coast of India, Ceylon, E. Bengal (Sundarbans), Andamans, Nicobars, Burma (Akyab, Bassein, Moulmein, Tenasserim), S. Thailand, Laos, throughout Malesia, Hainan, Formosa, Riu Kiu Is. (Oriomote I.), Marianas (Guam), Carolines (Palau, Yap, Truck, Ponape), N. Australia (Queensland), Bismarck Archipelago, Solomons, New Hebrides, New Caledonia, Fiji, Samoa. See Pac. Pl. Areas 2: map 164.

Ecology: In primary or secondary rain-forest, mostly restricted to inundated flood plains on tidal river banks, or in swampy localities along inland lakes and rivers; also behind the mangrove along tidal rivers or in upper mangrove swamps, forming almost pure stands. In East Java and Celebes it is also common or even gregarious in swamps or along lake shores under seasonally dry climate conditions.

The species also grows well under slightly saline conditions along tidal rivers (Burma, Borneo, New Guinea, Solomons, and Riu Kiu Is.) or on beaches near high water level (Java, New Guinea, Solomons). It has been found associated with *Nypa* (Brunei), *Hibiscus* and *Sonneratia* or *Heritiera* and *Myristica* (New Guinea), *Hibiscus*, *Pandanus*, and tree-ferns (Ponape), and on the edge of *Lumnitzera*-forest (Java) or just outside a *Cyrtosperma*-swamp (Caroline Is.).

There is a preference for heavy clay, loam, or rich volcanic soil, but trees also grow on poorer soils, such as coral reefs or beaches. Altitude mostly a little above sea-level,

occasionally higher, up to 500(—900) m. Fl., fr. Jan.—Dec., in full bloom generally in May and Sept.—Oct. See Schimper, Indo-Mal. Strandflora (1891) 68, 172 and Booberg (1931) *op. cit.*

Compilation of field-notes: Bole erect or crooked, sometimes more stemmed, *c.* 1—7½ m, tends to be bulbous at the base, but buttresses are also reported up to *c.* 60 cm high, 20 cm wide at the base and *c.* 7 cm thick (Celebes, Solomons, Guam). *Van Steenis 10499* from Java (Bantam) and *Walker & White BSIP 74* from the Solomons (Malaita I.) mention looping pneumatophores as in *Bruguiera*. The collection from Malaita I. has been made in an inland swamp-forest with 1½ m clay on solid rock. The buttresses branch into roots that spread widely over the surface of the ground, looping here and there into knob-like pneumatophores. The Java collection is from a low tree in a marshy forest.

Crown conical, diffuse or of thin irregular shape. Bark grey and yellow, rarely greyish or yellowish brown, smooth or fissured. Wood white, soft. Leaves when young or in shady places variegated with pale yellow broad smudges on the upperside of the veins (Malaya). Young leaves are mostly reported to be brown, older leaves can be shiny dark green, pink, purple above and green underneath, or dark green above and red or light green underneath. Rachis purple or partly green as well. Flowers scented, once cocoa odour is mentioned; flowerbuds deep red; calyx red, dull purple, or green with red; petals mostly reported to be white but also white tinged pink, greenish white, pinkish at the base or edges, cream, creamy white, or light yellow, as well as red (the latter in Burma, Malaya, and New Guinea), pink, and pale pink; stamens white, creamy white, pink, purple, red, or white and pale pink at the base; anthers cream, yellow, or golden; style pink, purple, red, or white, with yellowish white or pink stigma; ovary green with white ovules. Fruit mostly green or green tinged purple or red, often thick-winged at the base when young, barrel-shaped or with sharp corners when mature, mostly ovoid.

Galls: Leaf-galls caused by a gall-midge are reported near or on the lateral nerves from a plant collected in Jamdena (Tanimber Is.); see Docters van Leeuwen-Reynvaan, Zoocec. N.E. Indies (1926) 400.

Germination: The same way as described in *B. acutangula*, see p. 230; see also Roxburgh, Fl. Ind. 2 (1832) 634; Thomson, J. Proc. Linn. Soc. Bot. 2 (1858) 47, pl. 1A, fig. 3; Troup, Silv. Cult. Ind. Trees 2 (1921) 591.

Flowering and pollination: *Vaughan 74* reported visits of birds and insects in Zanzibar. Ridley has also observed fertilisation (meaning pollination I presume) and gave a precise description of the opening of the flowers, the scent, and the honey which attract many moths at night as the flowers fully expand at about 8 p.m. See Ridley, J. Str. Br. R. As. Soc. 41 (1904) 125; *op. cit.* 46 (1906) 263.

Dispersal: Mature fruits have very good buoyancy through the layer of spongy, fibrous pericarp. Dispersal by water along freshwater and tidal rivers and along lakes is thus very likely. The distribution pattern seems to fit this opinion. Local dispersal by crabs or small mammals such as rats and squirrels is not unlikely. See Ridley, Disp. (1930) 291, 292, 376.

Vernaculars: In Africa *Mto mondo*, *Mtoro-toro*, *Mtovo-tovo*, and *Maji maji* (Shambaa) or *Kufu kufu* (Bondei); in Madagascar *Jo'tatra*; in Bengal *Kumia* and *Borwi*, in Burma *Kye-bin* or only *Kyi*, and in Laos *Som pawng*. In Malesia the name *Putat* is mostly used, but this is a generic vernacular. The following combinations are found: in Malaya *Putat darat*, *Duna putat*, *Putat kampong*, *Putat kĕdol*, *Putat talang*; in Simalur I. *Putah aanem*; in Borneo *Putat aying* (Brunei) or *Putat ayĕr* (Sabah); in Ambon *Puta puta* and on Muna I. *Puta* only. Many other names are found on the field-labels in Malesia; some more

frequently seen are: in Simalur I. *Tu'vah* and the fruit is *Idjo Tua*, in Java *Songgom* or *Songgom laut* (Sund.) and *Pĕnggung* (Jav.), in the Philippines *Apálang*, in Halmahera *Palangasa*, in Talaud I. *Párangá*. From the Solomons *Falangada* or *Harangada*, *Futu* or *Hutu*, and *Cutnut* (in Pidgin), from Bougainville *Ai ai chiram*, from the Carolines *Kösöl* and in Samoa *Falanga*.

Uses: Wood. Balfour, Timbertrees ed. 2 (1862) 44, gave a survey of the different uses made of *B. racemosa*. In Bengal the wood is used for fuel while in New Britain (Bismarck Archipelago) the wood is used in house construction. In E. Africa (Mozambique) and in Madagascar bark-fibers are used for ropes.

Wood-anatomy. A good survey is found in Foxworthy, Philip. J. Sc. 4 (1909) Bot. 413, 420, 525, and in Walker (1948) *op. cit.* (under *B. salomonensis*).

Fish-poison. From Celebes and Moluccas the use of the bark and fruit is reported to poison fish for easy catching. The young bark contains much saponin. See Greshoff, Meded. 's Lands Pl. Tuin 29 (1900) 76, 176; Brown, Bur. For. Bull. 22, 3 (1921) 81; Duyster, Gift. Ind. Pl. (1927) 115; Tattersfield, Martin & Howes, Kew Bull. (1940) 170 (mentions also insecticidal properties of alcoholic extract of the bark); Quisumbing, Philip. J. Sc. 77 (1948) 166.

Medicinal uses. In Bengal fruits are dried and powdered. The powder is used as sniff in cases of headache. In Malaya root, bark, and leaves are used externally for boils (*Obat kajap*). Leaves are also pounded and applied externally for chicken-pox. See Burkill (1935) *op. cit.*

Food. On field-notes from Lingga I. it is stated that the leaves are eaten as *Ulam* (an uncooked dish with rice). In Sumbawa the young leaves are eaten with rice, like *B. macrocarpa*.

Cultivation. On the Riu Kiu Is. trees are grown easily from cuttings to form hedges as windbreaks (*Walker & Tawada 6670*), see Walker (1954) *op. cit.* In the Solomons (Santa Cruz) trees are also planted for hedges.

Remarks: Knuth (1939) *op. cit.* gave in fig. 3 A—H an illustration of *B. racemosa* but this figure represents *B. macrocarpa*.

Butonica rosata described by Miers was based on *Oldham 115*, a collection from Formosa. I have found this material at BM and K and in each herbarium half a flower was available. No original collection made by Sonnerat has been seen by me during my visit at the herbarium in Paris.

The typification of *B. rumphiana* has been discussed on 188 and 196.

The ovary is never winged, but the young fruit is mostly on the corners provided with a sort of coarse wing from top to bottom or at the base only, but they are often very irregularly developed on the four corners in a single fruit. The prominence of these wings is probably in part artificial by the drying process for the herbarium; the mature fruit is quadrangular in section and mostly completely wingless. However, a few collections from Bangkok, and especially from New Guinea, the Solomons, the New Hebrides, and Fiji, have full-grown pericarps the ribs of which are almost over their length or partly persistent as coarse, rather corky, wing-like prominences.

5. B. filirachis Payens, *sp. nov.*

B. pietersii Knuth, Pfl. R. Heft 105 (1939) 35, *p.p., typo excl.*

Folia elliptica, obovata vel obovato-oblonga, ± serrato-crenulata, nervis lateralibus 8—10-paribus. Racemi terminales, rachis gracillima. Flores parvi, calyce in gemma clauso segmentis fisso. Stamina exteriora bene evoluta i.e. 2-seriata, interiora uniseriata

staminoidea. Ovarium 2-loculare, tetragonum. Drupa tetragona, distincte 4-alata, apice truncata, basi in pedicellum extenuata, glabra.

Small tree *c.* 8 m; twigs 1½—3 mm ∅. *Leaves* not tufted, elliptic, obovate, or obovate-oblong, chartaceous, glabrous, *c.* (3—)5—9(—13) by (1½—)2—4(—5½) cm (leaf-index 1½—3), ± serrate-crenulate, acute or acuminate, base acute or cuneate, midrib prominent on both sides, nerves *c.* 8—10 pairs, less prominent above than beneath, venation and areolation equally distinct on both sides; petiole ½—1 cm. *Racemes* terminal, pendulous, *c.* 3—35 cm; rachis *c.* ½—1 mm ∅, not accrescent, cataphylls triangular, *c.* 1½ mm. Bracts *c.* 1—1½ by ½ mm. *Flowers* not scented. Opening buds *c.* 5 mm. Pedicels terete, thin, *c.* 4—8 mm. *Calyx tube c.* ¼ mm, the limb connate, disrupting into (2—)3(—4) unequal, chartaceous, convex segments, *c.* 4—6 by 2—10 mm, not accrescent. *Petals* 4, elliptic, obtuse, convex, *c.* 9—10 by 5—6 mm, insertion *c.* 2—3 mm wide. *Staminal tube c.* ½—3 mm; stamens in 3 whorls, inner one staminodial; filaments *c.* 6—14 mm; staminodia *c.* 1—2 mm, anthers *c.* ½ by ¼—½ by ⅓—½ mm. Disk a very small ring ¼ mm high. *Ovary* 2-celled, tetragonous, *c.* 2—4 by 1¼—2½ by 1—3 mm; ovules 2—4 per cell (total number 5—7); septum complete; style *c.* 1½ cm. *Fruit* (only 2 available) tetragonous, distinctly 4-winged, glabrous (excl. wings), *c.* 2½ by ½ by ½—¾ cm, truncate, tapering at base; wings *c.* 2—3½ mm wide; pericarp *c.* ½ mm thick, exocarp membranous, mesocarp fibrous, endocarp membranous; wings also fibrous. *Seed* ovoid, subtetragonous, *c.* 14 by 3 by 3 mm.

Typification: *Corner SFN 25890*, holotype in SING, isotypes in K and BO; *Ridley 8985*, paratype in SING.

Distribution: Sumatra East Coast and Malay Peninsula (Johore).

Ecology: In swampy lowland forests, on *Tristania* bank behind *Pandanus helicopus*. Fl. Febr.—Nov., fr. July.

Compilation of field-notes: Petals and stamens red or deep crimson pink.

Remarks: *B. pietersii* Knuth was described on the sterile holotype *Pieters 2536*; one paratype was added, *viz. Ridley 8985*. This is in flowering condition but no floral characters are mentioned from *B. pietersii*. Knuth noted that *B. pietersii* is closely related to *B. beccarii*, differing only in having short, thick petioles instead of a thin, long one (*c.* 1½ cm in the type of *B. pietersii*).

B. pietersii (as typified by *Pieters 2536*) has appeared not to belong to *Barringtonia* (see excluded names).

The paratype of *B. pietersii* is here also used as a paratype of *B. filirachis*.

6. B. revoluta Merr., Philip. J. Sc. 1 (1906) Suppl. 211; En. Philip. 3 (1923) 143; Knuth, Pfl. R. Heft 105 (1939) 36. — **Fig. 7.**

B. flagellata Lütjeharms & Van Ooststroom, Blumea 3 (1938) 95; Knuth, Pfl. R. Heft 105 (1939) 34.

Small or large tree, sometimes crooked or sprawling, *c.* 5—20(—33) m, dbh *c.* 25—50 cm; twigs *c.* 3—7 mm ∅. *Leaves* obovate-lanceolate, subcoriaceous, glabrous, *c.* 11—22 (—34) by 3—6(—13) cm (leaf-index 3—4), at edge serrate-crenulate and distinctly revolute, acute or acuminate (tip obtuse), base cuneate; midrib prominent on both faces, nerves *c.* 14—16 pairs, only prominent beneath, venation equally distinct on both faces; petiole slightly winged, *c.* 1—9(—11) cm, rugose, thick. *Raceme* terminal or ramiflorous, *c.* 70—80 cm with up to 90 flowers; rachis glabrous, 1—2 mm ∅; cataphylls *c.* 4—6 by 2—3 mm, triangular. Bracts triangular, *c.* 1 by ½ mm. Pedicels *c.* ½—2 cm, very thin, not accrescent. Opening buds *c.* 5 by 5 mm (10 by 10 mm when petals start unfolding). *Calyx* connate in bud, rupturing into (2—)3(—4) segments,

Fig. 7. *Barringtonia revoluta* Merr. a. Habit, × ⅔, b. flower, in section, × 4, c. fruit, × ⅔ (a—b. *BRUN 5162 (Ashton)*, c. *S. 4852 (Hassan)*).

tube *c.* 1—2 mm high, hardly accrescent; segments convex, elliptic or suborbicular, 9—12 by 6—10 mm (*c.* 12 by 14 mm in a 2-lobed calyx), persistent, slightly accrescent, papyraceous. *Petals* 3—4, elliptic, obtuse, convex, *c.* 1¾—2 by 1—1¼ cm; insertion *c.* 3—4 mm. *Staminal tube c.* 1½ mm, stamens in 4 whorls, inner one staminodial, filaments *c.* 2½—3½ cm, staminodia *c.* 1¼ cm; anthers *c.* ¾—1 by ½—¾ by ½—¾ mm. Disk thin, outside grooved, ¼—½ mm high. *Ovary* 3(—4)-celled, trigonous, obpyramidal with acute edges, glabrous, *c.* 3—5 by 2½—4 mm; (2—)3—4 ovules per cell (total number up to 8—10); septum complete; style *c.* 3½—4½ cm. *Fruit* sharply 3—4-gonous, distinctly pedicelled, *c.* 4½—6 by 1¼—1¾ by 1—1½ cm, truncate, cuneate to the base, sometimes a little curved, sides depressed towards the base; pericarp *c.* ½—1 mm thick at the sides and 1—3 mm at the corners, exocarp thin, mesocarp thin with spongy parenchyma and few anastomosing fibres, endocarp membranous. *Seed* ovoid, ± trigonous, *c.* 3 cm by 8 by 9 mm.

Typification: *B. revoluta* Merr.: *Curran 3507* (Palawan), holotype in PNH (lost), isotypes in K, L.

B. flagellata Lütjeharms & Van Ooststroom: *Lütjeharms 4189* (Enggano I.), holotype in L, isotype in BO.

Distribution: Sumatra (Muara Pedjangki), Malaya (Pahang), N. Borneo (Sarawak, Brunei, Sabah), Palawan. Fig. 8.

Ecology: In primary forest on sandy-clay in hilly areas as well as along riverbanks or in periodically inundated plains, from sea-level up to 200 m. Fl. Jan.—July, fr. Febr.—Oct.

Compilation of field-notes: Bark pale brown, crumbling, rough or smooth, pale grey-green and brown mottled, shallowly cracked. Outer bark thin, hard, inner bark hard, redbrown to cream on inner side; cambium white; sapwood hard, rich yellow. Flower-buds cream; petals red, bright red, deep pink, pink, or creamy yellow; stamens pale yellow, deep pink at base and apex or rich pink; anthers pale yellow. Fruit green when immature, red, magenta, or brown when ripe, on long slender stalks.

Vernaculars: In Sumatra *Pĕranap* and *Putat*, in Borneo *Buah carrot* (Dusun), *Putat samba* (Brunei lang.), *Rĕngas* or *Karut* (Iban), as well as *Putat*, the generally used Malay name for *Barringtonia*. In Palawan *Pusak* (Tagb. dial.).

Remarks: In the herbarium the leaves are often glaucous. The ovary is mostly 3-celled and the fruit 3-gonous, but material from Borneo is also 4-celled and 4-gonous on the same tree. Another typical variation is the combination of long pedicels and petioles with acuminate leaves or short pedicels and petioles with acute leaves. Both variations grow together in Borneo and Palawan.

7. B. samoensis A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 508, *cum* var. *β*; Walp., Ann. 4 (1857) 852; Mueller in Camb., A Year in New Hebr. (1873) App. 10; Drake del Castillo, Ill. Fl. Ins. Pac. (1890) 171; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; Hook. *f.*, Bot. Mag. 50 (1894) 7337, *excl. syn. p.p.*; Reinecke, Bot. Jahrb. 25 (1898) 661; Setchell, Dept. Mar. Biol. Carn. Inst. Wash. 20 (1924) 63, t. 3 & 4; Hochr., Candollea 2 (1925) 445; Lloyd & Aiken, Bull. Lloyd Libr. & Mus. 33 (1934) 79, fig. 79 ('*samonensis*'); Christophersen, Bull. Bern. P. Bish. Mus. 128 (1935) 154; Knuth, Pfl. R. Heft 105 (1939) 26; Yuncker, Bull. Bern. P. Bish. Mus. 178 (1943) 88; *ibid.* 184 (1945) 54; Guillaumin, Ann. Mus. Col. Marseille 55/56 (1948) 38. — *Butonica samoensis* Miers, Trans. Linn. Soc. Bot. 1 (1875) 75, t. 14, fig. 20—25 (*excl. Barclay 3487*). — **Fig. 11f.**

B. racemosa [*non* (L.) Spreng.] Gaud. in Freyc., Voy. Bot. (1826) t. 107; *ibid.* (1830) 483.

B. rubra [*non* (Pers.) Bl.] Miq., Fl. Ind. Bat. 1, 1 (1855) 487, *pro specim. Zippel.* —

B. confusa Lütjeharms & Van Ooststroom, Blumea 3 (1938) 100; Knuth, Pfl. R. Heft 105 (1939) 35.

Stravadium semisutum Miers, Trans. Linn. Soc. Bot. 1 (1875) 89. — *B. semisuta* Knuth, Pfl. R. Heft 105 (1939) 49.

B. clemensii Knuth, Pfl. R. Heft 105 (1939) 23.

B. longipedicellata Kaneh. & Hatus., Bot. Mag. Tokyo 53 (1939) 153, fig. 75; Hosokawa, Trans. Nat. Hist. Soc. Taiwan 33 (1943) 211.

B. ceramica Hatusima, Alphab. List Pl. Sp. Hort. Bot. Bog. (1957) 30; *op. cit.* (1963) 32; Hort. Bot. Bog. Ind. Sem. (1963) 4; all *nomen.*

Shrub or small tree, *c.* 2—12(—20) m; dbh *c.* 8—20 cm; twigs *c.* 3—7 mm ∅. *Leaves* obovate-oblong or obovate-lanceolate, chartaceous, *c.* 25—100 by 7—24 cm (leaf-index 2½—4), serrate-crenulate, acute or acuminate, base cuneate, midrib prominent on both sides, nerves *c.* (15—)20—40 pairs, prominent underneath; petiole *c.* 1½—5½(—7) cm. Cataphylls triangular-lanceolate, *c.* 1—2 by ½ cm. *Racemes* terminal or ramiflorous, pendulous, *c.* 20—55 cm, densely flowered (*c.* 150 flowers); rachis *c.* 1—2 mm ∅, accrescent to *c.* 3 mm, fissured, glabrous or pulverulent. Bracts triangular, *c.* 2—12 by 1—4 mm; bracteoles *c.* 1 by ¼ mm. Opening buds *c.* 5—7 mm. Pedicels terete, thin, *c.* 4—25 mm. *Calyx* connate with an apical pore; tube *c.* ½—1½ mm high; limb rupturing into 3—4 unequal, semiorbicular, convex segments, *c.* 5—7 by 3—7 mm, slightly accrescent, coriaceous. *Petals* 4, convex, *c.* 1—3½ by ¾—1 cm, membranous; insertion *c.* 2—5 mm wide. *Staminal tube c.* 1—3 mm high, stamens in 3—4 whorls, inner one staminodial; filaments *c.* 1½—3 cm; staminodia *c.* 1—5 mm; anthers *c.* ⅓—¾ by ¼—⅓ by ¼—½ mm. Disk thick, *c.* ½ mm high. *Ovary* 3—4-celled, subtetragonous, subglobular, glabrous or pulverulent, *c.* 2—3 by 1—3 by 1—2 mm; 1—4 ovules per cell (total number *c.* 5—12); septa complete; style filiform, *c.* 2½—3 cm. *Fruit* ovoid, 3—4-gonous, *c.* 4½—7 by 2½—4½ cm, apex truncate, base tapering, rugose, 6-ribbed; pericarp *c.* 2—3 mm thick, exocarp *c.* ½—1 mm; mesocarp fibrous, *c.* 1—1½ mm; endocarp a thin brown membrane *c.* ½ mm. *Seed* ovoid, often 3-gonous, fissured, *c.* 3—4 by 2—3 by 1½—2½ cm.

Typification: *B. samoensis* A. Gray, *Butonica samoensis* Miers: U.S. Expl. Exp. (Samoa), holotype in US, isotype in P.

B. samoensis var. *β* Gray: U.S. Expl. Exp. (Samoa), holotype in US.

B. rubra [*non* (Pers.) Bl.] Miq., *B. confusa* Lütjeharms & Van Ooststroom: *Zippelius 53d* (Ambon), holotype in L.

Stravadium semisutum Miers, *B. semisuta* Knuth: *Powell 46* (Samoa), holotype in K.

B. clemensii Knuth: *Clemens 198* (Papua), holotype in B (lost), isotypes in A, L, ZT; *Clemens 1482*, paratype in B (lost).

B. longipedicellata Kaneh. & Hatus.: *Kanehira & Hatusima 4670* (Palau), holotype in FU (not seen).

B. ceramica Hatusima: tree cult. in Hort. Bog. V—A—78—78a (Ceram).

Distribution: SE. Celebes (Staring Bay), Moluccas (Morotai, Halmaheira, Sula, Ceram, Ambon), New Guinea (Morobe and Milne Bay Distr.), Micronesia (Guam, Palau), Polynesia (Samoa Is.). Fig. 8.

Ecology: In primary moist rain-forest, on swampy ground or along rivers, *c.* 10—1000 m altitude. Fl., fr. Jan.—Dec.

Compilation of field-notes: Bole *c.* 5½ m, terete; crown *c.* 5½ m, thin, sparsely branched; bark *c.* 7 mm thick, brown or grey-brown, rough, mottled, somewhat peeling, covered with scattered lenticells. Wood dirty white. Rachis reddish; flower-buds reddish green or light green when ripe. Calyx reddish green; petals white, pink, or red; stamens pink, red, or dark beefy red; anthers yellow. Fruit 4-angled, warty or rugose, green when

immature, red or purplish green like cocoa on lax drooping rachis when mature, *c.* 6—9½ by 3½—4 cm, poisonous.

Vernaculars: In SE. Celebes *Puta*, in Samoa *Falaga* or *Lau falaga* and *Fia oli*.

Remarks: For *B. rubra* [*non* (Pers.) Bl.] Miq. see also the remark on p. 195.

The type specimen of *B. longipedicellata* has twice been requested on loan but without result. On the strength of its description and figure I decided it is conspecific with *B. samoensis*.

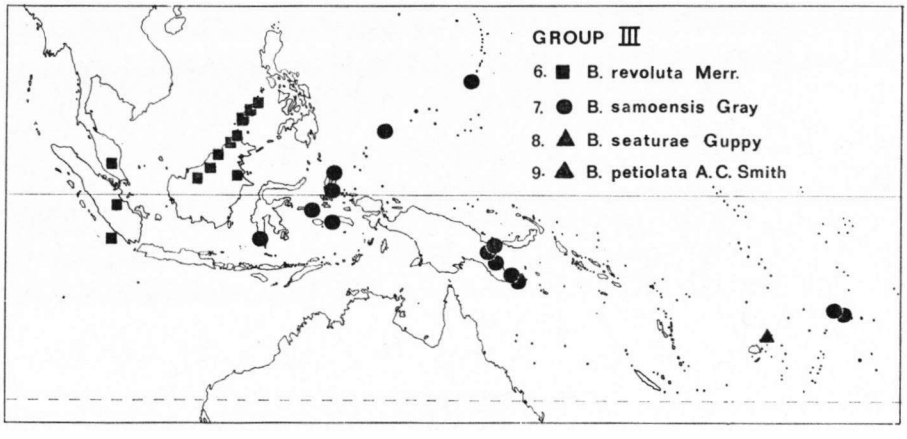


Fig. 8. Localities of the species of Group III.

8. B. seaturae Guppy, Pl. Disp. 2 (1906) 574.

Medium tree *c.* 4—20 m; dbh *c.* 40 cm; twigs 8—10 mm ∅. *Leaves* obovate, glabrous, subcoriaceous, *c.* 24—32 by 10—13 cm (leaf-index 2½—3), almost entire, acuminate, base cuneate, midrib prominent on both sides, lateral nerves *c.* 15—17, prominent underneath; petiole 1—2 cm. Cataphylls triangular, *c.* 15—20 by 8—10 mm. *Spikes* terminal, pendulous, *c.* 29—33 cm (*c.* 70 flowers), rachis *c.* 3 mm ∅, accrescent to *c.* 9—12 mm, glabrous. Opening buds *c.* 2 cm. *Calyx* closed in bud, the tube *c.* 4 mm high, the limb disrupting into 3—4 unequal, elliptic, convex, papyraceous lobes *c.* 15 by 10—15 mm. *Petals* 4, elliptic, convex, membranous, *c.* 2½—3 by 2½—3 cm (in opening bud), insertion *c.* ¾—1 cm wide. *Staminal tube c.* ½—2 mm high; stamens in 7—8 whorls, inner one staminodial; filaments *c.* 2 cm; staminodia *c.* 4—7 mm; anthers *c.* 1—2 by ½—1 by ½—1 mm. Disk thin, *c.* ¼ mm high or almost absent. *Ovary* 4-celled, subtetragonous, *c.* 1 by ½ by ½ cm; ovules 2—4 per cell (total number 10—14); septa complete; style filiform, terete, *c.* 4 cm. *Fruit* (sec. Guppy) oblong, at least 7½ cm long, obscurely angled, with a hard pericarp and thin perishable outer coats, not buoyant.

Typification: *B. seaturae* Guppy: Unknown, not located at Kew. Neotype: *Damanu C4*, in K; paratype *Damanu R18*, in K.

Distribution: Fiji (Vanua Levu). Fig. 8.

Ecology: In wet lowland at 200—300 m. Fl. Jan.

Compilation of field-notes: Bark thick, grey and white; wood white. Petals white.

Vernaculars: *Vutu* or *Vutu vala*.

Uses: The wood is used for case timber.

Remarks: This species is only known from the poor description by Guppy and two recent collections by Damanu, which I was able to use for my description. It is closely related to *B. racemosa*, but differs from the latter by its larger flowers, the high number of staminal whorls, the thick rachis, and according to Guppy by a different fruit structure. Guppy, *l.c.* 573, remarked about the 4 species he knew from Fiji that *B. asiatica* and *B. racemosa* share a pericarp with an outer fibrous husk to which the buoyancy is due, while *B. edulis* and *B. seaturae* possess a hard stone surrounding the seed, that of *B. edulis* being able to float for a few weeks, but that of *B. seaturae*, an inland species, being non-buoyant.

9. B. petiolata A. C. Smith, Bern. P. Bish. Mus. Bull. 141 (1936) 102, fig. 54; Knuth, Pfl. R. Heft 105 (1939) 36; Parham, Dep. Agr. Fiji Bull. 21 A (1942) 42, 70; A. C. Smith, Bull. Torrey Bot. Club 70 (1943) 546; Parham, Pl. Fiji Isl. (1964) 143.

Tree, *c.* 8—20 m; twigs *c.* 2—4 mm ∅. *Leaves* at the apex of the twigs but not crowded, elliptic or oblong, glabrous, *c.* (9—)13—21(—23) by (3—)5—10 cm (leaf-index 2—3), chartaceous, almost entire, obtuse to acuminate, base cuneate or oblique, midrib very prominent on both sides but near the apex flattening above, nerves *c.* 8—12 pairs, only prominent underneath; petiole *c.* (1—)3—7 cm, thick and rugose at base. *Spikes* terminal, pendulous, *c.* 26—47 cm (*c.* 26 fl.), rachis glabrous, *c.* 1½—2 mm ∅. Opening buds *c.* 10 mm. *Calyx* closed in bud, the limb rupturing into 4 unequal segments; tube *c.* ½—2 mm high; segments convex, herbaceous, *c.* 4—5 by 4 mm. *Petals* 4, elliptic, convex, *c.* 1¾ by 1¼ cm, membranous, fimbriate, obtuse; insertion *c.* 2 mm wide. *Staminal tube* *c.* 4—5 mm high outside and *c.* 10—11 mm high inside; stamens in 4 whorls, inner one staminodial; filaments *c.* 3½ cm; anthers *c.* 1 by ½ by ½ mm. Disk a thick ring, *c.* 1 mm high. *Ovary* 4-celled, subtetragonous, *c.* 4—5 by 2—3 mm; *c.* 1—2 ovules per cell (total number 6—8); septa complete, style *c.* 2—4 cm. *Fruit* (3—)4-gonous, truncate at both ends, narrow at base, glabrous, *c.* 3½—5½(—7) by 1—2¼(—3½) by 1—1½(—3½) cm, with small wings *c.* 3—4 mm wide in upper half of fruit; pericarp *c.* 4 mm thick, exocarp *c.* 1 mm, mesocarp *c.* 2½ mm with dispersed anastomosing fibres, endocarp *c.* ½ mm with fibres. *Seed* ovoid, furrowed, *c.* 1¾ by ¾ by ½ cm.

Typification: *B. petiolata* A. C. Smith: *A. C. Smith 597*, holotype in US, isotypes in BO, K, P; *Horne 619*, paratype in K (not seen); *Smith 1626*, paratypes in BO, P, US.

Distribution: Viti Levu and Vanua Levu. Fig. 8.

Ecology: In dense forest on mountain slopes, from 100—600 m. Fl. April and Nov., fr. Dec.

Compilation of field-notes: Racemes 30—50 cm; calyx greenish, tinged pink; petals greenish, tinged pink or pale pink; stamens pink; fruit green, *c.* 7 by 3½ cm, 4- or rarely 3-angled.

Vernaculars: On Vanua Levu *Vutu*.

Remarks: Five different species occur in Fiji of which three are endemic: *B. edulis* with edible seed, *B. petiolata*, and *B. seaturae*.

10. B. novae-hiberniae Laut., Bot. Jahrb. 45 (1911) 362; *ibid.* 57 (1922) 351, 352; Knuth, Pfl. R. Heft 105 (1939) 37, fig. 5; Peekel, Ill. Pl. Bism. Arch. (1945) 1289, fig. 1288 (*ined.*). — **Fig. 11 g.**

B. excelsa (*non* Bl.) Guillaumin, J. Arn. Arb. 12 (1931) 258.

B. oblongifolia Knuth, Pfl. R. Heft 105 (1939) 41.

B. brosimos Merr. & Perry, J. Arn. Arb. 21 (1940) 292.

Small tree *c.* 5—20 m; dbh 30—36 cm; twigs *c.* 4—7(—10) mm ∅. *Leaves* obovate-

oblong, glabrous, *c.* 13—40(—57) by 5½—12(—26) cm (leaf-index 1½—3½), chartaceous, almost entire, slightly revolute, cuspidate, caudate, or obtuse, base cuneate or acute, midrib prominent at both sides, nerves *c.* (9—)12—18(—23) pairs, less prominent above than beneath, venation equally distinct on both sides; petiole (½—)2—5(—6½) cm. *Racemes* terminal or lateral from the branchlets, pendulous, *c.* 20—47 cm, ± 30-flowered, rachis *c.* 2—3 mm ∅, accrescent to *c.* 5 mm, slightly fissured and pulverulent or glabrous. Cataphylls few, triangular or lanceolate, *c.* 5—12 by 3—4 mm, chartaceous, fimbriate, acute. Pedicels 2—10 mm, ± pulverulent. Bracts lanceolate, *c.* 20 by 3 mm. *Flowers* scented. Opening buds *c.* 10—15 mm. *Calyx tube* cup-shaped, *c.* 6—10 mm high, with a large apical pore or hole, or sometimes divided into 3—4 unequal segments, chartaceous. *Petals* 4(—5), elliptic, obtuse, convex, *c.* 3½—4½ by 1½—2¼ cm, rather fleshy, margin membranous and fimbriate towards the apex, insertion *c.* 5—9 mm wide. *Staminal tube c.* 5—9 mm high outside and 8—25 mm on the inside, stamens in (6—)8—10 whorls, innermost one with ill-developed anthers or staminodial, filaments *c.* 4—5½ cm, staminodia *c.* 1½—2¼ cm; anthers *c.* 1—1¼ by ½—¾ by ½—¾ mm. Disk a flat, wide ring, *c.* 2 mm high. *Ovary* 4-celled, subtetragonous *c.* 5—8 by 4—6 by 4—6 mm, ovules 1—3 per cell [total number up to (5—)8—9(—16)]; septa incomplete; style *c.* 4—7 cm. *Fruit* subtetragonous, broad obovoid, ± 7—8-ribbed, glabrous, *c.* (4—)5½—7½ by (1½—)2½—3½ by (2—)2½—3 cm (in litt. and on field labels 6—15 by 2—7½ cm), truncate, tapering to base, shortly pedicelled; pericarp 3—7 mm thick (18 on one field label), exocarp thin, *c.* 1 mm, mesocarp with fibres anastomosing in different directions, *c.* 3—4 mm, endocarp with many small fibres, *c.* ½—1½ mm. *Seed* ovoid or spindle-shaped, fissured, *c.* 2—4 by 1—1¾ by ¾—1½ cm (on field label 35—82 by 17—25 mm).

Typification: *B. novae-hiberniae* Laut.: *Peekel 138 & 139* (New Ireland), syntypes in B (lost), *Peekel 139*, lectotype in WRSL.

B. oblongifolia Knuth: *Guppy 52* (Solomons), holotype in K.

B. brosimos Merr. & Perry: *Brass 2598* (Solomons), holotype in A, isotypes in BM, BO, BRI, L, SING; *Kajewski 1950*, paratypes in A, BO, BRI.

Distribution: New Guinea (Huon Peninsula only), Admiralty Is., Misima I., New Ireland, New Britain, Solomons (Bougainville, Treasury I., New Georgia, and S. Cristobal), Santa Cruz Is., New Hebrides. Fig. 9.

Ecology: In primary rain-forest or secondary forest on rich alluvial soil, also reported from open or partially cleared spaces or planted in villages and gardens, from sea-level up to *c.* 200 m. Fl., fr. Jan.—Dec.

Compilation of field-notes: Bole erect or crooked; crown spreading in a flattish cone or umbrella-shaped, individual leafy branches clearly visible. Bark thick, suberose, brown with vertical rows of large lenticells *c.* 1½—2 cm apart; wood hard, fawn. Leaves bright or pale green, shiny or glaucous, gives good shade. Flowerbuds purplish with green caps, calyx purple, pink, or green; petals in bud greenish cream, shaded purple, fading at maturity, or purplish, fading to cream, tinged purple at maturity. Also said to be yellow (in three cases, once tinged with red or cream with purple veins); stamens cream, white, creamy white, or white, tinged red at apex; style green or green tipped purple. Fruit green, light green, green with a purple tinge, or light green with dark green irregular lines and dots; another form is blue or purple.

Vernaculars: Many different names are reported from the various islands. From Huon Peninsula *Pao* (Laluan lang.), in New Britain *Arpo* and *Pao*, in Bougainville *Hari* and *Ai ai*, in Treasury I. *Sioko*, in S. Cristobal *Hara*, in New Georgia *Hala* (Kwara'ae lang.) as well as *Fala* or *Kenu* (Kwara'ae lang.), in the New Hebrides *Nevingen* or *Velingeh* (Native almond).

Uses: Commonly planted in villages and gardens as an ornamental tree and as a fruit tree. The seeds are eaten raw and said to taste very pleasant, greatly prized and eaten also by Europeans. According to several field-labels two forms occur: One with a green fruit which is mostly eaten and one with a purple fruit. The flavour of both is said to be the same.

Remarks: There seems to be an unusual variability in the number of staminal whorls (from 6 to 10); even staminodia may be lacking. The calyx can be quite open in bud with a large apical pore or hole or is already divided into 3—4 unequal segments. This variability may be due to selection and cultivation by the people on the different islands since time immemorial. The same remark applies to *B. procera*, another *Barringtonia* with edible seed, growing in the same region.

11. B. gigantostachya Koord. & Val., Bull. Inst. Bot. Btzg 2 (1899) 9; Bijdr. Booms. Java 6 (1900) 11; Back., Schoolfl. (1911) 530; Koord., Exk. Fl. Java 2 (1912) 665; Knuth, Pfl. R. Heft 105 (1939) 22; Back. & Bakh. *f.*, Flora Java 1 (1963) 353.

See for further synonym under the variety.

a. var. **gigantostachya.**

Small, rather irregular tree, *c.* 10—15 m, dbh *c.* 20—40 cm; twigs distinctly (3—5 mm wide) winged, 15—20 mm ∅. *Leaves* almost sessile, obovate-lanceolate, rarely obovate-oblong, glabrous, *c.* (30—)40—75(—106) by (9—)11—19(—24) cm [leaf-index (3—) 3½—5], chartaceous or subcoriaceous, crenulate, cuspidate or obtuse, base cuneate, nerves *c.* (22—)25—30(—40) pairs, less prominent above than beneath, venation equally distinct on both sides. *Spikes* terminal, lax-flowered, pendulous, *c.* 60—125 cm; rachis *c.* 7—20 mm ∅ at base, *c.* 3—5 mm at apex, accrescent in length, fissured. Cataphylls lanceolate, some triangular, convex, glabrous *c.* 1½—9 by ½—1½ cm, chartaceous, serrate, acute. Bracts sessile, narrow-triangular, *c.* 3—20 by 2—8 mm, serrate. *Flowers* sessile, vanilla-scented. Bracteoles triangular, *c.* 2—4 by 1—1½ mm. Opening buds *c.* 10—15 mm. *Calyx* connate, with an apical pore, tube *c.* (2—)4—10 mm, limb rupturing into 3—4(—5) unequal, convex segments *c.* 5—15 by 6—15 mm, chartaceous or subcoriaceous. *Petals* 4(—5), elliptic, obtuse, convex, *c.* 2—3½ by 1½—2 cm, rather fleshy, margin membranous, fimbriate towards the apex, insertion *c.* 5—11 mm wide. *Staminal tube* *c.* 4—10 mm high, stamens in 5—6 whorls, inner one staminodial; filaments *c.* 3—6 cm, staminodia *c.* ½—1½ cm; anthers *c.* ¾—1 by ½—¾ by ½ mm. Disk annular, undulating, ± grooved, *c.* 1—2 mm high. *Ovary* 4-celled, tetragonous or subglobular, *c.* 6—8(—10) by 4—6 by 4—6 mm; ovules 4—7 per cell [total number (12—)16—22 (—26)], septa incomplete or complete; style *c.* 4—5 cm. *Fruit* ovoid, ± tapering at both ends, glabrous, *c.* 8½—10 by 3—4½ by 3½—5 cm; pericarp *c.* 3—5 mm thick, exocarp 1—3 mm, mesocarp hard, fibrous *c.* 2 mm, endocarp a thin brown membrane. *Seed* ovoid, distinctly fissured, *c.* 5 by 2—2½ by 2—2½ cm.

Typification: *B. gigantostachya* Koord. & Val.: syntypes *Koorders 5402—5408* (Java), in BO and L. Lectotype: *Koorders 5403*, in L.

Distribution: Central Java (Tegal, Banjumas). Fig. 9.

Ecology: In teak-forest on red volcanic loam from *c.* 60—1000 m altitude. Fl. May—Nov., fr. Aug.—Sept.

Compilation of field-notes: Bole rather crooked, terete, lower part gnarled, *c.* 7—11 m, crown *c.* 3—5 m, of irregular shape, sparingly branched with dichotomous branches. Bark smooth or superficially fissured, both lengthwise and transverse, grey. Young twigs distinctly winged, shiny, light yellow or reddish brown, very brittle. Cataphylls red. Rachis light green to pale purple. Flowerbuds light green; calyx pale green; petals

white or dirty white (fallen flowers brown-yellow); stamens white, pink near the apex, anthers yellow; disk pale green or yellow. Fruit green or pale dirty pink. Habit of tree as *Dillenia pentagyna* (*Koorders 5403*).

Vernacular: *Songgom*, Javanese.

Remarks: The species is very rare and from 15 specimens I examined only 3 were fruiting.

In leaf-characters it is closely related to *B. macrocarpa* and according to Moll & Janssonius, Mikrographie 3 (1918) 500, also to *B. spicata* (= *B. acutangula* ssp. *spicata*) as far as wood-anatomy is considered.

b. var. **megistophylla** (Merr.) Payens, *stat. nov.* — *B. megistophylla* Merr., Pl. Elm. Born. (1929) 213; Knuth, Pfl. R. Heft 105 (1939) 22.

Rachis densely winged, wings in pairs underneath each flower, *c.* 1½—4½ by ½ cm.

Typification: *B. megistophylla* Merr.: *Elmer 21823*, holotype lost, isotypes in BM, BO, BRI, HBG, K, L (leaf only), P, SING, U.

Distribution: NE. Borneo (Tawao, Sangkulirang, and E. Kutai). Fig. 9.

Ecology: In dense humid forest, on loam and limestone, at *c.* 60—200 m. Fl. June, fr. Aug.

Compilation of field-notes: Bole *c.* 7 m, crown *c.* 3 m; bark smooth, superficially fissured, living bark *c.* 10 mm thick, dirty white; wood yellowish. Flowerbuds pink; rachis light green with reddish brown fissures; petals ivory; fruit green. Rare tree.

Vernaculars: In Sangkulirang *Tubang palong* and in E. Kutai *Kaju gĕdang* or *Putat*.

Remarks: Only 3 collections are known: *Elmer 21823*, *Kostermans 5385* and *13301*.

12. B. integrifolia (Montr.) Schltr, Bot. Jahrb. 39 (1906) 200; Guillaumin & Beauvisage, Ann. Soc. Bot. Lyon 38 (1914) 92; Knuth, Pfl. R. Heft 105 (1939) 19; Guillaumin, Bull. Soc. Bot. Fr. 86 (1939) 174; Fl. Nouv. Caléd. (1948) 227. — *Stravadium integrifolium* Montrouzier, Mém. Ac. Lyon 10 (1860) 210; Miers, Trans. Linn. Soc. Bot. 1 (1875) 89. — *B. montrouzieri* Vieill., Bull. Soc. Linn. Normand. 10 (1866) 100, *nom. illeg.*; Guillaumin, Ann. Mus. Col. Marseille 19 (1911) 154.

Eugenia racemosa Forst. *f.*, Prod. Fl. Austr. (1786) 39, *non* L. 1753.

B. intermedia Vieill., Bull. Soc. Linn. Normand. 10 (1866) 98; Guillaumin, Ann. Mus. Col. Marseille 19 (1911) 154; Knuth, Pfl. R. Heft 105 (1939) 26; Guillaumin, Bull. Soc. Bot. Fr. 86 (1939) 174; Ann. Mus. Col. Marseille 55/56 (1948) 38. — *Butonica intermedia* Miers, Trans. Linn. Soc. Bot. 1 (1875) 73. — *Michelia intermedia* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240.

Small tree *c.* (2—)6—10(—15) m; twigs *c.* 5—10(—12) mm ∅. *Leaves* sessile, obovate-lanceolate, glabrous, *c.* 21—35(—43) by 5—9(—12) cm (leaf-index 3—4), subchartaceous, entire, acute or obtuse, cuneate at base; midrib, nerves, and venation equally prominent on both sides; nerves in 18—20(—25) pairs, marginal vein distinct. *Racemes* terminal, pendulous, glabrous, sparsely flowered, *c.* (30—)45—80(—103) cm, rachis 2½—5 mm ∅, lengthwise fissured. Bracts sessile, lanceolate to triangular, *c.* 10—25 by 2—7 mm, papyraceous. Opening bud *c.* 8—10 mm, with apical pore. Pedicels laterally flattened, *c.* (4—)8—20 mm, accrescent up to 30 mm. *Calyx* tube *c.* 3 mm; limb connate, with apical pore, rupturing into 2—4 unequal, elliptic segments *c.* 9—19 by 5—11 mm, accrescent. *Petals* 4, elliptic, convex, *c.* 2¼—2¾ by 1¼—1¾ cm, papyraceous, fimbriate, obtuse, insertion *c.* 4—6 mm wide. *Staminal tube c.* 1½—2 mm high, stamens in 5—7 whorls, inner one staminodial; filaments *c.* 18—25 mm, staminodia *c.* 5—10 mm; anthers *c.* 1—1¼ by ½—¾ by ¾ mm. Disk annular, *c.* 1 mm high, with ± revolute margin. *Ovary* (2—)4-celled, tetragonous, sometimes pulverulent, slightly winged, *c.* 3—5 by 2—5 by

4 mm; ovules (0—)1—2(—4) per cell (total number 4—5), septa incomplete; style *c.* 3½ cm. *Fruit* sublinear-oblong, excl. the wings *c.* 7½—10 by 1 by ¾—1 cm, each of the 4 corners with an irregular wing *c.* ½—2½ cm wide with transverse anastomosing venation (fruit body is lengthwise veined), truncate, base tapering into the pedicel, accrescent; pericarp *c.* 1 mm thick, exo-, meso-, and endocarp very thin. *Seed* linear-oblong, ± spindle-shaped, tetragonous, not fissured, *c.* 6 by ¾ cm.

Typification: *B. integrifolia* (Montr.) Schltr, *Stravadium integrifolium* Montrouzier, *B. montrouzieri* Vieill.: *Montrouzier s.n.*, holotype probably in LY, isotype in MPU (not seen).

Eugenia racemosa Forst. *f.*, *non* L.: *Anderson s.n.* (1774), holotype in BM, not in GOET (F.-G. Schröder *in litt.* 29-5-1967).

B. intermedia Vieill., *Butonica intermedia* Miers, *Michelia intermedia* O. Kuntze: *Vieillard 2235* (not *2239*), holotype in P, isotypes in BM, K.

Distribution: New Caledonia, Art and Loyalty Is. (Lifu I.). Fig. 9.

Ecology: Along rivers and creeks from sea-level up to 100(—500) m. Fl., fr. Jan.—Dec.

Compilation of field-notes: Stem thick, crown spreading, sparsely branched. Flowerbuds greenish white; petals white or pink; fruit green.

Remarks: In BM an Anderson collection from 1774 and a specimen from the Forster herbarium (one leaf only) bear the name *Eugenia racemosa*. It is possible that the leaf from the Forster herbarium belongs to the Anderson sheet and hence I believe Anderson 1774 is the type specimen of *Eugenia racemosa* Forster *f.* The epithet *racemosa* is pre-empted under *Barringtonia*.

Though vegetatively very alike, the remarkably winged fruit and the calyx with an apical pore distinguish this species at once from *B. racemosa* and *B. macrocarpa*.

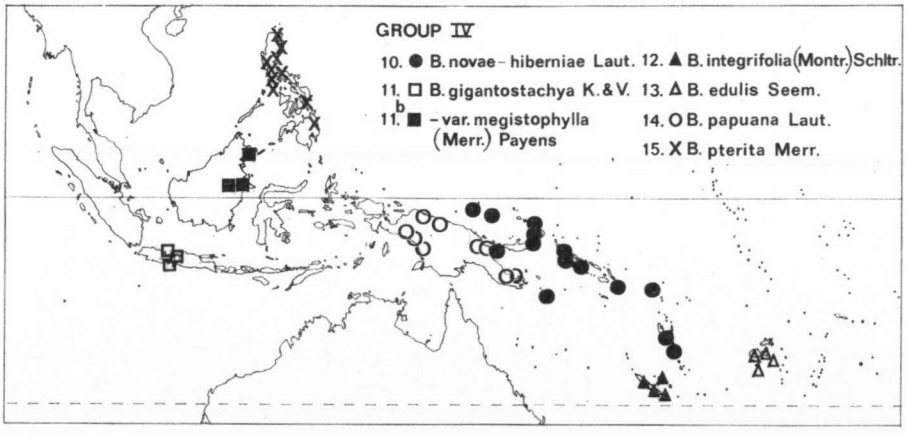


Fig. 9. Localities of the species of Group IV.

13. B. edulis Seem., Fl. Vit. (1866) 82; Drake del Castillo, Ill. Fl. Ins. Pac. (1890) 171; Guppy, Pl. Disp. 2 (1906) 573; Knuth, Pfl. R. Heft 105 (1939) 26; Parham, Dep. Agr. Fiji Bull. 21 A (1942) 42, 70; Fl. Fiji Isl. (1964) 143. — *Butonica edulis* Miers, Trans. Linn. Soc. Bot. 1 (1875) 76. — *Huttum edule* Britten, J. Bot. 39 (1901) 67.

Small tree, *c.* 6—15 m; dbh *c.* 30—40 cm; twigs *c.* 7—10 mm ∅. *Leaves* conferted, obovate-oblong, glabrous, very glossy on both sides, chartaceous, *c.* 17—45 by (5½—)

11—20 cm (leaf-index 2½—3¼), serrate-crenulate towards apex, acuminate, base cuneate, midrib and nerves equally prominent on both sides, nerves *c.* 15—20 pairs; petiole *c.* ½—1½ cm. *Racemes* ramiflorous and terminal, pendulous, *c.* 20—50 cm, densely flowered (40 fls); rachis *c.* ½ cm ∅, ± fissured, yellowish grey-green pulverulent. Bracts lanceolate. *Flowers* not scented. Opening buds *c.* 10 mm with a mucro. Pedicels *c.* ½—1 cm. *Calyx* closed in bud, disrupting into 2—3 elliptic, obtuse lobes 8—16 by 5—12 mm, ± accrescent, pulverulent, chartaceous; tube 2—3 mm high. *Petals* 4, elliptic, convex, *c.* 2¾—3 by 1¾—2 cm; insertion *c.* 6—8 mm wide. *Staminal tube c.* 4 mm high, stamens in 4—5 whorls, inner one staminodial, filaments *c.* 3½—4 cm, filaments of the outer whorls longer than the inner; staminodia connate up to *c.* 8 mm, free filiform part *c.* 15 mm; anthers *c.* 1 by ½—¾ by ½ mm. Disk inconspicuous, *c.* ¼ mm high. *Ovary* (3—)4-celled, tetragonous, grooved, greyish yellowish pubescent, *c.* 4—7 by 3—5 by 3—5 mm; ovules 2(—4) per cell (total number 8—12), septa complete; style *c.* 4½—7 cm. *Fruit* ellipsoid, *c.* 4½—5 by 1½—2 by 1½—2 cm, truncate, tapering towards base, tomentose; pericarp *c.* 3—6 mm thick, exocarp thin, soft (fleshy when fresh), *c.* 1—2 mm, mesocarp hard with small fibres, *c.* 1½—3 mm; endocarp a hard, thin layer with some thick fibres, *c.* ½—1 mm thick. *Seed* ovoid, ± fissured, *c.* 3—3½ by 1 cm.

Typification: *B. edulis* Seem., *Butonica edulis* Miers, *Huttum edule* Britten: *Seemann 150*, holotype in BM, isotypes in K and P.

Distribution: Fiji (Viti Levu, Kandavu, Ovalau, Lakemba). Fig. 9.

Ecology: In forest, woodland, and pasture, from sea-level up to *c.* 400 m. Fl., fr. Sept.—Dec.

Compilation of field-notes: Bark almost smooth, greyish brown. Wood with thick cream sapwood and soft cream-brown heartwood. Flowerbuds greenish and hairy. Petals white, stamens red (*Bryan 535* from Lakemba) or white (*Smith 307* from Kandavu). Fruit green, fleshy, and firm with a small white seed.

Vernaculars: Generally known as *Vutu kana* or just *Vutu* (the general name for *Barringtonia* in Fiji), but in literature also *Vutu dina* is mentioned. See Seemann, A Mission to Viti (1862) 323 and (1866) *op. cit.* 83 under *B. sp.* This name applies to an edible species with a hard pericarp, while *Vutu kana* has a soft one. I have had no material to check if there is a possible difference between the two.

Uses: The seed is edible.

Remarks: Other edible species of *Barringtonia* are *B. procera* (Miers) Knuth and *B. novae-hiberniae* Laut. found on the islands east of New Guinea. *B. edulis* and *B. procera* are very much alike in the herbarium, but differ in the following characters: *B. edulis* has petioled leaves, pedicelled flowers, and an ovoid fruit (green when fresh), while *B. procera* has (sub)sessile leaves and flowers and an 8-gonous fruit (purple when fresh).

B. novae-hiberniae has several characters in common with *B. edulis* but differs in having almost open flowerbuds or buds with a large apical pore, while *B. edulis* has a completely closed calyx which disrupts into 2—3 segments.

14. B. papuana Laut., Nova Guinea 8 (1910) 314, (1912) 845; Bot. Jahrb. 57 (1922) 349; Knuth, Pfl. R. Heft 105 (1939) 23.

Small treelet, *c.* 3—10 m; dbh *c.* 5 cm; twigs 8—12 mm ∅. *Leaves* linear-lanceolate, glabrous, *c.* (47—)60—113(—126) by (1½—)5—8 cm [leaf-index 12—23(—31)], ± stiff, serrate-crenulate, acuminate or cuspidate, base long-cuneate; lateral nerves 70—95 pairs, equally prominent on both sides as is the venation and midrib; petiole *c.* (1½—)4—7 (—12) cm, ± winged by the decurrent leafbase. *Racemes* rami- or cauliflorous, more or less erect, glabrous, *c.* 3—14 cm long with ± 10 flowers; rachis 1½—2 mm ∅. Cataphylls

triangular, *c.* 9—11 by 3 mm. Bracts lanceolate or linear-lanceolate *c.* 2½—10 by ½—2 mm. Bracteoles triangular, *c.* 2 by ¼—1 mm. Pedicels 2—3 cm. Opening buds *c.* 10 mm. *Calyx tube c.* 2—5 mm high, the limb closed, rupturing into a persistent ring and a caducous cap *c.* 6—8 by 10 mm, or into 2—4 persistent, not accrescent segments *c.* 12—20 by 10—20 mm. *Petals* elliptic, obtuse, convex, *c.* 3—4 by 1½—2 cm, membranous, insertion *c.* 4—7 mm wide. *Staminal tube c.* 2½—6 mm high outside and *c.* 15—18 mm inside; stamens in (5—)6 whorls, innermost one staminodial; filaments *c.* 3½—4½ cm, staminodia *c.* 3 mm; anthers *c.* ¾—1 by ½—¾ by ¼—½ mm. Disk a narrow ring *c.* 1¼—2½ mm high. *Ovary* 4-celled, subtetragonous or globular, *c.* 4—7 by 3—6 by 3—5 mm; ovules 2—4 per cell [total number (9—)13—16]; septa complete; style *c.* 3—4 cm.

Typification: *B. papuana* Laut.: *Versteeg 1759*, holotype in B (lost), isotypes in BO, K, L, U, WRSL; *Versteeg 1821*, paratypes in B (lost), BO, K, L, WRSL.

Distribution: New Guinea (Tor, Sepik, Otakwa, & Lorentz R., Papua: North Distr.). Fig. 9.

Ecology: Along rivers in primary and secondary forest at low altitudes up to 25 m. Fl. May—Oct.

Compilation of field-notes: Slender bole with a single tuft of leaves terminating the trunk or with a few branches. Leaves somewhat stiff, shiny. Racemes cauliflorous, low down on the trunk; calyx green tinged purple; petals greenish white or white, stamens pink or creamy-yellow; anthers brown-yellow. Flowers not scented.

Vernacular: In Papua *Sehsegeh* (Orokaiva lang.).

Remarks: The cycadoid habit of the tree resembles that of *B. calyptrocalyx* var. *boridiensis* and *B. papeh*.

I have seen no fruiting specimens.

15. B. pterita Merr., Philip. J. Sc. 9 (1914) Bot. 322; En. Philip. 3 (1923) 142; Knuth, Pfl. R. Heft 105 (1939) 20.

Small tree, *c.* 7—10 m; dbh *c.* 10—12 cm; twigs *c.* 5—8(—10) mm ∅. *Leaves* mostly obovate-lanceolate or linear-lanceolate, rarely obovate-oblong, chartaceous, glabrous, *c.* (13—)17—40(—52) by 3—9 cm [leaf-index (3½—)4—5(—10)], ± serrate-crenulate towards the apex, cuspidate or acuminate, base longly cuneate, midrib prominent at both faces, nerves *c.* (15—)20—25(—28) pairs; petiole ½—1 cm. *Racemes* or spikes terminal or ramiflorous, *c.* 58—71(—144) cm (*c.* 60 fls); rachis 2½—3 mm ∅, accrescent to *c.* 5 mm. Cataphylls lanceolate or triangular, *c.* 5—25 by 3—5 mm, chartaceous. Bracts triangular, *c.* 2½—5 by 1—2 mm, serrate. *Flowers* not scented. Opening buds *c.* 10 mm. Pedicels *c.* (0—)5—12 mm, often tetragonous or ± winged apically. *Calyx* connate in bud, disrupting into 2(—3) unequal segments, the tube *c.* ½ mm high, lobes convex, *c.* 9—10 by 6—11 mm, papyraceous. *Petals* 4, elliptic, convex, *c.* 1½—2 by ¾—1 cm, membranous, slightly fimbriate towards the obtuse apex; insertion *c.* 2—5 mm wide. *Staminal tube c.* 1½—3 mm, stamens in 3 whorls, innermost one staminodial; filaments *c.* 3—3½ cm, staminodia *c.* ¾ cm, anthers *c.* ½—¾ by ½ by ½ mm. Disk a small ring, *c.* ½ mm high. *Ovary* (3—)4-celled, tetragonous, winged, *c.* 5 by 3—5 by 3—5 mm; ovules 3—5 per cell (total number up to 8—18); septa complete; style *c.* 3½ cm. *Fruit* distinctly 4-winged, tetragonous, glabrous, *c.* 4—6 by 1—2½ by 1—2 cm, truncate, tapering at base; wings *c.* 4—7 mm wide; pericarp *c.* 3 mm thick, exocarp thick, fleshy, *c.* 2 mm, when dry with a few fibres, mesocarp fibrous, *c.* 1 mm, endocarp a thin, brown membrane. *Seed* ovoid, distinctly fissured, *c.* 2½—3½ by 1—1¼ cm.

Typification: *B. pterita* Merr.: *Ramos B.S. 15121* (Luzon), holotype in PNH

(lost), isotypes in K, US; *Elmer 9168*, paratypes in BO, E, K, L, US, W, WRSL.

Distribution: Philippines (Luzon, Mindoro, Leyte, Mindanao). Fig. 9.

Ecology: On side of creeks and on a ridge in Dipterocarp forest, from sea-level up to 170 m. Fl. April—June, fr. June—Aug.

Compilation of field-notes: Petals pink or greenish white.

Remarks: *Addura 268* and *Gutierrez PNH 78121* from Luzon, *Ramos B.S. 15189* from Leyte, and *Ramos & Pascasio B.S. 34810* from Mindanao have distinctly sessile flowers. The latter two specimens are mentioned by Merrill (1923) as belonging to *B. pterita* together with his type material which has pedicelled flowers. All pedicelled material has been collected in S. Luzon and on Mindoro.

16. B. calyptrocalyx K. Sch. in K. Sch. & Hollr., Fl. Kais. Wilh. Land (1889) 91; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; K. Sch. & Laut., Fl. Schutzgeb. (1900) 462, 464; Laut., Nova Guinea 8 (1910) 314, 315; Bot. Jahrb. 45 (1911) 363; *ibid.* 57 (1922) 351, 352; Knuth, Pfl. R. Heft 105 (1939) 25.

B. calophylla K. Sch. & Laut., Fl. Schutzgeb. (1900) 463; Laut., Nova Guinea 8 (1910) 315; Bot. Jahrb. 57 (1922) 347, 352; Knuth, Pfl. R. Heft 105 (1939) 24.

B. carrii Knuth, Pfl. R. Heft 105 (1939) 23.

Further synonym under a variety.

KEY TO THE VARIETIES

1. Leaves glabrous.
   2. Leaves obovate-lanceolate or linear-lanceolate (leaf-index 3½—6½), nerves 32—65 pairs. Racemes 30—135 cm. Style 2½—3½ cm. . . . . **a. var. calyptrocalyx**
   2. Leaves linear-lanceolate (leaf-index 4—7), nerves 14—37 pairs. Racemes 10—30 cm. Style 2—2½ cm. **c. var. boridiensis**
1. Leaves hairy underneath . . . . . **b. var. mollis**

a. var. calyptrocalyx.

Shrub or small tree, *c.* (2—)3—7(—10) m, dbh *c.* 5—10(—15) cm; twigs *c.* 8—12(—20) mm ∅. *Leaves* obovate-lanceolate or linear-lanceolate, glabrous, *c.* (32—)60—135 by (6—)10—25 cm (leaf-index 3½—6½), coriaceous, serrate-crenulate, acuminate, cuneate at base, midrib slightly keeled above, prominent underneath, nerves *c.* (32—)40—65 pairs, venation equally prominent on both faces; petiole *c.* (1—)2—5(—13) cm. *Racemes* cauliflorous well below the leaves, pendulous, *c.* 30—75(—135) cm, rachis 1—4 mm ∅, accrescent, with up to 71 flowers (on 51 cm), ± fissured, puberulous. Bracts lanceolate, *c.* 3—6 by 1—1½ mm. Pedicels (2—)5—17 mm. Bracteoles triangular, *c.* ¼—2 by ½—1 mm. Opening buds *c.* 8—10 mm. *Calyx* closed in bud, rupturing circumscissile into a caducous cap *c.* 5—6 by 8—12 mm and a cup-shaped ring *c.* 2—5 mm high, rarely rupturing into 2—3 irregular segments *c.* 5—11 by 5—14 mm. *Petals* (3—)4, elliptic, obtuse, membranous, convex, entire, *c.* 1¾—2½ by 1—1½ cm; insertion *c.* 2—4 mm wide. *Staminal tube c.* 1½—5 mm high; stamens in (4—)5(—6) whorls, inner one staminodial; filaments *c.* 25—30 mm; staminodia connate up to *c.* ½—6 mm, free part *c.* 3—9 mm; anthers *c.* ¾—1 by ½—¾ by ½—⅔ mm. Disk annular, ½—1¼ mm high. *Ovary* 2—3(—4)-celled, tetragonous, pulverulent, *c.* 3—5 by 3—7 by 2—5 mm; ovules 2—4(—6) per cell [total number (4—)6—13(—22)]; septa complete; style *c.* 2½—3½ cm. *Fruit* ovoid or spindle-shaped, truncate, *c.* 3½—7 by 1½—4 by 1—3½ cm, often with *c.* 8 parallel ribs; pericarp

c. 1½—6 mm thick; exocarp *c.* ½—4½ mm, mesocarp fibrous, *c.* ½—1½ mm, endocarp a thin brown membrane. *Seed* ovoid, *c.* 2½—3½ by 1¼—2 by 1¼—1½ cm, furrowed.

Typification: *B. calyptrocalyx* K. Sch.: *Hollrung 551* (New Guinea), holotype in B (fruit preserved only), isotype in WRSL (inflorescence and leaf).

B. calophylla K. Sch. & Laut.: *Tappenbeck 22* (New Guinea), holotype in B (lost), isotype in WRSL.

B. carrii Knuth: *Carr 12444* (Papua), holotype in B (lost), isotypes in BM, K, L, SING; *Carr 11324*, paratypes in BM, K, L, SING.

Distribution: New Guinea (from Hollandia to Milne Bay Distr.) and in New Britain (Gazelle Peninsula). Fig. 10.

Ecology: Understorey tree in marshy forest, along creeks, and in submontane rain-forest, from sea-level up to 1400 m. Fl. May—Oct., fr. Jan.—Oct.

Compilation of field-notes: Straight shrub or small tree, scarcely branched with a terminal crown of leaves only. Bark grey, smooth or mottled and flaky. Wood cream or yellow with pronounced growth rings. *Schodde 2976* from Papua (Sogeri Region) states the stems to be myrmecophilous. Petals white-pink to deep rose-red, calyx pink, stamens and style dark red. Pedicels light green. Fruit red or deep pink on pendulous, cauline racemes.

Vernaculars: Only one name from New Britain: *Papao*, and from Papua: *Bura bura* (Musa lang.).

Remarks: *Schodde 2976* has articulated flowers. This feature has also been found amongst *B. apiculata*-material.

A raceme can still have flowers at apex while almost mature fruits are developing at the base. The fruiting part of the rachis is abruptly thicker (*c.* 3 mm) than the flowering part.

In *Brass 8003* and *24407* the flowers are sessile at the apex of the rachis and pedicelled at the base. In var. *boridiensis* some collections have sessile flowers only.

b. var. **mollis** Laut., Bot. Jahrb. 57 (1922) 352; C. T. White, Proc. R. Soc. Queensl. 38 (1927) 248; Knuth, Pfl. R. Heft 105 (1939) 25.

Leaves hairy underneath, hairs straight, single *c.* (⅛—)⅓—½(—¾) mm, white, brown, or ferrugineous. Flowers often nearly sessile.

Typification: *B. calyptrocalyx* var. *mollis* Laut.: *Ledermann 10525*, holotype in B (lost), isotype in WRSL.

Distribution: Aru Is. (Wokam), NE. & E. New Guinea, New Britain (Gazelle Peninsula). Fig. 10.

Ecology: Understorey shrub or small tree in primary or secondary rain-forest, often common on occasionally inundated plains or along rivulets in hilly areas, from sea-level to *c.* 100 m. Fl. March—Dec., in full bloom in Aug., fr. July—Dec.

Compilation of field-notes: Unbranched or very sparsely branched shrub or small tree with leaves at the apex of stem or branches only. Bark grey or dark brown with round, pustular lenticells and very fine cracks. Wood white, heartwood yellow, not clearly defined. Flowerbuds green-red. Petals greenish white or white with a pink tinge, reddish pink, bright pink, or red, stamens pink. Fruit light red, red, or orange red.

Vernaculars: In Papua the following names are used: *Sehsega* (Orokaiva lang.); *Sesewa* (Oitatandi lang.); *Sjedon* (Kamtuk lang.); as well as *Kusap* (Jal lang.) and *Kala* (Sentani lang.) in New Guinea. In New Britain it is *La malo malo* (W. Nakanai).

Uses: In New Britain the bark is boiled and then used as a fish-poison.

Remarks: A number of inflorescences have almost sessile flowers (*viz. NGF*

6502) or sessile and pedicelled flowers on one raceme like in var. *calyptrocalyx*. In contrast with var. *boridiensis*, var. *mollis* grows only on wet lowland sites.

c. var. **boridiensis** (Knuth) Payens, *stat. nov.*

B. boridiensis Knuth, Pfl. R. Heft 105 (1939) 24.

Leaves linear-lanceolate, *c.* (22—)27—60(—78) by (3½—)5—10(—13) cm (leaf-index 4—7), coriaceous, nerves *c.* (14—)18—26(—37) pairs. Racemes or spikes *c.* 10—30 cm. Petals *c.* 2—3 by 1—2 cm. Style *c.* 20—25 mm.

Typification: *B. boridiensis* Knuth: *Carr 13351*, holotype in B (lost), isotypes in BM, K, L, SING; *Carr 13022, 15360, 15422*, paratypes in BM, K, L, SING.

Distribution: SE. New Guinea. Fig. 10.

Ecology: Common in rain-forest undergrowth, in montane forest common in secondary growth, at *c.* (50—400—)1300—1950 m. Fl. Jan.—Sept., fr. Febr.—Sept.

Compilation of field-notes: Small tree or shrub, unbranched with a terminal whorl of leaves. Racemes cauliflorous, well below the leaves. Calyx dull purple, petals pink or deep rose-lilac, stamens rose-red or deep salmon pink, anthers yellow. Fruit red, pale yellowish green, or pale greenish white (the latter probably from an immature fruit).

Vernacular: Only one name from Okapa: *Megu*.

Remarks: Ten collections were made in the Eastern Highlands, all above 1300 m. Two made at lower altitude. This is the only *Barringtonia* growing well at higher altitudes (above 1700 m). The cycadoid habit resembles that of *B. papeh* and *B. papuana*, the latter differing distinctly in having very long, slender leaves and large, white flowers.

17. B. apiculata Laut., Bot. Jahrb. 57 (1922) 350; Knuth, Pfl. R. Heft 105 (1939) 39.

B. sepikensis Laut., Bot. Jahrb. 57 (1922) 351, fig. 4; Knuth, Pfl. R. Heft 105 (1939) 41, fig. 8.

B. forbesii Baker, J. Bot. 61 (1923) Suppl. 20; C. T. White, Proc. R. Soc. Queensl. 38 (1927) 248; Knuth, Pfl. R. Heft 105 (1939) 37.

? *B. mengkokaensis* Knuth, Pfl. R. Heft 105 (1939) 16, fig. 4.

Small to medium-sized tree, (3—)8—25(—30) m, dbh *c.* 20—40 cm; twigs *c.* (3—)5—8 (—13) cm. *Leaves* elliptic, or obovate-oblong, or obovate-lanceolate, glabrous *c.* 13—40(—50) by 5—14(—16) cm (leaf-index 1¾—3), chartaceous or coriaceous, entire, rounded, obtuse, or acute, base cuneate; midrib and nerves prominent on both faces, nerves *c.* (7—)10—14 pairs, venation prominent on both sides; petiole *c.* (½—)1—5 cm. *Racemes* ramiflorous, pendulous, *c.* 8—45 cm, with up to 40 flowers; rachis slightly fissured, greyish pulverulent, 2—3 mm ∅. Bracts lanceolate *c.* 7 by 1½ mm. *Flowers* weakly sour fragrant. Pedicels *c.* 4—27 mm with an articulation at *c.* 1—12 mm from the rachis. Bracteoles triangular, *c.* 1 by ½ mm. Opening buds 6—10 mm, often mucronate. *Calyx* closed, either rupturing circumscissile above the base and throwing off a caducous cap *c.* 2½—5 by 6—13 mm wide, leaving a calyx tube *c.* 2—8 mm high, or more rarely rupturing into 4 irregular segments *c.* 8—10 by 10—15 mm, slightly pulverulent outside. *Petals* 4, elliptic, obtuse or acute, convex, *c.* 22—40 by 7—18 mm, chartaceous, fimbriate; insertion *c.* 2—6 mm wide. *Staminal tube c.* 2—6(—11) mm high; stamens in 5, 7, or 8 whorls, 1 or 2 inner ones staminodial (sometimes with ill-developed anthers), filaments *c.* 10—30 mm; staminodia connate up to *c.* 5—11 mm, their free part *c.* 1—6(—10) mm, anthers *c.* ¾—1½ by ½—1 by ½ mm. Disk a thin ring ½—2 mm high. *Ovary* 3—4-celled, obpyramidal, 3—4-gonous, pulverulent, *c.* 3—6 by 4—8 by

4—6 mm; ovules 0—6 per cell (total number 3—31); septa complete; style *c.* 16—40 mm. *Fruit* ovoid, *c.* 45 by 23 by 21 mm, truncate, tapering at base; pericarp *c.* 2½ mm thick; exocarp thin, hard, *c.* ½ mm; mesocarp slightly spongy with fibres dispersed, *c.* 1 mm; endocarp thin, fibrous, *c.* ½ mm. *Seed* ovoid, *c.* 35 by 13 by 13 mm.

Typification: *B. apiculata* Laut.: *Ledermann 9959* (New Guinea), holotype in WRSL, isotype in K; *Ledermann 12868*, paratype (not seen, probably lost in B).

B. sepikensis Laut.: *Ledermann 8042* (New Guinea), holotype in WRSL, *Ledermann 10403*, paratype in K.

B. forbesii Baker: *Forbes 803* (New Guinea), holotype in K, isotypes in BM and L.

B. mengkokaensis Knuth: *Heinrich 349* (SE. Celebes), holotype in B (lost).

Distribution: SE. Celebes, Misoöl, Waigeo, throughout New Guinea, Rossel I. Fig. 10.

Ecology: Rain-forest tree from New Guinea, in Waigeo growing in *Vatica-Intsia-Adina* or *Vatica-Horsfieldia* forest (*Van Royen 5159* and *5476*). Altitude from *c.* 30—1000 m. Fl. Jan.—Dec., fr. only one collection in March.

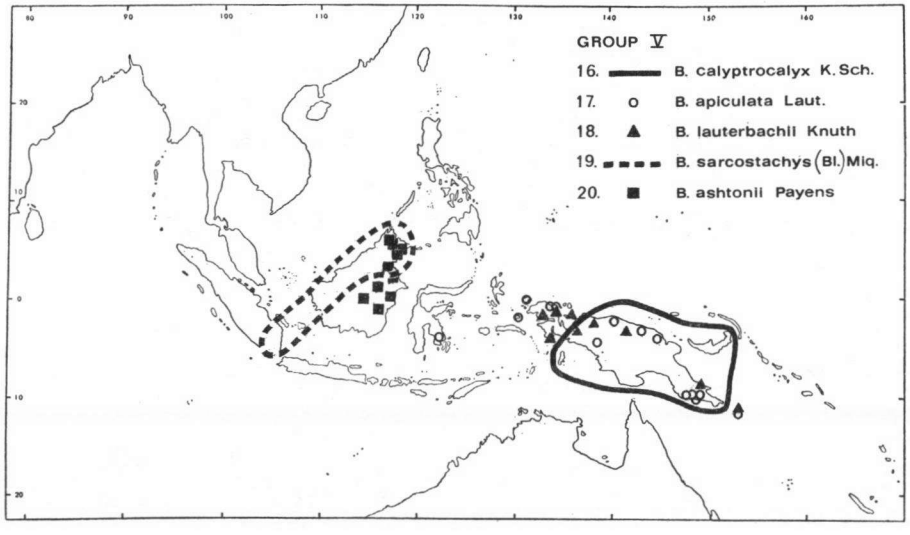


Fig. 10. Localities or ranges of the species of Group V.

Compilation of field-notes: Bark rough, flaky or fissured, grey. Wood yellow or cream, heartwood pale brown. Flower white, cream, or pink, also twice mentioned to have waxy petals. Filaments yellow or pink, anthers yellow. A field label from a collection made by *Sutrisno 67* from a tree cultivated in the Botanical Gardens at Bogor under V.A. 116, gives an accurate description of colours: petioles violet towards the base; rachis green; pedicels tinged red; calyx green; petals outside glossy, inside dull, basal part tinged red, centre whitish, apex pale-whitish to yellow-green; flowers weakly sour-fragrant, open at 1 p.m.; disk pale yellow; filaments white at the base, white-yellow at apex; ovary pale green; style pale towards the base, violet-red towards apex; stigma yellow (due to pollen?).

Vernaculars: 5 different names are given from 3 different areas in New Guinea and Waigeo. In Central Papua (Vanapa River): *Me-A*; Sepik District: *Numbinyangra*

(Timbunke: Sepik), *Kusap* (Jal: Madang) and *Punda* (Orne lang., Kaiye village); Waigeo: *Toplie*.

Remarks: So far 7 species of *Barringtonia* have been recorded from Celebes; according to the description *B. mengkokaensis* does not fit any of these. In the apiculate, closed calyx it resembles *B. apiculata* to which it also could belong by its other characters, except its almost sessile leaves. As *B. apiculata* is hitherto known only from New Guinea and some western adjacent islands, this might extend its area to SE. Celebes; but my reduction must be regarded as distinctly tentative.

Like in *B. calyptrata* and *B. neo-caledonica* a second whorl of staminodia was found in *Forbes 803*, the type specimen of *B. forbesii* Baker and in *Ledermann 8042*, the type specimen of *B. sepikensis* Laut. This feature of having more than one staminodial whorl also occurs occasionally in *B. papeh* Laut., where sometimes up to 3 staminodial whorls are found.

The number of ovules per cell varies. In *Forbes 803* and *Ledermann 8042* there are 4—9 ovules per cell, total number thus varying from 17—31.

Only 1 fruit collection was made by *Brass 3855*. On the field label the size was stated as 7 by 4 cm. On the herbarium sheet is one fruit 4½ by 2½ by 2 cm.

The pollen-morphological investigation by Mr. J. Muller showed a strange variety of pollen types within this species. Even sterile anthers were found. This might well be a sign that hybridisation may have taken place. *B. lauterbachii* showed also a variety of pollen types. All other *Barringtonia* species belong to clearly defined types.

18. B. lauterbachii Knuth, Pfl. R. Heft 105 (1939) 37. — *B. pauciflora* Laut., Bot. Jahrb. 57 (1922) 348, *non* King 1901.

Small to large tree, 10—23(—31) m; dbh *c.* 38—71 cm; twigs *c.* 2—5(—7) mm ∅. *Leaves* oblong or obovate-oblong, glabrous, *c.* 10—23(—38) by 3½—9(—12) cm (leaf-index 2½—3), papyraceous, entire, rounded, acute, or caudate, base cuneate, midrib prominent at both faces, nerves *c.* 11—15(—20) pairs, prominent underneath, distinct above; petiole *c.* (½—)1—3(—5) cm. *Racemes* terminal or ramiflorous, rachis *c.* 2—9 cm by *c.* ½—2 mm ∅, accrescent to 4 mm ∅ in fruit, *c.* 16-flowered, grey pulverulent, not fissured. Bracts caducous, not seen. Opening buds *c.* 8 mm, crowned by a mucro *c.* ¾ mm long. Pedicel pulverulent, *c.* ¾—1½(—3) cm, accrescent to 1½—5 cm by 2—3 mm. *Calyx* closed in bud, disrupting circumscissile into a persistent ring *c.* 5—7 mm high and a caducous cap *c.* 3—4 by 8 mm, rarely rupturing into 2—3 irregular segments *c.* 4—11 by 5—10 mm; calyx tube 2—3 mm high. *Petals* 4—5, elliptic, convex, *c.* 2—2½ by 1—1½ cm, membranous, acute or rounded, insertion, *c.* 2½—4 mm wide. *Staminal tube c.* 3 mm high; stamens in 6—7 whorls, inner one staminodial; filaments *c.* 1¾—2 cm; staminodia connate, *c.* 8—10 mm, their free filiform part *c.* 1—2 mm; anthers *c.* ¾ by ½ by ½ mm. Disk annular, *c.* 1½ mm high. *Ovary* 3—4-celled, obpyramidal, grey pulverulent, *c.* 3—6 by 3—5 by 3—4 mm; ovules 1—3 per cell (total number *c.* 6—8); septa complete; style *c.* 1½—2½ cm. *Fruit* ovoid or cylindrical, *c.* 4½—6½ by 1½—4½ by 1½—3½ cm, pulverulent, wrinkled, truncate at both ends, distinctly pedicelled; pericarp *c.* 1—3 mm thick, exocarp thin, hard, *c.* ½—1½ mm, mesocarp fibrous, *c.* ½—1 mm; endocarp a thin brown membrane. *Seed* ovoid, *c.* 3½—5 by 1½—2 by 1—2 cm, deeply grooved.

Typification: *B. lauterbachii* Knuth, *B. pauciflora* Laut., *non* King: *Ledermann 8801* (New Guinea), holotype in B (lost), isotype in WRSL.

Distribution: New Guinea, also in the adjacent Adi, Japen, and Rossel Is. Fig. 10.

Ecology: A rare tree in primary rain-forest growing in sandy clay soil. In Rossel I.

it is a tree from the subcanopy layer. Altitude from sea-level up to 750 m, on the N. slope of Mt Dayman (Milne Bay Distr.) collected by *Brass 23157* at 1550 m, in a moist hollow in an oak-forest. Fl. Febr.—Oct., fr. March—Oct.

Compilation of field-notes: Bole 7—12 m, straight; crown *c.* 5—19 m, not spreading widely. *Kostermans 305* reported buttresses on a 16 m high tree. Bark *c.* 13—17 mm thick, outside black, brown-grey, or brown, not peeling, rough with deep fissures. Inner bark 12—14 mm thick, yellow or lightbrown. Wood clearly defined in white or yellow sapwood *c.* 5 cm thick and brown or yellow heartwood. Flowerbuds yellowish white; calyx pink; petals white, yellowish white, cream, or pink; stamens yellow or rose-red. Fruit pale or dark green; seeds of *Kostermans 342* are hollow inside.

Galls: *Schram BW 6036* has small, brown leaf-galls.

Vernaculars: In New Guinea *Oesin* or *Oesem* (Biak lang.), *Bottegaib* or *Oedaub* (Manokwari lang.), and *Temakkofoes* (Tehid lang.).

Uses: *Moll BW 11533* reported the use of the bark as a fish-poison from Adi I.

Remark: The structure of the pollen resembles that of *B. niedenzuana*. Like in *B. apiculata* a variety of pollentypes has been found.

19. B. sarcostachys (Bl.) Miq., Fl. Ind. Bat. 1, 1 (1855) 490; Walp., Ann. 4 (1857) 851; Knuth, Pfl. R. Heft 105 (1939) 34. — *Stravadium sarcostachys* Bl., in Fl. Serr. 7 (1851) 24. — *Doxomma sarcostachys* Miers, Trans. Linn. Soc. Bot. 1 (1875) 102. — **Fig. 11, photogr. 3.**

B. dolichobotrys Merr., J. Str. Br. R. As. Soc. 77 (1917) 204; En. Born. (1921) 419; Pl. Elm. Born. (1929) 212; Knuth, Pfl. R. Heft 105 (1939) 22.

B. anacardiifolia Ridl., Kew Bull. (1938) 284; Knuth, Pfl. R. Heft 105 (1939) 34.

See for further synonym under the forma.

a. forma **sarcostachys.**

Small to large tree, *c.* (7—)8—33(—40) m; dbh *c.* (5—)15—30(—50) cm; twigs *c.* 8—15 mm ∅. *Leaves* obovate, elliptic, or lanceolate, glabrous, *c.* (15—)20—40(—45) by (4½—)7—15 cm (leaf-index 2½—4), subcoriaceous, almost entire, ± revolute, mostly rounded, rarely acuminate, base cuneate; nerves *c.* (10—)14—16(—20) pairs; petiole slightly winged by decurrent blade, *c.* 1—9(—13) cm. Cataphylls triangular, *c.* 6—14 by 2—5 mm. *Spike* terminal, pendulous, *c.* (24—)42—130(—180) cm; rachis *c.* 4 mm ∅, accrescent to *c.* 10—15 mm ∅, sparsely flowered, glabrous, shiny brown, woody. Bracts sublanceolate-triangular, *c.* 4—11 by 2—4 mm. *Flowers* not scented. Opening buds *c.* 15 mm. *Calyx* closed in bud, limb rupturing into (2—)4(—5) unequal segments, the tube *c.* (4—)7—9(—12) mm high, ± accrescent; segments convex, suborbicular, *c.* (6—)14—18(—22) by (7—)12—16(—20) mm, ± accrescent, coriaceous, obtuse or acute. *Petals* 4, elliptic, convex, *c.* (3—)3½—4½(—5) by (1¾—)2—2½(—3) cm, coriaceous, obtuse; insertion *c.* 7—9(—12) mm wide. *Staminal tube* *c.* 4—5 mm high; stamens in 4—6 whorls, inner one staminodial; filaments *c.* 3½—5 cm; staminodia *c.* 1½—2½ cm; anthers *c.* 1—1½ by ½—1 by ¼—¾ mm. Disk annular, 1½—2 mm high. *Ovary* 4-celled, subtetragonous with rounded edges, glabrous, *c.* (5—)9—13(—20) by (7—)9—10(—15) by (4—)5—10(—13) mm; ovules 4—6 per cell (total number *c.* 14—20); septum complete; style *c.* (4—)5—6½(—7½) cm. *Fruit* ovoid to subglobular, rarely pear-shaped, *c.* (5—)6—10(—11) by (3½—)4½—6(—7½) by (3—)4—6(—7½) cm; pericarp *c.* (2½—)4—10 mm thick, exocarp thin, very hard, *c.* (1—)2—5 mm, mesocarp thin with very hard fibre bundles, *c.* (1—)2—5 mm, endocarp a thin brown membrane. *Seed* ovoid-subglobular, *c.* 3½—6½ by 2½—4½ by 2—4 cm, with *c.* 14 deep fissures.

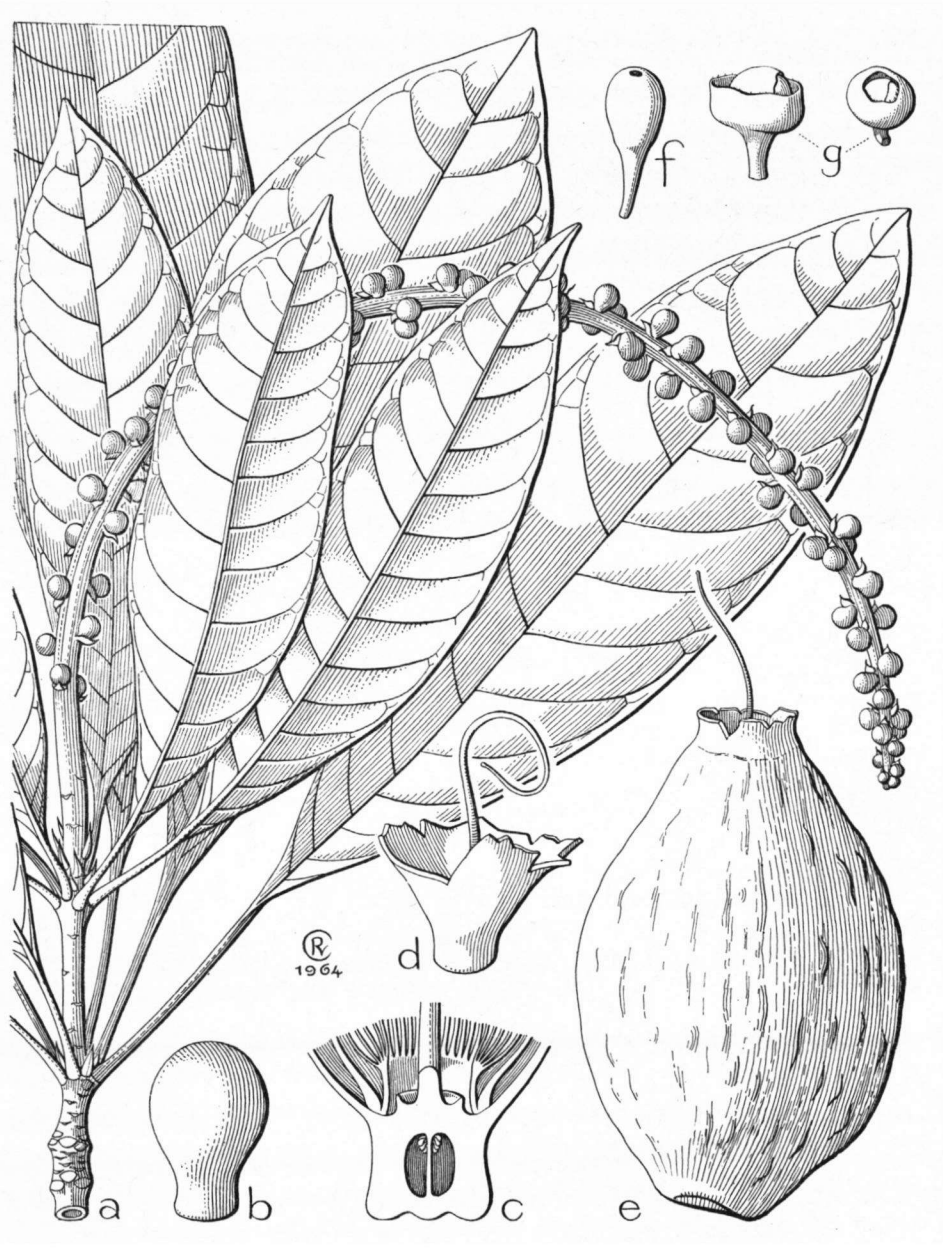


Fig. 11. *Barringtonia sarcostachys* (Bl.) Miq. a. Habit, × $\frac{1}{8}$, b. bud, nat. size, c. flower in section, × 2, d. flower after anthesis, nat. size, e. fruit, × $\frac{1}{8}$. — *B. samoensis* A. Gray. f. Young bud, × 2. — *B. novae-hiberniae* Laut. g. Young bud, × 2 (a—d. *SAN 23737*, e. *S. 13040*, f. *Hartley 10561*, g. *BSIP 4820* (*Cowmeadow*)).

Typification: *B. sarcostachys* (Bl.) Miq., *Stravadium sarcostachys* Bl., *Doxomma sarcostachys* Miers: *Praetorius* (Sumatra), *Herb. Lugd. Bat. 898.204.176—181*, holotype in L, isotype in BO.

B. dolichobotrys Merr.: *Villamil 278* (Sabah), holotype in K, isotype in US.

B. anacardiifolia Ridl.: *Haviland 2934* (Sarawak), holotype in K, isotypes in BM, BO, L, SAR, SING.

Distribution: S. Sumatra, W. & N. Borneo, Tarakan I. (off E. Borneo). Fig. 10.

Ecology: In primary forest, mostly in hilly areas; reported to grow in old logged Dipterocarp forest as well as amongst palms and climbers on clayish sandy and rocky soils, from sea-level up to 300 m. Fl., fr. Jan.—Dec., generally flowering abundantly in April and May.

Compilation of field-notes: Bole 5—15 m, crown 3—7 m; bark cracked, fissured, red-brown, grey, or greenish brown, mottled; outer bark brownish, brittle, soft; inner bark pink or white, *c.* 5—20 mm thick, fibrous; cork-cambium red or yellow; cambium light yellow; sapwood yellow or white. Flowerbuds reddish; calyx green; petals white; filaments white; anthers yellow; style pink. Fruit green when immature, red, pinkish, or reddish brown when mature.

Vernaculars: In Sumatra *Putat-talang* (seafish-putat), in Sarawak *Keroot* or *Langkong* (Iban), in Sabah *Tĕmpalang* or *Tampalang* (Dusun) or *Putat*, the commonly used Malay name for *Barringtonia*.

Uses: From Sarawak it is reported by Paie & Ashton that the bark is used as a fish-poison. In Sabah the tree is planted as an ornamental and the bark is also used for poisoning fish.

b. forma **dolichophylla** (Merr.) Payens, *stat. nov.*

B. dolichophylla Merr., J. Str. Br. R. As. Soc. 77 (1917) 205; En. Born. (1921) 419; Knuth, Pfl. R. Heft 105 (1939) 21.

Leaves linear-lanceolate, long-cuneate at base, 30—100 by 5—10½ cm (leaf-index 4½—6 or even 8—9); nerves 25—50 pairs; petiole very short, 1—1½ cm.

Typification: *B. dolichophylla* Merr.: *Hose 610* (Sarawak), holotype in K, isotype in BM.

Distribution: Borneo (Sarawak, Brunei, Sabah).

Ecology: In primary, mixed Dipterocarp or old secondary forest on hillside on dry ground, from sea-level up to *c.* 50 m. Fl., fr. April—July.

Compilation of field-notes: Tree *c.* 7—10 m; bark brown or blackish mottled; outer bark grey, *c.* 6—25 mm thick, fibrous; inner bark whitish, *c.* 6 mm, soft; sapwood yellow. Petals whitish pink; fruit dark reddish.

Vernaculars: In Brunei *Putat* (Malay) and *Tubai langkong* (Iban), in Sabah *Langkong* (Iban).

Remarks: Sofar only 4 collections of this form have been made: In Sarawak *Hose 610 (type)*; in Brunei *Ashton BRUN S 7842*; in Sabah *Fuchs & Muller 21173* and *Mikil SAN 30224*.

20. B. ashtonii Payens, *sp. nov.*

Folia elliptica vel oblonga interdum obovata, integra, nervis lateralibus 8—12-paribus. Spicae terminales; rachis gracilis. Flores parvi, calyce in gemma clauso, segmentis mucronatis. Stamina exteriora bene evoluta 2- vel 3-seriata, interiora uniseriata staminoidea. Ovarium 3(—4) loculare, costis 4 tetragonum. Drupa ovoidea, apice basique leviter attenuata, rugosa, ± 4-costata.

Small tree *c.* 4—13(—17) m; dbh 10—45 cm; twigs 2—3 mm ∅. *Leaves* elliptic or oblong, sometimes obovate, glabrous, subcoriaceous, *c.* (8—)10—15(—21) by (3—)4—6(—9) cm (leaf-index 2—3), entire, acuminate or cuspidate, base cuneate, acute, or obtuse, midrib prominent on both sides, nerves *c.* 8—12 pairs, prominent underneath; petiole *c.* 1—3(—4½) cm. Cataphylls triangular, *c.* 5—7 by 3—4 mm. *Spikes* terminal, pendulous, *c.* (15—)30—77 cm (*c.* 40 flowers), rachis *c.* ½—1 mm ∅, accrescent to *c.* 3 mm, glabrous or slightly pulverulent. Bracts linear-lanceolate, *c.* 10—12 by 1½—2 mm, acuminate. Opening buds *c.* 5 mm, 1—2 mm mucronate. *Calyx* closed in bud, the tube *c.* ½—1 mm high, the limb disrupting into 2—3 equal, ovate, convex, papyraceous, mucronate lobes *c.* 6—8 by 4—6 mm. *Petals* 4, elliptic, convex, membranous, *c.* 11—13 by 6—8 mm, obtuse or rounded, insertion *c.* 1½—3 mm wide. *Staminal tube c.* 1—2 mm high; stamens in 3—4 whorls, inner one staminodial; filaments *c.* 1¾—3 cm; staminodia *c.* 11—13 mm; anthers *c.* ½—¾ by ½ by ½ mm. Disk thick, ½—1(—2) mm high. *Ovary* 3(—4)-celled, tetragonous with 4 ribs, *c.* 3—4 by 1½—2 by 1—2 mm; ovules 1—2 per cell (total number 4—7); septa complete; style filiform, terete, *c.* 2¼—2¾ cm. *Fruit* ovoid, slightly tapering at both ends, *c.* 4½—5 by 2—3 by 2—3 cm, rugose, ± 4-ribbed; pericarp *c.* 1½—2 mm thick, exocarp ½ mm, mesocarp hard, fibrous, *c.* 1¼—1½ mm, endocarp a thin membrane. *Seed* ovoid, *c.* 2¾ by 2 by 1¼ cm.

Typification: Flowering material: *Kostermans 5289*; holotype in L, isotype in BO; fruiting material: *Kostermans 13352*; paratype in L.

Distribution: North and Central-East Borneo. Fig. 10.

Ecology: Mostly along rivers in primary forest, at low altitude, up to 200 m. Fl. June—Nov., fr. Aug.—Dec.

Compilation of field-notes: Flowers red or pink; calyx white-green. Fruit dirty purplish, redbrown, or red.

Remarks: The species is named after Dr. P. S. Ashton, who for many years hunted after *Barringtonia* during his explorations in Borneo.

Related to *B. lauterbachii* on account of its mucronate calyx as well as the leaf nervation.

21. B. calyptrata [Benth., Fl. Austr. 3 (1866) 288, *nomen* in note under *B. speciosa*] (Miers) R. Br. *ex* Bailey, Queensl. Agr. J. 18 (1907) 125; Cat. Queensl. Pl. (1913) 209; C. T. White, Proc. Linn. Soc. N.S.W. 44 (1919) 823, 825; Proc. R. Soc. Queensl. 34 (1923) 46; Knuth, Pfl. R. Heft 105 (1939) 19. — *Butonica calyptrata* Miers, Trans. Linn. Soc. Bot. 1 (1875) 76. — *Michelia calyptrata* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240. — *Huttum calyptratum* Britten, J. Bot. 39 (1901) 67; Ill. Bot. Cook's Voy. 2 (1901) 40, t. 123. — **Fig. 12.**

B. racemosa [*non* (L.) Spreng.] F. v. M., Fragm. 9 (1875) 118.

B. edulis (*non* Seem.) Bailey, Queensl. Agr. J. 18 (1907) 125, t. 11; Cat. Queensl. Pl. (1913) 209.

B. flava Laut., Nova Guinea 8 (1910) 314; Bot. Jahrb. 57 (1922) 350; C. T. White, J. Arn. Arb. 10 (1929) 246; Knuth, Pfl. R. Heft 105 (1939) 20.

Small to medium-sized tree, *c.* 10—12(—27) m, dbh *c.* 25—60(—80) cm; leaf-bearing twigs terete, *c.* 3—8(—11) mm ∅. *Leaves* obovate-oblong, glabrous, *c.* (10—)16—29 (—35) by (2—)4—13 cm (leaf-index 2—3¼), coriaceous, obtuse, sometimes cuspidate or emarginate, base cuneate, margin entire with a distinct marginal vein; nerves *c.* (8—)12—18(—20) pairs, nerves and veins prominent on both sides; petiole *c.* ½—2(—3) cm. Cataphylls *c.* 2—5 by 2 mm, triangular. *Spikes* ramiflorous, pendulous, rachis up to *c.* 40 cm by 3—7 mm ∅, with up to 60 flowers, fulvous or greyish pulverulent. Bracts sessile, lanceolate, *c.* 8—20 by 3 mm. *Flowers* sessile, not scented. Bracteoles narrowly

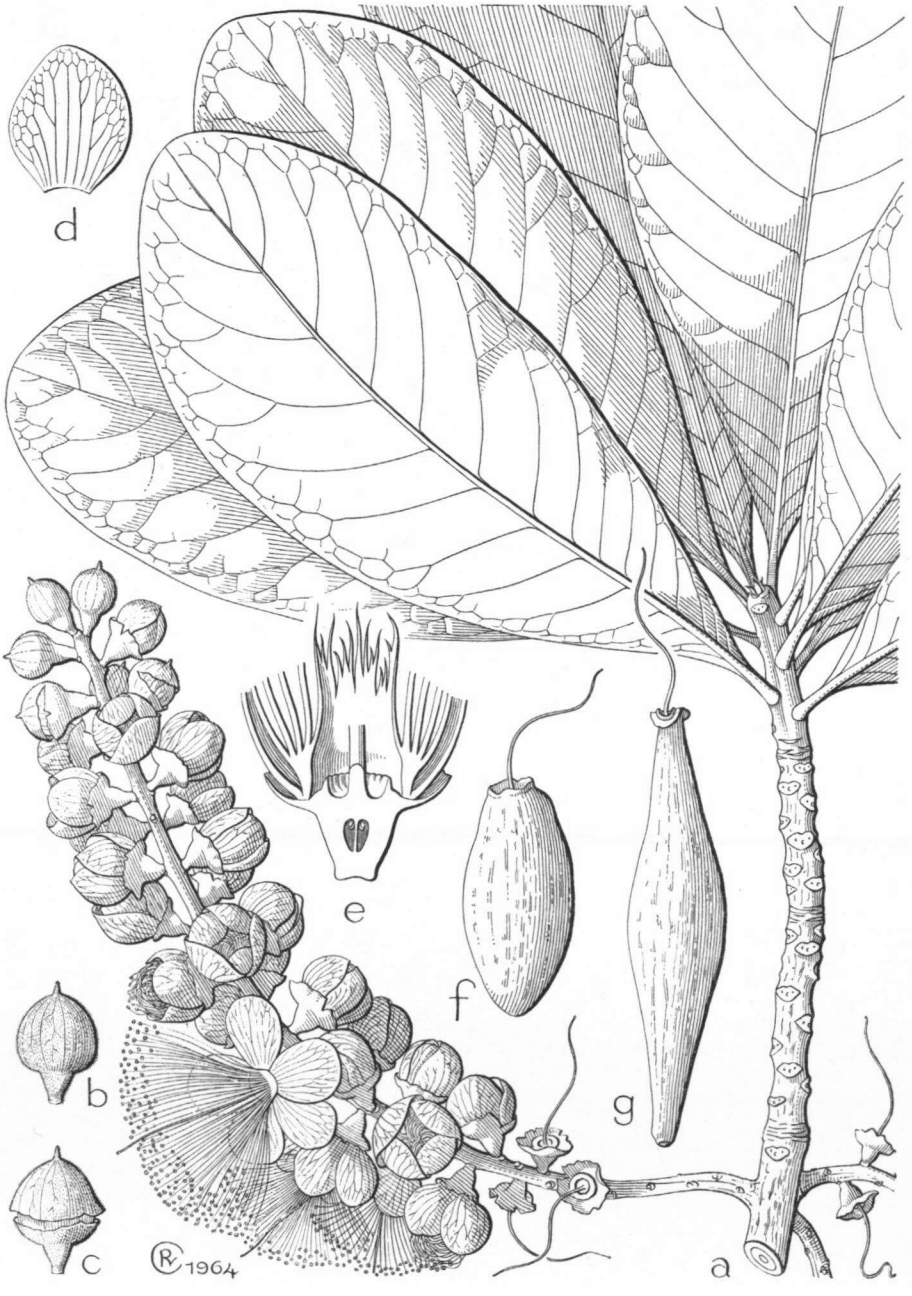


Fig. 12. *Barringtonia calyptrata* (Miers) R. Br. *ex* Bailey. a. Habit, × $\frac{2}{3}$, b. bud, nat. size, c. circumscissile calyx, nat. size, d. petal, × 2, e. flower in section, × 2, f—g. fruits, × $\frac{2}{3}$ (a—e. *Darbyshire 749*, f. *J. E. Blades s.n.*, Dec. 1942, g. *NGF 14043* (*Womersley*)).

triangular, *c.* 2—3 by 1 mm. Opening buds *c.* 7—12 mm, mucronate. *Calyx* closed, at anthesis rupturing into a caducous cap *c.* 3—8 by 10—12 mm and a persistent cup-shaped ring *c.* 2—3 mm high, rarely disrupting into 4 irregular segments *c.* 5—6 by 5—10 mm, outside greyish or fulvous pulverulent. *Petals* 4(—5), elliptic, obtuse, *c.* (1—)1¼—2½(—2¾) by (½—)¾—1¾ cm, insertion *c.* 3—9 mm wide. *Staminal tube c.* 2—3 mm high, stamens in 4—5(—7) whorls, 1(—2) inner one(s) staminodial, filaments *c.* 20—35 mm, staminodia connate up to *c.* 4—10 mm, free filiform part *c.* 2—5(—10) mm, bent inwards against the style; anthers *c.* ½—1¼ by ½—1 by ⅓—¾ mm. *Ovary* (2—)3—4-celled, terete, grooved, grey green or fulvous pulverulent, *c.* 3—4 by 3—4 mm; ovules 2—4 per cell (total number per ovary 5—14); septa sometimes incomplete; style rather thick, terete, *c.* 30—45 mm. Disk *c.* (¼—)1—1½(—2) mm high. *Fruit* ovoid or spindle-shaped, *c.* 5—9½ by 1¾—2½ by 1½—2¼ cm, truncate, pericarp *c.* 2 mm thick, exocarp thin, rather furrowed when dry, mesocarp fibrous, endocarp a thin brown membrane. *Seed* subglobular, *c.* 2 by 1½ by 1½ cm.

Typification: *B. calyptrata* (Miers) R. Br. *ex* Bailey, *Butonica calyptrata* Miers, *Michelia calyptrata* O. Kuntze, *Huttum calyptratum* Britten: *Banks & Solander s.n.* (Lizard I.), holotype in BM, isotype in K.

B. flava Laut.: *Versteeg 1827* (New Guinea), holotype in WRSL, isotypes in BO, K, L, and U.

Distribution: Aru Is. (Wokam), New Guinea (Merauke, Port Moresby, Morobe), Daru, Yule, Lusancay, Hammond, and Thursday Is., N. Australia (Queensland, Cook Distr.), Lizard I. Fig. 13.

Ecology: Typical tree of open savannah, resisting savannah grass fires, also found in riverine forests and at the margin of gallery rain-forest in an eucalypt savannah. Altitude from sea-level up to 230 m, once found at 1500 m (*Clemens 6435* in Papua, Morobe Distr.). Fl. May—Nov., fr. Febr.—Nov. In full bloom generally in October.

Compilation of field-notes: Bark thick, rough, furrowed or with fissures, scaly, peeling off in small flakes, dark brown or grey; outer bark fibrous, inner bark *c.* 12 mm, pale pink or red. Wood with clearly defined rays and xylem (*Gray NGF 8090*). Flowerbuds pale green or green-white. Calyx creamy white inside, petals and stamens always white, cream, or light yellow, anthers yellow. Flower odourless. Fruits green.

Vernaculars: In Wokam (Aru Is.) it is called *Tufan*; near Merauke in New Guinea *Putat*, the usual Malay name for *Barringtonia*, is used. From Papua 4 different names are given: *Koo-tree*, *Fofora*, *Tolamiai*, and *Go-oh*, the latter in the Matopali language. From Port Douglas (Australia) Reynolds mentioned *Corned Beef wood*, because the smell of the wood is like corned beef.

Uses: Reynolds reported the use of wood for making fruitcases, but it proved too heavy for this purpose, see White (1919) *op. cit.* The wood is soft and the timber has an even grain. It is used in Papua only for flooring and interior work of buildings (*Brown 275*).

Medicinal use: *Blades s.n.* noted on his field label from Papua the use of a boiled liquid mixture from leaves and bark of the *Koo-tree* in cases of pain in the chest and fever. When taking the liquid (1 cup only) the diet is restricted and no meat is allowed.

Remarks: R. Brown already recognized this species as distinct (*in sched.*) under the present name, on a Banks & Solander specimen from Lizard I., but Bentham *l.c.* referred to it in a note, suggesting its intermediate position between *B. asiatica* and *B. acutangula*.

Three specimens have been found (*Schodde 3078*, *NGF 4511*, *L. S. Smith 11982*) in which there are two whorls of staminodia, instead of one as is normal in the genus *Barringtonia*. This variation is otherwise only known to occur in *B. apiculata*, *B. neocaledonica*, and in *B. papeh*, the latter having sometimes up to 3 whorls of staminodia.

22. B. papeh Laut., Bot. Jahrb. 57 (1922) 346; Knuth, Pfl. R. Heft 105 (1939) 25; Peekel, Ill. Fl. Bism. Arch. (1945) 1292, fig. 1291 (*ined.*).

B. peekelii Knuth, Pfl. R. Heft 105 (1939) 24.

Tree, *c.* 3—20 m; dbh *c.* 17 cm; twigs *c.* 1—1½ cm ∅. *Leaves* obovate-lanceolate, chartaceous or subcoriaceous, glabrous, *c.* 50—135(—162) by 18—36 cm (leaf-index 3—4), glossy on both sides, entire, acuminate, base cuneate, nerves *c.* 26—65 pairs; petiole *c.* 1—5(—8) cm. *Spikes* ramiflorous, pendulous, *c.* (15—)50—90(—105) cm, rachis 1½—3 mm ∅, accrescent to 4—7(—9) mm, with up to 66 flowers, densely yellow puberulous. *Flowers* sessile or subsessile (pedicel in fr. 3 mm). Opening buds *c.* 1½ cm ∅. *Calyx* closed in bud, mucronate, rusty-puberulous, rupturing circumscissile into a persistent cup-shaped ring *c.* 2—5 mm high and a caducous cap *c.* 8 by 15 mm. *Petals* 4, elliptic, convex, *c.* 3 by 1½—1¾ cm, membranous, entire, insertion *c.* 5—8 mm wide. *Staminal tube c.* 7 mm, stamens in 8 whorls of which 3 staminodial; filaments *c.* 3½ cm; staminodia *c.* 1¼ cm; anthers *c.* 1½ by ¾ by ½ mm. Disk annular, 2 mm high. *Ovary* 4-celled, obpyramidiform, yellow puberulous, *c.* 5—6 by 5—7 by 5 mm; ovules 4—6 per cell (total number *c.* 16—20); septa incomplete; style *c.* 3½—4¾ cm. *Fruit* ovoid, tetragonous, *c.* 5—7½ by 2½—5½ by 2½—5½ cm, ± winged when young, puberulous, apex ± truncate, tapering at base; pericarp *c.* 3—4 mm thick, exocarp thin, hard, *c.* ½ mm, mesocarp spongy with some dispersed fibres, *c.* 2—3 mm, endocarp fibrous, *c.* ½ mm. *Seed* ovoid, *c.* 3¼ by 2¼ by 2 cm, deeply grooved with *c.* 13 ribs.

Typification: *B. papeh* Laut.: *Peekel 373* (New Ireland), holotype in B (lost), isotype in WRSL; *Peekel 624*, paratype in B (lost) and WRSL.

B. peekelii Knuth: *Peekel 996* (New Ireland), holotype in B (lost).

Distribution: SE. New Guinea (Milne Bay Distr.), New Britain, New Ireland, Rossel I., Solomons (Bougainville, Shortland, Choiseul, and San Cristobal Is.). Fig. 13.

Ecology: On coastal, undulating plain in rain-forest or in well-drained lowland secondary rain-forest at altitudes up to 50 m. Fl., fr. May—Dec.

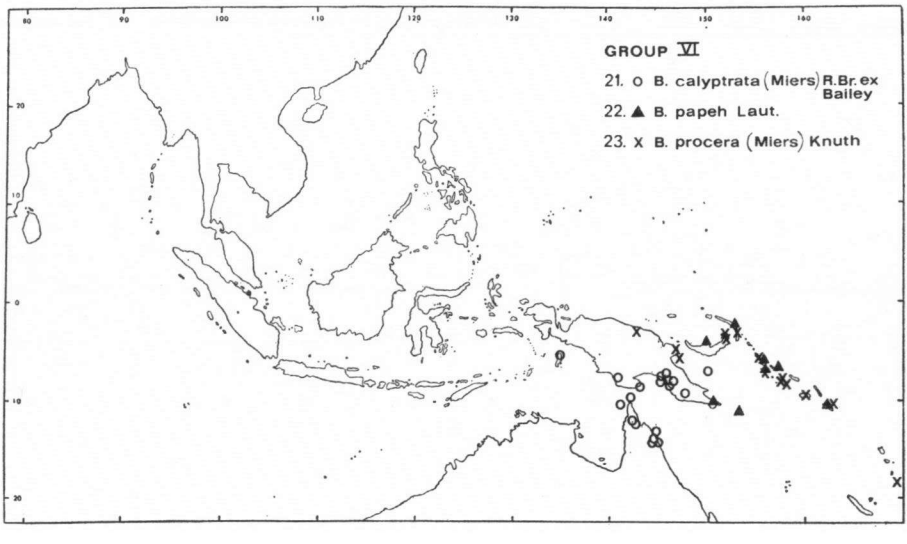


Fig. 13. Localities of the species of Group VI.

Compilation of field-notes: Slender, single-stemmed or little branched tree. Bark dark brown. Leaves dark green, very large, clustered and tufted at branch ends. Rachis 50—105 cm, thick; petals pink or white; stamens pale yellow. Fruit green or brown, red when ripe.

Vernaculars: In New Ireland *A pape* and in Bougainville *Turimu*.

Remarks: The number of staminodial whorls is derived from two specimens only. The cycadoid habit it shares with *B. papuana* and *B. calyptrocalyx* var. *boridiensis*.

23. B. procera (Miers) Knuth, Pfl. R. Heft 105 (1939) 25; Guillaumin, Ann. Mus. Col. Marseille 55/56 (1948) 38. — *Butonica procera* Miers, Trans. Linn. Soc. Bot. 1 (1875) 74. — *B. excelsa* (*non* Bl.) Benth. in Hook., Lond. J. Bot. 2 (1843) 221. — **Fig. 1 d—f.**

B. schuchardtiana K. Sch. in K. Sch. & Hollr., Fl. Kais. Wilh. Land (1889) 92; Notizbl. Bot. Gart. Berl. 1 (1895) 54; K. Sch. & Laut., Fl. Schutzgeb. (1900) 463; Laut., Bot. Jahrb. 57 (1922) 349; Knuth, Pfl. R. Heft 105 (1939) 37.

B. speciosa (*non* J. R. & G. Forster) K. Sch., Notizbl. Bot. Gart. Berl. 1 (1895) 54.

B. magnifica Laut., Bot. Jahrb. 45 (1911) 363; *ibid.* 57 (1922) 350; Knuth, Pfl. R. Heft 105 (1939) 24; Peekel, Ill. Fl. Bism. Arch. (1945) 1287, fig. 1286, *ined.*; Walker, For. Br. Sol. Isl. Prot. (1948) 131.

B. guppyana Knuth, Pfl. R. Heft 105 (1939) 25. — *B. edulis* (*non* Seem.) Guppy, The Solomon Isl. and their Natives, London (1887) 85.

Small tree, *c.* 7—15 m; dbh *c.* 7½ cm; twigs 1—1½ cm ∅. *Leaves* tufted, obovate-oblong, chartaceous, glabrous, *c.* 29—55(—62) by 8—24 cm (leaf-index 2½—3½), very glossy on both sides, serrate-crenulate towards the apex, acuminate (tip recurved), base cuneate, midrib, nerves, and veins equally prominent on both faces, nerves *c.* 17—23 pairs; petiole *c.* 0—1 cm. Cataphylls lanceolate, *c.* 2½—12 by 1—3 cm. *Spikes* terminal, pendulous, *c.* 30—80 cm, densely flowered (up to 120 fls); rachis *c.* ½ cm ∅, slightly fissured, yellowish grey-green, pulverulent. Bracts triangular, *c.* 10 by 5 mm. *Flowers* not scented. Opening buds *c.* 10—15 mm. *Calyx* closed in bud, rupturing into 2(—4) lobes; tube *c.* 2—3 mm high, accrescent; lobes *c.* ¾—1¾ by ¾—1¾ cm, accrescent, pulverulent. *Petals* 4, elliptic, obtuse, convex, *c.* 2¼—3 by ½—2 cm; insertion *c.* 4—7 mm wide. *Staminal tube* *c.* 4—5 mm high; stamens in 5—6 whorls, inner one staminodial; filaments *c.* 2—4½ cm, outer whorls with larger filaments than inner ones; staminodia connate up to *c.* 1 cm, free filiform part *c.* 1—1½ cm; anthers *c.* ¾—1 by ½—¾ mm. Disk inconspicuous, *c.* ¼ mm high. *Ovary* 4-celled, obpyramidal, tetragonous, fissured, greyish yellowish pulverulent, *c.* 3—7 by 3—5 by 3—5 mm; ovules 1—3 per cell (total number 8—12); septa sometimes incomplete; style *c.* 4—5½ cm. *Fruit* cylindrical, ± 8-sided, hooked near the base on alternate ribs, *c.* 6—7½ by 3—4 by 3—3½ cm, truncate at both ends; pericarp *c.* 3—6 mm thick, exocarp thin, *c.* 1—2 mm; mesocarp hard with small fibres, *c.* 1½—3 mm; endocarp a hard thin layer with some thick fibres, *c.* ½—1 mm. *Seed* ovoid, slightly fissured, *c.* 3—3½ by 1—2 by 1—1¾ cm.

Typification: *B. procera* (Miers) Knuth, *Butonica procera* Miers, *B. excelsa* (*non* Bl.) Benth.: *Hinds s.n.* (New Hebrides), holotype in BM, isotypes in CGE, K.

B. schuchardtiana K. Sch.: *Hollrung 473* (New Guinea), holosyntype in B (only fruit preserved), isosyntype in WRSL; *Hollrung 791*, holosyntype in B (lost), isosyntype in WRSL.

B. magnifica Laut.: *Peekel 146* (New Guinea), holotype in B (lost), isotype in WRSL.

B. guppyana Knuth, *B. edulis* (*non* Seem.) Guppy: *Guppy 59* (Solomons), holotype in K, *Guppy 135*, paratype in K.

Distribution: New Guinea (Augusta R., Huon Peninsula), Tami I., New Britain,

New Ireland, Solomons (Bougainville, Treasury & Shortland, New Georgia, Hobupeka, Vangunu, Guadalcanal, and San Cristobal Is.), New Hebrides. Fig. 13.

Ecology: In secondary rain-forest, common in lowland, in sagu-swamp and as village-tree, at low altitude. Fl., fr. Jan.—Dec.

Compilation of field-notes: Slender, sparsely branched tree; bole *c.* 4 m, crown *c.* 9 m. Leaves convex, stiff, very glossy, tip recurved, crowded towards ends of thick branchlets marked with prominent leaf-scars. Rachis thick, up to 1 m long. Flowerbuds brownish green; calyx red, petals cream or white, revolute; stamens red or cream; anthers brown. Fruit dark purple, crowded on terminal spikes, 6 cm ∅ at base and 4 cm ∅ at apex.

Vernaculars: In Tami I. *Mbalingan lewo*; in New Britain *Poa vutug*; in New Ireland *A pana hutun*; in Treasury & Shortland Is. *Borolong*; in New Georgia *Tinga*; in Hobupeka I. *Kina*; in San Cristobal *Hara*; the latter is the generic name for both edible species on the island; in New Hebrides *Va rodh*.

Uses: The seed is edible. Commonly planted around villages in San Cristobal I. or grown in plantations in Treasury & Shortland Is.

Remarks: Knuth (1939) *op. cit.* indicated as his type of *B. guppyana Guppy 135*. However, on the herbarium-sheet in K, Knuth definitely indicated *Guppy 59* as the holotype; this specimen is indeed the most complete material of the two collections.

The fruit and staminal whorls of the type-material of *B. schuchardtiana* in B and WRSL doubtless belong to *B. procera*. The twig with leaves, however, belongs to *B. acutangula*. Other Hollrung specimens collected at the same locality are indeed *B. acutangula*, complete with inflorescences. I therefore fear that some mistake has been made with the material. The description by Schumann (1889) *op. cit.* does not apply to the type-material I was able to study from WRSL.

2. Sect. **Stravadium**

(Juss.) Miq. Fl. Ind. Bat. 1, 1 (1855) 488; C. Muell. in Walp., Ann. 4 (1857) 850; Clarke, Fl. Br. Ind. 2 (1879) 508. — *Stravadium* Juss., 1789; Pers., 1807 (*Stravadia*); Meisn., 1838 (*pro subg.*); Niedenzu, 1892 (*pro subg.*), incl. sect. *Eustravadium* Niedenzu, 1892. — sect. *Eustravadium* Knuth, 1939.

Meteorus Lour., 1790.

Botryoropis Presl, 1851.

Megadendron Miers, 1875.

Doxomma Miers, 1875; Durand 1888; Niedenzu, 1892; Knuth, 1939 (*pro sect.*).

See for full references under the genus.

Calyx lobes free from the beginning, their margin thin, mostly scarious, often finely ciliate or fimbriate.

Taxonomic relationships within § Stravadium.

The section comprises 16 species in all, 2 of which, *viz. B. acutangula* and *B. macrostachya*, are widely distributed, from Afghanistan to Australia and from southern China to the Moluccas respectively. Fig. 3. They may well be among ancient species. The centre of diffusion lies somewhat more western than that of § *Barringtonia*, in Central Malesia; also 8 species range westward into continental SE. Asia, and, besides *B. acutangula*, only 3 reach Melanesia, of which 2 are endemic in New Caledonia. Fig. 14.

Much less characters are available for judging primitive and derived character combinations than in § *Barringtonia*. But grouping of species, reticulately webbed in affinity, is also possible here.

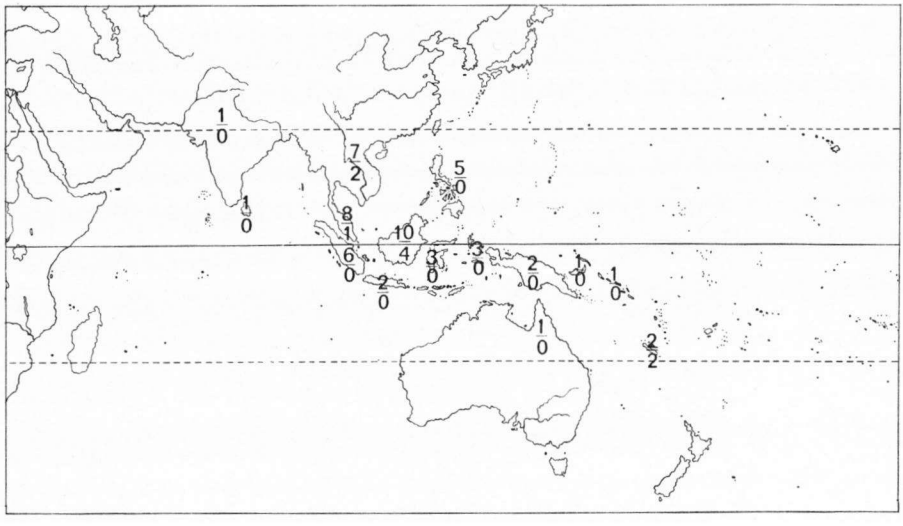


Fig. 14. Species density in § *Stravadium*, above the hyphen the total number of species for each area, sland or island group, below it the number of endemic species.

VII. Acutangula Group. Fig. 16.

24. *B. acutangula* — Afghanistan, SE. Asia, Malesia, N. Australia.
25. *B. scortechinii* — Thailand, Malaya, Sumatra, Borneo.
26. *B. niedenzuana* — Moluccas, New Guinea, Bismarck Arch., Solomons.

The 3 species in this group have the same leaf characters; otherwise they are not closely related. *B. acutangula* has pedicelled flowers and a subspecies with sessile ones. *B. scortechinii* has only sessile flowers, while *B. niedenzuana* has pedicelled ones. The fruit of *B. acutangula* is tetragonous and small, like in *B. niedenzuana*, while *B. scortechinii* has a big ovoid fruit. The 3 species belong to 3 different pollen types within one main type, *B. scortechinii* being wider apart than the other two species.

VIII. Macrocarpa Group. Fig. 18.

27. *B. macrocarpa* — Burma, Vietnam, Thailand, Malaya, Sumatra, Java, Borneo.
28. *B. fusiformis* — Malaya.
29. *B. hallieri* — Borneo.
30. *B. havilandii* — Borneo.
31. *B. pauciflora* — Thailand, Laos, Vietnam, Malaya.

In this group endemic species prevail. The flowers are all distinctly pedicelled except in *B. pauciflora* in which the ovary tapers into the pedicel, the leaves are petioled except in *B. macrocarpa* and *B. fusiformis* in which the petiole is not sharply set off against the decurrent blade. *B. pauciflora* is a rare species from SE. Asia and differs also from other species in this group by a high number of staminal whorls, like in species from Melanesia. They belong to one pollen type together with the species of group IX.

IX. Macrostachya Group. Fig. 20.

32. *B. macrostachya* — S. China, Vietnam, Thailand, Burma, Malaya, Sumatra, Borneo, Philippines.
33. *B. pendula* — S. China, Thailand, Burma, Malaya, Sumatra, Borneo.
34. *B. lanceolata* — Borneo.
35. *B. reticulata* — Sumatra, Malaya, Borneo, Philippines, Celebes.

All species of this group have sessile flowers on a long, rather thick rachis, *B. lanceolata* excepted. *B. lanceolata* is the most remarkable species of this group in having almost clustered flowers, a very thick, woody-fibrous pericarp, and the not strictly apical ovules which are superposed. Originally it was referred to the genus *Careya*, later to *Planchonia*, but it is without doubt a true *Barringtonia*, as proved by the embryonal structure. There is nothing special with the pollen type.

This group is narrowly related to the previous one through *B. macrostachya* and *B. pauciflora* in having similar leaf characters; it is linked to the Acutangula Group through *B. macrostachya* which is related to *B. scortechinii*. All 4 species belong to one pollen type, *B. reticulata* being transitional to the pollen type found in the Augusta Group.

X. Augusta Group. Fig. 23.

36. *B. augusta* — Thailand, Burma.
37. *B. curranii* — Borneo, Palawan.

Two closely related species, differing from each other in winged or wingless ovaries, leaves entire or distinctly serrate-crenulate. Both have sessile flowers and 5—6 whorls of stamens, rachis puberulous. The Augusta Group is related to the Neocaledonica Group because of the flowers being sessile and the general habit of the leaves being almost equal. Pollen-morphologically, however, the groups stand wide apart. As to pollen, the Augusta Group is related with the Macrostachya Group.

XI. Neocaledonica Group. Fig. 23.

38. *B. neo-caledonica* — New Caledonia.
39. *B. longifolia* — New Caledonia.

Narrowly related endemic species, differing from each other in the number of staminal whorls. In *B. neo-caledonica* the outer staminal whorls are higher connate than the inner ones. In *B. longifolia* the style is far smaller than the stamens. Palynologically of one pollen type, but linked with § *Barringtonia*, Calyptrata Group.

24. B. acutangula (L.) Gaertn., Fruct. 2 (1791) 97, t. 101; Bl., Bijdr. (1826) 1097; Roxb., Fl. Ind. 2 (1832) 635; Kostel., Allg. Med. Pharm. Fl. 4 (1835) 1535; Graham, Cat. Bombay Plants (1839) 74; Span., Linnaea 15 (1841) 204; Oken, Allg. Naturgesch. 3, Bot. 2, 3 (1841) 1927; Hassk., Cat. Hort. Bog. (1844) 263; Voigt, Hort. Calc. (1845) 51; Thw., En. Zeyl. (1859) 119; Dalz. & Gibs., Bomb. Fl. (1861) 95; Benth., Fl. Austr. 3 (1866) 288; Bedd., Fl. Sylv. Madr. 2 (1869) t. 204; *ibid.* 3 (1869) 112; Brandis, For. Fl. NW. & Centr. Ind. (1874) 235; Kurz, Rep. Pegu (1875) App. lxvi, App. B, 52; J. As. Soc. Beng. 46, ii (1877) 71; Fl. Burma 1 (1877) 497; Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 508; F.-Vill., Nov. App. (1880) 86; Lanessan, Pl. Util. Col. Franç. (1885) 317; Warb., Bot. Jahrb. 13 (1891) 388; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892)

33; Nairne, Flow. Pl. W. India (1894) 115; K. Sch. & Laut., Fl. Schutzgeb. (1900) 462; Bailey, Queensl. Fl. 2 (1900) 666; King, J. As. Soc. Beng. 70, ii (1901) 140; Fischer, Bombay Nat. Hist. Soc. 15 (1904) 546; Brandis, Ind. Trees ed. 1 (1906) 330; Strachey, Cat. Pl. Kumaon & Garhwal & Tibet ed. 2 (1906) 66; Bamber, Bombay Nat. Hist. Soc. 19 (1909) 69; Haines, For. Fl. Chota Nagpur (1910) 353; Talbot, For. Fl. Bombay Pres. 2 (1911) 47; Kanjilal, For. Fl. Siwalik & Jaunsar Forest (1911) 216; Bailey, Cat. Queensl. Pl. (1913) 209; Witt, Descr. List Trees North. & Berar For. Circles Centr. Prov. (1916) 116; Ewart & Davies, Fl. North. Terr. (1917) 199; Kirtikar & Basu, Ind. Med. Pl. 1 (1918) 558, pl. 427; Gamble, Fl. Pres. Madras 1 (1919) 487; Troup, Silvicult. Ind. Tr. 2 (1921) 590, f. 222; Gagn., Fl. Gén. I.-C. 2 (1921) 860; T., Ind. For. 48 (1922) 616, pl. 17; Laut., Bot. Jahrb. 57 (1922) 347, 353; Haines, Bot. Bihar & Orissa 3 (1922) 368; Merr., En. Philip. 3 (1923) 141; Craib, Fl. Siam. En. 1 (1931) 667; Bentall, Trees Calcutta (1933) 252; Merr., Comm. Lour. (1935) 280; Knuth, Pfl. R. Heft 105 (1939) 43; Corner, Ways. Trees (1940) 353, fig. 123; Vidal, La Vég. du Laos (1956); Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 106. — *Tsjeria-samstravadi* Rheede, Hort. Mal. 4 (1683) 15, t. 7. — *Eugenia acutangula* Linné [Fl. Zeyl. (1748) 85, no 190] Sp. Pl. (1753) 471; Sp. Pl. ed. 2 (1762) 673; Willd., Sp. Pl. 2, 2 (1800) 966. — *Stravadium acutangulum* J. St. Hil., Exp. Fam. 2 (1805) 166; Sweet, Hort. Brit. ed. 1 (1826) 159. — *Stravadium rheedii* Blume, in Fl. Serr. 7 (1851) 24, *excl. syn.*; Miers, Trans. Linn. Soc. Bot. 1 (1875) 82. — *Butonica rubra* Miers, Trans. Linn. Soc. Bot. 1 (1875) 70, t. 14, fig. 1—3. — *B. rubra* Baill. *ex* Lanessan, Pl. Util. Col. Franç. (1885) 621, *nomen, non* Bl. 1851. — *Michelia acutangula* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240. — *Huttum acutangulum* Britten, J. Bot. 39 (1901) 67.

Butonica terrestris [Rumph., Amb. 3 (1743) 181, t. 115 & 116;] Miers, Trans. Linn. Soc. Bot. 1 (1875) 69, *excl. syn.*; *specimen* & tab. 14, fig. 4—9. — *Stravadia rubra* Pers., Syn. 2 (1807) 30, *pro* tab. Rumph. 115, *nomen illeg.*; DC., Prod. 3 (1828) 289, *ditto*. — *Stravadia alba* Pers., *op. cit., pro* tab. Rumph. 116, *nomen illeg.* — *B. alba* Kostel., Allg. Med. Pharm. Fl. 4 (1835) 1536. — *B. terrestris* Knuth, Pfl. R. Heft 105 (1939) 19, *excl. syn. p.p.*; *excl. specimen.*

Meteorus coccineus Lour., Fl. Coch. 2 (1790) 410; ed. Willd. 2 (1793) 499; Spreng., Syst. Veg. 3 (1826) 127. — *Stravadium coccineum* DC., Prod. 3 (1828) 289; Miers, Trans. Linn. Soc. Bot. 1 (1875) 83. — *B. coccinea* Kostel., Allg. Med. Pharm. Fl. 4 (1835) 1536; Lanessan, Pl. Util. Col. Franç. (1885) 747; Knuth, Pfl. R. Heft 105 (1939) 44. — *Careya coccinea* Cheval., Cat. Pl. Jard. Bot. Saigon (1919) 64.

Stravadium costatum Blume, in Fl. Serr. 7 (1851) 24; Miers, Trans. Linn. Soc. Bot. 1 (1875) 88. — *B. costata* Miq., Fl. Ind. Bat. 1, 1 (1855) 489; Walp., Ann. 4 (1857) 851; Val., Bull. Dép. Agr. Ind. Néerl. 10 (1907) 37; Knuth, Pfl. R. Heft 105 (1939) 49. — *Michelia costata* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240.

Botryoropis luzonensis Presl, Epim. Bot. (1851) 220; Walp., Ann. 2 (1852) 642; Miq., Fl. Ind. Bat. 1, 1 (1855) 492. — *Stravadium luzonense* Miers, Trans. Linn. Soc. Bot. 1 (1875) 84. — *B. luzonensis* Vidal, Phan. Cuming. (1885) 13, 43, 113; Rolfe, J. Bot. 23 (1885) 213; Vidal, Rev. Pl. Vasc. Filip. (1886) 133; Merr., Fl. Manila (1912) 346; En. Philip. 3 (1923) 141; Knuth, Pfl. R. Heft 105 (1939) 47. — *Michelia luzonensis* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241.

Stravadium demissum Miers, Trans. Linn. Soc. Bot. 1 (1875) 81. — *B. demissa* Knuth, Pfl. R. Heft 105 (1939) 46.

Stravadium reticulatum (*non* Bl.) Miers, Trans. Linn. Soc. Bot. 1 (1875) 87, *excl. syn.* *B. reticulata* [non (Bl.) Miq.] Vidal, Phan. Cuming. (1885) 113; Rolfe, J. Bot. 23 (1885) 213; Vidal, Rev. Pl. Vasc. Filip. (1886) 133.

Stravadium gracile Miers, Trans. Linn. Soc. Bot. 1 (1875) 86. — *B. gracilis* Knuth, Pfl. R. Heft 105 (1939) 44; Blake, Austr. J. Bot. 2 (1954) 104, pl. 1, fig. 4; Specht, Rec. Am. Austr. Exp. Arnhem Land 3 (1958) 263, 324, 331, 400, 465, 495.

Stravadium denticulatum Miers, Trans. Linn. Soc. Bot. 1 (1875) 88. — *B. denticulata* Knuth, Pfl. R. Heft 105 (1939) 44.

Stravadium pubescens Miers, Trans. Linn. Soc. Bot. 1 (1875) 83. — *B. pubescens* Knuth, Pfl. R. Heft 105 (1939) 44.

B. tetraptera Laut., Nova Guinea 8 (1910) 315; Bot. Jahrb. 57 (1922) 348; Knuth, Pfl. R. Heft 105 (1939) 47.

Symplocos multiflora Eberh. & Dub., Agron. Colon. n.s. 1 (1913) 76, pl. II. — *B. eberhardtii* Gagn., Bull. Mus. Nat. Hist. Nat. 26 (1920) 72, *nom. illeg.*; Fl. Gén. I.-C. 2 (1921) 857. — *B. multiflora* Guillaumin, Bull. Soc. Bot. Fr. 71 (1924) 287; Knuth, Pfl. R. Heft 105 (1939) 48.

B. micrantha Gagn., Not. Syst. 3 (1914) 385; Bull. Mus. Hat. Hist. Nat. 26 (1920) 72; Fl. Gén.-I.-C. 2 (1921) 856, fig. 93; Knuth, Pfl. R. Heft 105 (1939) 44.

B. pedicellata Ridl., J. Fed. Mal. St. Mus. 10 (1920) 134; Fl. Mal. Pen. 1 (1922) 759; Craib, Fl. Siam. En. 1 (1931) 671; Knuth, Pfl. R. Heft 105 (1939) 33.

B. kermodei C. E. C. Fischer, Kew Bull. (1929) 311; Knuth, Pfl. R. Heft 105 (1939) 46; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 106.

B. martensii Knuth, Pfl. R. Heft 105 (1939) 46, *ex descr.*

B. kedahensis Knuth, *op. cit.* 47.

B. merguiensis Knuth, *op. cit.* 48.

B. balansae Knuth, *op. cit.* 48.

See for further synonyms under the subspecies.

KEY TO THE SUBSPECIES

1. Flowers distinctly pedicelled. Fruit oblong, acutely angled . . . . . **a.** ssp. **acutangula**
1. Flowers sessile. Fruit almost globular, 4-or 8-ribbed or slightly winged . . . . . **b.** spp. **spicata**

a. ssp. **acutangula.**

Shrub or small tree, 2—13(—25) m, dbh 20—90 cm, often more-stemmed; twigs *c.* 3—5 mm ∅. *Leaves* elliptic or obovate-oblong, glabrous or hairy underneath (leaf-index 2—3), *c.* (5—)6—16(—22) by 2—6(—8) cm, papyraceous, finely serrate-crenulate, apex obtuse, acute, or acuminate (tip emarginate), nerves *c.* (7—)10—12(—20) pairs; petiole *c.* 4—10(—15) mm. Cataphylls *c.* 1½—6 by 1—1½ mm, triangular. *Racemes* terminal, pendulous; rachis *c.* 20—45(—78) cm, by *c.* 1—2 mm ∅, densely flowered (up to 75 flowers). Bracts elliptic-lanceolate, acute, *c.* 1—5 by ¾—2 mm. Pedicels *c.* (1—)3—7 mm. Opening buds *c.* 5 by 5 mm. *Flowers* scented. Bracteoles *c.* ½—1 mm. *Calyx* tube *c.* ½ mm high, not accrescent; sepals free, semicircular, *c.* 2—3½ by 1½—3 mm, not accrescent, chartaceous, obtuse. *Petals* 4(—5), elliptic, obtuse, convex, *c.* 6—10(—12) by 4—7 mm, insertion 1—3 mm wide. *Staminal tube c.* 1—4½ mm high, stamens in 3 whorls, inner one staminodial, filaments *c.* 1—2 cm, staminodia 3—6 mm; anthers *c.* ½—¾ by ¼—¾ by ⅛ mm. *Ovary* 2(—3—4)-celled, 4(—5)-gonous, *c.* 1½—3 by 1½—3½ mm; ovules 2—4(—5) per cell (total number 4—8); septum complete; style *c.* 1—2 cm. Disk ½ mm high. *Fruit* angled or ovoid (when young ± 4-winged), *c.* 2—6 by 1—3 by 1—3 cm, tapering to the truncate apex, emarginate at base and with depressed sides,

pericarp *c.* 1—2 mm thick at the sides and 3—6 mm at the corners, divided into a thin fibrous wrinkled exocarp and a spongy parenchymatous mesocarp with two layers of anastomosing fibres closely arranged near exocarp and endocarp; endocarp a thin brown membrane covering the inside of the cell. *Seed* ovoid, grooved, *c.* 1—4 by ½—1½ by ½—1½ cm.

Typification: *B. acutangula* (L.) Gaertn., *Tsjeria samstravadi* Rheede, *Eugenia acutangula* L., *Stravadium acutangulum* J. St. Hil., *Stravadium rheedii* Bl., *Butonica rubra* Miers, *B. rubra* Baill. *ex* Lanessan, *Michelia acutangula* O. Kuntze, *Huttum acutangulum* Britten: *Herb. Hermann 190* (Ceylon), lectotype in BM.

Butonica terrestris Rumph., *Stravadia rubra* Pers., *Stravadia alba* Pers., *B. alba* Kostel., *B. terrestris* Knuth: *Rumphius tab. 115 & 116.*

Meteorus coccineus Lour., *Stravadium coccineum* DC., *B. coccinea* Kostel., *Careya coccinea* Cheval.: *Loureiro s.n.* (Cochinchina), holotype in BM.

Stravadium costatum Bl., *B. costata* Miq., *Michelia costata* O. Kuntze: *Herb. Lugd. Bat. 898.204.161* (Malesia), holotype in L.

Botryoropis luzonensis Presl, *Stravadium luzonense* Miers, *B. luzonensis* Vidal, *Michelia luzonensis* O. Kuntze: *Cuming 653* (Luzon), holotype in PRC (not seen), isotypes in BM, CGE, K, L, P, W.

Stravadium demissum Miers, *B. demissa* Knuth: *Masters 363, Griffith s.n.* (Malacca), *Griffith s.n.* (Mergui), *Griffith 74* (all not seen), *Helfer 2425, Griffith 2425*, syntypes in K; *Helfer 2422, 2425*, syntypes in W (*Wallich 3635a, c & d* belong to ssp. *spicata*).

Stravadium gracile Miers, *B. gracilis* Knuth: *F. v. Mueller s.n.* (Australia), holotype in K.

Stravadium denticulatum Miers, *B. denticulata* Knuth: *Hann 195* (Queensland), holotype in K, isotype in BM.

Stravadium pubescens Miers, *B. pubescens* Knuth: *König s.n.* (India), syntype in BM; *Wallich 3635e* (not *b*), syntypes in BM, P; *Dalzell s.n.*, syntypes in BM, K; *Thompson s.n.*, syntypes in BM, K, P, U; *Wight 1062*, syntypes in BM, HBG, K, L, P, W; *Wight 1063*, syntypes in K, BM, L; *Wight 1083* (not *1080*), syntypes in BM, CGE, E, K, L, P.

B. tetraptera Laut.: *Branderhorst 71* (New Guinea), holotype in B (lost), isotypes in BO, L, WRSL.

Symplocos multiflora Eberh. & Dub., *B. eberhardtii* Gagn., *B. multiflora* Guillaumin: *Eberhardt anno 1911* (Annam), holotype in P.

B. micrantha Gagn.: *Thorel 2036, Lecomte & Finet 1792, Godefroy s.n.* (Indochina), syntypes in P, *Thorel 2036* also in BM and K.

B. pedicellata Ridl.: *Evans Aug. 1917* (Malaya), holotype in K.

B. kermodei C. E. C. Fischer: *Kermode 7190* (Burma), holotype in K.

B. martensii Knuth: *Martens 100* (Borneo), holotype in B (lost).

B. kedahensis Knuth: *Haniff & Nur 7555* (Malaya), holotype in K, isotype in SING.

B. merguiensis Knuth: *Parker 2571* (Burma), holotype in B (lost), isotypes in DD and K.

B. balansae Knuth: *Balansa 1138* (Tonkin), holotype in B (lost), isotypes in K, L, P.

Distribution: Afghanistan, W. Pakistan, India, E. Pakistan, Burma, Thailand, Laos, N. and S. Vietnam, Cambodia, S. Sumatra (Palembang area only), Malaya, Borneo, Philippines, Celebes, Timor, New Guinea, and N. Australia. Fig. 16.

Ecology: Mostly growing along rivers, on plains regularly inundated during the wet monsoon, or in swamps and fresh water mangroves. Trees can be submerged for several weeks. According to Brass (J. Arn. Arb. 18, 1938, 184; 22, 1941, 285) along Daviumbu Lake and the Upper Wassi Kussa a typical, compact thrifty-looking treelet, often in pure stands, its crown loaden with fleshy sun-epiphytes and often draped with *Stenochlaena*, also a characteristic swamp forest tree in the Merauke area. In Central and East Borneo

it forms the *putat* type of the *rapak*-swamp forests where Endert found it associated wit *Coccoceras*, *Ixora*, and *Eugenia* (M. O. Born. Exp. 1925, 213. 1927).

In W. New Guinea the species has been found as one of the main trees in a *Rapanea*-vegetation on Mt Cycloop at 1600 m altitude (*Van Royen & Sleumer 6038*). In Australia (Queensland) it is often the main tree in a fringing community of rivers or it is found growing in water together with *Eucalyptus microtheca*.

It is stated to be a deciduous tree in India during March and April, in Papua during June or July and in Australia during June. Altitude from sea-level up to 750 m, in New Guinea once at 1600 m. Fl. & fr. Jan.—Dec., but in full bloom generally April and May.

Compilation of field-notes: Tree mostly crooked, spreading, often bushy. Bark grey or brown, intricately, longitudinally fissured or furrowed. Petals generally stated to be red, in Burma and Thailand they are often pink, while in the Malay Peninsula and New Guinea white flowers also occur (sometimes the buds are red, but in bloom petals turn white). Calyx green; stamens deep pink or dark red (*c.* 80—120 filaments says *Clarke 6884*), anthers yellow; style dark red, ovary yellow-green. Fruit green, tinged red or brown. Young fruit often winged, wings *c.* 1—5 mm wide, later disappearing. One collection from W. Borneo has winged ovaries (*Main 1750, exp. Polak*). In the Botanic Garden in Singapore a tree originating from Bombay has been growing there since 1929. In 1935 it was 2.60 m, in 1938 4.60 m, dbh 25 cm, already in 1932 flowering material had been collected from the treelet.

Galls: Leaf-galls were found on *Ramos 1943* from Luzon, Philippines. Flower-galls in *Koch 487* and *Branderhorst 71*, from New Guinea, the latter being the type of *B. tetraptera* Laut. See Docters van Leeuwen-Reynvaan, J. Siam. Soc. 15 (1922) 47; Zoocec. Neth. E. Indies (1926) 400; Uichango, Philip. J. Sc. 14 (1919) 536, pl. 1, fig. 2, pl. 7, fig. 1 & 3.

Germination: Under natural conditions seeds germinate soon after fruits have dropped on attaining maturity. The root develops close to the style and the primary shoot close to the pedicel. The seed remains within the pericarp. See Thomson, J. Proc. Linn. Soc. Bot. 2 (1858) 47; Chibber, Ann. Jard. Bot. Btzg. 29 (1916) 52, pl. 8; Troup, Silv. Cult. Ind. Trees 2 (1921) 590, fig. 222; T., Ind. For. 48 (1922) 616, pl. 17; De, Ind. For. 49 (1923) 268.

Dispersal: Fruit float very well on water; trees usually grow along rivers so that dispersal by water is most likely. See Ridley, Disp. Pl. (1930) 210, 291.

Vernaculars: In Indian sheets many different names are found on the field-labels; Burma material is often collected under *Kyi* or *Ché*, in Thailand *Chik kao*, *Chik dong*, or *Mai chik* and *Puk chik*; in Vietnam *Caỳ vung* or *Caỳ mûn* as well as *Ran bung*. In Malesia the name *Putat* is mostly used, but this name is given to *Barringtonia* in general. In New Guinea near Merauke it is *Katjuk* (Je dialect).

Uses: Wood. Balfour, Timbertrees ed. 2 (1862) 44, gives a survey of the different uses made of *B. acutangula*. So does Brandis (1874) *op. cit.* The English trade name 'Indian Oak' gives the impression that the wood is durable, also when in contact with water. There is no heartwood. It is used for boat-building, in construction of wells, for carts, rice-pounders, and by cabinet-makers.

Wood-anatomy. A good survey is found in Foxworthy, Philip. J. Sc. 4 (1909) Bot. 525 and in Desch, Mal. For. Rec. 15 (1941) 251. The latter also quotes earlier publications by Gamble and Pearson & Brown. For further reference see also Metcalfe & Chalk, Anat. Dicot. 1 (1950) 632, fig. 142A—B.

Fish-poison. The use of bark to poison fish for easy catching has been reported by Brandis (1874) *op. cit.* from India, by Brown, Bur. For. Bull. 22, 3 (1921) 81 from the

Philippines, as well as by Quisumbing, Philip. J. Sc. 77 (1948) 165. Carr, N. Queensl. Nat. 15 (1947) 3, describes a test conducted with 70 kg chopped up roots in a waterhole *c.* 135 by 14 m and 2 m depth, of the river Mitchell, resulting in a catch of 3 cornsacks of good fish. Catfish was not collected.

Medicinal uses. Witt (1916) *op. cit.* mentions medicinal uses from India. Leaves as well as fruit are used in native medicine. Kirtikar & Basu (1918) *op. cit.* state that the root is bitter and supposed to be similar to *Cinchona* in its properties, also held to be cooling and aperient. The seeds are used as an aromatic in colic, in parturition and ophthalmia. Said to induce vomiting. From the Philippines it is reported by Guerrero, Bur. For. Bull. 22, 3 (1921) 214, that the bark is used on wounds. In Borneo the fruits are eaten by Djčlawat (a kind of fish) without poisoning them.

Remarks: I have reduced a great number of species to two subspecies of *B. acutangula* (L.) Gaertn. The conspecificity of *B. acutangula* and *B. spicata* has been fully confirmed by palynological examination.

In both subspecies a number of specimens occur, previously distinguished as distinct species, which are more or less pubescent. This hairiness varies considerably in degree. Some specimens have a dense, ferruginous pubescence on rachis, ovaries, and on the nervation underneath the leaves; others are only slightly pubescent or pulverulent on rachis and ovaries. Pubescent and absolutely glabrous specimens are not growing in different areas but in mixed populations, hence I reduced these species to either ssp. *acutangula* or ssp. *spicata*. Specimens with sessile flowers and the more or less globular fruit are not always growing in mixed populations with the pedicelled ones. Therefore I want to distinguish them as two subspecies of *B. acutangula* (L.) Gaertn.

For an interpretation of Rheede and Rumphius figures see p. 195. The value of several synonyms based on these figures is also discussed. In the BM I found a specimen in Herbarium Hermann under the Flora Zeylanica number 190 which I am certain Linnaeus must have examined for his Flora Zeylanica. I therefore want to accept this Hermann specimen as a lectotype.

Several specimens from Burma, Thailand, and Borneo vary considerably in the number of cells and ovules in the ovaries. This variation is encountered in flowers on one and the same rachis. Some Australian collections *viz. Hann 195*, have larger leaves *c.* 16—22 by 6—8 cm with 19—20 pairs of lateral nerves.

b. ssp. **spicata** (Bl.) Payens, *stat. nov.* — **Photogr. 5.**

B. spicata Bl., Bijdr. (1826) 1097; Hassk., Cat. Hort. Bog. (1844) 263; Flora 27, 2 (1844) 594; Korth., Ned. Kruidk. Arch. 1 (1846) 206; Miq., Fl. Ind. Bat. 1, 1 (1855) 489; De Vriese, Pl. Ind. Bat. Or. (1856) 79; Walp., Ann. 4 (1857) 851; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; Koord. & Val., Bijdr. Booms. 6 (1900) 15; King, J. As. Soc. Beng. 70, ii (1901) 141; Backer, Schoolfl. (1911) 529; Hall. *f.*, Med. Rijksherb. 12 (1912) 26; Koord., Exk. Fl. Java 2 (1912) 666; Merr., En. Born. (1921) 420; Ridl., Fl. Mal. Pen. 1 (1922) 759; Craib, Fl. Siam. En. 1 (1931) 669; Ochse & Bakh., Veg. D.E.I. (1931) 358, fig. 227; Burkill, Dict. Ec. Prod. 1 (1935) 306; Henderson, J. Mal. Br. R. As. Soc. 17 (1939) 45; Knuth, Pfl. R. Heft 105 (1939) 49; Corner, Ways. Trees (1940) 355, fig. 123; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 107; Backer & Bakh. *f.*, Flora Java 1 (1963) 353. — *Stravadium spicatum* Bl. in DC., Prod. 3 (1828) 289; in Fl. Serr. 7 (1851) 24; Miers, Trans. Linn. Soc. Bot. 1 (1875) 85. — *Michelia spicata* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241.

B. horsfieldii Miq., Fl. Ind. Bat. 1, 1 (1855) 489; Walp., Ann. 4 (1857) 851; Koord. &

Val., Bijdr. 6 (1900) 17; Koord., Exk. Fl. Java 2 (1912) 666; Knuth, Pfl. R. Heft 105 (1939) 44. — *Stravadium horsfieldii* Miers, Trans. Linn. Soc. Bot. 1 (1875) 85. — *Michelia horsfieldii* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240.

B. nitida Miq., Fl. Ind. Bat. 1, 1 (1855) 490; De Vriese, Pl. Ind. Bat. Or. (1856) 78; Walp., Ann. 4 (1857) 851; Koord. & Val., Bijdr. 6 (1900) 18; Backer, Schoolfl. (1911) 529; Koord., Exk. Fl. Java 2 (1912) 666; Knuth, Pfl. R. Heft 105 (1939) 49. — *Stravadium lucidum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 88.

Stravadium globosum Miers, Trans. Linn. Soc. Bot. 1 (1875) 86, *excl. syn.* Span. — *B. globosa* Knuth, Pfl. R. Heft 105 (1939) 50, *excl. syn.* Span. See Excl. Names under *Perigara globosa.*

B. schmidtii Warb. *ex* Craib, Bot. Tidsskr. 32 (1915) 332; Fl. Siam. En. 1 (1931) 669, 672; Knuth, Pfl. R. Heft 105 (1939) 49.

B. edaphocarpa Gagn., Bull. Mus. Nat. Hist. Nat. 26 (1920) 73, fig. 95; Fl. Gén. I.-C. 2 (1921) 862, fig. 95; Burkill, Dict. Ec. Prod. 1 (1935) 305; Knuth, Pfl. R. Heft 105 (1939) 48; Corner, Ways. Trees (1940) 354, fig. 123.

B. bicolor Craib, Kew Bull. (1929) 118; Fl. Siam. En. 1 (1931) 668, 673; Knuth, Pfl. R. Heft 105 (1939) 31.

B. edaphocarpa var. *ladelli* Craib, Fl. Siam. En. 1 (1931) 669.

B. dentata Knuth, Pfl. R. Heft 105 (1939) 46.

B. winkleri Knuth, Pfl. R. Heft 105 (1939) 20, *ex descr.*

Chydenanthus dentato-serratus Knuth, Pfl. R. Heft 105 (1939) 59; *cf.* Airy Shaw, Kew Bull. (1949) 152; Back. & Bakh. *f.*, Fl. Java 1 (1963) 353.

Spikes c. 30—40 cm, rachis *c.* 1—2 mm ∅. *Fruit* subglobular or ovoid, *c.* 1½—3½ by 1—1½ by 1—1½ cm, apex truncate, base tapering, sides sometimes depressed, mostly distinctly 4- or 8-winged or ribbed.

Typification: *B. spicata* Bl., *Stravadium spicatum* Bl., *Michelia spicata* O. Kuntze: *Herb. Lugd. Bat. 898 . 204 . 229* (Java), holotype in L, isotype in U.

B. horsfieldii Miq., *Stravadium horsfieldii* Miers, *Michelia horsfieldii* O. Kuntze: *Horsfield s.n.* (Java, Prowoto), holotype in U, isotypes in BM and K (in K as collection *157*, in U as *20*).

B. nitida Miq., *Stravadium lucidum* Miers: *Reinwardt s.n.* (Java), holotype in L, isotype in U.

Stravadium globosum Miers, *B. globosa* Knuth: *Anderson s.n.* (Java), holotype in K, isotype in BM.

B. schmidtii Warb. *ex* Craib: *Schmidt 186* (Siam), holotype in K.

B. edaphocarpa Gagn.: *Lemarié s.n.* (Tonkin), holotype in P.

B. bicolor Craib: *Kerr 5874* (Siam), holotype in K, isotype in BM.

B. edaphocarpa var. *ladelli* Craib: *Ladell 227* (Siam), holotype in K.

B. dentata Knuth: *Yates 1617* (Sumatra), holotype in B (lost), isotypes in BO, BRI and S.

B. winkleri Knuth: *Hubert Winkler 3427* (Borneo), holotype in B (lost).

Chydenanthus dentato-serratus Knuth: *Bakhuizen van den Brink 1870* (Java), holotype in B (lost), isotypes in K, L, P, SING, U, and W.

Distribution: India (Orissa, Madras, W. and E. Bengal), E. Pakistan, Burma, Thailand, N. Vietnam, Sumatra (Indragiri and Palembang areas), Malaya, Java, Madura, Kangean Arch., Celebes, Philippines (Mindoro and Mindanao), Moluccas (Ceram), New Guinea (Idenburg and Sepik River areas). Fig. 16.

Ecology: Growing along rivers, in flood plains or on riverbanks; in marshy and during the wet monsoon regularly inundated areas. According to Corner (1940) characteristic

of tidal streams in the forest, and sometimes in rice-fields replacing them. Frequently of tufted habit with conically thickened stems in stands with a densely matted undergrowth of *Fimbristylis pauciflora* (photogr. 5). In Pahang (Malaya) it is reported from coastal *Eugenia grandis* forests. In Java it is frequently found in teak-forest or as a shrub in floating vegetation of shallow lakes. Reported to be briefly deciduous in New Guinea.

Altitude from sea-level up to 400 m. Fl., fr. Jan.—Dec., but in full bloom generally in April and May.

Compilation of field-notes: Petals mostly pink, red, or purple, in Thailand and the Philippines once mentioned to be yellow, white petals reported from Malaya, the Philippines, and New Guinea. Calyx green, filaments always red or pink, anthers yellow. Fruit pale or dirty green.

Galls: Leaf-galls, caused by a gall-midge, are described by Docters van Leeuwen-Reynvaan, Zoocec. Neth. E. Indies (1926) 400, fig. 744.

Vernaculars: In Thailand *Chik*, *Chik num*, or *Mai chik*; also *Pooy-sai* (Lao language) is mentioned twice. In Malesia the name *Putat* is mostly used, but this name is given to *Barringtonia* in general.

Uses: Several field-labels from Java (*viz.* Edeling and Koorders) state that the leaves are edible; they are eaten with rice or boiled as a vegetable. Ochse & Bakhuizen van den Brink (1931) *op. cit.* also mention the use of leaves as a vegetable.

On wood-anatomy a very thorough analysis can be found in Moll & Janssonius, Mikrographie 3 (1918) 494, fig. 197. They used wood collected by Koorders in Java; I have checked the voucher specimens in BO.

Remarks: I am not sure about the identity of *B. winkleri* Knuth, based on *Hub. Winkler 3427*, as the holotype in B and the isotype in WRSL are lost (information received by letter from both herbaria). The sessile fruit and the size of several plant parts cited fit the description of *B. acutangula* ssp. *spicata*. On the other hand, this would then be the only collection of this variety made in Borneo, which appears strange.

25. B. scortechinii King, J. As. Soc. Beng. 70, ii (1901) 138; Ridl., Fl. Mal. Pen. 1 (1922) 757; Burkill, Dict. Ec. Prod. 1 (1935) 306; Knuth, Pfl. R. Heft 105 (1939) 30; Corner, Ways. Trees (1940) 355. — **Fig. 15, photogr. 4.**

B. scortechinii King var. *globosa* Craib, Fl. Siam. En. 1 (1931) 673; Knuth, Pfl. R. Heft 105 (1939) 30.

Small to large tree, (2—)7—20(—40) m; dbh *c.* (3—)10—20(—40) cm; twigs *c.* 2½—4 mm ∅. *Leaves* obovate or elliptic, glabrous, *c.* 8—17(—21) by 5—7½ cm (leaf-index 1½—3), subcoriaceous, margin ± serrate-crenulate, ± revolute, acuminate, base cuneate; nerves *c.* 7—10 pairs, curving upwards rather sharply, venation distinct above, prominent beneath; petiole *c.* (½—)1½—5 cm. *Spikes* mostly ramiflorous, rarely terminal, pendulous *c.* (13—)20—55(—70) cm, with up to 65 flowers, rachis *c.* 3—7 mm ∅, accrescent, often fissured, glabrous or slightly pubescent. Bracts triangular, *c.* 4 by 2 mm. *Flowers* sweet-scented. Bracteoles triangular, *c.* ½ by ½ mm. Opening buds *c.* 5 mm, globular. *Calyx* open in bud, tube *c.* 2—3 mm high, ± accrescent; lobes (3—)4, thin, equal, convex, *c.* 2—5 by 4—7 mm, ± accrescent, apex obtuse. *Petals* 4, elliptic, convex, *c.* (1¼—)1¾ by (¾—)1 cm, thin, fimbriate, obtuse, insertion *c.* 3—4 mm wide. *Staminal tube* *c.* 3—4 mm; stamens in 4—5 whorls, the inner one staminodial; filaments *c.* 3 cm, staminodia *c.* 1¼ cm, anthers *c.* ¾ by ⅓ by ⅓—½ mm. Disk a thin, distinct ring *c.* 1—2 mm high. *Ovary* 3—4-celled, tetragonous, with distinctly winged edges, often pulverulent pubescent, *c.* 3—6 by 3—6 by 3—5 mm, ovules 3—4(—5) per cell (in 3-celled ovaries up to 6 ovules per cell) (total number up to 9—14); septa not complete; style *c.* 4 cm.

Fig. 15. *Barringtonia scortechinii* King. a. Habit, × $\frac{2}{3}$, b. mature bud, × 2, c. section of bud, × 4, d. fruit, × $\frac{2}{3}$ (a. *SAN 24981*, b—c. *SFN 30704* (*Corner*), d. *E. F. Allen SA 7650/170*).

Immature fruit tetragonous with distinct wings on the edges which are gradually disappearing when growing and maturing, finally ovoid with 8 ridges, *c.* 10—12 by 3—5 by 3—5 cm, fissured, rugose, dull, pulverulent; pericarp *c.* 4—8 mm thick, divided into a *c.* 2—3 mm thick exocarp and a 2—5 mm thick mesocarp with hard fibres in bundles, endocarp a thin brown membrane. *Seed* ovoid, *c.* 5—6 by 2—2½ cm.

Typification: *B. scortechinii* King: *Curtis 1296*, fl. & fr. syntype, in K, SING; *King's Coll. 3598*, fl. syntype, in BO, U, US; *King's Coll. 3854*, fr. syntype, in BM, K, P; *King's Coll. 6252*, fl. syntype, in K, SING; *Scortechini 237*, fl. syntype, in P; *Scortechini 595* (not *395*), fl. syntype, in K; *Scortechini 1674*, syntype (not seen); *Scortechini 2090* (not *2020*), fl. syntype, in SING, W. Lectotype: *King's Coll. 3854* (Malaya).

B. scortechinii King var. *globosa* Craib: *Kerr 15222* (Siam), holotype in K, isotypes in BM, SING.

Distribution: Peninsular Thailand, Malaya, Sumatra (Upper Riouw), Borneo. Fig. 16.

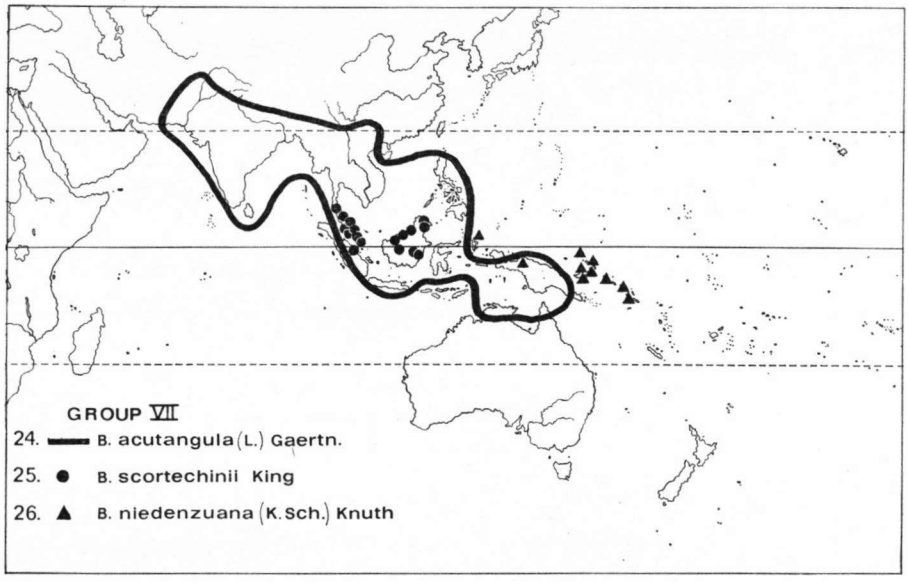


Fig. 16. Range or localities of the species of Group VII.

Ecology: In Malaya in swampy forest or near rivers in hillside forest; in Borneo in primary as well as in secondary forest, in hillside mixed Dipterocarp or *Quercus* forest, mostly in low undulating country up to 1400 m. Fl., fr. Jan.—Dec.

Compilation of field-notes: Bole *c.* 5—20 m, buttresses *c.* 2 m high, *c.* 1 m wide, and *c.* 5 cm thick (*Ashton S. 18201*), crown *c.* 2—17 m, round, branches spreading; bark scaly, peeling off in small flakes, finely longitudinally fissured, brown or red; outer bark pink, *c.* 1—2 mm thick, soft; inner bark white or yellow, *c.* 20 mm thick, soft, fibrous; cambium yellow; sapwood yellow. Leaves glossy bright green. Flowerbuds yellow-green with pink apex; calyx pale green; petals white, greenish white, yellowish, or white with a green or pink margin, in Borneo also reported to be pink, light red, or red; stamens white, pinkish white, or pale pink at base and white at apex; disk yellow;

style bright red or apex pink, base white. Fruit green with a reddish tinge; pericarp inside pink, outside fibrous; seed creamy white.

Galls: Leaf-galls were found on material from Malaya (*Corner SFN 30121* and *Nur SFN 11183*) as well as from Sumatra (*Soepadmo 189*).

Vernaculars: In Malaya *Putat gajah* (Elephant putat) and *Putat tuba*, in Borneo *Tĕmpalang* or *Tampalang* and *Langsat burung*. *Putat*, the common Malay name for *Barringtonia*, is used in both areas.

Uses: Wood. For a description of the wood-anatomy see Desch, Mal. For. Rec. 15 (1941) 251, pl. 60, fig. 1.

Fish-poison. Fruit and bark are used in Malaya as a fish-poison; however, from Malaya (*Wray 2087*) and from Borneo (*Kostermans 10170*) the fruit is reported to be edible.

26. B. niedenzuana (K. Sch.) Knuth, Pfl. R. Heft 105 (1939) 39, fig. 6. — *Careya niedenzuana* K. Sch., Notizbl. Berl.-Dahl. 2 (1898) 136; K. Sch. & Laut., Fl. Schutzgeb. (1900) 462; Laut., Bot. Jahrb. 57 (1922) 345, fig. 2. — *Cumbia niedenzuana* O. Kuntze, Deut. Bot. Monatsschr. 21 (1903) 172.

B. quadrigibbosa Laut., Bot. Jahrb. 57 (1922) 347, fig. 3; Knuth, Pfl. R. Heft 105 (1939) 40, fig. 7; Peekel, Ill. Fl. Bism. Arch. (1945) 1294, fig. 1293 (*ined.*).

B. bougainvilleana Knuth, Pfl. R. Heft 105 (1939) 41.

B. araiorhachis Merr. & Perry, J. Arn. Arb. 21 (1940) 293, fig. 1C.

Small tree, *c.* 4—13(—25) m; dbh *c.* 5—25 cm; twigs *c.* 2—5 mm ∅. *Leaves* obovate-oblong, glabrous (once noted pubescent underneath), *c.* 12—26(—35) by 4—9 cm [leaf-index (1½—)2—3], papyraceous; serrate-crenulate, acuminate, cuneate at base, midrib prominent on both sides, nerves *c.* 10—18 pairs, only prominent beneath, venation equally distinct on both faces; petiole *c.* 1—3½(—4½) cm. *Racemes* terminal or ramiflorous, pendulous, *c.* 20—90 cm, ± sparsely flowered (*c.* 30 flowers on a rachis 47 cm long); rachis *c.* 1—2 mm ∅, pulverulent or slightly pubescent. Cataphylls few, triangular or lanceolate, *c.* 1—9 by 1—1½ mm, papyraceous. Bracts triangular-lanceolate, *c.* 5—7 by 1½—2 mm, fimbriate. *Flowers* scented. Pedicels (2—)10—20 mm, articulating near the base, ferruginous-pulverulent or pubescent. Bracteoles minute, *c.* ½—1 mm. Opening buds *c.* 5—7 mm. *Calyx tube* cup-chaped, *c.* 4—5 mm high, from the beginning with 4 small lobes *c.* ½—2½ by 5 mm. *Petals* 4, elliptic, obtuse or acute, convex, *c.* 14—20 by 6—9 mm, membranous, margin revolute and fimbriate, insertion *c.* 2—3 mm wide. *Staminal tube c.* (2—)5—8 mm, in some specimens up to 5 mm connate on the outside and up to 7 mm on the inside; stamens in (3—)4—6 whorls, the inner one staminodial; filaments *c.* 17—20 mm; staminodia *c.* 4—8 mm; anthers *c.* ½—¾ by ⅓—½ by ⅓—½ mm. Disk distinctly undulating, grooved outside, annular, ½ mm high. *Ovary* (3—)4-celled, subtetragonous, *c.* 2—3 by 1½—3 by 1—3 mm, ferruginous-pubescent; ovules 2—4 per cell [total number up to 8—12(—16)]; septa incomplete; style *c.* 2—3¾ cm. *Fruit* oblong, spindle-shaped, tetragonous, sometimes distinctly (2½—5 mm wide) irregularly winged up to halfway or even hooked near the base, glabrous or rugose, *c.* 4½—6½ by 1—1¾ by ¾—1¼ cm, truncate; pericarp *c.* 1½ mm thick, exocarp thin, *c.* ½ mm, mesocarp with many small fibres, *c.* 1 mm thick. *Seed* spindle-shaped, slightly fissured, *c.* 3—3¾ cm by 5—7 by 5—6 mm.

Typification: *B. niedenzuana* (K. Sch.) Knuth, *Careya niedenzuana* K. Sch., *Cumbia niedenzuana* O. Kuntze: *Dahl s.n.*, holotype in B (lost). Neotype *NGF 7012 A. Floyd* (New Britain), in A, BO, BRI, L, LAE, SING.

B. quadrigibbosa Laut.: *Peekel 647* (New Ireland), holotype in B (lost), isotype in WRSL.

B. bougainvilleana Knuth: *Kajewski 2268* (not *2200*) (Bougainville), holotype in B (lost), isotype in A.

B. araiorhachis Merr. & Perry: *Brass 3190* (Solomons), holotype in A, isotypes in BM, BO, BRI, L.

Distribution: Moluccas (Talaud), N. New Guinea (Mamberamo Valley), New Britain, New Hanover, New Ireland, and the Solomons (Bougainville, Fauro, Santa Isabel, and Guadalcanal Is.). Fig. 16.

Ecology: Rain-forest tree on limestone slopes or in low damp places, even in a forest near a mangrove swamp, as understorey tree 'suppressed by *Ficus* and *Alstonia*' or in open marginal forest (New Guinea), from sea-level up to 700 m. Fl. Jan.—Nov., fr. April—Nov.

Compilation of field-notes: Crown large, conical, dense. Bark with irregular deep fissures, soft, spongy with scollop marks, grey-brown or grey-fawn. Outer bark smooth, grey; inner bark white streaked, orange-brown or straw coloured, *c.* 12 mm thick. Wood cream or pale straw-brown, with a light odour and well defined growthrings *c.* 6 mm thick; sapwood hardly defined. Leaves dark green above, paler green underneath, stiff, shiny, in terminal clusters of five, midrib pale green; petiole purple. *Kajewski 2268* has ferruginous pubescent nervation underneath. Flowerbuds pale green, sometimes with a slight purple tinge; calyx green-red mottled, green or leaden; petals purple, magenta, red, orange, pink, cream flushed pink, yellow, white; filaments light purple, dark red, or yellow; anthers yellow; fruit green or dark green.

Vernaculars: In Talaud *Buaro* (Karatal dial.), in New Hanover *Ta-autim*, in Bougainville *Ai ai chiram* and *Lususio*, in Santa Isabel *Falagori* or *Falangori* (Maringe lang.) and *Cut nut* in Pidgin, in Fauro I. *Fala* (Kwara'ae lang.).

Remarks: Schumann's description of *B. niedenzuana* being insufficient I prefer to select a neotype. Other specimens from New Britain are *NGF 7022, 7045, 7906, 7945, 10901, 10904, 21757* and *Rechinger 3674*.

The type of *B. bougainvilleana* is *Kajewski 2268*. Knuth (1939) *op. cit.* erroneously cited this as *Kajewski 2200* which is the type of *Litsea solomonensis* Allen (*Lauraceae*). See J. Arn. Arb. 23 (1942) 127.

The distribution pattern of the species is, with 2 distant localities towards the West, rather remarkable. One collection (*Lam 1006*) has been made in North New Guinea at Prauwenbivak, Lakes Plain, on the Mamberamo. Another collection (*Lam 2844*), from Talaud, has an ellipsoid fruit and the young flowers are sessile. In *NGF 7012* the very young stages also have sessile flowers.

27. B. macrocarpa Hasskarl, Flora 25, ii (1842) Beibl. 36; Cat. Hort. Bog. (1844) 263; Flora 27, ii (1844) 593, *descr. ampl.*; Miq., Fl. Ind. Bat. 1, 1 (1855) 485; Walp., Ann. 4 (1857) 850; Teysm. & Binn., Cat. Hort. Bog. (1866) 248; Koord. & Val., Bijdr. Booms. 6 (1900) 8; Backer, Schoolfl. Java (1911) 528; Koord., Exk. Fl. Java 2 (1912) 665; Knuth, Pfl. R. Heft 105 (1939) 23; Backer & Bakh. *f.*, Flora of Java 1 (1963) 353. — *Megadendron macrocarpum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 109, t. 15, fig. 1—8. — *Michelia macrocarpa* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241.

Stravadium insigne Bl., in Fl. Serr. 7 (1851) 21, 24, t. 654. — *B. insignis* Miq., Fl. Ind. Bat. 1, 1 (1855) 488; Walp., Ann. 4 (1857) 850; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33, fig. 13A—H; Koord. & Val., Bijdr. Booms. 6 (1900) 13; Backer, Schoolfl. (1911) 528; Koord., Exk. Fl. Java 2 (1912) 666; Heyne, Nutt. Pl. ed. 2 (1927) 1160; Ochse & Bakh., Veg. D.E.I. (1931) 357, fig. 226; Knuth, Pfl. R. Heft 105 (1939) 23, fig. 3A—H, figure erroneously referred to *B. racemosa*!; Backer

& Bakh. *f.*, Flora of Java 1 (1963) 353. — *Michelia insignis* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240. — *B. acutangula* [*non* (L.) Gaertn.] Bl., Bijdr. (1826) 1097 (*excl. syn.* Hort. Malab.).

B. serrata Miq., Fl. Ind. Bat. 1, 1 (1855) 488; Walp., Ann. 4 (1857) 851; Niedenzu in E & P., Nat. Pfl. Fam. 3, 7 (1892) 33; Koord., Exk. Fl. Java 2 (1912) 666; Craib, Fl. Siam. En. 1 (1931) 673; Knuth, Pfl. R. Heft 105 (1939) 48. — *Stravadium serratum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 87. — *Michelia serrata* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241.

B. acutangula [*non* (L.) Gaertn.] Zoll. *ex* Miq., Fl. Ind. Bat. 1, 1 (1855) 488, *in synon.*; Jacks., Ind. Kew. 2, Add. (1895) 1269, *nomen.*

Megadendron pallidum Miers, Trans. Linn. Soc. Bot. 1 (1875) 110, *pro parte, quoad folia.* — *B. pallida* Koord. & Val., Bijdr. Booms. 6 (1900) 12; Koord., Exk. Fl. Java 2 (1912) 665; Knuth, Pfl. R. Heft 105 (1939) 22.

B. helferi Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 509; Brandis, Ind. Trees ed. 1 (1906) 330; Craib, Fl. Siam. En. 1 (1931) 670; Knuth, Pfl. R. Heft 105 (1939) 21; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 106. — *Michelia helferi* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240.

B. comosa Gagn., Not. Syst. 3 (1914) 383; Fl. Gén. I.-C. 2 (1921) 861; Knuth, Pfl. R Heft 105 (1939) 17.

Small tree or shrub, *c.* 1½—6(—13) m; dbh 5—16 cm; twigs (5—)7—15 mm ∅. *Leaves* subsessile, close together, spirally arranged in several storeys, obovate-lanceolate or linear-lanceolate, chartaceous, glabrous, *c.* 30—60(—70) by 6—18 cm [leaf-index (3½—)4—6]; distinctly serrate-crenulate specially towards the apex, top cuspidate or obtuse, base narrowly cuneate, midrib very prominent above, distinct underneath, nerves less prominent above than beneath, *c.* (16—)22—30 pairs, venation equally distinct on both sides; petiole ½—1(—2) cm. *Racemes* terminal, pendulous, *c.* (26—)40—75 (—112) cm with *c.* 135 flowers; rachis *c.* 5—7 mm ∅ at base and *c.* 2—4 mm at apex, accrescent, at base with a dense tuft of lanceolate to triangular, convex, glabrous cataphylls *c.* 5—75 by 2—30 mm. Bracts triangular, *c.* 1½—5 by ½—2 mm. *Flowers* not scented, facing upwards on the pendulous rachis. Pedicels *c.* 5—15 mm. Opening buds *c.* 5—7 mm, red. *Calyx tube c.* ½—2 mm high, with 3—4 free, papyraceous, unequal, convex, broadly ovate lobes, *c.* 3—5 by 3—5 mm, accrescent to *c.* 7—9 by 5—6 mm. *Petals* 3—4, elliptic, obtuse, convex, *c.* 1¾—2¾ by ¾—1½ cm, insertion *c.* 1—4 mm wide. *Staminal tube c.* ½—5 mm high; stamens in 3—4 whorls, inner one staminodial; filaments *c.* 3—4 cm; staminodia *c.* 6—12 mm; anthers *c.* ½—1 by ¼—¾ by ¼—½ mm. Disk a ± grooved small ring ½—¾ mm high. *Ovary* 3—4-celled (in Borneo 3-celled), 3—4-gonous or subglobular, *c.* 4—6 by 2—4 by 2—4 mm; ovules 2—5 per cell [total number (4—) 8—18(—22), in Borneo 4—12, Java 8—18, Asia 18—22]; septa incomplete; style *c.* 35—42 mm. *Immature fruit* (only 2 available) ± 3—4-winged, 3—4-gonous, glabrous, *c.* 6?—12½ by 1½—3 by 1½ cm; pericarp *c.* 2½ mm thick, exocarp *c.* ½ mm, mesocarp fibrous, *c.* 1 mm, endocarp fibrous, *c.* 1 mm. *Seed* ovoid, distinctly fissured, *c.* 3½ (?) by ¾ by ¾ cm.

Typification: *B. macrocarpa* Hasskarl, *Megadendron macrocarpum* Miers, *Michelia macrocarpa* O. Kuntze: Description by Hasskarl.

B. insignis Miq., *Stravadium insigne* Bl., *Michelia insignis* O. Kuntze, *B. acutangula* Bl.: *Van Hasselt s.n., Herb. Lugd. Bat. 898 . 204 . 167—170* (Java), holotype in L.

B. serrata Miq., *Stravadium serratum* Miers, *Michelia serrata* O. Kuntze: *Zollinger 139 Z* (Java), holotype in U, isotypes in L, P (rich flowering material), and WRSL.

B. acutangula Zoll. *ex* Miq. *ex* Jacks. is a misidentification; the base is *Zollinger 139 Z* in U, the holotype of *B. serrata* Miq.

Megadendron pallidum Miers, *B. pallida* Koord. & Val.: *Horsfield s.n.* (Java, Patjitan), holotype in BM, isotypes in CGE, K, U.

B. helferi Clarke, *Michelia helferi* O. Kuntze: *Helfer KD 2426* (Tenasserim), holotype in K.

B. comosa Gagn.: *Balansa 2884* (Tonkin), holotype in P, isotype in K.

Distribution: N. Vietnam (Phuong-lam), S. Burma (Tenasserim, Bentinck I.), S. Thailand, Malaya (Pahang, Johore), S. Sumatra (Palembang area only), Enggano I., Java, W. & E. Borneo. Fig. 18.

Ecology: Along rivers, in swampy forest and areas inundated during the wet monsoon, from sea-level up to 300 m. Fl. Jan.—Dec., fr. June—Sept.

Compilation of field-notes: Rachis and pedicels dull rose-red; flowerbuds red; calyx purple or pink; petals pale yellowish pink, greenish pink, white, or pale pink; filaments deep pink or pink; anthers yellow. Fruit rose-purple, meat-colour, or yellowish red.

Vernaculars: In Thailand *Chik nom yan*; in Enggano *Inônoi*; in Java *Songol* or *Songgom*; in Borneo *Pôtet* and *Bulat*.

Uses: Ochse & Bakhuizen (1931) *op. cit.* mention the use of the young shoots as a vegetable (*lalab*) with rice.

Fish-poison. Roots rubbed with ashes used as a fish-poison is reported from Java as well as from Borneo (*Rutten 31*). See also Greshoff, Meded. 's-Lands Pl. Tuin 10 (1893) 86; 25 (1898) 80; 29 (1900) 76, 176; Duyster, Giftige Indische Planten (1927) 115.

Remarks: Knuth (1939) *op. cit.* figured this species as fig. 3 A—H but erroneously referred this to *B. racemosa*. The figure originated from Niedenzu (1892) *op. cit.* and was used by him to illustrate *B. insignis*. This is correct as the twig has two whorls of leaves above each other and a raceme with profuse flowerbuds with open calyx as is characteristic for *B. macrocarpa*.

For the wood-anatomy see Moll & Janssonius, Mikrographie 3 (1918) 500 in which is stated that the wood structure resembles that of *B. spicata* (= *B. acutangula* ssp. *spicata*).

I have only 5 collections in fruit among 42 examined, all more or less immature (one from Johore, one from Java, and three from Borneo). Like *B. gigantostachya* it is a rarely fruiting species. This rare fruiting was already observed by Hasskarl for the specimens cultivated in Hort. Bog. As a matter of fact the fruit described by Hasskarl measured 12½ by 3 cm, a size not met in my material. I wonder whether the large fruit described by Hasskarl is similar to the 'musiform' abnormality as is encountered in *B. pendula*.

B. macrocarpa, originally validated by a brief diagnosis, was later (1844) meticulously described, with all details necessary for a modern interpretation, on the basis of material from a large tree in the Bogor Botanic Gardens, originating from Java. Therefore, it is rather remarkable that Miquel, Valeton, Knuth, and even Backer maintained this name next to *B. insignis* described by Blume who was obviously not aware that he had the same thing in hand as Hasskarl. Possibly by the usual lack of voucher specimens from Hasskarl, these later authors only referred to material of specimens of Horsfield collected at Patjitan, Central S. Java. This very poor material (BM, CGE, K, U) is a mixture of *B. racemosa* (flowers) and *B. macrocarpa* (leaves). To complete the confusion Miers used the mixture of the Horsfield specimens for *Megadendron macrocarpum* (Hassk.) Miers and for the second time as the type of *Megadendron pallidum* Miers. It may be that authors were misled by Hasskarl's statement 'calyx .... clausus' which is nullified in its proper meaning by his description of the 'scarious-margined' sepals which indubitably shows that they are free from the beginning and not caused by later splitting. In the 1844 Catalogue *B. macrocarpa* is mentioned together with 4 other Javanese species,

among which *B. racemosa* and *B. acutangula*, suggesting it was distinctly different. It is still in the 1866 Catalogue.

28. B. fusiformis King, J. As. Soc. Beng. 70, ii (1901) 140; Ridl., Fl. Mal. Pen. 1 (1922) 759; Burkill, Dict. Ec. Prod. 1 (1935) 305; Henderson, J. Mal. Br. R. As. Soc. 17 (1939) 45; Knuth, Pfl. R. Heft 105 (1939) 46; Corner, Ways. Trees (1940) 354. — **Fig. 17.**

Small tree or shrub, *c.* 3—8(—16½) m; dbh *c.* 7½—12½ cm; twigs *c.* 2—5 mm ∅. *Leaves* obovate-oblong to obovate-lanceolate, *c.* 9—28 by 2½—8½ cm (leaf-index 3—4), papyraceous, finely serrate-crenulate (older leaves almost entire), obtuse or acute, sometimes cuspidate or acuminate, base emarginate or cuneate, midrib prominent at both sides, pubescent underneath, nerves *c.* 16—20(—25) pairs, prominent and pubescent underneath. Petiole *c.* ¼—½ cm. *Raceme* mostly terminal, sometimes lateral on a bare branch, with many cataphylls at the base, pendulous, rachis *c.* (20—)55—85 cm by 1—3 mm with up to 65 flowers, minutely rusty pubescent. Bracts lanceolate, *c.* 4—9 by 1—3½ mm, acute. Opening buds *c.* 5 mm. Pedicels thin, rusty pubescent, *c.* 5—35 by ½ mm, accrescent to 1½ mm ∅. Bracteoles triangular, *c.* ½ by 1 mm, rounded. *Calyx* open, tube *c.* 1½—2 mm high, not accrescent; sepals obtuse, *c.* 2—5 by 2—4 mm, not accrescent, minutely rusty pubescent. *Petals* 4, elliptic, obtuse, convex, *c.* 1¼—1½ by ½ cm, membranous; insertion *c.* 2—4 mm wide. *Staminal tube c.* 1—2 mm high; stamens in 4 whorls, inner one staminodial; filaments *c.* 2½ cm; staminodia *c.* 5 mm; anthers *c.* ½ by ⅓ by ¼ mm. Disk annular, ½—1 mm high. *Ovary* 4-celled, subglobular, *c.* 2—3 by 2—3 mm; ovules *c.* 3—5 per cell (total number *c.* 13—16); style *c.* 2½ cm. *Fruit* fusiform or ovoid, ± tetragonous and truncate at apex, *c.* (3—)4—6(—9) by (¾—)1½—2 by (¾—)1½—2 cm, rusty pubescent; pericarp *c.* 1—1½ mm thick, exocarp thin, mesocarp fibrous, endocarp very thin, all hard to distinguish. *Seed* ovoid, *c.* 2½—3½ by 1—2 cm.

Typification: *B. fusiformis* King: *King's Coll. 10094*, fl. syntype, in BM, K, P, SING; *King's Coll. 10388*, syntype, in BM, E, K, P, SING; *King's Coll. 10643*, fr. syntype, in BM, K, P, SING. Lectotype: *King's Coll. 10388*, fr.

Distribution: Malaya (Perak to Johore). Fig. 18.

Ecology: On riverbanks and in dense bamboo-forest at low altitude up to *c.* 200 m. Fl. May—Dec., fr. July—Jan.

Compilation of field-notes: Spreading tree, wood not very strong. Calyx mauve; petals pink, crimson, or red; stamens crimson or dark red. Fruit velvety green, tinged dark red, or greenish yellow with rich claret colour, *c.* 5—9 by 1—4 cm when fresh.

Vernaculars: In Malacca *Pokô* and *Putat padi*; in Selangor *Putat*, the common Malay name for *Barringtonia*, and in Pahang *Putat bukit* is used.

Uses: From Malacca it is reported that the leaves are eaten with chutnies.

29. B. hallieri Knuth, Pfl. R. Heft 105 (1939) 34.

Tree. *Leaves* obovate-lanceolate, glabrous, *c.* 28—68 by 9—19 cm (leaf-index 3—4), chartaceous, entire, caudate, base cuneate; midrib and nerves prominent on both sides; nerves *c.* 35—45 pairs; petiole *c.* 9—14 cm. *Flowers* in racemes; rachis slightly fissured, glabrous, *c.* 5 mm ∅. Pedicels *c.* 2—6 cm. Opening buds *c.* 1½ cm. *Calyx* open in bud, tube *c.* 2 mm high; sepals 4, triangular, *c.* 7—8 by 8 mm, chartaceous, fimbriate. *Petals* 4, elliptic, *c.* 2½—3 by 1½—2 cm, chartaceous, fimbriate; insertion *c.* 8—12 mm wide. *Staminal tube c.* 2 mm high; stamens in 4 whorls, inner one staminodial; filaments *c.* 2½ cm; staminodia *c.* 7 mm; anthers *c.* 1 by ½ by ½ mm. Disk a thin ring *c.* 1½ mm high. *Ovary* 4-celled, obpyramidical, slightly 4-gonous, glabrous, *c.* 8 by 6 by 6 mm; ovules 11—13 per cell (total number more than 30); septa incomplete; style *c.* 3 cm.

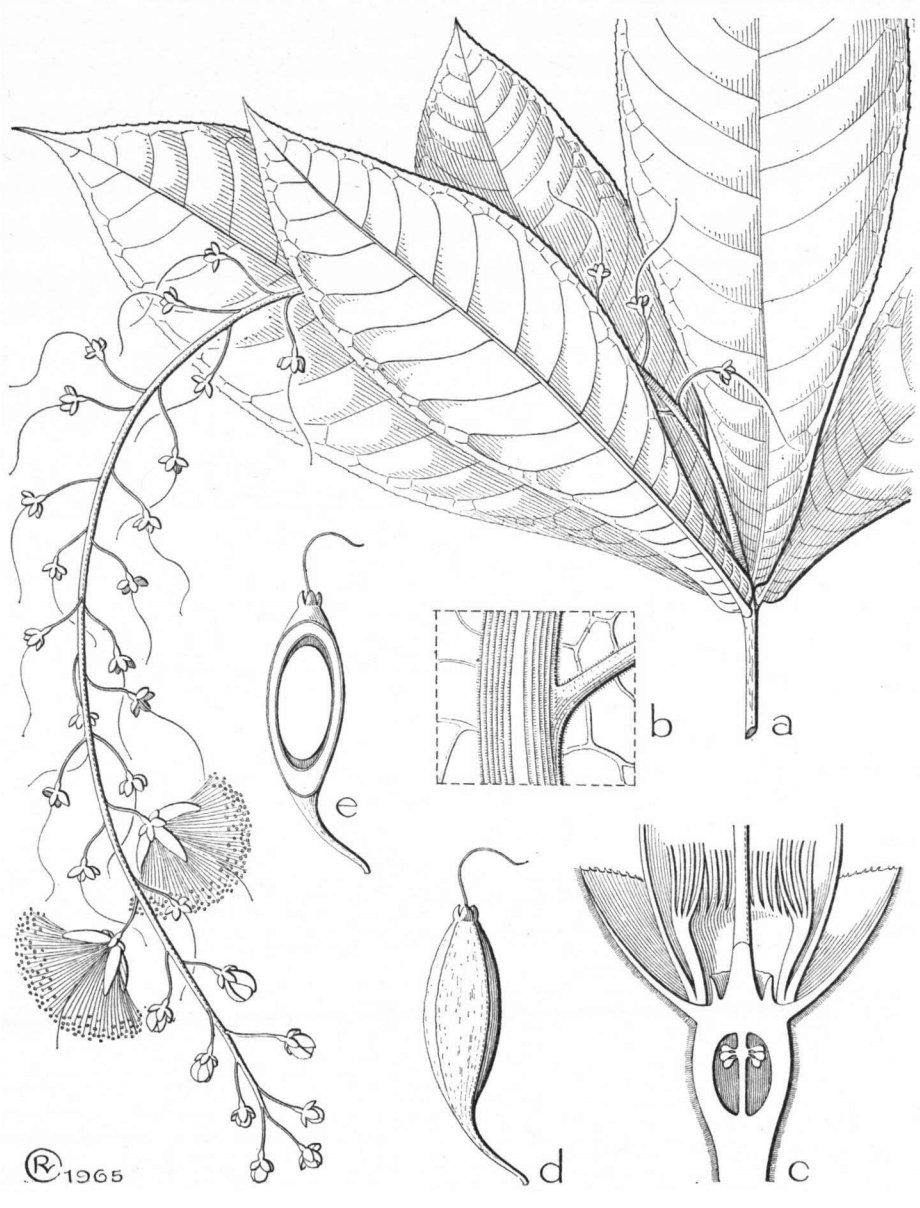


Fig. 17. *Barringtonia fusiformis* King. a. Habit, × $\frac{2}{3}$, b. detail of undersurface of leaf, × 12, c. bud, in section, × 8, d. fruit, × $\frac{2}{3}$, e. ditto, in section, × $\frac{2}{3}$ (a—b. *F. M. S. Pahang 3208 (Yeob)*, c. *SFN 24848 (Henderson)*, d—e. *SFN 23133 (Symington)*).

Typification: *Hallier 3067*, holotype in L; *Haviland 2936*, paratypes in K and SAR.
Distribution: Borneo. Fig. 18.
Ecology: Near river, up to *c.* 900 m altitude. Fl. March.
Remarks: Only 2 collections known. Fruit unknown, no twig or complete rachis has been collected. Remarkable are the long petiole and pedicel, the large number of ovules, and the caudate leaf-apex.

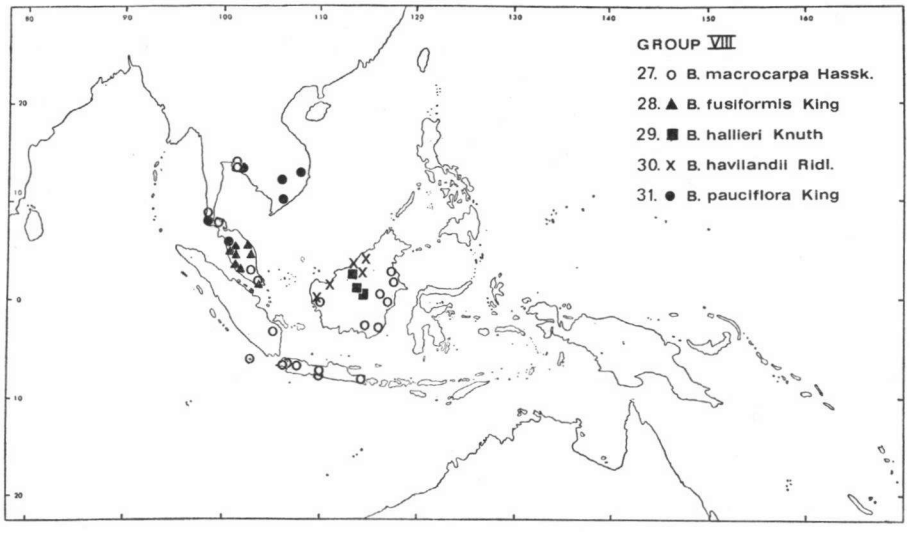


Fig. 18. Localities of the species of Group VIII.

30. B. havilandii Ridl., Kew Bull. (1938) 284; Knuth, Pfl. R. Heft 105 (1939) 34.
B. baramensis Knuth, *op. cit.* 33.

Tree; twigs *c.* 4—9 mm ∅. *Leaves* obovate-oblong, rarely obovate-lanceolate, glabrous, chartaceous, *c.* 24—37 by 8—11 cm (leaf-index 2½—4), serrate-crenulate, acuminate, base cuneate or attenuate; nerves *c.* 16—25(—32) pairs; petiole *c.* 1—2 (—7—11½) cm. Cataphylls triangular, *c.* 23 by 6 mm. *Racemes* terminal or lateral, pendulous, *c.* 40—110 cm; rachis *c.* 1½—4 mm ∅, pulverulent, slightly fissured. Bracts triangular, *c.* 3½ by ½ mm. Pedicels thin, *c.* ½—2 cm. Opening buds *c.* 8 mm. *Calyx* open in bud; tube *c.* 1—2 mm high; sepals 3—4, semicircular, *c.* 3—6 by 3—5 mm, papyraceous. *Petals* 3—4, elliptic, convex, *c.* 9—14 by 6—10 mm, membranous, obtuse, insertion *c.* 3—4 mm wide. *Staminal tube c.* 1—3 mm high, stamens in 3—4 whorls, inner one staminodial; filaments *c.* 2½—3½ cm; staminodia *c.* 1½—7 mm; anthers *c.* ¾ by ½ by ½ mm. Disk thin, *c.* ½—¾ mm high. *Ovary* 3(—4)-celled, trigonous or subtetragonous, *c.* 3—5 by 2—4 by 2—3 mm, pulverulent; ovules 2—5 per cell (total number 12—16); septa incomplete; style *c.* 2—3 cm.

Typification: *B. havilandii* Ridl.: *Haviland 2935*, holotype in SING, isotypes in K and SAR.
B. baramensis Knuth: *Hose 197*, holotype in B (lost), isotypes in AA, BM, CGE, and K.
Distribution: West Borneo. Fig. 18.
Ecology: Fl. April—Dec.

Compilation of field-notes: Flowers red or white, stamens pink.

Remarks: *Hallier 4* has long petioles *c.* 7—11½ cm. This species has only been collected 4 times and is poorly represented by inadequate material; the fruit is unknown. The species is closely related to *B. macrocarpa* Hassk. and *B. pauciflora* King.

31. B. pauciflora King, J. As. Soc. Beng. 70, ii (1901) 137; Ridl., Fl. Mal. Pen. 1 (1922) 757; Knuth, Pfl. R. Heft 105 (1939) 29.

B. longipes Gagn., Not. Syst. 3 (1914) 383; Fl. Gén. I.-C. 2 (1921) 861; Knuth, Pfl. R. Heft 105 (1939) 31.

B. abbreviata Craib, Kew Bull. (1930) 170; Fl. Siam. En. 1 (1931) 667; Knuth, Pfl. R. Heft 105 (1939) 32.

B. kratensis Craib, Kew Bull. (1930) 170; Fl. Siam. En. 1 (1931) 670; Knuth, Pfl. R. Heft 105 (1939) 33.

Small tree, *c.* 1—13 m; dbh 12½—17½ cm; twigs 3—5 mm ∅. *Leaves* oblong or obovate-oblong, glabrous, chartaceous, *c.* 12—27 by 3—12 cm (leaf-index 2½—3½), serrate-crenulate towards the acute to cuspidate apex, base cuneate or acute, midrib prominent on both sides, nerves *c.* 10—20 pairs, prominent underneath; petiole *c.* 2—6(—9) cm. Cataphylls triangular, *c.* 7 by 2 mm. *Racemes* terminal or ramiflorous, pendulous, *c.* (5—)30—70 cm, densely flowered, rachis *c.* 2—5 mm ∅, glabrous. Bracts triangular, *c.* 1 by 1 mm. Opening buds *c.* 7 mm. Pedicels *c.* 5—15 mm. *Calyx* open in bud; tube *c.* 1—4 mm high; sepals semiorbicular, *c.* 3—7 by 4—10 mm, papyraceous. *Petals* (3—)4, elliptic, obtuse, convex, *c.* 2—3 by 1—2 cm. *Staminal tube c.* 2—3 mm high, stamens in 4, 7, or 8 whorls, inner one staminodial, filaments *c.* 2 cm, staminodia *c.* 2—10 mm; anthers *c.* 1—1¼ by ½—1 by ⅓—½ mm. *Ovary* 4-celled, 4-gonous, obpyramidal, *c.* 3—6 by 3—7 by 2—4 mm; ovules 2—10(—18) per cell [total number 12—22(—63)]; septa complete or incomplete; style 2—5½ cm. Disk *c.* ¾—1 mm high. *Fruit* ovoid, ± tetragonous, *c.* 3½—4½ by 2—3 by 2—2½ cm, apex truncate, base tapering; pericarp *c.* 3 mm, exocarp with large fibres, *c.* 2 mm thick, mesocarp with fine fibres, *c.* 1 mm thick, endocarp a thin membrane. *Seed* ovoid, *c.* 3 by 1½ by 1½ cm.

Typification: *B. pauciflora* King: *King's Coll. 6355* (Malaya), holotype in SING, isotypes in BM, K, P; *Scortechini 939*, paratype, not seen.

B. longipes Gagn.: *Krempf, Harmand, Pierre 1305, Thorel 798, Chevalier 32052* (Indochina), syntypes in P; *Krempf* as isosyntype in BO; *Pierre 1305* as isosyntypes in BM, K, US.

B. abbreviata Craib: *Kerr 17226 A* (Siam), holotype in K, isotypes in BM, E, SING.

B. kratensis Craib: *Kerr 9456* (Siam), holotype in K, isotypes in BM, P.

Distribution: S. Thailand, S. Laos, S. Vietnam, Malaya (Perak only). Fig. 18.

Ecology: In evergreen forest from 50—700 m altitude. Fl. Febr.—Dec., fr. May—July.

Compilation of field-notes: Branches spreading; leaves deep green. Flowerbuds purplish or pink; petals white and pink; fruit green.

Dispersal: Squirrels or other small rodents may carry off the fallen fruit and eat the fleshy pericarp. See Ridley, Disp. Pl. (1930) 291.

Vernaculars: In S. Thailand *Chik dong*, in S. Vietnam *Cây cam lang*.

Remarks: On the same rachis I observed flowers with stamens in 4, 7, or 8 rows (*Pierre 1305, Thorel 798, Kerr 17226A*).

The specimens on which *B. abbreviata* was based (*Kerr 17226, 17226A*) deviate by a very short rachis (6 cm) but are all bare of flowers; I cannot make out whether these are juvenile or mature. To these specimens are added loose flowers in envelopes of which it is not clear whether they belonged to these rachises or were picked up from the ground.

These flowers also deviate from the average in having an exceptionally high number of ovules per cell (up to 18, with the high total of 63). I cannot discriminate these specimens from *B. pauciflora*.

32. B. macrostachya (Jack) Kurz, Rep. Pegu (1875) App. A, lxvi, App. B, 52 *in clavi*; Fl. Burma 1 (1877) 498; J. As. Soc. Beng. 46, ii (1877) 71; Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 509; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; King, J. As. Soc. Beng. 70, ii (1901) 137; Brandis, Ind. Trees (1906) 330; Merr., En Born. (1921) 419; Ridl., Fl. Mal. Pen. 1 (1922) 758; Craib, Fl. Siam. En. 1 (1931) 670; Burkill, Dict. Ec. Prod. 1 (1935) 305; Knuth, Pfl. R. Heft 105 (1939) 29; Corner, Ways. Trees (1940) 355; Merr., J. Arn. Arb. 33 (1952) 218; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 107. — *Careya macrostachya* Jack, Mal. Misc. 1 (5) (1821) 47; reimpr. in Hook., Bot. Misc. 2 (1830) 88; Calc. J. Nat. Hist. 5 (1843) 305; DC., Prod. 3 (1828) 295; W. & A., Prod. 1 (1834) 333, 334. — *Doxomma macrostachyum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 104. — *Michelia macrostachya* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241. — **Fig. 19.**

Eugenia acutangula (*non* L.) Lour., Fl. Coch. 1 (1790) 307, *excl. syn.* — *Stravadium cochinchinense* Bl., in Fl. Serr. 7 (1851) 24. — *Doxomma cochinchinense* Miers, Trans. Linn. Soc. Bot. 1 (1875) 101, tab. 16, fig. 1—5. — *B. cochinchinensis* Merr. *ex* Gagn., Fl. Gén. I.-C. 2 (1921) 862; Comm. Lour. (1935) 281; Knuth, Pfl. R. Heft 105 (1939) 31.

B. acuminata Korth., Ned. Kruidk. Arch. 1 (1846) 206; Walp., Ann. 2 (1852) 641; Miq., Fl. Ind. Bat. 1, 1 (1855) 490; Merr., Philip. J. Sc. 11 (1916) Bot. 295; Knuth, Pfl. R. Heft 105 (1939) 32; Holthuis & Lam, Blumea 5 (1942) 143, 217. — *Stravadium acuminatum* [Wall., Cat. 3636] Bl., in Fl. Serr. 7 (1851) 24. — *Doxomma acuminatum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 102. — *Michelia acuminata* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240.

B. cylindrostachya Griff., Not. 4 (1854) 655; Knuth, Pfl. R. Heft 105 (1939) 30. — *Doxomma cylindrostachya* Miers, Trans. Linn. Soc. Bot. 1 (1875) 100.

Doxomma sumatrana (*non* (Miq.) Miers) Miers, Trans. Linn. Soc. Bot. 1 (1875) 103.

B. balabacensis Merr., Philip. J. Sc. 4 (1909) Bot. 299; En. Philip. 3 (1923) 142; Knuth, Pfl. R. Heft 105 (1939) 36.

B. annamica Gagn., Not. Syst. 3 (1914) 383; Fl. Gén. I.-C. 2 (1921) 858, fig. 94; Knuth, Pfl. R. Heft 105 (1939) 31.

B. sumatrana (*non* Miq.) Ridl., Fl. Mal. Pen. 1 (1922) 758; Burkill, Dict. Ec. Prod. 1 (1935) 307.

B. craibiana Knuth, Pfl. R. Heft 105 (1939) 32.

B. wallichiana Knuth, *op. cit.* 33; Razi, Rec. Bot. Surv. India 28 (1959) 6.

B. rosea Wall. *ex* Knuth, Pfl. R. Heft 105 (1939) 32, *nom. inval., in synon.*

B. olivacea Knuth, *op. cit.* 33.

B. pendens Knuth, *op. cit.* 35.

B. molluccana Knuth, *op. cit.* 35.

B. isabelaensis Knuth, *op. cit.* 36.

B. fusicarpa Hu, Acta Phytotax. Sin. 8 (1963) 200, *ex descr.*

Small to medium-sized tree or shrub, *c.* 4—20(—30) m, dbh *c.* 3—35(—90) cm; twigs *c.* 5—10 mm ∅. *Leaves* obovate-oblong to oblong, glabrous, chartaceous, *c.* (10—)15—25(—45) by (4—)6—8(—10) cm [leaf-index 2—3(—3½)], shallowly serrate-crenulate, cuspidate or caudate, base cuneate; midrib prominent at both faces; nerves *c.* 14—18(—21) pairs; petiole *c.* 2½—10(—17) cm, thick at base. *Spikes* terminal or ramiflorous, pendulous, glabrous, *c.* (10—)19—45(—75) cm, with up to 60 flowers or

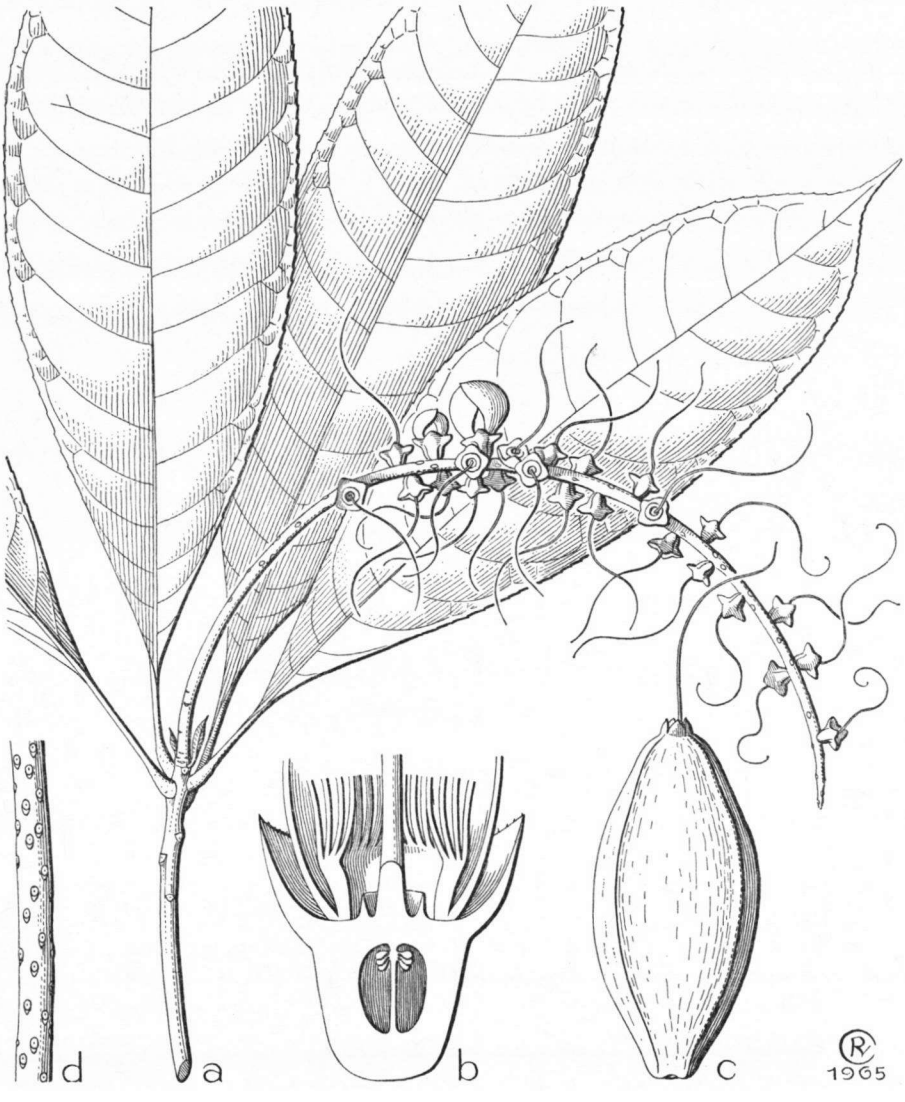


Fig. 19. *Barringtonia macrostachya* (Jack) Kurz. a. Habit, × $\frac{2}{3}$, b. bud, in section, × 4, c. fruit, × $\frac{2}{3}$, d. scars on rachis, × $\frac{2}{3}$ (a—b. *SFN 6577* (*I. H. Burkill*), c—d. *SFN 21792* (*Henderson*)).

more, rachis 3—5 mm ∅, accrescent to 10 mm. Bracts triangular, lanceolate, convex, *c.* 5—11 by 1½—3 mm. *Flowers* 4-merous, fragrant. Opening buds *c.* 7—9 by 7—9 mm. Sepals connate at the base only, separating further during anthesis. *Calyx tube c.* 1—3 mm high. Sepals free from the bud-stage, suborbicular, glabrous, convex, *c.* 3—5 by 4—6 mm, chartaceous. *Petals* 4, elliptic to suborbicular, convex, *c.* 2—2¼ by 1½ cm, insertion *c.* 5—8 mm wide. *Staminal tube c.* 1½—3 mm high; stamens in 4(—5) whorls, inner one

staminodial, *c.* 2½—3 cm, staminodia *c.* 7 mm, anthers *c.* ⅝ by ½ by ⅓—½ mm. Disk a distinct, thin grooved ring ½—1½ mm high. *Ovary* 4-celled, tetragonous, glabrous, *c.* 3—4 by 4—5 mm, rather woody and hard even when young; ovules 2—4(—6) per cell [total number up to 16(—24)]; septa complete; style *c.* 4—4½ cm. *Fruit* obovoid, tetragonous, 5½—9 by 2—4 by 2—3½ cm; pericarp *c.* 3—10 mm thick, exocarp ½—3 mm, mesocarp spongy and fibrous, 1—8 mm, and endocarp fibrous, *c.* ½—2 mm. *Seed* ovoid, *c.* 3—4½ by 1—2½ by 1—2½ cm.

Typification: *B. macrostachya* (Jack) Kurz, *Careya macrostachya* Jack, *Doxomma macrostachyum* Miers, *Michelia macrostachya* O. Kuntze: *Jack s.n.* (Pulau Penang), type material unknown. Jack's description.

Eugenia acutangula (*non* L.) Lour., *Stravadium cochinchinense* Bl., *Doxomma cochinchinense* Miers, *B. cochinchinensis* Merr.: *Loureiro s.n.* (Indochina), holotype in BM.

B. acuminata Korth., *Stravadium acuminatum* Bl., *Doxomma acuminatum* Miers, *Michelia acuminata* O. Kuntze: *Korthals s.n., Herb. Lugd. Bat. 898 . 204 . 137* (Borneo), holotype in L, isotype in BO; *Korthals s.n., Herb. Lugd. Bat. 898 . 204 . 138—143*, paratypes in L.

B. cylindrostachya Griff., *Doxomma cylindrostachya* Miers: *Griffith KD 2421* (Malaya), holotype in K, isotype in P. One specimen in P, *Griffith KD 2421* is from Bengal and belongs to *B. racemosa*.

Doxomma sumatrana (non (Miq.) Miers)Miers: *Beccari PB 881* (not *PB 851*) (Borneo), in K, BM, FI (not seen); *Beccari PB 1554*, in K, FI (not seen).

B. balabacensis Merr.: *Mangubat B.S. 422* (Balabac), holotype probably lost, isotypes in K, US.

B. annamica Gagn.: *Eberhardt 1649* (Annam), holotype in P.

B. craibiana Knuth: *Kerr 14558* (Siam), holotype in B (lost), isotype in BM, E, K; *Kerr 14218*, paratypes in BM, E, K.

B. wallichiana Knuth, *B. rosea* Wall. *ex* Knuth: *Wallich 3636* (not *1692*) (E. India), holotype in W (not seen), isotypes in BM, CGE, K.

B. olivacea Knuth: *Hose 144* (Sarawak), holotype in B (lost), isotypes in BM, K; *Beccari PB 881*, paratypes in BM, FI (not seen).

B. pendens Knuth: *De Vriese & Teysmann s.n.* (Celebes), *Herb. Lugd. Bat. 908 . 154 . 843*, holotype in L.

B. molluccana Knuth: *De Vriese & Teysmann 24* (Ambon), *Herb. Lugd. Bat. 908 . 146 . 1069*, holotype in L.

B. isabelaensis Knuth: *Warburg 11894* (Luzon), holotype in B (lost).

B. fusicarpa Hu: *Sino-Russ. Exped. 3313* (S. Yunnan), holotype in PE (not seen).

Distribution: China (S. Yunnan), Vietnam, S. Burma, S. Thailand, Malaya, E. & W. Sumatra, Batu Is., Riouw Archipelago, Anambas Is., Borneo, Philippines (Luzon, Samar, Palawan, Balabac, Basilan), N. Celebes, Moluccas (Morotai, Ambon). Fig. 20.

Ecology: In primary and secondary forest on hills, along rivers, or in periodically inundated or swampy areas; mostly reported from sand or loam, rarely from clay. Twice mentioned from a Dipterocarp forest, once from a *Dryobalanops beccarii* swamp-forest, from sea-level up to 700 m. One collection made by *Burkill & Holttum 8691* was collected at 1300 m on Fraser Hill (Malaya). Fl. Jan.—Dec., fr. Jan.—Oct., in full bloom during April—June.

Compilation of field-notes: Bole *c.* 1½—8 m, crown *c.* 3—9 m with spreading branches; bark smooth or scaly, brown, greenish yellow, greyish brown, or chocolate and grey mottled. Outer bark thin, fibrous, pink; inner bark thin, soft, fibrous or laminated and fibrous, whitish pink, yellow, or ochre-yellow; cambium yellow or cream. Wood

hard, sapwood yellowish. Leaves pinkish brown when young, glossy rich bright green when older. Rachis pink, purple, red, or crimson. Flowerbuds green, dirty green-white suffused red, greenish and red, yellow, dark purple, dark red, deep maroon red, red, or pinkish; calyx red, dark red, purple, pink, or magenta. Petals pinkish red, light red, pink—dark red, green with red edges, red, bright red, shiny claret, crimson, waxy pink and white, or white and red striped. From S. Yunnan, Malaya, Borneo, and the Philippines white flowers are reported by 7 collectors. Staminal tube red or pink; stamens deep red, pink, white-pinkish, pale yellow, or white; style red, claret, or magenta. Fruit green, pale green, green and red, red, greenish pink, pink, dark pink, deep bluish red, or dark red to black.

Dispersal: Possibly by squirrels or other small rodents which carry off the fallen fruit to eat the fleshy pericarp. The area of dispersal is limited. See Ridley, Pl. Disp (1930) 291.

Vernaculars: In Thailand *Chik* as well as *Chik nom* and *Chik nawn wan*; in Burma *Cây tam lang*, *Thay nya oo*; in Vietnam *Cay mung san*; in Malaya generally just *Putat*, the common Malay name for *Barringtonia*, but also *Putat gajah* (Elephant-putat, a name also given to *B. scortechinii*), *Buah putat* (this might only mean a fruiting putat), *Putat utan*, *Putat bukit putih* (white hill putat), *Pone tan* and *Jok* (Temuan lang.); in Sumatra *Kaju putat*, *Kaju si marte ni uwo*, *Tuwah dotan*; in Borneo *Tuba tampalang* and *Tampalang* (Dusun), *Semuting* (Dajak), and *Putat* also; in the Philippines *Apalang* (Tagh dial.), in Balabac *Ulam* (Moro dial.); in Morotai *Pangá ha.*

Uses: Medicinal. From Malaya *Haniff 16032* mentions the application of a paste made from the root by rubbing it on a stone; the paste is put around sore eyes. The same is also done against ring worm. A decoction of the leaves is said to be a cure for stomach ache. See Burkill (1935) *op. cit.*

Fish-poison. From Malaya, N. Borneo, and the Philippines the bark is reported to be used as a fish-poison. In the Philippines (Palawan) pounded fruits and bark are used in catching fresh water fish (*Edaño B.S. 14170*).

Remarks: The original type-collection of Jack from Penang could not be traced, but his description is sufficient to distinguish *B. macrostachya* from all other *Barringtonias*. Moreover, I have been able to examine 18 different collections from P. Penang made by *Burkill 2897, 6577*; *Curtis s.n.* several coll., *1581*; *Hullett 733*; *Kiah SFN 35353*; *King's Coll. 3402, 4136*; *Nauen s.n.*; *Ridley s.n., 9349*; *Wray 2410, 3136, 3635, 3642*, which fit the description.

About the typification of *B. rosea* there is a mystification. Knuth based *B. wallichiana* on 'Wallich n. 1692 (?) in herb. Vindob.' In Wallich's Catalogus this, as well as n. 1691, is a *Polygonum*. The name *B. rosea* is nowhere mentioned in Wallich's Catalogus, but occurs on a label of the three Wallich sheets at Kew of Wallich n. 3636 which in the Catalogus is named *Stravadium acuminatum* Wall. On 2 of these sheets also the numbers 1691 and 1692 are found on separate labels, besides n. 3636; all are provided with locality Chapidang 1827. Obviously all this material belongs to one species and the confusion is due to early muddling with the numbering.

Merrill and others accepted that Loureiro described a new species, *Eugenia acutangula*. In advocating this opinion they have forgotten to consider that Loureiro had at his disposal a number of botanical works by authors of the 18th century, as proved by his citations. There is no doubt that Loureiro in this, and many other cases, accepted and interpreted the names as given by such authors. If such identifications of Loureiro later proved to be wrong, one cannot accept his names as homonyms; they are really mis-identifications. Merrill has applied the same faulty reasoning in interpreting a number of Blanco's species; Blanco followed the same method in giving a name without

authority. A similar difficulty is found in the first parts of Blume's Bijdragen. Generally it is not difficult to discriminate between mis-identifications and the rare cases of homonymy (Van Steenis, *in litt.*).

The rachis of *B. macrostachya* is rather variable in appearance. Judging from herbarium material it is possible that the rachis is already thick in young stages and very densely flowered as well, but when in fruit becomes elongated and has the fruits not clustered close together as the flowering material would suggest.

Some regional variation in the shape of the fruit and the thickness of the pericarp has been observed. Material from S. Yunnan, Vietnam, Burma, Thailand, and Malaya: young fruit more or less globular, enlarging gradually, often becoming slightly 4-winged with wings up to 3 mm wide, later filling up to an obovoid, tetragonous fruit with a truncate apex and tapering or obtuse base. Pericarp thin, *c.* 5 mm. Material from Borneo: young fruit tetragonous, gradually enlarging to an obovoid or spindle-shaped, tetragonous fruit with truncate apex and emarginate base. Pericarp thick, spongy, *c.* 7—10 mm. Material from the Philippines and Celebes: more like that from Borneo except that the pericarp is only *c.* 3—4 mm thick.

33. B. pendula (Griff.) Kurz, J. As. Soc. Beng. 46, ii (1877) 71; Fl. Burma 1 (1877) 498; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; Brandis, Ind. Trees (1906) 330; Knuth, Pfl. R. Heft 105 (1939) 31. — *Careya pendula* Griff., Not. 4 (1854) 661; Ic. Pl. Asiat. 4 (1854) t. 634 A. — *Doxomma pendulum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 99, t. 15, fig. 9—15.

B. musiformis King, J. As. Soc. Beng. 70, ii (1901) 139; Ridl., Fl. Mal. Pen. 1 (1922) 758; Knuth, Pfl. R. Heft 105 (1939) 30; Corner, Ways. Trees (1940) 355.

B. yunnanensis Hu, Acta Phytotax. Sin. 8 (1963) 199.

Large tree *c.* 15—33(—47) m; dbh *c.* 20—80(—90) cm, twigs 3—5 mm ∅. *Leaves* obovate-lanceolate or obovate-oblong, glabrous, *c.* (11—)16—25(—36) by (4—)5—7 (—9) cm [leaf-index 3—4(—5)], subcoriaceous, often glaucous underneath, entire or ± serrate-crenulate towards the apex, often revolute, acuminate, base long-cuneate, midrib prominent on both surfaces, nerves *c.* 8—15(—18) pairs, only prominent beneath, venation equally distinct on both surfaces; petiole (1½—)3—4(—6) cm. *Spikes* ramiflorous, pendulous, *c.* (20—)32—41(—110) cm, with 40—50 flowers, rachis at base *c.* 5—6 mm ∅, at apex *c.* 2 mm, fissured and pulverulent. Bracts triangular, *c.* 4 by 5 mm. Bracteoles triangular, *c.* 4 by 3 mm. Opening buds *c.* 10—20 mm. *Calyx tube* *c.* 2—3 mm high, not accrescent; sepals free, suborbicular, *c.* 1¼—1¾ by 1¼—1¾ cm, chartaceous, slightly ferruginous-pubescent. *Petals* elliptic, rounded, convex, *c.* 2—3¾ by 1½—2½ cm, insertion *c.* 5—9 mm wide, fimbriate. *Staminal tube* *c.* 3—8 mm high, stamens in 4(—6) whorls, inner one staminodial, filaments *c.* 3—4 cm, staminodia filiform, *c.* 5—13 mm, anthers *c.* ¾—1 by ½ by ½ mm. Disk annular, *c.* 1½—2 mm high. *Ovary* (3—)4-celled, subterete or tetragonous, *c.* 5—8 by 5—8 by 5—8 mm, ferruginous pubescent with 4 distinct grooves or ribs on the corners; ovules 3—6 per cell [total number (12—)20]; style *c.* 4½—6 cm. *Fruit* ovoid or musiform, *c.* (6—)8—12½(—15) by (1½—)2—3½ cm, pulverulent, fissured and warty, very hard, truncate at the both ends, 1—4-celled; pericarp *c.* 4—6 mm thick, exocarp *c.* 1—3 mm thick, mesocarp *c.* 3—5 mm thick, hard, with fine fibers.

Typification: *B. pendula* (Griff.) Kurz, *Careya pendula* Griff., *Doxomma pendulum* Miers: *Griffith s.n.* (Mergui), holotype not seen, isotype in W.

B. musiformis King: *King's Coll. 5746* (Malaya), syntype in E, K, P, SING; *King's Coll. 6154*, syntype in BM, K, P.

B. yunnanensis Hu: *Sino.-Russ. Exped. 2745* (S. Yunnan), holotype in PE (not seen); *Wang 77875*, paratype in TAI; *Wang 79021*, paratype in PE (not seen).

Distribution: China (S. Yunnan), S. Thailand, S. Burma (Mergui), W. & S. Sumatra, Malaya, Borneo (Sarawak, Sabah). Fig. 20.

Ecology: Characteristic of hilly country, open jungle, mixed forests, as well as of lowland Dipterocarp forest, the latter in Sarawak, from almost sea-level up to *c.* 800 m. In S. Yunnan reported from *c.* 1200 m. Fl. Jan.—Aug., fr. March—Nov.

Compilation of field-notes: Bole slightly ribbed at base; crown narrow-lanceolate or branches spreading. Bark red-brown, mottled, with vertical cracks at *c.* 1½ cm intervals and thin chartaceous flakes; inner bark fibrous; wood light brown. Leaves very glossy bright green. Flowerbuds white, yellowish green, or light green. Calyx brownish green, inside at base pink or reddish green; petals white, tipped pink, thick and fleshy (*Soepadmo 200* from Sumatra reports red petals); stamens white; style white, tipped pink. Fruit green when young, pinkish green or red when mature, hard and woody, 10—15 cm long.

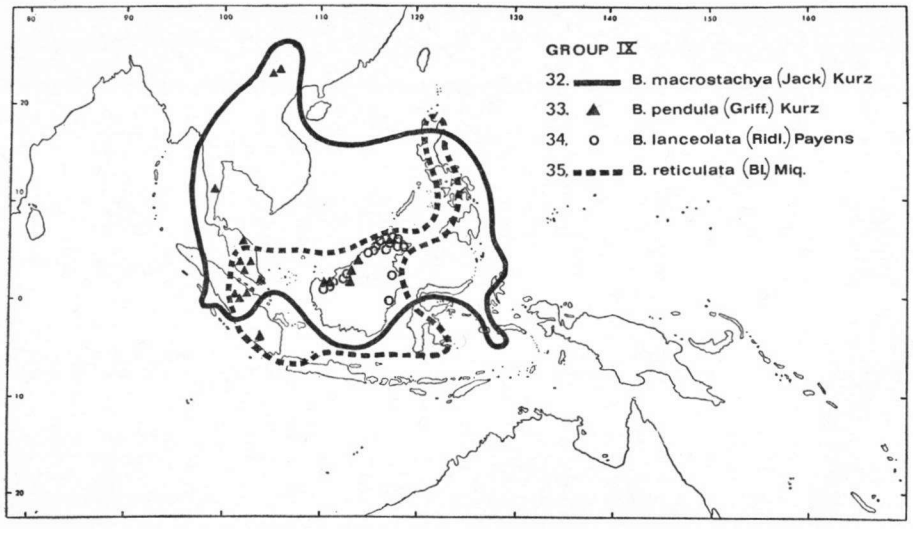


Fig. 20. Ranges or localities of the species of Group IX.

Vernaculars: In Malaya *Putat gajah* (Elephant putat), *Putat bukit* (Hill putat), or just *Putat*, the general Malay name for *Barringtonia*, also in Borneo. In Sarawak *Langkong* (Iban).

Remarks: In size this is one of the largest species of *Barringtonia*. It is not frequently found in the area. All fruiting specimens were seedless, some had musiform fruit, *viz. Forbes 2682* and *Soepadmo 200* from Sumatra; *Galau SAN 15646* and *Mikil SAN 31362* (both *NT 968*) from Sabah; this seems an anomalous development.

With the isotype specimen *Griffith s.n.* (Mergui) in W, I found a packet with 2 loose flowers; these have slightly winged, angular ovaries which is a characteristic feature of the flowers of *B. pauciflora*. I therefore doubt if these flowers belong to the type-sheet, as all other flowering material has distinctly grooved ovaries.

34. B. lanceolata (Ridl.) Payens, *comb. nov.* — *Careya lanceolata* Ridl., Kew Bull. (1938) 285. — *Planchonia lanceolata* Knuth, Pfl. R. Heft 105 (1939) 54; Kartawinata, Bull. Bot. Surv. India 7 (1965) 186. — **Fig. 21.**

Tree, *c.* (6—)8—26(—30) m; dbh *c.* (7—)10—33(—60) cm; twigs *c.* 1½—5 mm ∅. *Leaves* obovate-oblong to oblong, glabrous, *c.* 9—17(—20) by 3—7(—8) cm (leaf-index 2—3), papyraceous, entire or ± serrate-crenulate, acute or acuminate, rarely emarginate, base cuneate, midrib prominent on both faces; nerves 8—11 pairs; petiole *c.* (1—)3—5(—8) cm by 1—2 mm. *Spikes* ramiflorous, erect, *c.* ½—2½(—10) by ½—¾ cm with 2—12(—14) flowers. Bracts lanceolate, *c.* 3—7 by 1—3 mm, apex round. *Flowers* sessile. Bracteoles triangular, *c.* 1—1½ by 1½—2 mm. Opening buds *c.* 1 cm. *Calyx* tube *c.* 1—2 mm, not accrescent; sepals free, suborbicular, *c.* 3—6 by 5—9 mm, not accrescent, chartaceous. *Petals* 4, elliptic, convex, *c.* 23—30 by 10—16 mm, membranous, obtuse; insertion *c.* 3—8 mm wide. *Staminal tube c.* 3—4 mm, stamens in 4(—5) whorls, inner one staminodial; filaments *c.* 3½—5 cm, staminodia *c.* 12—20 mm, anthers *c.* 1 by ½—1 by ¼—½ mm. Disk annular, *c.* ½—1 mm high. *Ovary* 4-celled, subtetragonous, *c.* 5—11 by 4—9 by 4—8 mm, ovules 3—6 per cell [total number 10—24(—27)]; style *c.* 4½—5 (—6) cm. *Fruit* ovoid or nearly fusiform, *c.* (6—)6½—8½(—10½) by (2½—)3—5(—7) by 2½—5(—6) cm, smooth, sometimes shiny, very hard fibrous, somewhat truncate at apex and tapering towards the base, pericarp *c.* 6—15 mm thick, exocarp thin, *c.* 1—2 mm, mesocarp *c.* 6—12 mm thick with anastomosing, thick fibres, endocarp thin-fibrous, *c.* 1—2 mm. *Seed* ovoid or spindle-shaped, *c.* 3—4½ by 1½—3 by 1—2½ cm, mostly 5-ribbed.

Typification: *B. lanceolata* (Ridl.) Payens, *Careya lanceolata* Ridl., *Planchonia lanceolata* Knuth: *Haviland 2933*, holotype in K, isotype in SAR; *Haviland 537*, *Beccari PB 1515*, paratypes in K.

Distribution: Borneo (Sarawak, Brunei, Sabah, E. Kutai). Fig. 20.

Ecology: In primary hillside forest. Mostly reported growing in rich yellow clay soil. Found also in a secondary hillside forest and once in a periodically inundated area. In Sarawak it is growing well in mixed Dipterocarp-forests (Ashton). From sea-level up to 1200(—1700) m. Fl. March—Oct., fr. March—Nov., in full bloom during March and April.

Compilation of field-notes: Bole *c.* 7—17 m; crown *c.* 3—10 m, lanceolate with few irregular branches up to 3 m long. Ashton (*BRUN 255, S. 17737*) mentioned low buttresses, up to 30 cm at the base of a tree of 27 m. Bark smooth, dippled or slightly flaky with shallow cracks and transverse fissures, the flakes are square or elongated diamond shape. Outer bark hard, brown, grey, or reddish brown with grey patches *c.* 2½—5(—12½) mm thick; inner bark brown or pink, fibrous, soft; cambium yellow or purple; sapwood soft or medium hard, yellowish or white. Flowerbuds scarlet or red; calyx red or partly pink; petals reddish white, whitish pink, or white; stamens white. Fruit mostly described as green, but also light green tinged red, green flushed mauve, pale chocolate, pinkish green, olive green, grey green, apple green, and avocado-like, *c.* 11 by 4 cm when fresh (other diameters are 3¾—5 cm).

Vernaculars: In Sarawak *Putat* (Iban); in Sabah the common name is *Tampalang*. Other names reported are *Tatisai* and *Tĕlisai sugud* (Dusun), *Jambu huton* (Malay), and *Bubunak* (Murut dial.). Once reported as *Tampalang daun kĕtjil* (small leaved Tampalang).

Uses: From Sabah the use of the bark as a fish-poison is mentioned by Agama (*SAN 10694*).

Remarks: Kartawinata (1965) *op. cit.* recognized *B. lanceolata* as a true *Barringtonia* but referred it to *B. macrostachya* (Jack) Kurz.

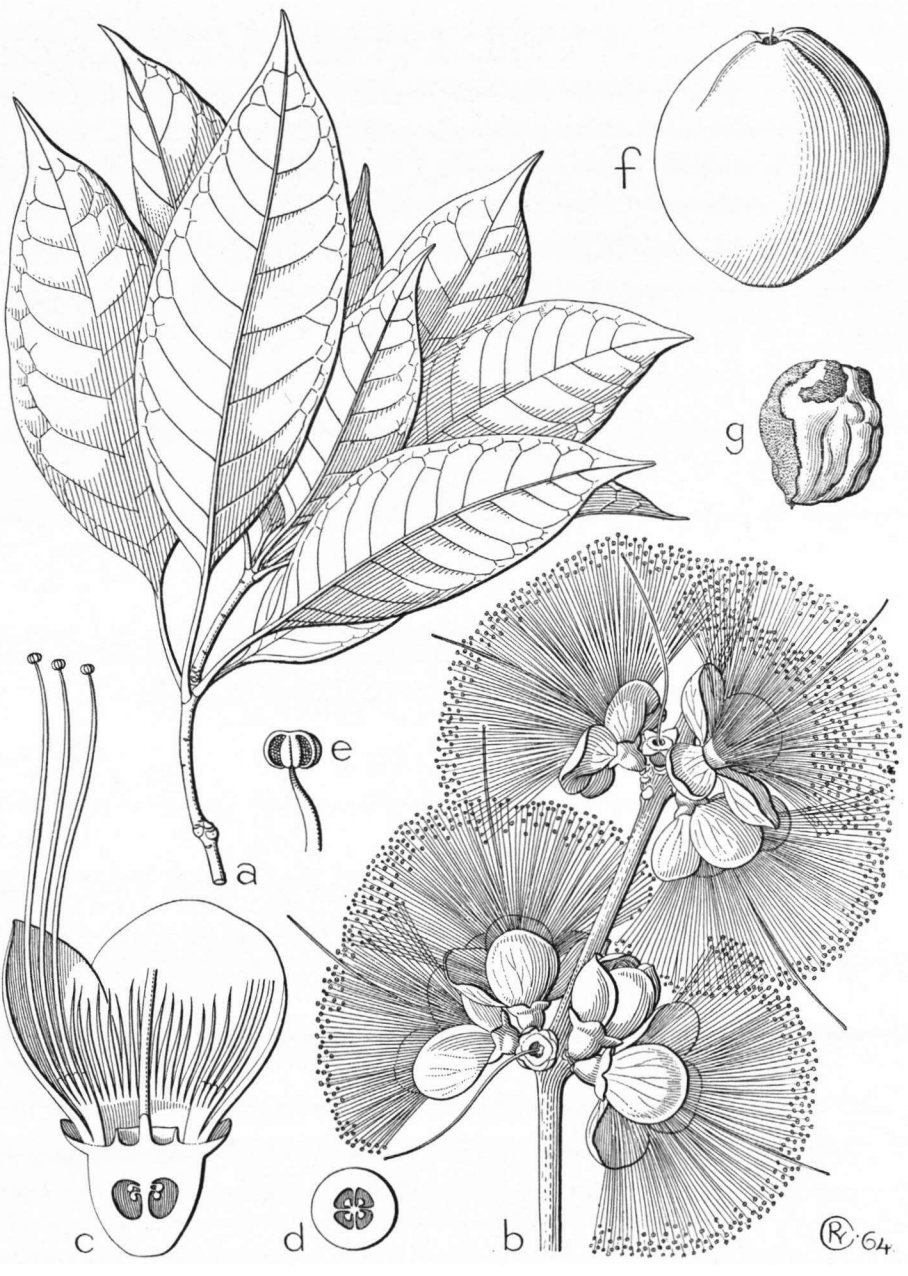


Fig. 21. *Barringtonia lanceolata* (Ridl.) Payens. a. Habit, × ⅔, b. inflorescences, × ⅔, c. flower, in section, × ⅔, d. ovary, in cross-section, × 2, e. open anther, × 8, f. fruit, × ⅔, g. seed, × ⅔ (a—e. *S. 13309* (*Ilias Paie*), f—g. *BRUN 255* (*Ashton*)).

In herbarium specimens the leaves are often light green to reddish brown or glaucous above.

Kostermans 21695 from Berau (E. Borneo) has rather long inflorescences of up to 10 cm; this collection was made in a periodically inundated area, while all other collections are from drier hill areas.

The ligneous fibre as found in the mesocarp consists of a ring of hard wood with radial rays around a center of soft parenchyma. This is a very characteristic feature and distinguishes the fruit of this species from all other *Barringtonias*.

Meijer SAN 26452 (*NT 49*) from Sabah is a collection of sterile twigs with leaves of *B. lanceolata*, but the loose fruit belongs to *B. sarcostachys*.

35. B. reticulata (Bl.) Miq., Fl. Ind. Bat. 1, 1 (1855) 490; Walp., Ann. 4 (1857) 851; Kurz, Nat. Tijd. Ned. Ind. 27 (1864) 164; Merr., Philip. J. Sc. 1 (1906) Suppl. 102; En. Born. (1921) 419; En. Philip. 3 (1923) 141; Pl. Elm. Born. (1929) 213; Knuth, Pfl. R. Heft 105 (1939) 47; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 107. — *B. acutangula* [*non* (L.) Gaertn.] Korth., Ned. Kruid. Arch. 1 (1846) 206. — *Stravadium reticulatum* Bl., in Fl. Serr. 7 (1851) 24. — *Michelia reticulata* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241. — **Fig. 22.**

B. sumatrana Miq., Fl. Ind. Bat. Suppl. (1862) 315; King, J. As. Soc. Beng. 70, ii (1901) 139; Merr., En. Born. (1921) 420; Knuth, Pfl. R. Heft 105 (1939) 35; Corner, Ways. Trees (1940) 356.

B. gitingensis Elmer, Leafl. Philip. Bot. 8 (1915) 2730; Merr., En. Philip. 3 (1923) 142; Knuth, Pfl. R. Heft 105 (1939) 36.

B. linggaensis Knuth, Pfl. R. Heft 105 (1939) 30.

Small tree or shrub, *c.* 2—10 m, dbh *c.* 3—20 cm; twigs *c.* 4 mm ∅. *Leaves* elliptic, glabrous, *c.* (11—)14—18(—22) by (3—)5—7(—8) cm (leaf-index 2½—3), coriaceous, slightly serrate-crenulate und revolute, acute (tip obtuse), base cuneate; nerves *c.* 9—18 pairs equally prominent above and beneath as are the veins; petiole ± winged by decurrent blade, *c.* 2½—6 cm, 2—3 mm ∅. Cataphylls *c.* 3—6 by 1—2½ mm, triangular. *Spikes* terminal, pendulous, *c.* 30—65 cm, rachis *c.* 2 mm ∅, accrescent to *c.* 6 mm, with up to 30 flowers, slightly fissured, glabrous. Bracts lanceolate, *c.* 3—6(—15) by 1—1½ mm. *Flowers* sessile, not scented. Bracteoles triangular, *c.* 1 by ½ mm. Opening buds *c.* 8 by 4 mm, divided into 4 lobes. *Calyx tube c.* 1½ mm, not accrescent; lobes free, not accrescent, equal, convex, coriaceous, suborbicular, *c.* 4½—6 by 4—6 mm, persistent. *Petals* 4, elliptic, obtuse, convex, *c.* 1¾—2 cm by 6—9 mm, membranous; insertion *c.* 2—3 mm wide. *Staminal tube c.* 2—3 mm high, stamens in 4 whorls, innermost one staminodial, *c.* 3 cm, staminodia *c.* 7 mm; anthers *c.* ½ by ⅛ by ⅛ mm. Disk annular, ½ mm high. *Ovary* 4-celled, tetragonous, with acute edges, glabrous, *c.* 4—6 by 4—5 by 3—4 mm; ovules 2—4 per cell (total number *c.* 16); septa complete; style *c.* 4—6 cm. *Fruit* tetragonous, *c.* 3½—5 by 1—2 by 1—1⅝ cm, mostly very shiny, sometimes dull in herb. material, truncate, sharply 4-angled, sides depressed at the base; pericarp *c.* 1—2 mm thick on the sides and 4—5 mm at the corners, exocarp thin, smooth, and mostly shiny, mesocarp a spongy parenchymous layer with anastomosing fibres, endocarp a thin brown membrane. *Seed* ovoid, *c.* 2 by ½—¾ by ½ cm, trigonous, deeply fissured, tapering at both ends.

Typification: *B. reticulata* (Bl.) Miq., *B. acutangula* [*non* (L.) Gaertn.] Korth., *Stravadium reticulatum* Bl., *Michelia reticulata* O. Kuntze: *Korthals s.n.* (Borneo), *Herb. Lugd. Bat. 898 . 204 . 205—207*, holotype in L, isotype in U.

B. sumatrana Miq.: *Teysmann H.B. 4536* (Sumatra), holotype in U, isotypes in BO, K, L.

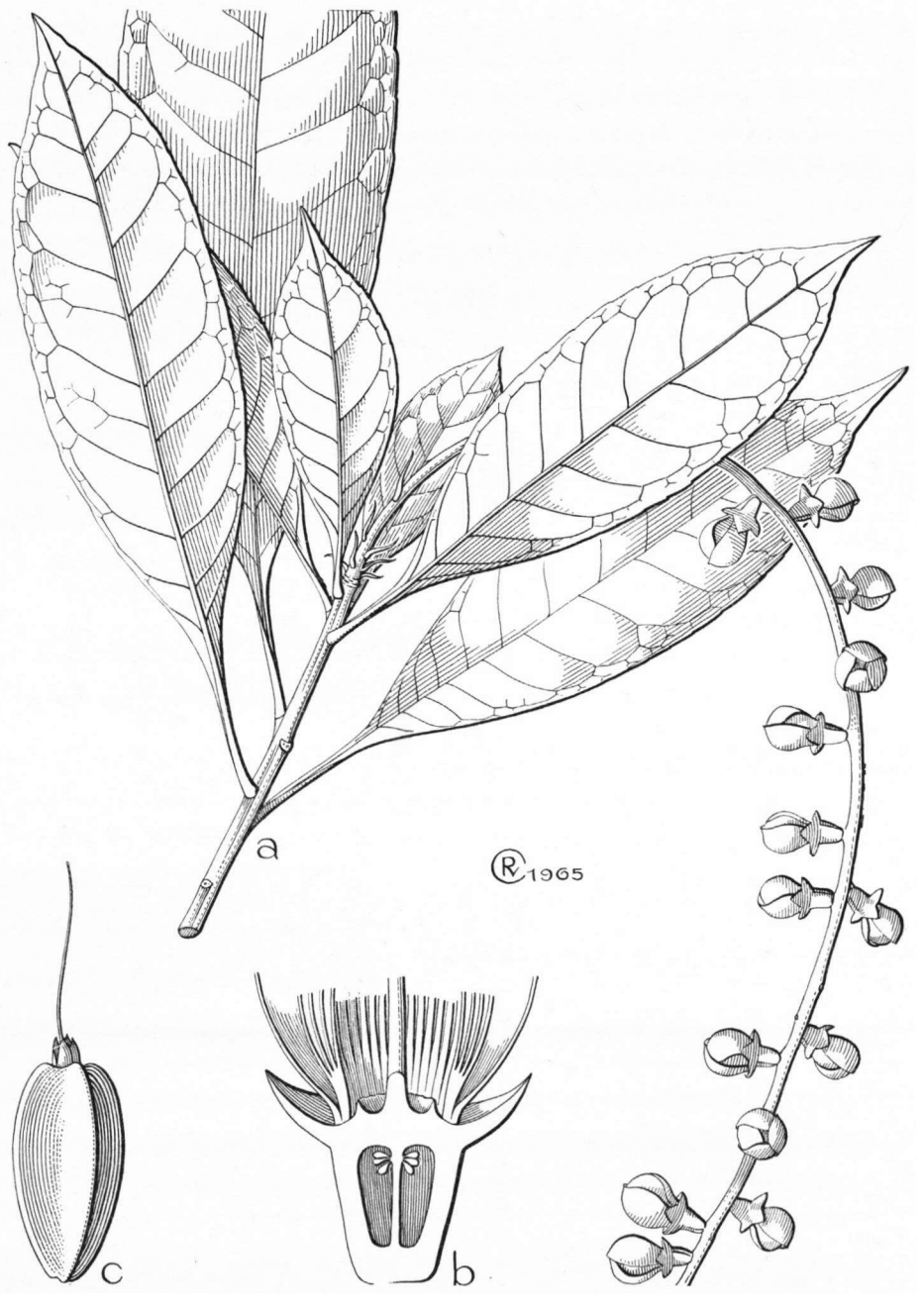


Fig. 22. *Barringtonia reticulata* (Bl.) Miq. a. Habit, × $\frac{2}{3}$, b. flower in section, × 4, c. fruit, × $\frac{2}{3}$ (a. *Hort. Bog. V-A-4* and infl. from *PNH 9764* (*Canicosa*), b. *PNH 9764* (*Canicosa*), c. *S. 12051* (*Brunig*)).

B. gitingensis Elmer: *Elmer 12238* (not *12236*) (Sibuyan), holotype in PNH (lost), isotypes in BM, BO, E, HBG, L, P, US, W.

B. linggaensis Knuth: *Bünnemeijer 7316* (Lingga), holotype in L.

Distribution: Malaya (Perak, Johore), S. Sumatra, Riouw and Lingga Arch., Banka, Karimata and Anambas Is., Borneo, Philippines (Luzon, Sibuyan, Mindanao), SE. Celebes. — Fig. 20.

Ecology: Along rivers, in marshy or peat-swamp forest, in heath-forest, or in Dipterocarp forest, mostly in sandy-clayish soil from almost sea-level up to 400 m (in Perak once at 1170 m). Fl., fr. Jan.—Dec., but generally in full bloom during April and October.

Compilation of field-notes: Bole 4 m, crown 5 m; bendy, drooping tree or small straggling shrub; bark deeply fissured, roughly cracked, grey. Flowerbuds reddish green or red-brown; calyx red, green, or light red-brown; petals white, greenish white, or pale green; stamens red, violet, dark pink, white but pink at the base or carmine at the apex; anthers brown or yellow; style red. Fruit green when immature, red or purple when mature.

Galls: On material from Durian I. (Riouw Arch.) a leaf-gall caused by a gall-midge has been described. See Docters van Leeuwen-Reynvaan, Zoocec. Neth. E. Ind. (1926) 401, fig. 745.

Vernaculars: In Sumatra *Putat halang, Putat rawa* (swamp-putat), *Bĕliman* (Mal. dial. Redjang), and *Pĕranap*. In Banka *Sĕmilang*, in Borneo *Rĕngas* (Iban), *Putat paja* (swamp-putat), *Putat darat* (country-putat), the latter also in Singapore, and *Putat hitam* (black-putat). In Sibuyan (Philippines) *Mago paho*. *Putat*, the usual Malay name for *Barringtonia*, is used in Sumatra, Singapore, Lingga, and Borneo.

Uses: On a field-label from a collection made in SE. Borneo it is stated that the juice of the wood is used to blacken teeth.

Remarks: From S. Sumatra I have a number of sterile collections made by the Forest Research Institute. The field-labels state tree-sizes from 15—26 m, dbh 18—39 cm, and bole up to 18 m. In one case buttresses are found 138 cm high, 64 cm wide at base, and 8 cm thick.

36. B. augusta Kurz, J. As. Soc. Beng. 42, ii (1874) 233; Rep. Pegu (1875) App. A, lxvi, App. B, 52; J. As. Soc. Beng. 46, ii (1877) 70; Fl. Burma 1 (1877) 498; Clarke in Hook. *f*., Fl. Br. Ind. 2 (1879) 509; Brandis, Ind. Trees ed. 1 (1906) 330; Craib, Fl. Siam. En. 1 (1931) 671, 672; Knuth, Pfl. R. Heft 105 (1939) 20 ('*angusta*'); Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 106. — *Stravadium augustum* Wall., Cat. (1831) 3637, *nomen*. — *Doxomma angustatum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 105. — *Michelia angusta* O. Kuntze, Rev. Gen. Pl. 1 (1891) 240.

B. pterocarpa Kurz, J. As. Soc. Beng. 42, ii (1874) 234; Rep. Pegu (1875) App. A, lxvi, App. B, 52; J. As. Soc. Beng. 46, ii (1877) 70; Fl. Burma 1 (1877) 498; Clarke in Hook. *f*., Fl. Br. Ind. 2 (1879) 509; Niedenzu in E. & P., Nat. Pfl. Fam. 3, 7 (1892) 33; Brandis, Ind. Trees ed. 1 (1906) 330; Gagn., in Fl. Gén. I.-C. 2 (1921) 858; Craib, Fl. Siam. En. 1 (1931) 671; Knuth, Pfl. R. Heft 105 (1939) 21; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 107. — *Michelia pterocarpa* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241.

Doxomma magnificum Miers, Trans. Linn. Soc. Bot. 1 (1875) 106, *non B. magnifica* Laut. 1911. — *B. miersiana* Knuth, Pfl. R. Heft 105 (1939) 30.

B. marcanii Craib, Kew Bull. (1928) 237; Fl. Siam. En. 1 (1931) 671; Knuth, Pfl. R. Heft 105 (1939) 21.

Small tree, *c*. 8—15 m, dbh *c*. 30 cm; twigs *c*. 8—15 mm ∅. *Leaves* obovate-oblong

or obovate-lanceolate, glabrous, *c.* 24—50(—70) by (7—)9—14(—19) cm (leaf-index 2½—4); chartaceous, towards the apex serrate-crenulate, apex (shortly) acuminate, especially when young, or obtuse, base cuneate; nerves *c.* 16—30 pairs; petiole *c.* 5—20 mm, rather thick, *c.* 4—6 mm ∅. *Spikes* terminal, with a thick rachis, pendulous, finely fulvous pulverulent, *c.* (37—)90—162(—213) cm with up to *c.* 370 flowers, some in pairs; rachis *c.* 5—8 mm ∅, fissured with distinctly enlarged scars, cataphylls at base of rachis, lanceolate to triangular, acute, convex, glabrous, *c.* 10—30 by 5—6 mm. Bracts sessile, often lanceolate, persistent, convex, 5 mm, accrescent to 12 mm, fulvous pulverulent, fimbriate, acute, sometimes bidentate. *Flowers* 4-merous, sessile. Opening buds *c.* 7 by 7 mm. *Calyx* tube *c.* 2—4 mm high, lobes free, broad-elliptic, fulvous pulverulent outside, convex, *c.* 3—11 by 3—9 mm, chartaceous, fimbriate, obtuse. *Petals* elliptic, convex, *c.* 15—30 by 9—15 mm when fully expanded, fimbriate at apex, obtuse, insertion *c.* 3—4 mm wide. *Staminal tube c.* 2—5 mm high; stamens in 6(—5) whorls, innermost one staminodial, *c.* 20—30 mm, staminodia *c.* 11—13 mm, anthers *c.* ¾ by ½ by ½ mm. Disk an undulating grooved ring *c.* ½—1 mm high. *Ovary* (3—)4-celled, tetragonous, fulvous pulverulent, *c.* 5—10 by 4—8 by 3—7 mm, each corner with an undulating wing *c.* 1—2 mm wide; base semi-amplexicaulous by a thickened ring; ovules 2—4(—8) per cell [total number up to (12—)16(—30)]; septa complete; style *c.* 3—7 cm, persistent, ± accrescent. *Fruit* oblong, 4(—3) gonous or ± terete, fulvous pulverulent, *c.* 5—7 by 2—2½ by 1½—2 cm, tapering towards top and truncate base; with undulating wings *c.* 3—5 mm wide; pericarp *c.* 3 mm thick, a thick exocarp, a very hard, fibrous mesocarp, endocarp a more loosely anastomosing layer of fibres covered by a thin brown membrane on the inside. *Seed* ovoid, fissured, *c.* 25 by 10 by 9 mm, subtrigonous, rounded at top and base.

Typification: *B. augusta* Kurz, *Stravadium augustum* Wall., *Doxomma angustatum* Miers, *Michelia angusta* O. Kuntze: *Wallich 3637* (Tenasserim), holotype in K, isotypes in BM (flower only) and CGE.

B. pterocarpa Kurz, *Michelia pterocarpa* O. Kuntze: *Kurz 3021* (Burma), holotype in K.

Doxomma magnificum Miers, *B. miersiana* Knuth: *Parish s.n.* (Tenasserim), holotype in K, isotype in BM (leaf fragment only).

B. marcanii Craib: *Marcan 1285* (Siam), holotype in K, isotype in BM; *Kerr 6811*, paratypes in K and BM.

Distribution: Mainland of SE. Asia: S. Burma and Thailand. Fig. 23.

Ecology: Along rivers in evergreen forest, up to *c.* 300 m. Fl. Febr.—May, fr. April—June.

Compilation of field-notes: Bark dark grey, rough, peeling off. Flowers scented. Petals white, greenish white, or pink, stamens greenish or white. Fruit green.

Vernaculars: In Burma *Kyi*, *Kyai-gyce*, and *Taung kyi*; in Thailand *Lung luang*.

Uses: Wood. Fairly good for fuel (*Parkinson 6512*, Burma). The wood is white and no heartwood can be distinguished.

Remarks: Closely allied to *B. curranii* Merr. from Borneo and Palawan, only differing by smooth ovaries and fruit, the leaves being less serrate.

B. marcanii Craib can not be maintained, differing only in larger leaves and flowers. The number of ovules per cell (7—9) is rather high. Their total number in 3 specimens averages 30, while in other specimens the total number is only 15.

37. B. curranii Merr., Philip. J. Sc. 1 (1906) Suppl. 211; J. Str. Br. R. As. Soc. 77 (1917) 204; En. Born. (1921) 419; En. Philip. 3 (1923) 142; Knuth, Pfl. R. Heft 105 (1939) 22.

B. rhodochlamys Airy Shaw, Kew Bull. (1950) 137.

Small to medium-sized tree, (2—)13—25 m; dbh *c.* 10—40 cm; twigs 1—1¾ cm ∅. *Leaves* obovate-lanceolate, rarely obovate-oblong, glabrous, *c.* 24—70(—90) by 9—13(—21) cm (leaf-index 3½—5), chartaceous, serrate-crenulate, acuminate or obtuse, base cuneate; midrib prominent at both faces, nerves *c.* (15—)18—26(—30) pairs, venation distinct on both sides; petiole *c.* 10(—25) mm, rather thick *c.* 7—10 mm. Cataphylls on sterile twigs *c.* 7—20 by 4 mm, triangular, lanceolate. *Spikes* terminal, pendulous, finely fulvous pulverulent, *c.* 40—100(—110) cm, with more than 50 flowers, some in pairs; rachis *c.* 10—15 mm ∅ at base, *c.* 4—7 mm at apex, accrescent in length. Cataphylls lanceolate, some triangular, convex, glabrous, *c.* 8—50 by 4—12 mm, chartaceous, serrate, acute. *Flowers* sessile. For bracts and bracteoles see remark. Opening buds ± globular with a subtetragonous ovary, *c.* 7—12 by 7—12 mm. *Calyx* open; tube *c.* 2—3 mm high; sepals 4, ovate-orbicular, ferruginous-pulverulent outside, convex, *c.* 4—7 by 4—11 mm, chartaceous, fimbriate. *Petals* 4, elliptic, obtuse, convex, *c.* 2¾—3½ by 1¼—2 cm, membranous, margin fimbriate to apex; insertion *c.* 4—7 mm wide.

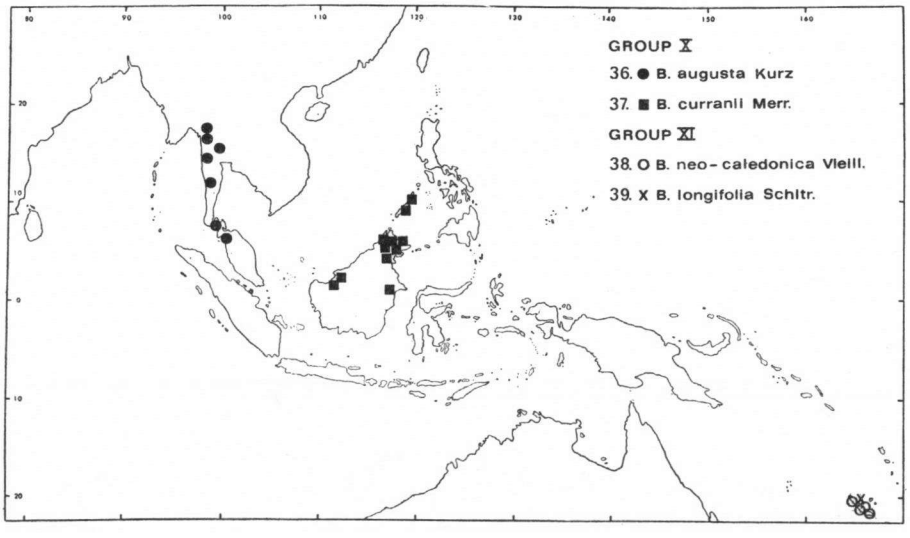


Fig. 23. Localities of the species of Groups X and XI.

Staminal tube *c.* 4—5 mm high; stamens in 5(—6) whorls, inner one staminodial; filaments *c.* 3—5 cm; staminodia *c.* 12—23 mm; anthers *c.* 1 by ½—1 by ½ mm. Disk annular, undulating, grooved, *c.* 1—1½ mm high. *Ovary* 4-celled, tetragonous, fulvous-pulverulent, *c.* 6—8 by 4—7 by 4—7 mm, at the base semi-amplexicaulous by a thickened ring; ovules 4—7 per cell (total number up to 22); septa complete; style filiform, *c.* 4—7 cm, ± accrescent. *Fruit* ovoid, subtetragonous or ± terete, tapering at both ends, ferruginous-pulverulent, *c.* 7—11 by 4—7½ by 4½—7½ cm; pericarp *c.* 5—10 mm thick, exocarp 2—6 mm, mesocarp hard, fibrous, *c.* 3—5 mm, endocarp a thin brown membrane. *Seed* ovoid, lengthwise fissured, *c.* 4—5 by 2—3 by 2—3 cm.

Typification: *B. curranii* Merr.: *Curran 3596* (Palawan), holotype not seen, isotype in K; *Bermejos 225*, paratype not seen.

B. rhodochlamys Airy Shaw: *Richards 1400* (Sarawak), holotype in K.

Distribution: Borneo (Sarawak: Mt Dulit and Hose Mts; Sabah: Mt Kinabalu; E. Kutai), Philippines (Palawan). Fig. 23.

Ecology: In Sarawak it is growing as an understorey tree on the Hose Mts and in secondary forest on Mt Dulit. In Sabah it has been collected along forest trails at Mt Kinabalu. It is also growing at low altitudes on hilltops. Three times mentioned growing in heavy black loam and coral limestone. Altitude almost from sea-level up to 1670 m. Fl., fr. Jan.—Dec.

Compilation of field-notes: Tree with rather straight stem. Bole *c.* 10—17 m in specimens *c.* 17—25 m tall. Bark grey, greyish green, or dark brown, pitted like *Agathis* (*Kostermans 5866*, Borneo, E. Kutai), smooth or flaky; outer bark soft and thick; inner bark fibrous and yellowish. Cambium yellow or white. Wood yellow, sapwood white. Calyx red, petals pink or red. Fruit pinkish, dark reddish, or light purple, green when immature.

Remarks: *B. curranii* and *B. rhodochlamys* are very similar, the latter (one collection only) merely differing by the larger leaves and many large (bright red) bracts *c.* 8 by 5½ cm and bracteoles *c.* 3½ by 1½ cm, which is admittedly an exceptional feature in the genus. In other specimens of *B. curranii* bracts and bracteoles were not available.

The species is near *B. augusta* Kurz from the mainland of Asia but differs from the latter by its wingless ovaries and fruit, as well as the serrate leaf margin.

38. B. neo-caledonica Vieill., Bull. Soc. Normand. 10 (1866) 99; Guillaumin, Ann. Mus. Col. Marseille 19 (1911) 154; Guillaumin & Beauvis., Ann. Soc. Bot. Lyon 38 (1914) 92; Guillaumin, Bull. Mus. Nat. Hist. Nat. 26 (1920) 435; Knuth, Pfl. R. Heft 105 (1939) 21; Guillaumin, Bull. Soc. Bot. Fr. 86 (1939) 174; Fl. Nouv. Caléd. (1948) 227; Guillaumin, Thorne & Virot, Univ. Iowa Stud. Nat. Hist. 20 (1965) 39. — *Doxomma neo-caledonicum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 103. — *Michelia neo-caledonica* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241 ('*neocalendonia*').

Small tree, *c.* 7—15 m; twigs *c.* 5—10 mm ∅. *Leaves* obovate-oblong or obovate-lanceolate, glabrous, *c.* (12—)17—26 by 5—8 cm (leaf-index 2¾—3½); chartaceous, serrate-crenulate, acute, base cuneate, midrib prominent at both faces; nerves 14—18 (—24) pairs; petiole *c.* 3—7(—10) mm, ± winged by decurrent leaf-base. *Spikes* terminal and ramiflorous, pendulous, *c.* 15—27 cm, densely flowered (50 fls); rachis *c.* 2—4 mm ∅, accrescent to *c.* 6 mm, fissured and grey-green or yellowish pubescent. Cataphylls caducous. Bracts and bracteoles linear-lanceolate, pulverulent, *c.* 22—40 by 1½—5 mm and *c.* 8—14 by 1—2 mm respectively. *Flowers* scented. Opening buds *c.* 10—12 mm. *Calyx* open in bud, the tube *c.* 2 mm high; lobes free, 3—5, unequal, suborbicular, pulverulent, *c.* 1—1½ by 1—1½ cm, coriaceous, at margin membranous, fimbriate. *Petals* 4, elliptic, convex, *c.* 2—3 by 1¼—2 cm, membranous or herbaceous, obtuse, insertion *c.* 4—10 mm wide. *Staminal tube c.* 3 mm high, sometimes of the outer whorls 6 mm; stamens in 7 whorls, inner one (rarely inner two) staminodial; filaments *c.* 2—3 cm, staminodia *c.* ½—1 cm; anthers *c.* 1—1¼ by ½—1 by ½—¾ mm. Disk thick, grooved at both sides, *c.* 1—1¼ mm high. *Ovary* 3—4-celled, subtetragonous, *c.* 4—5 by 3—5 by 3—5 mm, grey-green or yellowish pulverulent; ovules 3—6 per cell (total number 12—18); septa incomplete; style rather thick, *c.* 1½ mm at base, ½ mm at apex in ∅, *c.* 3—4½ cm long. *Fruit* subtetragonous, *c.* 5½—6 by 1¾—2 by 1—1¼ cm, truncate, tapering at base, ± fissured; pericarp *c.* 2 mm thick, exocarp thin, *c.* 1 mm, fibrous mesocarp and endocarp *c.* 1 mm. *Seed* ovoid, fissured, *c.* 4½ by 1 cm.

Typification: *B. neo-caledonica* Vieill., *Doxomma neo-caledonica* Miers, *Michelia neo-caledonica* O. Kuntze: *Vieillard 2630*, holotype in P, isotypes in BM, K.

Distribution: New Caledonia. Fig. 23.

Ecology: Small tree along rivers, also abundant in gullies along streambeds in fringing rain-forest, from sea-level up to 170 m. Fl. Oct.—Nov., fr. Febr.

Compilation of field-notes: Crown low, spreading; branches thick. Bark brown. Deciduous in September or beginning of October (*McKee 5571*); young leaves brownish green, older leaves light green. Flowerbuds pink; petals white or pale pink; stamens white.

Remarks: *McKee 5572* has somewhat different flowers. The inner whorls of stamens are *c.* 3 mm connate, the outer whorls *c.* 6 mm. As in *B. apiculata*, *B. calyptrata*, and *B. papeh* a second staminodial whorl occurs.

I have seen only one collection of a fruiting specimen, made by *Balansa 1493* in Febr. 1869 (in P).

Remarkably long bracts are found in this species, and this is also found in an allied species from Borneo and Palawan, *B. curranii*. Unfortunately in both cases the number of specimens bearing bracts and bracteoles is far too small to judge the constancy, and thereby the taxonomical value, of this character.

39. B. longifolia Schlechter, Bot. Jahrb. 39 (1906) 201; Guillaumin, Ann. Mus. Col. Marseille 19 (1911) 154; Knuth, Pfl. R. Heft 105 (1939) 37; Guillaumin, Bull. Soc. Bot. Fr. 86 (1939) 174; Fl. Nouv. Caléd. (1948) 227.

Small tree, *c.* 4—6 m; twigs *c.* 8—10 mm ∅. *Leaves* obovate-oblong, glabrous, *c.* 27—41 by 7—10 cm (leaf-index 3½—4), serrate-crenulate, acuminate, base cuneate, midrib prominent underneath, nerves equally distinct on both sides, *c.* 16—18 pairs; petiole *c.* 2½—3½ cm. *Spikes* terminal, pendulous, *c.* 48—51 cm, lax-flowered; rachis *c.* 2—3 mm ∅, accrescent to *c.* 5—7 mm, fissured, pulverulent. Bracts triangular, *c.* 1½—3 by 1 mm. Opening buds *c.* 10 mm. *Calyx* open in bud; tube *c.* 2 mm high; sepals 4, semiorbicular, glabrous, *c.* 3—4 by 3—7 mm, chartaceous. *Petals* 4—5, elliptic, obtuse, convex, membranous, *c.* 2—2½ by 1—1½ cm; insertion *c.* 4—5 mm wide. *Staminal tube c.* 4—5 mm high; stamens in 4 whorls, inner one staminodial, filaments *c.* 2—2½ cm; staminodia *c.* 5 mm; anthers *c.* 1 by ¾ by ¾ mm. Disk thick, *c.* 1 mm high. *Ovary* 4-celled, obpyramidal, subtetragonous, semi-amplexicaulous at the base, *c.* 4—7 by 4—6 by 4—5 mm; ovules 2—3 per cell (total number 8—10); septa complete; style thick, *c.* 1 cm.

Typification: *Schlechter 15616*, holotype not seen, isotypes in BM, K, P, and WRSL.

Distribution: New Caledonia (one collection). Fig. 23.

Ecology: On Ou-Hinna Mountain at 400 m altitude. Fl. Jan.

DUBIOUS NAME

B. beccarii Knuth, Pfl. R. Heft 105 (1939) 35, *nomen*, is mentioned as a name in a note under the description of *B. pietersii* Knuth, in which Knuth says that the latter species differs from it by the size of the petioles. I have not found this name on any sheet and it is unknown what Knuth intended to base this name on. Anyway the type of *B. pietersii* Knuth is not a *Barringtonia*. See excluded names.

EXCLUDED NAMES

Baranda angatensis Llanos, Mem. Acad. Cienc. Madrid 4, 3 (1859) 502 = *Symplocos oblongifolia* Vidal, *sec.* Hallier, Beih. Bot. Centralbl. 39, ii (1923) 94 = **Symplocos polyandra** (Blanco) Brand (*Symplocaceae*).

Typification: Sylvis di Angat, Mayo 1854, Manille, Llanos; isotype in L.

Merrill (En. Philip. 3, 1923, 143) concluded that, though F.-Villar had reduced this genus and species to *B. macrostachya* (Jack) Kurz, as did Index Kewensis, the description was too incomplete to place this

name. Because of the pea-sized nut it cannot of course be a *Barringtonia*. Hallier *f.* properly placed it and also found an isotype in L, which Merrill checked (J. Arn. Arb. 32, 1951, 409).

B. arborea (Roxb.) F. v. Mueller, Fragm. 5 (1866) 184 = **Careya arborea** Roxb. (*Lecythidaceae*).
A new combination made by Von Mueller, as he presumed that there was no difference between the genera *Barringtonia* and *Careya*.

B. australis F. v. M. in Ewart & Davies, Fl. North. Terr. (1917) 199, is a writing error made under *Careya australis* F. v. M. which they describe on p. 198. Knuth and also Kartawinata consider *Careya australis* synonymous with **Planchonia careya** (F. v. M.) Knuth (*Lecythidaceae*).

B. careya F. v. M., Fragm. 5 (1866) 183 = **Planchonia careya** (F. v. M.) Knuth, Pfl. R. Heft 105 (1939) 56 (*Lecythidaceae*).
See also Kartawinata, Bull. Bot. Surv. India 7 (1965) 181.

B. ceramensis Knuth, Pfl. R. Heft 105 (1939) 22, *p.p. quoad fructus* = *B. racemosa* (L.) Sprengel and *p.p. quoad folia* = **Buchanania amboinensis** Miq. (*Anacardiaceae*).
Typification: *De Vriese & Teysmann s.n.* (Ceram), holotype in L.
The name should be discarded as being based on discordant elements. See Van Steenis, Blumea 11 (1961) 132.

B. cymosa Fischer, Kew Bull. (1927) 89; Knuth, Pfl. R. Heft 105 (1939) 32; Hundley & U Chit Ko Ko, List Trees & Shrubs Burma ed. 3 (1961) 106 = **Chydenanthus excelsus** (Bl.) Miers (*Lecythidaceae*).
Typification: *Parkinson 1682*, holotype in K.
See Airy Shaw, Kew Bull. (1949) 152.

B. excelsa Bl., Bijdr. (1826) 1097. — *Stravadium excelsum* Bl. *ex* DC., Prod. 3 (1828) 289 = **Chydenanthus excelsus** (Bl.) Miers (*Lecythidaceae*).
Typification: *Blume 1733*, holotype in L.

B. pietersii Knuth, Pfl. R. Heft 105 (1939) 35, *p.p. typo incl.* = **Chydenanthus excelsus** (Bl.) Miers (*Lecythidaceae*).
Typification: *Pieters 2536*, holotype in L.
See the note under 5. *B. filirachis* Payens.

B. reinwardtii Miq., Fl. Ind. Bat. 1, 1 (1855) 488. — *Stravadium reinwardtii* Miers, Trans. Linn. Soc. Bot. 1 (1875) 88. — *Michelia reinwardtii* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241; *p.p. quoad flores* = *B. macrocarpa* Hasskarl and *p.p. quoad folia* = **Helicia robusta** (Roxb.) R.Br. *ex* Wall. (*Proteaceae*).
Typification: *Reinwardt s.n., Herb. Lugd. Bat. 908 . 146 . 1882*, holotype in L.
See Koord. & Val., Bijdr. Booms. Java 6 (1900) 3.

B. rigida Clarke in Hook. *f.*, Fl. Br. Ind. 2 (1879) 510. — *Doxomma rigidum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 104. — *Michelia rigida* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241 = **Symplocos rigida** (Miers) Clarke in Hook. *f.*, Fl. Br. Ind. 3 (1882) 581 (*Symplocaceae*).
Typification: *Maingay 767 & 2495* (not *2496*), syntypes in K. Only fruiting material.

B. sphaerocarpa Gardner, For. Dep. Bull. W. Austr. 32 (1923) 28, 69 = **Cassine glauca** (Rottb.) O. Kuntze (*Celastraceae*).
Typification: *Gardner 1491*, holotype in PERTH (fr. lost).
Gardner thought his new species had some affinity to *B. macrostachya*, in spite of the fact that the fruits were smaller and not angular. Knuth, Pfl. R. Heft 105 (1939) 50, assumed that the species is perhaps synonymous with *B. asiatica*, but he had seen no material. From PERTH I received the type specimen and a letter stating that the fruit had been removed and is now lost as it had been common practice in the former Herbarium of the Forests Department to remove all fruit from the specimens. However, the sterile sheet leaves no doubt about the identity of the type specimen.

B. vriesii Teysmann & Binnendijk, Nat. Tijd. Ned. Ind. 2 (1851) 308. — *Doxomma vriesii* Miers, Trans. Linn. Soc. Bot. 1 (1875) 106. — *Michelia vriesii* O. Kuntze, Rev. Gen. Pl. 1 (1891) 241 = **Chydenanthus excelsus** (Bl.) Miers (*Lecythidaceae*).
Typification: *Teysmann & Binnendijk, W. Java, Bantam*, holotype in L, isotype in K.

Perigara globosa Span., in Hook. Comp. Bot. Mag. 1 (1835) 350, *nomen*. — *Gustavia globosa* Span., Linnaea 15 (1841) 204, *nomen* = **Planchonia valida** (Bl.) Bl. See Kartawinata, Bull. Bot. Surv. India 7 (1965) 168 (*Lecythidaceae*).

Typification: *Zippelius s.n.* (Timor), holotype and drawing of this in L.

Both Miers in his original description of *Stravadium globosum* Miers, Trans. Linn. Soc. Bot. 1 (1875) 86 and Knuth, Pfl. R. Heft 105 (1939) 50 mention Spanoghe's names without having had access to his specimens. Miers based his description on a Javanese collection by Anderson (which is 24b. *B. acutangula* ssp. *spicata*), not on that of Spanoghe.

Stravadium macrophyllum Bl., in Fl. Serr. 7 (1851) 24. — *B. macrophylla* Miq., Fl. Ind. Bat. 1, 1 (1855) 491 = **Madhuca macrophylla** (Hassk.) H. J. Lam (*Sapotaceae*).

Typification: *sin. coll.*, Java, Tjitjiriengien, *Herb. Lugd. Bat. 898 . 204 . 210 & 908 . 225 . 1349*; holotype in L, isotype in BO (not seen).

Koorders & Valeton have first suggested this reduction, *cf.* Bijdr. Booms. Java 6 (1900) 3, which was *in sched.* checked by H. J. Lam. Though the sheets were in L inserted under *Madhuca macrophylla*, Van Royen omitted this synonym from the synonymy in *Madhuca* (Blumea 10, 1960, 33). Blume's epithet can, fortunately, not be used.

INDEX TO GENERIC NAMES

INDEX

To specific and infraspecific names

Accepted names have been printed in plain type, new names and combinations in **bold type,** and synonyms in *italics.* The numbers refer to the number of the species in this monograph, the letters to the forma, variety, or subspecies. Dub. = dubious name (listed on p. 258). Excl. = excluded names (listed on p. 258).