REVISION OF THE BURSERACEAE OF THE MALAYSIAN AREA IN A WIDER SENSE

Xa. CANARIUM Stickm. [1])

by

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Contents

INTRODUCTORY NOTES

1. History and scope

The scope of the present paper is primarily to give a taxonomical revision of the genus *Canarium*. Furthermore, attention has been paid to some subjects of a more general nature, mainly regarding morphology and geography, without, however, claiming completeness.

The last complete revision of the genus was published by Engler in 1883 (in DC. Mon. Phan. 4, 101—151). Of course this is now for the greater part out of date. The later revisions by the same author in E. & P., Nat. Pfl. Fam. ed. 1, 3[4], 1896, 238—242, and ed. 2, 19a, 1931, 443—450, are not really monographs; moreover, they lost in value by the introduction of a subdivision which was mainly based upon unessential characters.

[1]) I—IV in Blumea 7, 1952, 154—170; V—VI in Blumea 7, 1953, 413—472; Va in Blumea 8, 1955, 175—180; VIa and VII—IX in Blumea 7, 1954, 498—552; X in Bish. Mus. Bull. no. 216, 1955, 1—53.

Of fundamental importance for the knowledge of the present genus — though they are chiefly restricted to its Malaysian representatives — are the papers by H. J. Lam on its morphology (Ann. Jard. Bot. Btzg 42, 1931—32, 23—56 & 97—226, t. 5—7 & 11—16) and taxonomy (Bull. Jard. Bot. Btzg III, 12, 1932, 422—534). The present monograph is to be considered an extension and amplification of these works.

2. General part

The revision proper is preceded by a general part which consists of three chapters. It was accepted as a guiding principle, both in this general part as a whole and in the various chapters, first to state the facts and only afterwards to present their interpretation, making a clear distinction between the two. This is why the chapters on morphology and geography precede that on taxonomy.

a. MORPHOLOGY. The chapter on morphology is rather fragmentary. Lam already paid much attention to this subject, of which he made a very detailed study, partly on living material. I mainly restricted myself to some amplifications and some critical notes based on new material which occasionally led to slightly different views.

b. GEOGRAPHY. Lam did not pay much attention to the geographical details within the genus, which he only considered in connection with the supposed phylogeny of the family as a whole. Since, however, *Canarium* presents some striking illustrations of more or less well-known phytogeographical patterns, I gave a rather extensive and detailed account of this subject.

c. COMPARATIVE TAXONOMY. The purpose of the third chapter is to try and arrive at an overall picture, based on points stated in the two foregoing chapters as well as in the special part, thus making an attempt to describe the genus as a living entity with a history of its own. This chapter is consequently of a much more speculative nature than the other ones.

A *conspectus specierum* can be found at the end of the general part.

3. Special part

a. KEYS. The keys are made as clear as possible, both by being concise and by using primarily strictly differential characters. The first of these two points necessitates to compare the specimens with the descriptions. The consequence of the second point is that it may in most cases prove to be hard or even impossible to identify any random incomplete specimen, but it is expected that the key will appear to be a trustworthy guide to come to the name of a species of which complete material is at hand (for incomplete material may be referred to the key in Fl. Mal. I, 5, 1956, 251 as to Malaysian species; for specimens from other regions the chapter on geography may be of some help).

Though it appeared to be difficult to give an efficient key to the sections, complete keys for the species of each section are given, since after some experience it is usually quite easy to recognize the sections.

b. SYNONYMY. The synonymy is complete as far as possible. Infraspecific taxa have been mentioned only under the publication in which they were first distinguished.

c. LITERATURE. The literature cited is a selection of the more important publications only.

d. SPECIMENS. The specimens are cited geographically, and within each area alphabetically according to the collectors' names. In case of the serial numbers, however, under which the collections made on behalf of some institutes and services have been distributed, priority has been given to these over the names and numbers of the individual collectors. These series are:

BS. — Bureau of Science, Manila
BSIP. — British Solomon Islands Protectorate
BW. — Boswezen, Manokwari
FB. — Forestry Bureau, Manila
FRI. — Forest Research Institute, Bogor
KEP. — Conservator of Forests, Kepong
NBFD. — North Borneo Forest Department, Sandakan
NGF. — New Guinea Forestry, Lae
PNH. — Philippine National Herbarium, Manila
Service forestier de Madagascar
SF. — Singapore Fieldnumbers

Unnumbered specimens have been omitted with a few exceptions; in such cases the number of the herbarium sheet is recorded if any was given.

Except in the case of type specimens, I have refrained from mentioning all herbaria from which I examined specimens of a given number, since I have practically seen and labelled all specimens, up to about 1954 present in the following herbaria (the abbreviations are those proposed by Lanjouw & Stafleu, Ind. Herb. 1, ed. 3, 1956):

A, B, BISH, BK, BLAT, BM, BO, BR, BRI, BRSL, CAL, DD, E, EA, FI, G, K, KEP, L, LAE, LD, Manokwari, MAU, MEL, NSW, NY, P, PNH, SAR, SING, U, US, W, Z.

Under these circumstances it was also considered unnecessary to give a complete list of collectors' numbers at the end of this paper.

e. VERNACULAR NAMES. These have been omitted as I am convinced that the greater part of the names mentioned in literature and on field-labels are either quite untrustworthy or of a very local use only and as I feel myself incapable of making a selection out of the abundance of vernaculars. Local botanists are in a much better position to find out which names are reliable and of more common use and therefore of some value.

4. Acknowledgements

Finally I wish to thank all those who have helped me in so many ways. Apart from the directors of the herbaria mentioned above, who kindly put their valuable material at my disposal, often for a rather long time, and from the staffs of the herbaria at Kew, London, and Paris, who offered me hospitality, my thanks are particularly due to the members of the staffs of the Rijksherbarium and the Flora Malesiana Foundation, both at Leyden, who by their scientific as well as their technical and administrative assistance greatly facilitated my work.

GENERAL PART

I. MORPHOLOGY

Since Lam (Ann. J. Bot. Btzg 42, 1931/'32, p. 23—56 and 97—226, t. 5—7 and 11—16) already gave a broad survey of the morphology of the Malaysian *Burseraceae* in general, and of the *Canarieae* in particular, I shall mainly restrict myself to some amplifications and corrections.

1. Medullary vascular strands in the twigs.

The following types are clearly distinguishable:

Type 1. No vascular strands: 25, 26, 70, 72, 73.[1])

Type 2. All vascular strands scattered irregularly: 8, 9, 35, 50, 54, 56, 59, 61, 71, 75.

Type 3. Part of the vascular strands arranged peripherally:

a. Central ones scattered: 1, 4, 6, 8, 11, 12, 13, 14, 15, 16, 27, 37, 38, 40, 42, 43, 47, 49, 50, 51, 54, 61, 63, 65, 67, 68, 69.

b. Central ones also cylindrically arranged: 16, 17, 21, 27, 28, 35, 37, 39, 50, 61, 62, 64, 67.

Type 4. All vascular strands arranged peripherally: 1, 2, 3, 4, 5, 7, 8, 10, 11, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 36, 40, 41, 42, 43, 44, 45, 46, 48, 50, 51, 52, 53, 54, 55, 57, 58, 60, 61, 63, 65, 66, 67, 74.

a. *Type 1.* As medullary vascular strands are absent in the *Burseraceae* with the exception only of a few apparently highly specialized genera, their absence in some species of *Canarium* might seem a primitive character. However, among the five species in which these vascular strands are absent, two, *C. zeylanicum* and *C. paniculatum*, appear to be more or less derived species in a group in which medullary vascular strands are generally present. As moreover in both these species medullary vascular strands are found occasionally, it seems likely that their absence is not a primitive character at all.

The other three species mentioned, *viz. C. baileyanum, oleiferum,* and *trifoliolatum,* are representatives of *sect. Canariellum.* This case deserves some more attention, since the section just mentioned, on account of some apparently primitive characters, might be regarded as a relic-group, which implies that here the absence of medullary vascular strands might be primary. However, let us first have a look at the other three species of section *Canariellum.*

[1]) The figures refer to the number of the species in this monograph.

C. muelleri: type 2, vascular strands represented only by resiniferous ducts, which seems to be a specialization in the phloem of normal vascular strands. This species is closely allied to *C. baileyanum* and *C. oleiferum,* the latter being generally somewhat more specialized.

C. balansae: type 4; see, however, sub d.

C. whitei: type 2, vascular strands only consisting of sclerenchyma, which normally seems to represent a specialization of the xylem in these medullary vascular strands.

From this it might be inferred that in the three species under discussion the medullary vascular strands are in a highly specialized state and, in all probability, even more or less reduced. It seems therefore quite improbable indeed that the absence of vascular strands in three species of *sect. Canariellum* would represent a primitive character.

Concluding, it seems that the absence of medullary vascular strands in the twigs of *Canarium* should be considered as a derived feature.

b. Apart from some representatives of *sect. Canariellum, type 2* is specially characteristic of the *hirsutum*-group; in part of its species at least the peripheral strands may be cylindrically arranged.

c. *Type 3.* If a peripheral cylinder of medullary vascular strands is present, it is taxonomically speaking of little importance whether or not central strands are present. In many species more than one possibility is represented, and none of these types is restricted to one group only. Even the apparently highly advanced character of a second, central cylinder is scattered throughout the genus, with only a slight concentration in some related species of the *asperum*-group.

d. *Type 4.* The absence of central strands is the usual state, which is found in all groups of the genus. The only abnormality is shown by *C. balansae* of *sect. Canariellum*: apart from the peripheral strands, which are amphivasal, and in which the phloem mainly consists of one big resiniferous duct, the xylem consists for the greater part of sclerenchyma, whereas in the central pith a number of scattered big parenchymatic cells are present (the last remnants of reduced strands?).

e. The sequence of the types as given above is the same as that of the 'Phasen', introduced by Lam (1932a, 170—178), which sequence he supposed to be of phylogenetical value. Though at first sight this seems to be quite plausible, it is clear from the above considerations that this assumption is not supported by the taxonomic relationships, though it should be admitted that in the *Burseraceae* as a whole the absence of medullary vascular strands is more primitive than their presence. In *Canarium* it is therefore of no importance for the evaluation of the relative primitiveness of a given species.

The medullary vascular strands in a few species of *Santiria,* in one species of *Haplolobus,* and in most of the species of *Dacryodes* are mostly arranged according to type 2; in *Dacryodes* the types 3a and 4 are represented in a few species.

2. The spines of C. sumatranum.

The occurrence of spines on the twigs of young specimens of *C. sumatranum* seems to be a unique feature in the genus; they are conical, scaly,

up to 7 by 4 by 3 mm, and rather hard. Possibly they are not normal emergences but represent adventitious buds. This may be cleared up by anatomical and ontogenetical examination of fresh material.

3. Leaf.

As to the leaf I may refer to the extensive treatment by Lam (1932a, 147—159) in which he concluded that the pinnate leaf of the *Burseraceae* very well may be homologous with a branch. This theory is criticized on anatomical grounds by Sinia (1938, 69—105), and is in my opinion also in contradiction with the ontogenetical facts.

4. Stipules.

The following types are distinguishable:

Type 1. Stipules absent: 29—32, 34—38, 40, 43, 44, 47—50, 54—58, 70—75.

Type 2. Stipules represented by a basal pair of small, though otherwise normal leaflets, which are inserted at the very base of the petiole: 33.

Type 3. Stipules subulate: 39—42, 45—47, 50—54, 56, 59—69.

Type 4. Stipules flat or auricle-shaped: 1—28.

Except in *Canarium,* stipules are generally absent in *Burseraceae.* The only other exceptions are *Garuga* (stipules type 2) and *Dacryodes;* in the last named genus *D. edule* shows stipules of type 2, in *D. laxa* the basal pair of leaflets is sometimes smaller, inserted slightly above the base of the petiole, and in that case they are often very caducous except for (part of) the petiolule.

a. Among the species of *type 1,* there are some in which the absence of stipules may be very well considered primitive, *viz.:*

1. the isolated *sect. Canariellum,* which seems to have retained some more relic-characters.

2. the *oleosum*-group, which shows some relationship to *sect. Canariellum,* and which is considered here as the basic group of *sect. Pimela.*

3. *C. pseudodecumanum* and possibly also the *apertum*-group, which may be related with that species.

The other species without stipules, forming part of the *pilosum* and the *hirsutum*-group, are all related to species with stipules and sometimes even only occasionally lack stipules; moreover these are all more derived species. Only in the *hirsutum*-group may the absence of stipules in some species be primitive as well (see chapter III j).

b. The only type of stipules, which is known to occur in *Burseraceae* outside *Canarium* — and which may very well be primitive — is *type 2.* In *Canarium* this type occurs only in *C. decumanum,* a species of a rather obscure relationship; it is closely allied only to *C. pseudodecumanum,* which has no stipules. This type we may call *foliolar pseudo-stipules.*

c. Among the two types of stipules which are the most common in *Canarium,* and which are not known from any other *Burseraceous* genus, *type 3,* the subulate ones, may also in our opinion be termed *pseudo-stipules,* and I agree with Lam (1932a, 159—170) that they represent the next stage

in the 'regressive series', which started with the foliolar pseudo-stipules. The following two points seem in favour of this opinion:

1. Besides the situation of the stipules in *Dacryodes laxa,* especially some abnormalities in *C. hirsutum,* comparable with that case, seem to point to this derivation: *fig. 1.* Case *1a* shows that the lowest pair of leaflets is smaller and inserted more towards the base of the leaf than in normal leaves (in this case normal subulate stipules were present). The case depicted in *fig. 1b* is still more interesting: the basal pair of leaflets is inserted here still closer to the base of the petiole, the leaflets are smaller —about as small as the pseudostipules of *C. decumanum* — and their petiolules are flattened (this is in accordance with the normal subulate pseudo-stipules of this species, but stands in contrast to the petiolules of the foliolar pseudo-stipules of *C. decumanum*). Furthermore it is striking in this latter case that one of the leaflet-*blades* was detached in the herbarium-specimen, whereas normally the leaflets break off at the base of the petiolule and not at its apex; the remaining petiolule looked quite like a normal subulate pseudostipule. In the specimen I could not trace any stipule, but I am not quite certain about this point.

2. From an abnormal specimen of *C. subulatum* (*Kerr 5405*) it became evident that the bracts in *sect. Pimela* — in contradistinction to *sect. Canarium* — are homologous with the base of the petioles, the stipules taking no part in it, even being shifted rather high up on the leaf stalk. This means that in this case the stipules are no formations of the base of the petiole.

d. *Type 4.* The other kind of stipules which is within the *Burseraceae* only found in *Canarium* and here restricted to *sect. Canarium,* may be called true or secondary stipules (Lam's *meta-stipules*). In my opinion these are fundamentally different from the foregoing ones. This may be sustained by the following points:

1. As appears from a specimen of *C. kaniense* (*Clemens 1288*) the bracts are homologous with the base of the petiole and the stipules. This implies that, in contradistinction to *sect. Pimela,* in this case the stipules are formations of the base of the petiole.

2. I have tried to gain some insight into the taxonomic relationships of section *Canarium* (see chapter III). The picture I arrived at, mainly based on flower-characters, proved to be in accordance with geographical facts, and may therefore generally be regarded as trustworthy. Those species which, according to this scheme, would be most primitive, all possess very small, caducous stipules inserted at the conjunction of petiole and branchlet. In the species which seem to be more derived, the stipules are larger and more persistent and they are often inserted on the petiole. Moreover, in the last-named case the stipules function both as bud scales and as bracts. The auricle-shaped stipules seem to represent a reduced and function-less state. Though I agree with Lam that these stipules are regressive, I do not include them in his 'regressive Reihe' (pseudostipules) but rather in his 'progressive Reihe' (metastipules), in accordance with the taxonomical position of the species concerned. This opinion is supported by the variability of *C. maluense* (including forms with basal and with auricle-shaped stipules) and by that of *C. caudatum* (partly included by

Lam in his *Regressivae* under this name, partly — specimens with basal stipules — in his *Progressivae* under the name *C. pauciflorum*).

It is certainly striking that the comparative morphology of the stipules

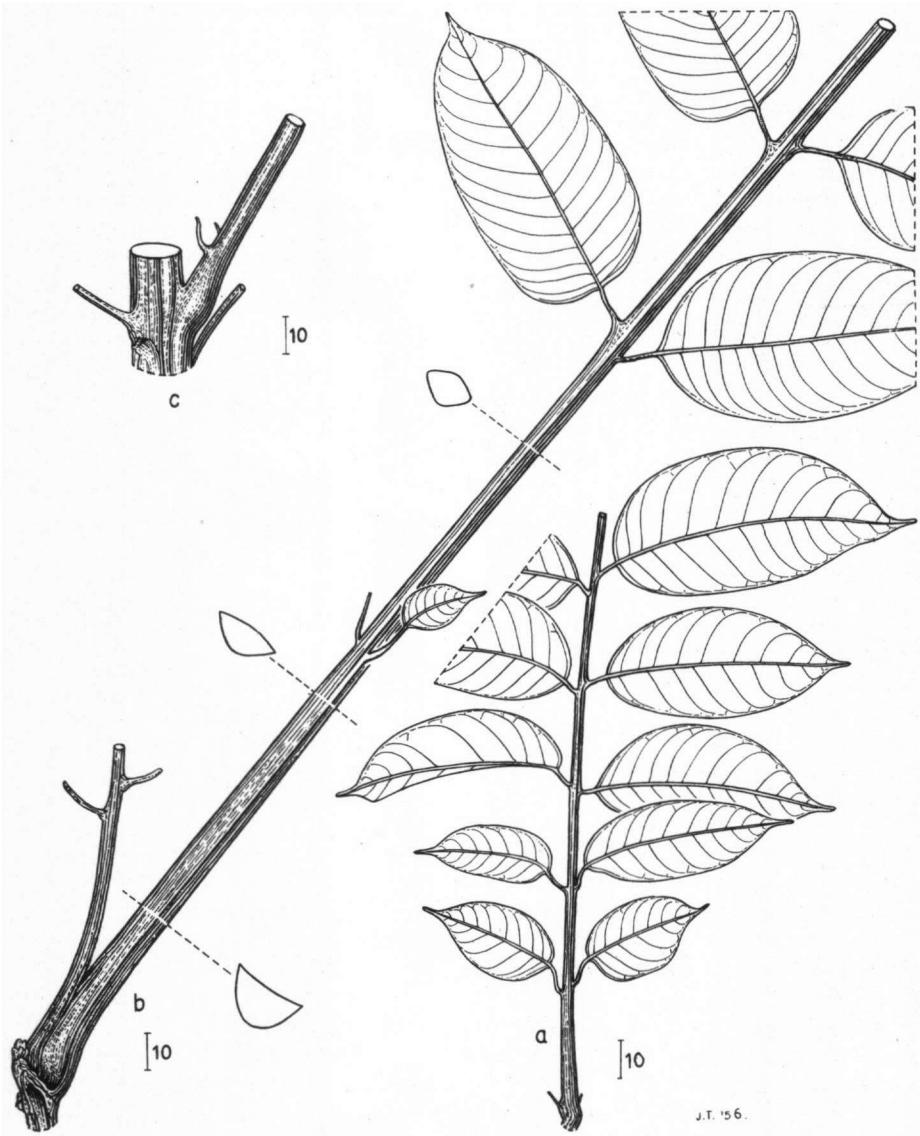


Fig. 1. Different phases in the development of subulate stipules in *C. hirsutum*. a. lowest pair of leaflets unusually small, b. lowest pair of leaflets still smaller and rather distant from the next pair, blades of the lowest pair caducous, c. normal subulate stipules. (a. from *Ahern 789*, b. from *BS. 7772*3, c. from *Merrill Sp. Blanc. 909*) (dimensions in mm).

turned out to be the best basis for the taxonomy of the genus. It is Lam's merit to have discovered the importance of this character and to have used it for the first time for subdividing the genus. It is distinctly satisfactory that, whereas I based myself in my taxonomic study of the genus primarily on reproductive characters, I arrived at almost the same classification as Lam. I have only a slightly different opinion on the phylogeny of the stipular types, and hence on the position of his *Auriculatae*, as discussed above.

5. Nervation.

The nervation is often very characteristic for the species though difficult to describe precisely. In the description of the nervation I have often made use of the term *intermediate veins*. With this term I mean to distinguish veins which originate from the midrib and run more or less parallel to the nerves. Usually they are easily distinguishable from the latter as they arise much closer to the next upper than to the next lower nerve, running nearly transverse to the midrib and usually zigzagging towards the margin, forming no part of the marginal archings. Even the less well developed nerves, which are present in some species, are well distinct from the intermediate veins by the above-mentioned characters.

6. Inflorescences.

The inflorescences may be either axillary or terminal, and either thyrsoid, racemose, or spicate. Especially the first-named distinction deserves a closer consideration, as it seems to be of taxonomical value.

Type 1. Inflorescences axillary: 3, 14, 18—23, 28, 32—51, 54—71, 73—75.

Type 2. Inflorescences terminal: 1, 2, 4—8, 10—13, 15—17, 21, 23—27, 29—31, 40, 41, 52, 53, 70, 72.

a. *Axillary inflorescences* — occasionally together pseudo-terminal — are distinctly predominant in *sect. Pimela,* with only two constant (the mutually closely allied *C. dichotomum* and *fusco-calycinum*) and two occasional exceptions (the closely allied species *C. pilosum* and *merrillii,* which are possibly also related to the foregoing two species). In the two latter species truly terminal inflorescences are rare; even the usually apparently terminal inflorescences of *C. merrillii* are mostly pseudo-terminal, the vegetative terminal bud being very minute and dormant during the flowering period but developing afterwards, thus dividing the large 'terminal' inflorescence into a number of smaller axillary infructescences.

Axillary inflorescences are further known from the *decumanum*-group (the possibly related *apertum*-group possesses terminal inflorescences, however), from most species of *sect. Canariellum*, which is supposed to be rather primitive (sometimes terminal, however, in the apparently most primitive species, *C. baileyanum,* and terminal in *C. oleiferum*), and finally from nine species of *sect. Canarium.* The latter case deserves some more attention, since these 9 species fall apart into two groups, as follows:

1. *C. perlisanum, harveyi, luzonicum,* and *ovatum* are all of them

species, which are also in some other characters rather deviating and are somewhat isolated within their respective groups.

2. The same may be true for *C. schweinfurthii*, which is apparently the ultimate species in the *denticulatum-series*. This is the more interesting, at the most primitive members of this group also show axillary inflorescences: *C. odontophyllum* always (in contradistinction to the closely allied *C. littorale*), as well as *C. karoense*, usually also *C. denticulatum* and *megalanthum*. In the development towards the west this character changes abruptly, however: *C. manii, zeylanicum, paniculatum*, and *madagascariense* all possess terminal inflorescences, and only the rather isolated *C. schweinfurthii*, which is aberrant in much more characters, shows again axillary inflorescences.

b. *Terminal inflorescences* appear to be the rule in *sect. Canarium;* in this section as well as in *sect Pimela* there is some evidence that they are derived from axillary ones (see a). This opinion is in accordance with the one expressed by Lam (1932a, 144—147).

c. The shape of the inflorescences is of no great importance; usually they are thyrsoid, only in the *hirsutum* and the *asperum*-groups there is a distinct tendency towards racemose or even — in the last-named group — spicate inflorescences. Further the case of the ♂ inflorescences of *C. album* is interesting: in the Chinese specimens the lateral cymes are long and stalked, in the Indo-Chinese ones they are shorter and sessile, and, moreover, this tendency towards condensation correlates with an increasing reduction in the flowers.

7. Bracts.

Some abnormalities illustrate in a very clear way the origin of the bracts. As these facts have been published before (Leenhouts, 1956, 211, f. 1), and are already mentioned above (the present chapter, 4 c & d), I shall confine myself here to a short summary:

a. The narrow-triangular bracts in *sect. Pimela*, and in all probability also those in *sect Canariellum*, are homologous with the basal part of the petiole.

b. The usually much broader, more or less leafy bracts of *sect. Canarium*, which usually enclose the flower buds, and which often show some resemblance to the stipules, are homologous with a pair of stipules and a minute basal part of the petiole.

8. Flowers.

Since Lam (1931—32a, 23—56 & 97—137) has given an extensive survey of the flower-morphology of the family, and in particular of the present genus, I did not pay special attention to this subject. Therefore I shall restrict myself to some cases of special interest.

a. *Petals.* There are only two exceptions to the normal shape of petals; as these are both of taxonomical importance, they deserve special attention:

1. The petals in the *apertum*-group are distinctly unguiculate.

2. Some species of the *hirsutum*-group are characterized by petals, which are strongly thickened in the upper half, with much broadened and rugose valvate margins, *viz C. rigidum, polyphyllum,* and *sumatranum.*

b. *Stamens.* Coalescence of the filaments, if more than at the very base only, is nearly exclusively restricted to *sect. Pimela. C. perlisanum* (aberrant in some more characters and of unclear affinity) is the only example in *sect. Canarium.*

The reduction of the stamens in the ♀ flowers is usually very slight only.

Lam (*l. c.* 116) used the term *didynamic* in a wrong sense; as appears from his description, he meant tridynamous, as the three episepalous stamens are often slightly larger than the epipetalous ones.

c. The *androphore* of *C. schweinfurthii,* which is unique in the genus, deserves special attention. In ♂ flowers of this species the tubular disk is strongly developed, and as the stamens are adnate to the whole length of the disk and exsert beyond its rim, they seem to be inserted on its margin, and together form a cylindrical extension of the receptacle.

9. Fruiting calyx.

In fruiting specimens of *sect. Pimela* and *sect. Canariellum* the calyx is only slightly enlarged as is usual in the family; in *sect. Canarium,* however, the calyx is nearly always distinctly accrescent in fruit.

10. Fruits.

Here again I shall restrict myself to a single correction of the extensive review, given by Lam for the whole family (*l. c.* 137—144).

The structure of some sterile, though nearly fully developed fruits of the Papuan *C. megacarpum,* in which the axial part was not developed

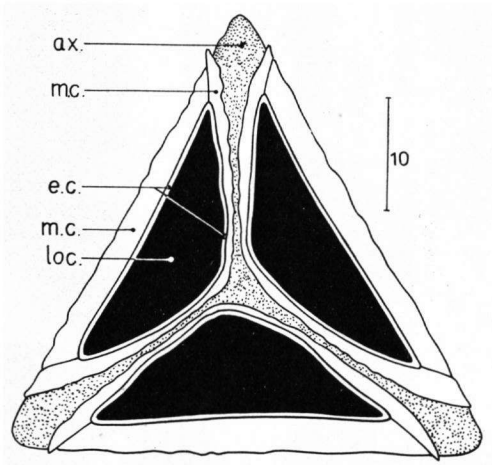


Fig. 2. *C. megacarpum,* cross-section of a sterile fruit. ax. axial part, mc. mesocarp, ec. endocarp, loc. locule (pericarp removed) (from an unnumbered specimen in *herb. L.*) (dimensions in mm).

WOOD ANATOMY IN THE GENUS CANARIUM

by Mr H. D. Ingle and Dr H. E. Dadswell

CANARIUM SPECIES	No of samples	RAYS: Horizontal gum canals	RAYS: m — marginal Oxalate crystals c — central	RAYS: m — marginal Silica deposits c — central	RAYS: m — marginal Vesselray-pitting c — central	PARENCHYMA: Vasicentric	PARENCHYMA: Sparse paratrach	PARENCHYMA: Silica deposits	PARENCHYMA: Oxalate crystals	FIBRES: Silica deposits
Section Canarium										
1. littorale	12	+	+ m	— —	+	+ —	+ —	+	—	—
4. patentinervium	1	+	+ m	— —	+	+	+ —	+	—	—
8. maluense	3	+	+ m	— —	+	+	—	+	—	—
11. sylvestre	1	+	+ m	— —	+	—	—	+	—	—
13. salomonense ssp. papuanum	5	+	+ m	— —	+	+	+	+	—	—
16. indicum var. indicum	14	+	+ m	— —	+		+	+	—	+
17. kaniense var. kaniense	1	+	+ m	— —	+	—	+	+	—	+
var. globigerum	1	+	+ m	— —	+	—	+	+	—	+
18. luzonicum	1	+	+ m	— —	+	—	+	+	—	—
19. ovatum	2	+	+ m	— —	+	—	+	+	—	—
20. odontophyllum	1	—	+ m	— —	+	—	+	+	—	—
21. denticulatum	3	—	+ m	— —	+	—	+	+	—	—
31. apertum	2	—	—	— —	+	+	+	+	—	—
Incertae sedis										
32. pseudodecumanum	3	—	+ m	— —	+	+	+ —	+	—	—
33. decumanum	1	—	+ m	— —	+	—	—	+	—	—
Section Pimela										
35. balsamiferum	1	—	—	— —	+	+	—	+	—	—
36. trigonum	1	—	—	— —	+	+	—	+	—	—
37. euryphyllum	2	—	—	+ m —	+	+	—	+	—	+
38. gracile	1	—	+ m	+ m —	+	+		+	—	+
51. australianum	10	—	+ m	+ m c	+	+	—	+	—	+
52. dichotomum	1	—	—	— —	+	—	—	+	—	—
54. hirsutum	2	—	—	+ m —	+	+	— +	+	—	+
58. polyphyllum	1	—	+ m	— —	+			+	—	—
60. vrieseanum	2	—	+ m	+ m + c	+	+	—	+	—	+
61. asperum var. asperum	8	—	+ m	+ m — + c	+	+	—	+	—	+
var. clementis	1	—	—	+ m + c	+	+	—	+	—	+
ssp. papuanum	1	—	+ m	— —	+	+	—	+	—	—
62. schlechteri	10	—	+ m	— —	+	+	—	+	—	—
63. acutifolium var. acutifolium	12	—	(+ c [3]) + m	+ m —	+[1]	+	— +	+	—	—
var. aemulans	2	—	+ m[2]	— —	+	+	— +	+	—	+
65. chinare	1	—	+ m	— —	+	+	—	+	—	—
Section Canariellum										
70. baileyanum	6	+	—	— —	+	—	—	+	—	—
71. muelleri	3	+	+ m	— —	+	—	—	+	—	—
72. oleiferum	2	+[3]	+ m	— —	+	—	—	+	—	—+[3]

as well as usual, makes it seem probable that the mesocarp, together with part of the endocarp, does not only form the lids, but fully surrounds the cells (outside of the endocarp of course). See *fig. 2.* From this follows that in normal fruits the dissepiments, though appearing as a seamless whole, are really composed of both mesocarp and axial tissue. This point deserves further ontogenetical study with fresh material!

Normal fruits of the same species support Lam's opinion that the lids and the 3-winged central part are of a different origin. The pericarp of the species just mentioned is fibrous, but fibres are only inserted on the lids, not on the ribs, which are the margins of the axial intrusion.

11. Wood anatomy.

Personally, I have given no attention to this point, but Mr H. D. Ingle, of the C. S. I. R. O., Melbourne, who, together with Dr H. E. Dadswell, made an anatomical study of wood samples of many species of *Canarium,* kindly put the tabulated results of their joint study at my disposal (see p. 286). It is interesting that in many cases species, or groups of species, which are thought to be related on grounds of outer morphology also show a closer affinity anatomically. On the other hand there are some surprising exceptions, for instance the differences between the varieties of *C. acutifolium* and between the subspecies of *C. asperum.* As a whole, however, the uniformity in the sections, especially in *sect. Canarium,* is striking, and the anatomically aberrant species are generally also those which are of uncertain taxonomical affinity.

[1]) Crystals distinctive — numerous per cell.
[2]) Often very small and of different appearance to those in rest of family.
[3]) Sparse in one sample.

II. GEOGRAPHY

> "I think that a small number of well-checked and well-interpreted data from a thoroughly known group are at least as valuable towards historical biogeography as a great number of facts on a less trustworthy basis."
>
> H. J. Lam, Blumea 3, 1938, 127.

With the words quoted above in mind, I have tried in this chapter to come to a geographical analysis of the genus *Canarium*. For that purpose I have subdivided the area of the genus into 11 regions, and some of these regions into a number of subregions, all as naturally delimited geographically as possible. For the sake of convenience these regions will be dealt with from West to East.

Species which are endemic in any of the accepted regions or subregions are denoted by an asterisk.

1. Africa.

27. *C. madagascariense* *28. *C. schweinfurthii*

Of these two *C. schweinfurthii*, restricted to the Central and West African rain-forest belt, is a very remarkable species, probably derived from the same stock as *C. madagascariense*, though probably isolated for a much longer time. *C. madagascariense* ssp. *madagascariense*, in East Africa confined to the coastal region, is furthermore abundant in the drier western and central parts of Madagascar.

2. Madagascar.

27. *C. madagascariense*

Subendemic, the western subsp. *madagascariense* occurs also in East Africa. Distinctly allied to *C. paniculatum* (Mauritius) and to *C. zeylanicum* (Ceylon).

3. Mauritius.

*26. *C. paniculatum*

Endemic. Allied to *C. madagascariense* (Madagascar, E. Africa) and to *C. zeylanicum* (Ceylon).

4. Ceylon.

*25. *C. zeylanicum*

Endemic. Interrelated between *C. manii* (Andaman Isl.) on the one side, and *C. paniculatum* (Mauritius) and *C. madagascariense* (Madagascar, E. Africa) on the other.

5. Continental S. and S.E. Asia (including the Andaman and Nicobar Isl., but excluding the Malay Peninsula).

1. *C. littorale*	*44. *C. parvum*
21. *C. denticulatum*	*45. *C. subulatum*
*24. *C. manii*	*46. *C. bengalense*
*42. *C. album*	*47. *C. strictum*
*43. *C. pimela*	*48. *C. euphyllum*

The most surprising fact is that to sect. *Canarium* belong only three out of the above ten continental Asiatic species. This is the more remarkable as the centre of distribution of this section apparently was West Malaysia — in contradistinction to the East Malaysian sect. *Pimela,* to which the other seven species belong — and since it apparently developed early enough for reaching both Africa and Samoa. Another interesting fact is that two out of these three species of sect. *Canarium* are the only *Canarium* species which are also — and even mainly — distributed outside the present region; both make the impression to be rather recent invaders.

The seven species of sect. *Pimela* are all rather closely related; they belong to the *pilosum*-group, which is the only typically western group in this mainly E. Malaysian section.

As *Canarium* is largely a representative of the lowland rain-forest, the most appropriate geographical subdivision of the continental Asian area appeared to be the one which mainly coincides with the large plains and river-basins, which are often separated by high ranges, as follows:

a. Deccan Peninsula.

47. *C. strictum*

This species is here restricted to the moist strip of lowland in the southern and south-western part; it is further known from Sikkim, Assam, and Upper Burma, without showing distinct morphological differences. It is remarkable that it is absent from Ceylon.

b. Bengal & Assam (Lower Ganges and Brahmaputra Basins).

46. *C. bengalense*	47. *C. strictum*

Both species also in Burma, *C. bengalense* moreover known from Thailand and S. Indo-China (Laos), *C. strictum* furthermore abundant in the S.W. Deccan.

c. Burma (Irrawaddy Basin)

21. *C. denticulatum*	47. *C. strictum*
46. *C. bengalense*	48. *C. euphyllum*

Of these 4 species, two (*C. denticulatum* and *euphyllum*) point to a relationship with the Andaman and Nicobar Isl., the two others (*C. bengalense* and *strictum*) form part of a series of species which are distributed from S. Indo-China to Bengal (*C. strictum* to the S.W. Deccan).

The distribution of *C. denticulatum* offers interesting details: the Burmese specimens belong to the West Malaysian ssp. *denticulatum,* which is also distributed in the Andaman Isl. I am inclined to assume that ssp.

denticulatum is a relatively recent invader into the Andamans, and through these islands, S. Burma .

d. Andaman & Nicobar Islands.

21. *C. denticulatum* 48. *C. euphyllum*
*24. *C. manii*

Phytogeographically these three species represent obviously more or less heterogeneous elements in the flora of this region.

C. euphyllum is distinctly related to the continental Asiatic species of the *pilosum*-group, notably to *C. strictum* and *bengalense;* moreover, the fact that *C. euphyllum* itself also occurs in S. Burma, points to a relationship between the present region and Burma.

C. denticulatum represents another element in the flora of this region. It is mainly restricted to W. Malaysia, though, besides the Andamans, it is known also from S. Burma. I am inclined to assume that it originated in West Malaysia and reached S. Burma via the Andamans.

C. manii, the only endemic species, is particularly related to *C. zeylanicum*; towards the east its relationship is undoubtedly with the *denticulatum*-group. The stock of this group must have originated rather early, however, as these species seem to be distinctly more primitive in some characters than the Malaysian representatives of the group, and are possibly closer to the *littorale*-group. *C. manii* represents the first link in a well-known biogeographical chain of affinity, which connects W. Malaysia via the Andamans, Ceylon, the Seychelles, and Madagascar (avoiding the Asiatic continent) with Africa.

It is, of course, quite risky to say anything about the time in which these species or their ancestors reached this area. *C. manii* must represent a very old element, being the first step in a series of species which even succeeded in reaching W. Africa and developed in that part of the world such an aberrant species as *C. schweinfurthii. C. euphyllum* is the only species which covers the whole subregion of the Andamans and the Nicobars, and may therefore have been a rather early invader from Burma. *C. denticulatum* seems to be a rather recent invader, though it succeeded in reaching S. Burma as well.

The geological data at hand seem to be insufficient for solving the problem of dating these migrations. The Andamans and Nicobars are part of an outer, non-volcanic arc, remainders of which are the Arakan Yoma in Upper Burma, and the islands W. of Sumatra. This arc consists of heavily folded Eocene deposits, which are discordantly covered by Miocene layers; consequently the upthrust of this region must have taken place in the Oligocene. Raised terraces and coral-reefs furthermore point to important vertical movements in the young Quarternary.

e. Thailand, Laos, Cambodia, Cochin China (Me-Kong & Me-Nam Basins).

43. *C. pimela* 46. *C. bengalense*
*45. *C. subulatum*

Out of these three species, *C. bengalense* is a western element, reaching Bengal, and more closely allied to *C. strictum* and *C. euphyllum. C. pimela*

represents the eastern species of the continental part of the *pilosum*-group. *C. subulatum* is endemic in this subregion, and is interrelated between the two other species. Therefore this subregion apparently forms the link between the *Canariums* of S. Asia and those of S.E. Asia.

f. Annam, Tonkin, & S. China (Song-koi and Song-bo Basins and coastal plains of Tonkin Bay).

1. *C. littorale*
42. *C. album*
43. *C. pimela*
*44. *C. parvum*

Three out of these 4 species (*C. album, pimela,* and *parvum*) are mutually closely allied and have the main part of their area in this region. *C. parvum* is endemic, both others occur also in Hainan, *C. pimela* is moreover known from Laos and Cambodia. These three species show doubtless close affinity to the W. Malaysian *C. pilosum,* possibly especially to its Bornean subsp. *borneense,* and to *C. merrillii,* also from Borneo.

In a way the occurrence of *C. littorale,* representing sect. *Canarium,* is exceptional. The few specimens, known from central Annam and belonging to f. *purpurascens,* are still more advanced than the typical specimens from the Malay Peninsula.

g. Hainan.

42. *C. album*
43. *C. pimela*

Both species occur also in S. China, which is not surprising. They are commonly cultivated, and their present distribution may therefore be only partly natural.

6. **West Malaysia** (Sunda-land).

1. *C. littorale*
*2. *C. latistipulatum*
*3. *C. perlisanum*
*4. *C. patentinervium*
*5. *C. caudatum*
*6. *C. divergens*
*7. *C. kinabaluense*
8. *C. maluense*
15. *C. vulgare*
20. *C. odontophyllum*
21. *C. denticulatum*
*22. *C. karoense*
*23. *C. megalanthum*
*29. *C. pseudopatentinervium*
*30. *C. grandifolium*
*31. *C. apertum*
*32. *C. pseudodecumanum*
33. *C. decumanum*
*39. *C. kostermansii*
*40. *C. pilosum*
*41. *C. merrillii*
*49. *C. intermedium*
*50. *C. kipella*
*52. *C. dichotomum*
*53. *C. fusco-calycinum*
54. *C. hirsutum*
?*55. *C. pseudosumatranum*
*56. *C. sumatranum*
61. *C. asperum*

Out of these 29 species (18 of which belong to sect. *Canarium,* 11 to sect. *Pimela*) 21 (or 20?) are endemics — 12 of these apparently very local —, 1 (*C. littorale*) is subendemic, and 7 species have a wider distribution (*C. maluense* is represented, however, by an endemic subspecies). These conditions point to a high degree of isolation in this part of the area.

Let us first of all have a closer look at these groups in general.

Among the endemics, 12 (among which 6 local endemics) belong to sect. *Canarium* and 9 (or 8?) to sect. *Pimela* (among which are 6 local endemics). The endemic species of sect. *Canarium* all belong to those which I regard as being relatively primitive; moreover, *C. littorale,* the species assumed to be the most primitive one in many respects, is subendemic (furthermore known only from central Annam in a few morphologically extreme specimens). The only representative of the more advanced *maluense*-group, *C. maluense* ssp. *borneense,* endemic in E. Borneo, is regarded as being the typological base of that group. All this strengthens the supposition that this part of the Malay Archipelago should be considered to represent the centre of origin, or at least the main centre of distribution, of this section. The endemic species of sect. *Pimela,* on the contrary, mainly belong to the more advanced *pilosum* and *dichotomum*-groups; two species (*C. pseudosumatranum,* possibly occurring also in Burma, and *C. sumatranum*) are rather restricted in distribution, and are related to the widely distributed *C. hirsutum,* a species that has developed several local endemics along the margin of its area.

Among the 7 more widely distributed species, 2 are mainly western, extending their area only slightly outside the present region, the other 5 are mainly East Malaysian, extending their area more or less to West Malaysia. The two principally West Malaysian species are *C. odontophyllum* and *C. denticulatum*; they are rather close relatives, the former occurs also in Palawan, the latter extends to Mindanao to the east and to the Andamans and S. Burma on the west side. Among the 5 East Malaysian species, 3 (*C. maluense,* represented by an endemic subsp. in E. Borneo; *C. decumanum,* also in E. Borneo; *C. vulgare* in Bawean and Kangean) touch only the border areas of Sunda Land. The two remaining ones (*C. hirsutum* and *C. asperum*) are distributed throughout the greater part of the Malaysian Archipelago. These two species apparently originated in E. Malaysia; in W. Malaysia, which they probably reached via the Philippines, their variability is strongly diminished, and here *C. asperum* is even only known from Borneo, Bawean, and Kangean.

After these general considerations, we may have a closer look at the subdivisions of the region.

a. Sumatra (incl. the adjacent islands).

1. *C. littorale*
4. *C. patentinervium*
5. *C. caudatum*
20. *C. odontophyllum*
21. *C. denticulatum*
*22. *C. karoense*
23. *C. megalanthum*
29. *C. pseudopatentinervium*
31. *C. apertum*
32. *C. pseudodecumanum*
40. *C. pilosum*
*49. *C. intermedium*
52. *C. dichotomum*
54. *C. hirsutum*
56. *C. sumatranum*

Out of these 15 species, 12 are West Malaysian endemics. Only 2, however, are restricted to Sumatra (*C. karoense* and *C. intermedium*). It is not surprising that only one of the more widely distributed, originally East Malaysian species, *viz. C. hirsutum,* reaches Sumatra.

Though Sumatra is apparently the centre of origin of *C. littorale*, and therefore of the whole *littorale*-group, and possibly also of the *denticulatum*-group, it seems to have been a much less important centre of speciation than for example Borneo, or even the Malay Peninsula.

b. Malay Peninsula.

1. *C. littorale*
*3. *C. perlisanum*
4. *C. patentinervium*
5. *C. caudatum*
21. *C. denticulatum*
23. *C. megalanthum*
*30. *C. grandifolium*
31. *C. apertum*
32. *C. pseudodecumanum*
40. *C. pilosum*
54. *C. hirsutum*
*55. *C. pseudosumatranum*
56. *C. sumatranum*

There are 13 species in all, among which 10 are West Malaysian endemics. Only 3 of these (*C. perlisanum, grandifolium,* and *pseudosumatranum,* the latter possibly also in Burma) are endemic in the Malay Peninsula. Consequently the picture is not very different from that in Sumatra. Here again, *C. hirsutum* is the only species with a wide area and East Malaysian relationships. All the other species are distributed throughout W. Malaysia, with the occasional exception of Java. *C. sumatranum* is the only species which is restricted to Sumatra and the Malay Peninsula; this is to be considered one of the marginal endemics of *C. hirsutum.*

c. Java (including Madura, Bawean, and Kangean).

1. *C. littorale*
15. *C. vulgare*
21. *C. denticulatum*
*50. *C. kipella*
54. *C. hirsutum*
61. *C. asperum*

There are 6 species, of which one endemic (*C. kipella,* in W. Java, closely allied to *C. intermedium* of S. Sumatra). West Malaysian endemics are furthermore absent. The only other typically West Malaysian species present are *C. littorale* and *C. denticulatum,* which both have an area slightly extending outside of W. Malaysia. Out of the three East Malaysian species two (*C. vulgare* and *asperum*) are here restricted to Bawean and Kangean; they are the only representatives of the genus on these small islands, which in this respect are apparently more closely related to E. Malaysia than to Java. *C. hirsutum,* finally, is found in all parts of Malaysia. In conclusion, the peculiar feature of this subregion is the relative paucity of species and the remarkable situation that 2 out of the 3 eastern species occur only in small islands which are very close to the mainland of Java but obviously occupy a singular position of eastern relationships as far as *Canarium* is concerned.

d. Borneo.

1. *C. littorale*
*2. *C. latistipulatum*
4. *C. patentinervium*
5. *C.caudatum*
*6. *C. divergens*
31. *C. apertum*
32. *C. pseudodecumanum*
33. *C. decumanum*
*39. *C. kostermansii*
40. *C. pilosum*

*7. *C. kinabaluense*
8. *C. maluense*
20. *C. odontophyllum*
21. *C. denticulatum*
23. *C. megalanthum*
29. *C. pseudopatentinervium*
*41. *C. merrillii*
52. *C. dichotomum*
*53. *C. fusco-calycinum*
54. *C. hirsutum*
61. *C. asperum*

The striking points are the large number of species (21 out of the 29 West Malaysian ones) and the high degree of endemism (6 species and 3 subspecies). These endemics all form part of West Malaysian groups, with the exception only of *C. maluense* ssp. *borneense*. The latter, however, is very close to the West Malaysian *littorale*-group, and in the author's opinion represents the link between that group and the East Malaysian *maluense*-group.

It is interesting to mention two closely related West Malaysian species (*C. odontophyllum* and *denticulatum*) both of which apparently have their centre of origin in Sumatra, and have developed more advanced forms in Borneo. Moreover, of these two species one (*C. odontophyllum*) reached Palawan, the other (*C. denticulatum*) extends its area to Mindanao and Basilan; accordingly they demonstrate the two possible connections between Borneo and the Philippines.

Finally, 3 species which have apparently their centre of origin in E. Malaysia, are present in Borneo. One of these, *C. decumanum*, is not known from the Philippines, and in Borneo it occurs apparently only in the S.E. part. Taxonomically speaking, it is possibly to be considered a relic species, and, together with *C. maluense*, which also is unknown from the Philippines, it seems to be an example of the possibility for a direct crossing of Macassar Strait. *C. hirsutum* and *C. asperum* have obviously reached Borneo via the Philippine track, according to the distributional patterns of the infraspecific taxa of these species.

7.Philippines.

*18. *C. luzonicum*
*19. *C. ovatum*
20. *C. odontophyllum*
21. *C. denticulatum*
*37. *C. euryphyllum*
*38. *C. gracile*
54. *C. hirsutum*
60. *C. vrieseanum*
61. *C. asperum*

The phytogeographical position of the Philippines concerning *Canarium* is rather interesting. Out of the comparatively small number of 9 species 4 are endemics — 2 probably and 2 possibly of East Malaysian origin, but all of them obviously isolated for rather a long time —, 2 are West Malaysian species which slightly penetrate into the Philippines, and the 3 remaining ones are East Malaysian, two of which are distributed throughout the greater part of Malaysia. These latter 3 species are represented in the Philippines by endemic varieties or forms.

Among the 4 endemics, two (*C. euryphyllum* and *gracile*) belong to sect. *Pimela*, which is chiefly East Malaysian, the other two (*C. luzonicum* and *ovatum*) to sect. *Canarium*, mainly West Malaysian. It is striking that the taxonomical position of all of these 4 species is somewhat puzzling.

C. euryphyllum and *gracile* are treated in the special part as specialized members of the *oleosum*-group — which is supposed to be the basic one of sect. *Pimela* —, but there remains some doubt whether or not *C. euryphyllum* is related to *C. hirsutum,* and *C. gracile* either to *C. merrillii* (Borneo) or to *C. dichotomum* (W. Malaysia). In any case, they have apparently been isolated during a rather long time. The two other species, *C. luzonicum* and *ovatum,* form part of the East Malaysian *vulgare*-group, though in some characters especially *C. luzonicum* shows some relationship with the western *littorale*-group, from which, in my opinion, the *vulgare*-group must have developed; the unusual axillary inflorescences of both species are also possibly relic-characters. Summarizing, the endemics point both to a rather high degree of isolation and to a predominant relationship with E. Malaysia, and there is some possibility, that the two representatives of the *vulgare*-group are to be considered remnants of an old track from W. Malaysia via the Philippines to E. Malaysia.

The two West Malaysian species, *C. odontophyllum* (Palawan) and *C. denticulatum* (Basilan and Mindanao), are both common in Borneo. They may demonstrate the two possible tracks from Borneo to the Philippines, assuming, of course, that theirs are no relic areas.

Among the three East Malaysian species, *C. vrieseanum* is, outside the Philippines, restricted to Celebes (2 endemic forms in the Philippines, the third one in Celebes). *C. hirsutum* and *asperum,* both probably of East Malaysian origin, but distributed throughout the greater part of the Malay Archipelago, are striking by their great variability in the Philippines. This variability mainly concerns the vegetative parts, however, and may therefore in part be due to ecological factors. One of the less advanced forms of both of these species reached W. Malaysia.

The conclusion is that the non-endemic species stress both the mainly East Malaysian relationship of the Philippines and their position as a bridge between E. and W. Malaysia, in which in more recent times the general direction seems to be from east to west.

Finally, the exceptional position of Palawan has to be mentioned. Its only three *Canarium* species are *C. odontophyllum, C. hirsutum,* and *C. asperum*; of the two last-named species only those forms which also occur in W. Malaysia. All typically Philippine elements are therefore lacking and, as far as *Canarium* is concerned, the flora of Palawan is a very impoverished Bornean one.

8. East Malaysia (including the Lesser Sunda Islands and the Aru Islands).

8. *C. maluense*
*9. *C. megacarpum*
*10. *C. lamii*
*11. *C. sylvestre*
*12. *C. piloso-sylvestre*
13. *C. salomonense*
15. *C. vulgare*
16. *C. indicum*
*17. *C. kaniense*
*36. *C. trigonum*
51. *C. australianum*
54. *C. hirsutum*
*57. *C. rigidum*
*58. *C. polyphyllum*
*59. *C. cestracion*
60. *C. vrieseanum*
61. *C. asperum*
*62. *C. schlechteri*

33. *C. decumanum*
*34. *C. oleosum*
*35. *C. balsamiferum*
*63. *C. acutifolium*
*64. *C. macadamii*
65. *C. chinare*

There are 24 species in all, 10 of which belong to the principally western sect. *Canarium*, 14 to the typically East Malaysian sect. *Pimela*. Out of the 24 species, 14 are endemic (8 of very local occurrence), 3 subendemic (all slightly penetrating into W. Malaysia, and all belonging to sect. *Canarium*!), and 7 species are more widely spread, 4 of these in an eastern direction (Pacific, Australia), and 3 towards the Philippines (among these the two wide-spread species *C. hirsutum* and *asperum*, the latter one also on Bawean and Kangean Islands).

Before dealing with the subregions, we will again have a somewhat closer look at these phytogeographically differing groups of species.

Among the 14 endemics, 5 belong to sect. *Canarium*, 9 to sect. *Pimela*. The 5 species of sect. *Canarium*, as well as all other representatives of this section in E. Malaysia, belong to two groups, *viz.* the *maluense* and the *vulgare*-group, the only exception being *C. decumanum*, the taxonomical position of which is uncertain. In my opinion, the *maluense* as well as the *vulgare*-group are relatively advanced within sect. *Canarium*; both have their chief distribution in E. Malaysia and Melanesia. The former is moreover represented in Borneo by *C. maluense* ssp. *borneense*, which forms a link with the more primitive western *littorale*-group. The latter is represented by *C. vulgare* — its most western species — in Bawean and Kangean (islands which, phytogeographically speaking, had probably better be included in E. Malaysia) and by two rather isolated species (*C. luzonicum* and *ovatum*) in the Philippines. All these facts seem to support the author's opinion, that sect. *Canarium* has to be considered of West Malaysian origin.

Likewise, the evidence derived from the endemics of sect. *Pimela* seem to point to an East Malaysian origin of this section. Its 9 species (5 of which local endemics) belong to several groups; 3 of them are even the possibly most primitive species of the allegedly basic *oleosum*-group. Of the two western groups, which are both advanced in many characters, the *dichotomum*-group is entirely absent, the *pilosum*-group being represented only by *C. australianum*. Furthermore the relationship with W. Malaysia in this section is restricted to two wide-spread species, *C. hirsutum* and *asperum*. The relationship with the Philippines is slightly stronger, but of greater importance is the relationship with the Pacific. In these respects the representatives of both sections show the same picture.

The 7 more widely spread species, finally, more or less emphasize the picture shown by the endemics and subendemics. Two of them belong to sect. *Canarium*, both going as far as the Solomon Islands (*C. salomonense* in the present region being represented by an endemic subsp.). Out of the 5 representatives of sect. *Pimela*, 2 (already mentioned above) are more widely distributed, one (*C. vrieseanum*) is represented in the Philippines by an endemic form, one (*C. australianum*) is also known from Australia, and one (*C. chinare*) from the Solomon Islands.

We will now pay some attention to the various subregions:

a. Celebes.

8. *C. maluense*
15. *C. vulgare*
33. *C. decumanum*
34. *C. oleosum*
35. *C. balsamiferum*
*36. *C. trigonum*
54. *C. hirsutum*
60. *C. vrieseanum*
61. *C. asperum*
63. *C. acutifolium*

First of all, it is interesting to note the low degree of endemism in regard of the fact that the number of species is not particularly small. The only endemic species, *C. trigonum*, is moreover closely allied to *C. balsamiferum*; further there are only some endemic varieties and forms.

A second point worth mentioning is, that both species belonging to sect. *Canarium* (*C. maluense* and *vulgare*) are regarded as primitive in their respective groups, and accordingly stress the supposition of a western origin of this section, pointing to Celebes as the gate through which this section — either directly from Borneo or indirectly via the Philippines — reached E. Malaysia.

For the rest, the relationships are mainly to the east. Besides the two wide-spread species *C. hirsutum* and *C. asperum*, the Philippines have only *C. vrieseanum* in common with Celebes, a species, which in the Philippines is restricted to Mindanao and in Celebes to the Northern Peninsula. The occurrence of *C. vulgare* and *C. asperum* in Bawean and Kangean is possibly less interesting in this connection, since both species are also known from the Lesser Sunda Islands.

Finally, it may be of some importance that the three allegedly most primitive species of the *oleosum*-group are represented; *C. trigonum* is endemic, *C. oleosum* is also known from the Moluccas, and *C. balsamiferum* from the Moluccas and New Guinea. This may indicate that Celebes possibly one time either formed part of the centre of origin of sect. *Pimela*, or was very close to it.

b. Lesser Sunda Islands.

15. *C. vulgare*
34. *C. oleosum*
61. *C. asperum*

All three species are principally East-Malaysian and occur also at least in Celebes and the Moluccas. Though none of them occurs in Java, two (*C. vulgare* and *asperum*) are known to occur in Bawean and Kangean. In the present subregion all are restricted to the eastern part (*C. vulgare* goes as far west as Flores — specimens from more western localities are probably cultivated —, *C. oleosum* reaches Timor, *C. asperum* Sumbawa).

c. Moluccas.

8. *C. maluense*
11. *C. sylvestre*
15. *C. vulgare*
16. *C. indicum*
33. *C. decumanum*
34. *C. oleosum*
35. *C. balsamiferum*
54. *C. hirsutum*
61. *C. asperum*
63. *C. acutifolium*

Though the number of species is fairly large it is rather surprising that none of them is endemic, but there are two endemic infraspecific taxa.

The section *Canarium* is represented by 5 species: the three already known from Celebes (*C. maluense, vulgare,* and *decumanum*), and 2 species, *C. sylvestre* and *C. indicum,* which represent more advanced types in the *maluense*-group and the *vulgare*-group *resp.* The two last-named species, as well as *C. maluense* and *C. decumanum,* extend their area farther to the east. These facts fit very well in the supposed gradual alteration of these two groups from west to east.

Sect. *Pimela* is also represented by 5 species, all also known from Celebes. It is interesting, however, to note the presence of the two supposedly most primitive species of this section — *C. oleosum* and *balsamiferum* — as well as the great variability of *C. hirsutum* and *C. asperum* in this subregion, the more so, as both these latter species are, among others, represented by their least specialized forms. *C. hirsutum* is even represented by its two subspecies, one of which spreads eastward, while the other is mainly distributed towards the west. It therefore seems that the Moluccas have played an important role in the history of the section *Pimela,* either as its centre of origin, or as an early and important secondary centre.

There are apparently no distinct differences between the North and the South Moluccas; from west to east there is a slight and gradual substitution of species, however. The 3 species known from the (Eastern) Lesser Sunda Islands also occur in the Moluccas.

d. New Guinea, including the Bismarck Archipelago.

8. *C. maluense*
*9. *C. megacarpum*
*10. *C. lamii*
11. *C. sylvestre*
*12. *C. piloso-sylvestre*
13. *C. salomonense*
16. *C. indicum*
*17. *C. kaniense*
33. *C. decumanum*
34. *C. oleosum*
35. *C. balsamiferum*
51. *C. australianum*
54. *C. hirsutum*
*57. *C. rigidum*
*58. *C. polyphyllum*
*59. *C. cestracion*
61. *C. asperum*
*62. *C. schlechteri*
63. *C. acutifolium*
*64. *C. macadamii*
65. *C. chinare*

New Guinea being both the largest landmass in E. Malaysia and the link between Malaysia on one side and Australia, Melanesia, and Polynesia on the other, neither the large number of species, nor the high degree of endemism is surprising (21, *resp.* 9); both numbers are of the same order as the Bornean ones, and in both cases our knowledge is doubtless still very insufficient.

Sect. *Canarium* is again — with the exception only of *C. decumanum* which is of uncertain relationship — represented by its two eastern groups, the *maluense* and the *vulgare*-group. Especially the *maluense*-group is well developed, being represented by 6 species, 3 of which are endemics. *C. maluense* and *C. sylvestre* are furthermore distributed to the west, the

latter seems also in New Guinea to be restricted to the western half. The 3 endemics are related to these two western species, and are also known only from Western New Guinea. *C. salomonense* is the only representative of the *maluense*-group which extends its area to the east; in New Guinea it is represented (only in the eastern half!) by an endemic subspecies. As to the two representatives of the *vulgare*-group, *C. indicum* extends its area farther to the west and to the east, and *C. kaniense* is distinctly related to this species, though in some characters slightly more specialized.

C. decumanum, in a western direction reaching as far as E. Borneo, is in New Guinea only known from the Vogelkop Peninsula.

Sect. *Pimela* is represented by 12 species, 5 of which are endemic. The *oleosum*-group, which I regard as the most primitive one, here reaches its eastern boundary; *C. oleosum* and *balsamiferum* are present. The more advanced *hirsutum* and *asperum*-groups are here fairly much diversified. Interesting, though puzzling, is the position of *C. australianum,* a species of E. New Guinea and N.E. Australia, which meanwhile comes closest to the West Malaysian *pilosum*-group.

The *hirsutum*-group is especially well represented. *C. hirsutum,* which itself is distributed all over the Malaysian Archipelago and the Solomon Islands, seems here, as well as in Sumatra and the Malay Peninsula, to have given rise to some marginal endemics (*C. rigidum, polyphyllum,* and *cestracion*). A striking fact is the similarity in many characters, especially in the strongly thickened petals, between *C. sumatranum* in W. Malaysia on the one side, and on the other side the Papuan species *C. polyphyllum, rigidum,* and possibly also *C. cestracion* (the flowers of which are still unknown).

The *asperum*-group is represented by 5 species, as follows: *C. asperum,* distributed throughout the greater part of the Malaysian Archipelago and Melanesia, is in New Guinea represented by both its subspecies, one of which (ssp. *papuanum*) is endemic, the other (ssp. *asperum*) being represented by some wide-spread forms. *C. schlechteri* is endemic and allied to *C. asperum* and *C. acutifolium. C. acutifolium* is furthermore known from Celebes, where it is represented by a distinctly more primitive, endemic variety. *C. macadamii* is endemic and closely allied to *C. acutifolium. C. chinare* is further known from the Solomon Islands and allied to some other Melanesian species of the *asperum*-group.

Obviously, the wealth of species, and also of endemics, is somewhat greater in the eastern half of the island as compared to the western part. This may partly be due to the larger amount of material from the eastern half, but my impression is that this is not the only cause. There are some species, *e. g. C. sylvestre,* which are apparently rather common in the western half and are unknown from the eastern part. Apparently, there is some shifting in the species-composition indeed, going from west to east; some western species reach their eastern boundaries, some eastern ones their western boundaries somewhere in New Guinea. As far as known, 5 species are here restricted to the western half (*C. megacarpum, lamii, sylvestre, piloso-sylvestre,* and *decumanum*), two of these, *C. piloso-sylvestre* (a local endemic, closely related to *C. sylvestre*) and *C. decumanum,* even

to the Vogelkop Peninsula. All these are representatives of the originally West Malaysian sect. *Canarium*, 4 of them representing the *maluense*-group. The *maluense*-group is in the eastern part represented by 2 species only, *viz. C. maluense*, which is the least specialized and most widely spread species of this group, and *C. salomonense*. The last-named species possibly entered New Guinea from the Solomon Islands, as the New Guinea subsp. *papuanum*, in some characters, especially some reductions in the fruit, seems to be more specialized than the subspecies of the Solomons, and moreover, ssp. *papuanum* is known only from the Northern Div. of Papua.

There are 9 species here restricted to the eastern part (*C. salomonense, kaniense, balsamiferum, australianum, rigidum, cestracion, chinare, macadamii*, and *schlechteri*). Only two of these belong to the western sect. *Canarium*, viz. *C. salomonense*, discussed above, and *C. kaniense*, which is a more specialized local endemic, closely allied to *C. indicum*. The remaining species all belong to the eastern sect. *Pimela*. One out of these 7 species, viz. *C. balsamiferum*, presents a good example of the incompleteness of our knowledge of the Papuan flora. Up till 1953 it was known only from Celebes and the Moluccas; in that year Brass collected a specimen on the Cape Vogel Peninsula, the easternmost point of New Guinea, and reported it to be common. It seems not likely that it is introduced there. *C. australianum* shows the same variability as the Queensland specimens, and is restricted to the regions along Torres Strait. The other species are all endemics or subendemics, belonging to the *hirsutum* or *asperum*-groups.

So far as *Canarium* is concerned, the Bismarck Archipelago (with the inclusion of the Admiralty Islands) has an impoverished Papuan flora; all 6 species (*C. indicum, oleosum, hirsutum, schlechteri, acutifolium*, and *chinare*) are also known from the mainland of New Guinea.

9. Micronesia.

54. *C. hirsutum*

This widely distributed species is known from the Palau Islands; the specimens seem to be related to Philippine ones.

10. Melanesia & Western Polynesia.

13. *C. salomonense*
*14. *C. harveyi*
16. *C. indicum*
54. *C. hirsutum*
61. *C. asperum*
65. *C. chinare*
*66. *C. vanikoroense*
*67. *C. smithii*
*68. *C. vitiense*
*69. *C. samoense*
*72. *C. oleiferum*
*73. *C. trifoliolatum*
*74. *C. balansae*
*75. *C. whitei*

There are 14 species in all, 9 of which are endemics and 2 subendemics (1 represented by an endemic subsp.).

The three more widely distributed species are all East Malaysian ones, which apparently, coming from New Guinea, reached Melanesia: *C. hirsutum* and *asperum* are known from the Solomon Islands only, *C. indicum* is also known from the New Hebrides but since the last-named

species is frequently cultivated by the natives of Melanesia on account of its fruits, its natural eastern boundary is somewhat uncertain.

As to the two subendemics, *C. salomonense* is furthermore represented in E. New Guinea by an endemic subspecies and *C. chinare* is also known by somewhat dubious specimens from the Admiralty Islands and New Guinea.

The 9 endemic species are distributed among the sections as follows: sect. *Canarium* 1 species (*C. harveyi,* belonging to the East Malaysian *maluense*-group); sect. *Pimela* 4 species (*C. vanikoroense, smithii, vitiense,* and *samoense,* all closely related to *C. asperum,* which itself reached the Solomon Islands); sect. *Canariellum* 4 species, restricted to New Caledonia and the Loyalty Islands.

Summarizing, there is a close relationship to New Guinea, though only very few species cross the boundary between the two regions and none of these goes farther east than the New Hebrides. The *Canarium* assemblage of the Fiji, Tonga, and Samoa Islands is exclusively composed of Melanesian endemics. New Caledonia stands quite apart, and is more related to Queensland as far as *Canarium* is concerned.

We now deal with the different subregions in somewhat more detail.

a. Solomon Islands.

13. *C. salomonense*
14. *C. harveyi*
16. *C. indicum*
54. *C. hirsutum*
61. *C. asperum*
65. *C. chinare*

Among these 6 species 3 are rather widely spread East Malaysian ones (*C. indicum, hirsutum,* represented by the Papuan var. *leeuwenii,* and *C. asperum,* the two last-named taxa reaching their eastern boundary here), 2 are subendemic, slightly extending their area to the west (*C. salomonense,* with an endemic subspecies in the extreme eastern part of New Guinea, and *C. chinare,* probably also on the Admiralty Islands and East New Guinea) and one species (*C. harveyi*) is Melanesian, found as far east as Samoa. Local endemics (except for some infraspecific taxa) are absent. So, even in its species-composition, this subregion is still predominantly Malaysian.

b. New Hebrides.

14. *C. harveyi*
16. *C. indicum*
66. *C. vanikoroense*

The first two species also occur in the Solomons; the Malaysian *C. indicum* reaches its eastern boundary here, *C. harveyi* is Melanesian (here represented by an endemic variety). *C. vanikoroense,* on the other hand, is the most western one of the small group of Melanesian endemics, belonging to the *asperum*-group. Its relationship may be as well with *C. chinare* in the west as with *C. smithii* in the east; the species itself is also known from Fiji.

c. Fiji Islands.

14. *C. harveyi*
66. *C. vanikoroense*
*67. *C. smithii*
*68. *C. vitiense*

In contradistinction to the New Hebrides the number of species is slightly larger and all are Melanesian endemics. *C. harveyi* is the only widely spread Melanesian species. The three others belong to the *asperum*-group of sect. *Pimela*. They are closely related, both mutually and to *C. samoense* of Samoa. Two are endemics, *C. vanikoroense* is also known from the New Hebrides. It may be that Fiji has acted as a secondary centre of speciation in Melanesia.

d. Samoa Islands.

14. *C. harveyi* *69. *C. samoense*

One endemic species (*C. samoense*), closely allied to *C. smithii* and *vitiense* of Fiji. *C. harveyi* is widely spread in Melanesia and represented here by var. *harveyi*, which is also known from Fiji and Tonga.

e. Tonga Islands.

14. *C. harveyi*

A widely spread Melanesian species; the same var. *harveyi* also known from Fiji and Samoa.

f. New Caledonia & Loyalty Islands.

*72. *C. oleiferum* *74. *C. balansae*
*73. *C. trifoliolatum* *75. *C. whitei*

These 4 species, all endemic, belong to sect. *Canariellum*, which is furthermore only represented in Queensland. This high degree of endemism is in complete agreement with the picture as given by many other taxa, and again demonstrates the prolonged isolation of this region.

C. oleiferum is the most interesting of these species. Apparently it is the only one which is spread all over New Caledonia. Moreover, it is the only species, the affinities of which are clear: it is rather closely related to the Australian species of the same section, *C. muelleri* and *baileyanum*; in some characters it seems to be somewhat more specialized, however. Therefore, we are inclined to conclude that *C. oleiferum* reached New Caledonia from Queensland.

The affinities of the other species are much less clear. All show some peculiar characters, part of which may be primitive ones. This points obviously to a long isolation. Two of them are very rare endemics of New Caledonia, *C. balansae* is only known from the Loyalty Islands.

11. Australia.

51. *C. australianum* *71. *C. muelleri*
*70. *C. baileyanum*

In Australia, the genus *Canarium* is restricted to Arnhem's Land and North and East Queensland. Among the 3 species, *C. australianum*, representing sect. *Pimela*, is subendemic — being also known from South New Guinea — and occupies at the same time the largest area in Australia. The two other species, both endemics, are restricted to Queensland. *C. baileyanum* and *muelleri* belong to sect. *Canariellum*; they are closely allied to *C. oleiferum* from New Caledonia but seem to be slightly more

primitive in some characters. *C. baileyanum* has a rather wide distribution (Cook Peninsula to Lismore, N.S.W., about 28° 30′ S, much farther south than *C. australianum*). *C. muelleri* is apparently a very local species (Cook Peninsula, Atherton Distr., about 17—18° S and 145—146° E). In my opinion these two species have to be considered as relics.

C. australianum is an interesting species. In Australia it is more restricted to the tropical rain-forest than is *C. baileyanum*, and extends southward only to about 19 or 20° S. It certainly belongs to sect. *Pimela*, and shows a distinct relationship to the *pilosum*-group, which for the rest is West Malaysian. On the other side, *C. australianum* shows some vegetative characters, which it has in common only with the section *Canariellum*, with the *oleosum*-group, and with the *decumanum*-group, all groups, which are supposed to be relatively primitive. Finally, the species occurs also in South New Guinea, showing the same range of variability there as in Australia.

III. COMPARATIVE TAXONOMY

> "Ik weet dat het geheim mij telkens weer ontvliedt. Maar het éven gezien te hebben, iets ervan (al verbeeld ik het mij misschien maar) te hebben vastgelegd — ik vraag niet meer."
>
> P. Geyl, 1958.

1. Introduction.

The scope of this chapter is to arrive at a synthesis of the genus as a whole instead of looking at it as a group of more or less independent, equivalent species.

Not unintentionally did I choose the title 'Comparative Taxonomy' for this chapter, not 'Phylogeny'. A chapter on phylogeny would pretend to give the genesis of the taxa along the time-axis. As fossils are fully unknown, I can work only in one time level, the present one; no more can be done than arranging the facts at my disposal — primarily morphological, secondarily geographical ones — in accordance with the supposed relationships between the species, trying to define the typological centres of these groups, and finally arranging these centres, their basic types, and by the latter the groups. The best to be expected is that the scheme given may, in its main lines, more or less approach the projection of the phylogeny upon its upper time level. Accordingly, the terms 'primitive' and 'advanced', though often used and apparently suggesting some direction in the relationships and lending some dynamism to the system, have been used in a typological sense and for shortness' sake only. They never mean to point to a direct derivation of a recent species from another recent one, even though in itself such a procedure is far from impossible.

2. Discussion.

The 'Bauplan' or type [1]) of the genus *Canarium*, based upon: comparison with related, less specialized genera, and a mutual comparison of all the characters represented in the genus as to primitiveness (as far as anything can be reasonably stated), may be characterized within the genus as follows:

Pith of the branchlets probably with resiniferous vascular strands. Leaves exstipulate. Inflorescences axillary, thyrsoid; bracts narrowly deltoid, homologous with the basal part of the petiole. Flowers dioecious (or possibly still bisexual?), (4?—)3-merous. Receptacle flat. Stamens 6, biseriate,

[1]) The word '*type*' is here used in a typological, not in a nomenclatural sense; it means a hypothetical plant, showing in all its characters either the most primitive state represented in the group concerned, or such a primitive state that all structures observed can be derived from it.

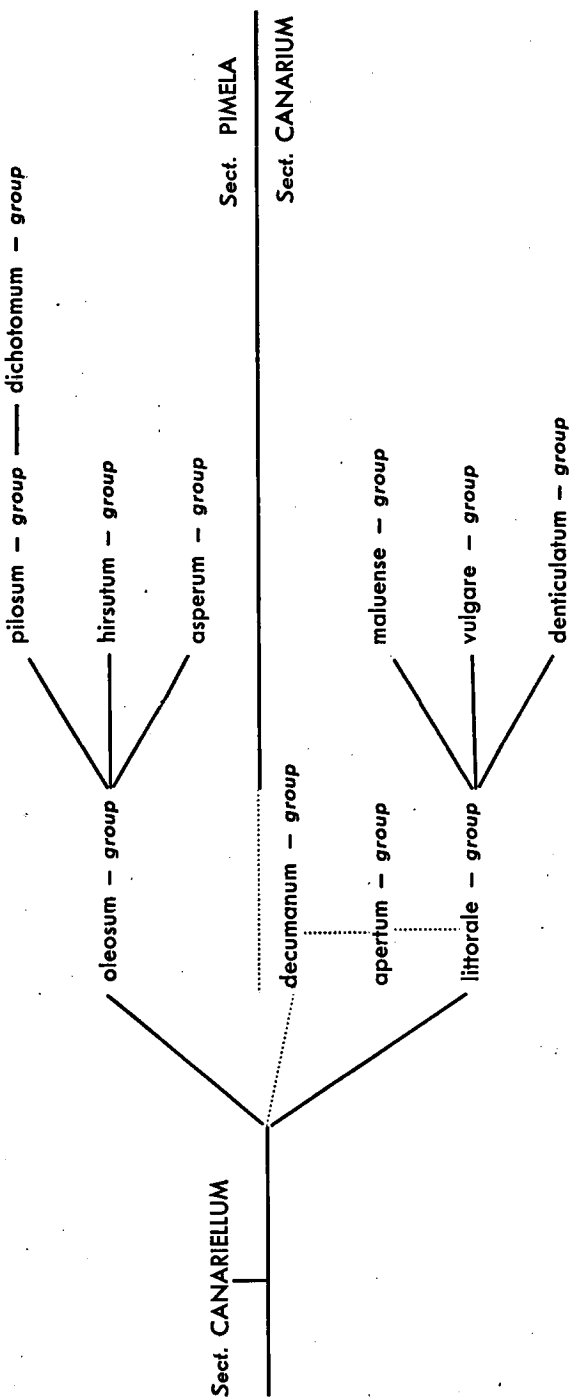


Fig. 3. A scheme of the relationships between the different sections and groups in *Canarium*.

free, in '♀' flowers not or hardly reduced. Disk annular, 6-lobed. Pistil sessile, 3-celled, in '♂' flowers only slightly reduced. Fruits with fleshy pericarp; pyrene with 3 fertile cells.

The main tendencies, realised in all or most of the sections, are:

1. the formation of stipules;
2. an increasing development of unisexual flowers, specially by the reduction of the pistil in the ♂ ones.

Other tendencies are mainly restricted to one of the sections, and will be dealt with under the section concerned.

A. Sect. Canarium

The type of this section differs from the generic type in the follow ing points:

1. The presence of true stipules (Lam's '*metastipulae*'), which within the *Burseraceae* is a unique character. 'Metastipules' are absent only in the *apertum*-group, the taxonomical position of which is somewhat puzzling, but which seems not to be very primitive.
2. The presence of pseudo-bracts, homologous with the stipules, as far as known in contradistinction with all other members of the family.

The main tendencies of this section are:

1. development of axillary inflorescences into terminal ones;
2. reduction of the epipetalous stamens;
3. excavation of the receptacle of ♀ flowers, in which case the disk is for the greater part becoming adnate to the receptacle and the pistil is developing a 'pseudo-gynophore'.

Comparing the above facts with those of the other sections it will be found, that as a whole the present section is the one most deviating from the generic type. For convenience sake, however, and since it was considered undesirable to start with a group of such uncertain relationships as sect. *Canariellum,* I preferred the sequence given here.

a. littorale-group. *Fig. 4.*

This group seems to be the most primitive one of sect. *Canarium*; its type nearly coincides with that of the section; it can be defined slightly more exactly, however, in the following points:

1. the stipules are inserted at the conjunction of petiole and branchlet; they are roundish, small, and early caducous;
2. the pistillode in the ♂ flower is still rather large, and provided with a slender style-remnant, and with small cells with sterile ovules.

None of the species of this group fully coincides with this type; closest to it is *C. littorale,* which mainly differs by its terminal inflorescences.

C. littorale is one of the most variable species of the whole genus. It cannot be sharply subdivided into infraspecific taxa, consequently only the status of forma has been given to the more extreme examples of those morphological tendencies, which are also more or less geographically defined. All these extreme forms gradually pass into a group of mainly Sumatran specimens, which seems to represent the more original form of the species

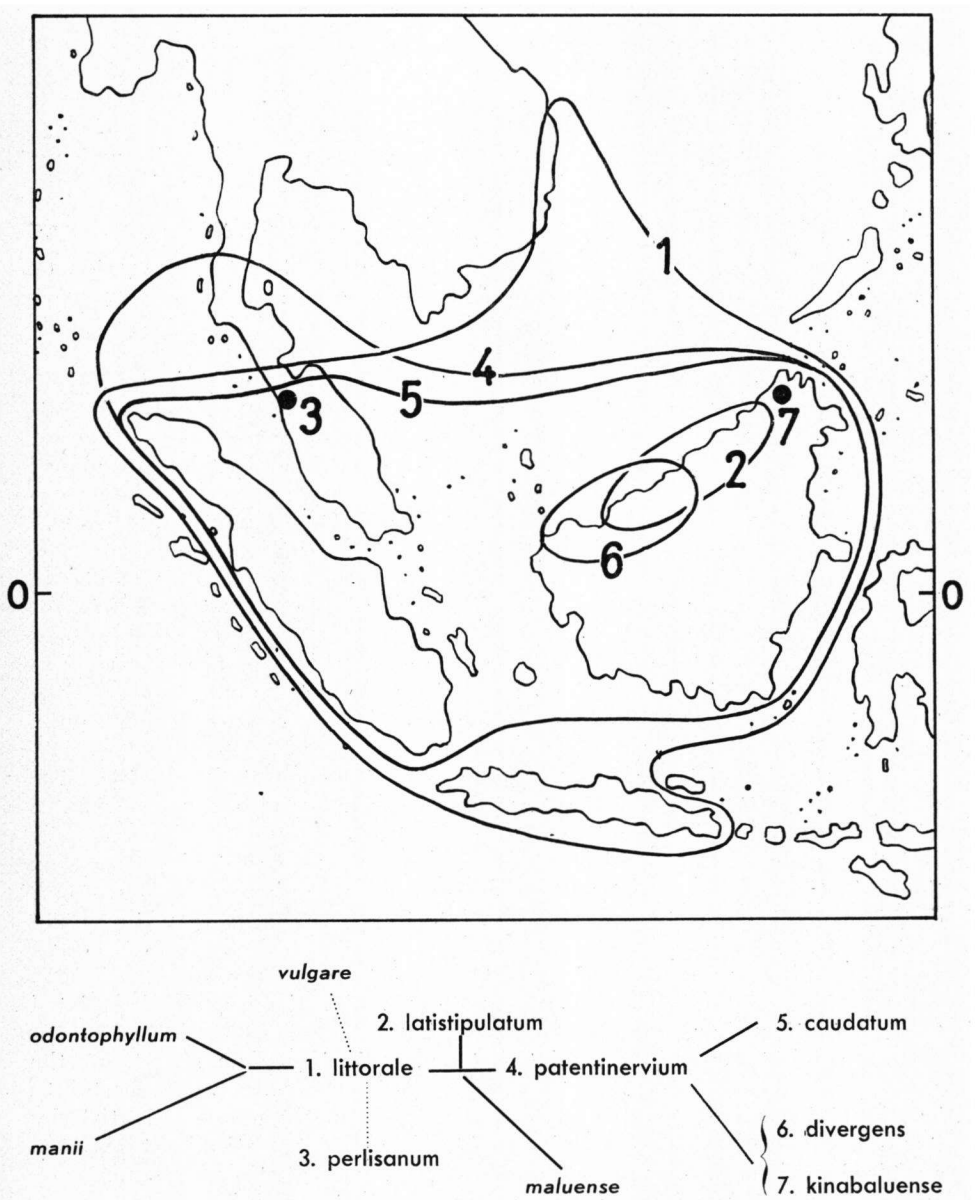


Fig. 4. *littorale*-group (in this and the following schemes unnumbered specific epithets in italics refer to related species, which are included in other groups).

(and which differs only very slightly from the Javanese f. *littorale*). The more extreme forms and the tendencies they represent are:

f. *purpurascens:* close to the basic form, margin of the leaflets more coarsely incised, lower side of the leaflets glaucous waxy; weakly developed in Sumatra (*C. glaucum*), well distinguishable in the Malay Peninsula (*C. purpurascens*), extremely developed in Annam.

f. *pruinosum:* a well distinguishable local group, related to the foregoing one; leaflets densely dentate throughout the margin, slightly bullate, white-waxy beneath; restricted to Borneo.

f. *tomentosum:* stipules slightly larger, leaflets more coriaceous, bullate, densely and minutely tomentose beneath, nervation strongly prominent on lower side; in Sumatra and the Malay Peninsula (*C. secundum*) merging into the central form, in Borneo well developed; particularly related to the next form.

f. *rufum:* differing from the preceding form mainly by its coarser leaves and inflorescences, its larger and more permanent stipules, its dentate leaf-margins, and the absence of a pistil-remnant in the ♂ flowers; in Sumatra not sharply delimited against the foregoing form, best developed in the Malay Peninsula. On the other side, this form seems to be rather closely related to *C. odontophyllum* — specially the Sumatran f. *odontophyllum* — and consequently to the base of the *denticulatum*-group.

C. latistipulatum and *perlisanum* seem to be marginal endemics, in Borneo and the Malay Peninsula resp., closely related to *C. littorale*. *C. perlisanum* is interesting by the presence of axillary inflorescences and connate stamens (both unique phenomena in this group and very rare even in the section) and by the stipules, which are inserted on the petiole; the taxonomic position of this species, which is known from one specimen only, is not quite certain, however.

C. patentinervium again seems to be directly connected with the basic group of *C. littorale* (some intermediate specimens are known). As a whole it seems to be slightly more derivative: it is much less variable and the much smaller number of secondary nerves seems to be caused by the reduction of part of them (these reduced secondary nerves are well distinguishable from strongly developed tertiary ones); it seems to be important as the basis of a group of species, characterized by entire leaf margins and shining lower side of the leaflets.

C. divergens and *kinabaluense* are marginal endemics, closely related to *C. patentinervium*.

C. caudatum is closely related to *C. patentinervium* (part of the ♀ specimens, especially from the Malay Peninsula, cannot with certainty be placed in one of the two species), it is distinctly more derivative by its 3-staminate ♂ flowers and by the tendency of the stipules to become auricle-shaped, more permanent, and inserted on the petiole (this tendency is especially developed in f. *auriculiferum*, which is mainly Bornean).

Finally, *C. maluense* ssp. *borneense*, the basic form of the *maluense*-group, in E. Borneo, is doubtless very closely related to *C. patentinervium* and *caudatum*.

Geographically, the centre of this group is apparently Sumatra, from where it radiated to the Malay Peninsula, Indo-China, Borneo, and Java.

Recent speciation seems to be chiefly marginal (the more advanced *denticulatum*-group apparently arose in Sumatra, however), whereas the central group retained its full variability and plasticity. The last-named fact remains rather puzzling. On the one side *C. littorale* seems to be rather close to the basis of a section that succeeded in extending its area to both West Africa and the Samoa Islands, and in developing such an extreme form as *C. schweinfurthii*, which thus apparently arose rather a long time ago; on the other side *C. littorale* looks rather like a young species, rather variable, especially in its geographical centre, and gradually developing some morphological tendencies towards the margins of its area. The extreme results of these tendencies, however differing mutually, cannot be sharply delimited against the central form. I cannot but conclude that *C. littorale* changed only very little during a very long time, that it remained in its original position, and that, on account of the relative stability of the climatological and other ecological conditions it lost only very little of its original gene-composition. Therefore, this widely distributed and common species possibly almost represents the trunk of a genealogical tree.

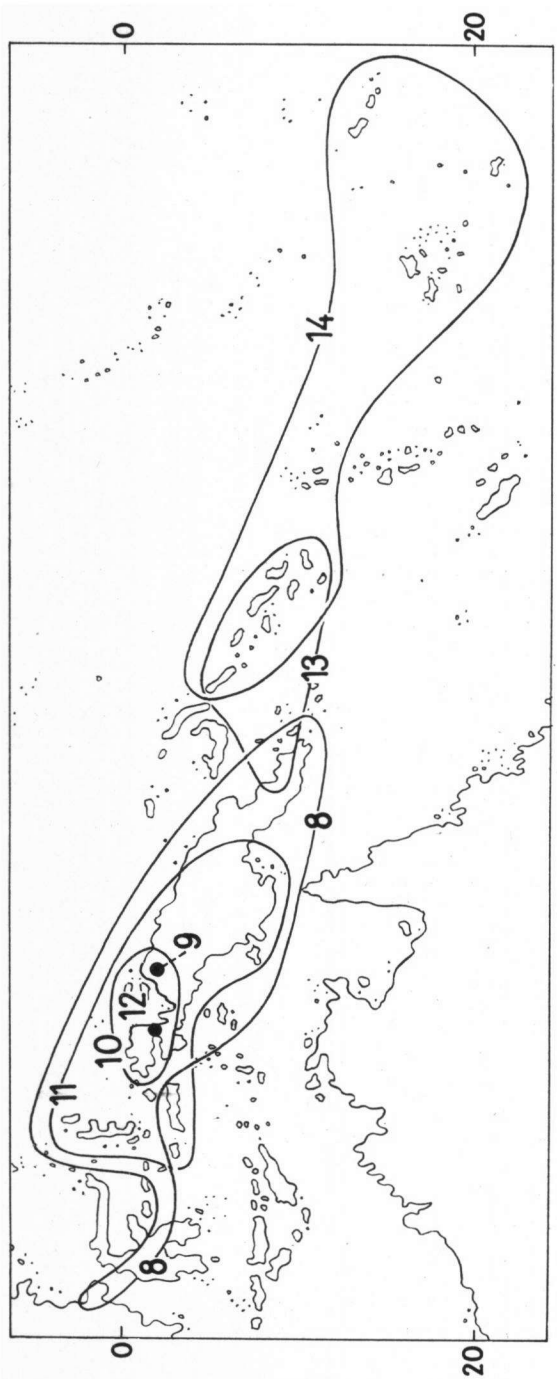
b. maluense-group. *Fig. 5.*

This group is connected with the *littorale*-group by *C. maluense* ssp. *borneense*, a taxon which on the one hand is very close to *C. maluense* ssp. *maluense*, seems to be more primitive, especially in its stipules and in the very slight reduction of the pistil in the ♂ flower; in both these characters it agrees with the basic species of the *littorale*-group. On the other hand it is rather alike *C. patentinervium* and *caudatum*, moreover, it is the only form of the *maluense*-group west of Macassar Strait. In my opinion it is the link between the *littorale* and the *maluense*-group, and the basic form of the latter.

The main morphological tendencies within this group are:

1. the stipules tend to become auricle-shaped, more permanent, and inserted on the petiole;
2. suppression of the epipetalous stamens;
3. two of the three fruit-cells become sterile, undergoing a rather strong reduction and being sometimes more or less shifted towards the periphery.

C. maluense is the central species, rather variable, and with a wide distribution (E. Borneo—New Guinea); f. *celebicum* is close to ssp. *borneense*, differing principally by the strong reduction of the pistillode (Lam, 1932b, cited part of these specimens under *C. littorale*!). The tendencies cited above are more or less incompletely realized already in the different forms of this species, thereby suggesting some evolution from west to east; f. *maluense* and *montanum* still show rather primitive characters, f. *lian* is intermediate, and f. *quadrangulare* is in all respects the most advanced one, with auricle-shaped stipules, some reduction in the number of stamens, and the sterile fruit-cells usually fully peripheral. This form of the Vogelkop Peninsula is very closely related to *C. sylvestre* (Moluccas and New Guinea), a much less variable species with often 3-staminate flowers and strongly reduced fruit-cells. *C. piloso-sylvestre* is a local endemic, differing in some minor characters only from *C. sylvestre*.



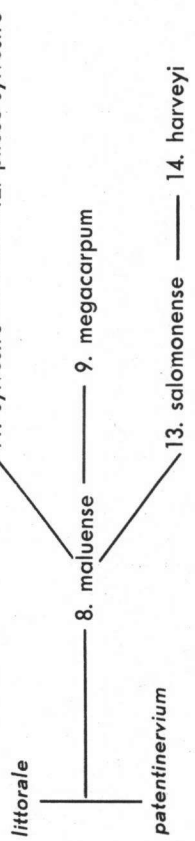


Fig. 5. *maluense*-group.

C. salomonense and *C. harveyi,* probably also the insufficiently known *C. lamii* and *C. megacarpum,* are pretty close to *C. maluense* f. *maluense*; they are all slightly more specialized in some flower and fruit-characters. *C. salomonense* comprises two subspecies, the more western of which, ssp. *papuanum* (E. New Guinea) shows a fruit of a slightly more advanced structure and is apparently more derived than the ssp. *salomonense* from the Solomon Islands. *C. harveyi* comprises in the various groups of islands some varieties, which are each specially characterized by their fruits; these different fruit-forms can not be arranged in a distinct continuous series.

C. megacarpum and *lamii* are still very incompletely known Papuan endemics, which apparently belong to this group.

Geographically this group ranges from East Borneo to the Samoa Islands with New Guinea as its main centre of speciation.

c. v u l g a r e-group. *Fig. 6.*

The main series of this group is formed by the species *C. vulgare* — *indicum* — *kaniense.* Within this series the main tendencies are:

1. the stipules, which are inserted at the conjunction of petiole and branchlet, and are rather caducous, entire, and up to 5 cm long in *C. vulgare,* tend to become more permanent, toothed to fimbriate at the margin (especially so in *C. kaniense* var. *globigerum*), and larger (up to 12 cm in *C. indicum* var. *platycerioideum*); rarely they are inserted on the base of the petiole;
2. all parts (branchlets, leaves, inflorescences, flowers, and fruits) tend to become coarser.

Again, as in the *maluense*-group, we see that the most western species — in the present group this is *C. vulgare* — is morphologically the form least deviating from the type of the section. It may be supposed that *C. vulgare* also rests upon the *littorale*-group, though the connection is less clear.

C. indicum is doubtless very closely related to *C. vulgare* (these two species are almost vicariads!) and differs mainly by its more specialized stipules and its coarser habit; its var. *platycerioideum* is an extreme local form from the Vogelkop Peninsula. *C. kaniense* is closely related to *C. indicum,* slightly more specialized in its stipules and its fruits; its var. *globigerum* is again an extreme local form.

The relationships of the Philippine species *C. luzonicum* and *ovatum* are not quite clear. In some respects they seem to be intermediate between the *littorale*-group — especially *C. luzonicum* shows, for instance in its stipules, distinct affinities to that group — and the *vulgare*-group. On the other hand they are both characterized by axillary inflorescences, which are supposed to be more primitive than terminal ones, and which are rare in the *littorale*-group and absent in the *vulgare*-group. In addition, *C. luzonicum* shows some tendency to reduction of the number of stamens in the ♂ flowers, whereas *C. ovatum* is distinguished by its unusual kind of stipules. Apparently, these two species have been isolated for rather a long time. As far as I can see there are three explanations possible for their descendance: 1e. they are descendants of a population which some time connected the *littorale*-group and the *vulgare*-group via the Philippines; 2e. the connection between the *littorale* and the *vulgare*-group was

brought about directly from Borneo to Celebes (near *C. vulgare*), and thus they may perhaps be derived from ancestors of the *vulgare*-group; or, 3e, they may represent an independent line, issued from the *littorale*-group more or less parallel to the *vulgare*-group.

Geographically speaking, the last-named group shows a distinct trend

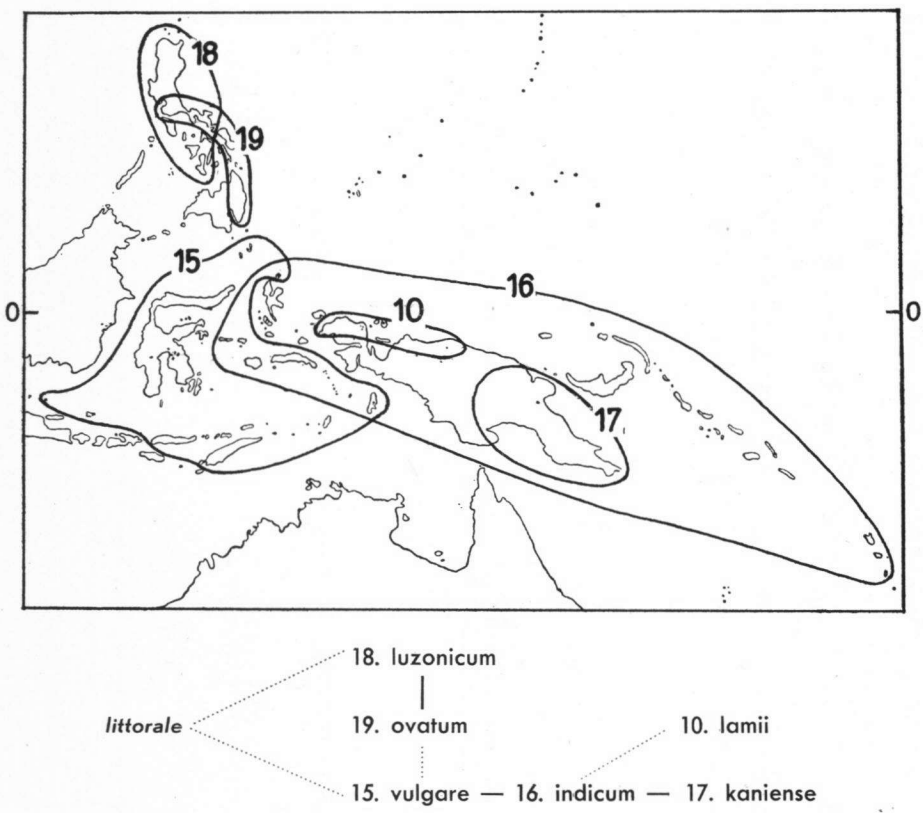


Fig. 6. *vulgare*-group.

from west (Bawean, Celebes) to east (New Hebrides), the link with W-Malaysia being established either via the Philippines or directly across the Macassar Strait.

d. d e n t i c u l a t u m - group. *Fig. 7.*

This is doubtless one of the most interesting groups of the genus, especially geographically. It comprises two series, the first of which consists of *C. odontophyllum, denticulatum, karoense,* and *megalanthum,* the second of *C. manii, zeylanicum, paniculatum, madagascariense,* and, to all probability, also *C. schweinfurthii.* Both series have apparently originated somewhere in the *littorale*-group. They show a high degree of parallelism in the development of many flower and fruit-characters. As to the stipules

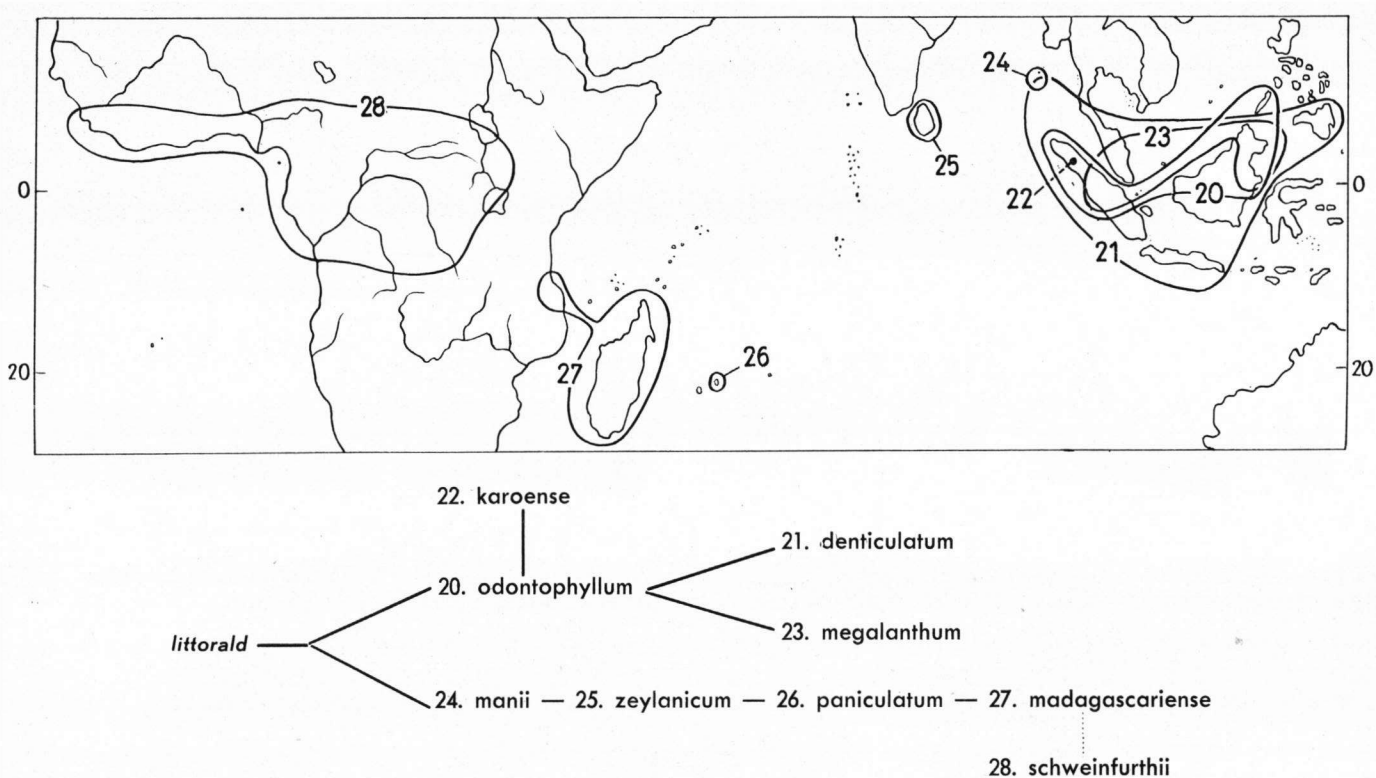


Fig. 7. *denticulatum*-group.

and the position of the inflorescences, and also geographically, both series developed along diverging lines, however.

The first series is characterized by axillary inflorescences and by a tendency towards less caducous, incised stipules; it spread mainly throughout W. Malaysia. Its basic species is probably *C. odontophyllum*, and more particularly the least specialized form of that species, f. *odontophyllum*. This form is very close to *C. littorale* f. *rufum*, its stipules being less specialized than in any other representative of the series, and the presence of a pistillode in the ♂ flowers is a primitive character, which is also lacking in all the other species. Forma *odontophyllum* is known from Sumatra and Borneo. *C. odontophyllum* f. *multifidum* lacks the pistillode in the ♂ flowers, and has much more specialized stipules which are less caducous, rather big, and deeply fimbriate along the margin. The last-named form is known from N. and E. Borneo; intermediates have been collected in N. and E. Borneo, and Palawan.

C. denticulatum is undoubtedly very close to *C. odontophyllum*, though distinctly more different from *C. littorale* f. *rufum* than that species, and therefore perhaps more advanced. It mainly differs from *C. odontophyllum* in the following points:

1. stipules pectinate;
2. pistillode in ♂ flowers usually fully reduced;
3. the margin of the leaflets is less dentate, the leaflets are less pubescent, and the nervation is less prominent.

As a whole, *C. denticulatum* f. *denticulatum* seems to be most closely allied to *C. odontophyllum*, though in the leaf-characters mentioned above *C. denticulatum* ssp. *kostermansii* comes closer to the last-named species. The position of the E. Bornean ssp. *kostermansii* is not quite clear; as it apparently shows a rather high degree of independence, a subspecific rank was proposed for it. Forma *denticulatum*, the least specialized of the two forms of ssp. *denticulatum*, has the larger area: W. Malaysia (though apparently rare in Borneo), S. Andaman, Burma, Basilan, and Mindanao; f. *fissistipulum* seems to be more specialized as to the characters mentioned above and is restricted to Sumatra, Banka, and Borneo (where it is the more common form).

C. megalanthum (Sumatra, Malay Peninsula, and Borneo) and *C. karoense* (Sumatra) are two species, which are closely allied (possibly even conspecific) and which undoubtedly belong to the relationship of *C. denticulatum*; they are different in some characters of minor importance only.

The second series is characterized by (mainly) terminal inflorescences and by caducous, entire stipules; in both characters it comes even closer to the recent representatives of the *littorale*-group than the first series. Furthermore, the pistillode in ♂ flowers is absent, and the receptacle in ♀ flowers is distinctly concave. This group developed in a western direction, its representatives being known from the Andamans to W. Africa. *C. manii* (Andamans), *C. zeylanicum* (Ceylon), *C. paniculatum* (Mauritius), and *C. madagascariense* (Madagascar and E. Africa), all mutually closely allied, represent a line of gradual development, both morphologically and geographically.

C. schweinfurthii (W. Africa) is in some respects one of the most

interesting species of the genus. Though it seems to be more closely allied to *C. madagascariense* than to any other species of the genus, it differs from the last-named species in some important characters, some of which are even unique in the genus. On the one hand it seems to be primitive by its axillary inflorescences and by the occasional presence of a distinct pistillode in the ♂ flowers; its strongly developed stipules, the deeply concave receptacle in the ♀ flowers, and the androphore in the ♂ flowers, on the other hand, rank it among the most highly developed species of the whole genus. It is restricted to the rain-forest belt of West and Central Africa, and must have been isolated for a very long time.

e. apertum-group. *Fig. 8.*

This group consists of 3 species only, which are closely related mutually. Their taxonomical position in the genus is far from clear. The most important characters of this group are:

1. no stipules; bracts lanceolate to subulate;
2. inflorescences terminal;
3. petals unguiculate (this character is unique in the genus);
4. pistil (as far as known) always stalked (pseudogynophore); pistillode in ♂ flowers absent;
5. large fruits.

The group is West Malaysian; *C. pseudopatentinervium* and *grandifolium* are very local endemics.

The general habit, the characters 2, 4, and 5 mentioned above, as well as the geography, more or less point to a relationship with sect. *Canarium*. On the other hand there is an indubitable resemblance to the *decumanum*-group, with which it moreover agrees in the characters 1, 4, and 5 just mentioned, as well as in a similar branch-anatomy (pith with only a peripheral cylinder of many small, sclerenchymatic vascular strands). Therefore it remains undecided whether the present group is more allied to the *decumanum*-group, and evolved parallel to sect. *Canarium* in some characters, or whether its resemblance to the *decumanum*-group is due to a parallel evolution within sect. *Canarium*.

f. decumanum-group. *Fig. 8.*

The relationships of this group, which consists of a pair of vicarious species, is obscure. At first sight both species show a distinct resemblance to sect. *Canarium*, and specially to its *apertum*-group. On the other hand, however, the *decumanum*-group possesses some unique characters of its own (especially the kind of stipules in *C. decumanum*, which is furthermore known only from the genera *Garuga* and *Dacryodes*) which are generally assumed to be primitive. It also shows in its vegetative characters some superficial resemblance to sect. *Canariellum* (which is supposed to represent a relic-group). Geographically, the two species are typical vicariads, *C. decumanum* being East Malaysian, *C. pseudodecumanum* West Malaysian, the demarcation apparently lying somewhere in E. Borneo (in the Philippines both species are absent).

Summarizing, this small group may represent an early independent segregate, which has taken its own course for a long time, either without

succeeding in producing more species, or the gap between the present group and other species derived from it became so wide that it is difficult now to recognize the *decumanum*-group as their indirect ancestors.

Looking back on sect. *Canarium* as a whole, the basis is apparently represented by the *littorale*-group, more in particular by *C. littorale* and *patentinervium*, its possible centre of origin being W. Malaysia. Direct derivatives are the *maluense*-group, distributed eastward to Samoa, and the *denticulatum*-group, developing to the west and reaching Africa, avoiding, however, continental Asia. Doubtless related is also the *vulgare*-group, which also developed eastward as far as the New Hebrides. Possibly the West Malaysian *apertum*-group is related to the *denticulatum*-group, but the position of this group as well as that of the probably related *decumanum*-group remains uncertain.

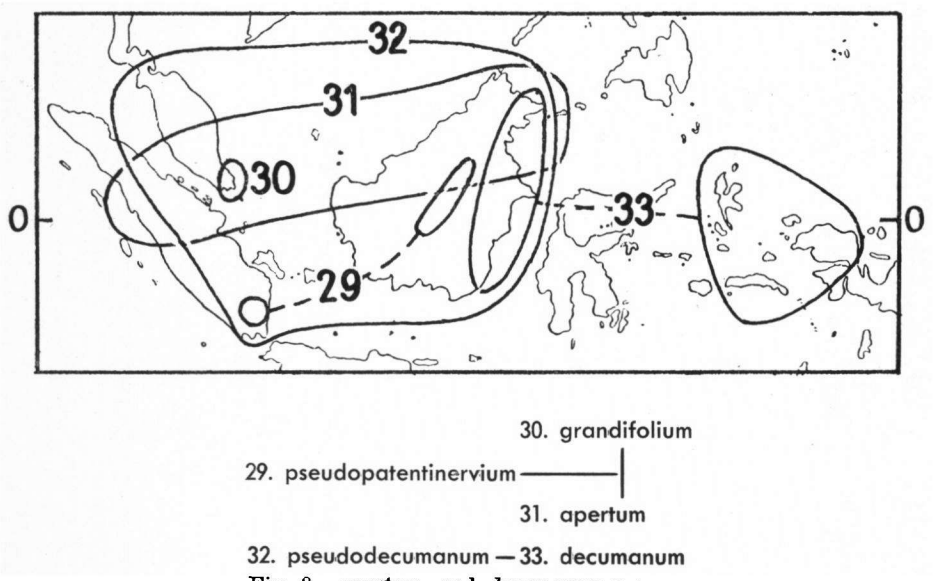


Fig. 8. *apertum*- and *decumanum*-groups.

B. Sect. Pimela

The type of this section fully coincides with that of the genus, which means that the present section seems to be less derived than sect. *Canarium*. It cannot be considered to represent the direct forerunner of the latter, however, though it has taken its own way, as may be clear from the main tendencies realized in this group, which are:

1. the formation of pseudo-stipules, in all probability homologous with the petiolules of a pair of reduced leaflets;
2. some tendency towards terminal inflorescences, though these are much less common than in sect. *Canarium*;
3. in some groups a tendency towards racemose, rarely even spicate, inflorescences (especially the ♀ ones);

4. a rather strong tendency towards connate stamens;
5. the absence (mostly) of a pistillode in ♂ flowers.

g. o l e o s u m - group. *Fig. 9.*

It is hardly open to doubt that this group comes closest to the type of sect. *Pimela*. All its species lack stipules, possess axillary inflorescences,

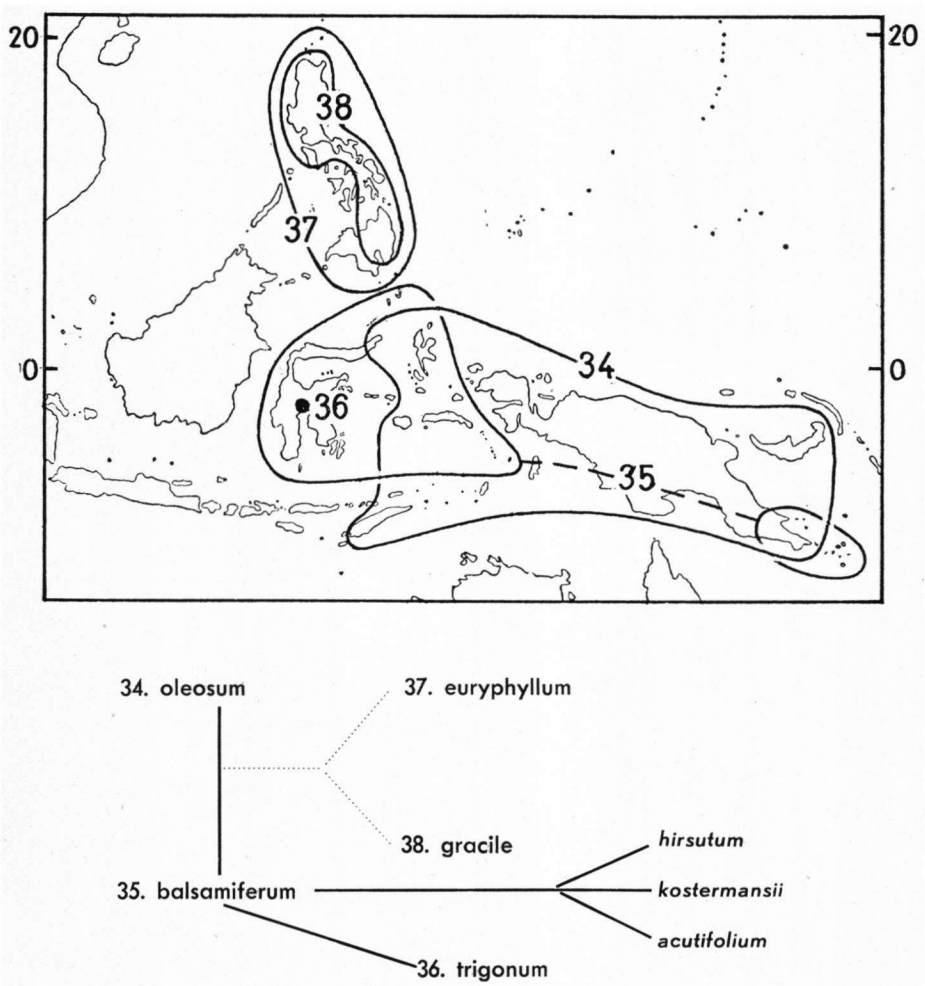


Fig. 9. *oleosum*-group.

and their stamens are free or only slightly connate. Moreover, *C. oleosum* is the only species of the whole section with a well-developed pistillode with style-remnant in the ♂ flowers. On the other side, in some characters — reductions in the fruit, ♀ flowers with a slightly concave receptacle — *C. oleosum* seems to be more advanced than the closely related *C. balsami-*

ferum. Both are distributed over most of E. Malaysia. *C. trigonum*, slightly differing from *C. balsamiferum*, particularly in its fruits, is a local endemic, known only from Central Celebes.

C. euryphyllum and *gracile* may represent rather strongly specialized Philippine species of this group. *C. euryphyllum* is particularly variable in its vegetative characters (the more pilose and rather uniform var. *ramosii* is restricted to the eastern part of the specific area and, in addition, shows in its flowers, fruits, and leaves some resemblance to *C. hirsutum*). *C. gracile* is very constant, morphologically rather isolated (particularly by the quite unusual development of the disk in the ♂ flowers, and by its fruits) and could possibly also form part of the *pilosum* or the *dichotomum*-group (related to *C. merrillii* and *pimela*?).

An interesting point is the concentration of the three main species of this group in E. Malaysia, especially Celebes, from where it apparently mainly spread to the east, possibly also to the Philippines (*C. euryphyllum* and *gracile*). Moreover, this group seems to be connected with the *pilosum*-group (the possibly most primitive species of this mainly West Malaysian group being *C. kostermansii* in E. Borneo), the *hirsutum*-group (the centre of which seems to be the Moluccas, as will be discussed below), and the *asperum*-group (some relationship between *C. balsamiferum* and *C. vrieseanum* from Celebes and Mindanao, the last-named species perhaps being the basic species of the group; moreover, the most primitive variety of the furthermore Papuan *C. acutifolium* is also an endemic of Celebes!).

h. p i l o s u m - group. *Fig. 10.*

This group seems to be slightly more advanced than the *oleosum*-group in the following characters:

1. the presence of stipules in most of the species; apparently, these tend to be shifted up the petiole and to be reduced. The absence of stipules in part of the species, particularly in *C. pilosum* ssp. *borneense*, in *C. pimela* and *parvum* (in the closely allied *C. album* they are present, though very caducous), and in the greater part of the specimens of *C. strictum* seems to be secondary;

2. the inflorescences distinctly tend to become terminal in *C. pilosum* and in *C. merrillii*; in both of these species truly terminal inflorescences are rare, but it is interesting to note that in *C. merrillii* the inflorescences are often only seemingly terminal, since the terminal vegetative bud is very small and only develops after flowering, the infructescences being distinctly axillary;

3. the stamens are nearly always distinctly connate, often more than half way up.

The group is mainly developed in W. Malaysia and continental Asia, with the exception only of *C. australianum*, but the taxonomical position of that species is not quite clear.

As a whole it is difficult to say something on relative primitiveness in this group on morphological grounds only, since either the differences between the species refer to comparatively unimportant characters (from a typological viewpoint), or it is difficult to say, whether a 'primitive' character is primary or secondary. The relationships between the individual

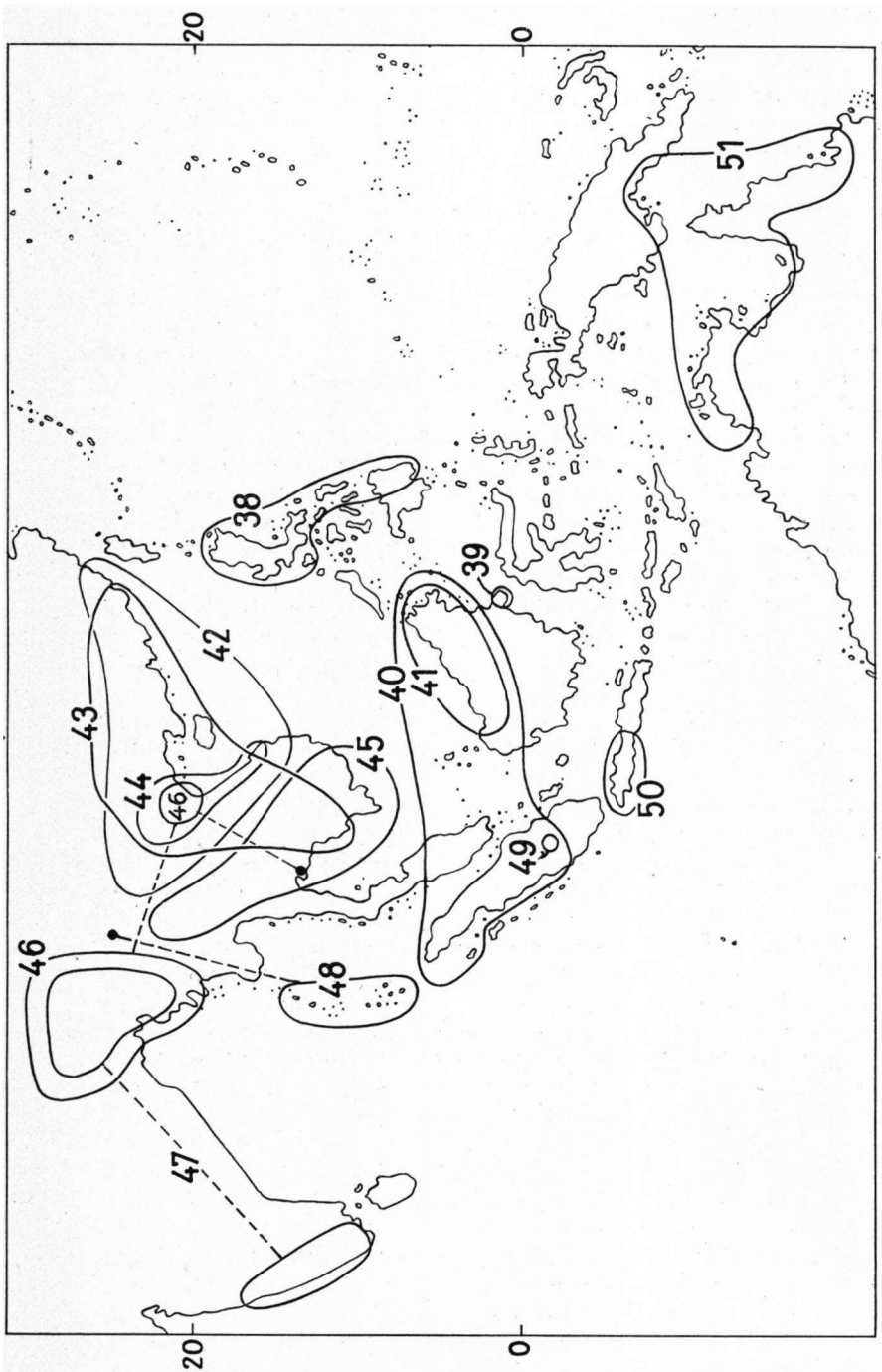


Fig. 10. *pilosum*-group.

species seem to point to *C. pilosum* as the central species; geographically also this seems to be very well possible.

C. kostermansii (E. Borneo) is doubtless rather closely related to *C. pilosum* though it is perhaps slightly more primitive in some characters. Moreover, it also shows some resemblance to *C. vrieseanum* and *balsamiferum*, which might mean that it may represent a link between the *pilosum*-group and the *oleosum*-group.

C. pilosum ssp. *borneense* may be slightly more derived in some characters than ssp. *pilosum*; it is distinctly related to *C. merrillii*, also in Borneo.

C. album seems to be rather closely related to *C. merrillii* or *pilosum* on the one side, on the other it is undoubtedly very close to *C. pimela* and *parvum*, which seem to be somewhat more derivative in some characters, especially in the absence of stipules (all Indo-China and S. China).

C. subulatum is morphologically as well as geographically interrelated between the E. Asiatic *pilosum*-like species (*album, pimela* and *parvum*) and the S. Asiatic *strictum*-like ones (*bengalense, strictum,* and *euphyllum*). Perhaps we may consider this species the link between the continental Asiatic species of the present group and the W. Malaysian ones. If this should be true, the resemblance between *C. merrillii* and *C. album* might be due to parallel development.

C. bengalense, strictum, and *euphyllum* are a group of mutually closely related species; *C. bengalense* is possibly slightly less specialized than the other species; *C. euphyllum* seems to have been isolated for a fairly long time.

C. intermedium and *kipella* are local endemics (of S. Sumatra and W. Java respectively), closely related mutually and again distinctly related to *C. pilosum.*

Summarizing, it may be that the group originated in E. Malaysia, somewhere near *C. balsamiferum,* that it developed towards the east (*C. australianum* being its last representative there) and, in some way crossing Macassar Strait, also towards the west. In W. Malaysia it developed it first centre of speciation with *C. pilosum* itself as the central species. From here it invaded the Asiatic continent, in view of the central position of *C. subulatum* in this part of the area probably via the Malay Peninsula and then migrated to the west as far as the S. Deccan, and to the N.E. to S. China and Hainan. As is obvious from the above reflections on the relationships of the individual species, this picture, however plausible, is of course very hypothetical, even more so than that given for most of the other groups.

i. d i c h o t o m u m - group. *Fig. 11.*

This group comprises only two species, *viz. C. dichotomum* and *fuscocalycinum*; these two species seem to be rather closely related, and may furthermore be allied to the *pilosum*-group. With the latter they have in common the often high-connate stamens and the tendency towards terminal inflorescences (which in the *dichotomum*-group is fully developed); furthermore the present group is restricted to W. Malaysia, which is also the main centre of the *pilosum*-group. It might be inferred that the *dichotomum*-

group is derived from the same ancestral form as is the *pilosum*-group. In some characters (especially the terminal inflorescences) it seems even to be slightly more advanced; the relationship seems to be insufficient, however, for including the two species in the *pilosum*-group.

C. dichotomum is the more common and more widely spread of the

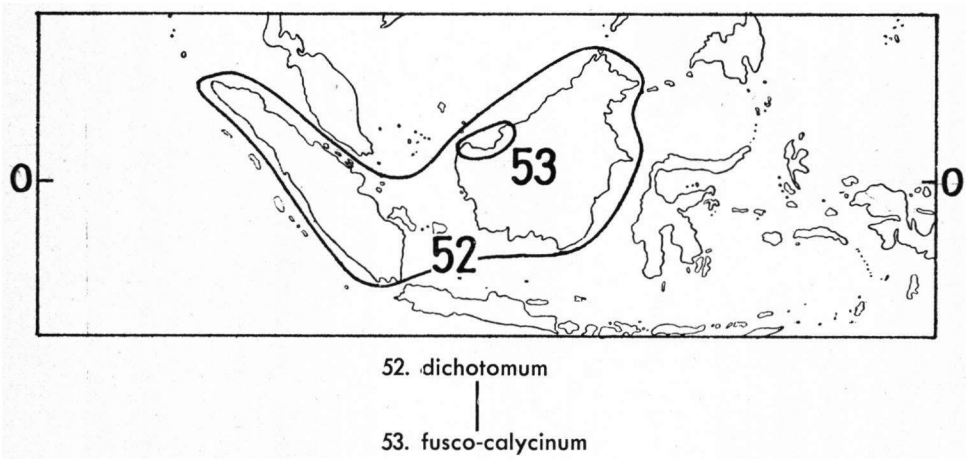


Fig. 11. *dichotomum*-group.

two species (Sumatra, Borneo); *C. fusco-calycinum* is a local endemic of Sarawak.

j. hirsutum-group. *Fig. 12.*

The types of this group and of the section as a whole nearly coincide, which may indicate that the present group is probably a relatively primitive one. The only uncertainty is whether the absence of stipules in some of the species should be considered primary or secondary; in my opinion at least in some of them (especially in some varieties of *C. hirsutum*) it may very well be a primitive character.

The very variable and widely spread *C. hirsutum* is here supposed to be the central species of this group, and the one which comes nearest to the type. The greatest variability of this species is to be found in the absence or presence of stipules and in the fruit-kernel. On account of the last-named character the species has been subdivided into two subspecies and on account of the stipules both subspecies have been subdivided again into two varieties. The distribution of the infraspecific taxa is interesting: the form with the least specialized fruits, f. *hirsutum*, is restricted to the Moluccas; both subspecies overlap in the Moluccas only, the one — ssp. *multicostulatum* — extending eastward, the other — ssp. *hirsutum* — westward. The exstipulate varieties of both subspecies are found near the Moluccan centre (the one, var. *multicostulatum*, in the Moluccas, the other, var. *beccarii*, in Celebes; the last-named variety is rather aberrant and may even represent a distinct species). Finally, in both directions just mentioned there is a rather distinct evolution of some

characters. It may be assumed that the eastern series had its centre of speciation in New Guinea, giving rise to *C. hirsutum* var. *leeuwenii*, *C. rigidum*, *polyphyllum*, and *cestracion*, all characterized by irregularly grooved fruit-kernels; furthermore, most of these species have exstipulate leaves with the exception only of *C. hirsutum* var. *leeuwenii* and *C. cestra-*

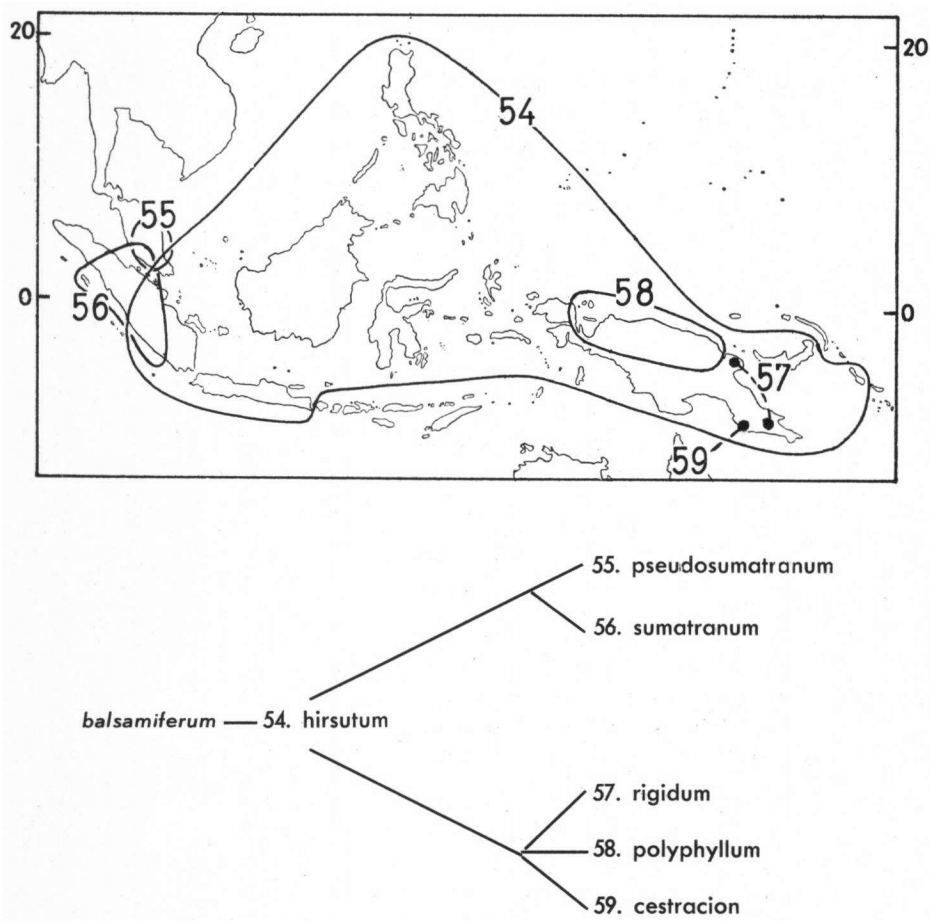


Fig. 12. *hirsutum*-group.

cion. (Since the latter possesses very small, caducous stipules and is doubtless very closely related to *C. polyphyllum* and *rigidum*, it remains to be considered whether the absence of stipules in the two last-named species is really a primitive character). Specializations of this series are the high-connate stamens, the absence of a pistillode, and the strongly thickened upper half of the petals, all found in *C. rigidum* and *polyphyllum* (the flowers of the closely related *C. cestracion* are still unknown).

The western series found its first centre of diversity in the Philip-

pines. Some forms with highly specialized fruit-kernels developed here; the least specialized of these, f. *scabrum,* which is closest to f. *hirsutum,* is the only one which reached W. Malaysia, possibly via the Philippines. At the very boundary of the group-area, a secondary centre of speciation has developed in Sumatra and the Malay Peninsula, which has given rise to *C. sumatranum* and *pseudosumatranum.* The specializations of these species are not very different from those at the eastern boundary of the area: the stamens are connate, the pistillode is fully suppressed, and *C. sumatranum* even possesses the same kind of strongly thickened petals. Here again one species, *C. sumatranum,* has no stipules (and again it seems questionable whether this character is primitive), whereas the other one has very caducous, small stipules.

The conclusion is that the *hirsutum*-group, which probably may be derived from the *oleosum*-group, developed from a centre in the Moluccas (an area which apparently also forms part of the centre of the *oleosum*-group) in two directions. It is interesting to note that the speciation is distinctly marginal, with a surprising parallelism in several specializations at both ends of the area.

k. a s p e r u m - group. *Fig. 13.*

The type of this group differs from the type of sect. *Pimela* in the following points:

1. subulate pseudo-stipules;
2. pistil in ♂ flowers strongly reduced;
3. 2 fruit-cells sterile and slightly reduced.

The two taxa which best match this description are *C. vrieseanum* and *C. acutifolium* var. *celebicum.* It is interesting that both of these show some affinities to *C. balsamiferum,* and that both occur in Celebes (the former also in Mindanao), which forms part of the area of the last-named species. This may imply that the centre of origin of the *asperum*-group coincides again with that of the *oleosum*-group.

C. vrieseanum, on the other side, shows already some of the general tendencies of the present group: narrowly thyrsoid to racemose inflorescences and slightly confluent stamens. This species seems neither to be very closely related to *C. acutifolium* nor to *C. asperum.*

C. acutifolium var. *celebicum* is doubtless the most primitive variety of this species; primitive characters of this variety as well as of var. *aemulans* in relation to var. *acutifolium* are the presence of 6 stamens, the permanence of pith in the branchlets, and the non-specialized stipules. In some other characters the Papuan var. *aemulans* seems to be more closely related to the equally Papuan var. *acutifolium,* which is characterized by hollow twigs, exceptionally long and thin stipules, 3 stamens, and small fruits with two strongly reduced sterile cells. The species as a whole is relatively primitive by the axillary, broadly thyrsoid inflorescences and the free stamens.

C. macadamii (New Guinea) seems to be closely related to *C. acutifolium,* is, however, still insufficiently known.

C. asperum is the central species of this group and the most variable one. The most primitive characters seem to be preserved in ssp. *papuanum*;

under this name are provisionally united at least three mutually more or less differing populations from different parts of New Guinea, all still insufficiently known. The main primitive character in relation to ssp. *asperum* is the thyrsoid inflorescence. The Philippine var. *clementis* is mainly characterized by a compoundly spicate inflorescence. Var. *asperum* doubtless is the most derived form — inflorescences nearly always racemose to even spicate —; it reached Borneo on the one side, New Guinea and the Solomon Islands on the other, and shows a great variability particularly in the vegetative characters, especially in the Philippines.

C. schlechteri (E. New Guinea and New Britain) which is rather closely related to *C. asperum*, seems to be slightly more derived by its confluent stamens which are slightly connate to the disk, and is furthermore characterized by its fruit.

The mutually closely related Melanesian species *C. chinare, vanikoroense, smithii, vitiense,* and *samoense* may be derived either from *C. asperum* or from *C. acutifolium* var. *aemulans.*

Summarizing, the most primitive forms of this group again show some relationship with the *oleosum*-group and are concentrated on Celebes. The main centre of speciation was apparently New Guinea, whereas *C. asperum* mainly evolved in a western direction, reaching as far as Borneo (perhaps via the Philippines) and Bawean and Kangean Island; in an eastern direction the group succeeded in reaching Samoa.

If now we review sect. *Pimela* as a whole, we find that the relationships of all its groups can be traced back to the *oleosum*-group and to Celebes and the Moluccas. Apparently we have to look here for the centre of the recent distribution of the section. Accordingly it is not surprising that 3 out of 5 groups are principally East Malaysian, and that both West Malaysian groups are the most advanced ones. It is certainly remarkable that these two western groups are unknown from the Philippines; the same is more or less true for the two eastern groups of the West Malaysian sect. *Canarium,* and both facts may point to a former possibility of a direct crossing of Macassar Strait (see, however, the *vulgare*-group).

Among the other 3 groups the *oleosum*-group is restricted to E. Malaysia (with probably 2 species in the Philippines); the other two groups are distributed from W. Malaysia to Melanesia, apparently crossing Wallace's line in the north via the (younger?) Philippine bridge.

C. Sect. Canariellum. *Fig. 14.*

It is not easy to state accurately the taxonomical position of this section, particularly as it seems to have been isolated for a very long time indeed. Part of its characters may be very primitive, part of them seem to be more derived than in any of the other sections. In my opinion, the following characters, in which the present section comes very close to the type of the genus, are really primitive:

1. the absence of stipules in all species;
2. axillary inflorescences in *C. muelleri* and sometimes in *C. baileyanum*;
3. in *C. baileyanum* apparently the flowers are more often truly

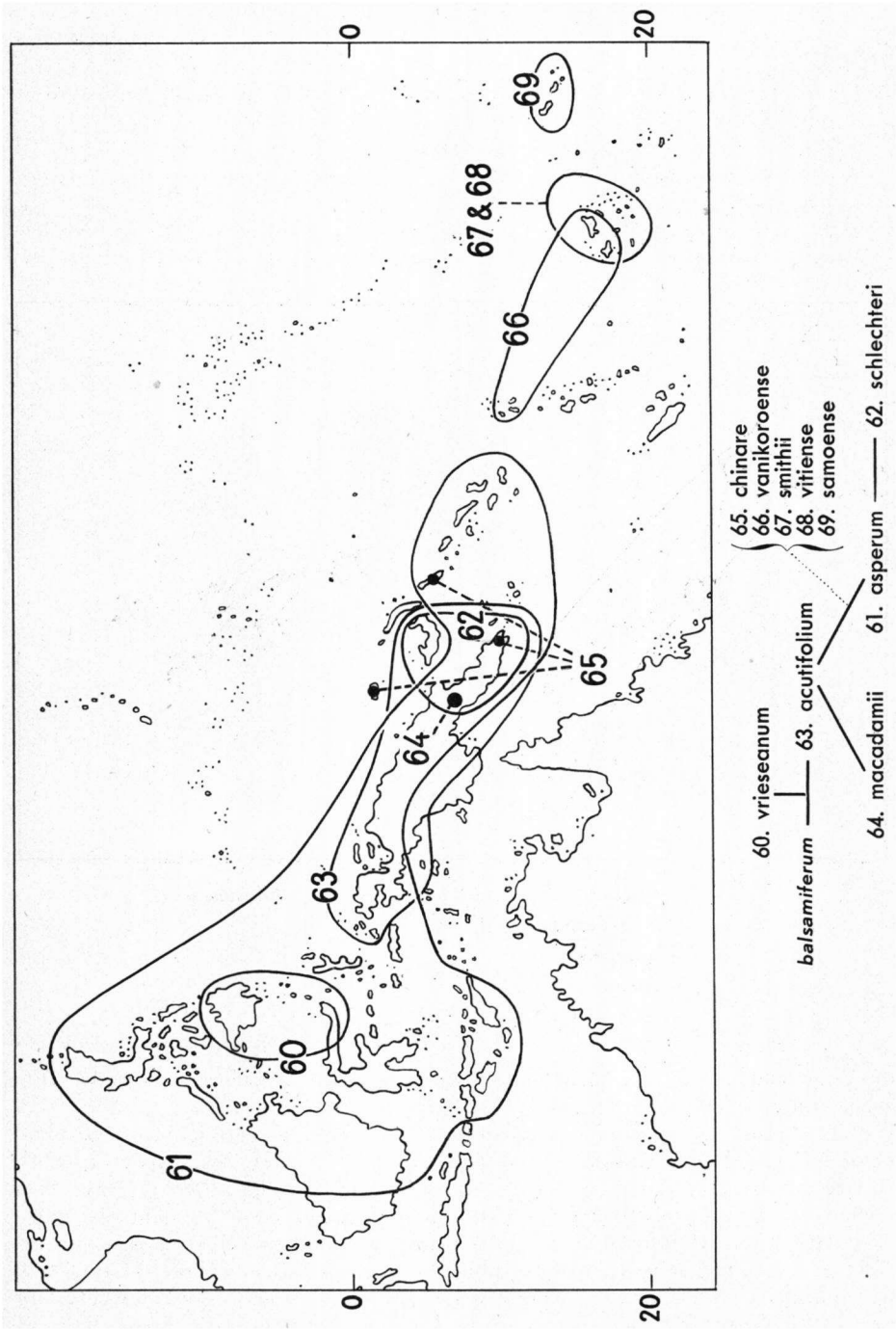


Fig. 13. *asperum*-group.

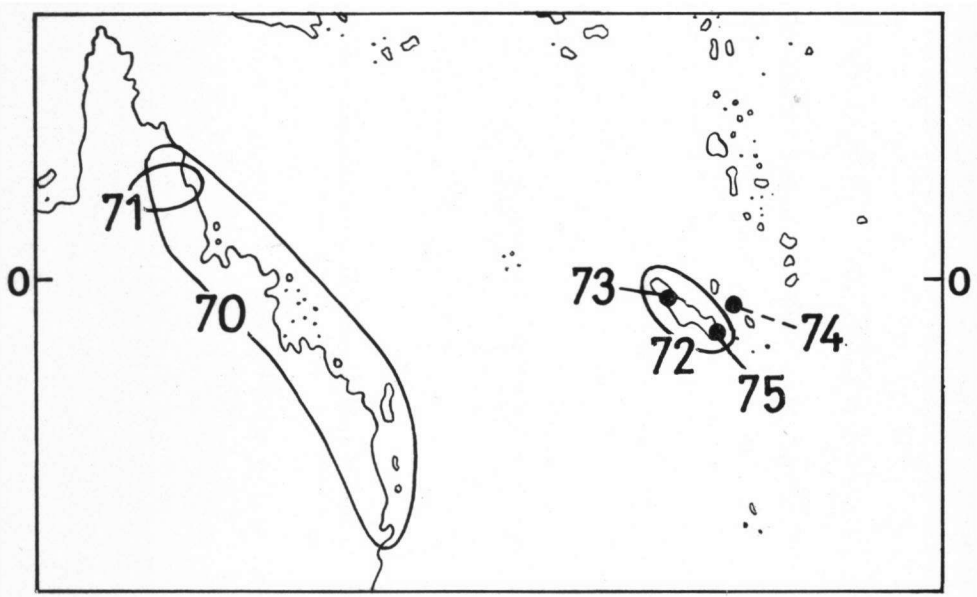
bisexual than in any other species of the genus; moreover, 4-merous flowers and fruits seem to be less rare in this species — and in the closely related *C. muelleri* — than in any other one.

For the rest, the flowers and fruits are like those of the type of the genus.

The most important tendencies seem to be:

1. the reduction of the number of ovary-cells, which in *C. oleiferum* and *whitei* is 2;

2. the apparent reduction of the vascular strands in the pith of the branchlets, a character which, as is discussed in chapter I, in all probability



71. muelleri — 70. baileyanum — 72. oleiferum
73. trifoliolatum
74. balansae
75. whitei

Fig. 14. Sect. *Canariellum*.

does not betray a primitive homology with related genera, but represents a secondary condition.

The most interesting series of species in this section is formed by *C. muelleri* — *baileyanum* — *oleiferum*. The former two species, both restricted to N.E. Australia, are doubtless very closely allied; *C. muelleri* seems by its apparently always axillary inflorescences to be slightly more primitive than *C. baileyanum*, which has pseudoterminal to terminal inflorescences. The close relationship between these two species and the New Caledonian *C. oleiferum* apparently supports the idea of a relatively old age of this group, since a direct land connection between Australia and

New Caledonia is supposed to have been broken since the Eocene. *C. oleiferum* is in some characters more advanced than the two Australian species (pistil 2-merous, inflorescences exclusively terminal).

The other three species of this section, *C. trifoliolatum, balansae,* and *whitei,* all New Caledonian, are apparently very rare (each of them is once collected only as far as I know); they all seem to be rather isolated taxonomically.

Attempt towards a synthesis.

If now we review the genus as a whole we may come to the following picture, which with all its inherent shortcomings may well represent the best synthesis attainable on account of the available facts.

We have found that the genus can be subdivided into 3 distinct sections and the *decumanum*-group, the taxonomical position of which remains unsolved. Out of these three sections, the first (*Canarium*) — the apparently most derived one — is centred in W. Malaysia, all its tracks leading to Sumatra; the second (*Pimela*) is East Malaysian, its tracks apparently pointing to Celebes and the Moluccas as the main centre of radiation; the third (*Canariellum*), which, on account of its showing some relic-characters, seems to represent an earlier off-shoot, is restricted to N.E. Australia and New Caledonia, apparently having reached the last-named island from Australia.

The above facts point to the East Malaysian—North Australian area as the most probable centre of origin of the genus *Canarium.*

Whether the forerunners of *Canarium* — which must have been closely related to the ancestors of *Dacryodes,* and which in turn both must have evolved from the *Protieae* and accordingly may have had their centre of origin in S. America — reached E. Malaysia from the southeast (in which case the *Canarieae* might be of subantarctic origin), from the west (arriving together with *Dacryodes*), or directly from the east, remains unsolved.

Either after reaching E. Malaysia, or on its way to that landmass, sect. *Canariellum* branched off; this section performed a development of its own in Australia and New Caledonia, possibly from early tertiary times onward.

Shortly afterwards, sect. *Pimela* developed in the Moluccas and the genus proceeded to W. Malaysia, where sect. *Canarium* began its development. It does not seem quite impossible to me that the *decumanum*-group, which according to morphological as well as geographical facts seems to have been isolated for a long time, is a relic of the original link between E. and W. Malaysia.

Initially, the direct crossing of Macassar Strait apparently remained fairly well possible; the *pilosum*-group — possibly after splitting off *C. australianum,* and then centering in East Malaysia — proceeded to the west, where it probably soon gave rise to the *dichotomum*-group. After some considerable diversification it may, either via Borneo or the Malay Peninsula, have reached continental Asia, possibly first in the region of the Me-Kong and Me-Nam-basins, and from there spread both to the west

and to the northeast. The *maluense*-group and perhaps also the *vulgare*-group crossed Macassar Strait in an eastern direction; it is not impossible, however, that the *vulgare*-group made use of the Philippine bridge at a later period.

Though the original centre of speciation in E. Malaysia may have been in Celebes and the Moluccas — where the *oleosum, hirsutum,* and *asperum*-groups seem to have originated — in more recent times the main centre of speciation developed in New Guinea, and from there some groups spread into Polynesia as far as Samoa.

In the mean time sect. *Canarium* richly diversified in W. Malaysia; by some unknown cause it was either not very successfull in getting a foothold in continental Asia, or it may later on have become obsolete there. The *denticulatum*-group spread far to the west however, and even succeeded in reaching Africa via the islands south of the Asiatic continent and Madagascar.

In more recent times, finally, the contact between E. and W. Malaysia remained apparently possible by the Philippine bridge; this track was mainly used by the *hirsutum*- and *asperum*-groups in a western and possibly by the *vulgare*-group in an eastern direction. Especially the western expansion of the *asperum*-group may have taken place in rather recent time, as it reached only as far as Borneo, and did not give rise to new species in W. Malaysia.

The picture given above is only partly in accordance with Lam's vision as to the phylogeny of the *Burseraceae* (1932b, 298—306). Being not familiar with the non-Malaysian representatives he regarded Africa as a possible centre of origin of *Canarium,* from where it might have reached Malaysia. This, however, seems improbable, both on account of the many highly advanced characters of the African *C. schweinfurthii* and of the relationships within the genus as stated above.

Conspectus specierum

A. Sect. Canarium

a. littorale-group

1. *C. littorale*
2. *C. latistipulatum*
3. *C. perlisanum*
4. *C. patentinervium*
5. *C. caudatum*
6. *C. divergens*
7. *C. kinabaluense*

b. maluense-group

8. *C. maluense*
9. *C. megacarpum*
10. *C. lamii*
11. *C. sylvestre*
12. *C. piloso-sylvestre*
13. *C. salomonense*
14. *C. harveyi*

c. vulgare-group

15. *C. vulgare*
16. *C. indicum*
17. *C. kaniense*
18. *C. luzonicum*
19. *C. ovatum*

d. denticulatum-group

20. *C. odontophyllum*
21. *C. denticulatum*
22. *C. karoense*
23. *C. megalanthum*
24. *C. manii*
25. *C. zeylanicum*
26. *C. paniculatum*
27. *C. madagascariense*
28. *C. schweinfurthii*

e. apertum-group

29. *C. pseudopatentinervium*
30. *C. grandifolium*
31. *C. apertum*

Incertae sedis

f. decumanum-group

32. *C. pseudodecumanum*
33. *C. decumanum*

B. Sect. Pimela

g. oleosum-group

34. *C. oleosum*
35. *C. balsamiferum*
36. *C. trigonum*
37. *C. euryphyllum*
38. *C. gracile*

h. pilosum-group

39. *C. kostermansii*
40. *C. pilosum*
41. *C. merrillii*
42. *C. album*
43. *C. pimela*
44. *C. parvum*
45. *C. subulatum*
46. *C. bengalense*
47. *C. strictum*
48. *C. euphyllum*
49. *C. intermedium*
50. *C. kipella*
51. *C. australianum*

i. dichotomum-group

52. *C. dichotomum*
53. *C. fusco-calycinum*

j. hirsutum-group

54. *C. hirsutum*
55. *C. pseudosumatranum*
56. *C. sumatranum*
57. *C. rigidum*
58. *C. polyphyllum*
59. *C. cestracion*

k. asperum-group

60. *C. vrieseanum*
61. *C. asperum*
62. *C. schlechteri*
63. *C. acutifolium*
64. *C. macadamii*
65. *C. chinare*
66. *C. vanikoroense*
67. *C. smithii*
68. *C. vitiense*
69. *C. samoense*

C. Sect. Canariellum

70. *C. baileyanum*
71. *C. muelleri*
72. *C. oleiferum*
73. *C. trifoliolatum*
74. *C. balansae*
75. *C. whitei*

SPECIAL PART

CANARIUM

Stickman, 1754, 10 (*sphalm. Cenarium*). — *Nanari* Adanson, 1763, 342, *nom. superfl.* — *Pimela* Loureiro, 1790, 407. — *Colophonia* Commerson *ex* Kunth, 1824, 352. — *Canariopsis* Blume *ex* Miquel, 1859, 651. — *Sonzaya* Marchand, 1867, 64. — *Lipara* Loureiro *ex* Gomes, 1868, 30, *nom. nud.* — *Canariellum* Engler, 1896, 242.

Type species: *C. indicum* L.

Trees, often buttressed, occasionally shrubs or (pseudo-)lianas. Bark usually smooth, somewhat scaly, greyish. *Twigs* terete or rarely angular; pith nearly always with vascular strands, the phloem of which mainly consists of some or only one resin-canal(s). *Leaves* spirally arranged or very rarely whorled in threes, usually more or less fascicled at the ends of the twigs; imparipinnate, very rarely unifoliolate. *Stipules* often present, inserted either on the twig next to the base of the petiole, or partly or entirely on the latter; rather different in shape and size, not rarely very caducous and visible in the terminal bud only. *Petioles* terete or flattened to channelled, especially near the base; swollen at the base, as are the nodes of the rhachis and both ends of the petiolules; pith always with vascular strands. *Rhachis* usually keeled above. *Petiolules* terete. *Leaflets* nearly to strictly opposite, base of laterals slightly oblique, margin entire to dentate or serrate, apex almost always distinctly acuminate, the nerves mostly more or less distinctly interarching near the margin, the veins mainly transverse; basal pair of leaflets usually smaller than the others. *Inflorescences* axillary (together sometimes pseudoterminal) or terminal, thyrsoid (sometimes reduced to racemes or spikes, especially the ♀ ones, which are always smaller), bracteate. *Flowers* 3-merous, unisexual, dioecious. *Receptacle* flat or (in ♀ flowers of many species) concave. *Calyx* cupular, sepals usually about halfway connate, the lobes deltoid; outside hairy or glabrous, inside nearly always densely sericeous. *Petals* 3, free, in bud usually imbricate, induplicate-valvate near the apex; nearly always oblong-obovoid, very rarely unguiculate, usually slightly conduplicate; entire, the apex usually with a small inflexed apiculum; fleshy and often rather thick with the exception of the margins; outside usually more or less hairy except the base and margins, inside very rarely hairy; creamy white. *Stamens* 6, in one whorl, epipetalous ones sometimes more or less to totally abortive; free to entirely connate, sometimes adnate to the disk; in ♀ flowers sterile and often less well developed; the filaments flattened (rarely filiform), tapering towards the apex; anthers dorsifix, attached slightly above their base, usually oblong to lanceolate, the thecae opening latero-introrse with a longitudinal slit, connective not strongly developed. *Disk* intrastaminal, 6-lobed, in ♂ flowers usually strongly developed, sometimes adnate either to the

stamens or to the pistillode, in ♀ flowers often adnate to the stamens and, if the receptacle is concave, nearly entirely adnate to the latter. *Pistillode* in ♂ flowers usually much reduced to absent, sometimes united with the disk to an 'ovariodisk', which even can bear a 'style'; pistil sometimes fully replaced by the strongly developed and massive disk. *Pistil* in ♀ flowers consisting of an ovoid to ellipsoid ovary, tapering into a cylindrical style, with a small, capitate, faintly 3-lobed stigma; when the receptacle is concave the pistil is usually shortly stalked, the stalk, however, represents no true gynophore, as it consists of the fertile part of the ovary; ovary 3-celled, with 2 collateral epitropous ovules per cell. *Infructescences* like the ♀ inflorescences, with thickened branches and enlarged calyces. *Fruits* usually plum-shaped, drupaceous, blue-black when ripe (rarely ivory-white or red), hairy, especially near base and apex, or glabrous; pericarp fleshy (rarely fibrous); pyrene stony, consisting of the mesocarp, the endocarp, and an axial intrusion; cells 3, 1 or 2 of which may be sterile and slightly to almost completely reduced (usually with the exception of the endocarp-layer, however). *Seeds* 1 per cell, testa brown; exalbuminous, oily, cotyledons palmatifid to 3-foliolate, contortuplicate or folded.

Distribution: Tropical W. and E. Africa, Madagascar, Mauritius, Ceylon, S.E. Asia (from S. Deccan to S. China and Hainan), Malaysia, N.E. Australia, and Melanesia as far east as Samoa.

Ecology: Mainly canopy elements of primary and secondary rain forests at low to medium altitudes; sometimes in monsoon forests or parklands, in Australia also on coastal dunes. Fl. mainly in the dry season, fr. in the rainy season; many species, however, have apparently no special flowering and fruiting seasons. The pollination is very probably effectuated by insects, the seed dispersal by birds (fruit pigeons) and mammals (monkeys).

Uses: The timber of almost all species is soft to moderately hard, moreover it is cross-grained; it plays no part of any importance in the world trade.

The resin, which is often abundant, is of more importance. Especially the *manila-elemi* (*C. luzonicum*) is used in pharmacy in ointments and plasters; moreover, it is a constituent of cellulose lacquers. (For further details see: Tschirch und Stock, Die Harze 2, 1935, 273—327). It is to be expected that the resins of many other species are also economically valuable, but very little is known of this matter.

The seeds of several species are estimated, though only in the Solomons they are (or were?) an important constituent of the diet; in Malaysia and China they are a valued titbit (in China the fleshy pericarp is also eaten). The oil pressed out the seeds is locally used.

KEY I. Introductory key

1.a. Stipules present (often rather caducous, traceable by their scars; in some species present only in the terminal bud and scars nearly invisible) 2
b. Stipules absent . . . . . **Key V**
2.a. Either stipules flattened, scars elliptic to linear, or stipules auricle-shaped, scars drop-shaped; sometimes stipules represented by a basal pair of small, caducous,

normal leaflets, scars minute, circular . . . . . sect. **Canarium, Key II**
b. Stipules subulate to narrowly triangular, scars minute, circular sect. **Pimela, Key III**

KEY II. Sect. CANARIUM

1.a. Stipules (or their scars) present 5
b. Stipules absent 2
2.a. Terminal bud 3—5 cm long. *W. Malaysia* . . . . **32. C. pseudodecumanum**
b. Terminal bud up to 1½ cm long 3
3.a. Leaves 1—2(—4)-jugate, usually glabrous; leaflets entire; apex shortly blunt-acuminate; leaflets greenish when dry. *W. Malaysia* **29. C. pseudopatentinervium**
b. Leaves (2—)3—7-jugate, very rarely glabrous; leaflets usually minutely fimbriate-serrate; apex blunt or acutely acuminate; leaflets brownish when dry 4
4.a. Leaflets elliptic, base cuneate; leaves 2—3-jugate. *Malay Peninsula* **30. C. grandifolium**
b. Leaflets more or less irregularly shaped, either greatest width near the base or margins parallel; base rounded or truncate to subcordate; leaves (2—)3—7-jugate. *W. Malaysia* . . . . . **31. C. apertum**
5.a. Stipules represented by a pair of normal small leaflets, which are inserted at the base of the petiole; scars small, circular. *Borneo, E. Malaysia* **33. C. decumanum**
b. Stipules and their scars not as above 6
6.a. Stipules inserted at the base of the petiole, partly or entirely on the branchlet 7
b. Stipules distinctly fully on the petiole (if dubious see under a) 18
7.a. Stipules entire, often very caducous 8
b. Stipules not entire, usually rather persistent 15
8.a. Stipules moderately caducous, oblong, 1—5 by ½—1¾ cm; scars linear, c. ½ cm long. *E. Malaysia, Kangean & Bawean* . . . . . **15. C. vulgare**
b. Stipules very caducous, reniformous to roundish, much smaller; scars elliptic, 1—2 mm long 9
9.a. Fruits 8 by 5 cm; pericarp fibrous; stone acutely triangular with concave sides. *New Guinea* . . . . . **9. C. megacarpum**
b. Fruits smaller; pericarp fleshy; stone not as above 10
10.a. Inflorescences axillary, together pseudo-terminal (vegetative terminal bud present). *Philippines* . . . . . **18. C. luzonicum**
b. Inflorescences terminal 11
11.a. Stamens in ♂ flowers 3. Leaflets caudate-acuminate, tapering at base and apex. *W. Malaysia* . . . . . **5. C. caudatum**
b. Stamens 6. Leaflets usually otherwise 12
12.a. Nerves few (5—15 pairs), mutual distance along the midrib large (1—1½ cm); veins inconspicuous. Leaflets glabrous, entire 13
b. Nerves rather many (9—22 pairs), dense (distance along midrib usually ½—1 cm); venation more or less conspicuous to prominent. Leaflets not rarely pubescent, mostly entire 14
13.a. ♂ Inflorescences very lax, branches long and transverse. ♂ Flowers 13 mm long. *Borneo* . . . . . **6. C. divergens**
b. ♂ Inflorescences not very lax. ♂ Flowers *c.* 8 mm long. *W. Malaysia* **4. C. patentinervium**
14.a. Nervation very regular, nerves dense, nearly straight and parallel (angle 75—85°), abruptly and distinctly interarching. Leaflets regular, elliptic to elliptic-ovate; base equilateral, rather broad; apex abruptly, shortly, broadly, and bluntly acuminate. Disk in ♂ flowers very rarely with a 'style'. *E. Malaysia, Borneo* **8. C. maluense**
b. Leaflets and nervation not conspicuously regular. Ovariodisk in ♂ flowers nearly always with a 'style'. *W. Malaysia, Indo-China* . . . **1. C. littorale**
15.a. Inflorescences terminal (vegetative terminal bud absent) 16
b. Inflorescences axillary, sometimes together pseudoterminal (vegetative terminal bud present) 17

16.a. Fruit-stone 2—3 cm diam., rounded triangular in cross-section, the sides usually convex. Stipules dentate. *E. Malaysia to New Hebrides* . . . **16. C. indicum**
b. Fruit-stone 3—4 cm diam., acutely deltoid in cross-section, sometimes even winged, sides usually concave. Stipules deeply repeatedly dentate to fimbriate. *New Guinea* . . . . . **17. C. kaniense**
17.a. Leaflets dentate to serrate, pilose. *Sumatra, Borneo, Palawan* **20. C. odontophyllum**
b. Leaflets entire, glabrous *Sumatra* . . . . . **22. C. karoense**
18.a. Stipules deeply incised, pectinate to dendriform 19
b. Stipules entire 20
19.a. Flowers ♂ 4—5 mm long, ♀ 7—8 mm. Fruits up to 3 by 1½ cm. *Philippines, W. Malaysia, Andamans, Burma* . . . . . **21. C. denticulatum**
b. Flowers ♂ 11 mm long, ♀ 13—15 mm. Fruits 5—5½ by 3½—4 cm. *W. Malaysia* **23. C. megalanthum**
20.a. Inflorescences axillary, sometimes together pseudo terminal (vegetative terminal bud present) 21
b. Inflorescences terminal (vegetative terminal bud absent) 25
21.a. Stipules oblong-spathulate, *c.* 3½ by ½ cm, together with the broadened basal part of the petiole enclosing the terminal bud. ♂ Flowers with androphore. *W. and Central Africa* . . . . . **28. C. schweinfurthii**
b. Stipules rotundate or linguiform, much smaller. No androphore 22
22.a. Leaflets crenulate, at least in the apical part. *Malay Peninsula* **3. C. perlisanum**
b. Leaflets entire 23
23.a. Stipules linguiform, stiff, coriaceous, persistent. *Philippines* . . **19. C. ovatum**
b. Stipules roundish or auricle-shaped, herbaceous, often rather caducous . . 24
24.a. Nerves usually up to 13 pairs. Pistil glabrous. Dried leaflets greenish-brown, the nerves straw-coloured. Fruit-stone nearly always distinctly ribbed. *Solomon Islands to Samoa and Tonga* . . . . . **14. C. harveyi**
b. Nerves 14—18 pairs. Pistil pilose. Dried leaflets dull yellowish- to red-brown, nerves not light-coloured. Fruit-stone smooth. *Philippines* . **18. C. luzonicum**
25.a. Leaflets dentate or serrate, at least in the apical part 26
b. Leaflets entire (rarely slightly undulate) 27
26.a. Leaflets chartaceous, distinctly, though sparsely, pubescent on midrib and nerves beneath; margin entirely minutely serrate. Stipules chartaceous. *Borneo* **2. C. latistipulatum**
b. Leaflets coriaceous, glabrous, or with a few hairs on the midrib beneath only; margin dentate towards the apex. Stipules coriaceous. *Borneo* **7. C. kinabaluense**
27.a. Ovariodisk in ♂ flowers with 'style'. Leaflets caudate-acuminate, tapering at both ends. *W. Malaysia* . . . . . **5. C. caudatum**
b. Disk in ♂ flowers without 'style'. Leaflets mostly otherwise 28
28.a. Fertile fruit-cells bean-shaped in cross-section thanks to a strong parietal rib 29
b. Fruit-cells without a strong parietal rib 31
29.a. Fruits nearly always pustular-scabrous. Leaves 2—9-jugate, glabrous or pilose. Pistil usually pilose. *Madagascar, E. Africa* . . . **27. C. madagascariense**
b. Fruits smooth to slightly papillose. Leaves up to 4-jugate, glabrous. Pistil glabrous 30
30.a. Fruits 2½—3 by 1½ cm. Nerves 9—12 pairs. *Andamans* . . . **24. C. manii**
b. Fruits 4½ by 2 cm. Nerves 12—18 pairs. *Ceylon* . . . **25. C. zeylanicum**
31.a. Stipules 1¼—2 by 1 cm, rather persistent. Fruits 6 by 4 cm. *New Guinea* **10. C. lamii**
b. Stipules (usually much) less than 1 by 1 cm. Fruits up to 5½ by 2¾ cm . 32
32.a. Nerves 15—23 pairs. *E. Malaysia* . . . . . **8. C. maluense**
b. Nerves 8—15 pairs 33
33.a. Twigs, leaves, and inflorescences pilose. *New Guinea* **12. C. piloso-sylvestre**
b. Plant glabrous 34
34.a. Leaflets tapering at both ends, base acute, acumen long and slender. Stamens 6—3. *E. Malaysia* . . . . . **11. C. sylvestre**
b. Leaflets not tapering at both ends, base broadly cuneate, truncate or cordate, acumen short and broad. Stamens 6 35
35.a. Pith of the branchlets with a number of small vascular strands, part of which

are peripherally arranged. Fruits flattened-ellipsoid; stone smooth with the exception of 3 blunt white ribs at the base. *New Guinea, Solomon Islands* **13. C. salomonense**

b. Pith of the branchlets without, or with a few peripheral, vascular strands. Fruits long-ovoid; stone faintly rugged. *Mauritius* . . . **26. C. paniculatum**

KEY III. Sect. PIMELA

1.a. Terminal bud *c.* 3 cm long, slender, curved, ferruginous-tomentose. *Sumatra, Malay Peninsula* . . . . . **56. C. sumatranum**

b. Terminal bud up to 1 cm long 2

2.a. Stipules (or their scars) present, at least in the terminal bud 3

b. Stipules absent 24

3.a. Stamens free (see also *C. vriesеanum*, in which the stamens are free in ♀ flowers, connate in ♂ ones) 4

b. Stamens more or less connate (unknown in *C. cestracion* and *chinare*) . . . 8

4.a. Stamens pilose. *Malaysia, Carolines, Solomon Islands* . . . **54. C. hirsutum**

b. Stamens glabrous 5

5.a. Disk pilose 6

b. Disk glabrous 7

6.a. Inflorescences up to 50 cm long, with many flowers. Flowers *c.* 4 mm. Calyx in fruit flat, the lobes reflexed. Fruits ovoid to globular. *E. Malaysia* **63. C. acutifolium**

b. Inflorescences up to 12 cm long, with up to *c.* 10 flowers. Flowers 7—13 mm. Calyx in fruit funnel-shaped. Fruits spindle-shaped. *Fiji* . . . **68. C. vitiense**

7.a. Fruits 9—14 by 4—11 mm; stone (nearly) smooth. Inflorescences usually spicate or compoundly spicate. *Philippines, E. Malaysia, Bawean & Kangean, Solomon Islands* . . . . . **61. C. asperum**

b. Fruits 25 by 13—15 mm; stone very rugged. Inflorescences thyrsoid. *Samoa* **69. C. samoense**

8.a. All vascular strands in the pith of the branchlets scattered. Fruits very characteristic (see description). *New Guinea* . . . . . **59. C. cestracion**

b. All or part of the vascular strands in the pith of the branchlets arranged into a peripheral cylinder. Fruits not as above 9

9.a. Leaflets distinctly densely papillose beneath, rough on the touch (sometimes every papilla bearing a hair). Stamens less than halfway up connate; pistil glabrous. Mature fruits bluish-black. *Borneo* . . . . . **41. C. merrillii**

b. Leaflets not papillose beneath (in *C. album* sometimes papillose, then stamens connate halfway up or more, pistil pilose, mature fruits white) 10

10.a. Inflorescences and infructescences terminal, pyramidal, laxly dichotomously branched, up to 40 cm long 11

b. Inflorescences and infructescences axillary (in *C. pilosum* sometimes terminal, then rather narrowly thyrsoid and up to 25 cm long) 12

11.a. Leaves 3- or more-jugate, subglabrous as are the branchlets. *Sumatra, Borneo* **52. C. dichotomum**

b. Leaves 1—2(—3)-jugate, thinly and shortly pubescent as are the branchlets. *Borneo* **53. C. fusco-calycinum**

12.a. Nerves 22—25 pairs. Pith of the branchlets with 2 concentric cylinders of vascular strands. Mature leaflets glabrous. *Borneo* . . . **39. C. kostermansii**

b. Nerves usually up to 20 pairs (if more, then central vascular strands in pith of branchlets not cylindrically arranged, and mature leaflets usually not glabrous) 13

13.a. Leaves (6—)9—10-jugate, (sub-)glabrous. All vascular strands in pith of branchlets peripherally arranged. Stamens in both ♂ and ♀ flowers connate for more than half the length of the filaments. Fruits acutely triangular in cross-section. *Continental SE. Asia* . . . . . **46. C. bengalense**

b. Leaves up to 6-jugate (in some species exceptionally up to 7-jugate, mainly on suckers; then differing in most of the other characters mentioned above) 14

14.a. Corolla 2—3 times as long as the calyx, flowers long and slender . . . 15

b. Corolla less than twice as long as the calyx (unknown in *C. chinare*) . . . 19

15.a. Tips of the branchlets, leaves, and inflorescences shaggy ferruginous-pilose, glabrescent. Fruits usually prismatic, slightly blunt-triangular in cross-section, truncate and with 3 distinct shoulders at the apex. *W. Malaysia* **40. C. pilosum**

b. Pubescence variable, usually tomentose, never shaggy. Fruits not as above . 16

16.a. Margin of the leaflets minutely serrate, dentate, or repandous. *Thailand, Indo-China* . . . . . **45. C. subulatum**

b. Leaflets entire 17

17.a. Stamens connate for half the length of the filaments or more Fruits white. *Indo-China, S. China, Hainan* . . . . . **42. C. album**

b. Filaments distinctly less than halfway connate. Fruits bluish-black . . . 18

18.a. Stipules usually inserted on the petiole at 1—3 cm from its base. Disk in ♂ flowers more or less cylindrical, 3 mm high; stamens up to 3 mm connate. Fruits *c.* 4 by 2 cm. *New Guinea, New Britain* . . . . **62. C. schlechteri**

b. Stipules usually inserted next to or on the base of the petiole. Disk in ♂ flowers cupular, ½ mm high; stamens slightly confluent at the base only. Fruits 1½—2¼ by 1½—1¾ cm. *Fiji* . . . . . **67. C. smithii**

19.a. Fruits remaining velvety pubescent for a long time. Stipules inserted on the petiole up to 1½ cm from its base, narrowly triangular, falcate (in *C. australianum* the stipules are also sometimes inserted on the petiole; for differences see there). *Philippines, Celebes* . . . . . **60. C. vrieseanum**

b. Fruits glabrous. Stipules usually inserted at the base of the petiole . . . 20

20.a. Young parts, lower side of leaflets, and inflorescences remaining densely pubescent for rather a long time. Stipules subulate. Leaflets often not fully entire; base in the upper pair of leaflets often in the lower half decurrent till the rhachis; nerves 12—24 pairs 21

b. Glabrous with the exception of the tip of the twigs. Stipules mostly flattened. Leaflets entire; base never as above; nerves 8—16 pairs 22

21.a. Leaflets 10—20 by 4—10 cm, tapering acuminate at apex, darkbrown when dry, densely reddish-brown pubescent beneath; nervation regular. *Continental S. Asia* **47. C. strictum**

b. Leaflets 7—11(—17) by 3—7 cm, apex rounded to acute, sometimes abruptly, very shortly, blunt-acuminate; greyish-green when dry; glabrous or minutely greyish to yellowish tomentose beneath; nervation usually rather irregular (nerves dense, tortuous, and more or less fading towards the margin). *Australia, New Guinea* . . . . . **51. C. australianum**

22.a. Base of lateral leaflets cuneate. Leaflets rather small and narrow (5—11 by 2—4½ cm). Fruits up to 2½ cm long. *New Guinea to Solomon Islands* **65. C. chinare**

b. Base of lateral leaflets truncate to rounded. Leaflets bigger and especially broader (8—18 by 3½—9 cm). Fruits 3½—4 cm long 23

23.a. Flowers glabrous. Calyx in fruit *c.* 5 mm diam. Pyrene of the fruits smooth. Pith of the branchlets with central vascular strands. *New Guinea* **64. C. macadamii**

b. Corolla outside pubescent. Calyx in fruits 12—15 mm diam. Pyrene of the fruits very rugose. Pith of the branchlets without vascular strands. *New Hebrides, Fiji* . . . . . **66. C. vanikoroense**

24.a. Leaves, inflorescences, and infructescences manifestly lax (lateral petiolules 1—1½ cm, terminal ones 3—4 cm, petioles 10—14 cm, interjugal parts 4—8 cm). Disk in ♂ flowers pistilloid, stalked, globular, hollow. Fruits oblique, bulging on one side; central canal much widened. *Philippines* . . . . **38. C. gracile**

b. Leaves, inflorescences, and infructescences not very lax. ♂ Flowers and fruits not as above 25

25.a. Filaments of the stamens pilose 26

b. Filaments glabrous 27

26.a. Branchlets slender (leafy part 3—4 mm thick). *Celebes* . . **36. C. trigónum**

b. Branchlets thick (1½—3 cm in the leafy part). *Celebes, Moluccas* **54. C. hirsutum**

27.a. Petals strongly thickened in the apical part, the broadened and flattened margins rugose. Fruits 4—5 by 2—2½ cm, the stone very rugose 28

b. Petals not strongly thickened. Fruits usually smaller, the stone smooth or with 3—6 longitudinal ribs 29

28.a. Leaflets narrow (6¼—15 by 1¼—4 cm), glabrous. *New Guinea* **57. C. rigidum**

b. Leaflets broader (5½—20 by 2½—8 cm), pubescent on midrib and nerves. *New Guinea* . . . . . **58. C. polyphyllum**
29.a. Mature leaflets more or less pubescent 30
b. Mature leaflets glabrous 32
30.a. Pith of the branchlets without central vascular strands. *Indo-China* **44. C. parvum**
b. Pith of the branchlets with central vascular strands 31
31.a. Leaflets entire. *Philippines* . . . . . **37. C. euryphyllum**
b. Leaflets undulate to dentate at the margin. *Continental S. Asia* **47. C. strictum**
32.a. Fruits 5 by 2½ cm. Leaves 7—9-jugate. Leaflets stiff-chartaceous. Nerves 16—20 pairs. *Malay Peninsula* . . . . . **55. C. pseudosumatranum**
b. Fruits up to 4 cm long (if more than 4 cm, then leaves less jugate and nerves less numerous) 33
33.a. Disk in ♂ flowers pistilloid, with 'style'. Fruits small (up to 2 by 1¼ cm) (in *C. balsamiferum* the fruits are 2—4 by 1¼—2 cm; this species is different by the minutely tessellate reticulation of the leaflets). *E. Malaysia* **34. C. oleosum**
b. Disk in ♂ flowers without 'style'. Fruits larger 34
34.a. Branchlets thick (*c.* 1½ cm in the leafy part), with very conspicuous, though not prominent, large (*c.* 1½ by 1½ cm) cordate laef-scars. Leaflets usually serrate to dentate. *Andaman and Nicobar Islands, Burma* . . **48. C. euphyllum**
b. Branchlets usually much more slender, leaf-scars much smaller. Leaflets entire 35
35.a. Pistil pubescent. Stamens free or filaments less than halfway up connate. ♂ Flowers *c.* 1 cm long (in *C. pilosum* the stamens are in ♂ flowers confluent at the base only; these ♂ flowers are only ½ cm long, however) 36
b. Pistil glabrous. Filaments more than halfway up connate 37
36.a. Leaflets rather large (9—24 by 2—9¼ cm), short-acuminate; reticulations minutely tessellate. Fruits ± round in cross-section, bluish-black. *Celebes, Moluccas* **35. C. balsamiferum**
b. Leaflets rather small (3½—12 by 2—4 cm), caudate-acuminate; reticulations not conspicuously dense. Fruits broad-triangular in cross-section, bright red when fresh. *Philippines* . . . . . **37. C. euryphyllum**
37.a. Pith of the branchlets usually without central vascular strands . . . 38
b. Pith of the branchlets usually with central vascular strands 39
38.a. Leaves 0—5-jugate; leaflets regular-shaped. Stamens in ♂ flowers confluent at the base only. Corolla in ♀ flowerbuds slender. Fruits ellipsoid to fusiform, 1½ cm in diam. *Borneo* . . . . . **40. C. pilosum**
b. Leaves 4—6-jugate; leaflets oblique, more or less falcate. Stamens in ♂ flowers about halfway up connate. Corolla in ♀ flowerbuds conical. Fruits ovoid, 1¼—2 cm in diam. *Indo-China, S. China, Hainan* . . . . **43. C. pimela**
39.a. Nerves 14—17 pairs. Filaments halfway connate; stamens in ♀ flowers as long as the pistil. *Sumatra* . . . . . **49. C. intermedium**
b. Nerves 10—12 pairs. Filaments nearly entirely connate, sometimes with interstaminal teeth; stamens in ♀ flowers about half as long as the pistil. *Java* **50. C. kipella**

KEY IV. Sect. CANARIELLUM

1.a. Leaves 5—8-jugate. *New Caledonia* . . . . . **75. C. whitei**
b. Leaves unifoliolate to 3-jugate 2
2.a. Branchlets and at least lower side of the leaves ferruginously pilose. Leaves usually unifoliolate. *New Caledonia* . . . . . **72. C. oleiferum**
b. Plant early glabrescent. Leaves usually 1—3-jugate 3
3.a. Base of leaflets cuneate, apex rounded to shortly and broadly acuminate. Flowers *c.* 4 mm long 4
b. Base of leaflets rounded to cordate, apex shortly acuminate. Flowers *c.* 2 mm long 5
4.a. Leaves usually 1-jugate; petioles terete. *NE. Australia* . . **70. C. baileyanum**
b. Leaves usually 3-jugate; petioles flattened above. *NE. Australia* **71. C. muelleri**
5.a. Leaves spirally arranged, 1—2-jugate. *New Caledonia* . **73. C. trifoliolatum**
b. Leaves whorled, 2—3-jugate. *Loyalty Islands* . . . . . **74. C. balansae**

KEY V. Species without stipules

1.a. Pith of the branchlets without vascular strands . . . . . Key IV
b. Pith of the branchlets with vascular strands 2
2.a. Terminal bud 3—5 cm long 3
b. Terminal bud up to 1½ cm long 4
3.a. More or less densely pubescent. Leaves 3—6-jugate; leaflets subsessile, 2(—3) times as long as wide. Inflorescences narrowly thyrsoid. Petals only slightly thickened in the apical part. Stamens free. Fruits 7 by 4½ cm or more. *W. Malaysia* . . . . . **32. C. pseudodecumanum**
b. Practically glabrous. Leaves 7—11-jugate; leaflets often distinctly stalked, 2½—4 times as long as wide. Inflorescences broadly thyrsoid. Apical part of the petals strongly thickened, with rugose lateral surface. Stamens connate. Fruits 1½ by 1 cm. *Sumatra, Malay Peninsula* . . . . **56. C. sumatranum**
4.a. Central part of the pith in the branchlets without vascular strands . . . 5
b. Central part of the pith in the branchlets with vascular strands 15
5.a. Inflorescences terminal. Petals unguiculate (in *C. pilosum* the inflorescences are very exceptionally also terminal, the petals are not unguiculate, however) key II no. 3
b. Inflorescences axillary. Petals not unguiculate 6
6.a. Leaflets more or less pubescent 7
b. Leaflets glabrous 8
7.a. Petals not strongly thickened in the apical part. Leaves 2—4-jugate. Nerves 10—12 pairs. *Indo-China* . . . . . **44. C. parvum**
b. Petals strongly thickened in the apical part. Leaves 3—11-jugate. Nerves 11—24 pairs. *New Guinea* . . . . . **58. C. polyphyllum**
8.a. Leaves whorled. *Loyalty Islands* . . . . . **74. C. balansae**
b. Leaves spirally arranged 9
9.a. Leaf-scars on the branchlets very conspicuous (though not prominent), cordate, 1½ by 1½ cm. Leaflets mostly serrate or dentate. *Andaman and Nicobar Islands, Burma* . . . . . **48. C. euphyllum**
b. Leaf-scars not very conspicuous. Leaflets entire 10
10.a. Nerves up to 15 pairs 11
b. Nerves 15—30 pairs 13
11.a. Stamens pilose. *Celebes* . . . . . **36. C. trigonum**
b. Stamens glabrous 12
12.a. Disk in ♂ flowers with a 'style'. Stamens in ♀ flowers free. Fruits ovoid to obovoid, 1¼—2 by ¾—1¼ cm. *E. Malaysia* . . . . . **34. C. oleosum**
b. Disk in ♂ flowers without 'style'. Stamens in ♀ flowers distinctly connate. Fruits 2—4 by 1—2 cm . . . . . key III no. 38
13.a. Stamens pilose, free. Nerves 20—30 pairs. *Moluccas* . . . **54. C. hirsutum**
b. Stamens glabrous, connate. Nerves 15—20 pairs 14
14.a. Nerves not distinctly interarching. *Malay Peninsula* **55. C. pseudosumatranum**
b. Nerves distinctly interarching. *New Guinea* . . . . . **57. C. rigidum**
15.a. Leaflets not fully entire. *Continental S. Asia* . . . . . **47. C. strictum**
b. Leaflets entire 16
16.a. Leaves, inflorescences, and infructescences manifestly lax (lateral petiolules 1—1½ cm, terminal ones 3—4 cm, petioles 10—14 cm, interjugal parts 4—8 cm). Disk in ♂ flowers pistilloid, stalked, globular, hollow. Fruits oblique, bulging on one side; central canal much widened. *Philippines* . . . . **38. C. gracile**
b. Leaves, inflorescences, and infructescences not very lax. ♂ Flowers and fruits not as above 17
17.a. Stamens pilose. Fruits prickly-hairy. *Celebes* . . . . . **54. C. hirsutum**
b. Stamens and fruits glabrous 18
18.a. Vascular strands in the pith of the branchlets without resiniferous parts. Fruits 2-merous. *New Caledonia* . . . . . **75. C. whitei**
b. Vascular strands in the pith of the branchlets with resiniferous ducts. Fruits essentially 3-merous . . . . . key III no. 35

I. SECTION CANARIUM

Sect. *Canaria* DC. Prod. 2 (1825) 79. — Sect. *Progressiva* and sect. *Regressiva* subsect. *Auriculata* H. J. Lam, Ann. Jard. Bot. Btzg 42 (1932) 214 and 209.

Stipules either foliaceous or pectinate, enveloping the terminal bud, or small and shrivelled, auricle-shaped, rarely absent; scars mostly linear or, if on the petiole, drop-shaped. *Bracts* usually consisting of the persistent connate stipules, concave, enveloping the flower buds, rarely lanceolate to subulate. *Leaflets* brownish when dry; margin entire to dentate; indument, if present, shortly tomentose. *Inflorescences* usually terminal, rarely all axillary. *Stamens* usually free or adnate to the disk, very rarely up to halfway connate. ♀ *Flowers* nearly always with a concave receptacle; in that case disk adnate to the receptacle and pistil stalked; *disk* and *pistil* usually glabrous. *Calyx* in fruit rarely less than 1 cm diam., usually flat with undulate margin, or more or less funnel-shaped, often densely tomentose. *Fruits* rather large, usually 5—7 cm long; pyrene smooth, sometimes with angle- and median ribs.

Distribution: Africa, Madagascar, Mascarenes, Ceylon, Burma, Andamans, Indo-China, Malaysia, Solomon Isl., New Hebrides, Fiji, Samoa, and Tonga.

1. **Canarium littorale** Blume, 1826, 1164; Roemer & Schultes, 1830, 1625; Blume, 1850, 218; Miquel, 1859, 645; Engler, 1883, 126; Koorders & Valeton, 1896, 36; Backer, 1911, 198; Koorders, 1912, 433; Heyne, 1927, 877; Lam, 1932a, t. 13 f. 104g, t. 15 f. 119b; 1932b, 498, t. 13 f. 82; Corner, 1940, t. 39, *sub C. sp.*; Lam, 1948, 5; Wyatt-Smith, 1953, 11, *cum fig.*; Leenhouts, 1956, 256; *non* Ridley, 1922, 375 (= *C. patentinervium* Miq.). — *C. glaucum* Blume, 1850, 219; Miquel, 1859, 645; Engler, 1883, 140; King, 1894b, 249; Merrill, 1921, 317; *non* Hochreutiner, 1905, 69 (= *Protium serratum* Engl.). — *C. tomentosum* Blume, 1850, 219; Miquel, 1859, 644; Engler, 1883, 120; Lam, 1932a, 214, t. 12 f. 93, t. 15 f. 119d, e, *incl. var. typicum et var. flavum*; 1932b, 496, t. 12 f. 81; Wyatt-Smith, 1953, 10, *cum fig.* — *C. serricuspe* Miquel, 1859, 649; Engler, 1883, 148; Heyne, 1927, 878. — *C. serrulatum* Miquel, 1859, 646; 1869, 116. — *C. purpurascens* Bennett, 1875a, 532; 1875b, 103; Engler, 1883, 115; King, 1894b, 245; Ridley, 1900a, 58; 1922, 370; Burkill, 1935, 432; *non* Henderson, 1939, 39 (= *C. perlisanum* Leenh.). — *C. rufum* Bennett, 1875a, 533; 1875b, 103; Engler, 1883, 107; King, 1894b, 244; Ridley, 1900a, 58; Guillaumin, 1909a, f. 17, 22^{14}, 23^{4}; Ridley, 1922, 372; Buckley, 1932, 34; Lam, 1932a, t. 11 f. 79, t. 13 f. 104 1; 1932b, 494, t. 12 f. 80; Burkill, 1935, 432; Wyatt-Smith, 1953, 9, *cum fig.* — *C. secundum* Bennett, 1875a, 532; 1875b, 103; Engler, 1883, 116; King, 1894b, 250; Ridley, 1900a, 58; Hochreutiner, 1904, 62; Guillaumin, 1909a, f. 9; Ridley, 1922, 375; Burkill, 1935, 432. — *C. acutum* Engler, 1883, 113. — *C. bennettii* Engler, 1883, 119. — *C. giganteum* Engler, 1883, 106. — *C. pruinosum* Engler, 1883, 106; Lam, 1932a, t. 11 f. 69; 1932b, 492, t. 12 f. 79. — *C. pseudocommune* Hochreutiner, 1904, 60, *incl.* also *var. subelongatum*; Guillaumin, 1909a,

f. 22[2]; Hochreutiner, 1910, 842, *incl.* also *var. genuinum.* — *C. subtruncatum* (*non* Engl.) Baker, 1924, 16. — *C. flavum* Ridley, 1930, 81.

Type: Java, Nusa Kembangan, Nov., *Blume 1736,* ♂ (L; isotypes in L, MEL, U).

Tree (3—)10—30(—44) m by 20—70(—100) cm, sometimes buttressed. *Branchlets* ¼—1 cm thick, glabrescent; pith with some large to many small vascular strands, all or part of them peripherally arranged. *Stipules* caducous, inserted on the branchlet near the base of the petiole, reniformous, 5 by 4 mm, with various intergrades to: subpersistent and inserted on the base of the petiole, semi-rotundate, 17 by 12 mm, margin repandous; nearly always tomentose. *Leaves* (0—)2—6-jugate, 17—60 cm long, glabrous to tomentose. *Leaflets* ovate to oblong-lanceolate, 3—27 by 1—9 cm, chartaceous to coriaceous, smooth to bullate, glabrous — sometimes waxy white beneath — to densely tomentose beneath and on the midrib above; base cuneate to faintly cordate, slightly inequilateral; margin entire to dentate or serrulate; apex (gradually to) rather abruptly shortly acute-acuminate, acumen mostly dentate or serrate; nerves 9—22(—29) pairs (angle 60—90°, gradually decreasing from base to apex), slightly curved, often partly arching near the margin. *Inflorescences* terminal, sometimes with additional ones in the upper leaf-axils, thyrsoid (♂) to subracemose (♀), 5—40 cm long, often densely reddish-brown tomentose, sometimes glabrous. *Bracts* concave. *Flowers* 8—13 mm long, outside densely ferruginously pubescent. *Calyx* 4—9 mm high. *Stamens* 6, filaments glabrous, in ♂ flowers often slightly connate, adnate to the disk, in ♀ flowers inserted on the rim of disk. *Disk* in ♂ flowers from globular, solid, tapering into a style-like appendix, to: cupular, thick-fleshy, without any rudiment of the pistil; 1—3 mm high, nearly always glabrous; in ♀ flowers minute, faintly 6-undulate, glabrous to tomentose. *Pistil* glabrous or pilose. *Infructescences* 5—25 cm long, densely tomentose, with 1—6 fruits; calyx funnel-shaped, triangular, *c.* 8 mm diam., to: flat, orbicular, 1½ cm diam., with undulate margin. *Fruits* ellipsoid (to obovoid), rounded triangular in cross-section, 4½—7 by 1½—3 cm, sparsely pilose to glabrous; pyrene smooth, acutely triangular in cross-section; lids 2—4 mm thick. *Seeds* 1—2, sterile cells moderately reduced.

Distribution: Indo-China, Sumatra, Malay Peninsula, Java, Borneo.

Taxonomy. This species is very variable, both in its vegetative parts and, to a lesser degree, in its flowers. Though nearly all of these variations are connected by intergrades with a central form, they are more or less geographically defined. For that reason and as the extreme specimens are very characteristic, I propose a subdivision of the species into 5 forms.

KEY TO THE FORMS

1.a. Lower side of the leaflets more or less glaucous- to white-waxy, glabrous except midrib and nerves 2
b. Lower side of the leaflets not waxy, usually distinctly pubescent . . . 3
2.a. Leaflets entirely densely dentate, distinctly white waxy beneath; midrib, nerves, and veins prominent beneath. *Borneo* . . . . . f. **pruinosum**
b. Leaflets scattered dentate, mainly towards the apex; more or less distinctly glaucous waxy beneath; midrib and nerves prominent beneath, veins inconspicuous. *Sumatra, Malay Peninsula, Annam* . . . . . f. **purpurascens**

3.a. At least veins and veinlets not very prominent beneath; pubescence on the lower side of the leaflets not minutely tomentose. *Sumatra, Java* f. **littorale**
b. Nervation and venation strongly prominent beneath, wafflelike; lower side of the leaflets densely minutely tomentose 4
4.a. Leaflets entire to scattered dentate to the apex. More slender form. *Borneo* f. **tomentosum**
b. Leaflets entirely densely dentate. More coarse form. *Malay Peninsula* f. **rufum**

a. forma **littorale.**

Branchlets slender. Stipules small, reniformous, inserted on the branchlet. Leaves 2—3-jugate. Leaflets ovate to lanceolate, c. 12—17 by 5—7 cm, chartaceous, nearly glabrous, not waxy beneath; base rounded to broadly cuneate; margin entire to scattered dentate near the apex; nerves 11—15 pairs. Flowers small; disk in ♂ ones with style-like appendix.

Specimens which exactly agree with the type are only known from Java; they are slightly deviating from the bulk, which is abundant on Sumatra, the Malay Peninsula, and Java.

b. forma **purpurascens** (Benn.) Leenh., *nov. stat.* — *C. purpurascens* Benn.

Type: Malacca, *Griffith Kew distr. 1142,* ♂ (K; isotypes in CAL, FI, G, L, P, W).

This form mainly differs from the foregoing one by its stouter habit, its slightly larger stipules, which are partly inserted on the base of the petiole, its 3—4-jugate leaves, and by its leaflets, which are slightly glaucous waxy beneath. It is known from Sumatra and the Malay Peninsula, furthermore from Indo-China.

This form is closely related to the foregoing one; especially in Sumatra they are transgrading into each other, the most extreme specimens are collected in Indo-China.

c. forma **pruinosum** (Engl.) Leenh., 1956, 258. — *C. pruinosum* Engl.

Type: Borneo, Sarawak, *Beccari PB 1970,* ♀ (K; isotypes in FI, K).

Leaflets waxy white beneath; margin closely dentate.

A local form, known only from Sarawak and North Borneo. It is the only one which is not connected by intergrades with other forms; though its characters are of minor importance its habit is very conspicuous.

d. forma **tomentosum** (Bl.) Leenh., *nov. stat.* — *C. tomentosum* Bl.

Type: (SE. Borneo ?, *Korthals ? in*) *herb. L. 898.319—381,* fr. (L; isotype in U).

Stipules caducous, inserted partly on the base of the petiole, c. 1 by 1¼ cm. Leaves 4—5-jugate. Leaflets medium-sized, coriaceous, margin entire to scattered dentate to the apex, lower side densely tomentose and with strongly prominent nervation.

Typical specimens of this form are only known from SE. Borneo. In Sumatra and the Malay Peninsula many specimens are intermediate between this form and f. *littorale.*

e. forma **rufum** (Benn.) Leenh., *nov. stat.* — *C. rufum* Benn.

Type: Malacca, Dec. 5, 1865, *Maingay 1434* = *Kew distr. 301,* ♂, lectotype (K; isotypes in CAL, L).

Habit stout. Stipules large, subpersistent, inserted partly on the petiole, with repandous margin. Leaves 4—6-jugate. Leaflets large, oblong-lanceolate, coriaceous, bullate, characteristic red-brown when dry; base rounded to slightly cordate; margin closely double-toothed; lower side densely tomentose and with very prominent nervation. Flowers large, ♂ ones with a capular disk. Fruits large, relatively narrow; calyx flat and circular.

This form is most closely related to f. *tomentosum*; it is rather abundant on the Malay Peninsula, furthermore it is known from Sumatra.

INDO-CHINA. Annam: *Poilane 4603* (b), *29499* (b).

SUMATRA. *Bartlett 7048* (d); *Beguin 550* (aff. d); *Endert E 816* (aff. e); *Forbes 2809* (aff. a); *FRI. bb. 91 (van Zon 31)* (aff. a), *bb. 2787 (Renwarin 73)* (aff. b), *bb. 2901 (Chairoeddin 11)* (aff. b), *bb. 5668 (Daood 10)* (aff. a), *bb. 6247, bb. 8493 (Ostwald 58)* (aff. a), *bb. 15561* (a—d), *bb. 22365* (aff. d), *bb. 23569* (aff. d), *bb. 24041* (aff. d), *bb. 31722* (aff. d), *bb. 31940* (aff. d), *bb. 32072* (aff. d), *bb. 32993 (Soegihan 3)* (e), *154 T SP 421 (Dorst)* (aff. d), *154 T SP 595 (v. d. Zwaan)* (aff. d); *Grashoff 308* (aff. a); *Koorders 10278 β* (b); *Korthals 1167* (b), *1275* (type *C. glaucum* Bl.) (b); *Krukoff 244* (aff. d), *289* (d); *Lambach 1242* (aff. a); *Meijer 3315* (a—d), *4085* (aff. a), *4223* (a—d); *N.N. Herb. Billiton 14* (aff. a); *Rahmat 8031* (e), *8079* (aff. e), *9255* (a—d); *Teysmann HB 704* (type *C. serricuspe* Miq.) (aff. a); *Yates 1689* (e), *2581* (d).

MALAY PENINSULA. *Burkill 1245* (aff. *C. patentinervium*); *Burkill & Haniff 17074* (aff. b); *Cantley 155* (aff. e), *5845* (a—b); *Curtis 803* (b), *862* (b), *959* (b), *2708* (b), *in herb. W 1891 no. 2486* (b); *Derry 945* (aff. a), *1220* (aff. a); *Fox 12731* (aff. b); *Griffith Kew distr. 1141* (type *C. bennettii* Engl.) (d), *Kew distr. 1142* (type *C. purpurascens* Benn.) (b), *Kew distr. 1143* (syntype *C. rufum*) (e), *Kew distr. 1145* (aff. a); *Hullett 76* (a—d); *KEP. 760 (Speldewinde)* (e), *911 (Hamid)* (aff. a), *2124 (Bonar)* (a—d), *3552 (Lambak)* (aff. a—d), *3881 (Ahmad)* (a—d), *5055 (Ahmad)* (e), *5670 (Mitchell)* (e), *7831 (Burkill & Holttum)* (a—d), *10570 (Hamid)* (e), *10771* (e), *10796* (aff. a), *11696 (Ahmad)* (a—d), *12605 (Strugnell)* (aff. b), *12731* (b), *14980 (Mahamad)* (aff. a—b), *17854 (Meh)* (e), *23237 (Sow)* (e), *23409 (Kalong)* (a—d), *24976 (Hamid)* (a—d), *27399 (Kedah)* (e), *27894 (Strugnell)* (e), *28377 (Walton)* (e), *28378* (e), *30865 (Symington)* (aff. e), *32392 (Hamid)* (e), *33855 (Hamid)* (b), *34112 (Tasi)* (aff. b), *34113 (Tasi)* (a—b—d), *38127 (Symington)* (e), *38377* (e), *39774 (Buyong)* (e), *42133 (Mat Bin Din)* (transition to *C. patentinervium*), *42440 (Hassan)* (aff. a), *42539 (Abdullah)* (aff. a, transition to *C. patentinervium*), *44702 (Symington)* (e), *44924 (Symington)* (e), *45022 (Symington)* (a—b), *53690 (Jaya)* (b), *56735 (Symington)* (aff. b), *62879 (Hamid)* (aff. d), *64104* (b), *64162 (Sudin)* (? e), *66390 (Shariff ben Omar)* (e), *70143* (a—d), *71339* (b), *73533* (c), *73778 (Ali)* (a—b); *King's coll. 345* (a—d), *1039* (e), *4026* (b), *4330* (aff. a), *5076* (e), *6097* (e), *6101* (a—d), *6181* (b), *7610* (aff. a—b), *7885* (b), *8004* (e), *10333* (e), *10601* (e), *10722* (aff. b); *Maingay 1439 = Kew distr. 300* (a—d), *1869 = Kew distr. 300* (a—d), *Kew distr. 301* (lectotype *C. rufum* Benn.) (e); *Ridley 351* (b), *421* (b), *1812* (a—d), *1867* (a—d), *5581* (aff. b), *6358* (aff. a), *9405* (b), *13511* (a—d); *Scortechini 175* (b), *1320* (e), *2039* (e), *2081* (a—d), *2089* (e); *SF. 3283 (Burkill)* (b), *11337 (Nur)* (a—b), *17034 (Burkill & Haniff)* (a—d), *21895 (Henderson)* (aff. a), *28501 (Corner)* (a—d), *28555 (Corner)* (a—b), *29011 (Corner)* (b), *29028 (Corner)* (b), *29327 (Corner)* (a—b), *30404 (Corner)* (a—d), *31770 (Kiah)* (a—d), *32630 (Nur)* (aff. a), *33553 (Corner)* (a—d), *34955 (Corner)* (a—d), *36493 (Ngadiman)* (e), *36827 (Ngadiman)* (a—d), *37071 (Corner)* (b), *39662 (Sinclair)* (aff. e), *40089 (Sinclair)* (a—d), *40361 (Sinclair)* (b), *40663 (Sinclair)* (a—d); *Teruya 1010* (aff. a); *Wallich 9046* (type *C. secundum* Benn.) (b); *Wray Jr. 1434* (e), *3325* (e), *3641* (e), *4175* (e).

JAVA. *Blume 1736* (type) (a); *Forbes 523* (aff. a); *FRI. Ja 6443 (Utja & Wasijat)* (aff. a), *Ja 6640 (Wasijat)* (aff. a); *Hildebrand 19* (? a); *Horsfield 1328* (type *C. serrulatum* Miq.) (aff. a); *Kalshoven 46* (aff. a); *Koorders (all β.-numbers) 967* (aff. a), *969* (? a), *970* (? a), *973* (aff. a, transition to *C. patentinervium*), *976* (? a), *12527* (a—b), *15669* (a—b), *22189* (a—d), *23944* (a—b), *23975* (aff. a), *24770* (aff. a), *26862* (aff. a), *29963* (aff. a), *33954* (a); *Korthals in herb. L 898. 319—314* (a).

BORNEO. *Beccari PB 1970* (type *C. pruinosum* Engl.) (c), *PB 2650* (type

C. giganteum Engl.) (aff. e), *PB 3276* (type *C. acutum* Engl.) (probably intermediate between a and *C. patentinervium* Miq.); *Endert 3638* (aff. a—b); *FRI. bb. 12065* (d), *bb. 13015* (aff. d), *bb. 16771* (a—d), *bb. 17743* (a—d); *Haviland 2850* (type *C. flavum* Ridl.) (♀ d), *2855* (c), *2855b* (c); *KEP. 34459* (*Flemmich*) (aff. d); *Korthals? in herb. L 898. 319—381* (type *C. tomentosum* Bl.) (d.); *Kostermans 4102* (aff. a), *4337* (a—c—d), *6603* (aff. a—d), *6720* (d), *7142* (d), *7458* (a—d), *7521* (a—d), *7529* (d), *7580* (a—d), *9818* (d); *NBFD. 15133* (*Wood*) (aff. a), *16269* (*Wood*) (d), *16844* (*Wood*) (c), *16933* (*Wood & Sisiran*) (aff. d), *17189* (*Wood*) (d), *17247* (*Wood*) (d).

cultivated:

Hort. Bot. Bogor VI B 27 (type *C. pseudocommune* Hochr. var. *subelongatum* Hochr.) (aff. a—b), *VI B 30* (aff. a), *VI B 37* (type *C. pseudocommune* Hochr.) (aff. b), *VII E 1* (♀ d); *Hort. Bot. Singapore Nur 99* (aff. d), *Nur 1512* (a—b), *Nur 2282* (aff. d).

Ecology: Rain-forests on dry or swampy soils, under everwet or (in E. Java) subseasonal conditions, mostly at low altitudes, rarely up to 2000 m. *Fl.* mainly Nov.—Apr., *fr.* mainly May—Sept.

Wood anat.: Beekman, Med. Proefst. Boschw. 5 (1920) 56; Desch, Mal. For. Rec. 15[1] (1941) 66 (hand lens); Moll & Janssonius, Mikr. Holzes 2 (1908) 107; Webber, Lilloa 6 (1941) 450.

Uses. The wood is used for house-building, though it is rather soft. The resin is used as a *damar;* in Indo-China it is said to be very sought after by the Chinese as a medicine against the itch.

2. Canarium latistipulatum Ridley, 1930, 81; Lam, 1932a, t. 5 f. 15, t. 15 f. 119a; 1932b, 508, t. 13 f. 86; Leenhouts, 1956, 258. — *C. littorale* (*non* Bl.) Lam, 1929, 116.

Type: Borneo, Sarawak, near Kuching, Febr. 20, 1893, *Haviland & Hose 2245,* ♂ (K; isotype in SAR).

Tree up to 30 m high. *Branchlets c.* ½ cm thick, glabrescent; pith with a peripheral cylinder of vascular strands appressed to the wood. *Stipules* subpersistent, inserted on the base of the petiole (up to 2½ mm high), rounded-ovate, 1—2 by 1—1¾ cm, margin minutely crenulate. *Leaves* 3—5-jugate. *Leaflets* oblong-lanceolate, 7—17 by 4—7 cm, chartaceous, subglabrous; base broadly cuneate (to rounded); margin serrate or dentate; apex abruptly rather long and slender acute-acuminate; nerves 9—13 pairs (angle 60—70°), slightly curved, distinctly arching close to the margin (often nearly transverse to the marginal nerve). *Inflorescences* (♀ unknown) terminal, laxly thyrsoid, 15—30 cm long, glabrescent. *Flowers* (♂) 1¼ cm, outside pulverulent. *Calyx* 3—5 mm high. *Stamens* glabrous, slightly connate at the base, sometimes adnate to the disk. *Disk* cupular, thick and fleshy, 1—2 mm high, glabrous, without pistil. *Infructescences* 5½ cm, densely tomentose, with 3 fruits; calyx funnel-shaped, triangular, 7 by 11 mm. *Fruits* unknown.

Distribution: Borneo (Sarawak and Br. N. Borneo).

BORNEO. *Elmer 21767; Haviland & Hose 2245* (type); *NBFD 7011* (*Puasa*), *SII. 10810* (*Majuyap*), *17245* (*Wood*).

Ecology: Lowland forest up to 150 m, apparently rare. *Fl.* Dec.—Febr., *fr.* July.

Note. Closely related to *C. littorale* and probably also to *C. patentinervium.* Especially characterized by its stipules and nervation, and more-

over differing from *C. littorale* in its ♂ flowers with slightly connate stamens and more complete reduction of the pistil. Furthermore related to *C. kinabaluense,* which is a coarser species, however.

3. Canarium perlisanum Leenhouts, 1955b, 186; 1956, 258. — *C. ? purpurascens* (*non* Benn.) Henderson, 1939, 39.

Type: Malay Peninsula, Perlis, Kaki Bukit, alt. 70 m, April 16, 1938, *SF. 35311* (*Kiah*), ♂ (SING).

Tree c. 10 m. *Branchlets* ½ cm thick, glabrous; pith with a peripheral cylinder of small vascular strands. *Stipules* caducous, inserted on the petiole ½—1 cm from its base, scars 3 mm long. *Leaves* 2-jugate, glabrous. *Leaflets* subsessile, broadly-elliptic, 11—16 by 5—7 cm, chartaceous; base rounded; margin crenulate, specially near the apex; apex gradually, long and broadly blunt-acuminate; nerves 14—18 pairs (angle c. 50°), straight, gradually arching close to the margin. *Inflorescences* (♀ unknown) axillary, narrowly thyrsoid, up to c. 13 cm long, most of the flowerclusters nearly sessile, glabrescent. *Bracts* concave. *Flowers* (♂) 8 mm, outside thinly tomentose. *Calyx* 4 mm high. *Stamens* glabrous, filaments halfway connate. *Disk* cylindrical, 6-lobed, 1 mm high, thinly pilose on the conical upper surface, with a central canal; no pistil. *Infructescences* and *fruits* unknown.

Distribution: Malay Peninsula (Perlis), once collected.

Malay Peninsula. *SF. 35311* (*Kiah*) (type).

Ecology: Limestone hill, 70 m, *fl.* April.

Note. Taxonomically a rather remarkable species. Apparently related to *C. littorale,* though the axillary inflorescences and the connate stamens are quite unusual in this section, as is the combination of rather many nerves and stipules which are inserted on the petiole.

4. Canarium patentinervium Miquel, 1861, 526; Kurz, 1875, 142, *sphalm. patentissimum*; Engler, 1883, 148; Hochreutiner, 1904, 59, *incl. var. genuinum* and *var. meizocarpum*; Guillaumin, 1909a, f. 22[3,7]; Heyne, 1927, 878; Lam, 1931, t. 5 f. 11, t. 6 f. 29c; 1932b, 506; Cretzoiu, 1934, 267, *incl.* also *var. nitidum;* Leenhouts, 1956, 258. — *C. subrepandum* Miquel, 1861, 525. — *C. nitidum* Bennett, 1875a, 533; 1875b, 103; Engler, 1883, 108; King, 1894b, 251; Ridley, 1900a, 58; 1922, 373; Burkill, 1935, 431. — *C. parvifolium* Bennett, 1875a, 536; 1875b, 104; Engler, 1883, 140; King, 1894b, 241. — *C. ? littorale* (*non* Bl.) Ridley, 1922, 375. — *Fig. 15.*

Type: Sumatra, Palembang, *Teijsmann HB 3736,* fr. (U; isotype in L).

Tree 12—40 m by 20—50(—180?) cm. *Branchlets* ½ cm thick, glabrescent; pith with a peripheral cylinder of rather large vascular strands and mostly some scattered small ones in the central part. *Stipules* caducous, inserted at the conjunction of branchlet and petiole, about reniformous, 3—5(—12) mm. *Leaves* (2—)3—4(—5)-jugate, 15—37 cm long, glabrous. *Leaflets* ovate to oblong-lanceolate, 4¼—6½—18 by 1½—3½—7¼ cm, coriaceous, shining beneath; base subequilateral, broadly cuneate (to subcordate); margin entire, rarely minutely dentate near the apex; apex gradually to subabruptly, shortly and bluntly acuminate; nerves 5—15 pairs (angle 60—70°), widely spaced, slightly curved, distinctly arching at some distance from the margin, not very conspicuous above; reticulations nearly

inconspicuous. *Inflorescences* terminal, some main branches sometimes in the upper leaf-axils, ♂ ones laxly thyrsoid, (7—)15—20(—30) cm long, thinly tomentose, many-flowered; ♀ ones more dense, 2—10 cm long, more densely tomentose and few-flowered. *Flowers* ¾—1 cm, pubescent outside. *Calyx* nearly truncate, in ♂ flowers 2½—4 mm high, in ♀ ones 6 mm. *Stamens* 6, glabrous, in ♂ flowers slightly connate at the base and sometimes adnate to the disk, in ♀ flowers rather strongly reduced, inserted on the disk. *Disk* in ♂ flowers pistilloid, globular, sometimes stalked, tapering into a long style-like appendix, in total 2 mm high; in ♀ flowers adnate to the receptacle, if this is concave; always glabrous. *Pistil* glabrous. *Infructescences* 6—8 cm long, densely and shortly, ferruginously woolly-tomentose, with 1—2(—4) fruits; calyx flat, 3-lobed, 11—14 mm diam. *Fruits* ellipsoid to obovoid, round to rounded-triangular in cross-section, glabrous, 3—6 by 1¾—3 cm; pyrene smooth; lids 3—5 mm thick. *Seeds* 1—3; sterile cells more or less reduced.

Distribution: Sumatra, Malay Peninsula, Banka, Anambas Islands, Borneo.

SUMATRA. *Diepenhorst HB 2336* (type *C. subrepandum* Miq.); *Forbes 2191, 2671, 2991; FRI. bb. 30119, S.W.K./I-26; Koorders 10678β.; Krukoff 4079, 4371* (transition to *C. littorale f. purpurascens*); *Lambach 1357; Teysmann HB 3736* (type). — Banka: *Hort. Bot. Bogor VI B 58* (type *C. patentinervium var. meizocarpum* Hochr.).

MALAY PENINSULA. *Alvins 159; Derry 12, 20, 58, 290; Goodenough 1342, 1755, 1868, 3799; Griffith 91, 1068, 1140, 1147* (syntype *C. nitidum* Benn.); *Hassan 1219; KEP. 865 (Hamid), 1422 (Burkill), 1816 (Rahman), 1867 (Kinsey), 20101 (Durant), 20413 (Mahamud), 23406 (Kalong), 23807 (Osman), 28397 (Walton), 28521 (Osman), 43496 (Browne), 43499 (Browne), 57327 (Lande), 66525 (Sow-Lindong), 67612 (Awang Bin Bulat), 69803, 70343 (Wyatt Smith), 70491 (Sow-Lindong), 71296; King's coll. 2618, 4263, 4604, 5658, 6998, 7870, 10916; Maingay 1532 = Kew distr. 353* (type *C. parvifolium* Benn.), *3116 = Kew distr. 350* (syntype *C. nitidum* Benn.); *Ridley 1868, 3799, 4584, 4729, 4734, 5007, 5081, 5981, 6010, 8401; Scortechini 856; SF. 1422 (Burkill), 32140 (Kiah), 35965 (Kiah), 36400 (Ngadiman), 36405 (Yassin), 36906 (Ngadiman); Sukoe 7677; Wallich 8546* (syntype *C. nitidum* Benn.).

BORNEO. *FEI. bb. 20733 (Henar 161)* (transition to *C. maluense?*); *Sarawak Forest Dept. S 220* (transition to *C. littorale*), *S 4899; SF. 26846 (Carr)*. — Anambas Islands: *SF. 20409 (Henderson)* (transition to *C. littorale f. purpurascens*).

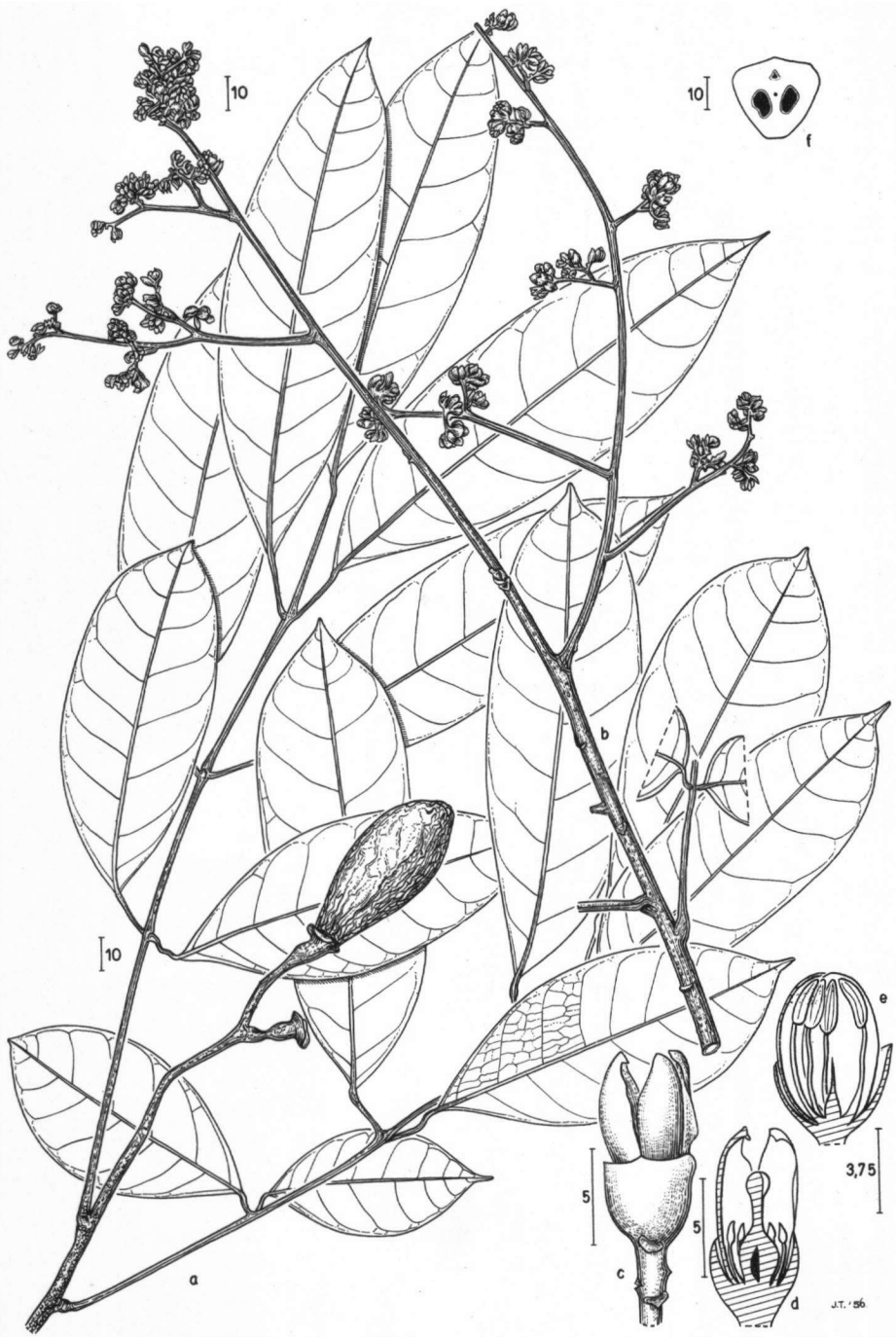
Ecology: Primary forests, up to 450 m (rarely up to 1150 m), *fl.* mainly Nov.—May, *fr.* mainly Sept.—April.

Notes. Most closely related to *C. littorale;* some intermediate specimens are known from Sumatra, Banka, and Borneo. However, the two species are nearly always quite distinguishable, specially in their leaf-characters. The leaves of the present species are very smooth, with few, widely spaced nerves, which are only slightly prominent; the reticulations are inconspicuous.

Some specimens from the Mahakam River, E. Borneo, are intermediate between this species and *C. maluense.*

In its vegetative parts very similar to the Malay Peninsular specimens of *C. caudatum,* a species with only 3 stamens in the ♂ flowers.

5. Canarium caudatum King, 1894b, 240; Ridley, 1922, 370; 1930, 81; Lam, 1931—32, t. 5 f. 12, t. 11 f. 57, t. 13 f. 104 m; 1932b, 443, t. 9 f. 54; Leenhouts, 1956, 259, f. 22d. — *C. pauciflorum* Ridley, 1930, 80; Lam, 1932a, t. 11 f. 55, t. 15 f. 119c; 1932b, 502, t. 13 f. 83.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T y p e: Malay Peninsula, Perak, Ulu Bubong, alt. c. 200 m, Jan., 1886, *King's coll. 10227*, ♂, lectotype (CAL; isotypes in A, BM, CAL, G, L).

Tree up to 18 m by 40 cm. *Branchlets* c. 3 mm thick, glabrescent; pith with a peripheral cylinder of large and small vascular strands. *Stipules* from: very caducous, inserted at the conjunction of branchlet and petiole, reniformous, c. 2 mm long, to: subpersistent, inserted on the petiole up to ¾ cm from its base, auricle-shaped, 3—5 mm long. *Leaves* 0—3(—4)-jugate, glabrous. *Leaflets* elliptic-ovate to elliptic-lanceolate, tapering at base and apex, 5½—12(—17) by 2½—5(—7¼) cm, subcoriaceous; base cuneate; margin entire; apex caudate-acuminate; nerves 7—11 pairs (angle 60—80°), curved, distinctly arching at some distance from the margin, not very conspicuous. *Inflorescences* terminal, laxly thyrsoid, thinly tomentose to glabrous, ♂ ones 10—30 cm long, ♀ ones 7—15 cm. *Flowers* subglabrous, ♂ ones 3—6 mm, ♀ ones 7—10 mm. *Calyx* subtruncate, in ♂ flowers 1—2 mm high, in ♀ ones 4 mm. *Stamens* glabrous, in ♂ flowers 3, adnate to the disk, in ♀ flowers 6, slightly confluent at the base, inserted on the disk. *Disk* in ♂ flowers consisting of 3 tomentose alternistaminal lobes, which are adnate to the rudimentary pistil, the latter being glabrous, flat, tapering into a filiformous, rudimentary style; in ♀ flowers glabrous, adnate to the receptacle and to the stamens. *Pistil* glabrous. *Infructescences* up to 15 cm long with few fruits; calyx funnel-shaped, faintly 3-lobed, 7—9 mm diam. *Fruits* spindle-shaped, triangular in cross-section, 4¾—7½ by 1¼—2¼ cm, glabrous; pyrene acutely triangular; lids c. ¼ cm thick. *Seeds* 1—2; sterile cells rather strongly reduced.

D i s t r i b u t i o n: Sumatra, Malay Peninsula, Borneo.

T a x o n o m y. The following two forms can be distinguished:

a. forma **caudatum.**

Stipules small, reniformous, inserted partly on the branchlet. Leaves and flowers large. Occupies the area of the species.

SUMATRA. *Koorders 21275β.; Rahmat 3576, 5213; Ridley 9013.*
MALAY PENINSULA. *Hume 7584, 7659A; KEP. 2933* (*Ahmad*), *4730* (*Foxworthy*); *King's coll. 4315, 8554* (syntype), *10016* (syntype), *10182* (syntype), *10227* (syntype); *Ridley 3110, 7363; Scortechini 454b, in herb. CAL 78298; SF. 19422* (*Henderson*).
BORNEO. *Beccari PB 1995, herb. 2173; Haviland 1864* (type *C. pauciflorum* Ridl.); *Haviland & Hose 3181* (paratype *C. pauciflorum* Ridl.).

b. forma **auriculiferum** Leenhouts, 1955b, 181; 1956, 260.

T y p e: Borneo, Sarawak, near Kuching, *Haviland 2877*, ♂ (SING; isotypes in BM, K, L, SAR).

Stipules auricle-shaped, inserted on the petiole. Leaves and flowers small. Sumatra and Borneo.

SUMATRA. *Buwalda 6644* (paratype), *6773* (paratype); *Rahmat 5044* (paratype).
MALAY PENINSULA. *KEP. 70317* (*Sow-Lindong*) (aff).
BORNEO. *BS. 2466* (*native collector*) (paratype); *FRI. bb. 15177, bb. 17015*

Fig. 15. *C. patentinervium* — a. twig with infructescence; b. ♀ inflorescence; c. ♀ flower; d. ditto in section; e. ♂ flower, longitudinal section; f. pyrene in cross-section. (a. from *Sinclair s.n. in herb. L 950.233—393*, the fruit from *Pl. Bog. exsicc. 124*; b. from *Hort. Bog. VI B 60*; c—d. from *Ridley 6010*; e. from *Hort. Bog. VI D 16*; f. from *Forbes 2991*) (dimensions in mm).

(*Joedotenojo*) (aff.), *bb. 18950* (*v. d. Zwaan 975*); *Haviland 2877* (type); *Haviland & Hose 3275* (paratype); *Hose 183* (paratype), *262* (paratype), *288* (paratype).

Ecology: Primary forests, sometimes bamboo-forests, up to c. 250 m, *fl.* mainly April—July, *fr.* mainly Oct.

Note. The major part of the specimens can be definitely referred to one of the forms, although a few are transitional. Forma *caudatum* is, especially in the Malay Peninsula, closely resembling *C. patentinervium*, from which it differs essentially only in its 3-staminate ♂ flowers. Apart from this, the lax inflorescences and the distant caudate leaflets often characterize the species.

6. Canarium divergens Engler, 1883, 143; Lam, 1932a, t. 12 f. 89; 1932b, 503, t. 13 f. 84; Leenhouts, 1956, 260.

Type: Borneo, Sarawak, Mattang, July 1866, *Beccari PB 2237*, ♂ (P; isotypes FI, K).

Tree. *Branchlets* c. ¼ cm thick, glabrous; pith with a peripheral cylinder of vascular strands and some central scattered ones. *Stipules* caducous, inserted on the base of the petiole, probably small. *Leaves* (1—)2—3-jugate. *Leaflets* oblong-lanceolate to elliptic-oblong, 5½—10½ by 2½—4½ cm, subcoriaceous, glabrous; base broadly cuneate to rounded; margin entire; apex subabruptly, broadly blunt-acuminate; nerves 8—11 pairs (angle 50—60°), straight to faintly curved, abruptly arching close to the margin. *Inflorescences* (♀ unknown) terminal and in the upper leaf-axils, broadly and very laxly thyrsoid, 10—15 cm long, with c. 12—15 flowers, subglabrous. *Flowers* (♂) 1¼ cm long, outside pubescent. *Calyx* 9 mm long. *Stamens* glabrous, often connate at base and adnate to the disk. *Disk* semiglobular to conical, 1 mm high, bearing on its top the tiny rudimentary pistil, glabrous. *Infructescences* and *fruits* unknown.

Distribution: Borneo.

Borneo. *Beccari PB 1755, PB 2237* (type).

Note. Apparently related to *C. patentinervium*. Characterized by its laxly branched inflorescences with rather large flowers.

The specimen *Haviland & Hose 3184* possibly also belongs to this species; it is different, however, by its smaller flowers (7—8 mm) with only 4—5 stamens each. In these respects it seems to be intermediate to *C. caudatum*.

7. Canarium kinabaluense Leenhouts, 1955b, 182, f. 1; 1956, 260.

Type: North Borneo, near Sandakan, 1920, *Ramos 1698*, fr. (L; isotypes A, BO, BM, K, P).

Tree 20 m by 25 cm. *Branchlets* ½—¾ cm thick, often lenticellate, glabrescent; pith with a peripheral cylinder of small vascular strands. *Stipules* subpersistent, inserted on the base of the petiole, suborbicular to elliptic, ¾—2½ by ¾—2 cm, subcoriaceous, densely sericeous-pubescent to glabrous, entire to denticulate, nerves anastomosing, conspicuous. *Leaves* 2—4-jugate. *Leaflets* broadly lanceolate to ovate or elliptic, 8—15—20 by (3½—)5½—10 cm, coriaceous, glabrous; base rounded to broadly cuneate; margin crenulate to the apex; apex rather abruptly broadly acute-acuminate; nerves (8—)11—12(—19) pairs (angle variable), straight to

curved, gradually arching at some distance from the margin. *Inflorescences* unknown. *Infructescences* terminal, laxly thyrsoid, 15—20 cm long, glabrescent, with c. 12 fruits; calyx widely funnel-shaped, 1¼ cm diam., with remnants of an annular, fimbriate disk and free stamens. *Fruits* narrowly spindle-shaped, triangular in cross-section, acute at base and apex, 6—6½ by 2—3 cm, glabrous; pyrene rounded triangular, smooth except the 3 acute angle ribs near the apex; lids 3 mm thick. *Seed* 1; sterile cells more or less strongly reduced and more or less shifted to the surface.

Distribution: North Borneo.

BORNEO. *Clemens 31612* (paratype), *31807* (paratype), *51315* (paratype); *Ramos 1698* (type).

Ecology: Altitude mostly 1000—1500 m, *fl., fr.* Dec.—Jan.

Note. Related to *C. patentinervium* and to *C. divergens;* differing from both by its large, coriaceous stipules and its coarse and stiff, often not fully entire leaflets. Furthermore related to the more slender *C. latistipulatum.* Referred by Merrill, 1922, 318, to *C. pseudocommune,* by Lam, 1932b, 498, to *C. littorale.*

8. Canarium maluense Lauterbach, 1920, 323, f. 1; Lane-Poole, 1925, 99; Lam, 1932a, t. 12 f. 90; 1932b, 504, t. 13 f. 85; Leenhouts, 1955b, 184, f. 5b; 1956, 260, f. 21h. — *C. lian* Lam, 1932a, 209, t. 12 f. 92, t. 15 f. 116b; 1932b, 440, t. 9 f. 52. — *C. quadrangulare* Lam, 1932a, 219, f. 104o, f. 116c; 1932b, 441, t. 14 f. 94.

Type: New Guinea, Kais. Wilh. land, Malu, alt. 50—100 m, July 30, 1912, *Ledermann 8079,* ♂ (BRSL; isotype in K).

Tree, 15—40 m high, 15—60 cm in diam. Sometimes with up to 1½ m high buttresses. *Branchlets* 3—7 mm thick, glabrescent, often lenticellate; pith rather loose, vascular strands ranging from: many scattered small ones, to: some large peripheral ones. *Stipules* ranging from: caducous, inserted at the conjunction of branchlet and petiole, scaly, 3 by 2 mm, to: persistent, inserted on the petiole up to ¾ cm from its base, auricle-shaped, up to 1¼ by 1¼ cm. *Leaves* 1—4-jugate. *Leaflets* ovate to oblong-eliptic, 4—15—25 by 3—10 cm, (sub-)coriaceous, smooth to bullate, subglabrous, rarely rather densely tomentose beneath; base broadly cuneate to subcordate, nearly equilateral; margin entire; apex rather abruptly acuminate, acumen short and blunt, often emarginate; nerves rather dense, 10—24 pairs (angle 90—60°, decreasing from base to apex), straight to faintly curved, abruptly arching at some distance from the margin. *Inflorescences* terminal and in the upper leaf-axils, thyrsoid, 1½—10 cm long, tomentose, flowers clustered. *Flowers* 3—9 mm long, outside tomentose. *Calyx* 1—4 mm high. *Stamens* 6 (in ♂ flowers a slight tendency to reduce this number), glabrous, in ♂ flowers more or less adnate to the disk, in ♀ flowers inserted on its rim. *Disk* glabrous to pilose, in ♂ flowers pistilloid or ovoid to globular, solid, ½—1 mm high; in ♀ ones adnate to the receptacle. *Pistil* partly pubescent, rarely glabrous. *Infructescences* thyrsoid, 4—10 cm long, tomentose to lenticellate, with up to 20 fruits; calyx flat to saucer-shaped, indistinctly 3-lobed, 1—1¼ cm diam. *Fruits* ovoid to ellipsoid, round (to quadrangular) in cross-section, 1¾—3 by 1—1¾ cm, glabrous; pyrene smooth, round to blunt-angular in section; lids 3—4 mm thick. *Seeds*

1(—2); sterile cells strongly reduced, sometimes (in quadrangular fruits) more or less shifted to the periphery.

Distribution: Borneo to New Guinea.

Ecology: Primary rain-forests, 0—1100 m. *Fl.* mainly June—July, *fr.* mainly Aug.—Oct.

KEY TO THE INFRASPECIFIC TAXA

1.a. Disk in ♂ flowers pistilloid, tapering into a 'style'. Pistil in ♀ flowers glabrous. Leaflets small (6—15 by 2¾—5½ cm) with 10—12(—15) pairs of nerves. *Borneo* . . . . . subsp. **borneense**

b. Disk in ♂ flowers without 'style'. Pistil in ♀ flowers partly pubescent. Leaflets larger (usually 10—20 by 5—10 cm) with 11—24 pairs of nerves. *Celebes to New Guinea* subsp. **maluense** 2

2.a. Stipules inserted at the conjunction of branchlet and petiole, caducous . . 3

b. Stipules inserted on the petiole, caducous to persistent 4

3.a. Leaflets 10—25 by 6—10 cm, coriaceous, bullate, tomentose beneath. *New Guinea* f. **bullatum**

b. Leaflets 10—20 by 4½—9 cm, neither coriaceous nor bullate, glabrous. *Celebes, Moluccas* . . . . . f. **celebicum**

4.a. Stipules caducous, inserted near the base of the petiole. *New Guinea* f. **maluense**

b. Stipules persistent, inserted on the petiole at some distance from its base . 5

5.a. Leaflets 1½—2½ times as long as broad. Sterile cells in the fruits not shifted to the periphery. *Moluccas* . . . . . f. **lian**

b. Leaflets 3—4 times as long as broad. Sterile cells of the fruits shifted to the periphery. *New Guinea* . . . . . f. **quadrangulare**

A. Subsp. **borneense** Leenhouts, 1955b, 184; 1956, 261.

Type: Borneo, Peak of Balikpapan, alt. 640 m, 14-7-1952, *Kostermans 7525*, ♂ (holotype in L, isotypes in BO, K).

Stipules caducous, small, inserted at the conjunction of branchlet and petiole. Leaflets elliptic, 6—15 by 2¾—5½ cm (about 2½ times as long as broad); nerves 10—12(—15) pairs. Inflorescences laxly thyrsoid, few-flowered. Flowers 8—9 mm long. Stamens slightly connate at base. Disk in ♂ flowers pistilloid, gradually narrowed into a filiformous rudimentary style. Pistil glabrous. Infructescences and fruits unknown.

Distribution: Borneo.

BORNEO. East Borneo: *Kostermans 7148* (paratype), *7362* (paratype), *7525* (type), *7591* (paratype).

Ecology: On sandstone or sand, alt. up to 700 m. *Fl.* June—July.

B. Subsp. **maluense**. — *C. lian* H. J. Lam. — *C. quadrangulare* H. J. Lam.

Stipules variable. Leaflets ovate to oblong-eliptic, 4—15—25 by 3—10 cm; nerves 11—24 pairs. Inflorescences not very lax, more-flowered. Flowers 3—6 mm long. Stamens more or less adnate to the disk, not mutually connate. Disk in ♂ flowers not pistilloid. Pistil partly pilose.

Distribution: Celebes to New Guinea.

Taxonomy. This subspecies is rather variable, mainly regarding the insertion of the stipules, the shape of the leaflets, the number of the nerves, and the reduction of the sterile cells in the fruits; some of these characters, particularly those of the stipules and the fruits, are rather distinctly grading from west to east. On account of these variations, the following 5 *formae*, though not sharply delimited, are distinguishable:

a. forma **celebicum** Leenhouts, 1955b, 184.

Type: Celebes, Malili, Lampea, alt. 50 m, 19-4-1929, *FRI. bb. 13573*, ♂ (L; isotype in BO).

Stipules caducous, inserted at the conjunction of branchlet and petiole, small, reniformous. Leaflets 10—20 by 4½—9 cm, 2—3 times as long as broad; nerves 14—18 pairs. Fruits with moderately reduced sterile cells.

Distribution: Celebes, Batjan.

b. forma **maluense.**

Stipules caducous, inserted on the base of the petiole, small. Leaflets 12—16 by 4½—6½ cm, 2½—3 times as long as broad; nerves 18—23 pairs. Fruits with moderately reduced sterile cells.

Distribution: New Guinea (*incl.* also Schouten Island).

c. forma **lian** (H. J. Lam) Leenhouts, *nov. stat.* — *C. lian* H. J. Lam.

Type: Moluccas, Morotai, E. of Pilowo, Guguti, alt. *c.* 60 m, 22-6-1926, *Lam 3531*, ♀, lectotype (BO; isotype in L).

Stipules persistent, inserted on the petiole, auricle-shaped. Leaflets 14—21 by 7—10½ cm, 1½—2½ times as long as broad, somewhat more pilose; nerves 18—21 pairs, prominent beneath. Fruits with moderately reduced sterile cells.

Distribution: Morotai, Batjan.

d. forma **bullatum** Leenhouts, 1955b, 184.

Type: W. New Guinea, Idenburg river, Bernhard Camp, alt. 900 m, 10-3-1939, *Brass & Versteegh 13136*, fr. (L; isotype in A).

Stipules caducous, inserted at the conjunction of branchlet and petiole, small. Leaflets 10—25 by 6—10 cm, 1½—2½ times as long as broad, coriaceous, bullate, more or less densely tomentose beneath; nerves 18—25 pairs, prominent beneath. Fruits with strongly reduced sterile cells, which are in the normal position.

Distribution: New Guinea, mostly at about 1000 m alt.

e. forma **quadrangulare** (H. J. Lam) Leenhouts, *nov. stat.* — *C. quadrangulare* H. J. Lam.

Type: W. New Guinea, Manokwari, Pami-colonisation, alt. 25 m, 17-9-1931, *FRI. bb. 15889* (*Tetelepta 5*), fr., lectotype (BO; isotype in L).

Stipules persistent, inserted on the petiole, auricle-shaped. Leaflets 12—24 by 4—8 cm, 3—4 times as long as broad; nerves 15—20 pairs. Fruits with very reduced sterile cells, which are shifted to the periphery, and sometimes are slightly prominent on the surface of the pyrene.

Distribution: W. New Guinea (Vogelkop).

CELEBES. *FRI. bb. 13573* (a: type), *bb. 26015* (a—b), *Cel./II-204* (*Waturanadang 643*) (a—e), *Cel./II-413* (*Waturanadang 479*) (a: paratype); *Kjellberg 1837* (a: paratype), *2012* (a: paratype).

MOLUCCAS. Morotai: *Lam 3531* (type *C. lian* H. J. Lam) (c); *Main & Aden 1313* (aff. b), *herb. BO 54121 & 54126* (*herb. L 951. 125—083/4*) (aff. b). — Batjan: *FRI. bb. 23160* (*De Haan 40*) (c), *bb. 23178* (aff. a); *unknown coll. VI* (*herb. BO 125210/1*) (syntype *C. lian* H. J. Lam) (aff. c). — Aru Islands: *FRI. bb. 25306* (b—e).

NEW GUINEA. *Bäuerlen 467* (b—e); *Beccari PP 722* (e); *Brass 8614* (b—c), *8984* (aff. b); *Brass & Versteegh 12586* (d: paratype), *13136* (d: type); *BW. 2129 (Mangold 73)* (b—c), *2672 (Schram)* (b); *Clemens 1326* (aff. d), *2084* (aff. d); *FRI. bb. 15886 (Tetelepta 2)* (syntype *C. quadrangulare* H. J. Lam) (e), *bb. 15889 (Tetelepta 5)* (lectotype *C. quadrangulare* H. J .Lam) (e), *bb. 25029* (b), *bb. 28923* (b—e), *bb. 30790* (b), *bb. 31112 (Van Eechoud 48)* (d: paratype), *bb. 31127 (Van Eechoud 66)* (d: paratype); *Lane-Poole 244* (b); *Ledermann 6984* (paratype) (b), *7969* (paratype) (b), *8079* (type) (b), *9419* (aff. d), *10481* (paratype) (b); *NGF. 2754* (b—d), *2845 (Heather)* (b); *Van Royen 4007* (e).

Notes. *Morphology and Taxonomy.* This species is a most interesting one, as is apparently forms a link between the W. Malaysian *C. littorale, patentinervium,* and allies on the one side, and the species with auricle-shaped stipules from the Moluccas and more eastern localities, *viz. C. sylvestre, piloso-sylvestre, salomonense, lamii,* and *harveyi,* on the other side. Many of the differences between these two groups of species — especially the differences in the stipules (caducous and inserted at the base of the petiole in the western species, persistent, inserted on the petiole, and auricle shaped in the eastern ones) and in the fruits (sterile cells moderately reduced in the western species, usually strongly so in the eastern ones), moreover the reduction of the ovary and of the number of stamens in the ♂ flowers — are more or less grading from west to east within *C. maluense,* which consequently is a very variable species.

The most primitive form in these respects is in my opinion subsp. *borneense,* which is moreover the most western form and the only one west of Wallace's line. Especially striking in this subspecies is the possession of an ovariodisk with 'style' in the ♂ flowers, and the indubitable relationship to *C. patentinervium.* From the latter it differs mainly in its more lax inflorescences and leaves. By these characters subsp. *borneense* strikingly resembles *C. caudatum* f. *auriculiferum.* From this it differs, however, by its stipules (caducous and inserted at the base of the petiole, instead of the persistent auricle-shaped ones, inserted on the petiole, of the latter) and the number of stamens in the ♂ flowers (6 instead of 3). Though it would be quite justified to consider subsp. *borneense* as a slightly different local population of *C. patentinervium,* I prefer to combine it with *C. maluense,* since I consider subsp. *borneense* the typological point of issue of *C. maluense.* Moreover, the apparently direct bridging of Makassar Strait is more strikingly demonstrated in this way.

The relationship of the western forms of *C. maluense* also is clear from the fact, that H. J. Lam, 1932b, *l.c.*, refers the Celebes-specimens for the greater part to *C. littorale*; one specimen he referred to *C. commune.*

Forma *bullatum,* in some characters rather primitive and probably closest to f. *celebicum,* forms a rather isolated, mainly mountainous, population in the eastern part of the area.

Possibly the most advanced form is f. *quadrangulare,* in its vegetative parts close to *C. sylvestre,* mainly differing by its very peculiar fruits. In *Van Royen 4007,* however, the sterile cells of the fruit are not shifted to the periphery, and in another specimen they are shifted in a different degree, even in a single fruit.

C. salomonense also shows some affinities to *C. maluense,* especially f. *lian;* it is distinctly different by its small leaflets.

The most striking character of *C. maluense* is the symmetry of the leaflets, especially of the base, and the regularity of the nervation.

9. Canarium megacarpum Leenhouts, 1955b, 186, f. 3; 1956, 261, f. 21 d—e.

Type: West New Guinea, W. Rauna, April 4, 1937, *FRI. bb. 22547* (*Salverda 561*), fr. (BO; isotype L).

Tree 35 m by 40 cm. *Branchlets* 1¼ cm thick, glabrescent; pith with many scattered small vascular strands. *Stipules* caducous, inserted on the base of the petiole, reniformous, 5 by 8 mm, densely tomentose, margin denticulate. *Leaves* 4—5-jugate. *Leaflets* ovate to elliptic-oblong, 15—17½(—19) by 5—7(—8½) cm, subcoriaceous, shortly fulvous-tomentose on midrib above and on all nerves beneath; base rounded to truncate; margin entire; apex rather abruptly shortly acute-acuminate; nerves 17—22 pairs (angle 55°), straight to faintly curved, only in the apical part distinctly arching. *Inflorescences, flowers* and *infructescences* unknown. *Fruits* ovoid, triangular in cross-section, 7—8 by 5 cm, glabrous; pericarp ½ cm thick, fibrous; pyrene sharply 3-winged, lids concave, scaberulous, 3—3½ mm thick. *Seeds* 2; sterile cell moderately reduced.

Distribution: West New Guinea.

NEW GUINEA. *FRI. bb. 22547* (*Salverda 561*) (type).

Ecology: Primary forest. *Fr.* April.

Note. Related to *C. maluense;* specially characterized by its fruits.

10. Canarium lamii Leenhouts, 1955b, 184, f. 2; 1956, 261.

Type: West New Guinea, Holtekang near Hollandia, alt. 2 m, Oct. 28, 1954, *BW. 1607* (*Brouwer*), fr. (L).

Tree 20—35 m by 50 cm. *Branchlets* 6—7 mm thick, scurfy; pith with a peripheral cylinder of small vascular strands. *Leaves* 3-jugate, glabrous. *Stipules* subpersistent, inserted on the petiole, 1—1½ cm from its base, decurrent, oblique-obovate, 1¼—2 by 1 cm, rather stiff. *Leaflets* ovate to lanceolate, 11—18 by 6—7 cm, coriaceous; base slightly oblique, rounded; margin entire; apex rather abruptly, shortly and bluntly acuminate; nerves 10—12 pairs (angle 60—80°), moderately curved, more or less distinctly arching close to the margin. *Inflorescences* and *flowers* unknown. *Infructescences* terminal, small, with 1 fruit; calyx flat, orbicular, 1¾ cm diam. *Fruits* ovoid, 6 by 4 cm, glabrous; pericarp ½—¾ cm thick, fibrous; pyrene smooth, rostrate at the apex, in cross-section rounded triangular; the lids ¾ cm thick, very hard. *Seeds* 1—2.

Distribution: West New Guinea.

NEW GUINEA. *BW. 1415* (*Koster*), *1468* (*Koster*), *1607* (*Brouwer*) (type), *1697* (*Schram*), *4636* (*Versteegh*).

Ecology: Primary and secondary forest at very low alt.; *fl.* and *fr.* in Oct.

Note. The affinities of this species remain uncertain. On the one side it seems to show some relationship with *C. maluense* and especially with *C. harveyi*; on the other side it reminds one of *C. indicum*. Apart from the differences in the stipules, the fruits of the present species and *C. indicum* are distinctly different, however, those of *C. lamii* being bigger,

with a very thick and apparently fibrous pericarp and very thick mesocarpal lids; moreover the pedicel in the infructescence is much thickened and the calyx reduced to a narrow ring around it, in contradistinction to *C. indicum* in which the pedicel is slender and the calyx much wider and spreading. The leaflets of *C. indicum* are nearly always distinctly widest in the basal half, those of *C. lamii* have their greatest width in the middle as is usual in the *maluense*-group. The flowers may prove to be decisive.

11. Canarium sylvestre Gaertner, 1791, 99, t. 102; De Candolle, 1825, 79; Heyne, 1927, 879; Lam, 1932a, t. 11 f. 54, t. 13 f. 104f, t. 15 f. 116a; 1932b, 442, t. 9 f. 53; Leenhouts, 1956, 261, f. 22e; *non* Blume, 1850, 217 (= *C. denticulatum* Bl.). — *C. sylvestre alterum* Rumphius, 1741, 155, t. 49. — *C. sylvestre* Willdenow, 1806, 760; Roxburgh, 1814, 49; 1832, 137, *excl. syn. Pimela nigra et C. pimela.* — *C. simplicifolium* Engler, 1883, 146. — *C. branderhorstii* Lauterbach, 1920, 322. — *C. appendiculatum* Lauterbach, 1920, 331.

Type: Moluccas, Morotai, Sangowo, 1949, *Main & Aden in herb. L 951. 125—085,* fr., neotype (L_1; isotype in BO).

Tree *c.* 20 m by 40 cm, sometimes buttressed. *Branchlets c.* ½ cm thick, glabrescent; pith with some large peripheral vascular strands, sometimes also some central ones. *Stipules* persistent, inserted on the petiole at ¼—1 cm from its base, auricle-shaped, 1½—4 mm long, thinly tomentose. *Leaves* 0—3-jugate, glabrous. *Leaflets* oblong-lanceolate to elliptic-oblong, 8—21 by 3½—10 cm, chartaceous, reddish-brown to cinnamomeous when dry; base cuneate; margin entire; apex subabruptly, long, and slender, blunt-acuminate; nerves 8—15 pairs (angle 60—70°), faintly curved, distinctly arching near the margin. *Inflorescences* (♀ unknown) terminal and sometimes in the upper leaf-axils, thyrsoid, 4—32 cm long, glabrous. *Flowers* (♂) *c.* 3 mm long, glabrous outside. *Calyx* 2—3 mm high. *Stamens* 6—3, free, glabrous. *Disk* cushion-shaped, solid, *c.* 1 mm high, glabrous. *Infructescences* terminal, narrowly thyrsoid, 6—7 cm long, with few fruits; calyx flat, triangular to nearly orbicular, 9—12 mm diam. *Fruits* ovoid, 3—5½ by 1½—2¾ cm, round to bluntly triangular in cross-section, glabrous; pyrene smooth with a blunt rib in the apical part of each angle; lids 2½—3½ mm thick. *Seeds* 3—1; sterile cells mostly slightly reduced.

Distribution: Moluccas (Morotai, Buru, Ceram, Ambon), New Guinea.

MOLUCCAS. Morotai: *Main & Aden in herb. L 951.125—085* (neotype). — Buru: *FRI. bb. 22836.* — Ceram: *Buwalda 5608, 5612; FRI. bb. 25809, bb. 25826.* — Ambon: *Buwalda 6125; FRI. bb. 10132, bb. 25978; Hombron s.n.* (type *C. simplicifolium* Engl.); *Robinson Pl. Rumph. Amb. 378, Pl. Rumph. Amb. 379; Warburg 17396* (paratype *C. appendiculatum* Lauterb.).

NEW GUINEA. *Aët 694; Branderhorst 343* (type *C. branderhorstii* Lauterb.); *Brass 7088; FRI. bb. 22556, bb. 25082, bb. 30622; Ledermann 9132* (type *C. appendiculatum* Lauterb.); *Van Royen 3205.*

Ecology: In primary mixed and sagu forests at low altitudes, up to 850 m; *fl.* mainly Aug., *fr.* April—Sept.

Uses. The wood, the resin, and the seeds are sometimes used; they are of minor importance.

Notes. Blume, *l. c.*, misinterpreted a specimen of *C. denticulatum*

f. *fissistipulum* as belonging to this species, and accordingly erroneously recorded *C. sylvestre* from Sumatra. In this he was followed by Miquel (1859 & 1861) and by Engler (1883).

This species is most close to *C. maluense* f. *quadrangulare* — which is distinctly different in its fruits — and to *C. piloso-sylvestre* — differing by its pubescence.

12. Canarium piloso-sylvestre Leenhouts, 1955b, 186; 1956, 262. — *Fig. 16.*

Type: West New Guinea, Mc Cluer Bay, Anakasi near Babo, alt. 50 m, May 16, 1941, *Aët (exp. Lundquist) 138*, ♂ (L; isotype in BO).

Large tree. *Branchlets* c. 4 mm thick, long remaining densely ferruginously woolly pubescent; pith with a number of small vascular strands, most of them arranged into a peripheral cylinder. *Stipules* subpersistent, inserted on the petiole up to 8 mm from its base, auricle-shaped to lingulate, up to 6 by 3½ mm, stiff, pilose. *Leaves* 1—2-jugate. *Leaflets* elliptic to obovate, 10—12 by 4½—6 cm, chartaceous, reddish-brown when dry, glabrous above, sparsely pilose beneath; base equilateral, cuneate; margin entire; apex rather abruptly long and slender blunt-acuminate; nerves 11—12 pairs (angle 60—70°), curved, distinctly arching at c. 3 mm from the margin, slightly sunken above. *Inflorescences* (♀ unknown) terminal, narrowly thyrsoid, c. 15 cm long, densely woolly pubescent. *Flowers* (♂) 8 mm long, glabrous outside. *Calyx* ¼ cm high, subtruncate. *Stamens* 3, slightly adnate to the disk, glabrous. *Disk* cylindrical, solid, 3-lobed, 2 mm high, glabrous. *Infructescences* and *fruits* unknown.

Distribution: West New Guinea.

NEW GUINEA. *Aët 138* (type).

Ecology: Alt. 50 m, *fl.* May.

Note. Though apparently very closely related to *C. sylvestre*, this specimen probably represents a distinct species, mainly differing by its pubescence and by the (♂) flowers, which are twice as large as in *sylvestre*. *C. sylvestre* is a very uniform species.

13. Canarium salomonense Burtt, 1935, 302; Leenhouts, 1955a, 32, f. 14; 1956, 263, f. 21f.

Type: Solomon Islands, Bougainville, Sept. 1932, *Waterhouse Y73*, ♀ (K; isotypes in A, BISH).

Buttressed tree up to about 30 m by 30—50 cm, sometimes with stilt-roots. *Branchlets* ½—¾ cm thick, glabrescent; pith with several small vascular strands, partly peripherally arranged. *Stipules* subcaducous, inserted on the petiole at 4—15 mm from its base, auricle-shaped, 3—4 by 4—7 mm. *Leaves* 1—3-jugate. *Leaflets* elliptic to ovate, 6—14(—19) by 2.5—6.5(—10.5) cm, chartaceous to coriaceous, glabrous; base broadly cuneate to subcordate; margin entire; apex abruptly, short- and blunt-acuminate; nerves 8—14 pairs (angle c. 70°) straight to slightly curved, distinctly arching at some distance from the margin. *Inflorescences* terminal, short ferruginous-pubescent, glabrescent, ♂ ones laxly thyrsoid, 20—30 cm long, many-flowered, ♀ ones more slender, 8—20 cm long, less-flowered. *Flowers* tomentose outside, ♂ ones 4—5½ mm long, ♀ ones c. 1 cm with a slightly

hollowed receptacle. *Calyx* in ♂ flowers 2 mm, in ♀ flowers 5½ mm. *Stamens* 6, glabrous, adnate to the disk. *Disk* glabrous, in ♂ flowers cylindrical, 6-lobed, 1 mm high, with a central canal, in ♀ flowers adnate

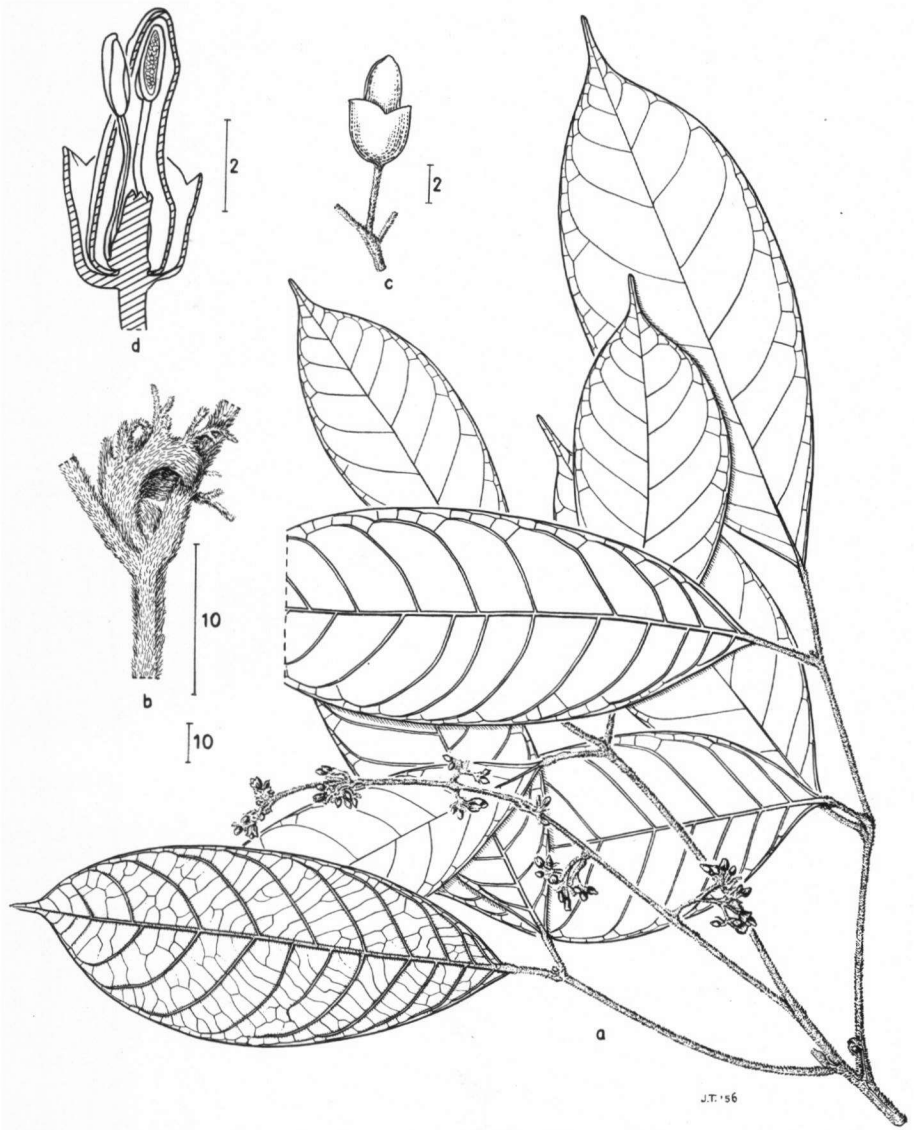


Fig. 16. *C. piloso-sylvestre* — a. twig with ♂ inflorescence; b. stipules; c. ♂ flower; d. ditto in section. (from *Aet 138*) (dimensions in mm).

to the receptacle, free rim 6-undulate, 1½ mm high. *Pistil* glabrous, in ♂ flowers none. *Infructescences* 10—12 cm long, with 1—4 fruits; calyx flat, faintly 3-lobed to orbicular, 1 cm diam. *Fruits* ellipsoid, 2.8—4.5 by

1.8—2.7 by 1.4—2.5 cm, glabrous; pyrene smooth, pointed at the base and with 3 strong, blunt, white ribs at the apex; lids 3—5 mm thick. *Seed* 1; sterile cells strongly reduced.

Distribution: East New Guinea, Solomon Islands.

Taxonomy. Two subspecies can be distinguished:

A. Subsp. **salomonense.**

Leaves 1—2(—3)-jugate, the terminal leaflet not rarely obsolete. Stipules subpersistent. Leaflets (oblong-)elliptic to ovate, 6—14(—19) by 2.5—6.5(—10.5) cm; acumen up to 1.5 cm long. Fruits usually slightly flattened on one side; lids 2.5 mm thick.

Distribution: Solomon Islands, perhaps also on Woodlark Island (N. of D'Entrecasteaux Islands).

NEW GUINEA. Woodlark Island: *Brass 28740* (aff.).

SOLOMON ISLANDS. Bougainville: *Kajewski 1924, 2056; Waterhouse 73, Y73* (type), *B 545* (paratype), *B 725.* — New Georgia: *Waterhouse 86.* — Duke Island: *Waterhouse 296, 297.* — Guadalcanal: *Kajewski 2712.* — Florida: *BSIP. 363 (Silas-Rouse).* — Malaita: *BSIP. 93 (Walker & White); Kajewski 2365.* — San Cristoval: *Brass 2847; Comins 112.*

Ecology: Rain-forests, up to c. 1000 m. *Fl.* June—Jan., *fr.* June—Oct.

Uses. Often cultivated, as the seeds are eaten by the natives; moreover, the resin is used for making torches.

B. Subsp. **papuanum** Leenhouts, 1955b, 188, f. 5f; 1956, 263, f. 21f.

Type: East New Guinea, Northern Div., foothills of Hydrographer's Range near new Inota village, alt. c. 125 m, Sept. 7, 1953, *Hoogland 3844*, fr. (L).

Leaves 3-jugate. Stipules rather caducous. Leaflets elliptic, 7—10 by 3—5 cm; acumen up to 3 mm long. Fruits more strongly flattened, rather small, 3.5 by 2.25 by 1.5 cm; lids up to 5 mm thick, very hard; sterile cells nearly totally reduced.

Distribution: East New Guinea.

NEW GUINEA. *Hoogland 3823* (paratype), *3844* (type), *3877* (paratype), *4831; NGF. 2099 (Cavanaugh & Fryar)* (paratype).

Ecology. Rain-forest up to 400 m alt., *fl. fr.* Sept.

Note. The present species is apparently related to *C. maluense*; the relatively broad, rather flattened pyrenes are characteristic.

14. Canarium harveyi Seemann, 1865, 35; Engler, 1883, 133; Hemsley, 1895, 171, 203, 210; Burkill, 1901, 31; Yuncker, 1943, 71; Leenhouts, 1955a, 35, f. 15, 16. — *C. sapidum* Hemsley, 1891, 504; Schumann und Lauterbach, 1901, 378; Lauterbach, 1920, 324. — *C. mafoa* Christophersen, 1935, 111, f. 14. — *C. sp. nov.* Guillaumin, 1931, 237, f. 2 B; 1948a, 28. — *C. vitiense* (*non* Gray) Degener, 1949, 294.

Type: Tonga Islands, Vavau and Lifuka, 1855, *Harvey s.n.*, fr. (K).

Tree up to c. 35 m high, rarely liana. *Branchlets* (4—)5—7(—9) mm thick, glabrescent; pith with some to many vascular strands, all or part of them peripherally arranged, central part of the pith sometimes vanishing. *Stipules* caducous, inserted on the petiole up to 1 cm from its base,

auricle-shaped, 4—17 by 2—11 mm, shortly tomentose outside, coarsely reticulate-nerved. *Leaves* 2—3(—4)-jugate, minutely brown tomentose when young, glabrescent. *Leaflets* broad-ovate to elliptic or oblong, 4—20(—35) by 2—7.5(—13) cm, herbaceous to coriaceous; base oblique, broadly cuneate, rounded, truncate, or faintly cordate, slightly decurrent; margin entire; apex more or less gradually acuminate, acumen blunt; nerves (6—)8—13 (—17) pairs (angle 90—50°, decreasing from base to apex), straight to faintly curved, distinctly interarching near the margin; some intermediate veins well developed. *Inflorescences* axillary to pseudoterminal, minutely brown tomentose, glabrescent, ♂ ones thyrsoid, 10—20 cm long, with many flowers, ♀ racemose, 3.5—9 cm, with 6—7 flowers. *Flowers* tomentose, ♂ 4—6 mm, subsessile, ♀ 6 mm, with a slightly hollowed receptacle. *Calyx* in ♂ flowers 2.5 mm, in ♀ ones 3.5—4 mm. *Stamens* 6, free (in ♀ flowers sometimes confluent with the disk), glabrous. *Disk* in ♂ flowers rather variable, 0.7—1 mm high, fleshy, glabrous to shortly brown tomentose, with a central canal; in ♀ flowers adnate to the receptacle with the exception of the faintly 6-lobed rim, glabrous. *Pistil* glabrous, in ♂ flowers absent. *Infructescences* 2—12 cm long, with 1—4 fruits; calyx flat, faintly 3-lobed, 6—8 mm in diam. *Fruits* extremely variable (see varieties), glabrous. *Seeds* usually 1(—2); sterile cells usually strongly to nearly entirely reduced.

Distribution: Solomon Islands, New Hebrides, Tonga-, Fiji-, and Samoa Islands.

Taxonomy. The present species is rather variable, especially in its fruit-characters, which apparently characterize the local populations of the different groups of islands. Therefore, even though the material at hand is still very insufficient, I propose the following provisional subdivision into 4 varieties:

a. var. **sapidum** (Hemsley) Leenhouts, 1955a, 37, f. 15d, g, k. — *C. sapidum* Hemsley.

Type: Solomon Islands, San Cristoval, Oct. 1890, *Comins 224*, ♀ and fr., lectotype (K).

Main characteristics: Part of leaves large, probably more than 40 cm long; their leaflets very large, up to 23—35 by 7—13 cm, apex abruptly and long and bluntly acuminate, acumen 1.7—3.3 by 0.5—0.6 cm; secondary nerves 10—17 pairs. Petals of female flowers tomentose at both sides. Fruits elliptic, 5 by 2.5 by 2.5 cm; pyrene faintly 6-angular, at base acutely 3-angular, smooth; lids 2—3.5 mm thick; 3-celled, 2 cells slightly reduced.

Distribution: Solomon Islands, Santa Cruz group excepted.

Solomon Islands. Shortland Island: *Guppy 320*. — Treasury Island: *Guppy 305* (paratype), *319* (paratype). — Oima Atoll: *Guppy 318* (paratype). — San Cristoval: *Comins 224* (type).

Ecology: *Fl.* Oct., *fr.* Aug., Oct. The nuts are eaten by pigeons.

b. var. **nova-hebridiense** Leenhouts, 1955a, 37, f. 15j, l, 16c. — *C. sp. nov.* Guillaumin.

Type: New Hebrides, Banks Islands, Vanua Lava, sea level, July 5, 1928, *Kajewski 408*, fr. (BISH; isotypes in A, K, P).

This variety is mainly characterized by its fruits, being obovoid, flattened at one side, with 2 lateral acute ribs, 2 ribs at the flattened side and a median one at the convex side, 5 by 3.2 by 2.3 cm, pyrene smooth, but for the 5 ribs; lids 2.5—3 mm thick; 3-celled, 2 cells strongly to almost entirely reduced.

Distribution: Solomon Islands (Santa Cruz) and New Hebrides (Banks Islands).

SOLOMON ISLANDS. Santa Cruz: *Kajewski 548* (paratype).
NEW HEBRIDES. Banks Islands: *Kajewski 408* (type).

Ecology: Rain-forest at sea-level. *Fr.* July, Nov.

c. var. **harveyi**; Leenhouts, 1955a, 38, f. 15a—c, e, f, h, n. — *C. harveyi* Seem. — *C. mafoa* Christophersen.

The main differences between this variety and the others are found in the fruits, which are relatively small, 3—4 by 2.4—2.8 by 1.7—1.9 cm, obovoid, 3-celled, 2 cells entirely or almost entirely reduced; pyrene smooth, but for 3 acute ribs. In nearly all other characteristics this variety is almost as variable as the species as a whole.

Distribution: Tonga-, Fiji-, and Samoa Islands, Niue.

TONGA ISLANDS. Vavau: *Crosby 213; Harvey s.n.* (type). — Eua: *Parks 16171, 16349.*
FIJI ISLANDS. Viti Levu: *Gillespie 3620, 3658; Smith 9314.* — Ngau: *Smith 7767.* — Vanua Mbalavu: *Smith 1506.* — Fulanga: *Smith 1151.*
SAMOA ISLANDS. Savaii: *Christophersen 2582, 3369* (paratype *C. mafoa* Christ.), *3373* (type *C. mafoa* Christ.). — Tutuila: *Swezey & Wilder 256.*
NIUE. *Yuncker 9849.*

Ecology: Forests, from sea-level up to *c.* 600 m. *Fl.* Sept.—Febr., *fr.* June—Dec.

d. var. **scandens** Leenhouts, 1955a, 39, f. 15m, p—r, 16a, b, d. — *C. vitiense* (*non* A. Gray) Degener.

Type: Fiji Islands, Viti Levu, Vatutavathe, alt. 150 m, May 5, 1941, *Degener 15196,* fr. (A; isotypes in BISH, K, NY).

The main differences between this and all other varieties are the following: Liana. Branchlets more slender (4.5 mm thick). Leaves relatively small in all parts; total length 12—28 cm. Leaflets 4—11 by 2—6 cm, coriaceous, grey-green when dry. Fruits extremely variable, more or less broadly ovoid, usually flattened on one side, 3.2—4 by 2—2.5 by 1.4—2.5 cm; pyrene smooth, with or without three acute ribs, or strongly rugose; lids 3—6 mm thick; 3-celled, (1—)2 cells very strongly or entirely reduced, sometimes (in sterile fruits, *Degener 15196*) situated close to pericarp.

Distribution: Fiji Islands (Viti Levu).

FIJI ISLANDS. Viti Levu: *Degener 15159* (paratype), *15196* (type); *Gillespie 2320* (paratype).

Ecology: Forests up to 400 m. *Fr.* May, Aug.

Uses. The nuts are eaten by both natives and Europeans in the Solomons and New Hebrides, and the resin is used as a perfume in Samoa.

15. Canarium vulgare Leenhouts, 1955a, 31, f. 13; 1955b, 188; 1956, 263, f. 19, 22g & 26—30. — *C. vulgare tertia et quarta species* Rumphius, 1741, 146, t. 47 F—I; Lotsy, 1902, t. opp. p. 46. — *C. commune* Linné, 1767, 127, *pro min. part. typo excl.*; Blume, 1826, 1161, *p. p.*; Roemer & Schultes, 1830, 1622; Blume, 1850, 214, *incl.* also *var. minor*; Miquel, 1859, 643; Bennett, 1875a, 531; 1875b, 102; Engler, 1883, 112, t. 2 f. 35—39; King, 1894b, 246; Engler & Prantl, 1896, f. 136 A—E; 1931, f. 211 A—E; Koorders & Valeton, 1896, 35; Backer, 1907, 264; 1911, 198; Koorders, 1912, 433; Koorders & Valeton, 1913, t. 149; Heyne, 1927, 873; Petch, 1930, 279, t. 35 & 36; Lam, 1932a, f. 51, t. 15, f. 124; 1932b, 509; Funke, 1932, 38—39; Went, 1932, 41; Van Heurn & Lam, 1937, 97; Van Steenis, 1938, 54; Corner, 1940, 178, t. 38; Lam, 1948, 5; Van Steenis, 1951, 232.

Type: Lesser Sunda Islands, Bali, Tjandikusuma, alt. 20 m, April, 1920, *Becking 142*, fr. (L; isotype in BO).

Tree up to 45 m by 70 cm; buttresses up to 3 m high and 1½ m wide. *Branchlets* c. ½ cm thick, smooth, glabrous; pith with many vascular strands, partly peripherally arranged. *Stipules* rather caducous, inserted at the conjunction of the petiole and the branchlet, rarely entirely on the base of the petiole, oblong, 1—5 by ½—1¾ cm, apex rounded, margin entire, glabrous to slightly pulverulent. *Leaves* (2—)4—5-jugate, glabrous. *Leaflets* ovate to oblong, 5—16 by 2½—7(—10) cm, chartaceous to subcoriaceous; base often slightly oblique, (broadly) cuneate; margin entire; apex gradually to subabruptly, rather long and slender-acuminate; nerves 12—15 pairs (angle 60—70°), straight to faintly curved, gradually arching at some distance from the margin. *Inflorescences* terminal (basal branches often axillary), broadly thyrsoid, minutely pulverulent, ♂ ones up to 35 cm long, main branches up to 20 cm, ♀ ones up to 20 cm long, main branches up to 10 cm. *Bracts* concave. *Flowers* tomentose, ♂ (sub)sessile, 5 mm long, ♀ stalked, 6—7(—12) mm, often with a concave receptacle. *Stamens* free, glabrous. *Disk* glabrous, in ♂ flowers solid, rather variable in size and shape, sometimes with a style-like appendix; in ♀ flowers adnate to the receptacle but for the rim. *Ovary* glabrous, in ♂ flowers none. *Infructescences* broadly thyrsoid, up to c. 15 cm long, with up to c. 12 fruits; calyx flat, orbicular with undulate margin, 7—13 mm diam. *Fruits* ovoid, round to slightly trigonous in cross-section, 3½—5 by 1½—3 cm, glabrous; pyrene smooth with 3 blunt, white ribs near the base; lids c. 4 mm thick. *Seeds* 3—1; sterile cells not strongly reduced.

Distribution: Kangean & Bawean Islands (near East Java), Lesser Sunda Islands (Flores, Timor, Wetar, Tanimbar), Celebes, Moluccas (Talaud, Morotai, Sula, Ceram, Banda, Aru).

Perhaps naturalized in some other parts of Malaysia, cultivated in tropical regions all over the world.

JAVA. Kangean Islands: *Backer 27830, 27954, 29608; Dames 22.* — Bawean: *Karta 1.*

LESSER SUNDA ISLANDS. Flores: *FRI. bb. 9638.* — Alor: *Jaag 527.* — Timor: *Van Steenis 18204.* — Wetar: *FRI. bb. 27244.* — Tanimbar: *Buwalda 4476; FRI. bb. 24355.*

CELEBES. *Docters van Leeuwen 1551; Forsten 438; FRI. bb. 15050, bb. 24114, bb. 32752 (Rorongpandey 2).*

MOLUCCAS. Talaud: *Lam 3131.* — Morotai: *FRI. bb. 24571, bb. 33753*

(Tangkilisan 45), bb. 33852 (Tangkilisan 165), bb. 33859 (Tangkilisan 172), bb. 33863 (Tangkilisan 177), bb. 33917 (Tangkilisan 247); Lam 3457. — Sula: *FRI. bb. 29787.* — Ceram: *FRI. bb. 23043.* — Bandanera: *Lauterbach 3038.* — Aru: *Beccari herb. 2166, 2169; FRI. bb. 25484.*

cultivated:

Backer 22; Bakhuizen v. d. Brink Jr. 1582; Bakker Jr. 20; Becking 142 (type) (most probably wild); *Blume 667; Britton, N. L. & E. G., 9326; BS 29255 (Wester), 85684 (Quisumbing); Cantley's coll. 2681; Chevalier 31334; Clemens, J. & M. S., 22427; Commerson 592; Dorgelo 1708; Evrard 2374; Fairchild 3702; Forbes 6, 1208; Gibbons 1026; Greenway 2884; Henderson 1360; Herb. d'Alleizette 1161; Hook(er?) 837; Hort. Bot. Bogor 42, 51, VI B 66, XII B IX 128; Hort. Bot. Pamplemousses 108, 150; Hullett 137; Jack 4199, 4790; Junghuhn in herb. U 32921; Kanehira 848; Karta 198; Kehding 1014; Koorders 917β, 975β; Kostermans 11087; Kuntze 5086, 5086 A; Lahaie 153, 193; Lam 2297; Lindeman 4486; Long 176; MacDaniels 413; Macrae 332; Nur 195; Parham 1540; PNH. 380 (Gonzalez), 394 (Quisumbing); Popta 00603/198 A, B, C; Proefstation voor de Java Suikerindustrie te Pasoeroean 305a, 315b; Ridley 6895; Rock 17140; SF. 4161 (Burkill), 34847 (Furtado); Volkens 35; De Voogd 667; De Vriese 45; Wallich 8493 D; Warburg 2059; Wawra 1247; Wetmore & Abbe 286; Wight 387; Wilder 462, 860; Zollinger 2994.*

Ecology: Mainly in primary forests on limestone, sometimes, locally gregarious, *fl.* mainly March—June (Java: Aug.—Dec.), *fr.* mainly April—May.

Wood anat.: Den Berger, Med. Proefst. Thee 97 (1926) 66 & Atlas pl. 11 fig. 44, Med. Proefst. Boschw. 13 (1926) 66 & Atlas ditto (*C. commune* L.) (hand lens); Moll & Janssonius, Mikr. Holzes 2 (1908) 108 (*C. commune* L.).

Uses. Planted as a shade-tree in nutmegplantations and as a roadside tree. The timber is rather soft and mainly used as firewood; in Bawean and Kangean it is also used for canoe-building; sometimes paddles are made out of the buttresses. The resin is not abundant and without importance. The seeds are highly estimated as a titbit, and are sometimes used as a substitute for almonds; the oil from the seeds is used as a substitute of coconut-oil. An emulsion of the seeds can be of importance as a baby-food (Heyne, *l. c.*). For an analysis of the seed-oil see Steger & Van Loon, Rec. Trav. Chim. Pays-Bas 59 (1940) 168.

Note. Closely related to *C. indicum* and for a long time not distinguished as a separate species; in consequence the synonymy of these two species is very complicated (see Leenhouts, 1955a, *l. c.*). Distinguishable from the last-named species by being more slender in all parts, and by its more or less caducous, entire stipules.

16. Canarium indicum Linné, 1759, 143; Leenhouts, 1955a, 26, f. 12; 1956, 266, f. 21g & 31—34. — *C. vulgare prima et secunda species* Rumphius, 1741, 145, t. 47 A—E. — *C. zephyrinum* Rumphius, 1741, 151, t. 48; Duchesne, 1836, 289; Blume, 1850, 217; Miquel, 1859, 643; *non* Fernandez-Villar, 1880, 40 (= *C. ovatum* Engl.); Engler, 1883, 149; Merrill, 1917, 304; Heyne, 1927, 879. — *C. commune* Linné, 1767, 127, *pro maj. part., typo incl.*; 1774, 741; Lamarck, 1783, 598; Linné, 1784, 885; 1797, 928; König, 1805, 360; Willdenow, 1805, 759, *incl.* also *var. β*; De Candolle, 1825, 79, *incl.* also *var. zephyrinum*; Roemer & Schultes, 1829, 78, *non* 1830, 1622 (= *C. vulgare* Leenh.); *non* Blanco, 1837, 791 (= *C. asperum* Benth.); *non* Fernandez-Villar, 1880, 40 (= *C. luzonicum* A. Gray);

Merrill, 1917, 301; *see also under C. vulgare* Leenh. — *C. mehenbethene* Gaertner. 1791. 98. t. 102. *nom. illeg.*; Miquel, 1859, 643; Engler, 1883, 149; 1896, f. 136 F—H; 1931, f. 211 F—H; Guillaumin, 1909a, f. 12—13; Lam, 1931—32, t. 5 f. 13—14, t. 15 f. 122a; 1932b, 515; Van Heurn & Lam, 1937, 97; White, 1950, 91. — *C. moluccanum* Blume, 1850, 216, *incl.* also *var. obtusatum*; Koorders & Valeton, 1896, 33, 313; 1897, t. 9; Guillaumin, 1909a, f. 22^1, f. 28; Backer, 1911, 197; Koorders, 1912, 433; Lauterbach, 1920, 320, *incl.* also *var. palla* and *f. porphyropyrena*; Heyne, 1927, 873. — *C. subtruncatum* Engler, 1883, 109. — *C. amboinense* Hochreutiner, 1904, 55; 1905, 5; Guillaumin, 1909a, f. 22^{20}; Hochreutiner, 1910, 841; Heyne, 1927, 873. — *C. shortlandicum* Rechinger, 1912, 184. — *C. polyphyllum* (*non* K. Sch.) Krause, 1913, 147. — *C. grandistipulatum* Lauterbach, 1920, 321; Lane-Poole, 1925, 189. — *C. nungi* Guillaumin, 1931, 236.

Type: Moluccas, *Hort. Bot. Bog. VI B 65*, ♀, neotype (L; isotypes in BR, BRSL, G, K, L, NY, P, U).

Tree up to 40 by 1 m, with buttresses. *Branchlets* 7—13(—25) mm thick, glabrescent; pith with a peripheral cylinder of small vascular strands close to the inner side of the wood, central part with a second cylinder or some dispersed strands. *Stipules* persistent, inserted at the conjunction of branchlet and petiole (orbicular to) ovate to oblong, 1½—12 by 1¼—14 cm, striate to reticulate, pulverulent to glabrous, often slightly cordate at base, margin coarsely to minutely fimbriate-dentate to undulating. *Leaves* 3—8-jugate, glabrous. *Petiolules* rather long (¾—3 cm) and slender. *Leaflets* oblong-obovate to oblong-lanceolate, (5½—)7—35 by (2—)3½—16 cm, herbaceous to coriaceous; base oblique, rounded to broadly cuneate; margin entire; apex gradually to subabruptly, bluntly acuminate; nerves (8—)10—15 (—20) pairs (angle 85—55°, decreasing from base to apex), straight to faintly curved, faintly or not arching near the margin. *Inflorescences* terminal, broadly thyrsoid, 15—40 cm long, minutely tomentose, rather many-flowered; bracts concave, dentate at the apex, caducous. *Flowers* tomentose, ♂ ones subsessile, *c.* 1 cm long, ♀ ones shortly stalked, up to 1½ cm long, with a concave receptacle. *Calyx* in ♂ flowers 5—7 mm long, in ♀ ones 7—10 mm. *Stamens* glabrous, in ♂ flowers free, in ♀ flowers adnate to the disk. *Disk* in ♂ flowers cushion-shaped, 1 mm high, glabrous, in ♀ flowers adnate to the receptacle except the minutely pilose margin. *Pistil* in ♂ flowers minute to none, in ♀ glabrous. *Infructescences* large, with up to *c.* 30 fruits; calyx flat, orbicular, margin often ruptured, 1¾—2½ cm diam. *Fruits* ovoid, round to slightly triangular in cross-section, 3½—6 by (1½—)2—4 cm, glabrous; pyrene rounded triangular in cross-section, smooth except the 3 more or less acute ribs at base and apex; lids 3—4 mm thick. *Seeds* usually 1; sterile cells slightly reduced.

Distribution: North Celebes (very probably naturalized), Moluccas (Ternate, Sula, Ceram, Ambon, Kai), New Guinea, New Britain, New Ireland, Solomon Islands, and New Hebrides.

Taxonomy. The following two varieties can be distinguished:

a. var. indicum. — All synonyms.

Branchlets up to 13 mm thick. Stipules up to 6 by 4 cm, dentate.

Leaves up to 7-jugate. Leaflets up to 28 by 11 cm, herbaceous to coriaceous. Fruits up to 6 by 3 cm.

Distribution: as the species.

CELEBES. *FRI. bb. 32448 (Panambunan 1).*

MOLUCCAS. *Hort. Bot. Bogor VI B 65* (neotype). — Ternate: *Beguin 662, 1002, 1003.* — Sula: *FRI. bb. 28817.* — Ceram: *Buwalda 5609; FRI. bb. 25899.* — Ambon: *Beccari herb. 2164; Boerlage 82; Dolleschal 261* (syntype *C. subtruncatum* Engl.); *Hort. Bot. Bogor VI B 83, VI B 88* (type *C. amboinense* Hochr.); *Lahaie 862; Robinson Pl. Rumph. Amb. 380, Pl. Rumph. Amb. 381; d'Urville 468; Warburg 17395.* — Kai: *Beccari herb. 2163.*

NEW GUINEA. *BW. 1512 (Schram), 1609 (Brouwer), 1693 (Schram), 2667 (Schram), 2735 (Schram); Docters van Leeuwen 11280; FRI. bb. 22557, bb. 32688 (Lundquist 69); Gjellerup 730; Hoogland 5036; Kanehira 3973; Lane Poole 338; Ledermann 8073* (syntype *C. grandistipulatum* Lauterb.), *10599* (syntype *C. grandistipulatum* Lauterb.); *NGF. 1819 (Mair), 2775 (Schacht); Warburg 20158; Waterhouse 407, 411, 412.* — New Britain: *Lauterbach 301; NGF. 3428 (Womersley), 3466 (Floyd), 7089 (Womersley & Kazakoff); Waterhouse 316, 405, 406, 882, 950, 951, 964.* — New Ireland: *Peekel 386* (type *C. moluccanum* Blume *var. palla* Lauterb.), *399* (type *C. moluccanum* Blume *f. porphyropyrena* Lauterb.), *555.*

SOLOMON ISLANDS. Bougainville: *Kajewski 1828; Waterhouse 69, 70, 106.* — Shortland Islands: *Rechinger, K. & L., 4900* (type *C. shortlandicum* Rechinger). — New Georgia: *BSIP. 3A (Walker); Waterhouse 110, 220, 298, 299; White 93A.* — Isabel: *Brass 3468.* — Guadalcanal: *BSIP. 3 (Walker).* — San Cristoval: *Brass 2631, 2701.*

NEW HEBRIDES. *Barrau NH 3, NH 22; Kajewski 122* (syntype *C. nungi* Guillaumin), *243* (syntype *C. nungi* Guillaumin).

cultivated:

Dept. of Agriculture Rabaul VB 1, VB 2, VB 3; Eames 197; Forbes 7; Greenway 2885; Hort. Bot. Bogor VI B 30, VI B 65a, VI D 10; Kanehira 739; Lam 3831, 6943; Marche 192; Moore 773.

locality unknown:

Van de Koppel 4140; De Vriese in herb. L 898.319—372 (type *C. subtruncatum* Engl.).

Ecology: Rain-forests at low altitude, rarely up to *c.* 250 m; planted up to 600 m or more. *Fl.* mainly Oct.—Dec., *fr.* mainly July—Dec.

Wood anat.: Webber, Lilloa 6 (1941) 450 (*C. mehenbethene* Gaertn.).

Uses. Mainly the same as in *C. vulgare,* though of less importance. In Melanesia the seeds apparently are highly estimated as a food and several races are cultivated, mainly varying in the form and size of the fruits.

b. var. **platycerioideum** Leenhouts, 1955b, 182; 1956, 269.

Type: West New Guinea, Vogelkop, Tisa near Steenkool, alt. 3 m, May 9, 1941, *FRI. bb. 32637 (Lundquist 18),* st. (BO; isotype in L).

Very coarse. Branchlets up to 2½ cm thick. Stipules sometimes inserted on the base of the petiole only, orbicular to obovate, 4—12 by 4—14 cm, subcoriaceous, glabrous, margin undulating, nervation lax, anastomosing (stipules resembling the basal leaves of *Platycerium*). Leaves 5—8 (or more?)-jugate, 80—135 cm long. Leaflets inequilateral, ovate, 25—35 by 13—16 cm. Flowers unknown. Fruits 6 by 3½—4 cm.

Distribution: N.W. New Guinea (Vogelkop).

NEW GUINEA. *Beccari PP 568* (paratype); *BW. 1928 (Schram), 1932 (Schram)* (aff.), *2545 (Brouwer)* (paratype), *4508 (Lasschuit); FRI. bb. 32637 (Lundquist 18)* (type), *bb. 32949 (Lundquist 230)* (aff.), *bb. 33446 (Kostermans 242)* (aff.); *Kostermans 77, 265, 2736* (aff.).

Ecology: Collected only at altitudes up to 30 m.

Note. Closely related to and for a long time confused with *C. vulgare*, moreover related to *C. kaniense*. For an account of the complicated nomenclature see Leenhouts, 1955, *l. c.*

17. Canarium kaniense Lauterbach, 1920, 322; Lam, 1932a, t. 15 f. 121; 1932b, 515, t. 13 f. 88; Leenhouts, 1956, 269, f. 1 a—h. — *C. gawadaense* Baker, 1923, 7; Lam, 1932a, t. 13 f. 104n; 1932b, 527, t. 14 f. 91.

Type: N.E. New Guinea, Kani Mts, alt. 1000 m. Dec. 25, 1907, *Schlechter 17051*, ♂ (BRSL; isotype in P).

Tree up to 40 m by 75 cm, sometimes with buttresses. *Branchlets* ½—1 cm thick, glabrescent; pith with one or two concentric cylinders of vascular strands. *Stipules* subpersistent, inserted either on the branchlet or on the petiole, elliptic to obovate, 1—8 by ½—4 cm, subcoriaceous, minutely pubescent to glabrous, margin repeatedly and more or less deeply dentate to fimbriate, nervation coarse, anastomosing. *Leaves* 3—5(—6)-jugate, glabrous. *Leaflets* ovate to oblong, 8—25 by 3½—9 cm, chartaceous to subcoriaceous; base slightly oblique, broadly cuneate to rounded; margin entire; apex gradually to abruptly, shortly to rather long, blunt-acuminate; nerves 9—18 pairs (angle 50—80°), straight to faintly curved, sometimes arching near the margin. *Inflorescences* (♀ unknown) terminal and in the upper leaf-axils, narrowly thyrsoid, *c.* 30 cm long, densely tomentose, main branches up to *c.* 9 cm; flowers in glomerules; bracts like the stipules, though smaller and less deeply fimbriate. *Flowers* (♀ unknown) subsessile, 7 mm long, pubescent. *Calyx* 5 mm. *Stamens* glabrous, slightly adnate to the disk. *Disk* annular, 1—2 mm high, thinly pilose. *Pistil* columnar, 1½ mm high, glabrous. *Infructescens* terminal, narrowly thyrsoid, 25—30 cm long, thinly pilose, with 5—6 fruits; calyx flat, orbicular, 1½—2 cm diam., with remnants of an annular disk and of free stamens. *Fruits* see under varieties. *Seeds* 1(—2); sterile cells slightly reduced.

Distribution: East New Guinea.

Taxonomy. The following two varieties are distinguishable.

a. var. **kaniense**. — All synonyms.

Stipules 1—3 by 0.5—2 cm, the margin dentate to slightly fimbriate only. Leaves 3—5(—6)-jugate. Leaflets ovate to elliptic, 8—12 by 3½—7 cm; acumen up to 15 by 3 mm; nerves 9—15 pairs. Fruits ovoid, deltoid in cross-section, 5—6 by 3—4 cm, glabrous; pericarp fleshy; pyrene smooth, triangular, with hollow sides, sometimes with acute angle-ribs and/or faint median ribs; lids 2—5 mm thick.

Distribution: As the species.

NEW GUINEA. *Clemens 7953; Forbes 519* (type *C. gawadaense* Baker); *Lauterbach 1554, 1571; NGF. 1285 (Smith); Schlechter 17051* (type).

Ecology: In forests at (25—)1000—2000 m alt., *fl.* Dec., *fr.* Jan.—March.

Uses. The oily seeds are eaten.

b. var. **globigerum** Leenhouts, 1955b, 182; 1956, 270, f. 21a—c, 22h.

Type: East New Guinea, Northern Div., 3 km North of Divinikoari

village, alt. 30 m, Aug. 23, 1953, *Hoogland 3727*, fr. (L; isotype in CANB.).

Stipules 3½—8 by 2—4 cm, the dentate margin densely fimbriate, segments subulate and branched, up to 2 cm. Leaves 4—6-jugate. Leaflets ovate to oblong, mostly 15—25 by 9 cm; abruptly caudate-acuminate, acumen up to 30 by 1 mm; nerves 12—18 pairs. Fruits globular, c. 5 cm diam.; epicarp egg-shell-like, pericarp somewhat fibrous; pyrene acutely 3-winged, specially in the lower half, lids slightly concave with a faint median rib; lids 1½ mm thick.

Distribution: like var. *kaniense*.

NEW GUINEA. *Clemens 1288; Hoogland 3727* (type); *NGF. W. 330.*

Ecology: like var. *kaniense*.

Notes: Sharply defined only by its fruit-characters. As both varieties are very insufficiently known, their status is still uncertain.

Related to *C. indicum*; it differs by its stipules and fruits.

18. Canarium luzonicum (Bl.) A. Gray, 1854, 374; Miquel, 1859, 651; Engler, 1883, 150; Merrill, 1905a, 30; 1905b, 53; Guillaumin, 1908c, 616, t. 19 f. 2; Merrill, 1908a, 80; Whitford, 1911, 56; Merrill, 1918a, 207; Brown, 1921, 40, 300, f. 11; Merrill, 1923, 351; Lam, 1932a, t. 11 f. 56; 1932b, 532; Burkill, 1935, 430; Manalo & West, 1950, 111; Quisumbing, 1951, 475; Leenhouts, 1956, 270. — *C. album* (*non* DC.) Blanco, 1837, 793; 1845, 546; 1879, 201; Merrill, 1905a, 30. — *Pimela luzonica* Blume, 1850, 220. — *C. commune* (*non* L.) Fernandez-Villar, 1880, 40. — *C. triandrum* Engler, 1883, 145, t. 3 f. 19—22; Jadin, 1894, t. 15 f. 9 A. — *C. polyanthum* Perkins, 1904, 95. — *C. carapifolium* Perkins, 1904, 91. — *C. oliganthum* Merrill, 1915a, 23; Lam, 1932b, 534.

Type: Philippines, Luzon, Rizal Prov., San Mateo, Jan. 1915, *Merrill Sp. Blanc. 713,* fr., neotype (L; isotypes in A, BM, K, L, NY, P, W).

Tree up to 35 m by 1 m or more. *Branchlets* 4—6(—8) mm thick, glabrescent, lenticellate; pith with many peripherally arranged vascular strands. *Stipules* caducous to subpersistent, inserted on the base of the petiole (up to 5 mm from the branchlet), orbicular, c. 8 mm diam., pubescent. *Leaves* 3—5-jugate, glabrous. *Leaflets* lanceolate to oblong, 6½—25 by 3½—8½ cm, subcoriaceous; base equilateral, broadly cuneate to cordate; margin entire; apex gradually, long and broadly, blunt acuminate; nerves 14—18 pairs (angle c. 65°), straight to slightly curved, gradually to subabruptly arching at some distance from the margin. *Inflorescences* axillary, together pseudoterminal, thyrsoid, glabrescent, ♂ ones 10—25 cm long, ♀ ones 5—18 cm; main branches up to 4½ cm long, in ♂ ones many-flowered, in ♀ ones 3—5-flowered. *Flowers* subsessile, pubescent, ♂ 2½—4 mm long; ♀ 6—8 mm, with a concave receptacle. *Calyx* ♂ 1½ mm high, ♀ 5 mm. *Stamens* glabrous, ♂ 6—3, free, ♀ 6, slightly connate at the base. *Disk* ♂ cushion-shaped, flat, solid, ⅓ mm high, densely tomentose; ♀ adnate to the receptacle, with a free rim, glabrous. *Pistil* ♂ none, ♀ pilose. *Infructescences* 4—10 cm long, glabrous, with 1—4 fruits; calyx flat, bluntly triangular, 10—12 mm diam. *Fruits* shortly ovoid to ellipsoid, round to bluntly triangular in cross-section, 2½—3¾ by 1½—2 cm, glabrous; pyrene smooth; lids c. 2½ mm thick. *Seeds* 1(—2); sterile cells small.

Distribution: Philippines (Mindoro, Luzon, Alabat Isl., Masbate, Ticao Isl., Bohol).

PHILIPPINES. Mindoro: *FB. 4062 (Merritt); PNH. 19180 (Conklin 723).* — Luzon: *Ahern 63* (syntype *C. carapifolium* Perkins); *Ahern's coll. Dec. Philipp. For. Flora 160; BS. 22482 (Ramos & Deroy); Calléry 63 bis, s.n.* (type *C. triandrum* Engl.); *Elmer 17803, 18207; FB. 1753 (Borden), 1990 (Ahern's coll.), 3271 (Ahern's coll.), 9623 (Zschokke), 12924 (Alvarez), 13140 (Bernardo), 15371 (Tamesis), 17511 (Curran), 23626 (Paraiso), 24213 (Barros), 30208 (Rabaya), 30209 (Rabaya), 30210 (Rabaya), 31261 (Paraiso); Loher 5859; Merrill 1894, 1898, 2010, 2610, 2624, Species Blancoanae 713* (neotype); *Vidal 696, 697, 698, 1342, 1345, 2292; Whitford 682, 856, 857, 879.* — Alabat Isl.: *BS. 47982 (Ramos & Edaño).* — Masbate: *FB. 2539 (Clark); Merrill 2615, 2618* (type *C. oliganthum* Merrill). — Ticao Isl.: *FB. 1070 (Clark); Vidal 2296.* — Bohol: *BS. 42649 (Ramos).*

Ecology: Common in primary forests at low and medium altitudes. *Fl.* (Apr.—) Aug.—Sept.(—Oct.), *fr.* (Aug.—)Jan.—Febr.(—May).

Wood anat.: Reyes, Dep. Agr. & Comm. Manila, Techn. Bull. 7 (1938) 161 (hand lens).

Uses. The timber, which is not very hard, is sometimes used. This tree is the principal source of *manila-elemi* (see Brown, *op. cit.* 40; Valenzuela *et al.*, Philip. J. For. 6, 1949, 54; Manalo & West, *l. c.*; Guenther, The essential oils, 4, 1950, 357; Quisumbing, *l. c.*). The seeds are eaten as *pili nuts*, though the main source of these is *C. ovatum*.

Note. This species is related to *C. vulgare* as well as to *C. ovatum*. The former does not occur in a wild state in the Philippines and is even rarely cultivated. The main differences between *C. luzonicum* and *C. ovatum* are: stipules orbicular, very caducous, and leaves rather thin in the former species, stipules persistent, acute, and stiff, and leaves stiff-coriaceous in the latter one. Moreover, the fruits of *C. ovatum* are usually much larger than those of *C. luzonicum*.

19. Canarium ovatum Engler, 1883, 110; Brown, 1921, 114, 300, f. 40; Merrill,1923, 352; Lam, 1932a, t. 12 f. 88, t. 15 f. 120b; 1932b, 533; Burkill, 1935, 431; Quisumbing, 1951, 476, 1036; Leenhouts, 1956, 271, f. 22 f. — *C. pachyphyllum* Perkins, 1904, 94. — *C. melioides* Elmer, 1911, 1079; Merrill, 1923, 351.

Type: Philippines, Luzon, Albany Prov., 1841, *Cuming 904*, ♂ (W; isotypes in BM, G, K, MEL, NY, P).

Tree up to 20 m by 50 cm. *Branchlets* 6—12 mm thick, glabrous, lenticellate; pith with many small vascular strands appressed to the wood. *Stipules* persistent, inserted on the petiole up to 6 mm from its base, deltoid to lingulate, 5—20 by 3—10 mm, acute, stiff-chartaceous, glabrescent. *Leaves* 2—4-jugate, glabrous. *Leaflets* ovate to elliptic, 4—24 by 2—12 cm, stiff-coriaceous; base oblique, (cuneate to) rounded to subcordate; margin entire; apex (rather) abruptly acuminate, acumen cuneate to long and slender, blunt; nerves 8—12 pairs (angle 60—90°), straight to faintly curved, rather abruptly or gradually arching at some distance from the margin. *Inflorescences* axillary, close together at the ends of the branches, narrowly thyrsoid to nearly racemose, 3—12 cm long, glabrescent, few-flowered; main branches decussate, up to 2½ cm, with up to 5 flowers. *Bracts* concave. *Flowers* (sub)sessile, pubescent, up to 12 mm long, ♀ ones with a slightly concave receptacle. *Calyx* ♂ 7 mm high; ♀ 8—9 mm. *Stamens* 6, glabrous, ♂

slightly adnate to the disk, ♀ inserted on the rim of the disk. *Disk* ♂ cylindrical, 3—3½ mm high, solid, densely tomentose, rim 6-lobed; ♀ adnate to the receptacle, with 6-lobed rim, glabrous. *Pistil* ♂ none, ♀ glabrous. *Infructescences* 3—9 cm long, with 1(—2) fruit(s); calyx flat, orbicular, 1¾—2 cm diam. *Fruits* ovoid to ellipsoid, acute, triangular in cross-section, 3½—6¼ by 2—2¾ cm, glabrous; pyrene triangular in cross-section, the sides slightly furrowed, angle-ribs rounded except at the acute base and apex; lids 1½—2 mm thick. *Seed* 1; sterile cells strongly reduced.

Distribution: Philippines (S. Luzon, Polillo, Samar, Leyte, Mindanao). Sometimes cultivated, also in other parts of Malaysia and in Micronesia and Melanesia.

PHILIPPINES. Luzon: *Britton 79; BS. 22158 (Ramos), 29007 (Ramos & Edaño); Cuming 904* (type); *Elmer 14472; FB. 10526 (Curran), 14290 (Aguilar), 24607 (Bawan), 25494 (Aguilar), 25514 (Cenabre), 25645 (Cailipan); Hagger Dec. Phil. For. Flora 287; Merrill 2067* (paratype *C. pachyphyllum* Perk.); *PNH. 381 (Gonzalez), 18527 (Mendoza 1520); Vidal 160, 694, 695, 699, 1335.* — Leyte: *Wenzel 1284.* — Mindanao: *Elmer 11007* (type *C. melioides* Elm.); *Wenzel 3092.*

cultivated:

Fénix 274; Llehua 71; Loher 432; NBFD. A 648 (Keith), A 4204 (Wood & Wyatt-Smith).

Ecology: Primary forests, up to 500 m. *Fl.* May—July, *fr.* Oct.—Dec.(—June).

Uses. One of the sources of *manila-elemi* (together with *C. luzonicum*) and the main source of *pili nuts*, which are used as almonds, and of *pilinut oil* (Brown, *l. c.*; Burk. *l. c.*; Quis. *l. c.*) and *pili-pulp oil* (L. T. Marañon *et al.*, Philip. J. Sc. 83, 1955, 359).

Note. Related to *C. luzonicum*; specially characterized by its stiff, lingulate, persistent stipules.

20. Canarium odontophyllum Miquel, 1861, 525; 1869, 117; Engler, 1883, 108; Lam, 1929, 118; 1932a, f. 122b; 1932b, 519, f. 89; Leenhouts, 1956, 271, f. 22i. — *C. beccarii* Engler, 1883, 107. — *C. palawanense* Elmer, 1913, 1754. — *C. multifidum* Lam, 1932a, 215, f. 122c; 1932b, 520.

Type: Sumatra, W. coast, Rau, *Teysmann HB 692*, st. (U; isotype in L).

Tree, up to 35 m high, up to 50 cm in diam., with buttresses. *Branchlets* ¾—3 cm thick, densely rusty tomentose, often glabrescent; pith with a peripheral cylinder of many small vascular strands. *Stipules* persistent, inserted near or on the base of the petiole, orbicular and dentate to oblong and repeatedly slit into 2—4 cm long lobes, specially at the base and apex, 2—9 by 1½—3½ cm, minutely tomentose, subglabrescent, nervation coarse, anastomosing. *Leaves* 3—8-jugate. *Leaflets* oblong to lanceolate, 15—40 by 5—10 cm, coriaceous, sparsely pilose to densely tomentose beneath and on the midrib above; base subequilateral, broadly cuneate to subcordate; margin dentate to serrate; apex abruptly, short and slender, acute-acuminate; nervation slightly sunken above, strongly prominent beneath; nerves 15—28 pairs (angle 55—65—90°), straight to faintly curved, gradually curving towards the margin, rarely distinctly arching; intermediate veins often strongly developed. *Inflorescences* axillary, together pseudo-terminal (some-

times truly terminal?), laxly thyrsoid, densely tomentose, ♂ ones 30—50 cm long, many-flowered, ♀ ones 15—20 cm long and with few flowers. *Bracts* often persistent, grading to the stipules. *Flowers* pubescent outside, ♂ 4—7 mm long, ♀ 8—9 mm, with a slightly hollowed receptacle. *Calyx* 3-parted, ♂ 2½—4½ mm high, ♀ 8 mm. *Stamens* glabrous, ♂ adnate to the disk, ♀ inserted on its rim. *Disk* glabrous, ♂ circular, flat, slightly concave in the centre, 6-lobed, ¼—1 mm high; ♀ adnate to the receptacle, rim 1 mm high, faintly 6-lobed. *Pistil* glabrous, in ♂ flowers strongly reduced to none. *Infructescences* mostly broadly thyrsoid, 20—35 cm long, densely tomentose, with up to 40 fruits; calyx saucer-shaped, triangular, about 1½ cm in diam. *Fruits* ovoid to ellipsoid, rounded triangular in cross-section, 2½—3½ by 1¾—2 cm, glabrous, ivory-white when fresh; pyrene smooth, faintly 3-ribbed; lids ½—2½ mm thick, bony. *Seed* 1; sterile cells more or less reduced.

Taxonomy. I have subdivided this rather variable species into 2 mutually grading forms, which partly exclude each other geographically, as follows:

a. forma **odontophyllum**. — *C. beccarii* Engl.

Stipules rather small, not deeply incised. Leaflets stiff-coriaceous, woolly-pubescent beneath, nervation waffle-like prominent (leaflets very similar to those of *C. littorale* f. *rufum*).

b. forma **multifidum** (H. J. Lam) Leenhouts, *nov. stat.* — *C. multifidum* H. J. Lam.

Type: Borneo, P. Laut, Sungeiparing, at low alt., *FRI. bb. 13255*, st. (BO) *n. v.*

Stipules large and deeply incised. Leaflets thinner, less pilose beneath and nervation less prominent.

Distribution: Sumatra, Borneo, and Palawan; f. *odontophyllum* is restricted to Sumatra and W. Borneo, f. *multifidum* to N. and E. Borneo, intermediates are known from N. and E. Borneo and Palawan.

SUMATRA. *Beumée A. 484* (a); *Teysmann HB 692* (type) (a), *HB 3862* (a).
BORNEO. *Beccari PB 2790* (type *C. beccarii* Engl.) (a), *PB 3912* (a); *Dickson 7* (a); *Elmer 20975* (aff. b), *21228* (a—b); *Endert 4718* (a—b); *FRI. bb. 16161* (b), *bb. 16164* (b), *bb. 19136 (v. d. Zwaan 1182)* (a—b); *Hose 171* (a); *Kostermans 5105* (b), *6904* (b), *6942* (b), *6969* (b); *NBFD. 4436 (Castro)* (b), *4590 (Puasa)* (a—b), *4593 (Clemente)* (a—b), *9444 (Agama & Valera)* (b), *A 3961 (Wood)* (a—b), *SAN 16088 (Wood)* (a—b).
PALAWAN. *Elmer 12889* (type *C. palawanense* Elm.) (a—b).

Ecology: In primary forests, up to 450 m. *Fl.* March—April and Sept.—Oct., *fr.* May—Nov.

Uses. Wood rather soft and of little use. Seeds edible.

Notes. Taxonomy and geography. The present species, especially f. *odontophyllum*, is close to *C. littorale* f. *rufum*; the leaflets are quite identic, the stipules are similar, though slightly larger; *C. odontophyllum* differs, however, by its axillary inflorescences (in this character it is possibly more primitive than *C. littorale*), by the differently shaped disk in the ♂ flowers, and by the smaller and less variable fruits. On the other side, there is doubtless a close relationship to *C. denticulatum*,

which, however, is much more slender in its habit, and possesses quite differently shaped stipules.

Forma *multifidum* is a very peculiar form, especially characterized by its stipules. In my opinion, f. *odontophyllum* represents the more primitive, f. *multifidum* the more advanced form of the species. If this is correct, the centre of origin of the species would possibly be in Sumatra, and its taxonomic source somewhere near *C. littorale* f. *rufum* (Sumatra and the Malay Peninsula).

Nomenclature: The type-specimen of the species is rather poor, it is sterile and the stipules are damaged; therefore its conspecificy with the other specimens, mentioned above, is not even beyond any doubt. For the time being, however, I preferred to maintain the current interpretation.

21. Canarium denticulatum Blume, 1826, 1162; Roemer & Schultes, 1830, 1623; Blume, 1850, 217, *incl.* also *var. latifolia*; Miquel, 1859, 644; Engler, 1883, 136; Koorders & Valeton, 1896, 39; Backer, 1911, 197; Koorders, 1912, 434; Ridley, 1922, 374; Heyne, 1927, 876; Lam, 1932a, f. 70, 104h, 123a, b and c; 1932b, 521, f. 90; 1948, 6; Leenhouts, 1956, 272, f. 21j, 22k, 37. — *C. sylvestre* (*non* Gaertn.) Blume, 1850, 217; Miquel, 1859, 644; 1861, 205; Engler, 1883, 114. — *C. fissistipulum* Miquel, 1861, 525; Engler, 1883, 115; Lam, 1932b, 524. — *C. spectabile* Miquel, 1869, 116; Engler, 1883, 147. — *C. coccineo-bracteatum* Kurz, (1870, 33, 67, *nom. nud.*) 1872, 296; Bennett, 1875a, 536; 1875b, 104; Kurz, 1877, 209; Engler, 1883, 149; King, 1894b, 246; Parkinson, 1923, 116. — *C. fuscum* Engler, 1883, 116; Koorders & Valeton, 1896, 47; Robinson, 1908, 185; Backer, 1911, 197; Koorders, 1912, 434. — *C. kunstleri* King, 1894b, 248. — *C. laciniatum* Elmer, 1911, 1084; Merrill, 1923, 350. — *C. elmeri* Merrill *ex* Lam, 1932b, 524, *in syn.*

Type: Java, Salak, *Blume 743*, st., lectotype (L).

Tree, 12—30(—50) m high, 30—80 cm in diam., sometimes with low buttresses, rarely a shrub. *Branchlets* 3—8 mm thick, minutely tomentose, usually glabrescent, sometimes lenticellate; pith with many small vascular strands, arranged into 1 or 2 peripheral cylinders. *Leaves* 2—6-jugate. *Stipules* persistent (to caducous), inserted on the petiole (0—)3—6 mm from the base, pectinate to dendriform, (½—)1—2½(—4) by ¾—1½ cm, minutely tomentose. *Leaflets* inequilateral, ovate to lanceolate, 5—20 by 2—15 cm, stiff-herbaceous to coriaceous, glabrous (rarely pilose); base cuneate to rounded or cordate, usually slightly oblique; margin entire to dentate or serrate; apex acuminate, acumen short and blunt to slender and acute; nerves 9—21 pairs (angle 65—85°), faintly curved, usually distinctly arching near the margin. *Inflorescences* axillary, together pseudo-terminal, rarely truly terminal, laxly thyrsoid, 12—35 cm long, densely (rarely sparsely) rusty tomentose; *bracts* lanceolate, grading to the stipules. *Flowers* densely pubescent, ♂ 4—5 mm, ♀ 7—8 mm, the latter with a concave receptacle. *Calyx* ♂ 3—4 mm high, ♀ 5—6 mm. *Stamens* glabrous, ♂ more or less adnate to the disk, ♀ inserted on the disk. *Disk* glabrous, in ♂ flowers annular, lobed, in ♀ flowers adnate to the receptacle except a low rim. *Pistil* glabrous, more or less stalked, in ♂ flowers strongly reduced. *Infructescences* densely tomentose, with up to 10 fruits; calyx

broadly funnel-shaped, triangular, 12—14 mm diam. *Fruits* ellipsoid to ovoid or obovoid, rounded triangular in cross-section, 2½—3 by 1¼—1½ cm, glabrous; pyrene smooth; lids 1—1½ mm thick. *Seeds* (3—)1; sterile cells strongly reduced, often without a lumen.

Distribution: S. Andamans, S. Burma, Sumatra, the Malay Peninsula, Java, Borneo, and the Philippines.

Ecology: Rain forests, up to 700 m. *Fl.* mainly June—Sept., *fr.* mainly May—Nov.

KEY TO THE INFRASPECIFIC TAXA

1.a. Leaflets tomentose beneath, sometimes subglabrescent; the margin entirely serrate to dentate. *Borneo* . . . . . subsp. **kostermansii**
b. Leaflets glabrous; margin entire to partly (rarely entirely) dentate. *Whole area* subsp. **denticulatum** 2
2.a. Nerves (14—)16—17(—21) pairs; lobes of the stipules broad; leaves 4—6-jugate; habit coarse. *Area as the species, S. Burma excepted* . . . f. **denticulatum**
b. Nerves (9—)11—12(—14) pairs; lobes of the stipules subulate; leaves 2—4-jugate; habit more slender. *Sumatra, Banka, Borneo* . . . . f. **fissistipulum**

A. Subsp. **denticulatum**. — All synonyms.

Branchlets usually glabrescent. Leaves glabrous. Stipules persistent, inserted on the petiole, up to 6 mm from its base. Leaflets coriaceous; base oblique, rounded; margin entire to sparsely dentate towards the apex (rarely entirely dentate); apex subabruptly, long acute-acuminate. Inflorescences nearly always axillary, together pseudo-terminal, up to 25 cm long. Disk in ♂ flowers annular, 12-lobed, ¾ mm high, fleshy. Pistil not or slightly stalked, in ♂ flowers ¼—½ mm high. Calyx in fruit broadly funnel-shaped, triangular, 12—14 mm in diam. Seeds (3—)1; fertile cells circular to triangular in cross-section, sterile cells strongly reduced.

Subsp. *denticulatum*, which occupies the whole area of the species, is somewhat variable, above all in its vegetative parts. For most of the specimens it is possible to distinguish between the two following forms, which partly exclude each other geographically:

a. forma **denticulatum**. — *C. denticulatum* Bl. *incl.* also *var. latifolia* Bl. — *C. spectabile* Miq. — *C. fuscum* Engl. — *C. kunstleri* King. — *C. laciniatum* Elm.

Tree, 20—30(—50) m high, 40—80 cm in diam. In all parts rather coarse form. Leaves 4—6-jugate. Stipules pectinate, 1—2½(—4) cm long, the lobes broad, laciniate. Leaflets rather dull; nerves (14—)16—17(—21) pairs, moderately prominent beneath.

b. forma **fissistipulum** (Miq.) Leenhouts, *nov. stat.* — *C. sylvestre* Auct. — *C. fissistipulum* Miq.

Type: Sumatra, Lampongs, Tarabangie, *Teysmann HB 4415*, fr. (U; isotypes in BRSL, K, L).

Tree, 15—25(—32) m high, 30 cm in diam., sometimes a shrub. In all parts more slender. Leaves 2—4-jugate. Stipules dendriform, usually slightly smaller than in f. *denticulatum*, the lobes subulate. Leaflets shining; nerves (9—)11—12(—14) pairs, slightly sunken above, rather prominent beneath, distinctly arching, veins less conspicuous than in f. *denticulatum*. Inflorescences more lax than in the former.

Distribution: f. *denticulatum*: S. Andamans, Sumatra (also Simalur), Malay Peninsula (Perak), Java, Borneo (very rare), Philippines (Basilan and Mindanao); f. *fissistipulum*: Sumatra, Banka, and Borneo; intermediate specimens: S. Andamans, Sumatra, S. Burma, Malay Peninsula, and Borneo.

ANDAMANS. *King's coll. in herb. L 898.319—142* (a), *in herb. CAL 78275* (a), *in herb. CAL 78276* (aff. a); *Kurz in herb. CAL 78277* (syntype *C. coccineo-bracteatum* Kurz) (aff. b); *Prain's coll. 59* (a), *91* (aff. a).

BURMA. *Parkinson 1963* (a—b).

THAILAND. *Kerr 11687* (a—b).

SUMATRA. *Diepenhorst HB 2515* (type *C. spectabile* Miq.) (a); *Engles-Julius 13* (a—b); *Forbes 3156* (b); *FRI. bb. 2529 (Pieters)* (a), *bb. 3148* (a), *bb. 7394* (a), *bb. 15437* (a), *bb. 18598 (Djabar 25/V-1(* (a), *bb. 31605* (a), *bb. 32011* (aff. b), *bb. 32992 (Kidjam Ginting Soegihan 2)* (a), *T 3 P 353* (b), *T 3 P 410* (b), *TB. 478* (a); *Grashoff 182* (b); *Lambach 1349* (b); *Pringo Atmodjo 427* (a); *Van Steenis 9803* (aff. b); *Teysmann HB 4415* (type *C. fissistipulum Miq.*) (b). — Simalur: *Achmad 524* (a), *574* (a), *1278* (a), *1299* (a), *1305* (a), *1362* (a). — Banka: *Anta 1198* (b), *1026* (b).

MALAY PENINSULA. *Curtis 2710* (syntype *C. kunstleri* King) (a); *KEP. 69016* (a); *King's coll. 7041* (syntype *C. kunstleri* King) (a), *7393* (syntype *C. kunstleri* King) (a), *7509* (lectotype *C. kunstleri* King) (a); *SF. 35195 (Kiah)* (aff. b).

JAVA. *Den Berger 707* (a); *Beumée 4489* (a), *6076* (a), *6076a* (a); *Blume 742* (a), *742a* (a), *743* (lectotype) (a), *in herb. L 898.319—192* (a); *van Borssum Waalkes 570* (a); *Houtsoorten Gedeh 576* (a); *Koorders* (all -numbers) *926* (a), *927* (a), *928* (a), *929* (a), *930* (a), *931* (a), *932* (a), *933* (a), *934* (a), *935* (a), *936* (a), *937* (a), *938* (a), *939* (a), *940* (a), *942* (a), *968* (a), *972* (a), *980* (a), *981* (a), *12166* (a), *13304* (a), *13385* (a), *13433* (a), *14041* (a), *20066* (a), *21899* (a), *24158* (a), *24609* (a), *25514* (a), *29170* (a), *34151* (a), *36764* (a); *Unknown coll. in herb. L 898.319—193* (a), *in herb. L 898.319—200* (type *C. denticulatum var. latifolia* Bl.) (a).

BORNEO. *Clemens 7009 (Sar. mus. 20187)* (aff. b), *7369 (Sar. mus. 22187)* (b); *Elmer 20575* (b), *20959* (b), *21145* (b), *21251* (b), *21614* (b); *Endert 5117* (b), *5407* (b); *Jaheri 820* (b), *1022* (b), *1182* (b); *KEP. 80502 (Wyatt-Smith)* (b); *NBFD. 1731 (Puasa)* (b), *3992 (Agama)* (b), *4539 (Puasa)* (b), *4628* (aff. b), *4781 (Otik)* (b), *7073 (Balajadia)* (b), *7098* (b), *8825 (Enggoh)* (aff. b), *9301 (Keith)* (b), *A 527 (Castro)* (aff. b), *A 793* (b), *A 801* (b), *A 851* (b), *SAN 15392 (Wood & Charington)*, *SAN 16001 (Wood)* (b), *SAN 16294 (Wood)* (a), *SAN 16548* (b), *SAN A 4667 (Wood)* (b), *SH 8825 (Enggoh)* (a—b), *SH 10628 (Puasa & Enggoh)* (b); *SF. 27177 (Carr)* (a—b); *D. D. Wood 2270* (b).

PHILIPPINES. Basilan: *FB. 18843 (Miranda)* (a); *Vidal 2286* (a). — Mindanao: *BS. 83501 (Ramos & Convocar 143)* (a), *83615 (Ramos & Convocar 403)* (a); *Elmer 11122* (type *C. laciniatum* Elmer) (a), *13291* (a); *FB. 13279 (Foxworthy c.s.)* (a), *20742 (Rafael & Ponce)* (a); *Wenzel 2635* (a); *Williams 2181* (a), *2870* (a).

locality unknown:

Unknown coll. in herb. L 898.319—209 (type *C. fuscum* Engler) (a).

Wood anat.: See Moll & Janssonius, Mikrogr. d. Holzes 2, 1908, 107.

B. Subsp. **kostermansii** Leenhouts, 1955b, 181; 1956, 272.

Type: E. Borneo, Sangkulirang Subdiv., Sg Menubar reg., alt. 30 m, June 15, 1951, *Kostermans 5226*, ♀ (L; isotypes in BM, BO, K).

All parts long remaining ferruginous pubescent. Leaves 2—4-jugate. Stipules as in f. *denticulatum*. Leaflets stiff-herbaceous, densely pubescent beneath and on the midrib above, more or less glabrescent; base nearly equilateral, rounded to broadly cuneate; the whole margin densely serrate (to dentate); apex gradually acuminate, acumen short and slender; nerves (14—)18—20 pairs, less distinctly arching than in the foregoing subsp. Inflorescences up to 35 cm long, lax and many-flowered.

Distribution: East Borneo.

BORNEO. *FRI. bb. 10751* (paratype), *bb. 12237* (paratype); *Kostermans 5112* (paratype), *5226* (type), *5300* (paratype), *5395* (paratype), *5907* (paratype), *5921* (paratype).

Taxonomy. The present species is especially closely related to *C. odontophyllum* and *megalanthum*, which are both distinctly more coarse in habit; moreover the former is different by the strongly prominent nervation and venation and the dense tomentum on the lower side of the leaflets, the second one by its exceptionally large flowers.

Furthermore, the present species seems to be related to *C. manii*; from the latter it is distinctly different, however, by its deeply incised stipules and its nearly exclusively axillary inflorescences.

Geography. Noteworthy is the geographical position of both forms of subsp. *denticulatum*. The area of f. *denticulatum* seems to be disjunct; the gap which is formed by Borneo (except for one specimen in the north, and some intermediate specimens) is filled up by f. *fissistipulum* (which possibly is the more evolved one, according to its stipules, and as it is in general more different from the related species).

22. Canarium karoense H. J. Lam, 1932a, 215, t. 15 f. 120a; 1932b, 514, t. 13 f. 87; Leenhouts, 1956, 274.

Type: Sumatra, E. coast, Karolands, Lao Pengulu, Dec. 18, 1927, *FRI. bb. 12512*, ♀ (BO; isotype in L).

Tree. *Branchlets c.* 1 cm thick, minutely tomentose, glabrescent; pith with a number of peripherally arranged small vascular strands. *Stipules* persistent, inserted partly or entirely on the base of the petiole, ovate to lanceolate, coarsely pectinate, 1½—5 by 1½—3 cm, subcoriaceous, glabrous, lobes blunt, nervation anastomosing. *Leaves* 4—7-jugate, glabrescent. *Leaflets* ovate to oblong, 8—22 by 4—8 cm, subcoriaceous, glabrous; base broadly cuneate to rounded; margin entire; apex subabruptly, short- and blunt-acuminate; nerves 10—15 pairs (angle 55—70°), curving, not distinctly arching. *Inflorescences* (♂ unknown) axillary, narrowly thyrsoid to racemose, 5—9 cm long, tomentose. *Flowers* unknown. *Calyx* in very young fruits 12 mm high, tomentose. *Stamens* and *disk* unknown. *Pistil* glabrous, stalked. *Infructescences* and *fruits* unknown.

Distribution: Sumatra.

SUMATRA. *FRI. bb. 12512* (type).

Ecology: Frequent in old forests, altitude unknown. *Fl.* Nov.—Dec.

Note. Possibly conspecific with *C. megalanthum*.

23. Canarium megalanthum Merrill, 1926a, 81; Lam, 1932a, t. 11 f. 68, t. 16 f. 127 d 1; 1932b, 446, t. 9 f. 55; Leenhouts, 1956, 274, f. 22j. — *Fig. 17.*

Type: North Borneo, near Weston, at low alt., March 1924, *Wood 1213*, ♀ (UC; isotypes in A, K, L).

Tree up to 40 m by 60—70 cm, without buttresses. *Branchlets* ½—1 cm diam., rusty-tomentose; pith with a peripheral cylinder of scattered vascular strands. *Stipules* subpersistent, inserted on the petiole at ¼—¾ (—3) cm from its base, 6—8 by 10—20 mm, deeply 3—4-lobed, stiff, densely and minutely fulvous-tomentose. *Leaves* (3—)4—5-jugate. *Leaflets*

obovate, lanceolate or oblong, 9—20 by 4½—8½ cm, coriaceous, glabrescent; base oblique, cuneate to cordate; margin entire; apex gradually to abruptly, shortly and slenderly acute-acuminate; nerves (10—)13—19 pairs (angle

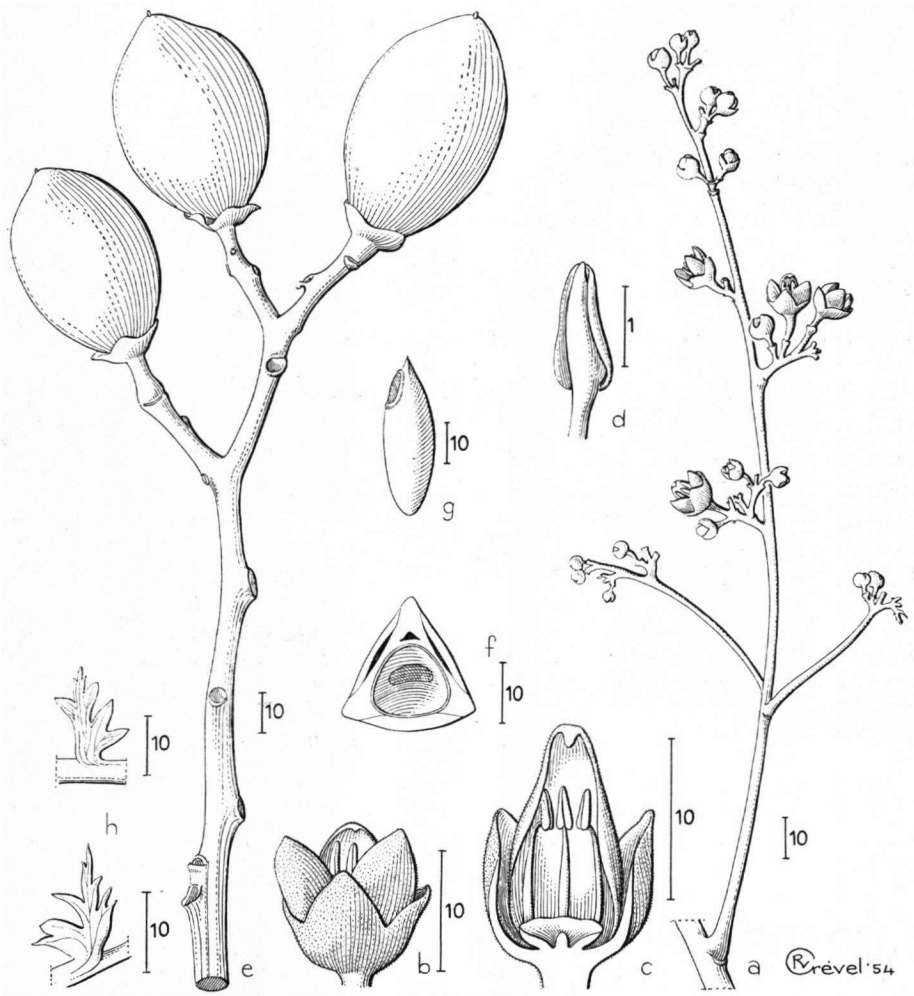


Fig. 17. *C. megalanthum* — a. ♂ inflorescence; b. ♂ flower; c. ditto in section; d. anther from dorsal; e. infructescence; f. pyrene in cross-section; g. seed; h. stipules. (a—d & h. from *Beccari PS 686;* e—g. from *SF. 21916*) (dimensions in mm).

60—70°), faintly curved, abruptly, usually distinctly, arching close to the margin. *Inflorescences* pseudoterminal to terminal, terminal ones broadly and laxly thyrsoid, 25 cm long (♀), main branches up to 9 cm, with few flowers; pseudoterminal ones narrowly thyrsoid, 25—30 cm long (♂), main branches 6—11 cm, thyrsoid, c. 10-flowered; minutely tomentose. *Flowers* pubescent, ♂ 8—11 mm, ♀ 13—15 mm. *Calyx* broadly cupular, ♂ 7 mm,

♀ 9 mm. *Corolla* ♀ pubescent at both sides, ♂ inside glabrous. *Stamens* adnate to the disk, filaments glabrous. *Disk* glabrous, ♂ saucer-shaped, 1 mm high, rim undulate; ♀ cupular, 2½—3 mm high, truncate. *Pistil* long-pilose; ♂ none. *Infructescences* c. 25 cm long, sparsely tomentose, with 4—5 fruits; calyx saucer-shaped, 3-lobed, 2—2½ cm diam. *Fruits* ellipsoid, sometimes acute, bluntly triangular in cross-section, 5—5½ by 3½—4 cm, sparsely, near the apex densely, ferruginously tomentose; pyrene smooth with 3, blunt to acute, angle-ribs, specially near the apex; lids 1—2 mm thick. *Seed* 1, spindle-shaped, acuminate at base, 4 by 1½ cm; fertile cell in cross-section circular, 1½ cm diam., sterile cells strongly reduced, without lumen.

Distribution: Sumatra, Malay Peninsula, Borneo.

SUMATRA. *Beccari PS 686.*

MALAY PENINSULA. *KEP. 45015 (Symington), 65589 (Cousens); SF. 21916 (Henderson).*

BORNEO. *Dario A 3359; KEP. 35517 (Symington); Kostermans 7097; NBFD. 4844 (Puasa), SAN 16341 (Wood); D. D. Wood 1213* (type).

Ecology: Rain-forests, up to 360 m. *Fl.* Sum.: Aug., Borneo: March—May, *fr.* May—July.

Uses. The wood is said to be hard. In Brunei this species is cultivated for its edible seeds which are among the largest of this genus. The resin is said to be abundant.

Notes. A rather remarkable species, without any doubt related to *C. denticulatum,* and possibly conspecific with the insufficiently known *C. karoense.*

Characterized by its rather large flowers and fruits; moreover, specimens in the herbarium often show black resin on the branches and the fruits, like in many *Anacardiaceae,* a feature which is very rare in *Burseraceae.*

24. Canarium manii King, 1894b, 247; Parkinson, 1923, 116. — *Fig. 18.*

Type: S. Andamans, Hobdaypore and Iusonabad, July 12, 1890, *King s.n. in herb. CAL 78302,* fr., lectotype (CAL; isotypes in BM, K).

Medium-sized to large deciduous tree. *Branchlets* 3—5 mm thick, scabrous, lenticellate, minutely pubescent, glabrescent, leaf-scars prominent; pith with a peripheral cylinder of vascular strands. *Leaves* 2—4-jugate. *Stipules* very caducous, inserted on the petiole 3—13 mm from its base, orbicular, c. 6 mm diam., leaving a distinct, drop-shaped scar. *Leaflets* ovate-lanceolate, the terminal ones elliptic, 8—14 by 3½—7 cm, thin coriaceous, glabrous; base of laterals slightly oblique, cuneate to cordate; margin entire, slightly revolute; apex rather abruptly acuminate, acumen slender, 8—15 mm long, blunt; nerves 9—12 pairs (angle 65—80°), basal ones sinuate, all others faintly curved to nearly straight, interarching close to the margin. *Inflorescences* terminal, thinly minutely pubescent, ♂ ones thyrsoid, 10—12 cm long, branches —4 cm long, ♀ ones subracemose, c. 7 cm long, branches —2½ cm long; bracts orbicular to lanceolate. *Flowers* densely pubescent, the ♂ ones 4—5 mm long, ♀ ones 7—8 mm, receptacle of the latter up to 1½ mm deep. *Calyx* in ♂ flowers c. 1 mm,

in ♀ flowers 5—6 mm. *Stamens* 6, glabrous, ♂ slightly confluent at the base, ♀ inserted on the margin of the disk. *Disk* glabrous, in ♂ flowers rather variable, always strongly developed, solid and conical or with a narrow central canal, in ♀ flowers connate with the receptacle except the margin. *Pistil* glabrous, distinctly stalked, in ♂ flowers absent. *Infructescences* with 1—2 fruits; the calyx flat, faintly 3-lobed, c. 9 mm in diam. *Fruits* ovate to obovate, elliptic to blunt-triangular in cross-section, 27—30 by 14—16 mm, glabrous, papillose; pyrene smooth; lids 2—3 mm thick. *Seed* 1; the fertile cell inside with a distinct peripheral rib; sterile cells strongly reduced.

Distribution: Middle and South Andaman.

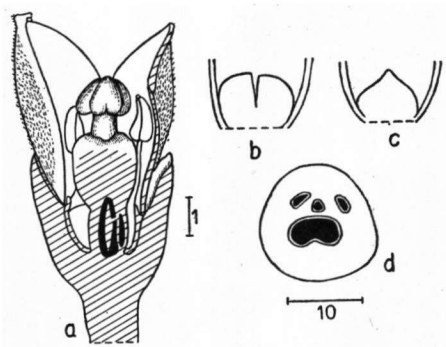


Fig. 18. *C. manii* — a. longitudinal section of ♀ flower; b. and c. longitudinal sections of pistilloid in ♂ flower; d. pyrene in cross-section. (a. from *Parkinson 1137;* the other figures from unnumbered specimens) (dimensions in mm).

ANDAMANS. Middle Andaman: *Parkinson 19, 1137.* — South Andaman: *King s.n. in herb. CAL 78301* (syntype), *78302* (lectotype), *78304, 78305, 78307, 78308* (all syntypes); *King's coll. in herb. CAL 78303, 78306* (syntype), *78309* (syntype). — Rutland Island: *Parkinson 1080.*

Ecology: Not uncommon; jungle with *Podocarpus neriifolia* Don and *Dipterocarpus* spp., at sea-level as well as on high hills. *Fl.* Febr.—April, *fr.* April—July.

Notes. This species seems to be related both to *C. denticulatum* and particularly to *C. zeylanicum.* From the former it distinctly differs by its not incised stipules and its terminal inflorescences; from the latter by its narrower leaflets, which are moreover shining on the upper surface, by its more lax nervation (since the intermediate veins are not strongly developed), by its more lax ♂ inflorescences, by its not acuminate anthers, by the disk in the ♂ flowers being not always solid (as apparently is the case in *C. zeylanicum*), and by its smaller fruits and calyces in fruit.

25. Canarium zeylanicum (Retz.) Blume, 1850, 218; Thwaites, 1858, 79; Beddome, 1871, t. 128; Bennett, 1875a, 532; 1875b, 103; Engler, 1883, 113, t. 3 f. 1—2, *excl. syn. C. commune Wight et Arnott*; Potter, 1891, t. 46 f. 4; Trimen, 1893, 239; Volkens, 1898, 168; Stepowski, 1905, 26,

f. 9—13; Merrill, 1917, 304; Lewis, 1926, 15; Petch, 1930, 282; Fischer, 1932, 53; Leenhouts, 1956, 262, f. 25. — *Kaekuriaghaha* Hermann, 1717, 52; Burmann, 1737, 28, *excl. syn. Hort. Malab. and Plukenett*; Linné, 1748, 234. — *Kaekuriaghaha odorata* Burmann, 1741, 153. — *Amyris zeylanica* Retzius, 1786, 25; Willdenow, 1799, 337; Kunth, 1824, 349, *sub. gen. Balsamodendron*; Sprengel, 1825, 218. — *C. balsamiferum* (*non* Willd.) Moon, 1824, 68. — *Balsamodendron zeylanicum* Kunth *ex* De Candolle, 1825, 76. — *Colophonia zeylanica* Paxton, 1849, 139. — *C. auriculatum* Winkler, 1908, 279.

Type: Ceylon, *herb. Koenig s.n.*, y. fl. (LD).

Large, buttressed tree. *Branchlets* 4—6 mm thick, the young parts densely minutely fulvous-tomentose, more or less glabrescent, slightly lenticellate; pith reddish-brown, shining, usually with a peripheral cylinder of small vascular strands, sometimes with scattered large white idioblasts. *Leaves* 3—4-jugate. *Stipules* early caducous, inserted on the petiole at 4—11 mm from its base, orbicular, about 1 cm diam. *Leaflets* elliptic-obovate, 8—14 by 4—7½ cm, herbaceous to coriaceous, glabrous; base equal to slightly oblique, rounded to slightly cordate; margin entire, sometimes slightly undulated, in dried specimens often revolute; apex gradually to rather abruptly acuminate, acumen cuneate or slender, up to 1 cm long, blunt; nervation slightly sunken above, rather prominent beneath, nerves 12—14—18 pairs (angle 45—80°), faintly curved, abruptly, distinctly arching near the margin; intermediate veins often strongly developed. *Inflorescences* terminal, sparsely, minutely, fulvous-tomentose, ♂ ones thyrsoid, 14—20 cm long (28 cm long and very broadly thyrsoid in the type of *C. auriculatum*), with a long branch at the base, ♀ ones narrowly thyrsoid to racemose, 7 cm long, with about 8—10 flowers. *Flowers* tomentose, ♂ ones 5 mm, ♀ 8½ mm, receptacle of the latter cupular, 1½ mm deep. *Calyx* 3½ mm, sepals more than halfway connate. *Stamens* 6, free, glabrous. *Disk* glabrous, in ♂ flowers solid, 1 mm high, in ♀ ones adnate to the receptacle, sometimes with a faint free margin. *Pistil* stalked, glabrous, in ♂ flowers absent. *Infructescences* small, lenticellate, with about 4 fruits; calyx flat, faintly 3-lobed, 1¼ cm diam. *Fruits* obovoid, 4½ by 2 cm, glabrous; pyrene nearly smooth, circular in cross-section; lids up to 5 mm thick; 1—2-seeded, the fertile cell(s) with a strong abaxial median rib, sterile one(s) strongly reduced.

Distribution: Ceylon.

CEYLON. *Christison 494; Conservator of Forests, Kandy, in herb. DD 35828; Hügel 3703; herb. Koenig s.n.* (type *Amyris zeylanica* Retzius); *Koenig in herb. L 898.319—385; Thwaites CP 2649.*

CAMEROONS. *Winkler 1157* (type *C. auriculatum* Winkler), apparently naturalized.

cultivated:

The greater part of the specimens examined originated from trees, cultivated a. o. in the botanical gardens at Bogor (*VII B 13*), Calcutta (a. o. *Pierre 4241*), Peradeniya, and from Port of Spain, Trinidad (*Dean 13328*); moreover the species has been tested as a shade-tree in Victoria, Cameroons (*c. f.* Volkens, *l. c.*).

Ecology: "Warm moister parts of the island, up to an elevation of 1500 ft." (Thwaites, 1864); "most frequently found in shallow soil, often on mere crusts of earth overlying slab rock, or on ridges. The fruits are

eaten by mynas. Monkeys eat the fleshy exterior." (Lewis, 1926); "common." (Trimen, 1893). *Fl.* May—Sept. (March in Cameroons), *fr.* March.

Wood anat.: "Wood rather light and soft, even grained, white." (Trimen, 1893).

Uses. In the Cameroons used as a shade-tree in nutmeg-plantations (Volkens, 1898). Wood sometimes used for the manufacture of tea-boxes. Resin used for lighting; the smoke is reputed to drive away snakes. The seeds are eaten.

Taxonomy: Related to *C. paniculatum* from Mauritius, and to *C. manii* from the Andamans.

Nomenclature. Incorrectly, in Index Kewensis 1 the name "*Amyris elemifera* Koenig *ex* Blume, Mus. Bot. 1, 1850, 218" is mentioned as a synonym of the present species. Blume, *l. c.*, cited as a synonym of *C. zeylanicum* "*Amyris Elemifera* (*haud* Linn.) Herb. Koenig.", which refers to a manuscript note on Koenig's specimen at Leyden.

Likewise Engler, *l. c.*, erroneously cited "*Canarium commune* Wight et Arnott, Prod., 1834, 175" as synonymous with the present species. From the original publication it is evident, that the combination just quoted never has been intended to be published as a new species, but as an interpretation of *C. commune* L.; according to the description *C. vulgare* Leenh. has been meant; the synonymy is very broad and includes moreover *C. zeylanicum* and *C. paniculatum*.

26. Canarium paniculatum (Lamk) Bentham *ex* Engler, 1883, 124; Guillaumin, 1909d, 140. — *Bursera paniculata* Lamarck, 1786, 768; Du Petit-Thouars, 1811, 40. — *Colophonia mauritiana* De Candolle, 1825, 79; Delessert, 1837, t. 56. — *C. mauritianum* Blume, 1850, 217; Vaugham and Wiche, 1941, 127, pl. 4. — *C. colophonia* Baker, 1877, 44, *nom. illeg.*; F. G(leadow), 1905, 167, t. 13. — *Fig. 19.*

Type: Isle de France, *Commerson s. n.*, ♂ (P; isotypes in BM, FI, L).

Tree, 10—16 m high, up to 2 m in diam. *Branchlets* ½—1 cm thick, glabrous, rather gnarly, lenticellate, with crowded, prominent leaf-scars; pith usually with a peripheral cylinder of vascular strands. *Leaves* 2—6-jugate, glabrous. *Stipules* caducous, inserted on the base of the petiole, auricle-shaped, *c.* 2 mm, the scars prominent, drop-shaped. *Leaflets* broad-elliptic to broad-ovate, 7—13 by 4½—8 cm, chartaceous to subcoriaceous; base (truncate to) cordate (rounded in the terminal leaflet); margin entire; apex subabruptly acuminate, acumen short, broad, and blunt; nerves 9—12 pairs (angle about 65°), the basal ones sinuous, the other ones straight to faintly curved, abruptly, usually distinctly arching close to the margin. *Inflorescences* terminal, thyrsoid, ♂ ones 15—20 cm, scurfy, ♀ 12—15 cm, rather densely tomentose. *Flowers* tomentose, ♂ ones 6 mm, ♀ 7 mm, the latter with a hollowed receptacle. *Calyx* 2½—3½ mm high. *Stamens* 6, glabrous, in ♂ flowers free, in ♀ ones slightly confluent at base and inserted on the margin of the disk. *Disk* glabrous, in ♂ flowers solid, faintly 6-lobed, 1 mm high, in ♀ flowers adnate to the receptacle, without or with a very faint free margin. *Pistil* glabrous, stalked, in ♂ flowers absent. *Infructescences* about 18 cm, subracemose, with few fruits, especially the lower ones long-stalked; calyx flat, nearly orbicular, 1¼ cm diam. *Fruits*

Fig. 19. *C. paniculatum* — a. twig with ♀ inflorescence; b. ♂ inflorescence; c. ♂ flower; d. ditto in section; e. ♀ flower in section; f. ditto detail, pistil removed; g. infructescence; h. fruit-kernel; i. ditto, cross-section; j. calyx in fruit; k. leaflet, lower side. (all from unnumbered specimens) (dimensions in mm).

long-ovoid, 3¼ by 1¼—1½ cm, glabrous; pyrene faintly rugged; lids 2½—4 mm thick; 1-seeded, sterile cells nearly entirely reduced.

Distribution: Mauritius.

MAURITIUS. *Aublet s.n.; Ayres s.n.; Bijoux 275, 276, 277; Blackburn s.n.; Boivin s.n.; Commerson s.n.* (type); *Martin s.n.; Richard s.n.; Du Petit-Thouars s.n.; Vaugham 395.*

Ecology: Inland- and mountain forests, apparently still common, though nearly not regenerating (see also Vaugham and Wiche, *l. c.*). *Fl.* Nov., *fr.* Nov., Febr.

Uses. The timber (*bois de colophane*) and the resin (*Mauritius elemi*) are of some importance (*cf.* Heckel, Bull. Imper. Inst. 8, 1910, 11, and Guillaumin, Agric. prat. Pays chauds 9, 2, 1909, 47 respectively).

Notes. Morphology. Resin abundant, clear. Flowers purple.

Taxonomy: Related to *C. zeylanicum* and *C. madagascariense.*

Nomenclature. The name *Canarium colophonia* Baker is illegitimate, since two older synonyms, viz. *Bursera paniculata* Lamk and *Colophonia mauritiana* DC., were mentioned.

27. **Canarium madagascariense** Engler, 1883, 111; Baillon, 1892, t. 227; Guillaumin, 1909d, 139; Perrier de la Bâthie, 1944, 286; 1946, 43, f. 10. — ? *C. harami* Bojer, 1837, 83, *nom. nud.*; Guillaumin, 1909c, 47; 1909d, 140. — *C. boivinii* Engler, 1883, 110; Baillon, 1892, t. 228; Guillaumin, 1909c, 46; 1909d, 139; Perrier de la Bâthie, 1944, 286; 1946, 45. — *C. multiflorum* Engler, 1883, 128; Baillon, 1892, t. 229, 230; Guillaumin, 1909c, 47; 1909d, 139; Perrier de la Bâthie, 1921, 203. — *C. obtusifolium* S. Elliot, 1891, 10; Guillaumin, 1909d, 139. — *C. liebertianum* Engler, 1899, 270; 1915, 782; 1931, 446; Brenan & Greenway, 1949, 78. — *C. pulchre-bracteatum* Guillaumin, 1909b, 72; Perrier de la Bâthie, 1944, 286; 1946, 46.

Type: Madagascar, Nossi-Bé, 1840, *Richard 340,* ♂ (P).

Tree, about 12—30(—35) m high, 30—60 cm (—2 m) in diam., often buttressed. *Branchlets* 4—12 mm thick, glabrous or short fulvous-tomentose, glabrescent, moderately lenticellate; pith with a peripheral cylinder of some to many small vascular strands, and usually with in the central part some to many small vascular strands, scattered or forming a second cylinder. *Leaves* 2—9-jugate. *Stipules* (sub-)caducous, sometimes persistent, inserted on the petiole up to 2 cm from its base, auricle-shaped or orbicular, rarely lingulate, glabrous to minutely fulvous-tomentose; scars often prominent. *Leaflets* lanceolate, ovate, elliptic or obovate, 4—20 by 2½—10 cm, chartaceous to coriaceous, smooth or bullate, glabrous above except the sometimes minutely tomentose midrib, beneath glabrous to hispidly pilose on the nerves; base cuneate to cordate; margin entire; apex blunt or gradually to rather abruptly acuminate, acumen short, broad and blunt; nervation more or less prominent beneath, nerves 7—20 pairs (angle 65—85°), straight to faintly curved, distinctly arching. *Inflorescences* terminal and in the upper leaf-axils, racemose to broadly thyrsoid, 5—35 cm long, densely ferruginously tomentose to subglabrous. *Flowers* 3—12 mm, tomentose, in ♀ flowers the receptacle concave. *Calyx* 2—4 mm high. *Stamens* 6, more or less adnate to the disk. *Disk* in ♀ flowers sometimes minutely pubescent, adnate to the receptacle, the free rim faintly 6-lobed, in ♂ flowers cushion-shaped,

faintly 6-lobed, with a narrow central canal, glabrous. *Pistil* usually partly or entirely pilose; in ♂ flowers absent. *Infructescences* small to rather large, usually lax, the branches slender to coarse, with few to many fruits; calyx flat, orbicular, ¾—1½ cm diam. *Fruits* circular, rounded triangular or rounded 6-angular in cross-section, 2½—5½ by 1½—3¼ cm, nearly always pustular-lenticellate, usually tomentose when young; pericarp thick and fleshy; pyrene circular or rounded 3—6-angular in cross-section, usually smooth, near the base and apex with 3 angle-ribs and sometimes 3 faint median ribs; lids 2—4(—6) mm thick, bony; 1(—3)-seeded, the fertile cells with a strong abaxial median rib.

Distribution: East Africa: Tanganyika, Mozambique; Madagascar.

Taxonomy. The present species is an extremely variable one; in many characters it is possible to distinguish between some rather or even very different types, which are, however, usually not sharply delimited. These variable organs and their distinguishable types are:

Leaflets. Described under the subspecies, which are primarily based on the variations of the leaflets. The type of subsp. *bullatum* stands isolated; the types of subsp. *madagascariense* and *obtusifolium* are connected by many intergrades and they are probably mainly defined by the climate.

Inflorescences and *flowers.* As a whole the following types are clearly distinguishable:

♀ : (The differences between the three types seem to be far too great for subspecies, the more so as intermediates are unknown. However, the material is very scanty — only 6 specimens out of a total of about 100 — and none of the types shows a distinct correlation either with the ♂ flowers and inflorescences, or with the infructescences, or even with the vegetative parts. The variation of these characters deserves to be studied in the field, making use of more plentiful material.)

1. *Inflorescences* broadly thyrsoid, up to 25 cm long, densely ferruginously tomentose. *Flowers* 6—7 mm, minutely brown-tomentose. *Pistil* densely pilose except the stalk and the style. This type only occurs in subsp. *madagascariense.*

2. *Inflorescences* smaller, rather lax. *Flowers c.* 3 mm, minutely grey-tomentose. *Pistil* pilose. Restricted to subsp. *madagascariense.*

3. *Inflorescences* 5—10 cm, racemose to narrowly thyrsoid. *Flowers* 12 mm (in *C. pulchre-bracteatum* they are even described as being 17 mm, but I suspect this to be a printing error; the type-specimen has now no flowers at all), densely ferruginous-tomentose. *Pistil* pilose or glabrous. Neither geographically nor morphologically correlated, and therefore not restricted to any one of the subspecies.

♂ : 1. *Inflorescences* broadly thyrsoid, 15—30 cm long, glabrous except the minutely tomentose ultimate parts; branches oblique to transverse, up to 20 cm long, broadly paniculate, many florous; bracts lanceolate to subulate, 5 by ¾ mm (*Uersch herb. L 939.69—90*: elliptical, 4 by 2½ mm). *Flowers c.* 5 mm, minutely ferruginously to grey tomentose. *Stamens* slightly confluent to the disk (*Uersch as above*: adnate to the disk); anthers 1¾ and 1¼ mm, acute. *Disk* ¾ mm high. This type is restricted to subsp. *madagascariense.*

2. *Inflorescences* 20—35 cm, rather densely stellate tomentose; branches

few, transverse, up to 15 cm long, the flowers more or less clustered; bracts subulate to elliptic, 5 by 1—4 mm. *Flowers* 7 mm, rather densely ferruginously tomentose. *Stamens* adnate to the disk; anthers 2 mm, blunt. *Disk* 2 mm high. This type is restricted to subsp. *bullatum*.

3. *Inflorescences* paniculate, 10—15 cm long, sparsely brown tomentose; sometimes with a rather long branch in the upper leaf-axil, furthermore branches few, up to 2½ cm long, flowers clustered; bracts usually broadly elliptic to ovate, rather persistent, 6 mm long. *Flowers* 7—8 mm, densely ferruginously tomentose. Otherwise identical with type 2. This type is mainly to be found in subsp. *obtusifolium*.

Infructescences and *fruits*.

1. Sharply delimited are some specimens with smooth *fruits*, which are about globular to ellipsoid, 3 by 2 cm. *Infructescences* small and with few fruits; calyx flat, orbicular, 1½ cm in diam., thin. *Leaflets* usually not very large, coriaceous. This type is represented by the following specimens: *Humbert 20369, Perrier 14013, R. N. 28—51, Service forestier 854 & 2388*, all from the eastern part of Madagascar. Though this group is sharply delimited in its fruit characters, this is in my opinion not sufficient for basing a new taxon upon.

2. *Fruit* globular to ellipsoid, about 2½—3 by 1½—2 cm. *Infructescences* rather large, lax; the axes slender; calyx flat, thin, ¾ cm diam. This type is represented in subsp. *madagascariense* and *obtusifolium* and specimens, which are intermediate between these two. It is vaguely delimited against type 3.

3. Mainly differing from type 2 by the *fruits*, which are always more oblong (3—3½ by 1¾—2½ cm) and by the fruit-bearing calyx, in which the thin margin is sharply delimited against the central part, which is tapering into the pedicel. This type is to be found in specimens typical of or close to subsp. *madagascariense*.

4. Close to the types 2 and 3. *Fruits* globular to oblong, 3—4 by 2½ cm. *Infructescences* large and coarse, the axes thick, pedicels short and thick; calyx flat, rather thin, 1½ cm diam. This type is restricted to subsp. *bullatum*.

5. *Fruits* large, ellipsoid, 4—5½ by 2½—3¼ cm, often only partly pustular-lenticellate, sometimes with remainders of the indumentum. *Infructescences* large, the axes thick, as are the pedicels; calyx 1½—2 cm diam., the narrow, thin margin sharply delimited against the semiglobular, ½—¾ cm high, central part. This type is restricted to subsp. *obtusifolium*.

From the above it may be clear, that the variability of this species is considerable, and that regarding some organs it is even possible to distinguish between some very different types. As, however, most of these variations do not correlate at all, or only slightly, with each other, and as they are usually not geographically defined, it is in my opinion not justified to split up the present species into some, which would be only vaguely demarcated against each other.

Mainly on account of the leaf-characters, which correlate more or less with some of the variations in the male inflorescences and in the infructescences and fruits, and which are rather strictly geographically defined (very

probably as a consequence of the climatological differences between the western and the eastern part of Madagascar), I propose a subdivision of the species into 3 subspecies. I am quite aware, that this subdivision is a provisional one, which does not fully justice to the variability of the species, and that, if more material and more field-knowledge is available, possibly some of the variations mentioned above may prove to characterize distinct local populations, which must be valued as well-defined varieties or even taxa of higher rank; the same might be the case regarding some deviating specimens.

KEY TO THE SUBSPECIES

1.a. Leaves 4—6-jugate; leaflets 12—20 by 6—10 cm, subcoriaceous, bullate, pilose on the nerves below, the base distinctly cordate, the apex abruptly acuminate. Infructescences very coarse. *N.E. Madagascar* . . . . . subsp. **bullatum**

b. Leaves 3—9-jugate; leaflets usually smaller and especially narrower, nearly always glabrous, the base cuneate to faintly cordate, the apex (blunt to) gradually acuminate. Infructescences more slender . . . . . 2.

2.a. Leaves (3—)7—9-jugate, deciduous; leaflets ovate to elliptic, 8—15½ by 3—6 cm, stiff chartaceous, the base rounded to subcordate, the apex gradually long-acuminate. Inflorescences and infructescences large. *W. Madagascar & E. Africa* . . . . . subsp. **madagascariense**

b. Leaves 2—4-jugate, not deciduous; leaflets usually smaller, coriaceous; the base usually acute; the apex rounded or subabruptly minutely acuminate. Inflorescences rather small, narrowly paniculate, few-flowered. *E. Madagascar* subsp. **obtusifolium**

A. Subsp. **madagascariense** — *C. multiflorum* Engl. — *C. liebertianum* Engl.

Leaves deciduous, (3—)7—9-jugate, usually glabrous. Leaflets ovate to elliptic, 8—15½ by 3—6 cm, stiff-chartaceous to coriaceous, sometimes hispidly pilose on the midrib beneath and especially in the nerve-axils; base (acute to) rounded to faintly cordate; margin entire; apex gradually acuminate, acumen short, broad, and blunt; nerves 8—12(—14) pairs (angle 65—75°), mutual distance (½—)1—1½ cm, straight, gradually curved towards the margin, gradually arching at about 2 mm from the margin; veins transverse, rarely intermediate ones well-developed. Inflorescences and flowers ♂ type 1, ♀ type 1 and 2. Infructescences and fruits type 2 and 3.

Distribution: Tanganyika (*incl.* also Mafia island), Mozambique, and Madagascar (mainly the western part).

Ecology: Primary forests up to 1800 m; in continental Africa especially on sandy river banks. *Fl.* mainly Oct.—Nov., *fr.* mainly Jan.—Febr. and May.

B. Subsp. **obtusifolium** (S. Elliot) Leenhouts, *nov. stat.* — *C. obtusifolium* S. Elliot — *C. boivinii* (*non* Engl.) Perrier de la Bâthie, 1944 and 1946, *l. c.*

Type: Madagascar, Fort Dauphin, *Scott Elliot 2933*, ♂ (K).

Evergreen tree. Leaves 2—4-jugate, the petiole, rhachis, and petiolules often minutely tomentose. Leaflets obovate to broadly elliptic, 4—8 by 2½—3½ cm, stiff-coriaceous, glabrous; base cuneate, rarely rounded to subcordate; margin entire; apex rounded to faintly acuminate; nervation strongly prominent beneath, nerves 7—12 pairs (angle 80—85°), straight

to faintly curved, rather abruptly arching near the margin; veins usually transverse, rarely some intermediate ones well-developed; reticulations partly invisible. Inflorescences and flowers (♀ unknown) type 3. Infructescences and fruits type 5 and 2.

Distribution: Madagascar, mainly the eastern part.

Ecology: Primary forests up to 1800 m. *Fl.* Dec.—Jan., *fr.* the whole year, though possibly mainly in Sept.—Dec.

C. Subsp. **bullatum** Leenhouts, *nov. subsp.*

Foliola ovata ad lanceolata, 12—15 × 7—8 cm, subcoriacea, bullata, nervatione subtus breve pilosa; basis cordata; apex abrupte et breve obtuso-acuminata; nervatione subtus prominente, nervi utrimque 15—18, conspicue arcuatim conjuncti. Inflorescentiae (♂) late paniculatae, magnae, pauce-ramosae, tomentosae. Flores ♂ 5 mm longi, dense tomentosi.

Type: Madagascar, forêt d'Ambatosoratra, 8-1-1949, *Cours 3368*, ♂ (P).

Evergreen (?) tree. Leaves 4—6-jugate, the petiole, rhachis, and petiolules minutely tomentose. Leaflets subsessile, ovate to lanceolate, 12—20 by 6—10 cm, subcoriaceous, bullate, above glabrous except for the minutely tomentose midrib, beneath short hispidly pilose on the nerves; base cordate; apex rather abruptly acuminate, acumen up to 1 cm long, broad, and blunt; nervation sunken above, strongly prominent beneath, nerves 15—20 pairs (angle *c.* 75°), straight to faintly curved, gradually, distinctly arching; veins transverse, intermediate ones not strongly developed. Inflorescences and flowers (♀ unknown) type 2. Infructescences and fruits type 4.

Distribution: N.E. Madagascar, between 14 and 18° S.L.

Ecology: Forests up to 300 m. *Fl.* Jan., *fr.* Dec.

Note. This subspecies is in its vegetative parts rather different from the two other ones, and is not connected with them by intergrades (as are these two mutually), but since the differences in the flowers and fruits are only small, I deem it preferable for the time being to value it as a subspecies rather than as a species.

TANGANYIKA. *Holtz 1093* (a), *2490* (a). — Mafia isl.: *B.L. Institut Amani 5700* (a); *Greenway 5378* (a).

MOZAMBIQUE. *Godefroy-Lebeuf s.n.* (a).

MADAGASCAR. Western part: *Grevé 12* (syntype *C. multiflorum* Engl.) (a), *12a* (syntype *C. multiflorum* Engl.) (a), *74* (syntype *C. multiflorum* Engl.) (a); *Humbert 20369* (b); *Perrier de la Bâthie 605* (a), *787* (a), *787 bis*, *5853* (a), *5860* (a), *13833* (a); *Réserve National 11* (a), *31* (a), *1636* (b); *Scott Elliot 2933* (type *C. obtusifolium* S. Elliot) (b); *Service forestier 1550* (b), *2808* (a), *2845* (b), *3449* (a), *4122* (a), *4124* (a), *4444* (a), *5277* (a), *6093* (b), *6415* (b). — Eastern part: *d'Alleizette herb. 639* (aff. a), *in herb. L 951.54—176* (a); *Bernier 152 (= Chapelier 152)* (syntype *C. boivinii* Engl.) (a); *Boivin s.n.* (lectotype *C. boivinii* Engl.) (aff. a); *Cours 853* (b), *943* (b—a), *3368* (type *C. madagascariense ssp. bullatum* Leenh.) (c); *Decary 15273* (a); *Geay 7058* (b); *Humbert 22809* (paratype *C. madagascariense ssp. bullatum* Leenh.) (c); *Lam & Meeuse 6000* (aff. b); *Lowel 144* (aff. a); *Perrier de la Bâthie 5868* (a), *5869* (a—b), *5880* (a—b), *5881* (aff. a), *5884* (b—a), *6401* (a—b), *6402* (aff. b), *14013* (b), *14217* (b), *15481*, *18408* (aff. a); *Réserve National 1288* (a), *1950* (a—b), *2628* (b), *2851* (a), *4895* (a); *Richard 340* (type) (a); *Service forestier 684* (aff. b), *854* (b), *980* (a—b), *1125* (b), *1368* (a—b), *1902* (a), *2087* (b—a), *2088* (aff. b), *2089* (b—a), *2388* (b), *2389* (paratype *C. madagascariense ssp. bullatum* Leenh.) (c), *2570* (aff. c), *2639* (aff. b), *2660* (aff. b), *2994* (aff. b), *3329* (a—b), *3661* (aff. b),

3739 (aff. b), *4650* (aff. b), *4713* (b), *5119* (b), *5228* (b), *5594* (aff. b), *6112* (a), *6419* (paratype *C. madagascariense ssp. bullatum* Leenh.) (c); *Thouvenot 70* (aff. b), *137* (b); *Ursch 70* (b), *197* (a), *209* (b), *222* (a). — Exact locality unknown: *Cours 2643* (b); *Homolle 2643* (a—b); *Service forestier 4486* (aff. a), *5020* (a); *Vaillant herb. 97* (b).

Wood anat.: See H. Lecomte, 1922, *l. c.*, t. 24.

Uses. The timber is resistant to sea-water, and therefore used for making canoes; furthermore for construction. The resin is used for many purposes; it is white and clear; it is used for caulking boats, it is burned as an incense, and it is in use as a medicine (*"contre affections des voies urinaires"*). The fruits and especially the seeds are eaten.

28. Canarium schweinfurthii Engler, 1883, 145; 1892, 99; Warburg, 1895, 199; Gilg, 1895, 312 & 412; Harms, 1895, 474; Guillaumin, 1908b, 266; Durand, 1909, 90; Guillaumin, 1909a, 238 f. $22^{25, 26}$; 1909c (1), 493, (2), 45; 1911a, 34; Engler, 1915, 780, f. 367; De Wildeman, 1916, 281; 1920, 167; Exell, 1927, 59; Vermoesen, 1931, 39—40; Hill, 1933, 879 f. 6; Aubréville, 1936, 107, t. 170; Dalziel, 1937, 315; Brenan & Greenway, 1949, 78; Troupin, 1950, 123; Exell & Mendonça, 1951, 305. — *C. chevalieri* Guillaumin, 1908a, 33. — *C. thollonicum* Guillaumin, 1908b, 266; 1909a, 238—239, f. 22^{23}, 23^{11}; 1911a, 35. — *C. velutinum* Guillaumin, 1908b, 267. — *Aucoumea ? velutina* Pierre *ex* Guillaumin, 1908b, 267, *nom. nud.* — *C. occidentale* Chevalier, 1909, 145; Guillaumin, 1909a, 238 f. 22^{24}, 27; 1910a, 454 f. 13; 1911a, 31. — *Boswellia occidentalis* Chevalier *ex* Guillaumin, 1911a, 32, *nom. nud.* — *Bersama zenkeri* Gürke *ex* Chevalier, 1920, 110, *nom. nud.* — *C. khiala* Chevalier, 1920, 110, *nom. nud.* — *Fig. 20.*

Type: Sudan-Belgian Congo, Niam Niam, Juru River, 11-5-1870, *Schweinfurth 3324*, y. fr. (K; isotype in P).

Deciduous tree, up to 50 m high, up to about 2 m in diam., without or with small buttresses. *Branchlets* 1—2 cm thick, subglabrous with the exception of the fulvous-tomentose terminal bud; pith with many small vascular strands, which are arranged in a double peripheral cylinder. *Stipules*, together with the broadened basal part of the petiole, enclosing the terminal bud, caducous, inserted on the petiole at 1½—5 cm from its base, oblong spathulate, *c.* 3½ by ½ cm, acute, thin-herbaceous, sparsely fulvous-tomentose, provided with a distinct median nerve. *Leaves* 8—12-jugate, up to 110 cm long. *Petioles* flattened and winged up to the stipule (scar)s, rather densely pilose as are the rhachides and petiolules. *Leaflets* shortly stalked, (ovate to) oblong, basal ones ovate and smaller, terminal one elliptic, 9—20 by 3—5½ cm, rather stiff chartaceous, minutely tomentose on the midrib above, scattered pilose on the nerves beneath; base sometimes slightly oblique, (rounded to) cordate; margin entire; apex acute, gradually to abruptly acuminate, acumen 1—1½ cm long, blunt to acute; nerves (15—)20—24 pairs (angle 65—90°, rather variable), straight to slightly curved or sinuate, sometimes slightly winding (probably these are strongly developed intermediate veins), rather abruptly bent near the margin, not distinctly arching. *Inflorescences* axillary, narrowly thyrsoid to subracemose (♀), minutely pubescent, more or less glabrescent, ♂ ones 20—30 cm long, many-flowered, ♀ ones 15—25 cm, with few flowers; ♂ flowers in short-stalked glomerules, ♀ ones 2—1 on a short branch; bracts ♂ ovate, acute,

up to 15 by 8 mm, ♀ broadly ovate, 7 by 6 mm. *Flowers* densely minutely tomentose, ♂ 10 mm long, ♀ 12 mm, with a hollowed receptacle. *Calyx* in ♂ flowers 6 mm, the sepals connate for 1—2 mm, exduplicative-valvate; in ♀ flowers 7—8 mm, the sepals halfway connate. *Stamens* 6, in ♂ flowers

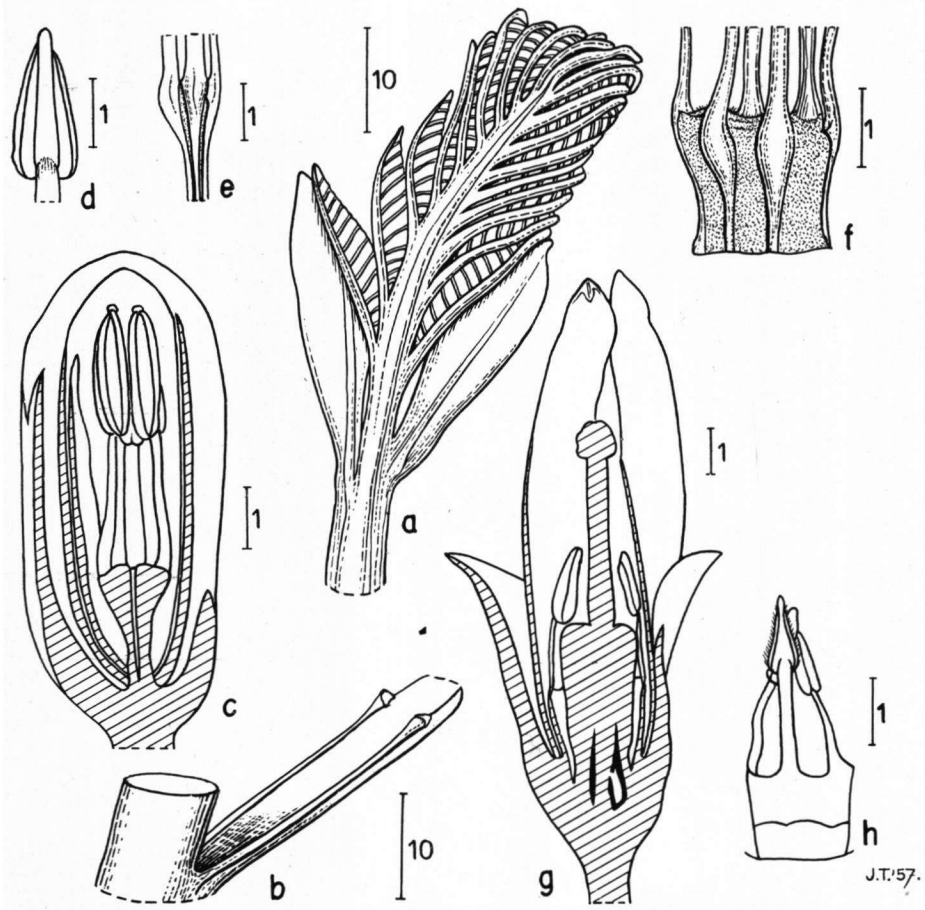


Fig. 20. *C. schweinfurthii* — a. young leaf with stipules; b. base of the petiole with stipule-scars; c. longitudinal section of ♂ flower; d. anther from the back; e. and f. disk with adnate bases of stamens in ♂ flowers; g. longitudinal section of ♀ flower; h. disk and stamens in ♀ flower. (a—b. from *Chevalier 8654;* c—e. from *Staudt 507;* f. from *Donis 2425;* g—h. from *Zenker 2481*) (dimensions in mm).

glabrous, adnate to the disk in such a way, that apparently they are inserted on an androphore; in ♀ flowers inserted on the disk, with some bristles on the thecas. *Disk* in ♂ flowers slender obconical, 1—2 mm high, minutely pubescent, with a narrow central canal, usually without, sometimes with a free, slender, 1—1½ mm high pistil, this sometimes even with cells and ovules (*J. Louis 2162:* solid ovariodisk with style-remnant); in ♀ flowers tubular, (1—)3½ mm high, faintly 6-lobed, glabrous, forming the 'staminal

tube' (or only the thicker basal part of it?). *Pistil* glabrous. *Infructescences* subracemose (to thyrsoid), usually 20—30 cm long, coarse, with up to 5 (rarely more) fruits; calyx saucer-shaped, triangular to faintly 3-lobed, *c.* 1½ cm in diam. *Fruits* ellipsoid to obovoid, round in cross-section, 34—37 by 17—20 mm, glabrous; pyrene pear-shaped, triangular at the base, rounded triangular in cross-section, acutely 6-ribbed near the apex; lids *c.* 3 mm thick. *Seeds* 1(—2); sterile cells moderately reduced.

Distribution: tropical West and Central Africa.

PORTUGUESE GUINEA. *Espirito Santo 1889.*

FRENCH WEST AFRICA. French Guinea: *Chevalier 20989.* — Upper Volta: *Vuillet 560, 561, 561b.*

SIERRA LEONE. *Dawe 549; Deighton 4738; H. C. King 183; Lane-Poole 190.*

LIBERIA. *Cooper 125, 192, 385.*

IVORY COAST. *Aubréville 21, 2257; Chevalier 15272* (syntype *C. chevalieri* Guill.), *15385* (syntype *C. chevalieri* Guill.), *16236* (type *C. occidentale* Chev.), *19244, 19392, 20066, 22112, 22288; Fleury 14, 80.*

GOLD COAST. *Irvine 2237.*

TOGO. *Mildbread 7278.*

NIGERIA. Northern provinces: *Lamb 43; Lehr P 4; Yates 21.* — Western provinces: *Brenan & Richards 8430; Kennedy 503; Thompson 17.* — Eastern provinces: *King-Churce 42; Talbot 3323.* — South Nigeria: *Foster 204; Kennedy 1665; Unwin 19.*

CAMEROONS. *Annet 447; Aubréville 692; Fleury 21* (= *herb. Chevalier 33470); Foury 61, 65; Hedin 284, 740, 1011, 1049, 1577, 1653, Ds. 13; Jacques-Félix 2946; Mildbread 7799, 8821, 9719; Staudt 507; Zenker 512, 2481, 2930.*

UBANGI-SHARI. *d'Alleizette in herb. L 951.54—169 & 173; Le Testu 2542; Thollon 19* (type *C. thollonicum* Guill.); *Tisserant 1012, 1443, 2396.*

SUDAN. Equatorial prov.: *Andrews A 1481; Cartwright 1; Turner 156; Wyld 74.*

ETHIOPIA. Acc. to Exell & Mendonça, *l. c.*

GABON. *Klaine 1326* (type *C. velutinum* Guill.); *Le Testu 1736, 5439, 7282.*

FRENCH CONGO. *Sargos 84.*

BELGIAN CONGO. Equatorial prov.: *Corbisier 805; Corbisier Baland 1798; Coûteaux 136; Dubois 674; de Giorgi 114, 229; Leemans 634; Louis 2162.* — Oriental prov.: *van den Brand 539; Germain 4499; Gilbert 1183, 1210; de Graer 266; Louis 438, 549, 1200, 1396, 2296, 3199, 3298, 6572, 8651, 9020, 11452, 13719, 14351; v. d. Meiren 83; Micha 24; Schweinfurth 3324* (type); *Troupin 499, 1730.* — Leopoldville prov.: *Donis 417, 2425; Ghesquière 14; Service forestier 29 (Cauwe), 53 (Cauwe); Toussaint 169, 2326; Vermoesen 1325, 1436, 1582, 1839, 1890, 2632.* — Kasai prov.: *Claessens 156, 381; Hardy 40; Joseph D 7a; Vanderyst 9277, 10425.* — Katanga prov.: *Delvaux 68, 200; Herman 2128; Hoffmann 828; Mullenders 1441.* — without locality: *Claessens 120, 446; Flamigny 7004, 9004; Gilbert 720, 1061; Goossens 2953; Jespersen 15; Lacomblez 84; De Wevre 891.*

UGANDA. *Bagshawe 111; Dümmer 1359; Eggeling 79* (= *Braznett 252*); *Scott Elliot 7167, 7502.*

TANGANYIKA. *Gillman 468; Wigg 322.*

ANGOLA. *Carrisso & Mendonça 22, 165; Gossweiler 8, 6565, 6891, 7042, 7074, 7084, 7089, 9170, 9351* (= *9357 ?*).

cultivated:

UBANGI-SHARI. *Chevalier 8654.*

TANGANYIKA. *Greenway 3372.*

ANGOLA. *Gossweiler 9357.*

Ecology: In primary rain-forests or, in drier regions, in the riverain forests; sometimes in periodically inundated places. Altitude up to 750(—1300) m. The leaves are falling at the end of the dry period (Jan.—Febr.). *Fl.* (Sept.—)Jan.—June(—July), *fr.* (Jan.—)Febr.—May(—Dec.).

Wood anat.: See Bertin, Les Bois du Cameroun, 1920, 137; Dalziel,

1937, *l. c.*; Jay, Timbers of W. Africa, ed. 3, 1950, 25; Fouarge *et all.*, Bois du Congo, 1953, 207, t. 20.

Uses. The timber is used by the natives for building canoes, by the Europeans for furniture; moreover it seems suitable for the manufacture of plywood, soft board, and paper. Decoction of the bark is used as a medicine against dysentery. The resin (*élémi africain*) is used by the natives for lighting and torches, for caulking canoes, gluing pottery, stiffening fishing-lines, and as a medicine, moreover natives sometimes oil their body with it, whether or not mixed up with clay, and by burning it they drive the mosquitoes out of their cabins; the missionaries use it as incense; on the European market it is in use for plasters, printing-ink, and varnish. (Analysis: Dunstan, Bull. Imp. Inst. London 6, 1908, 252). The fruits (apparently the pulp as well as the seeds) are eaten, usually after boiling. An edible oil is pressed out of the seeds. The nuts are used for carving and as a decoration.

Morphology: Some specimens, apparently in particular those from a higher altitude (e. g. *Jacques-Félix 2946*) are very coarse and hairy.

Taxonomy: Apparently, the present species is not closely allied to any other species of the genus; to all probability it has been isolated for a very long time. Unique are especially the strongly elongated stipules, and is the pseudo-androphore consisting of the elongated, tube-like disk, to which the stamens are entirely adnate.

29. Canarium pseudopatentinervium H. J. Lam, 1932a, 214, t. 13 f. 104e; 1932b, 490, t. 12 f. 77; Leenhouts, 1956, 274, f. 2h.

Type: Sumatra, Palembang, Lematang Ilir near G. Megang, alt. 75 m, April 14, 1923, *FRI. 153 T3P. 336*, ♀, lectotype (BO).

Tree 20—38 m by 20—60 cm. *Branchlets c.* ¾ cm diam., glabrescent; pith with many peripherally arranged small vascular strands and often with a central cavity. *Stipules* none. *Leaves* 1—2(—4)-jugate, glabrescent. *Leaflets* ovate to elliptic, rarely oblong, 5—12½ by 2¼—7 cm, rigid, (sub)-glabrous; base rounded (to broadly cuneate); margin entire; apex short-blunt-acuminate; nerves 7—14 pairs (angle 70—80°), faintly curved, not distinctly arching. *Inflorescences* (♂ unknown) terminal, thyrsoid, 8—15 cm long, densely tomentose, main branches up to 4 cm, racemose, with 10—15 flowers. *Bracts* subulate. *Flowers* (♂ unknown) subsessile, densely tomentose, buds 7 mm long. *Petals* distinctly unguiculate, apex incrassate-inflexed. *Stamens* free, glabrous. *Disk* adnate to the slightly concave receptacle, free rim 1 mm high, 6-lobed, the whole disk except for the outer base of the rim long-pilose. *Pistil* densely pubescent. *Infructescences c.* 7 cm long, with 1 fruit; calyx flat, 3-lobed, *c.* 2 cm diam. *Fruits* ellipsoid, circular to rounded-triangular in cross-section, 5—7 by 2—3 cm, glabrous; pyrene truncate-triangular in cross-section with hollow sides, smooth or with a faint median rib on the lids, acutely angular and acute at both ends; lids 3—4 mm thick. *Seeds* 1(—2); sterile cells moderately reduced.

Distribution: South Sumatra, Banka, Borneo.

SUMATRA. *Forbes 3037; FRI. T3P 577* (syntype), *153 T3P 336* (lectotype).
BORNEO. *FRI. bb. 10529* (syntype), *bb. 10849 (v. d. Zwaan 101)* (syntype), *bb. 18468 (v. d. Zwaan 720), bb. 27758.*

Ecology: Primary forests, up to 700 m. *Fl.* March—April, *fr.* July and Oct.

Note. Closely related to *C. apertum* and to *C. grandifolium*, the only other species with unguiculate petals.

30. Canarium grandifolium (Ridl.) H. J. Lam, 1932a, 215; 1932b, 527; Leenhouts, 1956, 275, f. 20a. — *Trigonochlamys grandifolia* Ridley, 1909, 31; 1922, 381. — *Fig. 21.*

Type: Malay Peninsula, Singapore, *Cantley's coll. s.n.*, ♀, lectotype (SING).

Tree 35 m by 60 cm. *Branchlets* ½—¾ cm diam., densely fulvous-tomentose when young; pith dark-brown, hard, with peripherally arranged small vascular strands. *Stipules* none. *Leaves* 2—3-jugate, 25—40 cm long. *Leaflets* elliptic, 10—17 by 5—8 cm, stiff-chartaceous to coriaceous, densely tomentose beneath and on the midrib above, nervation prominent beneath; base slightly oblique, broadly cuneate to rounded; margin revolute, minutely fimbriate-serrate to entire; apex rather abruptly short-acute-acuminate; nerves 10—14 pairs (angle 65—75°), faintly curved, sometimes arching close to the margin. *Inflorescences* terminal, densely ferruginously tomentose, ♂ thyrsoid, *c.* 18 cm long, flowers clustered, ♀ racemose to spicate, 6—10 cm long, with *c.* 12—15 flowers. *Bracts* subulate. *Flowers* pubescent, ♂ 13 mm, ♀ 15 mm with a slightly concave receptacle. *Calyx* ♂ 11 mm, ♀ 15 mm. *Petals* unguiculate, apex inflexed-acuminate, incrassate. *Stamens* free, glabrous. *Disk* ♂ cupular, 1 mm high, densely erect-pilose, ♀ densely pubescent, adnate to the receptacle, free rim 1 mm. *Pistil* not stalked, densely woolly pubescent; ♂ none. *Infructescences* and *fruits* unknown.

Distribution: Malay Peninsula (Johore, Singapore), apparently rare.

Malay Peninsula. *Cantley's coll. s.n.* (lectotype *Trigonochlamys grandifolia* Ridl.); *KEP. 70139; Ridley 10735* (syntype *Trigonochlamys grandifolia* Ridl.).

Ecology: *Fl.* Febr.

Note. Closely related to *C. apertum.*

31. Canarium apertum H. J. Lam, 1932a, 214, t. 5 f. 6; 1932b, 491, t. 12 f. 78; Buckley, 1932, 36; Wyatt-Smith, 1953, 8, *cum fig.*; Leenhouts, 1956, 275. — *Santiria serrulata* Engler, 1883, 160, *non C. serrulatum* Miquel, 1859.

Type: *Santiria serrulata* Engl.: Borneo, Sarawak, Mattang, May 1886, *Beccari PB. 1630*, ♂ (K; isotype in FI).

Tree 25—30(—45) m by 40—120 cm, buttressed. *Branchlets* ½—¾ cm diam., sparsely tomentose or glabrescent; pith dark-brown, hard, with a peripheral sclerenchymatic cylinder (vascular strands usually invisible). *Stipules* none. *Leaves* 2—7-jugate. *Leaflets* oblong-elliptic to ovate, 4—13(—15½) by 2—5(—9) cm, rigid, subcoriaceous, subglabrous to more or less pubescent, specially on the prominent nerves beneath; base nearly equilateral, rounded to subcordate; margin often revolute, fimbriate, serrate (rarely dentate or repandous) to entire; apex acute to rounded, rarely emarginate; nerves 11—16(—18) pairs (angle *c.* 65°), straight or more or less irregularly curved, sometimes arching close to the margin. *Inflorescences* (♀ unknown)

Fig. 21. *C. grandifolium* — a. twig with ♀ inflorescence; b. longitudinal section of old ♀ flower; c. ditto, longitudinal section of the disk. (*Cantley's coll. s.n.*) (dimensions in mm).

terminal, broadly thyrsoid, 10—30 cm long, densely rusty pubescent, main branches up to 13½ cm, broadly paniculate, many-flowered. *Bracts* subulate. *Flowers* (♀ unknown) *c.* 1 cm long, pubescent. *Calyx* 8—9 mm. *Petals* unguiculate, apex inflexed-acuminate, incrassate. *Stamens* free, glabrous. *Disk* cup-shaped, 1 mm high, densely erect-pilose. *Pistil* none. *Infructescences* terminal and sometimes in the upper leaf-axils, 6—8 cm long, rusty tomentose to glabrous, with 1 fruit; calyx saucer-shaped to cupular, deeply 3-lobed, 12—15 mm diam., with the remains of 6 stamens and 1—2 mm high, faintly 6-lobed, rusty long-pilose disk. *Fruits* ovoid, acuminate, circular in cross-section, 4—5 by 2—2¾ cm, fulvously tomentose, specially near the base and apex; pyrene rounded in cross-section, angle-ribs blunt, lids with a faint median rib each; lids up to 7 mm thick, very hard. *Seeds* 1(—2); sterile cells nearly invisible.

Distribution: Sumatra, Malay Peninsula, Borneo.

SUMATRA. *FRI. bb. 26395, bb. 27513 (Buwalda 94), bb. 28617 (Buwalda 394).*
MALAY PENINSULA. *KEP. 1147 (Foxworthy), 10689 (Hamid), 18427, 18506 (Foston), 38181 (Klang); SF. 28437 (Corner).*
BORNEO. *Beccari PB. 1630* (type *Santiria serrulata* Engl.); *FRI. bb. 10534, bb. 11202, bb. 16796, bb. 16827, bb. 21159 (v. d. Zwaan 37), bb. 26062, bb. 28377, bb. 29677, bb. 29710; Kostermans 8956; NBFD. SAN 15239 (Wood).*

Ecology: Primary forests up to 200(—500) m. *Fl.* Febr. (Mal. Pen.), May—June (Borneo), *fr.* May (Mal. Pen.), Aug. & Dec. (Borneo), Nov. (Sum.).

Wood anat.: Desch, Mal. For. Rec. 15[1] (1941) 63 (hand lens).

Notes. Closely related to *C. grandifolium* and also to *C. pseudopatentinervium.*

It is very remarkable, that two out of these three species were at first described as *Santiria* (*incl.* also *Trigonochlamys*). Yet the fruit- and flower-characters are typically those of *Canarium.*

Incertae sedis

Sect. *Regressiva* subsect. *Foliosa* H. J. Lam, 1932a, 209.

The relationship of the next 2 *spp.*, which are mutually closely related, is uncertain. In fertile characters they are close to sect. *Canarium,* in vegetative characters they remind of some species of sect. *Pimela,* specially of *C. australianum.*

32. Canarium pseudodecumanum Hochreutiner, 1904, 61; 1905, 88; 1910, 851; Heyne, 1927, 878; Lam, 1932a, t. 13 f. 104a; 1932b, 438, t. 9 f. 51; Wyatt-Smith, 1953, 6, *cum fig.*; Leenhouts, 1956, 275. — *Canariopsis decumana* (*non* Bl.) Miquel, 1861, 206, 527. — *Canarium decumanum* (*non* Gaertn.) Engler, 1883, 132; Lam, 1929, 116.

Type: Sumatra, Lampong, *Hort. Bot. Bog. VI E 6a,* st. (BO; isotypes in BR, BRSL, G, K, L, NY, P).

Tree up to 50 m by 165 cm, with large buttresses. *Branchlets* (¾—)1½—2½ cm diam., angular, glabrescent, leaf-scars large, terminal bud slender, 3—5 cm by 7—9 mm, densely ferruginously woolly pubescent; pith thick, with many small vascular strands, appressed to the thin wood-cylinder. *Stipules* none. *Leaves* often nearly in whorls of four, (3—)4—6-

jugate. *Leaflets* nearly sessile, lanceolate to oblong, 5—28(—33) by (2—)3—10(—12) cm, subcoriaceous, subglabrous above, densely minutely tomentose to sparsely stellately pubescent or nearly glabrous beneath; base rounded to subcordate; margin minutely serrulate (to subentire); apex rather abruptly, shortly acute-acuminate; nerves 20—25 pairs (angle variable), tortuous, more or less distinctly arching towards the margin, prominent beneath; reticulations very dense, waffle-like beneath. *Inflorescences* (♀ unknown) axillary, narrowly thyrsoid, up to 16 cm long, many-flowered, tomentose; flowers in glomerules. *Bracts* lanceolate to subulate. *Flowers* (♀ unknown) 7—9 mm long, pubescent. *Calyx* 3½ mm high. *Stamens* free, glabrous. *Disk* cupular, 2 mm high, fleshy, densely erectly pilose. *Pistil* none. *Infructescences* unknown; calyx with remnants of a 6-lobed, fimbriate disk. *Fruits* ellipsoid, subtrigonous in cross-section, 7—8½ by 4½—6 cm, densely tomentose when young, glabrescent, scurfy; pyrene smooth, with 3 angle-ribs near the apex and often a faint median rib on each of the lids; lids 4—5 mm thick. *Seeds* (3—)2—1; all cells irregular-shaped, sterile ones slightly or not reduced.

Distribution: Sumatra, Malay Peninsula, Borneo.

SUMATRA. *Dumas 1667; FRI. bb. 4878, bb. 27045, bb. 33025 (Soegihan 4); Hort. Bot. Bog. VI E 6a* (type); *Teysmann in herb. U 032918.*

MALAY PENINSULA. *KEP. 10885 (Hamid), 11452 (Meh), 12208 (Abdullah), 13451, 43563 (Symington), 46052 (Ja'amat); Kerr 15839.*

BORNEO. *Elmer 21253; FRI. bb. 12431, bb. 13666, bb. 19984 (Henar 3).*

Ecology: Primary forests, up to 280 m. *Fl.* Apr. (Mal. Pen.), Oct. (Borneo), *fr.* March and Aug.—Nov. (Sum.).

Uses. The wood is very soft. The abundant resin is used for caulking canoes. An edible oil is pressed out of the seeds, which also are eaten.

Notes. Closely related to *C. decumanum,* different from the latter by the absence of stipules and by the serrate leaflets. The two species are nearly vicariads, even in Borneo.

33. Canarium decumanum (Rumphius, 1741, 166, t. 55) Gaertner, 1791, 99, t. 102; Willdenow, 1805, 760; De Candolle, 1825, 80; Roemer & Schultes, 1829, 80; *non* Engler, 1883, 132 (= *C. pseudodecumanum* Hochr.); Koorders & Valeton, 1896, 48, 313; 1897, t. 8; Guillaumin, 1909a, f. 22^{13}, 23^{5}; Backer, 1911, 198, *excl. specim. sumatr.;* Koorders, 1912, 434; Senn, 1912, t. 22; Koorders, 1913, t. 150; Merrill, 1917, 300; Heyne, 1927, 876; *non* H. J. Lam, 1929, 116 (= *C. pseudodecumanum* Hochr.); H. J. Lam, 1931—1932a, t. 6 f. 24—44, f. 52, t. 15 f. 115a; 1932b, 435; Hildebrand, 1934, 267; H. J. Lam, 1948, 5; Leenhouts, 1956, 276, f. 22a, 39 & 40. — *Pimela decumana* Blume, 1850, 223. — *Canariopsis decumana* Blume *ex* Miquel, 1859, 652; *non* Miquel, 1861, 206, 527 (= *C. pseudodecumanum* Hochr.).

Type: Moluccas, *Hort. Bot. Bog. VI E 5* (= *Pl. Bog. Exsicc. 116*), fr., neotype (L; isotypes in B, BO, BRSL, G, K, L, NY).

Tree, 30—60 by 1½—2 m, with very large buttresses (up to 8 m high and 5 m wide). *Branchlets* 1—1½ cm diam., angular, glabrescent, with large leaf-scars, terminal bud slender, acute, 4—5 cm by 6 mm, densely brown-tomentose; pith thick with many peripherally arranged small vascular

strands. *Stipules* represented by the basal pair of leaflets, which are rather caducous — leaving a small circular scar —, inserted at the conjunction of branch and petiole and very small (petiolule 4—10 mm, blade 1½—2½ by ¾—2 cm). *Leaves* spirally arranged, (3—)4—5(—6)-jugate, 35—45 cm long. *Leaflets* ovate to oblong, 5—10—30 by 2½—5—10 cm, stiff-chartaceous to coriaceous, glabrescent; base rounded to subcordate; margin entire; apex gradually long and acutely acuminate; nerves 17—22—26 pairs (angle *c.* 60°), tortuous, towards the margin dissolving into a lax marginal reticulation, rather prominent beneath, some of the nerves more or less reduced (similar to intermediate veins); reticulations dense. *Inflorescences* axillary, narrowly thyrsoid, densely minutely tomentose, ♂ 4—19 cm long, many-flowered, main branches up to 6½ cm, flowers clustered; ♀ 5—7 cm, few-flowered, main branches very short. *Bracts* lanceolate to subulate. *Flowers* pubescent, ♂ 7—9 mm, ♀ 8—14 mm. *Calyx* ♂ 3½ mm high, ♀ 4½—7 mm. *Stamens* free, glabrous. *Disk* ♂ cushion-shaped, 2 mm high, faintly 6-lobed, densely pilose; ♀ 6-lobed, 1 mm high, fimbriate. *Pistil* pubescent, ♂ none. *Infructescences* subracemose, with few fruits; calyx flat, 1 cm diam. *Fruits* ellipsoid, subtrigonous in cross-section, 7—8½ by 4½—6 cm, glabrescent, scabrous; pyrene smooth except of 3 angle-ribs near the apex and a faint median rib on each of the lids; lids 4—5 mm thick. *Seeds* (3—)2—1; cells irregularly shaped, sterile ones not or slightly reduced.

Distribution: East Borneo, Moluccas (Morotai, Ternate, Batjan, Ceram), New Guinea (Vogelkop). According to Rumphius (*l. c.*), also in South Celebes, Buton, Halmaheira, the Sula Islands, and Buru. Not rarely cultivated, especially in Java.

BORNEO. *FRI. bb. 10155, bb. 26371; Kostermans 6956; NBFD. SAN 16109 (Wood).*
MOLUCCAS. Morotai: *FRI. bb. 33893 (Tangkilisan 220), bb. 33903 (Tangkilisan 233); Lam 3637.* — Ternate: *Beccari herb. 2168.* — Ceram: *FRI. bb. 25864 (Buwalda 519).*
NEW GUINEA. Vogelkop: *Beccari PP 735; BW. 2626 (Brouwer).*
cultivated:
JAVA. *Bakhuizen v. d. Brink Jr. 3661; Hort. Bot. Bog. VI E 5* (neotype), *VI E 5a; Koorders 22422β 40350β.*

Ecology: Primary forests at low altitudes. *Fl.* April—May, *fr.* June—Nov.

Uses. The resin and the seeds are used, but they are of no great importance.

Notes. Closely related to *C. pseudodecumamum;* different from the latter by the stipules and the entire leaflets.

Young specimens very much resemble *Flindersia schottiana* F. Muell. (*Rutac.*), which however can easily be recognized by the presence of distinct pellucid oil-glands in the leaflets.

II. SECTION PIMELA

DC. Prod. 2 (1825) 80. — *Pimela* Lour. Fl. Coch. (1790) 407. — Sect. *Regressiva* subsect. *Subulata* H. J. Lam, Ann. Jard. Bot. Btzg 42 (1932) 209.

Stipules subulate to lanceolate, not rarely absent; scars orbicular, minute. *Bracts* deltoid to subulate, not consisting of connate stipules. *Leaflets* greyish-green when dry; margin entire to serrate; indument, if

present, mostly consisting of hispid hairs. *Inflorescences* mostly axillary to pseudo-terminal, very rarely terminal. *Stamens* often partly to entirely connate, rarely adnate to the disk. *Receptacle* in ♀ flowers nearly always flat, very rarely slightly concave. *Disk* usually 6-lobed, often pilose. *Pistil* very rarely stalked, mostly pilose. *Calyx* in fruit rarely more than 1 cm diam., outside usually glabrous, inside mostly sericeous, flat, lobes often reflexed. *Fruits* small, 2½—3½(—5) cm long; pyrene often with angle- and median ribs, sometimes entirely tuberculate.

Distribution: Continental S.E. Asia from S. Deccan to S. China and Hainan, Andamans and Nicobars, Malaysia, Carolines, New Britain, N. Queensland, Solomon Isl., New Hebrides, Fiji, Samoa, and Tonga.

34. Canarium oleosum (Lamk) Engler, 1896, 241, f. 136 Q—S; Guillaumin, 1909a, 246, f. 8, 18, 22^{5}, $23^{12, 13}$, 25, 26 P, 30; 1910, 454, f. 2, t. 12 f. 2; Merrill, 1917, 303; Heyne, 1927, 878; Lam 1932a, t. 12 f. 91, t. 13 f. 100—101; 1932b, 483, t. 11 f. 74; Meyer Drees, 1951, 43; Leenhouts, 1956, 278, f. 20b, 21 l, & 41. — *Nanarium minimum sive oleosum* Rumphius, 1741, 162, t. 54. — *Amyris oleosa* Lamarck, 1783, 362. — *C. microcarpum* Willdenow, 1806, 760; Poiret, 1811, 72; Miquel, 1859, 646; Engler, 1883, 125; Vorderman, 1894, 111; Hochreutiner, 1905, 90, *incl. f. minor;* Boorsma, 1907, 29. — *C. laxiflorum* Decaisne, 1834, 477; Spanoghe, 1841, 188. — *C. pimela* (*non* Koen.) Spanoghe, 1835, 346.

Type: Lesser Sunda Islands, Timor, (*Riedlé & Guichenot s.n.),* ♀ & fr., neotype (P; isotypes in G, K, NY).

Tree 17—20(—30) m by 25—50 cm; sometimes buttressed. Branchlets ¼—½ cm thick, soon glabrescent; pith with a peripheral cylinder of vascular strands. *Stipules* none. *Leaves* (0—)3—5(—7)-jugate, glabrous. *Leaflets* ovate to lanceolate, 2—18 by 1—7 cm, thin-chartaceous; base slightly oblique, cuneate to rounded; margin entire; apex gradually narrowed into a short, broad, and blunt acumen; nerves 10—15 pairs (angle 60—80°), straight to slightly curved, rather abruptly and conspicuously arching at some distance from the margin; intermediate veins strongly developed; reticulations lax. *Inflorescences* axillary, slender, narrowly and laxly thyrsoid, (4—)30—45 cm, glabrous; branches patent but for the longer basal ones, up to 4½ cm (♂ ones sometimes up to 10 cm), long-stalked, ♂ ones many-flowered, ♀ ones up to 5-flowered. *Flowers* 5—7 mm long, glabrous, ♀ ones sometimes with a slightly concave receptacle. *Calyx* 2—3 mm high. *Stamens* glabrous, in ♂ flowers slightly connate at the base, in ♀ flowers free. *Disk* in ♂ flowers pistilloid, ovoid, sometimes shortly stalked, 1½ mm high, pilose at the apex, tapering into a short, style-like appendix; in ♀ flowers cupular, 6-undulate, 1 mm high, fimbriate. *Pistil* glabrous (very rarely tomentose). *Infructescences* slender, with up to 5 fruits; calyx flat, triangular, 3½—5 mm diam., with reflexed lobes. *Fruits* ovoid to obovoid, round in cross-section, 1¼—2 by ¾—1¼ cm, glabrous; pyrene faintly 6-ribbed, sometimes slightly rugose; lids 2 mm thick. *Seed* 1; sterile cells nearly obsolete.

Distribution: Lesser Sunda Islands (Alor, Timor, Wetar), N. Celebes, Moluccas (Morotai, Ternate, Batjan, Obi, Buru, Kai Islands), New Guinea, and New Britain.

LESSER SUNDA ISLANDS. Timor: *(Riedlé & Guichenot s.n.)* (type *C. laxiflorum* Decne) (neotype *Amyris oleosa* Lamk). — Wetar: *FRI. bb. 27191.*

MOLUCCAS. Morotai: *Main & Aden 1425.* — Batjan: *Beccari herb. 2188.* — Obi: *Atasrip 113, 122.* — Buru: *Beccari herb. 2187; Hort. Bot Bog. VI B 27a; Teysmann 53.* — Kai Islands: *Beccari herb. 2186, herb. 2189; Jaheri 475.*

NEW GUINEA. *Beccari PP 179, PP 202, herb. 2183; BW. 1830 (Schram), 2783 (Schram), 3324 (Runtoboy 1), 3593 (Kalkman); Clemens 8215, 8263 A; NGF. 4560 (Hart); Warburg 20163.*

NEW BRITAIN. *NGF. 162 (Haas); Waterhouse 348, 409, 899.*

locality unknown:

Hort. Bot. Bog. VI E 2, VI E 13, VII B 9, VII B 10 (type *C. microcarpum f. minor* Hochr.), *VII B 10a.*

Ecology: Primary and secondary forests, mostly below 400 m, rarely up to 700(—1200) m. *Fl.* May—Nov., *fr.* May—Oct. (Dec. in New Britain).

Uses. The wood can be used as a light constructional timber. The wood of the buttresses is said to be one of the components of the scented wood *kaju rasamala.* The oily parts of the resin are used as a balm on wounds and for hair lotions; in New Guinea it is for the latter purpose mixed with coconut-oil.

Notes. Closely related to *C. balsamiferum* and on the whole rather uniform. The two forms, mentioned by H. J. Lam (1932b, *l. c.*), a small-leaved and a large-leaved one, are only vaguely distinguishable.

Some specimens from New Guinea have fairly coriaceous leaflets; they have been collected at *c.* 1000 m. Some specimens, especially one from Morotai (*Main & Aden 1425*), are long remaining densely tomentose.

Guillaumin (1911c, 710) was the first to record this species from Indo-China. In this he based himself on *Pimela oleosa* Lour., typified by Indo-Chinese material and with a reference to the E. Malaysian *Nanarium oleosum* of Rumphius (the type of *Amyris oleosa* Lamk). Poiret *l. c.* erroneously referred Loureiro's species to *C. microcarpum* Willd. See also Merrill (1935, 227). Already Engler (1883, *l. c.*) expressed doubt about this synonymy and H. J. Lam (1932a, 208) gave a new name to the species of Loureiro, *viz. C. engleri* H. J. Lam, which is up till now only known from Loureiro's description.

35. Canarium balsamiferum Willdenow, 1806, 760; Engler, 1883, 150; Merrill, 1917, 301; Heyne, 1927, 876; Lam, 1932a, t. 16 f. 127 c 2; 1932b, 485, t. 12 f. 75; Cretzoiu, 1934, 266, *incl. var. typicum* and *var. englerianum;* Leenhouts, 1956, 279. — *C. odoriferum leve* Rumphius, 1741, 156, t. 50. — *Boswellia balsamifera* Sprengel, 1825, 313. — *Pimela glabra* Blume, 1850, 222, *excl. basionym Boswellia glabra* Roxb. — *Pimela paucijuga* Blume, 1850, 226. — *Canariopsis glabra* Blume *ex* Miquel, 1859, 653. — *Canariopsis paucijuga* Blume *ex* Miquel, *l. c.*; Engler, 1883, 151; Merrill, 1917, 305. — *C. celebicum* Engler *ex* Koorders, 1903b, 97, *nom. nud.;* Koorders, 1922a, t. 31; 1922b, 17. — *C. englerianum* Hochreutiner, 1904, 56; 1910, 845. — *C. longissimum* Hochreutiner, 1904, 58; 1910, 846. — *C. rooseboomii* Hochreutiner, 1904, 62; 1910, 848. — *C. poeloetimbeo* Engler *ex* Hochreutiner, 1904, 58, *nom. nud.*; Koorders-Schumacher, 1914, 61.

Type: Celebes, Malili, Usu, alt. 200 m, Jan. 31, 1934, *FRI. Cel./II-234,* fr., neotype (L; isotype in BO).

Buttressed tree, 15—30 m by 20—40(—70) cm. *Branchlets* ½—1¾ cm

thick, glabrescent; pith with many vascular strands, which are sometimes arranged in two concentric cylinders. *Stipules* none. *Leaves* (3—)5—8-jugate, glabrous. *Leaflets* lanceolate to oblong, 9—24 by 2—9¼ cm, herbaceous to coriaceous; base of the laterals often strongly oblique, broadly cuneate to slightly cordate; margin entire; apex acute, rather abruptly, short (*c.* 1 cm) and slenderly blunt-acuminate; nerves 8—15 pairs (angle 60—70°), little curved, rarely distinctly interarching close to the margin; reticulations very slender and rather dense. *Inflorescences* axillary, glabrescent, slender, ♂ ones narrowly thyrsoid, 10—50 cm, main branches *c.* 2(—10) cm, patent, thyrsoid, 3—11-flowered; ♀ ones mostly racemose, 4—10 cm. *Flowers* (nearly) glabrous, ♂ ones 1 cm long, ♀ ones 5—6 mm. *Calyx* 3—5 mm high. *Stamens* glabrous, in ♂ flowers connate for 1—2 mm, in ♀ ones very slightly connate. *Disk* in ♂ flowers thick and ovoid to club-shaped, 4 mm high, more or less deeply (3—)6-lobed, with a central canal, pubescent, inner side and apex with long, erect hairs; in ♀ flowers cupular, ¾ mm high, 6-undulate, pubescent outside and long-fimbriate. *Pistil* densely pubescent except at the base; in ♂ flowers none. *Infructescences* in the more coarse specimens short and dense, 5—8 cm long, with 2—5 rather large, fertile fruits; in more slender specimens up to 25 cm long, slender, fruits smaller and often some of them sterile; calyx *c.* 7 mm diam., flat, 3-lobed, lobes reflexed. *Fruits* ovoid, acute, specially at the apex, round or slightly trigonous in cross-section, 2—2½—4 by 1¼—2 cm, glabrous or slightly pubescent at the top; lids conspicuous, faintly keeled, c. 2½ mm thick. *Seeds* 3.

Distribution: Celebes, Moluccas (Talaud Islands, Morotai, Halmaheira, Buru, Ambon, Kai Islands), New Guinea (*incl.* also Louisiada Isl.).

CELEBES. *FRI. bb. 7532, bb. 17292 (Tumbel 6), bb. 17566, bb. 28218, bb. 28235, Cel./II-129, Cel./II-234* (neotype), *Cel./II-478; Hochreutiner Pl. Bogor. exsico. 121* (type *C. longissimum* Hochr.); *Koorders 16296β; Riedel 5709; Teysmann 11974, 12384, 12424.*

MOLUCCAS. Talaud Islands: *Lam 2870, 2978.* — Morotai: *FRI. bb. 33770 (Tangkilisan 74), bb. 33844 (Tangkilisan 156), bb. 33905 (Tangkilisan 235).* — Halmaheira: *FRI. bb. 24936.* — Buru: *Hort. Bot. Bog. VI D 11 (Binnendijk 4742)* (type *C. englerianum* Hochr.). — Ambon: *Korthals s.n.* — Kai Islands: *Hort. Bot. Bog. VI D 12 (Jaheri 2392)* (type *C. rooseboomii* Hochr.); *Jaheri 477.*

NEW GUINEA. *Brass 21962.* — Louisiada Isl.: *Brass 27713.*

locality unknown:
Hort. Bot. Bog. VI D 14.

Ecology: In primary forests from low altitudes up to *c.* 700 m. *Fl. fr.* (mainly) May—July.

Uses. According to Rumphius the aromatic oil from the resin is highly estimated, as it is sweeter scented than that of most other *Canarium* species known to him.

Notes. The best subdivision of this variable species is that given by H. J .Lam (1932b, *l. c.*). As the characters are very vague and as the 3 forms are not geographically separated, he did not provide them with names.

The species is closely related to *C. trigonum* and, though in a lesser degree, to *C. oleosum.*

36. Canarium trigonum H. J. Lam, 1932a, 219; 1932b, 487, t. 14 f. 95; Leenhouts, 1956, 280.

Type: Celebes, Malili Distr., near Kawatta, alt. 200 m, *FRI. Cel./II-401* (*Gonggrijp 2*), ♀ & fr., lectotype (BO; isotypes in K, L).

Tree, 20—28 m by 20—30 cm. *Branchlets* 3—4 mm thick, glabrescent; pith with a peripheral cylinder of some large to many small vascular strands, in the latter case appressed to the wood. *Stipules* absent. *Leaves* 2—5-jugate, glabrous. *Leaflets* elliptic-lanceolate, 5½—15 by 2½—5 cm, chartaceous; base cuneate; margin entire; apex acute, rather abruptly, long and slender (5—15 by 1½—2 mm) blunt-acuminate; nerves 7—12 pairs (angle 55—65°), curved, not arching except in the apical part; reticulations lax. *Inflorescences* axillary, glabrous, slender, ♂ ones narrowly thyrsoid, *c.* 20 cm long, main branches patent, up to 1½ cm, 2—3-flowered; ♀ ones racemose, 4—8 cm long, with few flowers only. *Flowers* nearly glabrous, ♂ ones 4—5, ♀ 7—8 mm long. *Calyx c.* 3 mm long. *Stamens* in ♂ flowers connate for 1 mm, filaments pilose, anthers acute-acuminate; in ♀ flowers free, totally pilose. *Disk* cylindrical in ♂ flowers, 2 mm high, densely pubescent, with or without a central canal; in ♀ flowers cupular, 6-lobed, 1 mm high, fimbriate. *Pistil* densely pilose, in ♂ flowers absent. *Infructescences* small, with only one fruit; calyx flat with reflexed lobes, 7 mm diam. *Fruits* shortly ovoid, trigonous in cross-section, *c.* 3½ by 2½ cm; pyrene rounded-triangular in cross-section, the sides flat to slightly concave; lids thick; cells equally well developed.

Distribution: Central Celebes.

CELEBES. *FRI. Cel./II-401 (Gonggrijp 2)* (lectotype), *Cel./II-416 (Gonggrijp 17)* (syntype).

Ecology: In old forests, 200 m. *Fl. fr.* May—July.

Note. This apparently rare species is closely related both to *C. balsamiferum* and to *C. euryphyllum*. It is best characterized by its fruits.

37. Canarium euryphyllum Perkins, 1904, 99; Merrill, 1923, 350; Lam, 1932a, t. 12 f. 80; 1932b, 531; Leenhouts, 1956, 280. — *C. perkinsae* Merrill, 1906a, 26; 1923, 352. — *C. todayense* Elmer, 1911, 1087. — *C. purpureum* Elmer, 1912, 1503. — *C. ramosii* Merrill, 1913, 374, *incl.* also *var. parvum*; 1923, 353; Lam, 1932b, 532. — *C. paucinervium* Merrill, 1914b, 364; 1923, 352. — *C. stenophyllum* Merrill, 1915a, 25; 1923, 354. — *C. microphyllum* Merrill, 1918b, 304; 1923, 351.

Type: Philippines, Luzon, Principe Prov., Baler, 1903, *Merrill 1045*, fr. (PNH †; isotypes in K, NY).

Tree 10—15(—40) m by 10—25(—40) cm. *Branchlets* ¼—½ cm thick, often glabrescent; pith with a peripheral cylinder of small vascular strands, the few central ones rarely arranged into a second cylinder. *Stipules* none. *Leaves* 2—7-jugate. *Leaflets* elliptic (to lanceolate), slightly falcate, 4½—18 by 2—6 cm, very rarely nearly orbicular and straight, 3½ cm diam., mostly chartaceous; base cuneate (to rounded); margin entire; apex abruptly, long and slender, blunt-acuminate; nerves (5—)8—10(—15) pairs (angle variable), straight, gradually curved towards the margin and indistinctly arching at *c.* 2 mm from it. *Inflorescences* axillary, thyrsoid to racemose, 15—20 cm, glabrescent. *Flowers c.* 1—1½ cm long, glabrous to very shortly pilose outside, specially the corolla. *Calyx* 3 mm high, widely cupular. *Corolla* much exserted, not slender. *Stamens* glabrous, in ♂ flowers faintly

connate. *Disk* in ♂ flowers tubular to cupular, up to 2½ mm high, fimbriate, on the inner side densely pilose; in ♀ flowers annular, 6-undulate, 1 mm high, long-pilose. *Pistil* pilose, in ♂ flowers nearly always totally absent. *Infructescences* 10—20 cm long, glabrous, with up to 5 fruits; calyx flat, triangular, 5 mm diam., lobes reflexed. *Fruits* broadly elliptic, broadly triangular in cross-section, 2¾—3 by 1¼—1¾ cm, glabrescent except for the apex; pyrene smooth; lids 2 mm thick; fruits often sterile. *Seed* 1; sterile cells rather strongly reduced.

Distribution: Philippines (Palawan excepted).

Taxonomy: The following two varieties are distinguishable:

a. var. **euryphyllum**. — *C. perkinsae* Merr. — *C. todayense* Elm. — *C. purpureum* Elm. — *C. stenophyllum* Merr. — *C. microphyllum* Merr.

Branchlets soon glabrescent. Leaves (2—)4—7-jugate, (nearly) glabrous. Leaflets falcate, 4½—10—12 by 2—4 cm, rarely straight and orbicular, rather stiff. Inflorescences narrowly thyrsoid to racemose; partial panicles often sessile, 2—3(—5)-flowered, rarely stalked, up to 3½ cm long, and with up to 12 flowers. Flowers *c.* 1 cm long. Fruits up to 1½ cm broad, red when fresh; often sterile.

Distribution: as the species.

PHILIPPINES. Mindoro: *Bartlett 13545; BS. 39553, 39622, 40841, 40904; Edaño 3238; FB. 3622 (Merritt), 3695 (Merritt); MacGregor 121* (syntype *C. perkinsae* Merr.); *PNH. 13783 (Sulit 4067), 17426 (Conklin 71), 17653 (Sulit & Conklin 5073), 17707 (Sulit & Conklin), 18694 (Conklin 279).* — Batanes Isl.: *BS. 80420 (Ramos 501), 80421 (Ramos 990), 80427 (Ramos 506).* — Babuyan Isl.: *BS. 79295 (Edaño).* — Luzon: *BS. 20539; Elmer 14644; FB. 30315 (Sulit 132); Loher 14083; Merrill 1045* (type), *1081* (paratype); *PNH. 9769 (Canicosa); Ramos 1477, 1550* (type *C. stenophyllum* Merr.); *Vidal 158.* — Catanduanes: *BS. 30351* (type *C. microphyllum* Merr.). — Sibuyan: *Elmer 12145* (syntype *C. purpureum* Elm.), *12219* (syntype *C. purpureum* Elm.); *FB. 18862 (Fischer), 27039 (Sajor).* — Samar: *BS. 17453.* — Negros: *Elmer 9627, 10053.* — Panay: *BS. 31147 (Ramos & Edaño), 32288 (MacGregor), 32371 (MacGregor), 35277 (Martelino & Edaño), 35333 (Martelino & Edaño), 42486 (Edaño), 45992 (Edaño), 46045 (Edaño); FB. 17836 (Cortes & Rendal), 24597 (Achacoso); PNH. 33882 (Taleon 1472).* — Mindanao: *Clemens 494, 684; Elmer 10845, 11268* (type *C. todayense* Elm.); *PNH. 9939 (Sulit 3252).* — Bucas Grande Isl.: *BS. 35043 (Ramos & Pascasio), 35138 (Ramos & Pascasio).*

Ecology: Rather common tree in forests, up to 500 m (on Mt Katanglad, Mindanao, once collected at 1700 m). *Fl.* Nov.—June, *fr.* (mainly) April—Aug.

Uses. The wood is often said to be very hard.

b. var. **ramosii** (Merr.) Leenhouts, 1956, 280. — *C. ramosii* Merr. — *C. paucinervium* Merr.

Type: Philippines, Leyte, Dagami, Aug. 1912, *Ramos 1168*, ♂ (PNH †; isotypes in BRSL, FI, G, U, Z).

The main differences to var. *euryphyllum* are: Rather densely, hirsutely pilose on the branchlets, petioles, leaf-rhachids, petiolules and leaflets (midrib above, all nerves beneath). Leaves mainly 2—4-jugate. Leaflets less falcate, mainly 12—18 by 4½—6 cm, less stiff. Inflorescences more often thyrsoid and more-flowered. Flowers longer (14 mm). Fruits slightly broader (1½—1¾ cm), black; no sterile ones seen.

Distribution: Philippines (Samar, Leyte, Mindanao: Surigao Prov. only).

PHILIPPINES. Samar: *BS. 24496 (Ramos); FB. 24598 (Sasquety).* — Leyte: *Ramos 1168* (type); *Wenzel 103* (type *C. ramosii* Merr. *var. parvum* Merr.), *468, 875, 1517.* — Mindanao: *BS. 83472 (Ramos & Convocar); Wenzel 2986, 3144, 3188.*

Ecology: In forests at low altitudes. *Fl.* June—Sept., *fr.* (mainly) April—Aug.

Note. This species, apparently related to *C. balsamiferum,* is well characterized by its fruits, and by its flowers with a long, much exserted, though not very slender corolla. The leaves are more distinctly caudate than those of the related species.

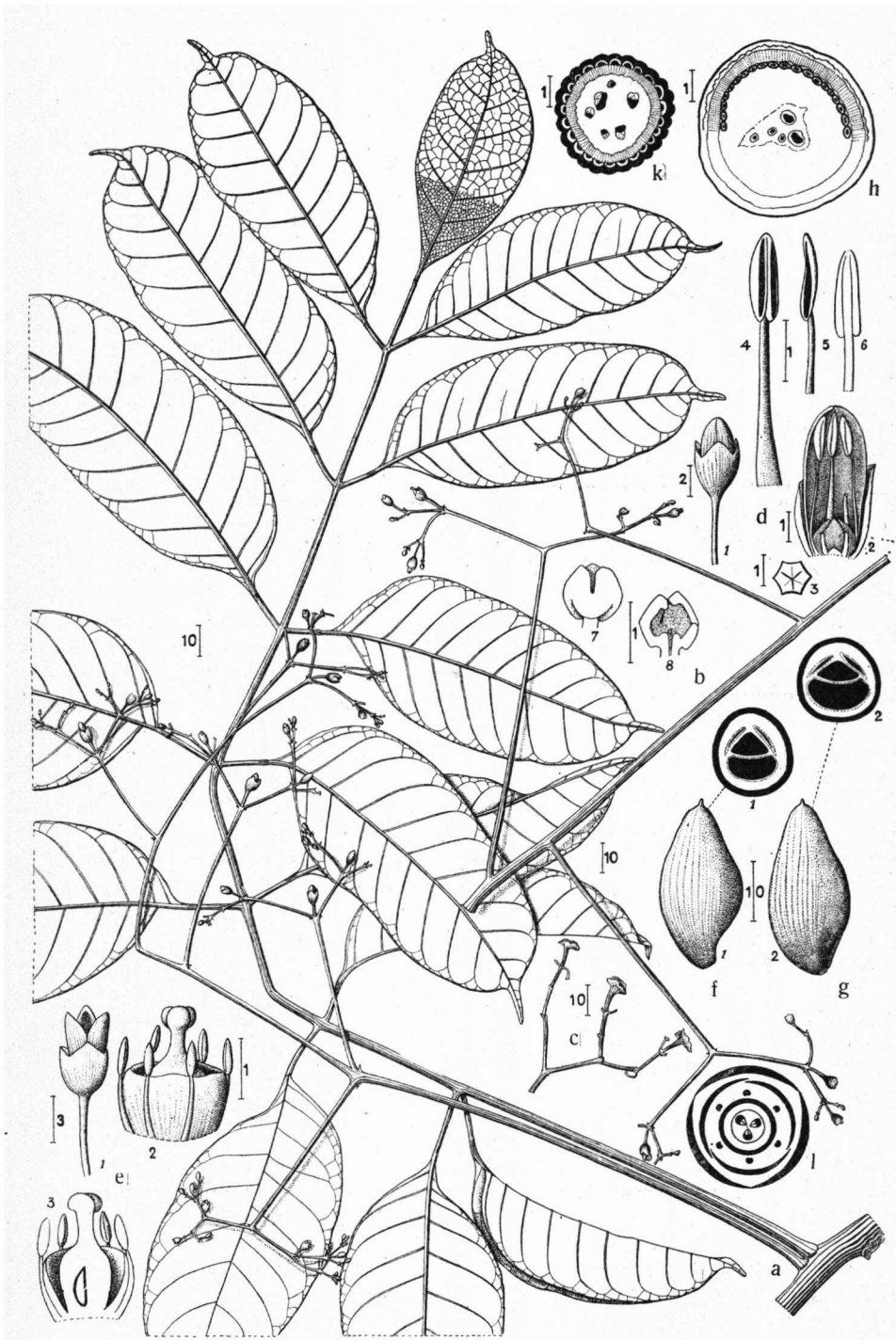
38. **Canarium gracile** Engler, 1883, 140; Elmer, 1911, 1078; Merrill, 1923, 350; Lam, 1932a, t. 12 f. 84; 1932b, 531; Leenhouts, 1956, 282, f. 20c & 21 m. — *C. antonii* Elmer (*ex* Merrill, 1923, 350, *in syn.*), 1939, 3711, *descr. angl.* — *Fig. 22.*

Type: Philippines, Luzon, Tayabas Prov., 1841, *Cuming 795,* ♂ (L; isotypes in BM, FI, K, MEL, W).

Often shrub-like tree, 5—15 m by 5—25 cm. *Branchlets* slender, glabrescent; pith loose with indistinct vascular strands, most of them peripherally arranged. *Stipules* absent. *Leaves* (1—)4—5(—7)-jugate, glabrous. *Leaflets* oblique-elliptic, slightly falcate, (5—)8—14 by (2—)3—4½ cm, chartaceous; base cuneate; margin entire; apex abruptly, rather long and broadly (up to 2 by ½ cm) blunt-acuminate, acumen curved; nerves 9—11 pairs (angle *c.* 75° at the broader, 50—60° at the narrower side), straight to faintly curved, gradually more so towards the margin, more or less distinctly arching in the apical part only; reticulations lax. *Inflorescences* axillary, broadly and laxly thyrsoid, ♂ ones mostly 30—40 cm, ♀ ones 60—80 cm long, glabrous; all axes very slender; main branches patent, up to 10 cm (♀ ones up to 15 cm), repeatedly laxly cymose, terminal parts monochasial, 2—3 cm long, *c.* 10-flowered (♀ ones with fewer flowers); *bracts* broadly deltoid. *Flowers* 6—7 mm long, slender, glabrous outside, ♀ ones sometimes with a slightly concave receptacle. *Calyx* 3—3½ mm high. *Stamens* glabrous, slightly confluent at the base. *Disk* in ♂ flowers strongly developed, 2½ mm high, glabrous, *c.* globose, 6-lobed, ½ mm stalked, with a narrow central, conical canal, which is sometimes closed at the top, and which sometimes includes a minute rudiment of the pistil; in ♀ flowers 1 mm high, annular, faintly 6-lobed. *Pistil* glabrous. *Infructescences* with few fruits; calyx saucer-shaped, 3-lobed, 1 cm diam. *Fruits* ovate-oblong to bottle-shaped, bulging on one side, blunt at base and apex, the latter pointed by the persistent style-base, round in cross-section, 2½—3½ by 1¼—1½ cm, smooth, glabrous; pericarp very thin; pyrene smooth; lids 1—1½ mm thick, bony. *Seed* 1; sterile cells much reduced, linear, *c.* 6 by 1 mm; central canal strongly developed, 4—5 mm diam.

Distribution: Philippines (Palawan excepted).

Fig. 22. *C. gracile* — a. leaf and ♂ inflorescence; b. ♀ inflorescence; c. part of infructescence; d. ♂ flower: 1. bud, 2. ditto opened, 3. disk from above, 4—6. stamens, 7. disk, 8. ditto in longitudinal section; e. ♀ flower: 1. habit, 2. calyx and corolla removed, 3. ditto in longitudinal section; f—g. fruits with their cross-sections; h. cross-section of twig (only one half of the anatomy drawn); k. cross-section of petiole; l. diagram of ♀ flower. (a, d, h, k. from *BS. 28555;* b—c, e—f, l. from *Elmer 7322;* g. from *Elmer 13337*) (dimensions in mm). *del.* Amir Namsah and Darmosoediro.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PHILIPPINES. Mindoro: *BS. 41080 (Ramos); FB. 3750 (Merritt), 4094 (Merritt); Whitford 1406, 1451.* — Luzon: *Adduru 133; BS. 13313 (Ramos), 20891 (Escritor), 23474 (Ramos), 28555 (Ramos & Edaño), 45199 (Ramos & Edaño), 45382 (Ramos & Edaño), 46665 (Ramos & Edaño); Cuming 795* (type), *800, 849, 885; Elmer 15823, 16133; FB. 25520 (Manuel); PNH. 37202 (Edaño); Ramos 1130; Vidal 162, 2287.* — Polillo: *BS. 10367 (MacGregor).* — Samar: *BS. 17461 (Ramos), 24511 (Ramos); PNH. 6235 (Sulit 2818).* — Leyte: *Elmer 7322; Wenzel 373.* — Biliran: *BS. 18716 (MacGregor).* — Mindanao: *BS. 83474 (Ramos & Convocar 2), 84125 (Ramos & Convocar 564); Elmer 10944, 11076, 13337; PNH. 10641 (Mendoza & Convocar 553), 11028 (Edaño 1600), 11268 (Edaño 1972); Williams 3040.*

Ecology: In primary forests at low and medium altitudes, rarely up to 600 m. *Fl.* Jan.—Oct., *fr.* (Jan.—)May—July.

Uses. Wood moderately hard.

Note. Apparently related to *C. euryphyllum*. Best characterized by its very widely branched leaves, inflorescences, and infructescences, and by its peculiar ventricose fruits, which, moreover, show an exceptionally large central cavity in cross-section.

39. **Canarium kostermansii** Leenhouts, 1955b, 191, f. 5a; 1956, 281. — *Fig. 23.*

Type: E. Borneo, E. Kutei, Sangkulirang Subdiv., G. Tepian Lobang on Menubar River, June 18, 1951, *Kostermans 5315*, ♀ (L; isotypes in BM, K).

Tree, 30 m by 60 cm. *Branchlets* rather slender, up to 1 cm thick, brown tomentose, ± glabrescent; pith with 2 concentric cylinders of vascular strands. *Stipules* very caducous, inserted on the petiole 1/3—3 cm from its base, subulate, *c.* 6 mm, leaving a prominent scar. *Leaves* 4—7-jugate. *Leaflets* lanceolate, slightly oblique, 10—22 by 3—7 cm, rather stiff chartaceous, glabrous; base unequally, broadly cuneate; margin entire; apex gradually narrowed into a long and slender (up to 15 by 3—4 mm), acute acumen; nerves 22—25 pairs (angle *c.* 60°), straight, faintly curving towards the margin, abruptly arching very close to the margin. *Inflorescences* (♂ unknown) axillary, racemose, 10—15 cm long, thinly tomentose, glabrescent. *Flowers* (♂ unknown) 12 mm long, with a slightly concave receptacle. *Calyx* 9 mm high. *Stamens* 4¼ and 5½ mm long, connate for 1½ mm; filaments glabrous. *Disk* annular, ½ mm high, up to 1½ mm fimbriate. *Pistil* glabrous. *Infructescences* racemose, 10—20 cm long, with 3—6 fruits; calyx funnel-shaped, 3-lobed, c. 1 cm diam. *Fruits* spindle-shaped, 3 by 1¼ cm, glabrous; pyrene faintly 5-angular in cross-section, smooth; lids *c.* 2 mm thick. *Seed* 1; sterile cells moderately reduced.

Distribution: Borneo.

BORNEO. *Kostermans 5315* (type); *NBFD. SAN 17153 (Wood).*

Ecology: Alt. up to *c.* 600 m. *Fl.* June, *fr.* Oct.

Note. This species is apparently allied with *C. pilosum*. It is mainly different from the latter by its more-jugate leaves, the large number of nerves, and by its fruits.

40. **Canarium pilosum** Bennett, 1875a, 533; 1875b, 103; Engler, 1883, 121; King, 1894b, 243; Ridley, 1900a, 58; 1922, 372, f. 39, *incl.* also *var. hirtellum;* Lam, 1932a, 212, t. 13 f. 104i, *incl.* also *var. hirtellum;* 1932b,

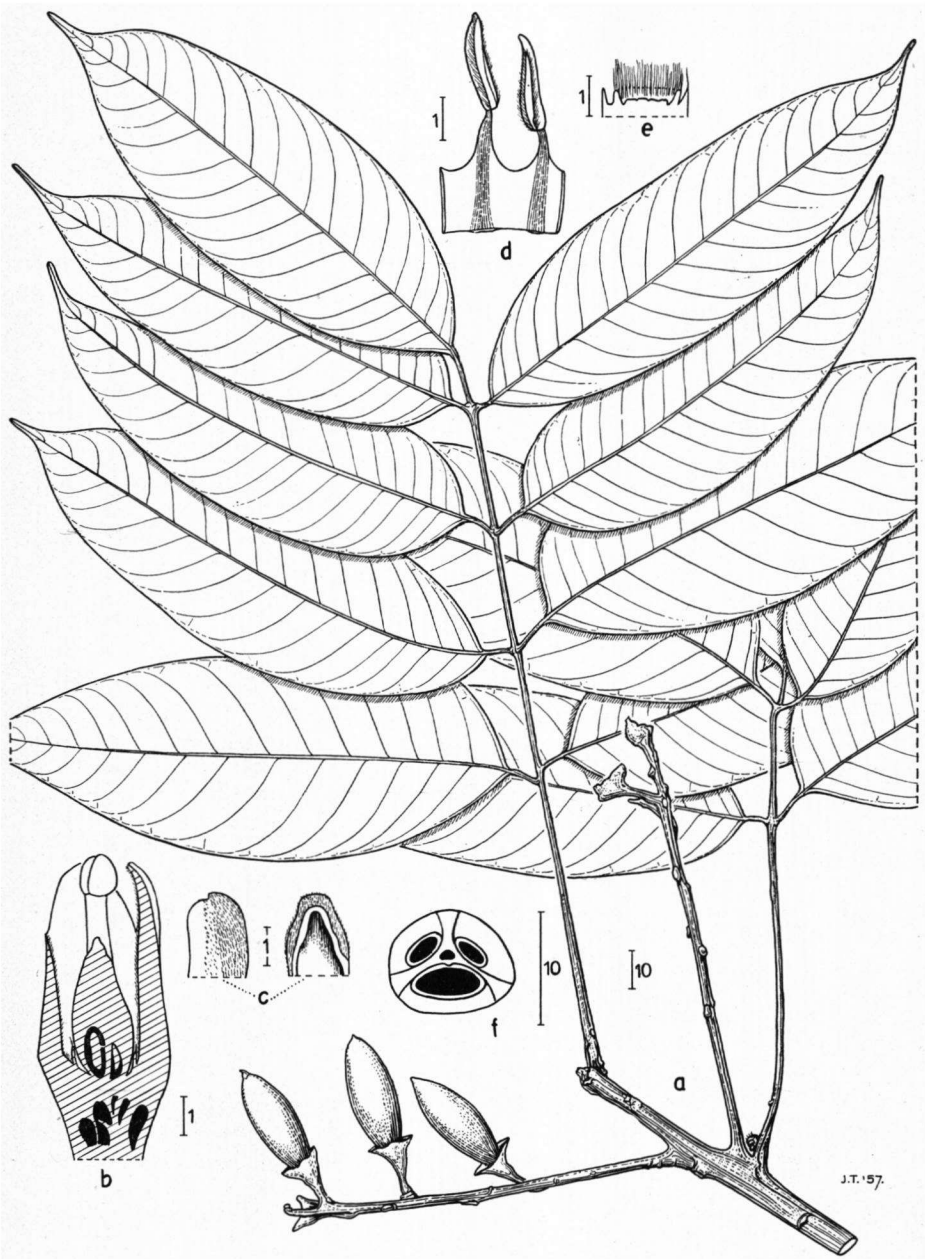


Fig. 23. *C. kostermansii* — a. twig with infructescences; b. longitudinal section of old ♀ flower; c. apex of petal; d. staminal tube of ♀ flower from inside; e. disk of ♀ flower in section; f. cross-section of fruit-kernel. (a. and f. from *NBFD SAN 17153;* b—e. from *Kostermans 5315*) (dimensions in mm).

472, t. 11 f. 68; Burkill, 1935, 432; Leenhouts, 1955a, 24, f. 11; 1956, 281, f. 21n. — *C. grandiflorum* Bennett, 1875a, 533; 1875b, 103; Engler, 1883, 122; King, 1894b, 242; Ridley, 1900a, 58; 1922, 370; Burkill, 1935, 429. — *C. hirtellum* Bennett, 1875a, 534; 1875b, 103; Hooker, 1887, t. 1575; Engler, 1883, 121; King, 1894b, 244. — *C. motleyanum* Engler, 1883, 133; Merrill, 1921, 317. — *Dacryodes scandens* Husson, 1952, 164, f. 1; Kalkman, 1954, 518.

Type: Malay Peninsula, Nov. 16, 1867, *Maingay 3103* (= *Kew distr. 302)*, ♂ (K; isotype in CAL).

Tree 10—28(—37) m by 20—45(—65) cm; buttresses, if present, up to 1 m high. *Branchlets* slender, ½—1 cm thick, long remaining densely woolly pubescent; pith with a peripheral cylinder of vascular strands, rarely also some in the central part. *Stipules* mostly persistent, inserted at the base of the petiole or on the petiole up to 2¼ cm from the base, subulate, up to 2 cm, sometimes absent. *Leaves* (0—)2—4(—6)-jugate, more or less pubescent in all parts, rarely entirely glabrous. *Leaflets* ovate to oblong-lanceolate, 4—25 by 1½—10 cm, chartaceous, totally glabrous to pubescent on the midrib above and woolly pubescent beneath; base (subcordate or) rounded to broadly cuneate; margin minutely serrulate to entire; apex gradually to subabruptly, short and bluntly to long and acutely acuminate; nerves 8—15 pairs (angle from base to apex 80—50°), curving, geniculate near the margin, often more or less arching. *Inflorescences* axillary to pseudoterminal, rarely terminal, glabrescent, rather few-flowered, ♂ ones narrowly thyrsoid, 4—10—26 cm long, ♀ ones more racemose, 1½—10 cm. *Flowers* ½—1¼ cm long, slender, specially the ♂ ones. *Calyx* in ♂ flowers 2—4 mm high, in ♀ ones 5—6 mm. *Stamens* glabrous, in ♂ flowers 6—8 mm long, connate for ½—3 mm; in ♀ flowers 4 mm long, nearly entirely connate. *Disk* cupular, up to 1 mm high, pilose. *Pistil* in ♂ flowers very small or absent. *Infructescences* 1½—10 cm long, with 1—4(—8) fruits crowded at the top of the stalk; calyx saucer-shaped, 3-lobed, 6—13 mm diam. *Fruits* see under ssp.

Distribution: Sumatra (*incl.* also Simalur), Malay Peninsula, Borneo.

Taxonomy. The following two subspecies — in S. Sumatra and E. Borneo linked together by some intermediate specimens — are distinguishable:

A. Subsp. **pilosum**. — *C. grandiflorum* Benn. — *C. hirtellum* Benn. — *C. motleyanum* Engl.

Stipules nearly always present. Flowers 1 cm long or more, densely pubescent outside. Stamens in ♂ flowers connate for 2—3 mm. Pistil pilose. Fruits oblong (to ovoid), at the apex nearly always truncate and with 3 'shoulders', rarely tapering, mostly rounded 3-angular in cross-section, (1¾—)2¼—3¼ by (¾—)1—1½ cm, glabrous except sometimes at apex; pyrene smooth, the sides concave to faintly keeled; lids 1½(—3) mm thick. Seed nearly always 1, the sterile cells strongly reduced.

Distribution: as the species.

SUMATRA. *Bartlett 7345; Dumas 1632; FRI. bb. 9150, bb. 32099, 43 T 1P 702, 180 T 1P 702; herb. L 897.363—301; Junghuhn 16.* — Simalur: *Achmad 485, 640, 662, 845, 980, 1160, 1472, 1561.*

MALAY PENINSULA. *Beccari herb. 2196; Burkill 862, 1284; Curtis 630, 650, 656,*

2251; Hullett 516; KEP. 361 (Rahman), 829, 918 (Hamid), 9633 (Omar), 18188 (Symington), 32822 (Walton), 41015 (Sow), 54666, 54810, 54828, 65600, 69013, 73054, 73513; King's coll. 2983, 6054, 6138, 6519, 6778, 7901, 8819; Mahamet 1869; Maingay 1388 (= Kew distr. 312) (type *C. grandiflorum* Benn.), *1969 (= Kew distr. 302), 3103 (= Kew distr. 302)* (type); *Ridley 289, 656, 1869 (= Mahomet 1869?), 3976, 4654, 12570; Scortechini 424b; SF. 13129 (Haniff), 20088 (Holttum), 21429 (Henderson), 26135 (Corner), 26197 (Corner), 31590 (Corner), 33142 (Corner), 34995 (Ngadiman), 36135 (Corner), 36420 (Ngadiman), 37130 (Corner), 39996 (Sinclair); Wallich 8100, 8102* (syntype *C. hirtellum* Benn.), *9047* (syntype *C. hirtellum* Benn.); *Wray Jr. 2645.*

BORNEO. *Barber 283* (syntype *C. motleyanum* Engl.); *Motley 243* (type *C. motleyanum* Engl.); *NBFD. SAN 16326 (Wood), SAN 16530 (Wood).*

cultivated:

FIJI ISLANDS. *Gillespie 3434.*

Ecology: Rather common in primary forests, also in swamps, up to *c.* 350(—1250) m. *Fl.* (Dec.—)March—Aug.(—Oct.), *fruiting* (March—) April—July(—Nov.).

Uses. The wood is said to be durable against insects and is used for house-building.

Note. In one specimen (*Henderson SF. 21429*) I found fertile fruits and ♂ flowers.

B. Subsp. **borneensis** Leenhouts, 1955b, 193, f. 5d; 1956, 282. — *Dacryodes scandens* Husson.

Type: North Borneo, Mt Kinabalu, Penataran basin, near Bidow-Bidow Falls, alt. 1500 m, Sept. 1, 1933, *Clemens 40163*, ♀ & fr. (L; isotypes in A, BM, BO, G, NY).

Tree *c.* 10(—25) m high, very rarely a pseudoliane. Stipules absent. Leaves 0—5-jugate. Leaflets always glabrous; base sometimes subcordate; margin always entire; intermediate veins more strongly developed. Inflorescences narrower and with few flowers. Flowers glabrous, ♂ ones *c.* 5 mm long, less slender. Stamens in ♂ flowers slightly confluent at base. Disk in ♂ flowers rather variable, with or without a rudimentary pistil. Pistil in ♀ flowers glabrous. Fruits ellipsoid to fusiform, tapering at base and apex, 3¾—4½ by 1½ cm.

Distribution: Borneo (Mt Kinabalu).

BORNEO. *Clemens 31095* (type *Dacryodes scandens* Husson), *40163* (type), *40546* (paratype), *40599* (paratype); *Kostermans 7140* (aff.), *7184* (aff.); *SF. 26356 (Carr)* (paratype).

Ecology: In forests, *c.* 1500 m. *Fl.* Sept.—Oct. (Jan., March), *fr.* April, July, Sept.—Oct.

Note. *C. pilosum* is apparently the centre of a group of rather closely related species, *viz. C. kostermansii, merrillii* — especially close to *C. pilosum* ssp. *borneensis* —, *album, pimela, parvum, subulatum, intermedium,* and *kipella,* moreover perhaps also *C. australianum. C. pilosum* itself is a rather variable species, especially its ssp. *borneensis*; ssp. *pilosum* is usually well characterized by the insertion of the stipules (on the petiole at a rather large distance from its base), by the long and very slender flowers, and by the fruits, which are often more or less truncate or even 'shouldered' at the apex. Most of the related species are much less variable; though in general appearance often very much resembling *C. pilosum,* they are constantly different each in a few characters.

41. Canarium merrillii H. J. Lam, 1929, 117; 1932a, 213, t. 16 f. 133, *incl. var. originarium & var. villosum*; 1932b, 489, t. 12 f. 76; Leenhouts, 1956, 282. — *non C. merrillii* Perkins, 1904, 98, *nom. nud.* (= *C. asperum* Benth.).

Type: North Borneo, Sandakan, Oct.—Dec. 1921, *Elmer 20326*, ♂ (PNH †; isotypes in A, BM, G, K, L, NY, P, SING, U, Z).

Small tree, 10—20 m by 15—40 cm. *Branchlets* slender, glabrescent; pith not very compact, with some large peripheral vascular strands. *Stipules* very caducous, inserted at the base of the petiole, or on the petiole up to 1 cm from the base, subulate, 2—5 mm. *Leaves* 0—5-jugate. *Leaflets* (ob)ovate to lanceolate, (3—)5½—16 by (1¼—)2¾—5½ cm, stiff chartaceous, upper side glabrous except the midrib, lower side with scattered to crowded papillae, sometimes each of them provided with a soft hair; base cuneate; margin entire; apex subabruptly narrowly acute-acuminate; nerves 6—14 pairs (angle 50—60°), gradually curving, more or less distinctly arching at some distance from the margin. *Inflorescences* glabrous or slightly pubescent, either in the upper leaf-axils, narrowly thyrsoid, few-flowered, or together forming one lax terminal panicle, in the latter case up to 30 cm long, main branches up to 15 cm, laxly thyrsoid, the ♂ ones with 15—20 flowers, ♀ ones with fewer flowers. *Flowers* 8—9 mm long, rather slender, nearly glabrous outside. *Calyx* 4—5 mm high. *Stamens* glabrous, in ♂ flowers 8 mm long, connate for ½—2¼ mm, in ♀ flowers 4—5 mm, connate for 2 mm. *Disk* 1½ mm high, fimbriate, in ♂ flowers cupular, rather thick, in ♀ flowers thinner and slightly 6-undulate. *Pistil* glabrous, in ♂ flowers absent. *Infructescences* shorter and more compressed than the inflorescences, main branches with 3—6 fruits each; calyx saucer-shaped, 3-lobed, 6—7 mm diam. *Fruits* elliptic, tapering specially to the apex, trigonous in cross-section, 2½—3 by 1.1—1½ cm, glabrous; pyrene rounded 3-angular, smooth; lids ½—1½ mm thick, bony. *Seeds* 1(—2), sterile cells compressed, linear.

Distribution: Borneo (specially Br. N. Borneo).

BORNEO. *Amdjah 1036* (paratype); *Beccari PB 239; Clemens 26808, 26808 A, 27158, 27159, 30712, 40585, 50212; Elmer 20326* (type); *Endert 4507* (type *C. merrillii var. villosum* H. J. Lam); *NBFD. 3249 (Orolfo), 9995 (Enohai), A 590 (Kadir), A 677 (Kadir), A 4379 (Wood & Wyatt-Smith); SF. 26715 (Carr).*

Ecology: In old forests, mostly at high altitudes (1000—1600 m), rarely in the lowlands. *Fl.* Sept.—March, *fr.* Jan.—Dec.

Uses. The wood is soft.

Notes. This species is related to *C. pilosum* (Sumatra, Malay Peninsula, Borneo), especially to its ssp. *borneensis*, and to *C. album* (Indo-China); mainly characterized by the scabrous lower side of the leaflets, a character which furthermore I only occasionally met with in *C. album*.

Though the inflorescences often look like being truly terminal, the terminal bud nearly always develops after anthesis and the infructescences are then segregated into a number of axillary ones.

42. Canarium album (Lour.) Raeuschel, 1797, 287; De Candolle, 1825, 80; Roemer et Schultes, 1829, 81; Hance, 1871, 38; Engler, 1883, 149; Guillaumin, 1908c, 617, t. 19 f. 1; 1909a, 238, f. 22^{12}, 240, f. 23^{1}; 1909c,

365; 1911c, 714, f. 76 (p.p. = *C. subulatum* Guill.); Hayata, 1911b, 52; Merrill, 1917, 304; Walker, 1928, 100, 102; Merrill, 1935, 226; Walker, 1954, 148, f. 82. — *non C. album* Blanco, 1837, 793 (= *C. luzonicum* A. Gray). — ? *C. sinense Cana* Rumphius, 1741, 154; Thunberg, 1784, 368. — *Pimela alba* Loureiro, 1790, 408; 1793, 495; Poiret, 1811, 72; Blume, 1850, 220. — *Hearnia balansae* De Candolle, 1894, 580. — *C. tonkinense* Engler, 1896, 240; Guillaumin, 1911c, 711 (p.p. = *C. parvum* Leenh.); 1946, 678 (*p. min. p.*, fig. excl.; the major part is *C. parvum* Leenh.). — *C. copaliferum* Chevalier, 1918, 807, *nom. nud.* — *Fig. 24.*

Type: Tonkin, Phù-Tho Prov., Chân-Môn For. Res., 21/22-4-1914, *Fleury in herb. Chevalier 30122*, ♀, neotype (L; isotype in P).

Tree, (4—)10—20(—30) m high, 14—50—150 cm diam. *Branchlets* 5—6 mm thick, the young parts fulvous tomentose, soon glabrescent, older parts sometimes gnarly by the strongly prominent scars of leaves and inflorescences; pith with a peripheral cylinder of small vascular strands, rarely moreover some strands in the central part. *Leaves* 3—6-jugate. *Stipules* present in the bud only, inserted on the twig next to the base of the petiole, even the scar usually nearly invisible. *Leaflets* usually distinctly sinuous (especially the basal pairs), lanceolate or elliptic (to ovate), 6½—14 by 2—5½ cm, chartaceous to coriaceous, gabrous or with some scattered bristles on the nerves below, lower side often minutely verrucose; base oblique, cuneate to rounded; margin entire; apex gradually to subabruptly acuminate, acumen up to 2 cm long, blunt; nerves 12—16 pairs (angle 65—75°), straight to faintly curved in the broader, strongly curved in the narrower side of the leaflet, more or less distinctly arching near the margin; intermediate veins sometimes distinctly developed; venation dense. *Inflorescences* axillary, minutely tomentose to glabrous, the ♂ ones thyrsoid, 15—30 cm long, many-flowered, the ♀ ones racemose, 3—6 cm long, with up to 12 flowers. *Flowers* sparsely tomentose to glabrous, ♂ ones 5½—8 mm long, ♀ ones *c.* 7 mm. *Calyx* 2½—3 mm, in ♀ flowers subtruncate. *Stamens* 6, glabrous, the filaments more than halfway (in ♀ flowers up to nearly totally) connate. *Disk* ♂ globular to cylindrical, 1—1½ mm high, faintly 6-lobed, with a central canal or solid, the upper side with some bristles; in ♀ flowers annular, faintly 3-undulated, 1 mm high, thick and fleshy, pilose on the inner surface. *Pistil* densely shortly pilose, in ♂ flowers minute or none. *Infructescences* 1½—15 cm long, with 1—6 fruits; the calyx flat, 3-lobed, ½ cm diam., the lobes recurved. *Fruits* ovoid to spindle-shaped, round in cross-section, 2½—3½ by 1½—2 cm, glabrous, white when mature; pericarp rather thick, coarsely wrinkled when dry; pyrene acuminate, rounded (to 6-angular) in cross-section, with a distinct groove between the blunt angle-ribs and the lids, the latter with a faint median rib, surface furthermore slightly undulated; lids 1½—2(—3) mm thick. *Seeds* 1—2, the sterile cells slightly reduced, round in cross-section.

Distribution: Annam (from about 16° N.L. northwards), Tonkin, Southern China (up to about 27° N.L.), and Hainan; as the species is much cultivated in the same region (especially in Southern China, also occasionally in Formosa, in Japan — Nagasaki — and in Okinawa Isl.) possibly part of the 'wild' specimens are naturalized ones.

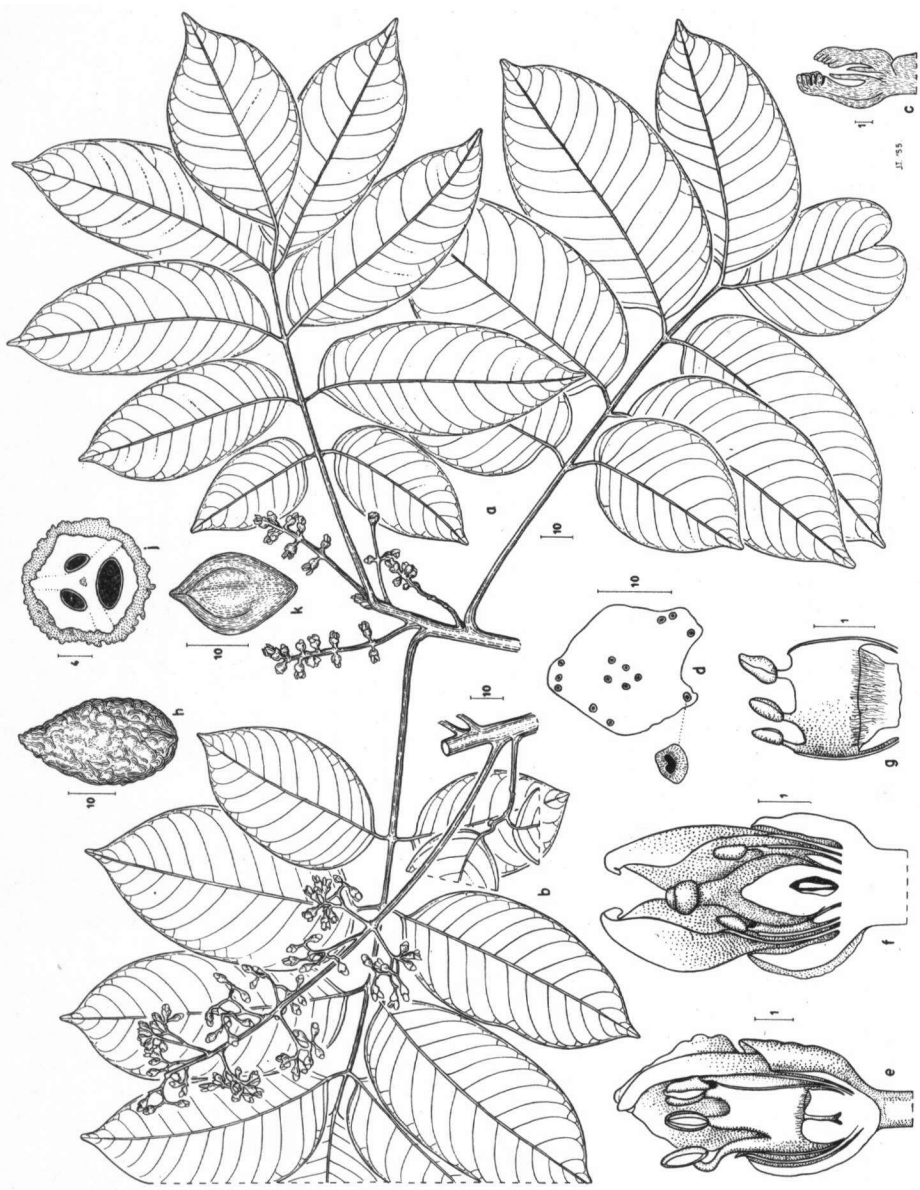


Fig. 24. *C. album* — a. twig with ♀ inflorescences; b. ♂ inflorescence; c. terminal bud, showing the stipules; d. twig, cross-section of the pith; e. longitudinal section of ♂ flower; f. ditto of ♀ flower; g. ditto, stamens and disk of ♀ flower; h. fruit; i. ditto, cross-section; k. fruit-kernel. (a, f—g. from *Wilson 3816*; b. from *Pételot 5751*; c. from *Fung 20421*; d. from *Lei 729*; e. from *Wilson 3375*; h. from *Canton Christian College 1890*; j—k. from *Lei 868*) (dimensions in mm).

ANNAM. *Fleury in herb. Chevalier 30141; Poilane 29914.*

TONKIN. *Balansa 3706* (type *Hearnia balansae* DC. & *C. tonkinense* Engl.); *Casalta 5; Fleury in herb. Chevalier 30122* (neotype), *37542* (syntype *C. copaliferum* Chev.), *37921, 37960, 38026; Pételot 2592, 5751.*

CHINA. Yunnan: *Wang 76379, 77759, 80718.* — Kwangsi: *Ching 7395, 8083.* — Kwang-tung: *Canton Christian College 1813 (Levine), 1890 (Levine); Tsiang 2101.* — Fukien: *Carles 572, 699; Chung 4662, 6860; Warburg 5579.*

HAINAN. *Chun & Tso 43766; Fung 20421; How 70461, 70807; Lau 42, 1786, 1850, 3504, 26756; Lei 729, 868; Liang 62097, 63216, 63325, 63472; Tsang 432, 722; Wang 32908.*

cultivated:

MALAY PENINSULA. P. Penang: *SF. 3767 (Haniff).*

CHINA. *Chung 2396, 2778, 7357, 8524; Dunn 90; Fang 2293; Feng 12394; Fortune 55, 55a; herb. Hance 15677; Keng 26; MacClure 1720, 1752, 1760; Wilson 3375, 3376, 3816.*

JAPAN. Nagasaki: *Thunberg Pl. obscurae 99.*

OKINAWA ISL. acc. to Walker, 1954, *l. c.*

Ecology: In parklands to dense forests, on dry to moist soils, usually at medium alt. (400—1200 m). *Fl.* (March—)May—June(—Aug.), *fr.* June—Oct.(—Dec.).

Uses. Planted as an ornamental tree. The wood is not very durable; it is in use a. o. for cheap furniture and for matches. The resin also is in use, but most important are the fruits, which are a highly esteemed titbit, and from which the fleshy parts as well as the seeds are eaten, prepared in several ways. Furthermore, the nut is used for making carvings.

Notes. Morphology. In broad outline, there are some small differences between the specimens from China and those from Indo-China, especially in the ♂ inflorescences and flowers. The branches of the ♂ inflorescences in Chinese specimens are usually branched in the upper half only, and consequently the lateral cymes are distinctly stalked; in Indo-Chinese specimens, the cymes are branched almost from the base, moreover they are much shorter (the type-specimen of *C. tonkinense*, however, is very laxly thyrsoid). In addition, in ♂ flowers of Indo-Chinese specimens the ovarial rudiment is usually lacking, or, if present, very tiny, in Chinese specimens it is more often present and less strongly reduced. In my opinion, in both these characters the Chinese specimens are slightly more primitive than are the Indo-Chinese ones.

Stipules are always present in this species (in contradistinction to *C. pimela)*, if only in the terminal bud, and it is often difficult detecting their scars in older leaves. This is why *C. tonkinense* was described by Engler, and afterwards by Guillaumin, as having no stipules at all.

Taxonomy. The present species belongs to the relationship of *C. pilosum*; apparently it is closest to *C. pimela* (same region; the latter is different by the absence of stipules, the more lax nervation, and the fruits, which are black when fresh, and almost smooth when dried). The most distinctive characters of the present species are the slightly sinuate leaflets, which are light greyish-green when dry and possess a very minute and dense venation.

Nomenclature. Rumphius's *C. sinense Cana* probably belongs to the present species rather than to *C. pimela* (his *Tsjacana* possibly is *C. pimela,* his *Tengio Cana* in my opinion is no *Canarium* at all).

43. Canarium pimela Leenhouts, *nov. nom.* — ? *C. sinense Tsjacana* Rumphius, 1741, 154. — *Pimela nigra* Loureiro, 1790, 407; 1793, 495; Blume, 1850, 220. — *C. pimela* König, 1805, 361, t. 7 f. 1, *nom. illeg.*; Persoon, 1807, 616; Sprengel, 1825, 125, *excl. syn. C. sylvestre*; De Candolle, 1825, 80; *non* Blume, 1826, 1162 (= *C. kipella*); Roemer & Schultes, 1829, 80, *excl. spec. Javanicae;* 1830, 1623; *non* Spanoghe, 1835, 346 (= *C. oleosum*); *non* Blanco, 1845, 545 (= *C. asperum)*; Hance, 1871, 38; Engler, 1883, 122; Forbes & Hemsley, 1886, 113; Merrill, 1917, 304; Walker, 1928, 103, 104; Merrill & Chun, 1935, 253; Merrill, 1935, 227. — *Lipara nigra* Loureiro *ex* Gomes, 1868, 30, *nom. nud.* — *C. nigrum* (Lour.) Engler, 1896, 240, *nom. illeg.*; Guillaumin, 1909a, 238 f. 22^{19}; 1909c, 365, 493; 1911c, 710; Chevalier, 1918, 806; Guillaumin, 1946, 677. — *non C. nigrum* Roxburgh, 1814, 49 (= *C. acutifolium). — Fig. 25.*

Type: Cochin-China, 1774, *Loureiro s. n.*, ♀ (P).

Tree, (7—)10—20(—30) m high, 15—150 cm diam. *Branchlets* 7—10 mm thick, glabrous; pith with a peripheral cylinder of vascular strands, moreover central part sometimes with some strands. *Leaves* 4—6-jugate, glabrous. No *stipules*. *Leaflets* oblique, often distinctly falcate, broad-elliptic (to ovate or suborbicular, rarely oblong), 6—17 by 2—7½ cm, chartaceous to coriaceous; base acute, often decurrent; margin entire; apex rather abruptly acuminate, acumen short, broad, and blunt; nerves (8—)11(—15) pairs (angle 70—75°), straight to faintly curved, more strongly curving and more or less distinctly arching near the margin; veins and veinlets coarsely reticulate. *Inflorescences* axillary, glabrous, laxly thyrsoid (♂) to subracemose (♀), 15—40 cm long, ♂ many-, ♀ few-flowered. *Flowers* (sub)glabrous, ♂ 7 mm, slender, ♀ 9 mm. *Calyx* in ♂ flowers 2½ mm, distinctly lobed, in ♀ flowers 3½—4 mm, subtruncate. *Corolla* in ♀ flowerbuds characteristically conical. *Stamens* 6, glabrous (except 2 rows of bristles on the anthers in ♀ flowers), in ♂ flowers nearly halfway, in ♀ flowers slightly more than halfway connate. *Disk* annular, ½—1 mm high, fimbriate, in ♂ flowers thick-fleshy, with a narrow central canal, in ♀ flowers thin, 6-undulate. *Pistil* glabrous, in ♂ flowers absent. *Infructescences* 8—35 cm long, lax, with 1—4 long-stalked fruits; calyx nearly flat, faintly triangular to suborbicular, 8—10 mm diam. *Fruits* narrowly-ovoid, 3—4 by 1¾—2 cm, circular to faintly triangular in cross-section, glabrous; pericarp thin, minutely wrinkled when dry; pyrene nearly circular in cross-section, smooth or with a faint median rib on the lids; lids *c.* 3 mm thick. *Seed(s)* 1—2; fertile cells usually with a distinct adaxial rib, sterile cells moderately reduced.

Distribution: Southern China (from about 27° N.L. southwards), Hainan, Tonkin, Laos, Annam, and Cambodja; as the species is much cultivated, especially in Southern China and Tonkin, possibly part of the 'wild' specimens are naturalized ones.

China. Kwang-si: *Ching 6536; Morse 318.* — Kwang-tung: *Canton Christian College 775 (Levine), 2489 (To), 4000 (Laam); Ho 60121; MacClure 453 (CCC. 7101); Merrill 10929; Tsiang 469, 2168.* — without locality: *Chun 5287.*

Hainan. *Chun & Tso 44379; Henry 8731; How 70764, 72094, 72644, 73381; Lau 26195, 26767; Liang 61765, 62447; MacClure 767; Wang 35669.*

Tonkin. *Balansa 3694, 4602; Bon 1545; Fleury in herb. Chevalier 30091, 37543, 37833, 37958; Pételot 2653; Service forestier de l'Indo-Chine 8, 57.*

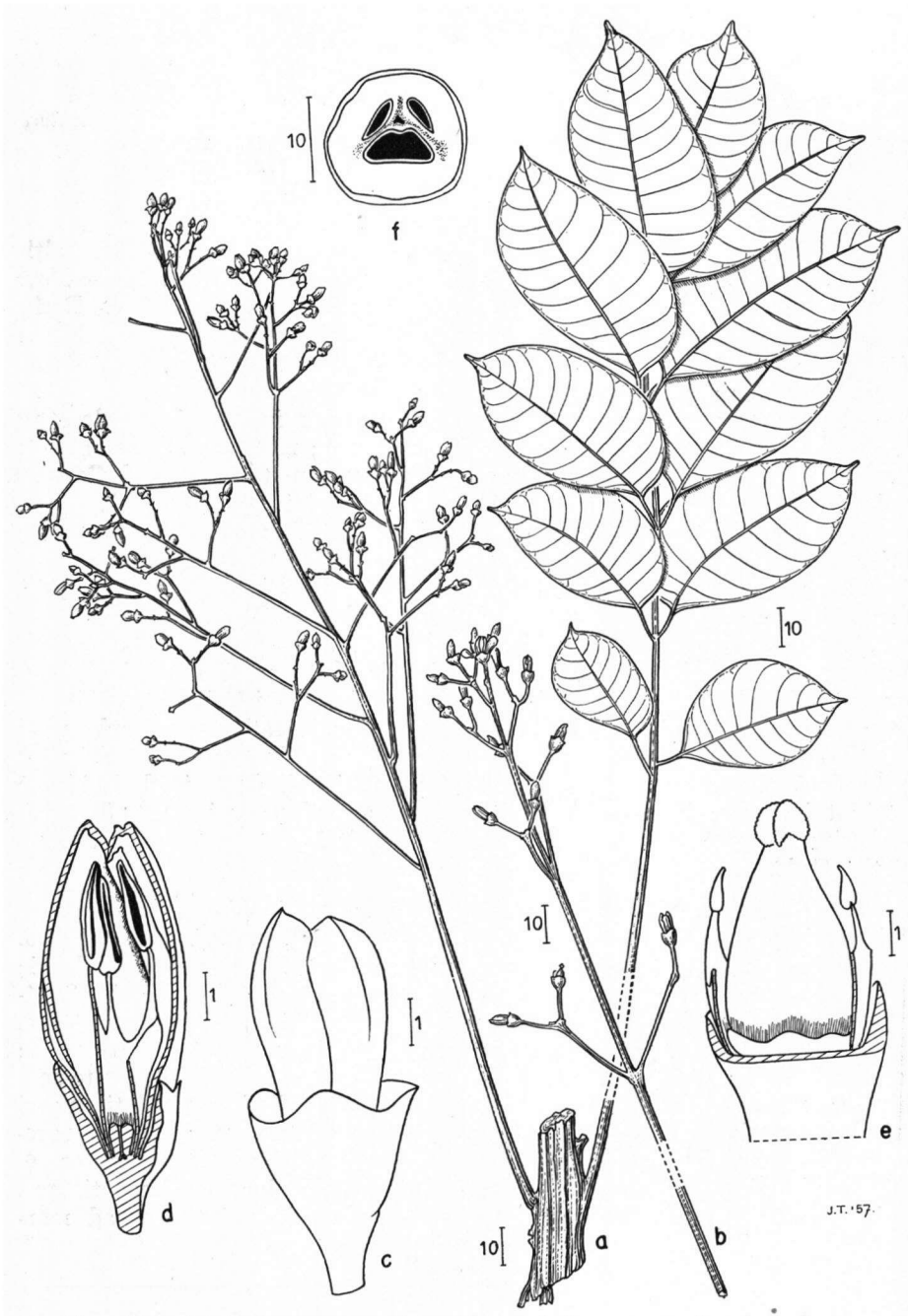


Fig. 25. *C. pimela* — a. twig with ♂ inflorescence; b. ♀ inflorescence; c. ♂ flower; d. ditto, longitudinal section; e. ♀ flower, partly cut, corolla removed; f. fruit in cross-section. (a. from *Balansa 4602;* b. from *Hance 5866;* c—d. from *How 72094;* e. from *Burke s.n.;* f. from *How 72644*) (dimensions in mm).

LAOS. *Kerr 20890; Poilane 2013.*
ANNAM. *Loureiro s.n.* (type); *Poilane 10255.*
CAMBODJA. *Collard s.n.*
cultivated:
CHINA. *Bodinier 1453; Hance 5866; Lingnan Univ. herb. 11112 (To); MacClure 1721 (CCC. 13545), 1756 (CCC. 13580), 1757 (CCC. 13581); Wright 110*
INDO-CHINA. *Balansa 3856; Fleury in herb. Chevalier 37721.*
MAURITIUS. *Burke in herb. L 955.045—534* (also in G).
CUBA. *Jack 8540.*

Ecology: In dense forests to parklands, usually at medium altitudes (up to 1000 m). *Fl.* (March—)April—May(—Dec.), *fr.* May—Nov.

Uses: Planted as an ornamental tree. Timber of little use. Resin used for lighting (for composition *cf.* Crevost, Bull. Econ. Indo-Chine, Nouv. Sér. 28, 1925, 30). The fruits are still more esteemed than those of *C. album* (see Hance, *l. c.*; Walker *l. c.*).

Notes. Taxonomy. The present species is especially close to *C. album* (same region; for differences see there); moreover, there is some likeness to *C. gracile* (Philippines; very different in its fruits and flowers, and with very widely branched inflorescences and infructescences).

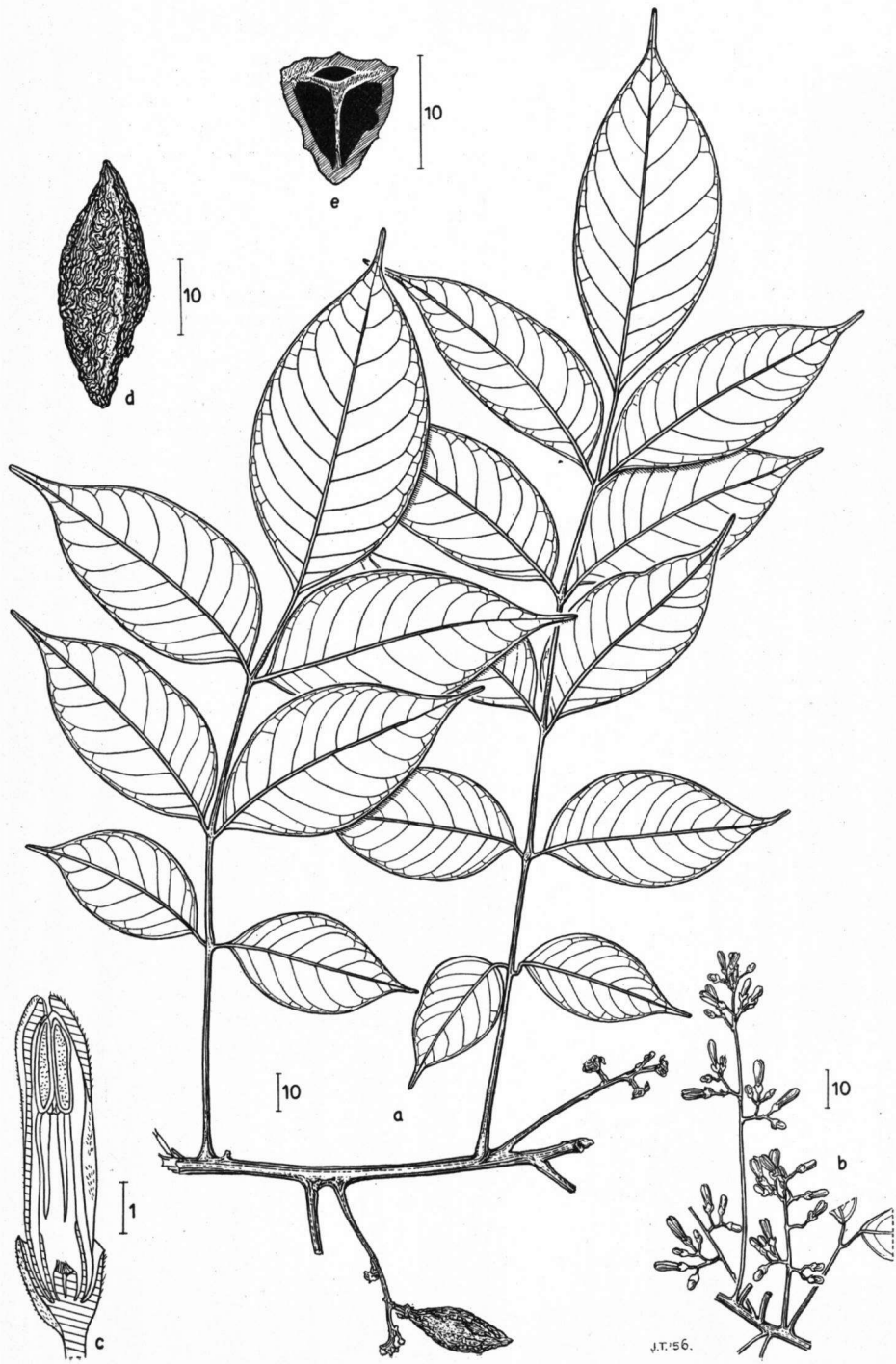
Nomenclature. The conspecificity of Rumphius's *C. sinense Tsjacana* is not quite certain, though probable.

The name *C. pimela* Koen. is illegitimate, as *Pimela nigra* Lour. is mentioned as a synonym (art. 73 Intern. Rules of Nomencl., ed. Stockholm). The correct name should have been *C. nigrum*. In 1814 however, Roxburgh published his *C. nigrum*, which is quite another species. Consequently Engler's name *C. nigrum* (Lour.) is also illegitimate, being a later homonym (1896). As the name *C. pimela* is rather commonly used for the present species, which moreover is a well-known one, cultivated for a long time already on account of its fruits, I deem it desirable to retain this name; in my opinion, this is in accordance with art. 81, and, by basing the new name upon the same type, it is not contrary to art. 74 of the Code.

44. Canarium parvum Leenhouts, *nov. sp.* — *C. tonkinense* (*non* Engl.) Guillaumin, 1911c, 711, *pro parte*; 1946, 678, f. 83[3-8], *p. maj. p.* — *Fig. 26.*

Latin diagnosis. Arbor parva. Ramuli c. 4 mm diam., glabri; medulla paucis fasciculis vasorum peripheralibus suffulta. Folia 3—4-jugata, estipulata. Foliola elliptico-ovata, 6½—13 × 3—5 cm, chartacea, supra in costae basim et subtus in nervis omnibus minute pubescentia; basis subobliqua, late cuneata; margo integer; apex subabrupte acuto-acuminata; nervi utrimque 10—12, ad marginem folioli geniculati, nervi apicales conspicue arcuatim conjuncti. Inflorescentiae ♀ axillares, racemosae, 5—7 cm longae, c. 6—7 flores gerentes, glabrescentes. Flores ♀ 5½ mm longi, subglabri. Calyx 3 mm altus. Stamina 6, filamentis pro majore parte connatis. Discus annularis, 1 mm altus, intus et ad marginem longe-pilosus. Pistillum dense pilosum.

Fig. 26. *C. parvum* — a. twig with infructescences; b. ♂ inflorescences; c. ♂ flower in longitudinal section; d. fruit; e. fruit-kernel in cross-section. (a. from *Balansa 3835;* b. from *Pételot 3023;* c. from *Eberhardt 4355;* d—e. from *Bon 3317*) (dimensions in mm).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Type: Tonkin, Tu-Phap, June 1887, *Balansa 3835*, ♀ & fr. (L; isotypes in K, P).

Shrub or small tree, 1—5(—*c.* 14) m high, 15—30 cm diam. *Branchlets* 3—5 mm thick, glabrous with the exception of the minutely velvety terminal bud, sometimes lenticellate; pith with some peripheral vascular strands. *Leaves* (2—)3—4-jugate. *Stipules* none. *Leaflets* ovate to elliptic-ovate (to suborbicular), 4½—8½(—13) by 2—5½ cm, herbaceous to stiff-chartaceous, often slightly pubescent on the base of the midrib above, scattered shortly soft-hairy beneath, specially on the nerves; base slightly oblique, rounded and decurrent to cuneate; margin entire; apex usually abruptly acuminate, acumen ½—1½ cm long, slender, blunt to acute; nerves *c.* 10—12 pairs (angle *c.* 55—75°), faintly curved, geniculate near the margin, apical ones distinctly arching. *Inflorescences* axillary, scattered minutely pilose to nearly glabrous, the ♂ ones narrowly thyrsoid, 4½—9 cm, few-flowered, the ♀ ones racemose, 3—7 cm, with few flowers. *Flowers* ♂ 7—10 mm long, slender, minutely pubescent, ♀ 5½ mm, subglabrous. *Calyx* in ♂ flowers 1½—2 mm, in ♀ ones 3 mm. *Stamens* 6, glabrous, in ♀ flowers minute; filaments in ♂ flowers *c.* $^1/_3$ connate, in ♀ flowers more than halfway connate. *Disk* annular, 1 mm high, in ♂ flowers thick-fleshy, the margin truncate, faintly 6-lobed, ciliate, with a narrow central canal, in ♀ flowers inner surface and margin long-pilose. *Pistil* densely ferruginously hairy, in ♂ flowers absent. *Infructescences* 4—11 cm long, minutely greyish pilose, with 1—4 fruits; calyx 3-lobed, *c.* 5 mm diam., the lobes recurved. *Fruits* spindle-shaped, 3-angular in cross-section, 3—3½ by *c.* 1¼ cm, glabrous; pyrene with 1(—3) blunt (to acute) ribs at every angle, the lids with a faint median rib, and distinctly bordered; lids 1 mm thick, very hard; seeds (1—)2, sterile cell(s) rather strongly reduced.

Distribution: Tonkin and N. Annam.

TONKIN. *herb. d'Alleizette in herb. L 951.54—172; Balansa 3835* (type), *4322; Bon 3317; Eberhardt 4355; Fleury in herb. Chevalier 37685; Lecomte & Finet 398, 648, 674, 689; Pételot 3023, 5838; Prades 11; Service forestier de l'Indo-Chine 25 (Butreau).* ANNAM. *Poilane 29373* (dubious specimen); *Service forestier de l'Annam 20.*

Ecology: In forests at low altitudes. *Fl.* March—Aug., *fr.* (April—) June—Oct.(—Dec.).

Notes. Apparently related to *C. pimela* and *album*; characterized by its small dimensions, its slender brown twigs, small, distinctly acuminate leaflets with few, strongly curved nerves, and by the absence of stipules.

45. Canarium subulatum Guillaumin, 1908c, 613; 1911c, 715; 1946, 680, f. 84[6-9]; Leenhouts, 1956, 211 f. 1 i—j. — *C. vittatistipulatum* Guillaumin, 1908c, 612; 1911c, 714; 1946, 680. — *C. cinereum* Guillaumin, 1908c, 612; 1911c, 717. — *C. rotundifolium* Guillaumin, 1908c, 614, t. 19 f. 3; 1911c, 713; Craib, 1926b, 248; Guillaumin, 1946, 680. — *C. thorelianum* Guillaumin, 1908c, 614, t. 19 f. 4; 1911c, 712; 1946, 680, f. 84[1-5]. — *C. kerrii* Craib, 1911, 26; Guillaumin, 1911c, 716; Craib, 1912, 35; 1926b, 247; Guillaumin, 1946, 680. — *C. album* (*non* Raeusch.) Guillaumin, 1911c, 714, *p. maj. p.* — *C. venosum* Craib, 1926a, 341; 1926b, 248; *non* Guillaumin, 1946, 679 (= *C. littorale*).

Type: S. Cochin-China, Lepoo Mts, March 1866, *Pierre 690c*, ♂, lectotype (P; isotypes in A, BM, L, NY, SING).

Tree, (8—)10—15(—25) m high, 30—60 cm diam., apparently sometimes deciduous. *Branchlets* 4—9(—15) mm thick, fulvous-tomentose when young, glabrescent, leaf-scars strongly prominent; pith with a peripheral cylinder of small vascular strands. *Leaves* 2—5-jugate. *Stipules* more or less caducous, inserted at the conjunction of branchlet and petiole or up to 1 cm on the latter, subulate to filiform, ¾—2½ cm long, tomentose. *Leaflets* broad-ovate to lanceolate, 9—18 by 3½—11 cm, stiff-herbaceous to chartaceous, usually tomentose on midrib and nerves above, densely tomentose on the whole lower surface, rarely glabrescent; base in the basal pair of leaflets equilateral, rounded to cordate, in the higher pairs oblique, upper half rounded, lower half cuneate and decurrent, sometimes, especially in the uppermost pair of leaflets, till the base of the petiolule; margin minutely serrate, dentate or repandous, often with hair tufts; apex gradually acuminate, acumen short, blunt or acute; nervation often more or less waffle-like prominent beneath, nerves 12—20 pairs (angle 55—90°, gradually decreasing from base to apex), straight to faintly curved, geniculate near the margin, in the apical part only more or less distinctly arching; sometimes some intermediate veins well-developed. *Inflorescences* axillary, narrowly laxly thyrsoid (♂) to racemose (♀), scattered pubescent, ♂ ones 7—25 cm long, ♀ ones 8—10 cm. *Flowers* 7—11 mm, minutely pubescent, slender. *Calyx* 2½—3½ mm, faintly lobed. *Stamens* 6, glabrous, in ♂ flowers up to halfway connate, in ♀ flowers small, at least halfway connate. *Disk* fimbriate, in ♂ flowers thick-annular, *c.* 1 mm high, with a narrow central canal or solid, in ♀ flowers annular, *c.* ¾ mm, faintly 6-lobed. *Pistil* in the upper part more or less densely pilose or glabrous, in ♂ flowers usually absent. *Infructescences* 2½—8 cm long, with 1—4 fruits, more or less densely tomentose; calyx saucer-shaped, 6 mm diam., faintly 3-lobed, the lobes often recurved. *Fruits* ovoid, round to triangular in cross-section, 2¾—3½ by 1½—2 cm, scattered pilose to glabrous; pyrene rounded triangular in cross-section, smooth except a faint median rib on the lids; lids 2—3 mm thick; seeds 3(—2), sterile cell slightly reduced.

Distribution: Thailand, Cambodja, Cochin-China; a dubious specimen (*Parkinson 224*) from Mid-Andaman.

THAILAND. Prāyap: *Kerr 605* (syntype *C. kerrii* Craib), *605a* (syntype *C. kerrii* Craib), *3201, 3203, 5405, 5406, 5406 A, 5545; Winits 126.* — Mahārāt: *Suvarnasuddhi 358.* — Pitsanulōk: *Kerr 5729, 8914.* — Udawn: *Akkanitat 17; Din 138; Kerr 5814* (type *C. venosum* Craib); *Lakshnakara 933.* — Rachasima: *Mai Noe 191.* — Prāchinburi: *Collins 403, 1534.* — Rāchaburi: *Kerr 12835, 12835 A.*

CAMBODJA. *Béjaud 733, 782; Mueller 453; Pierre 690f, 690g, 690h, 910* (syntype *C. rotundifolium* Guill.), *4238.*

COCHIN-CHINA. *Chevalier 36724; Harmand 766, 790, s.n.* (syntype *C. rotundifolium* Guill.); *Phung u Dieu 70; Pierre 154* (syntype *C. thorelianum* Guill.), *690a* (syntype *C. cinereum* Guill.), *690b* (syntype), *690c* (lectotype), *690d, 690e* (syntype), *4237* (syntype *C. cinereum* Guill.), *4239* (syntype *C. vittatistipulatum* Guill.), *4239a* (syntype *C. vittatistipulatum* Guill.); *Poilane 181, 17309, 19203, 19517; Thorel 1096* (syntype *C. thorelianum* Guill.).

INDO-CHINA. without exact locality: *Pierre 106* (syntype *C. cinereum* Guill.).

Ecology: Scattered in usually more or less periodically dry, more

or less dense to rather open (even savannah-forest), usually deciduous, mixed or dipterocarp forest, at low to rather high alt. (up to 1100 m). *Fl.* March—May(—Oct.), *fr.* May—Aug.(—Sept.).

Uses: The timber is soft and light; it is used for cheap furniture and constructions. The olive-like fruits are eaten.

Notes: The present species is rather variable, especially in its vegetative parts (number, size, and shape of leaflets, pubescence). Though there is some correlation between part of these variations, they are all grading, and it is impossible even to distinguish between some distinct forms. In general, the specimens from the higher parts of Thailand, above *c.* 700 m, are characterized by few-jugate leaves with rather narrow, tomentose leaflets, the base rounded and very oblique, the margin minutely serrate, nervation strongly prominent (*C. venosum*). Specimens from the lower parts of Thailand and part of the Indo-Chinese ones posses more-jugate leaves (especially the Indo-Chinese ones), much broader, less hairy leaflets, with a cordate and less oblique base, with the margin more distinctly incised, and with a less prominent nervation (*C. kerrii* and *rotundifolium*). Typical specimens of *C. subulatum* are very close to *C. venosum*; they differ mainly in their more-jugate leaves with somewhat larger leaflets.

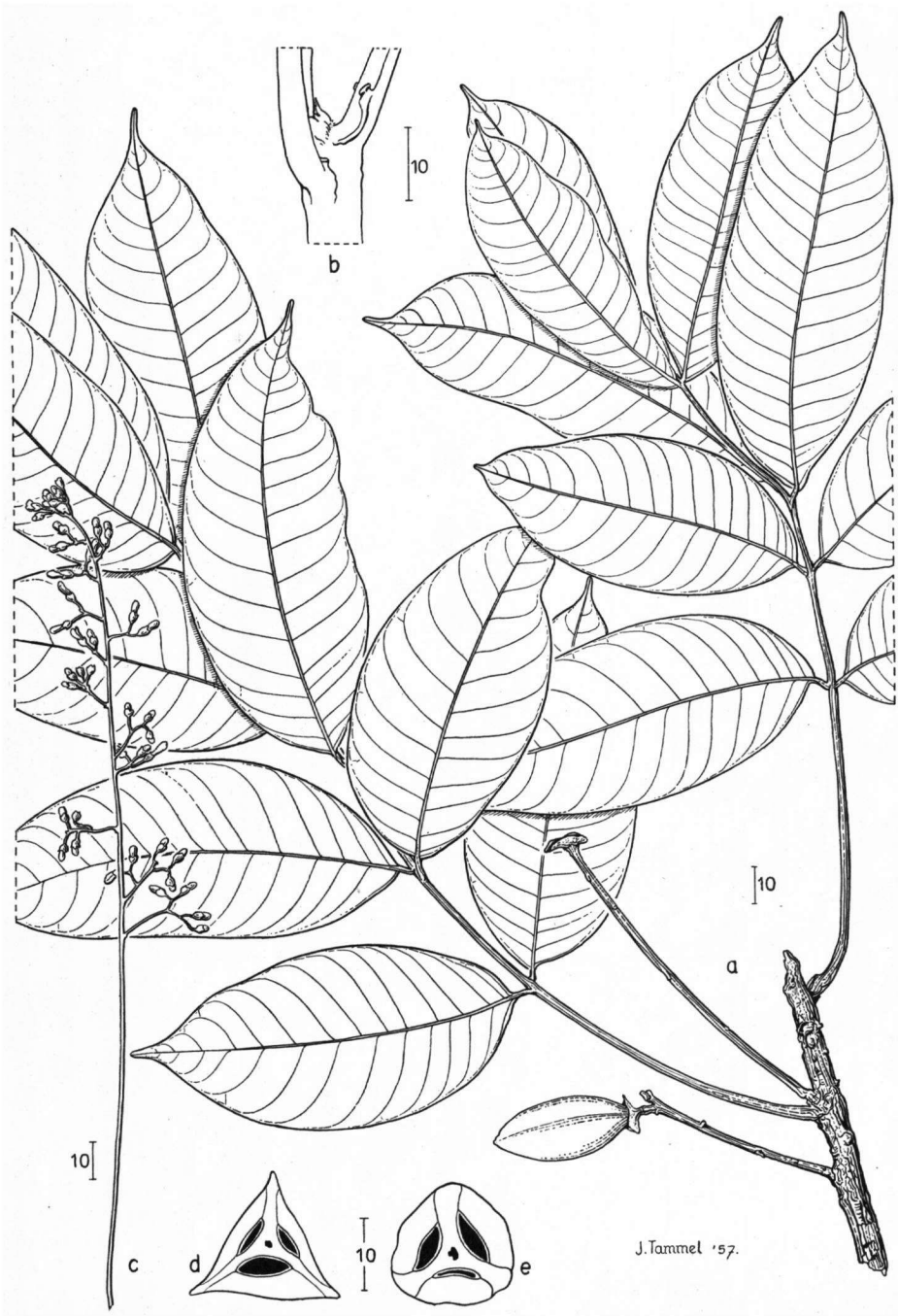
The species as a whole is best characterized by the long and slender flowers, and by the base of the uppermost pair of leaflets, which usually at the lower side is decurrent till the rhachis.

46. Canarium bengalense Roxburgh, [1814, 49, *nom. nud.*] 1832, 136; Bennett, 1875a, 534; 1875b, 103; Kurz, 1875, 142; 1877, 209; Gamble, 1878, 15; Engler, 1883, 118; Watt, 1889, 94; King, 1894a, 185, t. 10; Kanjilal *et al.*, 1936, 224. — *Fig. 27.*

Type: India, *W. Roxburgh*, st. (BM). This specimen bears the name 'Canarium bengalense' in Roxburgh's handwriting.

Tree, about 25 m high and 75—120 cm in diam., buttressed. *Branchlets* 1—1½ cm thick, lenticellate, the young parts sparsely and shortly greyish pubescent, the thick terminal bud fulvous pubescent; pith thick, with a closed peripheral cylinder of xylem strands. *Leaves* (6—)9—10-jugate, (sub)glabrous. *Stipules* caducous, inserted on the petiole, 0—8 mm from its base, subulate, *c.* ¾ cm, pubescent; scar prominent. *Leaflets* oblong to ovate, 7—20 by 3—5 cm, chartaceous, sometimes sparsely pubescent on the nerves beneath; base oblique, rounded, in the upper pair of leaflets usually on the lower side decurrent till the base of the petiolule; margin entire or faintly repandous; apex gradually or subabruptly acuminate, acumen ¾—1(—2) cm, rather broad (rarely slender), and blunt; nerves 14—20 pairs (angle variable, usually about 65°), faintly curved, more strongly so towards the margin, at least the apical ones distinctly arching; intermediate veins sometimes well-developed. *Inflorescences* (♀ unknown) axillary, narrowly thyrsoid, 30—40 cm long, subglabrous;

Fig. 27. *C. bengalense* — a. twig with infructescences; b. bases of petioles with stipule-scars; c. ♂ inflorescence; d—e. cross-sections of fruit-kernels. (a. and e. from *Peal 317;* b. and d. from *Poilane 1858;* c. from *Macalpine s.n. in herb. DD 59852*) (dimensions in mm).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branches 3—4 cm long, laxly rebranched, with up to *c.* 7 flowers. *Flowers* (♀ unknown to me, described after Roxburgh, *l. c.*) 7 mm, nearly glabrous. *Calyx* 2 mm. *Stamens* 6, glabrous, connate for about half the length of the filaments. *Disk* in ♂ flowers tubular, 1½—1¾ mm high, margin and inner surface densely pilose by stiff erect hairs, in ♀ flowers annular, 3-lobed, fimbriate. *Pistil* in ♂ flowers minute, densely tomentose. *Infructescences* axillary, racemose, 5—9 cm, scurfy, with 1—3 fruits at the apex; calyx saucer-shaped, 3-lobed, 1 cm diam. *Fruits* spindle-shaped, acute at apex, triangular to circular in cross-section, 4½—5 by 1¾—2 cm, glabrous; pyrene acute (to blunt) triangular in cross-section, the angle-ribs sometimes prominent, lids with a faint median rib; lids 1½—3 mm thick; seed(s) 1—2, the sterile cell(s) moderately to strongly reduced.

Distribution: Bengal, Assam, Burma, Thailand, and Indo-China (Laos).

BENGAL. *Dent in herb. DD 56489; Macalpine in herb. DD 59852.*
ASSAM. *Griffith 658 (= Kew distr. 1144); Peal 265, 281, 317; Punkayastha & Toshat 3; Kanjilal 1631, 4966, 5354.*
BURMA. *Sukoe 7612.*
THAILAND. Chantaburi: *Lakshnakara s.n.*
LAOS. *Poilane 1858.*
without locality: *Smith 447.*

Ecology: In evergreen, moist, mixed forests, usually at medium alt. (370—1000 m). *Fl.* (Jan.—)May—July, *fr.* (June—)Nov.—Jan.

Wood anat.: See Gamble, Man. Ind. Timb., 1881, 68.

Uses: The timber is used for tea-boxes and for shingles; it is also in use for construction. The brittle and amber-coloured resin is used as incense; when mixed with bees wax, it is also a good substitute for shellac for use in stiffening crêpe (see Cooke, Rep. Gums, Resins, *etc.* in the India Museum, 1874, 97; for analysis: Hooper, Agric. Ledger *no.* 3, 1908, 49). In native medicine the leaves and bark are used externally for rheumatic swellings. Fruits edible.

Notes. Morphology. The specimen *Henry 13171* from S. Yunnan probably belongs to this species; if so, it would present a valuable link between the Laos specimen and the main part of the area. It differs in some points, chiefly by the large number of nerves (22—24 pairs), which are very dense, the distinctly transverse veins, and the blunt-triangular, truncate fruits.

Taxonomy. Related to *C. strictum* and *subulatum*. Mainly characterized by the large number of leaflets, and by the usually acutely triangular fruits; moreover, the two latter species are usually distinctly more hairy.

47. Canarium strictum Roxburgh, [1814, 49, *nom. nud.*] 1832, 138; Wight & Walker-Arnott, 1834, 175; Walpers, 1842, 558; Dalzell & Gibson, 1861, 52; Beddome, 1871, t. 128; 1872, t. 181; Bennett, 1875a, 534; Engler, 1883, 118; Lubbock, 1892, 333, f. 237, *sp. uncertain*; King, 1894a, 186, t. 13; Cooke, 1902, 202; Gamble, 1915, 172; Talbot, 1949, 103. — *Rhus dhuna* Buchanan-Hamilton *ex* Wallich, 1847, *no.* 8502, *nom. nud.* — *Pimela stricta* Blume, 1850, 226. — *C. sikkimense* King, 1894a, 187, t. 11, 12. — *C. reziniferum* Brace *ex* King, 1894a, 188; Kanjilal *et al.*, 1936, 224.

Type: *Hort. Bot. Calcutta s. n.*, introduced from Tinnevelly, S. India, lectotype (BM).

Tall, buttressed tree, up to 50 m by 150 cm. *Branchlets* ½—2½ cm diam., often rather gnarly, usually densely ferruginously woolly when young, gradually more or less glabrescent; pith with a peripheral cylinder of vascular strands and a number of scattered ones. *Stipules* nearly always absent, if present very caducous, inserted at the conjunction of petiole and branchlet, subulate, about 7 mm, densely woolly pubescent. *Leaves* 3—5 (in young specimens up to 7)-jugate, pubescence very variable. *Leaflets* short-stalked, ovate to elliptic, 10—20 by 4—10 cm, thin- to stiff-coriaceous, glabrous above, subglabrous to rather densely, ferruginously tomentose beneath; base oblique, subcordate or rounded to broadly cuneate, usually slightly decurrent, sometimes in the basal half of the upper pair of leaflets decurrent to the very base of the petiolule; margin faintly undulate to slightly (in young specimens distinctly) dentate; apex gradually to more or less abruptly acuminate, acumen ½—1 cm, blunt to acute; nerves 12—22 pairs (angle 60—80° near the base, 50° near the apex), nearly straight (except some strongly sinuous basal ones), usually abruptly and distinctly arching near the margin. *Inflorescences* axillary, sometimes together pseudo-terminal, narrowly thyrsoid (♀ sometimes racemose), densely ferruginously woolly to minutely fulvous-tomentose, more or less glabrescent, ♂ ones 15—40 cm, the flowers in short-stalked, rather many-florous glomerules, ♀ 7—20 cm, few-flowered, the branches with up to 3 flowers. *Flowers* ♂ 7 mm, ♀ 9 mm. *Calyx* subglabrous to ferruginously woolly outside, ♂ 4 mm, ♀ 5½ mm, both with short blunt lobes. *Petals* outside subglabrous to densely appressedly pubescent. *Stamens* 6, glabrous, in ♀ flowers episepalous ones slightly longer than epipetalous ones; filaments connate for ¼—¾ their length; anthers distinctly acuminate. *Disk* long-pilose on margin and inner surface, ♂ annular, 1 mm high, ♀ faintly 6-lobed, ½ mm high, fleshy. *Pistil* glabrous or with some scattered appressed hairs; in ♂ flowers (nearly) absent. *Infructescences* racemose, 10—20 cm, glabrous, with 1—3 rather long-stalked fruits; calyx saucer-shaped, faintly 3-lobed to 3-angular, 1¼ cm diam. *Fruits* obovoid to ellipsoid, nearly circular to rounded triangular in cross-section, blunt at base and apex, 3¼—4½ by 1¾—2¼ cm, (sub)glabrous; pyrene smooth, angle-ribs blunt, the lids with a faint to distinct median rib each; lids 2½ mm thick; fertile cells 1(—2), sterile ones faintly (to strongly) reduced.

Distribution: S.W. Deccan, Sikkim, Assam, and Upper Burma.

S.W. DECCAN. *Anglade 19, in herb. CAL 78206; Barber 5724; Beddome 214, 274, 1097, 1098, 1099, 1100, 1101; Bell in herb. Sedgwick & Bell 5991; Bourdillon 925; Bourne 820; Gibson in herb. CAL 78202/3; Hallberg & Mc Cann in herb. BLAT 35046; Law 5; Sauliere 546; Stocks in herb. CAL 78210; Talbot 1223, 1879, 2731; herb. DD 27017—9.*

SIKKIM. *Kari 4030; King s.n.* (lectotype *C. sikkimense* King).

ASSAM. *Kanjilal 5595; Mann s.n.* (lectotype *C. reziniferum* King), *s.n.* (syntype *C. reziniferum* King); *Masters in herb. L 898.319—366; Rowbotham in herb. DD 48571; herb. DD 48865.*

cultivated: *Anderson 28; Hort. Bot. Calcutta*, div. specimens (type); *Pierre 4240.*

localities unknown: *Hohenacker 578; Wight 208 (= Kew distr. 405), in Wallich 4888; NN. 2258; herb. CAL 78204, 78209.*

Dubious specimens: (mostly young shoots or suckers).
S.W. Deccan. *Ambo in herb. Sedgwick & Bell 7198; Bourne 16 R; Gamble 15501, 18253, 18253a; Wight & Arnott 538; herb. DD 29397.*
Assam. *Hamilton 824; Macalpine R 1; Rowbotham in herb. DD 48570; herb. DD 49936.*
Upper Burma. *Dent 37.*
cultivated: *Raizada in herb. DD 89270.*
locality unknown: *herb. CAL 78211.*

Ecology: In evergreen, moist hill-forests, from sealevel to about 1600 m (apparently preferably at about 500 m). *Fl.* Dec.—July, *fr.* Sept.—March. M. C. Cooke, Rep. on Gums, Resins etc., 1874, 95, describes and figures the combs which the bee *Trigona laeviceps* makes from a mixture of the resins of this and some other trees. This "wax" is known in commerce as *pwê-nyet* (or: *poon-yet, pwai-nget*).

Uses. The wood is soft and of little use. The resin is black (in thin plates amber-coloured) and is used locally for many purposes (see Beddome, 1871, *l. c.*; M. C. Cooke, *op. cit.*, 93 & 95; A. W. Bennett, 1875b, 103; G. Watt, Diet. Econ. Prod. India 2, 1889, 96; D. Hooper, Agric. Ledg., 1908, no. 3, 47; Guillaumin, Agric. Prat. Pays Chauds 9(2), 1909, 48).

Notes. Morphology. The tree is probably usually deciduous (though this is only rarely reported), as the beautiful crimson colour of the tree in young foliage is often mentioned.

This species is a rather variable one. Part of the northern specimens (among which the types of *C. sikkimense* and *reziniferum*) posses rather large, coriaceous leaflets, slightly cordate at base, with a distinctly incised margin, and beneath with a very prominent nervation and a dense, ferruginous tomentum; the branchlets of these specimens are very coarse, the pubescence is dense and long, and remains for a long time, and the ♂ inflorescences are large, more loosely branched, and many-flowered. There seems to be, however, a gradual transition between these and the other, less coarse, specimens; moreover the flower- and fruit-characters are within the same narrow variability. As far as I can see (the material is rather incomplete, many specimens are very insufficient), even the large geographical gap does not coincide with any clear morphological boundary.

In my opinion, this species is closely related to both *C. bengalense* (differing by more-jugate leaves, entire leaflets, larger and more widely branched inflorescences, and acutely triangular fruits) and *C. euphyllum* (pith of branchlets without vascular strands, leaves coarse and glabrous, disk in ♂ flowers nearly glabrous, fruits much smaller and with 1 fertile and 2 strongly reduced cells).

Nomenclature. The type-specimen of *C. strictum* consists of one leaf of a young tree only, and is very poor indeed. Moreover, this tree apparently did not come to maturity, and so Wight & Arnott, 1834, *l. c.*, cite: "Introduced into the Botanic Garden of Calcutta, where it does not appear to have flowered. We consider it a very doubtful species." The reasons, why I nevertheless retain the name, are that in my opinion there is only one — though a very variable — species of *Canarium* in Southern India, and that complete specimens are available, collected in the type-region by Beddome (his nrs. *1097* & *1098*).

48. Canarium euphyllum Kurz, [1870, 33 & 67, *nom. nud.*] 1872, 295; Bennett, 1875a, 535; 1875b, 103; Kurz, 1877, 208; Engler, 1883, 123; Prain, 1891, 306; 1893, 68; King, 1894b, 241; Parkinson, 1923, 115. — *Fig. 28.*

Type: S. Andaman, Port Mouat, ridge in centre, *Kurz in herb. CAL 78235,* ♂ (CAL; isotypes in CAL, K, P).

Rather large, evergreen or deciduous tree, up to *c.* 30 m high (Burma spec. 40 m), diam. *c.* 60(—100) cm, with small buttresses. *Branchlets* 1½ cm thick, glabrous except the ferruginous shaggy-pilose terminal bud, leaf-scars very conspicuous, though not prominent, cordate, *c.* 1½ by 1½ cm, smooth; pith with a compressed peripheral cylinder of vascular strands. *Leaves* 4—6(—8)-jugate, glabrous. *Stipules* absent. *Leaflets* ovate to oblong, 10—25(—35) by 5—9 cm (basal pair much smaller), chartaceous; base oblique, rounded to subcordate; margin coarsely serrate or dentate, rarely entire; apex abruptly acuminate, acumen short, acute; nerves 12—19(—*c.* 30) pairs (angle 65—80°), straight to faintly curved, abruptly, often indistinctly, arching close to the margin; intermediate veins often strongly developed. *Inflorescences* (♀ unknown) axillary, narrowly thyrsoid, 20—45 cm long, (sub)glabrous; the branches transverse, up to *c.* 4 cm long, with 4—6 flowers; *bracts* subulate. *Flowers* (♂) 1 cm, minutely tomentose. *Calyx* 4½ mm. *Stamens* 6, glabrous, the filaments about halfway connate. *Disk* annular, 1—2 mm high, fleshy, glabrous, with a narrow central canal. *Pistil* minute to none, glabrous. *Infructescences* racemose, 10—20 cm, rather coarse, with 3—5 fruits; calyx saucer-shaped, 3-angular, 1 cm diam., with the remains of a 6-lobed, fimbriate disk. *Fruits* ovoid-ellipsoid, rounded triangular in cross-section, 2½ by 1¼ cm, glabrous, verrucose; pyrene rounded triangular in cross-section, smooth; lids 1—1½ mm thick. *Seed* 1; sterile cells moderately reduced.

Distribution: Burma, Andamans, and Nicobar Islands.

BURMA. Bhamo distr.: *Maung Mya 3699.*

ANDAMANS. Great Coco Isl.: *Prain in herb. CAL 78240/1.* — Baratang Isl.: *Osmastri 9.* — S. Andaman: *Dep. Cons. Andamans in Imperial Forest Coll. herb. 1246; King in herb. CAL 78239; King's coll. 342, in herb. CAL 78235/4; Kurz in herb. CAL 78235* (type). — without exact locality: *Bradley B 5829, in herb. DD 27539; Hildebrand 12; Kirat Ram 3665; Parkinson in herb. DD 8649.*

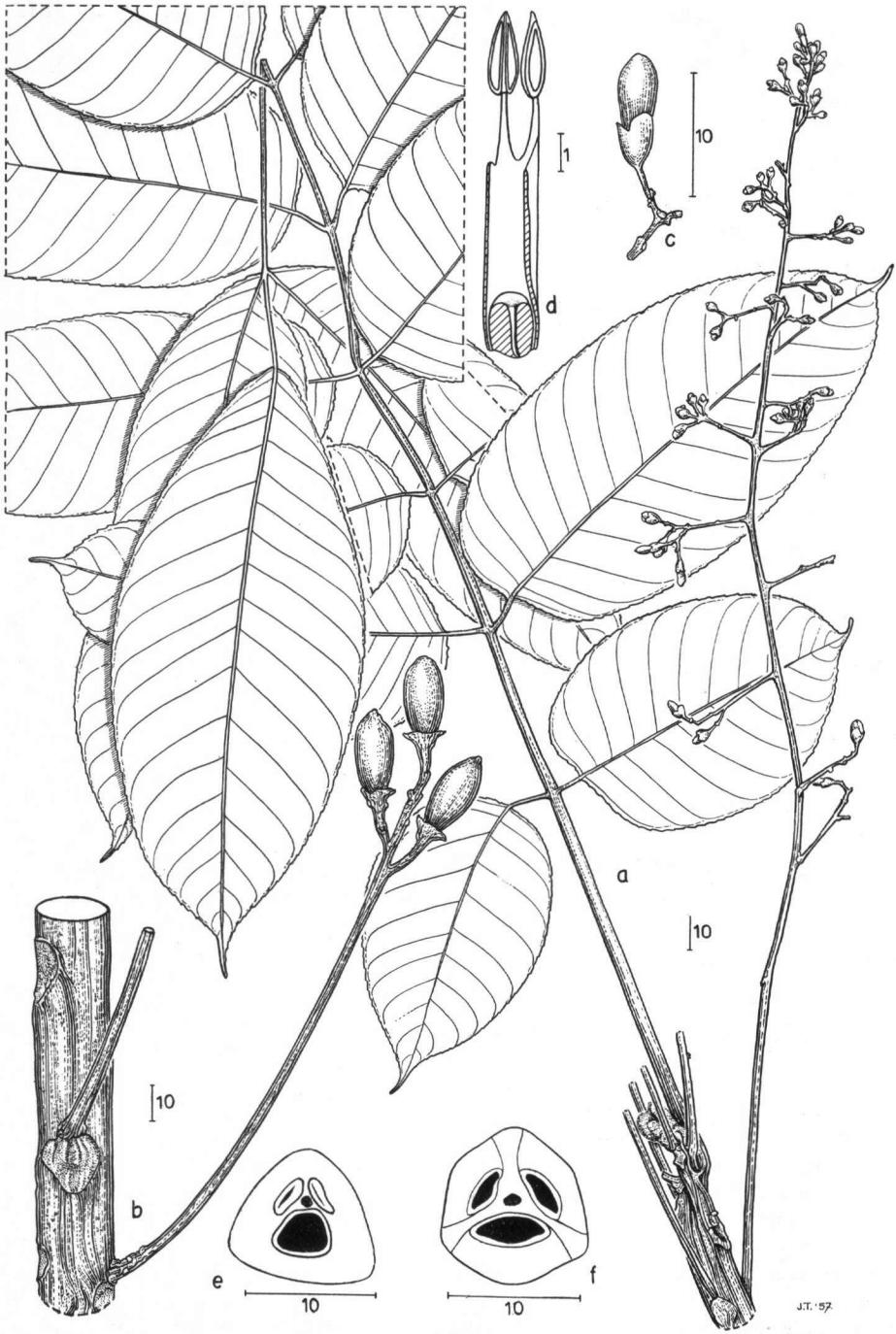
NICOBAR ISLANDS. Car Nicobar: *Heinig in herb. CAL 78242.* — Great Nicobar: *Chengappa 23034.*

Ecology: A common species in the jungle at low alt. (Burma up to 850 m). *Fl.* May—June, *fr.* Febr.—May.

Wood anat.: See Rendle, Commercial Mahoganies and allied Timbers, 1938, 27; Handb. Empire Timbers, 1945, 37.

Uses. Logs sometimes used as floats for rafting timber. Timber (*Indian white mahogany*) used for matches, boxes, planks, and indoor constructions. Resin (*dhup*) used for burning and for binding arrows.

Notes. Morphology. The specimen *Maung Mya 3699*, the only one from Burma seen by me, is in many characters slightly different from those of the Andamans and Nicobars (leaflets smaller, *viz.* 8½—14 by 4½—5 cm, coriaceous, slightly pilose beneath; lower side of the base in the upper pair of leaflets decurrent up to the rhachis; margin minutely dentate; fruits distinctly 6-angular in cross-section, the fertile cell smaller,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the sterile ones less reduced); probably it deserves subspecifical status, but on account of the very insufficient material I do, for the time being, not care to distinguish it taxonomically.

Though Kurz mentioned caducous subulate stipules in the present species, I could not trace them in any of my specimens.

Taxonomy. A very distinctive species, apparently related to *C. bengalense* and *strictum*, both Indian and Burmese.

Geography. Apparently the most widely spread *Canarium* species of the Andaman Islands (moreover the only species known from the Nicobar Islands), and the only one with a continental Asiatic relationship. Both these facts point at an old relationship between the Andaman and Nicobar Islands and Burma, older than the Sumatran relationship.

49. Canarium intermedium H. J. Lam, 1932a, 213, t. 11 f. 76, t. 13 f. 104b; 1932b, 482; Leenhouts, 1956, 285. — *Fig. 29.*

Type: Sumatra, G. Kaba, Ayer Angat, alt. 660 m, '1881/'2, *Forbes 2875*, ♀, lectotype (BO; isotypes in BM, FI, L).

Tree *c.* 35 m by 50—85 cm. *Branchlets c.* 9 mm thick, soon glabrescent; pith with many vascular strands, part of them peripherally arranged. *Stipules* absent. *Leaves* 3—6-jugate. *Leaflets* lanceolate, 4—12 by 2—3½ cm, chartaceous, glabrous; base rather oblique, broadly cuneate; margin entire; apex gradually, shortly and broadly blunt-acuminate; nerves 10—12 pairs (angle 50—60°), straight to faintly curved, gradually and distinctly arching at 1½—2 mm from the margin. *Inflorescences* (♂ unknown) axillary, narrowly thyrsoid, 11—18 cm, soon glabrescent; main branches up to 4½ cm, often with only one well-developed flower. *Flowers* (♂ unknown) 7 mm, glabrous. *Calyx* 4—6 mm high. *Stamens* glabrous, 3—3½ mm long, filaments almost wholly connate, sometimes with interstaminal teeth. *Disk* minute, annular, pilose. *Pistil* glabrous, stalked. *Infructescences c.* 15 cm, with 2—3 fruits, glabrous; calyx flat, 3-angular, 11 mm diam. *Fruits* elliptic, faintly trigonous in cross-section, *c.* 3 by 2 cm, apparently containing 2 *seeds*; sterile cell not very reduced.

Distribution: S. Sumatra.

SUMATRA. *Forbes 2875* (lectotype); *FRI. bb. 8692* (syntype).

Ecology: In forest, 600—900 m.

Note. This species is closely related to *C. kipella* from W. Java.

50. Canarium kipella (Bl.) Miquel, 1859, 646; Engler, 1883, 129; Koorders & Valeton, 1896, 41; Backer, 1911, 197; Koorders, 1912, 433; Lam, 1932a, t. 13 f. 104d, t. 15 f. 117c; 1932b, 480, t. 11 f. 73; 1948, 6; Leenhouts, 1956, 285. — *C. pimela* (*non* Koen.) Blume, 1826, 1162. — *Pimela kipella* Blume, 1850, 220. — *Pimela kitengo* Blume, 1850, 221. — *C. kitengo* Miquel, 1859, 647; Engler, 1883, 148; Koorders & Valeton, 1896, 46; Backer, 1911, 199; Koorders, 1912, 433.

Fig. 28. *C. euphyllum* — a. twig with ♂ inflorescence; b. older twig with infructescence; c. ♂ flower; d. ditto, longitudinal section of staminal tube and disk; e. and f. cross-sections of fruit-kernels. (a. from *herb. CAL 78228*, the inflorescence and c. and e. from *Imp. For. Coll. herb. 1246*; b. and e. from *Kirat Ram 3665*; f. from *Maung Mya 3699*) (dimensions in mm).


10

Type: Java, *Blume (?) in herb. L. 898.319—296,* ♂ (L).

Tree, 25 m, with small buttresses. *Branchlets* c. 8 mm thick, lenticellate, young parts densely ferruginously woolly tomentose; pith with many vascular strands, sometimes arranged into 1 or more concentric cylinders. *Stipules* (nearly?) always absent. *Leaves* 4—8-jugate. *Leaflets* oblong-lanceolate, 7—16 by 2½—5(—6) cm, thinly chartaceous, glabrous; base often oblique, cuneate to truncate; margin entire; apex gradually shortly (c. 1 cm), broadly, and bluntly acuminate; nerves 14—17 pairs (angle 60—70°), faintly to strongly curved, gradually, often rather distinctly, arching at 1 mm from the margin. *Inflorescences* axillary, narrowly thyrsoid, densely woolly pubescent, glabrescent, ♂ ones 9—27 cm long, ♀ ones 7—15 cm; partial panicles about decussate, patent, rather long-stalked, ♂ ones up to 4—5 cm long, with up to 12 flowers, ♀ ones 2½ cm long, with 8—10 flowers. *Flowers* 7—8 mm long, slightly pubescent outside. *Calyx* ¼ cm high, nearly truncate. *Stamens* glabrous, 6—7 mm long, connate for 3—4 mm. *Disk* pilose, in ♂ flowers subglobose, 1½—2 mm high, with a central canal, in ♀ flowers cupular, 1 mm high, 6-undulate. *Pistil* glabrous, in ♂ flowers absent. *Infructescences* up to 20 cm long, thinly pilose, branches with 1 fruit only; calyx spreading, ½ cm diam. *Fruits* ovoid, round in cross-section, 2½—3¼ by 1—1½ cm, glabrous; pyrene ± 6-angular; lids rather thick. *Seeds* 1—2; sterile cell(s) often very reduced.

Distribution: W. Java (Mt Salak; Palabuanratu).

JAVA. *Blume in herb. L 898.319—297* (syntype *Pimela kipella* Bl.), *in herb. L 898.319—293, 295, 296* (type *Pimela kipella* Bl.), *in herb. L 898.319—299, 908.352—967* (type *Pimela kitengo* Bl.); *Hort. Bot. Bog. VI B 67; Koorders (β-numbers) 3035, 12256, 33083; NN. s.n. in herb. L. 898.319—298.*

Ecology: In hill (?) forests, apparently a rare species. *Fl.* April—May, *fr.* May.

Wood anat. Moll & Janss. Mikr. 2 (1908) 108.

Note. Closely related to *C. intermedium.*

51. Canarium australianum F. von Mueller, 1862, 15; Lam, 1932b, 529; White, 1936, 55; Leenhouts, 1956, 284, f. 44. — *C. australasicum* F. von Mueller *ex* Bentham, 1863, 377; Engler, 1883, 120; Jadin, 1894, 88, f. 43; Engler, 1896, f. 136 J—P; 1931, f. 211 J—P; Bailey, 1898, 31; Guillaumin, 1909a, f. 22^{17}; White, 1922, 38; *non C. australasicum* Leenhouts, 1952, 159, *quae est C. baileyanum* Leenh. — *Sonzaya australiana* Marchand, 1868, 27, 64, t. 5.

Type: Australia, Queensland, Sweer's Island, *Henne s. n.,* ♀ & fr., lectotype (BR).

Tree, 20(—30) m by 45 cm. *Branchlets* c. 1 cm thick, young parts shortly ferruginously pubescent; pith with many small vascular strands, for the greater part (rarely all of them) peripherally arranged. *Stipules* caducous, inserted at the base of the petiole, rarely on the latter up to 11 mm from the base, subulate, 7—15 mm. *Leaves* 3—4(—6)-jugate. *Leaf-*

Fig. 29. *C. intermedium,* twig with ♀ inflorescences. (*FRI. bb. 8692*) (dimensions in mm). *del.* J. Tammel.

lets ovate, 7—11(—17) by 3—7 cm, thinly coriaceous, glabrous or minutely tomentose beneath; base rounded to truncate, rarely cuneate or cordate, slightly oblique, in the apical pair of leaflets the lower leaflet-half mostly decurrent to the base of the petiolule; margin entire or slightly dentate; apex rounded to acute, sometimes truncate or shortly and broadly blunt-acuminate; nerves 15—24 pairs (angle mostly 75—80°), straight to slightly curved, often tortuous, rather abruptly distinctly arching at some distance from the margin. *Inflorescences* axillary, narrowly thyrsoid, fulvous tomentose; ♂ ones *c.* 25 cm long, ♀ ones 8—15 cm; branches up to 3 cm, ♂ ones with *c.* 12 flowers, ♀ ones with 3—4 flowers. ♂ *Flowers* 4—5 mm long, ♀ 6½ mm. *Calyx* respectively 2½ and 3½ mm high. *Stamens* glabrous, connate, in ♂ flowers for about half the length of the filaments, in ♀ flowers almost wholly. *Disk* in ♂ flowers truncate, deeply 6-grooved, ¾ mm high, with a central canal, outside glabrous, upper surface and inside densely woolly pubescent; in ♀ flowers annular, ¾ mm high, 6-lobed, glabrous. *Pistil* tomentose, in ♂ flowers nearly totally reduced. *Infructescences* up to 18 cm long with up to 5 fruits; calyx spreading, 3-angular, 9—10 mm diam. *Fruits* ovoid, round to rounded-triangular in cross-section, *c.* 2 by 1¼ cm, glabrous; pyrene rugulose, faintly 3-ribbed to the apex; lids 2 mm thick. *Seed* 1; sterile cells rather strongly reduced.

Distribution: S.E. New Guinea (Wassi Kussa, Mabaduan, Pt Moresby) and N. Australia (N.E. Queensland and Arnhem's land).

Taxonomy. Two varieties can be distinguished:

a. var. **australianum.**

Leaflets densely short-tomentose beneath.

Distribution: As the species.

NEW GUINEA. *White 52.*

AUSTRALIA. *Cunningham 170.* — Queensland: *Bailey 396; Bancroft 33; Blake 15137; Brass 2044; Cunningham 60; Flecker 1107; Haines 156 Q; Illingworth 63; Kajewski 1319; Mac Gillivray 93; Merrotsy 39; Roth 288; Stuart 51; Warburg 19174.* — Arnhemsland: *Brown 5425a; Specht 978, 1074 (a).*

b. var. **glabrum** Leenhouts, 1955b, 189; 1956, 285.

Type: Australia, Northern Territory, Gulf of Carpentaria, Bickerton Island, South Bay, June 15, 1948, *Specht 571*, fr. (L; isotypes in K, LAE).

Leaflets fully glabrous.

Distribution: As the species.

NEW GUINEA. *Brass 6561, 8425* (paratypes)

AUSTRALIA. Queensland: *Brass 2005* (paratype); *Hill 94; Michael 1360* (paratype); *Stephenson 700; Thomson 18* (paratype); *Thurston 268 (Flecker 3819)* (paratype); *White 11682* (paratype). — Arnhem's land: *Brown 5425* (paratype); *Prager 28* (paratype); *Schomburgk 116; Schultz 586; Specht 571* (type), *1074* (paratype).

Ecology: In Papua only found in rain-forest (Mabaduan) and in monsoon-forest (Wassi Kussa), in Australia also in more open forests on rather dry, sandy soil, and on coastal, sparsely timbered dunes, always at low altitudes; apparently restricted to regions subject to a periodically dry period. *Fl.* Nov.—April, *fr.* (mainly) April—June.

Uses. In Australia, tin fossickers and miners are said to prefer the

wood of this tree above all others available for making pick- and axe-handles. The resin is used by the aborigines for spear fastening.

Notes. The species is apparently related to *C. pilosum*; it is, however, quite distinct in many characters, especially in its leaflets, which look more or less like those of *C. decumanum* and of some species of sect. *Canariellum*. Among the Australian species it is the only one with stipules.

According to Whitehouse (*in sched.*), the fruits are eaten by birds, especially by Torres Strait pigeons.

52. Canarium dichotomum (Bl.) Miquel, 1859, 648, *incl.* also *var. lucidula*; Engler, 1883, 141; Lam, 1929, 116; 1932b, 447, t. 9 f. 57; Leenhouts, 1956, 283, f. 22b. — *Pimela dichotoma* Blume, 1850, 222. — *C. endertii* Lam, 1932a, 210, t. 15 f. 117a; 1932b, 450, t. 10 f. 60; 1936, 17.

Type: Sumatra, *Korthals 957*, ♂ (L; isotype in U).

Tree, 15—32 m by 15—60 cm, rarely shrub-like and up to 7 m high; buttresses up to 1½ m high. *Branchlets* ½—2 cm thick, glabrescent; pith with a peripheral cylinder of minute vascular strands. *Stipules* caducous to persistent, inserted at the base of the petiole or slightly on the latter, subulate to linear, often abruptly broadened at base, ½—1½ cm. *Leaves* 3—5(—8)-jugate, glabrous. *Leaflets* ovate to oblong, 5—25(—36) by 2½—9(—13½) cm, chartaceous to coriaceous; base oblique, rounded to broadly cuneate; margin entire; apex gradually to subabruptly blunt-acuminate, acumen rather short and broad (—1½ by ½ cm); nerves 9—18 pairs (angle variable), straight to slightly curved, gradually, mostly distinctly, arching close to the margin. *Inflorescences* terminal, sometimes some additional axillary ones in the uppermost leaf-axils, laxly thyrsoid, glabrous, ♂ ones 19—42 cm long, many-flowered, ♀ ones 6—25 cm, with few flowers, axes dark red (*statu vivo*); main branches in ♂ inflorescences repeatedly dichotomous, up to 25 cm long, in ♀ ones not distinctly dichotomous, up to 6(—20) cm, flowers in cymules. *Flowers* (nearly) sessile, 6—9(—12) mm long, sometimes (even ♂ ones) with a slightly concave receptacle (best developed in the large-flowered, coarse Borneo-specimens), glabrous outside. *Calyx* 5—8 mm high. *Stamens* glabrous, in ♂ flowers confluent at the base, in ♀ flowers connate for the greater part; thecae in ♂ ones distinctly acuminate. *Disk* 1 mm high, in ♂ flowers cupular to flattened, pilose within, in ♀ flowers annular, faintly 6-undulate, minutely tomentose, margin fimbriate. *Pistil* in ♂ flowers much reduced, pilose; in ♀ flowers glabrous, sometimes with a 1 mm high pseudo-gynophore. *Infructescences* up to 40 cm long, main branches up to 17 cm, with 1—2(—10) fruits; calyx funnel-shaped, trigonous, 8—10 mm diam. *Fruits* narrowly oblong, acute at both ends, trigonous in cross-section, 2¾—4 by 1—2 cm, glabrous; pyrene acutely to rounded triangular; lids rarely with a median rib, 1½—2 mm thick. *Seeds* 1—2, sterile cells moderately reduced.

Distribution: Sumatra, Borneo.

SUMATRA. *Dumas 1561; Forbes 2742; FRI. bb. 26047; Korthals 957* (type); *Lambach 1350; Lörzing 4622; Meijer 3190; Teysmann HB 687* (type *C. dichotomum var. lucidula* Miq.).

BORNEO. *Amdjah 259; Clemens 21537; Elmer 20231; Endert 3316* (syntype *C. endertii* H. J. Lam); *FRI. bb. 11769 (v. d. Zwaan 414)* (syntype *C. endertii* H. J.

Lam), *bb. 11939* (syntype *C. endertii* H. J. Lam), *bb. 14651, bb. 20703 (Henar 128), bb. 29418; Kostermans 5525, 5527, 6534, 7283a; NBFD. 2963 (Caguiela), A 1322 (Cuadra), SAN 15161 (Wood); Omar 101; Ramos 1807; Richards 1382, 1487; Villamil 257; 5953 = Sarawak herb. 21537.*

Ecology: In primary forests on dry grounds; altitude up to 1200 m. *Fl.* mainly June—Aug., *fr.* (mainly) Sept.

Uses. The resin is clear and is said to be useful.

Notes. A rather variable species. At first sight it seemed possible to distinguish between a coarse form, mainly collected in Borneo and representing *C. endertii* H. J. Lam, and a more slender form, comprising the Sumatra specimens, which is *C. dichotomum* Miq. *sensu stricto*. Typical specimens of *C. endertii* differ from typical specimens of *C. dichotomum* by their glabrescence, by more lingulate, persistent stipules inserted on the petiole, larger inflorescences and flowers, and ♀ flowers with a concave receptacle. As there are intermediates in various degrees an acceptable demarcation of two taxa is rendered impossible.

The species is best characterized by the rather large, broadly paniculate inflorescences and infructescences, both not very dense, the latter with slender, triangular fruits.

53. Canarium fusco-calycinum Stapf *ex* Ridley, 1930, 82; Lam, 1932b, 449, t. 9 f. 58; Leenhouts, 1956, 283.

Type: Borneo, Sarawak, near Kuching, Dec. 7, 1892, *Haviland 1981*, ♂ (K; isotypes in BM, SAR).

Tree. *Branchlets* slender, minutely villous; pith with peripheral vascular strands. *Stipules* caducous, inserted at the base of the petiole, linear, 7 by 2 mm. *Leaves* 1—2(—3)-jugate. *Leaflets* ovate to oblong, 2—25 by 1½—12½ cm, stiff chartaceous, glabrous above except on the midrib, more or less densely pubescent beneath; base broadly cuneate to faintly cordate; margin entire; apex rounded, abruptly shortly and broadly to long, slender and acutely acuminate; nerves 10—24 pairs (angle 55—65°), faintly curved, geniculate near the margin, sometimes (in large leaflets) distinctly arching. *Inflorescences* (♀ unknown) terminal, pyramidal-thyrsoid, up to 40 by 30 cm, villous, many-flowered; main branches up to 20 cm, broadly thyrsoid. *Flowers* (♀ unknown) subsessile, buds ovoid, closed, 9 mm long. *Stamens* connate for greater part. *Disk* cupular, small, erectly pilose, without rudimentary pistil. *Infructescences* and *fruits* unknown.

Distribution: Borneo (Sarawak).

Borneo. *Beccari PB 3809; Haviland 1981* (type).

Ecology: *Fl.* April, Dec.

Notes. This apparently rare species is possibly allied to *C. vriesea-num* as well as to *C. pilosum*.

C. decipiens H. J. Lam (1932a, 209) is probably conspecific (see under doubtful species).

54. Canarium hirsutum Willdenow, 1805, 760; Engler, 1883, 150; Merrill, 1917, 302; Heyne, 1927, 877; Lam, 1932a, t. 13 f. 104c, t. 15 f. 117d, t. 16 f. 127d3 and f. 134; 1932b, 466, t. 11 f. 67; Burkill, 1935, 430; Lam, 1948, 7; Leenhouts, 1955a, 14, f. 7; 1956, 287. — *C. odoriferum*

hirsutum Rumphius, 1741, 157, t. 51. — *C. hispidum* Blume, 1823, 109; 1826, 1163, *incl.* also *var. scabrum*; Roemer & Schultes, 1829—30, 81, 1624; Hasskarl, 1844, 617, *incl. var. majus*; Engler, 1883, 131, *incl.* also *var. tomentellum*: Koorders & Valeton, 1896, 43; Koorders, 1898, 375; Solereder, 1899, 217, f. 43F; Hochreutiner, 1905, 86, *incl. f. minor*; Guillaumin, 1909a, 238, f. 22[4]; Backer, 1911, 198; Koorders, 1912, 433; Blaauw, 1917, t. 6; Ridley, 1922, 374; Henderson, 1930, 91. — *Boswellia hirsuta* Sprengel, 1825, 313, *non* Smith, 1819. — *C. altissimum* Blume, 1826, 1163; Engler, 1883, 130; Merrill, 1923, 355. — *Pimela hirsuta* Blume, 1850, 223. — *Pimela hispida* Blume, 1850, 224, *incl.* also *var. axillaris, imbricata* and *scabra*. — *Pimela altissima* Blume, 1850, 225. — *C. multipinnatum* Llanos, 1851, 107; Blanco, 1879, 87; Fernandez-Villar, 1880, 40; Merrill, 1918a, 207; 1923, 351; Beans *& al.*, 1932, 299—302, t. 2 f. 2. — *Canariopsis altissima* Blume *ex* Miquel, 1859, 651. — *Canariopsis hispida* Blume *ex* Miquel, 1859, 652, *incl.* also *var. tomentella*. — *Canariopsis hirsuta* Blume *ex* Miquel, 1859, 653. — *C. riedelianum* Engler, 1883, 130. — *C. greshoffii* Koorders, 1898, 375; 1903, 95; 1922a, t. 26; 1922b, 14. — *C. emarginatum* Engler *ex* Koorders, 1903, 97, *nom. nud.*; 1922a, t. 25; 1922b, 13. — *C. bersamifolium* Perkins, 1904, 90. — *C. radlkoferi* Perkins, 1904, 96. — *C. warburgianum* Perkins, 1904, 99; Merrill, 1923, 355. — *C. ahernianum* Merrill, 1906b, 70; Whitford, 1906, 415; Merrill, 1923, 415. — *C. racemosum* Merrill, 1908b, 141; Elmer, 1911, 1077; Merrill, 1923, 353. — *C. nervosum* Elmer, 1908, 482; 1915, 2566; Merrill, 1923, 352. — *C. costulatum* Elmer, 1911, 1080; Merrill, 1923, 349. — *C. ellipsoideum* Merrill, 1915a, 26; 1923, 350. — *C. robustum* Merrill, 1916a, 184; 1923, 353. — *C. subcordatum* Ridley, 1920, 175; 1922, 374. — *C. palawense* Lauterbach, 1921, 515; Kanehira, 1931, 288; 1933, 160, f. 59; 1935, 344. — *C. longiflorescens* Elmer (*ex* Merrill, 1923, 352, *in syn.*), 1939, 3713, *descr. angl.* — *C. oxygonum* Quisumbing & Merrill, 1928, 155. — *C. bataanense* Merrill *ex* Sasaki, 1930, 295, *nom. nud.* — *C. multijugum* Lam, 1932a, 212, t. 5 f. 5; 1932b, 476, t. 11 f. 7. — *Fig. 30.*

Type: Moluccas, Morotai, Totodoku, alt. 30 m, May 6, 1949, *FRI. bb. 33772 (Tangkilisan 77)*, fr., neotype (L; isotypes in A, BO, SING).

Tree *c.* 10—25(—48) m by 20—60(—200) cm. *Branchlets* very stout, 1½—3 cm thick, the tip ferruginously pubescent; pith large, with many small vascular strands, which are all or nearly all appressed to the wood-cylinder (rarely all scattered). *Stipules* nearly always present, rather caducous, inserted on the petiole ½—5 cm from its base, subulate, 4—12 mm, pubescent. *Petiole* thick (up to 2 cm at the base) with sharp edges. *Leaves* 4—13-jugate, up to 2 m long, pubescence variable. *Leaflets* subsessile except the basal ones, mostly ovate to rather narrowly lanceolate, 5—45 by 2½—15 cm, chartaceous, sparsely pilose to glabrous; base rounded to cordate; margin entire; apex gradually to rather abruptly short-acuminate; nerves 12—30 pairs (angle 60—90°), straight to slightly curved, usually not arching but for the apical ones. *Inflorescences* axillary, laxly thyrsoid (♂) to subracemose (♀), ♂ up to 70 cm long, ♀ up to 30 cm, ♂ flowers usually crowded in many-flowered glomerules, ♀ ones single or in few-flowered cymules; usually densely tomentose. *Flowers* 1—1¼ cm long, short-stalked. *Calyx* shallowly cupular, subtruncate, 1½—3½ mm high. *Corolla* much

exserted, densely appressedly fulvous-tomentose without. *Stamens* free, filaments slender, pilose, in ♂ flowers *c.* 1 cm, twisted, in ♀ flowers *c.* ½ cm. *Disk* in ♀ flowers 6-lobed, 1 mm high, pilose, in ♂ flowers cupular, *c.* 2 mm high, densely erect-pilose. *Pistil* sometimes stalked, densely pilose; in ♂ flowers (nearly) absent. *Infructescences* recurved to pendulous, racemose, up to *c.* 15 cm long and with few fruits, to thyrsoid, more than 30 cm long and with many fruits; calyx 4—16 mm diam., flat, lobes often recurved. *Fruits* nearly always with long-remaining, irritating, stiff, reddish-brown hairs, ovoid, 2—6¼ by 1¾—4½ cm, otherwise rather variable (see varieties).

Distribution: Throughout Malaysia (not yet known from the Lesser Sunda Islands), Carolines (Palau), and Solomon Islands.

Taxonomy. This species is very variable, especially in its fruits. As these differences in the fruits are correlated with some vegetative characters, and as all these variations are more or less geographically restricted, I propose the following subdivision of the species:

KEY TO THE VARIETIES

1.a. Pyrenes with some straight ribs only (at most 3 at every angle and a median one on every lid); fruits very variable, mostly densely setose. Leaves 4—12-jugate; leaflets usually relatively broad, especially near the base. Inflorescences narrowly thyrsoid subsp. **hirsutum** 2

b. Pyrenes deeply irregularly furrowed all over the surface; fruits short and broad, sparsely setose to nearly glabrous. Leaves 6—10-jugate; leaflets relatively narrow, sparsely tomentose to glabrous. Inflorescences rather broadly thyrsoid subsp. **multicostulatum** . . . 3

2.a. Stipules present . . . . . var. **hirsutum**

b. Stipules absent . . . . . var. **beccarii**

3.a. Stipules absent . . . . . var. **multicostulatum**

b. Stipules present . . . . . var. **leeuwenii**

A. Subsp. **hirsutum**. — Nearly all synonyms, except two (see under subsp. *multicostulatum*).

Leaves 4—12-jugate. Leaflets relatively broad, specially near the base. Inflorescences narrowly thyrsoid. Fruits very variable, mostly densely pilose. Pyrene with some straight ribs, at most 3 at every angle and a median one on every lid.

a. var. **hirsutum**. — Synonyms as the subsp.

Stipules present. Pyrene with 3—12 straight ribs; fruit long remaining pilose. Seeds 1—2, sterile cells more or less reduced.

Distribution: Carolines (Palau Isl.) and throughout Malaysia, except New Guinea and New Britain.

Notes. In this very polymorphous and wide-spread variety some geographical forms are distinguishable, which are mainly characterized by their fruit structure.

1. forma **scabrum** (Bl.) Leenhouts, 1955a, 16. — *C. hispidum var. scabrum* Bl. — *Fig. 30b.*

Type: Java, Salak, *Blume in herb. L 898.319—289*, ♂ (L; isotypes in U, W).

This form is characterized by its small, strongly pilose fruits, its pyrene with acute angle-ribs, flat sides with a median rib, and mostly with 2 sterile cells. It is the most common, western form and found eastward as far as Palau Isl., Philippines, and Borneo.

Note: One of the more remarkable local races, belonging to this form, described as *C. multipinnatum* Llanos, is restricted to the Philippines and is characterized by its 10—12-jugate leaves, its small (9—11 by 4½—5 cm), broadly elliptic, abruptly and shortly broad-acuminate leaflets (like those of *C. euryphyllum*) and its small flowers.

2. forma **ahernianum** (Merr.) H. J. Lam, 1932a, 212; 1932b, 468. — *C. ahernianum* Merr. — *Fig. 30c.*

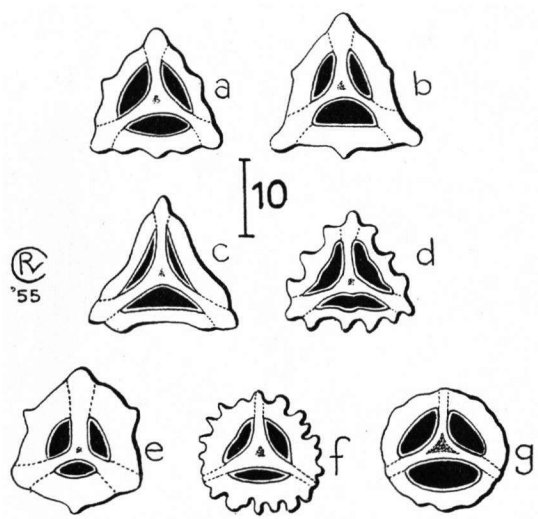

Fig. 30. *C. hirsutum*, cross-sections of fruit-kernels — a. *f. hirsutum* (*Kostermans 143*); b. *f. scabrum* (*Koorders 27312*); c. *f. ahernianum* (*BS. 22833*); d. *f. racemosum* (*PNH 9897*); e. *var. beccarii* (*Beccari herb. 2171*); f. *var. multicostulatum* (*Beguin 2245*); g. *var. leeuwenii* (*Kajewski 1931*) (dimensions in mm).

Type: Philippines, Luzon, Rizal Prov., Antipolo, Febr. 1904, *FB. 422 (Ahern's coll.)*, fr., lectotype (PNH; isotypes in BM, K, NY, SING).

Pyrene with blunt angle-ribs, hollow sides without a median rib, and mostly with 2 sterile cells; fruit rather broad, very hairy; leaflets densely pilose, nerves only slightly prominent.

Apparently restricted to Luzon.

3. forma **racemosum** (Merr.) H. J. Lam, 1932a, 212; 1932b, 469. — *C. racemosum* Merr. — *Fig. 30d.*

Type: Philippines, Mindanao, Davao Distr., Mt Apo, Todaya, alt. 1100 m, May 1909, *Elmer 10763*, fr., neotype (L; isotypes in A, BM, BRSL, E, FI, G, K, NY, P, U, W, Z).

Pyrene with blunt angle-ribs, lids with a median rib and well-developed,

acute marginal ribs, 1 sterile cell; leaflets very pilose, nerves sunken above, prominent beneath.

Known from Samar, Leyte, and Mindanao.

4. forma **hirsutum.** — *Fig. 30a.*

This form is characterized by a thick-walled pyrene with blunt angle-ribs, lids with median rib and slightly thickened margins, and mostly 2 sterile cells.

Known from S.W. Celebes (Bonthain) and the Moluccas (Morotai, Halmaheira, and Ternate).

b. var. **beccarii** Leenhouts, 1955b, 189; 1956, 289. — *Fig. 30e.*

Type: S.E. Celebes, Lepo-Lepo near Kandari, July 1874, *Beccari herb. 2171,* fr. (FI; isotype in L).

Pith of the branchlet with many, scattered, small, vascular strands. Stipules absent. Leaflets sparsely, patently stiff-pilose on the nerves beneath; nerves 14—16 pairs. Fruit ellipsoid, round in cross-section, acute at apex, 2¾—3 by 1¾—2 cm; pyrene rostrate, gibbous, angle-ribs acute, lids with acute median rib; 2 sterile cells.

Distribution: S.E. Celebes.

Note. The taxonomic position and status of this variety remains doubtful.

B. Subsp. **multicostulatum** Leenhouts, 1955b, 191, f. 5e; 1956, 289. — *C. hirsutum* Willd. *f.* ♃ *leeuwenii* and *f.* ♂ *multicostulatum* H. J. Lam. — *C. multijugum* H. J. Lam.

Type: Moluccas, Halmaheira, W. Pitu, alt. 60 m, Nov. 11, 1922, *Beguin 2245,* fr. (L; isotype in BO).

Leaves 6—10-jugate. Leaflets relatively narrow, sparsely tomentose to glabrous. Inflorescences rather broadly paniculate. Fruits short and broad, sparsely pilose to nearly glabrous; pyrene deeply irregularly furrowed all over the surface.

c. var. **multicostulatum.** — *C. hirsutum* Willd. *f.* ♂ *multicostulatum* H. J. Lam. — *C. multijugum* H. J. Lam. — *Fig. 30f.*

Stipules absent. Leaves 9—10-jugate. Nerves 20—25(—30) pairs. Leaflets glabrous. Fruits broadly ovate, terete, 2 by 1½—1¾ cm, nearly glabrous; pyrene deeply and irregularly furrowed.

Distribution: Moluccas (Halmaheira).

d. var. **leeuwenii** Leenhouts, 1955b, 191; 1956, 289. — *C. hirsutum* Willd. *f.* ♃ *leeuwenii* H. J. Lam. — *Fig. 30g.*

Type: Solomon Islands, Bougainville, Kugumaru, Buin, alt. 150 m, July 5, 1930, *Kajewski 1931,* fr. (L; isotypes in A, BISH, BO, BRI, G, P, SING).

Pith of the branchlets very fibrous. Stipules present. Leaves 6-jugate. Leaflets glabrescent; nerves 14—15 pairs. Fruits nearly globose, 3½ by 2¾ by 2¾ cm, nearly glabrous, with very thick (4 mm), fibrous pericarp; pyrene irregularly shallowly furrowed (peach-like), 2 cells sterile.

Distribution: Solomon Islands, New Britain, and New Guinea.

SUMATRA. *Beccari PS 495 (sp. dub.* aff. 1); *Teysmann HB 601* (type *Canariopsis hispida var. tomentella* Miq.) (1), *HB 706* (1).

MALAY PENINSULA. *Burkill 906* (type *C. subcordatum* Ridl.) (1); *SF. 18242* (*Henderson*) (1).

JAVA. *Backer 18576* (1), *27870* (1), *27922* (1); *Blume 1365* (type *C. altissimum* Bl.) (1), *in herb. L 898.319—214* (1), *in herb. L 898.319—278, 280* (syntype *Pimela hispida var. axillaris* Bl.) (1), *in herb. L 898.319—279* (syntype *Pimela hispida var. axillaris* Bl.) (1), *in herb. L 898.319—287, 289* (type *C. hispidum var. scabrum* Bl) (1), *in herb. L 901.65—289* (syntype *C. hispidum* Bl.?) (1), *in herb. L Carp. 890a* (1); *Brinkman 823* (1); *Burck in herb. L Carp. 1450* (1?); *Buwalda 3137* (1); *Horsfield 214* (1), *in herb. U 032897* (1); *Koorders (all β numbers) 916* (1), *918* (1), *919* (1), *920* (1), *921* (*sp. dub.* 1), *922* (1), *923* (1), *924* (1), *925* (1), *943* (1), *944* (1), *945* (1), *946* (1), *947* (1), *948* (1), *949* (1), *950* (1), *951* (1), *952* (1), *953* (1), *954* (1), *955* (1), *956* (1), *957* (1), *958* (1), *959* (1), *960* (1), *961* (1), *963* (1), *964* (1), *965* (1), *966* (1), *978* (1), *982* (1), *997* (1), *7566* (1), *12521* (1), *12525* (1), *12773* (1), *13161* (1), *15675* (1), *20258* (1), *22706* (1), *23782* (1), *24644* (1), *25080* (1), *25126* (1), *25324* (1), *26089* (1), *26127* (1), *26860* (1), *27237* (1), *27312* (1), *27314* (1), *28881* (1), *28883* (1); *Korthals 138* (1), *in herb. L 898.319—288* (1), *in herb. L 908.339—765* (1), *in herb. L 898.319—213, 925. 250—620* (1); *Kostermans 6220* (1); *Kostermans & Van Woerden 173* (1); *Noltée 4605* (1); *Reinwardt in herb. L 898.319—286, 909.54—181, 182* (1); *De Voogd 663* (1); *herb. L 898.319—132* (type *C. hispidum var. majus* Hassk.) (1).

BORNEO. *Clemens 9898* (1), *10035* (1), *26991* (1), *27391* (1); *Endert 2175* (1); *FRI. bb. 10152* (1), *bb. 18959 (v. d. Zwaan 984)* (1); *Korthals in herb. L 898.319—281, 282, 284* (type *Pimela hispida var. imbricata* Bl.) (1); *Kostermans 4662* (1), *4679* (1), *6959* (1); *Mondi 132* (1); *NBFD SH 10290 (Enohai)* (1); *SF. 20128 (Henderson)* (1), *20231 (Henderson)* (1); *Van Steenis 737* (1), *981* (1).

PHILIPPINES. Palawan: *BS. 45932 (MacGregor)* (1), *77723 (Edaño)* (1); *Elmer 12941* (1); *FB. 3803 (Curran)* (1), *23355 (Natividad)* (1), *29236 (Cenabre)* (1); *Merrill 9199* (1), *9314* (1); *Vidal 2293* (1). — Busuanga: *Marche 357* (1). — Mindoro: *FB. 3627 (Merritt)* (1), *3728 (Merritt)* (1); *Merrill 2230* (syntype *C. radlkoferi* Perk.) (1); *PNH. 19027 (Conklin 569)* (4—1); *Whitford 1445* (1). — Luzon: *Ahern 789* (1); *BS. 19182 (Reillo)* (1), *21968 (Ramos)* (type *C. ellipsoideum* Merr.) (aff. 1?), *22833 (MacGregor)* (2), *28197 (Fénix)* (1), *45723 (Ramos & Edaño)* (type *C. oxygonum* Quis. et Merr.) (1), *76865 (Ramos)* (1); *Elmer 15527* (2), *17093* (2); *FB. 123 (Barnes)* (syntype *C. ahernianum Merr.*) (aff. 2), *329 (Barnes)* (1), *422 (Ahern's coll.)* (lectotype *C. ahernianum* Merr.) (2), *2558 (Borden)* (1), *17592 (Curran)* (1), *17899 (Barros)* (1), *24289 (Bawan & Borromeo)* (3?), *25826 (Paraiso)* (1), *30828 (Oro)* (a); *Loher 274* (1), *5862* (1); *Merrill 1985* (a), *2349* (paratype *C. bersamifolium* Perk.) (1), *2607* (1), *Species Blancoanae 608* (1), *Species Blancoanae 909* (1); *Ramos 1930* (2); *Vidal 703* (1), *1024* (1), *1344* (1), *2283* (1); *Whitford 1254* (syntype *C. ahernianum* Merr.) (2); *Williams 363* (2). — Catanduanes: *BS. 75782 (Ramos & Edaño)* (1.) — Samar: *BS. 24450 (Ramos)* (paratype *C. robustum* Merr.) (3); *FB. 12833 (Rosenbluth)* (3); *PNH. 6080 (Sulit)* (1), *14485 (Sulit 4325)* (1). — Leyte: *Elmer 7242* (type *C. nervosum* Elm.) (1); *Wenzel 761* (1), *1555* (1). — Negros: *Elmer 10341* (paratype *C. nervosum* Elm.) (1); *FB. 20685 (Tamesis)* (1). — Panay: *Vidal 2298* (1). — Basilan: *FB. 20081 (Miranda)* (1); *Hallier 4524* (aff. 1). — Mindanao: *Ahern 697* (1); *BS. 15699 (Fénix)* (1—2), *49216 (Ramos & Edaño)* (1), *83686 (Ramos & Convocar)* (1); *Elmer 10763* (neotype *C. racemosum* Merr.) (3), *10817* (1), *11069* (1), *11215* (type *C. costulatum* Elm.) (3), *12015* (1); *FB. 31279 (Ponce)* (1); *PNH. 9897 (Sulit 3151)* (3); *Zwickey 601* (3).

CELEBES. *Beccari herb. 2169 A* (paratype *C. hirsutum var. beccarii* Leenh.) (b), *herb. 2170* (paratype *C. hirsutum var. beccarii* Leenh.) (b), *herb. 2171* (type *C. hirsutum var. beccarii* Leenh. (b), *herb. 2172* (paratype *C. hirsutum var. beccarii* Leenh.) (b); *FRI. bb. 5431* (4), *bb. 17289 (Tumbel 3)* (a—b?), *bb. 19603 (Verhoef 118)* (4), *bb. 21389 (Waturandang 144)* (?), *Cel./I-1* (4), *Cel./I-94* (?), *Cel./III-54* (aff. b?), *Cel./-316 (Waturandang 538)* (aff. 4), *Cel./V-382* (?); *Koorders (all β numbers) 16293* (aff. 4), *16295* (aff. 4), *16301* (4?), *16306* (type *C. greshoffii* Kds.) (?), *16309* (?); *Posthumus 2544* (*sp. dub.?* aff. b); *Riedel s.n.* (type *C. riedelianum* Engl.) (a); *Teysmann 14170* (4—1?).

MOLUCCAS. Morotai: *FRI. bb. 33772 (Tangkilisan 77)* (neotype *C. hirsutum* Willd.) (4), *bb. 33832 (Tangkilisan 143)* (4); *Lam 3652 (sp. dub.); Main & Aden 626* (4), *932* (4). — Halmaheira: *Beguin 1758* (4), *2106* (type *C. multijugum* H. J. Lam; paratype *C. hirsutum ssp. multicostulatum* Leenh.) (c), *2245* (type *C. hirsutum ssp.*

multicostulatum Leenh.) (c). — Ternate: *Beguin 6* (4), *1409* (4); *FRI. bb. 24539 (de Haan 351)* (aff. 4). — Sula Islands: *FRI. bb. 28832* (?), *bb. 29321* (aff. 4). — Ceram: *FRI. bb. 25882 (Buwalda 537)* (a—b?).

New Guinea. *Brass 3869* (d?); *Docters van Leeuwen 11275* (paratype *C. hirsutum var. leeuwenii* Leenh.) (d); *FRI. bb. 30280* (c?).

Carolines. Palau Islands: *Kanehira 549* (1), *2317* (1); *Kanehira & Hatusima 4945* (1); *Ledermann 14330* (type *C. palawense* Laut.) (1); *Takamatsu 1526* (1).

Solomon Islands. Bougainville: *Kajewski 1931* (type *C. hirsutum var. leeuwenii* Leenh.) (d).

Ecology: Rather common in primary, rarely in secondary forests, in wet to dry localities, mostly at low altitudes (rarely up to 1800 m). *Fl. fr.* throughout the year, *fl.* specially Febr.—July, *fr.* specially April—Sept.

Wood anat.: Moll & Janssonius. Mikr. Holzes 2 (1908) 102 (*C. hispidum* Bl.).

Uses. Wood moderately hard to rather soft. "According to the natives of Bukidnon decoction of roots is good for stomach trouble" (Sulit). Resin rather abundant and probably of some importance (see Buckley, Mal. For. Rec. *no.* 11, 1932, 29).

Notes. *C. hirsutum* is a variable and wide-spread species, which, like *C. pilosum,* forms the centre of a group of related, more constant species, each differing in a few characters and each with a rather limited area. In contradistinction to *C. pilosum,* however, *C. hirsutum* is apparently also geographically the centre of this group of species, as is demonstrated very well by the map fig. 12.

The mutual relationship of the infraspecific taxa of *C. hirsutum* is not quite clear. The subdivision is based mainly on fruit characters, but these prove to be correlated with characters of the leaflets (hairiness, more or less prominent nervation, colour of the dried leaves), an efficient description of which is often difficult. In contradistinction to most species of *Canarium,* this and some related species posses strong ribs on the fruit kernels. I believe the form with the slightest development of these ribs the most primitive one. This is forma *hirsutum* from the Moluccas (this distribution is interesting, since *C. balsamiferum,* which in my opinion is a more primitive species, closely related to *C. hirsutum,* is known from Celebes and the Moluccas).

From this basal form, development has apparently taken two directions, morphologically as well as geographically. Subsp. *multicostulatum* represents the eastern direction towards New Guinea: the ribs on the fruit kernels are many and they are strongly, though irregularly developed; in contradistinction to subsp. *hirsutum* the fruits are rather soon glabrescent; moreover, in var. *multicostulatum* the stipules are absent. (This subspecies forms the connection with the related Papuan species *C. polyphyllum, rigidum,* and *cestracion,* all of which posses strongly furrowed fruit kernels, glabrous fruits, and no stipules.) I did not come across any specimen intermediate between subsp. *multicostulatum* and subsp. *hirsutum,* and apparently these two trends represent the primary segregation within the species.

Subsp. *hirsutum* — especially var. *hirsutum* — represents the western direction of development. Like in some other species — *e. g. C. asperum* and *euryphyllum* — in the Philippines the variability, especially in some

characters of minor taxonomical importance, is fairly large. Here two rather well distinguishable races have been evolved, *viz.* formae *ahernianum* and *racemosum*, both showing an extreme development of the ribs on the pyrene. Forma *scabrum* is close to forma *hirsutum* — there are some intermediate specimens — and it occurs throughout the Philippines and the western half of the Malaysian Archipelago. It is rather variable, and some local populations are more or less distinguishable, but constant, well definable forms have apparently not (yet) developed.

I am still not quite certain about the status of var. *beccarii*. On the one side it is a well defined local population, quite distinct from the other forms by the absence of stipules and by the rather hairy lower side of the leaflets; on the other side, it is doubtless very close to *C. hirsutum*, especially in its flowers and fruits, and some specimens from N. Celebes and Ceram seem to be intermediate between f. *hirsutum* and var. *beccarii*. Up to now the flora of Celebes is still too insufficiently known for solving puzzles like this one.

The species as a whole is usually easily recognizable: the habit is very coarse, the twigs are stout with a thick and soft pith, the petioles are heavy and sharp-edged, the leaflets stiff and scabrous, the flowers rather large, conical in bud, and pilose, the fruits usually densely prickly hairy.

55. Canarium pseudosumatranum Leenhouts, 1955b, 193, f. 4; 1956, 286. — *C. sumatranum* (*non* Boerl. & Koord.) H. J. Lam, 1932b, 474, *pro min. parte* (*incl.* t. 11 f. 69b); Wyatt-Smith, 1953, 7, *cum fig.*

Type: Malay Peninsula, Selangor, Kuala Lumpur Distr., Bukit Langong for. res., May 9, 1951, *KEP. 55781 (Sow Lindong)*, ♂ (KEP; isotype in K).

Tree, up to *c.* 50 m by 120 cm, with short thick buttresses. *Branchlets* stout, *c.* 12 mm thick, glabrous but for the tomentose terminal bud; pith with a peripheral cylinder of small vascular strands closely appressed to the wood. *Stipules* absent (see Notes). *Leaves* 7—9-jugate, glabrous. *Leaflets* narrowly lanceolate, 13—20 by 3½—5 cm, stiff-chartaceous; base slightly oblique, rounded to subcordate, often slightly decurrent; margin entire; apex gradually, long (*c.* 1 cm) and slender blunt-acuminate; nerves 16—20 pairs (angle *c.* 55°), straight to slightly curving, close to the margin strongly curving and indistinctly arching. *Inflorescences* (♀ unknown) axillary, narrowly thyrsoid, *c.* 20 cm long, glabrous, partial panicles nearly decussate, patent, up to 2 cm long, shortly stalked, laxly cymose, many-flowered; *bracts* small, triangular. *Flowers* (♀ unknown) 1 mm pedicelled, 7 mm long, slender. *Calyx* 2 mm high, (sub)glabrous. *Petals* outside towards the top slightly rugose. *Stamens* glabrous, unequally high confluent at the base (*c.* 2—4 mm). *Disk* tubular, 1 mm high, thick-fleshy, on the rim and the inner side densely pilose; no pistil. *Infructescences* unknown. *Fruits* ovoid, round in cross-section, 5 by 2½ cm, glabrous; pericarp rather thick; pyrene with blunt angle-ribs, lids very distinct, each with an acute median rib; lids 2½ mm thick. *Seeds* 2, sterile cell slightly smaller.

Distribution: Assam (?) and the Malay Peninsula.

MALAY PENINSULA. *KEP. 2132 (Bonar)* (paratype), *11599 (Hamid)* (paratype), *20476 (Strugnell)* (paratype), *20900 (Bain)* (paratype), *23087 (Symington)* (paratype),

55781 (Sow Lindong) (type), *71256 (Wyatt-Smith)* (paratype), *71974 (Sow Lindong)* (paratype).

Ecology: Lowland and hill forests, *fl.* March—May, *fr.* Dec.

Notes. Possibly, one inadequate specimen from Assam — *Upendranath Kanjilal 4966,* fr., Darrang Distr. — belongs also to the present species. It is distinctly smaller in its vegetative parts and its fruits, however, and there are stipule-scars at the base of the petiole. It might represent a separate subspecies or even a related species; more complete material is desirable.

The species is related to *C. sumatranum,* differing, however, by the absence of stipules, by the narrower, stiff, gradually acuminate leaflets, the narrow inflorescences, and especially by the much larger, quite different fruits.

56. Canarium sumatranum Boerlage & Koorders *in* Koorders-Schumacher, 1910, 25; Guillaumin, 1912, 211, t. 16; Lam, 1931—32a, t. 5 f. 3, t. 11 f. 78, t. 16 f. 132; 1932b, 474, t. 11 f. 69, *excl. fr.*; Leenhouts, 1956, 286. — *Fig. 31.*

Type: Sumatra, Bengkulu, Mokko-Mokko, alt. 100 m, Febr. 19, 1891, *Koorders 10282 β,* st. (BO).

Tree up to 50 m by 120 cm, with up to 1½ m high buttresses; in young specimens the stem and branches thorny. *Branchlets* stout, 1½—2 cm thick, glabrous except the densely reddish-brown tomentose terminal bud which is *c.* 3½ cm long, acute and often curved, pith thick with numerous, scattered, small vascular strands, most of them crowded towards the periphery. *Stipules* nearly always absent, if present early caducous, inserted at the base of the petiole, subulate, *c.* 3 mm. *Leaves* 7—11-jugate, often without a terminal leaflet. *Leaflets* oblong, *c.* 20 by 5—8 cm, herbaceous (to subchartaceous), glabrous; base very broad, subcordate to broadly cuneate; margin entire; apex rounded, abruptly shortly and blunt-acuminate, or gradually long (—2½ cm) acute-acuminate; nerves 20—26 pairs (angle 80—90°), s-shaped to faintly curving, close to the margin abruptly strongly curving upwards and more or less distinctly arching. *Inflorescences* (♀ unknown) axillary, broadly and laxly thyrsoid, up to 45 cm long, many-flowered, slightly puberulous towards the tips or glabrous, main branches up to 17 cm, narrowly thyrsoid on a long stalk; *bracts* minute, squamate. *Flowers* (♀ unknown) subsessile, 8—9 mm long, glabrous outside. *Calyx* 3 mm high. *Petals* towards the top much incrassate with rugose lateral surfaces. *Stamens* glabrous, 7 mm long, connate for (2—)4—5 mm. *Disk* about globular, with 6 thick lobes and a central canal, 1 mm high, minutely pubescent, without pistil. *Infructescences* laxly thyrsoid, 20—30 cm long, with *c.* 15—20 fruits, glabrous; calyx saucer-shaped, triangular, 7 mm diam.; remains of the disk faintly 6-lobed, about 1 mm high, fimbriate. *Fruits* ovoid, rounded 3-angular in cross-section, 1½ by 1 cm, glabrous; pyrene nearly smooth; lids 1 mm thick. *Seeds* 2, sterile cell slightly smaller.

Distribution: Sumatra, Malay Peninsula.

SUMATRA. *Achmad 1416; FRI. bb. 5989; Koorders 10282 β* (type); *Lörzing 5677, 5677a.*

MALAY PENINSULA. *KEP. 4452 (Borges); Wray Jr. 3493.*

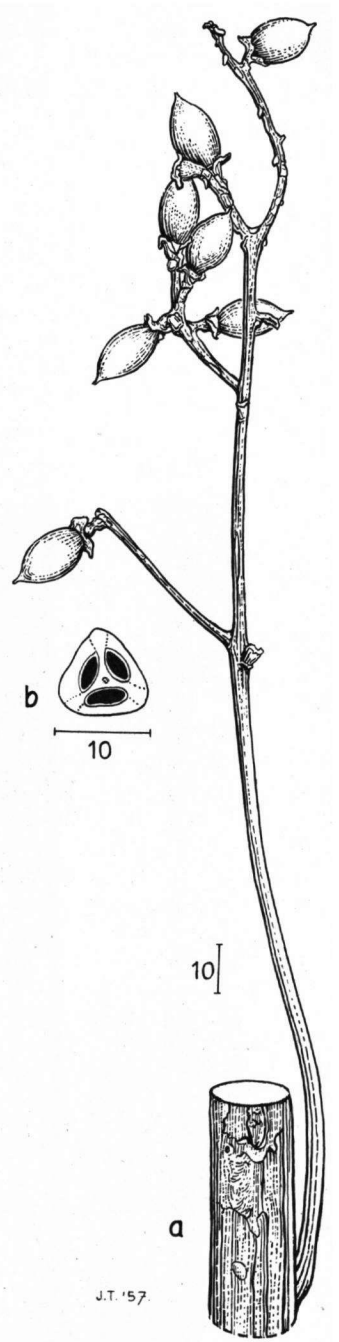

Fig. 31. *C. sumatranum* — a. infructescence; b. fruit-kernel in cross-section (*Wray jr. 3493*) (dimensions in mm).

Ecology: In primary and secondary forests, up to 500 m, *fl.* May, Oct., Nov. (Sum.), *fr.* Oct. (Mal. Pen.).

Wood anat.: Webber, Lilloa 6 (1941) 450, t. 3 f. 7.

Notes. In the Malay Peninsula the closely related *C. pseudosumatranum* is much commoner than the present species. The two species were usually confused, though they differ in many points (see under the preceding species).

57. Canarium rigidum (Bl.) Zippelius *ex* Miquel, 1859, 648; Engler, 1883, 142, t. 3 f. 3—5; 1896, f. 136 V—W; 1931, f. 211 V—W; Lam, 1932a, t. 12 f. 85; 1932b, 478, t. 11 f. 71, *excl. syn. Pimela (Canariopsis, Canarium) angustifolia* Bl.; Leenhouts, 1956, 290. — *Pimela rigida* Blume, 1850, 222. — *Fig. 32.*

Type: New Guinea, *Zippel 189*, ♂ (L; isotypes in BRSL, U).

Slender tree up to 25 m. *Branchlets* rather stout, 7—12 mm thick, glabrous but for the tips; pith with a peripheral closed cylinder of small vascular strands. *Stipules* absent. *Leaves* 6—12-jugate, glabrous. *Lateral petiolules* 2—11 mm. *Leaflets* lanceolate, 6¼—15 by 1¼—4 cm, chartaceous; base rounded to subcordate; margin entire; apex gradually, long and slender-acuminate; nerves 15—20 pairs (angle 70—85°), irregular, not to faintly curved, abruptly arching at *c.* 1—2 mm from the margin; intermediate veins strongly developed. *Inflorescences* (♀ unknown) axillary, laxly thyrsoid, 10—20 cm long, glabrous, peduncle globular-thickened at the base; main branches subdecussate, up to 5 cm, dichotomously branched, crowded-9—12-flowered; *bracts* persistent, deltoid, 1 mm long. *Flowers* (♀ unknown) subsessile, glabrous, 6 mm long. *Calyx* 3 mm high. *Petals* much incrassate towards the apex, the broadened and flattened margins of the apical part rugose. *Stamens* glabrous, 4½—5 mm long, connate for 2 mm. *Disk* cushion-shaped with elevated margin, 1 mm high, minutely pubescent on the upper surface, with a central canal, but without a rudimentary pistil. *Infructescences* 12—25 cm long, with 1—3 fruits, glabrous; main branches up to 6 cm; calyx shallowly saucer-shaped with a 3-lobed margin; remains of a circular, fimbriate disk present. *Fruits* ellipsoid, tapering at the base, acuminate at the apex, rounded 6-angular in cross-section, 4 by 2—2½ cm, glabrous; pericarp rather thick and fleshy; pyrene circular in cross-section with many irregular, longitudinal ribs, which are up to 5 mm high and 1—2 mm wide; lids 2½ mm thick. *Seed* 1, sterile cells only slightly reduced.

Distribution: New Guinea.

New Guinea. *Carr 15959; Clemens 8031; Zippel 189* (type).

Ecology: Primary and secondary forests, both at low altitude and up to 1000—1200 m, *fr.* March.

Note. Closely related to *C. polyphyllum*, and possibly even not specifically distinct. As, however, the material of both species is rather scanty, and as, up to now, it shows some real differences both in the fruits and in the leaves, I prefer for the time being to keep them apart.

58. Canarium polyphyllum K. Schumann *in* Schumann & Hollrung, 1889, 63; Lam, 1932a, t. 11 f. 77; 1932b, 479, t. 11 f. 72; Leenhouts, 1956, 290, f. 20d; *non* Kärnbach, 1893, 16, and Krause, 1913, 147, *cum fig.*

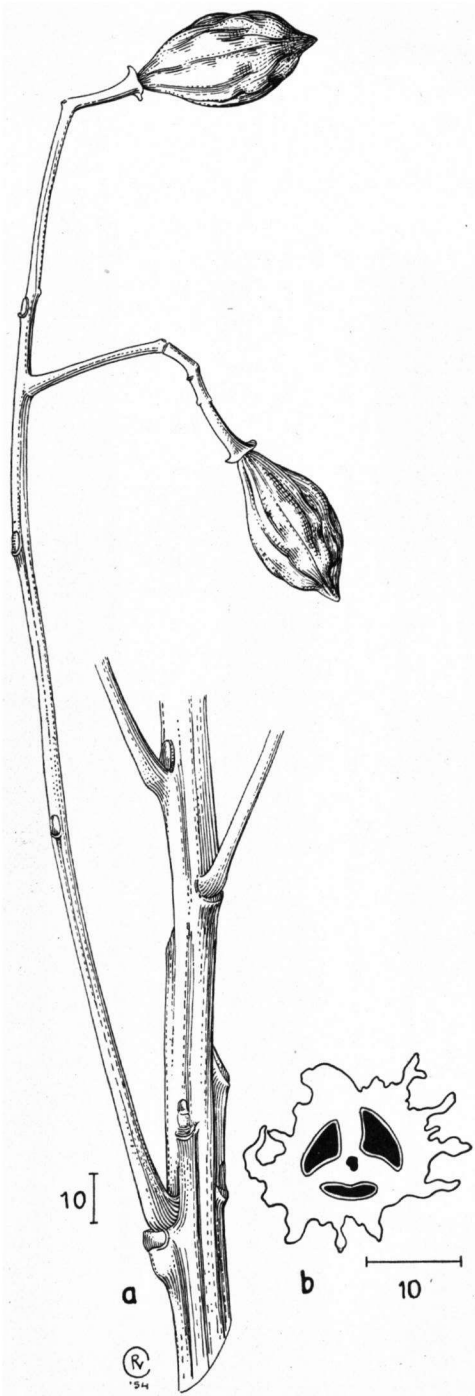

Fig. 32. *C. rigidum* — a. infructescence; b. fruit-kernel in cross-section (a. from *Carr 15959;* b. from *Clemens 8031*) (dimensions in mm).

(very probably these both refer to *C. indicum* L.). — *C. ledermannii* Lauterbach, 1920, 328, f. 2 A—E. — *Fig. 33.*

Type: N.E. New Guinea, Augusta River, 1887, *Hollrung s.n.*, ♂ (B; isotypes in BRSL, K, L, MEL, P, U).

Tree, up to 30 m high, with buttresses. *Branchlets* ¾—1½ cm thick, glabrous, the velvety young parts excepted; pith with many minute vascular strands, closely appressed to the wood-cylinder. *Stipules* absent. *Leaves* 3—11-jugate. *Leaflets* narrowly oblong, 5½—20 by 2½—8 cm, chartaceous, glabrous but for the minutely pubescent midrib above and midrib and main nerves beneath; base rounded (to subcordate); margin entire; apex rounded, rather abruptly, shortly and acute-acuminate; nerves 11—24 pairs (angle 60—70—90°), slightly irregular, strongly curving towards the margin, indistinctly arching remote from it; intermediate veins more or less well developed. *Inflorescences* (♀ unknown) axillary, laxly thyrsoid, 15—48 cm long, pubescent towards the tips; partial panicles up to 8 cm long, long-stalked, cymose, *c.* 15-flowered, flowers clustered; *bracts* persistent, deltoid, 1 mm long. *Flowers* (♀ unknown) subsessile, 6 mm long, glabrous. *Calyx* 2½—3 mm high. *Petals* thickened towards the apex, the inflexed apiculum much thickened and rugose. *Stamens* glabrous, *c.* 4½ mm long, connate for *c.* 1½ mm. *Disk* 1 mm high, cushion-shaped, faintly 6-lobed, deepened towards the centre, narrowed at base, long-pilose on the upper surface; no pistil. *Infructescences* racemose to thyrsoid, 10—25 cm long, with 5—7 fruits, glabrescent; main branches up to 5 cm long, with 1—2 fruits; calyx flat, faintly 3-lobed to circular, 8—10 mm diam., margin slightly undulate; remains of a 6-lobed, long-fimbriate disk present. *Fruits* ellipsoid, tapering at both ends, rounded 3-angular to circular in cross-section, 4—5 by 2—2½ cm, glabrous; angle-ribs of the pyrene acute, surface of the lids slightly undulate; lids *c.* 1 mm thick. *Seed* 1, sterile cells slightly reduced.

Distribution: New Guinea.

New Guinea. *FEI. bb. 33504 (Kostermans 317); Hollrung in herb. L 898.319—342* (type); *Hoogland 5059; Ledermann 7504, 7941* (type *C. ledermannii* Laut.), *8277; NGF. 8764 (Womersley); Schlechter 16886.*

Ecology: In dense to open primary forests, up to *c.* 400 m, *fl.* June—Nov., *fr.* Sept.

Note. Closely related to *C. rigidum* (see there).

59. Canarium cestracion Leenhouts, 1955b, 189, f. 5g; 1956, 290, f. 21k.

Type: S.E. New Guinea, Central Prov., Koitaki, alt. 500 m, July 5, 1935, *Carr 12796,* fr. (SING; isotypes in BM, K, L).

Tree *c.* 20 m. *Branchlets* 8 mm thick, glabrous; pith fibrous by many, scattered small vascular strands. *Stipules* very caducous, inserted on the twig near the base of the petiole, leaving a minute scar. *Leaves* 3—5-jugate, glabrous. *Leaflets* ovate-lanceolate, 11—20 by 4½—7 cm, stiff-chartaceous; base rounded to broadly cuneate; margin entire; apex gradually narrowed into a short, broad and blunt acumen; nerves 10—12 pairs (angle 65—75°), straight to faintly curved, more strongly curved towards the margin, more or less distinctly arching at some distance from it. *Inflorescences* and *flowers* unknown. *Infructescences* axillary, racemose,

15—20 cm long, with 1—3 fruits, glabrous; calyx flat, 3-angular, 6—8 mm diam., lobes reflexed. *Fruits* ellipsoid, acuminate at base and apex, narrowly triangular in cross-section, 4—4½ by 2½—2¾ by *c.* 1½ cm, glabrous; pyrene deeply furrowed, angle-ribs very prominent, as are the median ribs of the lids; lids 3½ mm thick. *Seeds* 1—2; fertile cells long and narrow, sterile ones almost entirely reduced.

Distribution: E. New Guinea (Central Prov.).

NEW GUINEA. *Carr 12796* (type).

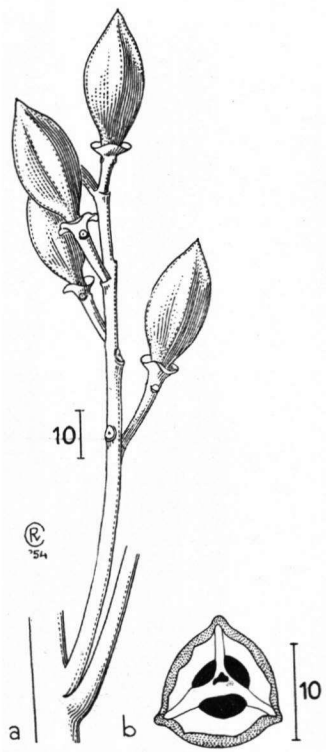

Fig. 33. *C. polyphyllum* — a. infructescence; b. fruit in cross-section (*Kostermans 317*) (dimensions in mm).

Ecology: In forests, 500 m. *Fr.* July.

Note. Apparently related to *C. rigidum* and *polyphyllum*; specially characterized by its very peculiar fruits.

60. **Canarium vrieseanum** Engler, 1883, 142, t. 3 f. 15—18; Koorders, 1922a, t. 30; 1922b, 17; Lam, 1932b, 455, t. 10 f. 63; Leenhouts, 1956, 291. — *C. williamsii* Robinson, 1908, 185; Brown, 1921, 302, f. 37; Merrill, 1923, 355. — *C. tongcalingii* Elmer, 1911, 1082; Merrill, 1923, 354. — *C. sibulanense* Elmer, 1911, 1085; Merrill, 1923, 353. — *C. dolichophyllum* Merrill, 1915a, 20; 1923, 350. — *C. villosiflorum* Elmer, 1915, 2569.

Type: Celebes, *De Vriese in herb. L 898.319—382*, ♀ & fr. (L).

Tree 15—25(—31) m by 30—45 cm, buttresses small or absent. *Branchlets* slender to rather stout, nearly always densely, minutely woolly ferruginous-pubescent, as are the leaves, inflorescences and sometimes the infructescences; pith with a peripheral cylinder of rather large vascular strands. *Stipules* inserted on the petiole up to 1½ cm from the base, often ribbon-shaped, tapering, and falcate, $^2/_5$—1 cm. *Leaves* 3—5(—7)-jugate. *Leaflets* ovate to oblong, 7—30 by 3—12 cm, chartaceous, more or less densely fulvous-pubescent on the midrib above and on all nerves beneath, rarely nearly glabrous; base slightly oblique, rounded to cuneate; margin entire; apex rather abruptly, up to 3 cm long, slender-acuminate; nerves rather prominent beneath, 12—18(—24) pairs (angle 55—75°), parallel, straight or slightly curved, more strongly curving towards the margin, gradually and vaguely arching close to it. *Inflorescences* axillary, narrowly thyrsoid (♂) to racemose (♀), 20—30(—60) cm long, 1—3(—5) cm wide, main branches patent, about 1½ cm long, 3—5-flowered (♀ ones 1—3-flowered), rarely some basal ramifications strongly developed. Buds fusiform, slender, fulvous-tomentose, closed. *Flowers* 6—10 mm long, nearly sessile. *Calyx* 6—8 mm high. *Stamens* glabrous, in ♂ flowers slightly and irregularly confluent at the base; in ♀ flowers free. *Disk* in ♀ flowers faintly 6-lobed, 1—2 mm high, fimbriate; in ♂ flowers ovoid, 1 mm high, pilose, with a central canal. *Pistil* densely pilose, ♂ none. *Infructescences* ascending to erect, 10—20(—45) cm long, with *c.* 5—10(—40) fruits; calyx flat, deeply 3-lobed (lobes not reflexed), ¾—1½ cm diam. *Fruits* ovoid, acute, round in cross-section, 1¾—3¼ by ¾—2¼ cm, remaining velvety for a long time; pyrene very faintly 6-ribbed, nearly smooth; lids *c.* 2½ mm thick. *Seed* 1.

Distribution: Philippines (Mindanao, according to H. J. Lam also in Luzon), Central and N. Celebes. A record from Buru, Moluccas, based on a cultivated tree in the Bogor Botanical Garden, is doubtful.

Taxonomy. Fairly polymorphous species, which can easily be subdivided into three local forms:

a. forma **vrieseanum.**

Slender form. Branchlets less than 1 cm thick. Leaves 3—5-jugate. Leaflets lanceolate, moderately hairy. Inflorescences narrowly thyrsoid, infructescences mostly racemose.

Distribution: Celebes.

b. forma **williamsii** (C. B. Rob.) Leenhouts, 1956, 291. — *C. williamsii* C. B. Rob.

Type: Philippines, Mindanao, Zamboanga Prov., Sax River, alt. 120 m, Febr. 7, 1905, *Williams 2111*, ♂ (PNH †; isotypes in K, NY).

Stout and hairy form. Leaves 6—7-jugate. Leaflets ovate, relatively large. Inflorescences and infructescences more widely thyrsoid, rather large, the latter with many fruits.

Distribution: Mindanao.

c. forma **stenophyllum** Leenhouts, 1955b, 194; 1956, 291.

Type: Philippines, Mindanao, Davao Prov., Mati, March—April 1927, *BS. 49156 (Ramos & Edaño)*, fr. (SING; isotype in NY).

Rather stout form. Leaves *c.* 7-jugate, nearly glabrous. Leaflets stiff, c. 20 by 4 cm; nerves 20—26 pairs, dense. Inflorescences small. Fruits rather small (*c.* 1¾ by 1¼ cm).

Distribution: Mindanao (Davao Prov.).

PHILIPPINES. Mindanao: *BS. 36680 (Ramos & Edaño)* (b), *49156 (Ramos & Edaño)* (type) (c), *49539 (Ramos & Edaño)* (paratype) (c); *Elmer 10996* (type *C. toncalingii* Elm.) (aff. c), *11206* (type *C. sibulanense* Elm.) (aff. b), *13347* (b), *13644* (type *C. villosiflorum* Elm.) (b); *FB. 20749 (Rafaël & Ponce)* (type *C. dolichophyllum* Merr.) (b), *28843 (Mallonga)* (b); *PNH. 13566 (Añonuevo 168)* (b), *13666 (Añonuevo)* (aff. c); *Williams 2111* (type *C. williamsii* C. B. Rob.) (b).

CELEBES. *Forsten in herb. U 78894* (a); *FRI. bb. 14151* (a), *bb. 14541* (a), *bb. 19414 (Uno 67)* (a); *Koorders (β numbers) 16302 (sp. dub.), 16313* (a), *16314* (a); *Riedel in herb. L 932.106—105* (aff. a); *Teysmann 5718* (a); *De Vriese in herb. L 898.319—382* (type) (a), *in herb. L 898.319—383* (a), *in herb. L 908.146—1893* (a), *in herb. L 908.146—1894* (a); *De Vriese & Teysmann in herb. L 908.146—1891/2* (a).

cultivated:

Hort. Bot. Bog. VI B 16 (a), *VI E 10* (a).

Ecology: In primary and secondary forests up to 500 m, *fl.* July—Dec.(—Febr.), *fr.* Dec.—Febr. (Celebes), March—June (Philipp., f. *stenophyllum*), July—Oct. (Philipp., f. *williamsii*).

Uses. The wood is said to be rather tough and hard, rarely more soft. The seeds are edible. Locally the resin is used for lighting purposes.

Notes. This species is related to *C. asperum*, particularly to its var. *clementis* from the Philippines.

C. vrieseanum is best distinguished by its rather narrow inflorescences, which are often nearly of the same width from base to apex, by the fusiform, brown tomentose flower-buds, and by the velvety pubescent, ovoid to ellipsoid fruits; moreover, the shape of the stipules is typical, they are nearly always stiff and slightly curved towards the branchlet.

61. Canarium asperum Bentham, 1843, 215; Engler, 1883, 135; Lam, 1932b, 461, t. 10 f. 66; Meijer Drees, 1951, 42; Leenhouts, 1955a, 10, f. 5; 1955b, 189; 1956, 293. — *Dammara nigra legitima* Rumphius, 1741, t. 53. — *C. commune* (*non* L.) Blanco, 1837, 791; Merrill, 1905a, 30; 1918a, 207. — *C. pimela* (*non* Koen.) Blanco, 1845, 545, t. 343; 1879, 200, t.; Merrill, *ll. cc.* — *Pimela legitima* Blume, 1850, 222. — *Pimela villosa* Blume, 1850, 223. — *Pimela denticulata* Blume, 1850, 226. — *C. legitimum* Miquel, 1859, 647; Engler, 1883, 127; Merrill, 1917, 300. — *Canariopsis villosa* Miquel, 1859, 652. — *Canariopsis aspera* Miquel, 1859, 653. — *Canariopsis denticulata* Blume *ex* Miquel, 1859, 654. — *C. villosum* Bentham & Hooker *f. ex* Fernandez-Villar, 1880, 40; Vidal, 1883, 19, t. 28 f. A; Brown, 1921, 49, f. 13; Merrill, 1923, 354; Yenko *et al.* 1934, 5, 9, t. 7 f. 3. — *C. molle* Engler, 1883, 109. — *C. minutiflorum* Engler, 1883, 123; Merrill, 1923, 351. — *C. zollingeri* Engler, 1883, 127; Koorders, 1912, 434; Heyne, 1927, 880. — *C. cumingii* Engler, 1883, 132; Elmer, 1911, 1077. — *C. luxurians* Engler, 1883, 146, *nom. illeg.* — *C. solo* Engler *ex* Koorders, 1903, 98, *nom. nud.*; 1922a, t. 29; 1922b, 16. — *C. treubianum* Engler *ex* Koorders, 1903, 98, *nom. nud.*; 1922a, t. 32; 1922b, 18. — *C. calophyllum* Perkins, 1904, 91; Merrill, 1923, 349; Lam, 1932a, t. 12 f. 83; 1932b, 529. — *C. juglandifolium* Perkins, 1904, 93; Merrill, 1906a, 28. — *C. lucidum* Perkins, 1904, 94; Merrill, 1923, 351; Lam, 1932a, t. 12 f. 82; 1932b, 530. — *C. poly-*

neurum Perkins, 1904, 96; Merrill, 1923, 353. — *C. stachyanthum* Perkins, 1904, 97; Merrill, 1906a, 29. — *C. thyrsoideum* Perkins, 1904, 98; Merrill, 1906a, 28. — *C. valetonianum* Engler (*ex* Koorders, 1903, 98, *nom. nud.*) *ex* Hochreutiner, 1904, 63; 1905, 86; 1910, 850; Koorders, 1922a, t. 33; 1922b, 18. — *C. koordersianum* Engler (*ex* Koorders, 1903, 97, *nom. nud.*) *ex* Hochreutiner, 1904, 63; Koorders, 1922a, t. 27; 1922b, 14. — *C. reticulatum* Merrill, 1908b, 141; 1923, 353; Lam, 1932b, 530, *non C. reticulatum* Ridley, 1930, 83, *quae est Dacryodes rostrata* H. J. Lam. — *C. clementis* Merrill, 1908b, 142; Elmer, 1911, 1078, *incl. var. perumbrinum.* — *C. leytense* Elmer, 1911, 1081. — *C. apoense* Elmer, 1911, 1083; Merrill, 1923, 349. — *C. ogat* Elmer, 1911, 1086; Merrill, 1923, 352; Lam, 1932b, 352. — *C. sibuyanense* Elmer, 1912, 1502. — *C. euphlebium* Merrill, 1913, 372; 1923, 350. — *C. wenzelii* Merrill, 1914b, 363; 1923, 355. — *C. heterophyllum* Merrill, 1915a, 19; 1923, 350. — *C. lagunense* Merrill, 1915a, 21; 1923, 350. — *C. barnesii* Merrill, 1915a, 22; 1923, 349. — *C. sanchezii* Merrill, 1915a, 27; 1923, 353. — *C. agusanense* Elmer, 1915, 2564; Merrill, 1923, 349. — *C. subvelutinum* Elmer, 1915, 2566. — *C. urdanetense* Elmer, 1915, 2568; Merrill, 1923, 354; Lam, 1932b, 531. — *C. samarense* Merrill, 1916a, 183; 1923, 353. — *C. tamborae* Lauterbach, 1920, 327. — *? C. fulvum* Lauterbach, 1920, 330; Lam, 1932a, t. 16 f. 127c[1]; 1932b, 458, t. 10 f. 64. — *C. unifoliolatum* Merrill, 1921, 267; 1923, 354; Lam, 1932b, 533. — *C. papuanum* H. J. Lam, 1932a, 211, t. 12 f. 86, t. 13 f. 104k; 1932b, 459, t. 10 f. 65.

Type: New Guinea, *Hinds*, ♀ & fr., *n. v.*

Tree 8—35 m by 5—70(—more than 100) cm, rarely a shrub, very rarely buttressed. *Branchlets* rather slender, nearly always glabrous but for the tip; number and arrangement of vascular strands in the pith very variable. *Stipules* subpersistent or caducous, inserted beside the petiolar base or rarely on the petiole up to 1¼ cm from the base, subulate, 1—10 mm. *Leaves* 0—6-jugate. *Leaflets* very variable, ovate to elliptic, rarely obovate or lanceolate, 4—30 by 2—10 cm, generally rather rigid, chartaceous to coriaceous, glabrous to more or less pubescent, specially beneath; base rounded to cuneate, slightly oblique; margin entire, in young plants often serrulate to dentate and with tufts of hair on the teeth; apex mostly more or less abruptly, up to *c.* 2 cm long, tapering to narrowly, acutely to bluntly acuminate; nerves rather prominent beneath, 7—20 pairs (angle 50—80°), straight to slightly curved, sometimes abruptly arching close to the margin. *Inflorescences* axillary, spicate to thyrsoid, ♂ up to *c.* 40 cm long, ♀ ones 1—20(—32) cm, mostly slender and flexible, pendulous to ascending, sometimes rigid and erect; more or less hirsutely pubescent to glabrous. *Flowers* 3—7 mm long, ♀ ones very rarely with a slightly concave receptacle. *Calyx* 1½—5 mm high. *Stamens* glabrous, 1½—5 mm long, free, rarely slightly connate at the base or adnate to the disk. *Disk* pilose, in the ♀ flowers 3- or 6-lobed to subtruncate, *c.* 1 mm high; in the ♂ flowers cup-shaped with sometimes a small ovarial rudiment, to subglobose, with or without a central canal, more or less 6-lobed, up to 1½ mm high. *Pistil* pubescent, rarely glabrous. *Infructescences* (sub)spicate, flexible to rigid, with many fruits; *calyx c.* 2½—5 mm diam. with strongly reflexed lobes (*asperum*-type) to *c.* 1 cm diam., funnel-shaped, deeply 3-lobed (*calophyl-*

lum-type). *Fruits* ovoid to subglobose, subacute, round or slightly trigonous in cross-section, 9—14 by 4—11 mm, glabrous; pyrene smooth to slightly rugose, rarely very faintly 6-ribbed; lids *c.* 2 mm thick. *Seed* 1; sterile cells entirely reduced or nearly so.

Distribution: Bawean & Kangean Islands near E. Java, Lesser Sunda Islands (Sumbawa, Sumba, Flores; according to Meijer Drees also in Timor), Borneo (apparently rare), Philippines, Celebes, Moluccas, New Guinea, and Solomon Islands.

Taxonomy. Extremely variable species, the infraspecific taxonomy of which is not yet clear, however abundant the material may be. The subdivision given here is therefore but a tentative one.

KEY TO THE INFRASPECIFIC TAXA

1.a. Inflorescences spicate to narrowly thyrsoid . . . . . var. **asperum**
b. Inflorescences more widely branched 2
2.a. Inflorescences compoundly spicate . . . . . var. **clementis**
b. Inflorescences thyrsoid . . . . . subsp. **papuanum**

A. Subsp. **asperum**. — All synonyms with the exception of *C. papuanum*.

Inflorescences either spicate to (♂) narrowly thyrsoid, or compoundly spicate.

a. var. **asperum**. — All synonyms of the subsp. except those mentioned under var. *clementis*.

Inflorescences spicate or narrowly thyrsoid. In all other characters nearly as variable as the species.

Distribution: As the species.

JAVA. Kangean Islands: *Backer 27578 (= 27864?), 27823, 27864; Beguin F 2.* — Bawean: *Buwalda 2998, 3141; Karta 49.*

LESSER SUNDA ISLANDS. Sumbawa: *FRI. bb. 10322; De Voogd 1710; Warburg 17060* (type *C. tamborae* Laut.); *Zollinger 3424* (type *C. zollingeri* Engl.). — Sumba: *Iboet 78, 451.* — Flores: *Elbert 4312; FRI. bb. 8228, bb. 8930, bb. 9985, bb. 11369, bb. 21432.*

BORNEO. *Castro & Melegrito 1433; Kostermans 4678; NBFD. 4956 (Keith), SAN 16404 (Wood & Charington), SAN A 4194 (Wood), SH 10277 (Valera).*

PHILIPPINES. Palawan: *BS. 736 (Foxworthy), 910 (Foxworthy), 77884 (Edaño); Ebalo 500; Elmer 12658, 13228; FB. 3605 (Curran), 3788 (Curran), 3805 (Curran), 4145 (Curran), 29183 (Cenabre); Merche 89; Merrill 723* (type *C. polyneurum* Perk.), *9206, 9232, 9579; PNH. 12 (Edaño), 207 (Edaño 512), 12330 (Sulit 3765), 13375 (Fox 55), 14176 (Edaño 2672), 23050 (Celestino & Ramos 157).* — Culion: *Herre 1008, 1017; Merrill 663.* — Mindoro: *BS. 15307 (Kienholz 323), 39674 (Ramos), 40680 (Ramos & Edaño); Merrill 2256* (syntype *C. thyrsoideum* Perk.); *PNH. 17478 (Conklin 122); Whitford 1480.*— Babuyan Islands: *FB. 26630 (Velasco).* — Luzon: *Adduru 137; Ahern's coll. Decades 110; Bartlett 14550; BS. 480 (Fénix), 7200 (Ramos), 11157 (MacGregor), 11173 (MacGregor), 13878 (Ramos)* (type *C. heterophyllum* Merr.), *13958 (Loher), 14945 (Ramos)* (type *C. lagunense* Merr.), *17764 (Otanes), 20468 (Ramos)* (paratype *C. lagunense* Merr.), *20579 (Ramos)* (paratype *C. lagunense* Merr.), *23634 (Ramos), 26839 (Edaño), 29037 (Ramos & Edaño), 29627 (Ramos & Edaño), 29770 (Ramos & Edaño), 46541 (Ramos & Edaño), 76944 (Ramos), 78177 (Quisumbing), 82308 (Quisumbing); Clemens 16739, 18059; Cuming 689* (type *C. cumingii* Engl.), *769* (type *C. luxurians* Engl.), *1006* (type *C. minutiflorum* Engl.); *Elmer 8255, 8567, 8766, 8876, 8926, 9234, 15659, 17586, 18312, 22364; FB. 125 (Barnes), 697 (Borden), 1284 (Borden), 1311 (Borden), 1312 (Borden), 1314 (Borden), 1319 (Borden), 1554 (Borden), 1676 (Borden), 2789 (Meyer), 3146 (Ahern's coll.), 7108 (Klemme), 7667 (Curran), 10794*

(Curran), 10896 (Curran), 11973 (Tamesis), 11982 (Tamesis), 12927 (Alvarez), 12969 (Alvarez), 13964 (Merritt & Darling), 15207 (Bernardo), 17622 (Curran), 17745 (Curran), 18348 (Alvarez), 18586 (Alvarez), 19701 (Whitford), 20138, 21292 (Sandkuhl), 21681 (Domingo), 21957 (Adduru), 22818 (Diaz & Alambra), 23862 (Paraiso), 24218 (Lopez), 25403 (Labitag), 25422 (Duldulao), 26282 (Paraiso), 26510 (De Mesa & Magistrado), 26997 (De Guzman), 27781 (Ranario), 28410 (Valdez), 28604 (Salvoza), 28605 (Salvoza), 29042 (Velasco), 30427 (Sulit & Co.), 30851 (Oro), 31072 (Oro); Fénix 186; Galutera in herb. L 956.072—871; Loher 430, 431, 433, 439, 5855; Merrill 1056 (type *C. lucidum* Perk.), *1858* (type *C. odlophyllum* Perk.), *1974* (type *C. juglandifolium* Perk.), *2119* (syntype *C. thyrsoideum* Perk.), *2129, 2348, 2556, 2821, 2864, 2936, Species Blancoanae 558; Otanes 2063; PNH. 4587 (Alcasid & Edaño), 6975 (Sulit), 6976 (Sulit), 9733 (Canicosa 170), 17947 (Edaño 5112), 33442 (Rañeses), 33481 (Orden Jr.), 33486 (Rivera), 33492 (Agra); Ramos 353, 1880; Sulit & Students 18; Vidal 174, 701, 1025, 1337, 1343, 1346, 1347, 2282, 2285, 2294, 2295; Whitford 74, 296, 376, 1154, 1309; Williams 553, 1373.* — Sibuyan: *Elmer 12095, 12225* (type *C. sibuyanense* Elm.). — Masbate: *Merrill 2617* (type *C. barnesii* Merr.), *2756, 3083.* — Samar: *BS. 24149 (Ramos)* (paratype *C. samarense* Merr.), *24191 (Ramos)* (type *C. samarense* Merr.), *24214 (Ramos)* (paratype *C. samarense* Merr.), *24385 (Ramos), 24479 (Ramos), 24879 (Edaño)* (paratype *C. samarense* Merr.); *FB. 24585 (Phasis); PNH. 6178 (Sulit), 6331 (Sulit), 14421 (Sulit 4261), 14427 (Sulit 4269), 14493 (Sulit 4333), 14507 (Sulit 4355).* — Leyte: *Vidal 159; Wenzel 293* (type *C. euphlebium* Merr.), *1388, 1394, 1725.* — Bohol: *BS. 42855 (Ramos).* — Cebu: *FB. 6412 (Espinosa), 6447 (Everett), 15252 (Cenabre).* — Negros: *Britton 346; Elmer 9630, 10113.* — Panay: *BS. 42449 (Edaño), 42451 (Edaño), 46184 (Edaño).* — Guimaras: *FB. 282 (Gammill); Vidal 2290.* — Sulu Islands: *Santos 4771.* — Mindanao: *BS. 34720 (Ramos & Pascasio)* (type *C. unifoliolatum* Merr.), *35088 (Ramos & Pascasio), 35178 (Ramos & Pascasio), 37264 (Ramos & Edaño), 38458 (Ramos & Edaño), 48862 (Ramos & Edaño), 48889 (Ramos & Edaño), 48906 (Ramos & Edaño), 49443 (Ramos & Edaño), 83954 (Ramos & Convocar), 83956 (Ramos & Convocar); Clemens 1150* (type *C. reticulatum* Merr.); *Elmer 11096, 11638* (type *C. apoensis* Elm.), *11859* (type *C. ogat* Elm.), *13275* (type *C. agusanense* Elm.), *13947* (type *C. subvelutinum* Elm.), *14074* (type *C. urdanetense* Elm.); *FB. 11884 (Miranda), 15227 (Klemme), 17993 (Miranda), 20774 (Miranda), 22459 (Klemme), 24169 (Miranda), 24472 (Miras, Sabino & Oliveros), 26602 (Ceballos), 27712 (Angeles & Selorio), 31043 (Aguilar), 31223 (Ponce, Logan & Vega); Kanehira 2490, 2603; PNH. 11093 (Edaño 1696); Wenzel 2597, 2608, 2615, 3093, 3223, 3374.* — Exact locality unknown: *Vidal 161, 1334, 1338.*

Celebes. *Beccari herb. 2178; Elbert 3443; FRI. bb. 5428, bb. 6650, bb. 12656, bb. 15128, bb. 17047, bb. 17504, bb. 21109 (Waturandang 36), bb. 21308 (Waturandang 63), bb. 22952 (Van der Star 9), bb. 24706, bb. 31866, bb. 31911; Hort. Bot. Bog. VI D 3; Koorders (all β numbers) 16298* (syntype *C. treubianum* Engl.), *16300, 16305* (syntype *C. treubianum* Engl.), *16310* (syntype *C. treubianum* Engl.), *16315* (syntype *C. treubianum* Engl.), *16317* (syntype *C. treubianum* Engl.), *16318* (type *C. solo* Engl.); *Lam 2437; Noerkas 377; Teysmann 12225, 12786; De Vriese 80, 136; Warburg 15419.*

Moluccas. Talaud: *Lam 2580.* — Morotai: *Anang 311; FRI. bb. 33735 (Tangkilisan 23), bb. 33861 (Tangkilisan 174), bb. 33880 (Tangkilisan 207), bb. 33918 (Tangkilisan 248); Lam 3505; Main & Aden 795, 935, 936, 946, 1440, 1505, 1545.* — Halmaheira: *FRI. bb. 24912.* — Ternate: *Beguin 2a.* — Batjan: *Teysmann in herb. L 898.319—197/8, in herb. L 898.319—310.* — Sula Islands: *FRI. bb. 28783, bb. 28857, bb. 29784, bb. 29871.* — Ceram: *Eyma 2806; FRI. bb. 17554, bb. 19652, bb. 25894, bb. 31933 (Salverda 6).* — Ambon: *Robinson Pl. Rumph. 376, Pl. Rumph. 377; Zippelius 238a.* — Exact locality unknown: *Hochreutiner Pl. Bog. Exsicc. 120; Hort. Bot. Bog. VI B 90a; Unknown coll. in herb. L 898 319—196* (type *Pimela denticulata* Bl.).

New Guinea. *Aet 305; BW. 1156 (Koster), 1853 (Schram), 2518 (Brouwer), 2624 (Brouwer), 3190 (Stefels), 4502 (Lasschuit 5603), 4604 (Versteegh); Carr 12188, 12777; Docters van Leeuwen 10310; FRI. bb. 33335 (Kostermans 102), bb. 33346 (Kostermans 117), bb. 33347 (Kostermans 118), bb. 33604 (Kostermans 447); Kanehira & Hatusima 11460; Kostermans 104, 113; Ledermann 7345* (syntype *C. papuanum* H. J. Lam), *7743* (type *C. fulvum* Lauterb.); *Van Royen 3404; Zippelius in herb. L 898.319—302, 304* (type *Pimela legitima* Bl.).

Solomon Islands. Bougainville: *Kajewski 1572; Waterhouse 89, Y 89.* —

Guadalcanal: *Kajewski 2462*. — Malaita: *Kajewski 2356*. — San Cristoval: *Brass 2824*.

cultivated:

Boivin s.n., Jard. bot. de Bourbon (type *C. molle* Engl.); *Loher 430 A, Jard. bot. Manila*.

Ecology: Apparently common in primary and secondary forests on very different, dry to wet, sometimes marshy, soils, sometimes found in more open forests or savannahs. Mainly occurring at low altitudes, up to *c.* 500 m, more rarely, mainly in the Philippines, found at altitudes above 1000 m (up to 1800 m). *Fl. fr.* chiefly March—Oct.

Wood anat.: Reyes, Dep. Agr. & Comm. Manila, Techn. Bull. 7 (1938) 161, pl. 24 fig. 3 (hand lens); Webber, Lilloa 6 (1941) 450.

Uses. The wood is said to be moderately hard, sometimes hard to very hard, or rather soft; it is of little durability. The resin is locally used for fuel and lighting purposes and sometimes recorded as caulking material for canoes and for painting hats. For the composition of the resin see Brown, *l. c.* (under *C. villosum*).

Notes. The type variety of this extremely variable species is also polymorphous itself. It consists of a number of local races, which are usually not sharply demarcated. The most common form, which has the same distribution as the species, is forma *villosum* (Bl.) H. J. Lam, characterized by its relatively large and nearly glabrous leaflets, its long and slender inflorescences and infructescences, and its small ovoid fruits.

The typical *C. asperum*, which is restricted to the Moluccas and New Guinea, is easily distinguishable by its rigid inflorescences and infructescences and fruits which are slightly larger than in forma *villosum*.

Closely related to the latter is forma *triphyllum* H. J. Lam (*in* Leenhouts, 1955b, 189), known only from Borneo, Morotai, and Ternate, a rather peculiar form with stiff trifoliolate leaves.

As is shown by the abundance of synonyms there is a surprising variability, especially in the vegetative parts, in the Philippine Islands. It is possible to distinguish quite a number of forms, all of which are related to forma *villosum*. As most of them are only vaguely demarcated, it is no use mentioning them all. The most extreme ones are: *C. lucidum* Perk., a small tree with 2-jugate leaves and small (4—7—11 by 2½—3—5½ cm), coriaceous leaflets, main nerves 8—11 pairs, collected in Luzon at high altitudes; *C. urdanetense* Elm., with unifoliolate, rarely 1-jugate, small (leaflet 6—7 by 2½—3 cm) leaves, the leaflet convex, main nerves prominent beneath, once collected in Mindanao at high altitudes; *C. reticulatum* Merr., with rather large, coriaceous, bullate leaflets, nerves sunken above, strongly prominent beneath, costa above and nerves beneath rather densely hirsutely pilose, margin serrulate; known from Samar, Leyte, Panay, and Mindanao, at medium altitudes.

Most of the Philippine specimens, and especially the more extreme ones, are characterized by a fruiting-calyx of the *calophyllum*-type and by slightly larger, ellipsoid fruits (*c.* 15 by 9 mm); in these respects they remotely resemble *C. vrieseanum*.

C. luxurians Engl. was based upon a specimen with witches' brooms in the inflorescences, a feature which is common in this species, and which

is furthermore only known to occur in *C. acutifolium*. They represent very dense, sterile structures, up to 25 cm diam.

Although *C. fulvum* Laut. is possibly conspecific with *C. schlechteri* rather than with the present species, I prefer to include it in *C. asperum*, being the more variable and more common species. The type specimen consists only of young leaves and ♂ flowers which are intermediate between the two species. *C. schlechteri* is characterized by its adult leaves, its fruits and its sometimes more specialized ♂ flowers.

b. var. **clementis** (Merr.) Leenhouts, 1956, 295. — *C. clementis* Merr. — *C. leytense* Elm. — *C. wenzelii* Merr.

Type: Philippines, Mindanao, Lake Lanao, Camp Keithley, March 1907, *Clemens s. n.*, ♂ and fr., lectotype (PNH †; isotype in G).

Leaves 3—4(—5)-jugate. Leaflets medium-sized (10—17 by 5—8 cm), glabrous to densely ferruginously tomentose beneath; nerves 15—20 pairs; veins transverse, dense. Inflorescences compoundly spicate, flowers in glomerules.

Distribution: Philippines (Luzon, Leyte, Mindanao).

PHILIPPINES. Luzon: *Vidal 1341* (aff.); *Williams 641*. — Leyte: *Elmer 7274* (type *C. leytense* Elm.); *Wenzel 351* (type *C. wenzelii* Merr.). — Mindanao: *Elmer 11730* (type *C. clementis var. perumbrinum* Elm.); *Wenzel 2670*.

CELEBES. *Rachmat 685* (aff.).

B. Subsp. **papuanum** (H. J. Lam) Leenhouts, 1955a, 12; 1956, 295. — *C. asperum* Benth.; Lauterbach, 1912, 827; 1920, 327. — *C. papuanum* H. J. Lam.

Type: New Guinea, Nassau Mts, Explorator's bivouac, Oct. 1926, *Docters van Leeuwen 10536*, ♂, lectotype (BO; isotype in L).

Inflorescences more widely and laxly thyrsoid.

Distribution: New Guinea, (low to) 1000—1800 m.

NEW GUINEA. *Clemens 3798, 4731, 6643; Docters van Leeuwen 10536* (lectotype *C. papuanum* H. J. Lam); *Gjellerup 118* (syntype *C. papuanum* H. J. Lam); *Ledermann 10630, 10909; NGF. 1278 (Smith)*.

Notes. Insufficiently known taxon, which for the time being had probably best be inserted here.

Fairly variable in its vegetative and its flower parts. The ovariodisk in the ♂ flowers is quite variable in shape: the toadstool-shaped one, mentioned by H. J. Lam, is not typical, as I have also observed it in some Philippine specimens of subsp. *asperum*. The triangular shape of the fruits, also mentioned by H. J. Lam, though looking quite different from subsp. *asperum*, is in my opinion of minor importance, as they are all young or sterile.

Docters van Leeuwen 10536 is said to have been collected of a climbing plant.

Note. The species as a whole is best characterized by the small, ovoid to ellipsoid fruits, though these are not very different from those of *C. oleosum* and *C. acutifolium*. Var. *asperum*, moreover, is characterized by its often spicate inflorescences and infructescences.

62. Canarium schlechteri Lauterbach, 1920, 328; Lam, 1932a, t. 12

f. 87, t. 15 f. 117c; 1932b, 454, t. 10 f. 62; Leenhouts, 1956, 296, f. 20e. — *C. gutur* De Miklouho-Maclay, 1885, 353, 357, *nom. nud.*

Type: N.E. New Guinea, Djamu River, alt. 250 m, Nov. 25, 1907, *Schlechter 16884*, ♂ (B †; isotypes in BRSL, L, P).

Tree up to 25 m by 30—40 cm, sometimes faintly buttressed. *Branchlets* slender, glabrescent; pith with many rather small vascular strands, peripheral ones distinctly, central ones more or less distinctly, cylindrically arranged. *Stipules* inserted on the petiole up to 3 cm from the base, rather caducous, filiform, 2—3 mm. *Leaves* 3—6-jugate, glabrous to about woolly pubescent. *Leaflets* ovate to lanceolate, (5—)12—20 by (3—)5—7 cm, subcoriaceous, glabrous or thinly puberulous on the midrib above and on the nerves beneath; base slightly oblique, rounded to subcordate, sometimes attenuate; margin entire; apex acute, more or less abruptly short acute-acuminate; nerves 11—20 pairs (angle 50—60°), straight to slightly curved, not to distinctly and abruptly arching near the margin, nerves and veins often slightly sunken above, prominent beneath; intermediate veins not rarely well developed. *Inflorescences* (♀ unknown) axillary, narrowly thyrsoid, 12—22 cm long, sparsely tomentose to glabrous, main branches up to 1½ cm, up to 9-flowered; *bracts* subpersistent, subulate, up to 8 mm. ♂ *Flowers* (♀ unknown) slender, 8—9 mm long, short-stalked. *Calyx* nearly truncate, 3 mm high, tomentose to scabrous. *Stamens* 7—8 mm long, glabrous, irregularly confluent at the base for up to 2 mm, tube more or less adnate to the disk. *Disk* 3 mm high, narrowly cupular to cylindrical, rim pilose, truncate to somewhat undulate, rudimentary ovary minute. *Infructescences* axillary, up to *c.* 10 cm long, glabrous, with 1—3 fruits; calyx saucer-shaped, triangular, 1 cm diam.; remains of the disk 1 mm high, slightly 6-lobed, fimbriate. *Fruits* fusiform, acute, round to slightly triangular in cross-section, 4 by 2 cm, glabrous; pyrene acutely 6-ribbed to deeply furrowed all over the surface; lids *c.* 3 mm thick; cells small, elliptic to round. *Seeds* 1—2.

Distribution: E. New Guinea and New Britain.

NEW GUINEA. *Brass 24141; Forbes 77; Hoogland 3856, 4195, 4605, 4976; NGF. 1328 (Smith), 2929 (Womersley), 8646 (Womersley & Brass); Saunders 43; Schlechter 16884* (type).

NEW BRITAIN. *NGF. 1879 (Mair), 1897 (Mair), 3426 (Womersley), 6614 (Floyd).*

Ecology: Rain-forests up to 250 m, *fl.* June, Aug., and Nov., *fr.* March, May—Sept.

Uses. Produces a damarlike resin. The seeds are edible.

Note. See for the identity of *C. fulvum* Laut. under *C. asperum.*

63. Canarium acutifolium (DC) Merrill, 1917, 302; Lam, 1932a, t. 11 f. 58, t. 13 f. 104j, t. 15 f. 117b; 1932b, 451, t. 10 f. 61; Lam & Husson, 1952, 164; Chattaway, 1953, 30, f. 3; Leenhouts, 1956, 291, f. 22c. — *Dammara nigra* Rumphius, 1741, 160, t. 52. — *? C. nigrum* Roxburgh, (1814, 49, *nom. nud.*), 1832, 138. — *Marignia acutifolia* De Candolle, 1825, 79; Henschel, 1833, 116. — *Pimela acutifolia* Blume, 1850, 221. — *Pimela laxiflora* Blume, 1850, 221. — *C. longiflorum* Zippelius *ex* Miquel, 1859, 647; Engler, 1883, 125. — *C. rostratum* Zippelius *ex* Miquel, 1859, 647, *nom. illeg.*; Engler, 1883, 128. — *C. lineistipula* K. Schumann & Lauterbach,

1901, 379; Lauterbach, 1920, 331; Lane-Poole, 1925, 98. — *C. aemulans* Lauterbach, 1920, 326, f. 2 F—O; Engler, 1931, f. 213 F—O; Lam, 1932a, t. 12 f. 81; 1932b, 453. — *C. legitimum* (*non* Miq.) Heyne, 1927, 877, *pro maj. parte*. — *C. leeuwenii* H. J. Lam, 1932a, 210; 1932b, 449, t. 9 f. 59.

Type: New Guinea, *Zippelius 194*, ♀ & fr., neotype (L; isotypes in BRSL, U).

Tree, 20(—40) m by 20—90 cm; buttresses, if present, up to 3 m high. *Branchlets* up to 1½ cm thick, soon glabrescent; pith with a peripheral cylinder of vascular strands, closely appressed to the wood-cylinder, sometimes moreover some scattered ones in the central part; central part nearly always disappearing (very probably by the action of ants). *Stipules* subpersistent, inserted at the base of the petiole, filiform, 1—3½ cm long. *Leaves* (2—)3—5(—7)-jugate. *Leaflets* ovate to narrowly oblong, 7—30 by 4—11½ cm, chartaceous, glabrous; base slightly oblique, rounded to broadly cuneate; margin entire; apex rather long and slender (¾—2 by ¼ cm) blunt-acuminate; nerves 11—25 pairs (angle 80—90°), slightly, towards the margin more strongly, curved, more or less distinctly arching close to the margin. *Inflorescences* axillary, laxly pyramidal-thyrsoid, nearly always glabrous, ♂ ones up to 50 cm, ♀ ones up to 40 cm long, main branches up to 20 cm, partial panicles long-stalked, many-flowered. *Flowers* c. 4 mm long, shortly pedicelled, (sub)glabrous outside, ♀ ones with a slightly concave receptacle. *Calyx* 2—2½ mm high. *Stamens* 3 or 6, free, glabrous. *Disk* glabrous, in ♂ flowers irregularly shaped, 1½ mm high, with a central canal in which the minute rudimentary pistil is immersed; in ♀ flowers a faintly 3—6-lobed rim, 1 mm high. *Infructescences* like the inflorescences, rigid, with many fruits; calyx flat, triangular, 3—6 mm diam., tips of the lobes reflexed. *Fruits* see varieties. *Seed* 1, sterile cells strongly reduced.

Distribution: Central Celebes, Moluccas, and New Guinea.

Taxonomy. The following varieties are distinguishable:

KEY TO THE VARIETIES

1.a. Stamens 3 . . . . . var. **acutifolium**
b. Stamens 6 2
2.a. Nerves 20—25 pairs . . . . . var. **celebicum**
b. Nerves 12—15 pairs . . . . . var. **aemulans**

a. var. **celebicum** Leenhouts, 1955b, 188; 1956, 292.

Type: Celebes, Menado, Palu, Sidaunta, alt. 400 m, July 13, 1939, *FRI. bb. 28279*, ♀ (L; isotypes in A, SING).

Branchlets solid; pith with a peripheral cylinder of vascular strands and some scattered ones in the central part. Stipules inserted on the petiole at 1—5 mm from the base, up to 1½ cm. Leaflets oblong to lanceolate, 10—22 by 4—6 cm; the apex more gradually narrowed; nerves 20—25 pairs, nearly straight. Inflorescences and flowers (♂ unknown) thinly tomentose. Stamens 6. Disk 6-lobed, pilose as is the pistil. Fruit-calyx 5—6 mm diam. Mature fruits unknown.

Distribution: Central Celebes.

CELEBES. *FRI. bb. 28279* (type), *Cel./V-190* (paratype), *Cel./V-310* (paratype).

Ecology: Collected at 250—400 m; *fl.* July.

Note. A specimen from the Solomon Islands, Bona (*BSIP. 364, Naqu*) seems to be very close to this variety. It mainly differs by the strongly articulated bases of the petioles, the rather long stipules, inserted at the base of the petiole or on the twig (so as in var. *acutifolium*) and the number of nerves (12—18 pairs); the fruits are different from those of var. *acutifolium* and *aemulans*, being ellipsoid, 2 by 1 cm, the stone with 6 faint ribs, and with 1 or 2 seeds developing (the fruits of var. *celebicum* are still unknown). As the material is rather insufficient, I hesitate to describe it as a new variety, let alone a new species.

b. var. **aemulans** (Laut.) Leenhouts, 1956, 292. — *C. aemulans* Laut.

Type: N.E. New Guinea, Kani Mts, alt. 1000 m, May 26, 1908, *Schlechter 17779*, ♂, lectotype (B †; isotypes in BR, BRSL, K, L, P).

Differing from var. *celebicum* in its leaflets, which are ovate to oblong, 7—18 by 3¾—8½ cm, gradually to abruptly acuminate, and with 12—15 pairs of nerves. Inflorescences often smaller. Fruits subglobular, 1¾ by 1½ cm; sterile cells less reduced.

Distribution: New Guinea and New Britain.

NEW GUINEA. *BW. 2739 (Sohram); Carr 14261, 14482; Schlechter 17587* (syntype), *17779* (lectotype).

NEW BRITAIN. *NGF. 6670 (Floyd), 6674 (Floyd).*

Ecology: Up to 1000 m, *fl. fr.* Dec.—May.

c. var. **acutifolium.** — Synonymy as the species with the exception of *C. aemulans.*

Branchlets nearly always becoming hollow. Stipules inserted at the base of the petiole, 1½—3½ cm long. Leaflets 12—30 by 4—11½ cm; the apex abruptly acuminate; nerves 11—15—20 pairs. Inflorescences and flowers nearly always glabrous. Stamens 3. Pistil glabrous. Fruit-calyx 3—3½ mm diam. Fruits ovoid, acute, round in cross-section, 12—15 by 8—10 mm, glabrous; pericarp thin; pyrene tuberculate; lids 1½—2 mm thick.

Distribution: Moluccas (Kei Islands, according to Rumphius also on Manipa, Kelang, Ceram, and Ambon), New Guinea (incl. also P. Japen, Waigeo, Misool, and Aru Islands).

MOLUCCAS. *Jaheri 476.*

NEW GUINEA. *Aet 259, 420; Beccari herb. 2180, herb. 2181; Brass 5834, 8201; BW. 19 (Versteegh 21), 295 (Koster 15), 367 (Bouwer 15), 496 (Schram 49), 651 (Mangold), 740 (Versteegh), 1139 (Koster), 2099 (Mangold 43), 2546 (Brouwer), 3522 (Kalkman); Carr 11619, 12877, 16517; Docters van Leeuwen 9854, 10643* (type *C. leeuwenii* H. J. Lam), *11090, 11312, 11393; FRI. bb. 25270, bb. 25356, bb. 30564, bb. 33302 (Kostermans 58), bb. 33303 (Kostermans 60); Hoogland 3265, 3508, 3896, 4526, 4532, 5024; Hoogland & Floyd 3815; Kanehira & Hatusima 12627, 12628; Kostermans 304, 2655; Lane-Poole 197, 306; Ledermann 8806, 12326; Macadam 3; Moszkowski 253, 255; NGF. 865 (Cavanaugh), 1226 (Smith), 1719 (Smith), 1730 (Smith), 2030 (Cavanaugh & Fryar), 2409 (Cavanaugh & Fryar), 3677 (Womersley), 3809 (Womersley), 4544 (Hart), 4581 (Jackson & MacDonald), 5802 (Womersley), 8047 (Gray & Floyd), 8092 (Gray), 8159 (MacDonald); Pleyte 1018, 1020; Pulle 292; Roditz & Klink 231* (type *C. lineistipula* K. Sch. & Laut.); *Van Royen 3824, 5265, 5300; De Zeeuw 19, 45; Zippelius 157* (type *C. longiflorum* Zipp. and *Pimela laxiflora* Bl.), *194* (neotype *Marignia acutifolia* DC.).

Ecology: In New Guinea apparently the most common species of

the genus, both in primary and in secondary forests, specially in more open places (forest-edges, river-banks, clearings), mostly on wet (sometimes temporarily inundated) clayey soil, up to c. 200(—700) m. *Fl.* mainly July—Sept., *fr.* mainly Jan.—March.

Uses. Wood rather soft to very hard, tough, but easily splitting. The resin, though abundant, seems to be of little importance; it is used for lighting purposes and for caulking boats.

Notes. I have included *C. leeuwenii* H. J. Lam in this variety. The only specimen known of this is *Docters van Leeuwen 10643*; it bears very young fruits and differs from the typical *C. acutifolium* by its dense, hirsute, reddish-brown tomentum. The hairiness is very variable in most species of *Canarium*, and this specimen was collected at a rather high altitude (700 m).

Pleyte noted on his *no.* 1020 from Misool that the specimen was a pseudoliana 30 m by 4 cm; other collections from him in adjacent localities are, however, made from trees; I have my doubts about this field note.

Notes. The inflorescences of this species sometimes develop witches' brooms like those of *C. asperum*.

Apparently var. *celebicum* is the most primitive (6 stamens), var. *acutifolium* the most specialized form of this species (3 stamens); var. *aemulans* is intermediate between the two forms: nearly identical with var. *acutifolium*, though with 6 stamens. The species as a whole is closely related to *C. asperum* ssp. *papuanum*.

C. acutifolium is best characterized by the very long and filiformous stipules and by the large, widely thyrsoid inflorescences and infructescences, with small flowers and fruits, the latter resembling those of *C. asperum*. Moreover, the usually hollow twigs, and the leaflets, which are greyish-green and shining when dry, rather coarsely prominulous reticulated, and with a rounded, rather abruptly short- and blunt-acuminate apex, are typical.

64. Canarium macadamii Leenhouts, 1955b, 191, f. 5c; 1956, 289.

Type: N.E. New Guinea, Morobe Distr., Wau, alt. 1500 m, *J. B. McAdam 206*, ♂ & loose fr. (BRI; isotypes in L, LAE).

Large tree, c. 30 m by 75 cm. *Branchlets* slender, somewhat scabrous, lenticellate; pith with a peripheral cylinder of vascular strands, central ones more or less clearly cylindrically arranged. *Stipules* caducous, inserted at the base of the petiole, linear, 5—6 mm, glabrous, as are the leaves and the inflorescences. *Leaves* 2—4-jugate. *Leaflets* oblique-ovate, 12—18 by 6—9 cm, (sub)coriaceous; base oblique, rounded; margin entire; apex abruptly, short (5 mm) blunt-acuminate; nerves 14—16 pairs (angle 60—70°, in the basal part up to 90°), straight to slightly curved, vaguely to distinctly arching close to the margin. *Inflorescences* (♀ unknown) axillary, narrowly thyrsoid, c. 12 cm long; branches up to 2½ cm, with up to 15 clustered flowers. *Flowers* (♂) 7 mm long, short-pedicelled, glabrous outside, with a slightly concave receptacle. *Calyx* 4½ mm high. *Stamens* slightly confluent at base. *Disk* conical, 1½ mm high, halfway with a 6-lobed rim, glabrous, with a central canal, widening to the base and enclosing the rudimentary pistil. *Infructescences* c. 8 cm long, with 1 to few fruits; calyx flat, triangular, 5 mm diam., lobes reflexed. *Fruits* ellipsoid, round in cross-section, 3½ by

1½—2 cm, acuminate at the apex, glabrous; pyrene smooth; lids 3 mm thick. *Seed* 1, sterile cells moderately reduced.

Distribution: New Guinea (Morobe Distr.).

NEW GUINEA. *Macadam 206* (type).

Ecology: Forested slope, on rich clay or loam soil, locally common, 1500 m.

Note. Doubtless closely related to *C. acutifolium*, specially to its var. *aemulans*. Different by its larger flowers, and especially by the larger, more spindle-shaped fruits.

65. Canarium chinare Grutterink & H. J. Lam, *in* Leenhouts, 1955a, 7, f. 4; Leenhouts, 1956, 289.

Type: Solomon Islands, Bougainville, alt. 950 m, Aug. 12, 1930, *Kajewski 2089*, fr. (A; isotypes in BISH, BO, BRI, G, L, P, SING).

Tree up to 25 m. *Branchlets* slender, scabrous, tips sparsely appressedly pubescent; pith with many vascular strands, partly arranged in a peripheral cylinder. *Stipules* caducous, inserted at the conjunction of petiole and branchlet on a faintly prominent 2—3 mm long rim, oblong-lingulate to subulate, 1½—6½ mm. *Leaves* 2—6-jugate, glabrous. *Leaflets* ovate to oblong-elliptic, 5—11 by 2—4½ cm, chartaceous to coriaceous; base cuneate, in laterals slightly oblique; margin entire; apex bluntly short-acuminate; nerves 8—14 pairs (angle 50—55°), nearly straight to faintly curved, more or less distinctly interarching close to the margin. *Inflorescences* and *flowers* unknown. *Infructescences* axillary, subracemose, 4—8 cm long, with 1—2 fruits; calyx saucer-shaped, 3-lobed, 8 mm diam.; remains of 6 fimbriate disk-lobes present. *Fruits* ellipsoid, 2 by ¾ cm, glabrous; pyrene irregularly grooved; lids *c.* 1½—2 mm thick. *Seed* 1; sterile cells nearly entirely reduced.

Distribution: New Guinea (Milne Bay Distr.), Admiralty Islands (Los Negros), and Solomon Islands (Bougainville).

NEW GUINEA. Milne Bay district: *Brass 21869.*
ADMIRALTY ISLANDS. Los Negros: *NGF 558 (Hepplethwaite).*
SOLOMON ISLANDS. Bougainville: *Kajewski 2089* (type).

Ecology: Rain-forests, up to 950 m. *Fr.* Febr.—Aug.

Notes. The alliance of this species seems to be especially with *C. macadamii* and *vanikoroense.*

The fruits are described from unripe ones from New Guinea. These are in good agreement with sterile fruits from Los Negros; the sterile fruits of the type specimen are slightly larger, however. The conspecificity of the type specimen on the one hand and both other specimens on the other is not beyond doubt.

66. Canarium vanikoroense Leenhouts, 1955a, 7, f. 3. — *C. linguistipulum* Leenhouts, 1955a, 5, f. 2.

Type: New Hebrides, Santa Cruz group, Vanikoro Isl., Sept. 25, 1928, *Kajewski 539*, ♂ (A).

Tree, 15—20 m high. *Branchlets* 6—13 mm thick, glabrous; pith with a peripheral cylinder of vascular strands. *Stipules* inserted at the conjunction of petiole and branchlet or on the latter up to 3 mm from its base, narrowly lanceolate, 6—7 mm long, inserted on a slight rim. *Leaves* 2—5-jugate.

Leaflets ovate, 8—17 by 3½—8 cm, coriaceous, glabrous; base of laterals slightly oblique, truncate to rounded; margin entire; apex rather abruptly bluntly acuminate; nerves 9—16 pairs (angle 90—60°, decreasing from base to apex), basal ones straight, the others more or less strongly curved, more or less distinctly interarching close to the margin. *Inflorescences* (♀ unknown) axillary, together sometimes pseudo-terminal, thyrsoid, 12—25 cm long, the few transverse branches up to 4 cm long, few-flowered, glabrous. *Flowers* (♀ unknown) 7 mm long. *Calyx* 5 mm, outside glabrous. *Corolla* densely appressedly pubescent. *Stamens* 6, glabrous, the filaments slightly more than halfway connate. *Disk* in ♂ flowers urceolate, slightly 6-lobed, 1 mm high, shortly and densely pubescent, with a narrow central canal, in ♀ flowers apparently consisting of 6 free, ciliate lobes. *Pistil* in ♂ flowers absent. *Infructescences* racemose to thyrsoid, 25—30 cm long, with 5—6 fruits; the calyx flat, faintly 3-lobed, 1.2—1.5 cm in diam. *Fruits* ovoid, more or less acute at both ends, 3¾ by 2 cm, glabrous except some scattered hairs near the apex; pyrene very rugose; lids 3—5 mm thick. *Seeds* 2; the sterile cell moderately reduced.

Distribution: New Hebrides (Santa Cruz group) and Fiji.

NEW HEBRIDES. Santa Cruz: Vanikoro Isl., *Kajewski 539* (type).

FIJI ISLANDS. Viti Levu: *Gillespie 3616; Tothill 422* (both paratypes of *C. linguistipulum* Leenh.), *515* (type *C. linguistipulum* Leenh.). — Vanua Levu: *Smith 6782* (paratype *C. linguistipulum* Leenh.).

Ecology: Rain-forests, 0—250 m. *Fl.* Sept., *fr.* May, Oct., and Dec.

Notes. The relationships of this species are apparently on the one hand with *C. chinare*, on the other with *C. smithii*. From the former species it mainly differs by its broader leaves and its bigger fruits, from the latter by its stipules and its connate stamens.

As only fruiting material of *C. linguistipulum* and one ♂ flowering specimen of *C. vanikoroense* are known at present, and these are not fully identical, the conspecificity of the two is not certain.

67. **Canarium smithii** Leenhouts, 1955a, 12, f. 6 — *C. vitiense* (*non* A. Gray) Degener, 1949, 266, 295. — *C. bacciferum* Leenhouts, 1955a, 19, f. 9.

Type: Fiji Islands, Vanua Levu, Mathuata, Seangganga plateau, vic. of Natua, alt. 100—200 m, Nov. 25/Dec. 8, 1947, *A. C. Smith 6708*, ♂ (A; isotypes in K, L).

Tree, 7—30 m by up to 1½ m. *Branchlets* slender, glabrescent, becoming more or less scabrous; pith with a peripheral cylinder of vascular strands and usually a second cylinder in the central part. *Stipules* caducous, inserted at the base of the petiole or on the latter up to 1 cm from the base, subulate, 3—4 mm long, minutely fulvous pubescent. *Leaves* 2—5(—6)-jugate, more or less glabrescent. *Leaflets* elliptic, 3½—15 by 2½—6 cm, (sub)coriaceous, glabrous; base more or less oblique, rounded to broadly cuneate; margin entire; apex gradually to rather abruptly, shortly and bluntly acuminate; nerves 7—15(—c. 20) pairs (angle 60—85°), nearly straight to curved, more or less distinctly interarching close to the margin. *Inflorescences* axillary, glabrous, ♂ ones thyrsoid, 3—30 cm long, rather many-flowered, ♀ ones racemose. *Flowers* (♀ unknown) 1 cm long, densely appressedly pubescent. *Calyx* 3½—4 mm. *Petals* with a very distinct, inflexed apiculum. *Stamens*

6, confluent at the very base, glabrous. *Disk* cupular, ½ mm high, long-pilose. *Pistil* rudimentary, 0.1 mm. *Infructescences* (sub)racemose, 7—20 cm long, with 3—8 fruits; calyx flat, 3-lobed, 7—8 mm diam., the lobes spreading to slightly reflexed; remainders of a 6-lobed, pilose disk. *Fruits* ovoid to nearly globular, 16—22 by 14—17 mm; pyrene circular in cross-section, rugose; the lids 2 mm thick. *Seed* 1; sterile cells strongly reduced.

Distribution: Fiji Islands.

FIJI ISLANDS. Viti Levu: *Degener 15429* (paratype *C. bacciferum* Leenh.); *Gillespie 4248, 4267, 4359* (paratypes *C. bacciferum* Leenh.); *Greenwood 940* (paratype *C. bacciferum* Leenh.), *1102*; *Smith 5856* (paratype *C. bacciferum* Leenh.), *6275* (type *C. bacciferum* Leenh.), *8434, 9019*. — Ovalau: *Gillespie 4542* (paratype *C. bacciferum* Leenh.). — Vanua Levu: *Smith 6477* (paratype), *6708* (type).

Ecology: Forests, up to *c.* 1000 m. *Fl.* Sept.—Dec., *fr.* apparently Jan.—Dec.

Uses. The timber is sometimes used for construction.

Note. Related to *C. chinare, vanikoroense,* and *vitiense.*

68. Canarium vitiense A. Gray, 1854, 373 (*incl. var. b*); Seemann, 1865, 35; Engler, 1883, 134; Drake del Castillo, 1886, 135; Leenhouts, 1955a, 17, f. 8.

Type: Fiji, Vanua Levu, mountains of Mathuata coast, 1838/42, *Wilkes exp. s.n.*, fr. (GH; isotypes in K, P).

Shrub or tree (up to 20 m). *Branchlets* 3½—6 mm thick, youngest parts thinly tomentose, glabrescent; pith with a peripheral cylinder of many small vascular strands, central part with a few scattered ones. *Stipules* inserted at or on the base of the petiole, caducous, subulate, 2 mm long. *Leaves* 1—4-jugate, densely brown tomentose when very young, glabrescent. *Leaflets* elliptic, 5½—11½ by 3½—5¾ cm, herbaceous to thin coriaceous; base cuneate to rounded, slightly decurrent; margin entire; apex more or less abruptly bluntly acuminate; nerves 8—12 pairs (angle 70—80°), faintly curved, interarching near the margin; reticulations coarse, prominulous at both sides. *Inflorescences* ♂ axillary to pseudo-terminal, with up to 10 flowers, racemose to thyrsoid, 4½—12 cm long, youngest parts thinly minutely pubescent; ♀ axillary, racemose, 3—4 cm long, with up to 6 flowers. *Flowers* ♂ 12—13 mm long, ♀ 7 mm. *Calyx* ♂ 7—8 mm, ♀ 5 mm, both thinly pilose outside, densely, shortly, and appressedly pilose inside. *Corolla* outside densely shortly pilose. *Stamens* 6, slightly adnate to the disk, glabrous. *Disk* in ♂ flowers extremely variable, 1 mm high, either faintly 6-lobed and cupular, or an ovariodisk present, in the upper part always with long stiff spreading hairs, in ♀ flowers 6-lobed, ¾ mm high, not very thin, longciliate. *Pistil* in ♂ flowers strongly reduced to absent, in ♀ flowers densely and shortly pilose. *Infructescences* racemose, 7—12 cm long, with up to 6 fruits; the calyx funnel-shaped, 5—6 mm high, 8—12 mm in diam. *Fruits* fusiform, 1¾—3 by 1—1½ cm, glabrous except for some hairs at the apex; pyrene irregularly deltoid in cross-section, with some slight ridges; lids *c.* 1½ mm thick. *Seed* 1, sterile cells strongly reduced.

Distribution: Fiji Islands.

FIJI ISLANDS. Viti Levu: *Horne 686; Smith 7114, 9422*. — Ovalau: *Gillespie 4447, 4521, 4553; Seemann 97; Smith 7280, 8050*. — Vanua Levu: *Smith 6468; Wilkes s.n.* (type). — Koro: *Smith 996*. — Exact locality unknown: *Horne 218, 354*.

Ecology: In dense forest, up to 600 m. *Fl.* Jan., *fr.* apparently the whole year.

Uses. The fruits are eaten.

Note. Closely related to *C. smithii,* moreover related to *C. samoense.* Best characterized by its fusiform fruits, tapering at base and apex, and by the funnel-shaped calyx in fruit.

69. **Canarium samoense** Engler, 1883, 134; Christophersen, 1935, 113; Yuncker, 1945, 44; Leenhouts, 1955a, 22, f. 10. — *Canarium sp. nov.,* Horne, 1881, 285.

Type: Samoa Islands, *Powell 311,* fr. (K).

Rather large tree (up to 20 m). *Branchlets* 9 mm thick, glabrous; pith with many small vascular strands, the peripheral ones more or less cylindrically arranged. *Stipules* inserted at the base of the petiole, caducous, probably small and subulate. *Leaves* 3—6-jugate, glabrous. *Leaflets* broad-elliptic to elliptic-oblong, slightly oblique, 7½—14 by 3½—4½ cm, chartaceous (to coriaceous); base slightly oblique, rounded to cuneate, somewhat decurrent; margin entire; apex tapering blunt-acuminate; nerves (8—)13—16 pairs (angle 70—80°), faintly curved, more or less abruptly and distinctly interarching at some distance from the margin; reticulations coarse, prominulous at both sides. *Inflorescences* (♀ unknown) axillary, 6—11 cm long, few-flowered. *Flowers* (♀ unknown) 8 mm long. *Calyx* 5 mm, outside glabrescent. *Corolla* outside densely appressedly pubescent. *Stamens* 6, free, glabrous. *Disk* cupular, fleshy, *c.* 1½ mm high, glabrous. *Pistil* absent. *Infructescences* axillary, racemose, 6—13 cm long, with 1—3 fruits; calyx flat, 3-lobed, 1 cm in diam., outside glabrous, with remnants of an annular disk. *Fruits* ellipsoid to ovoid, 2½ by 1¼—1½ cm, acuminate at apex, glabrous; pyrene very rugged; lids 2 mm thick. *Seed* 1, sterile cells strongly reduced.

Distribution: Samoa Islands.

Samoa Islands. Savaii: *Christophersen 2770.* — Upolu: *Christophersen 290, 1833; Graeffe 1385.* — Exact locality unknown: *Horne 5; Powell 311* (type).

Ecology: Forests, up to 500 m. *Fl.* Sept., *fr.* March, Aug.

Uses. Resin used for embalming.

Note. Closely related to *C. smithii* and *C. vitiense.* Up to now, the material available is insufficient for giving a more definite circumscription of these three species, which vegetatively are almost indistinguishable. *C. vitiense* is well characterized by its differently shaped fruits; *C. smithii* and *samoense* differ slightly in their flowers and in the leaves. Only in the field may it be possible to decide, which ♂ and ♀ specimens and fruits belong together, and whether these three species are good ones, or are variants of one single species.

III. SECTION CANARIELLUM

Genus *Canariellum* Engler, 1896, 242. — Sect. *Canariellum* Leenhouts, 1955a, 40. — Subgen. *Canariellum* Leenhouts, 1956, 251.

Pith of the *branchlets* not rarely without vascular strands. No *stipules.*

Inflorescences axillary or terminal. *Stamens* usually free. *Pistil* often 2-celled. *Calyx* in fruit small.

Distribution: N.E. Australia and New Caledonia.

70. Canarium baileyanum Leenhouts, 1955a, 45, f. 19. — *Bursera australasica* F. M. Bailey, 1892, 8; 1895, 14; 1899, 223; 1909, 85, f. 71; Francis, 1922, 218. — *Protium australasicum* Sprague, 1912, 370; Francis, 1929, 175, f. 112—113; 1951, 200, f. 114—115; Lam, 1932b, 321. — *Santiria ? spec.* J. J. Swart, 1942, 393. — *Canarium australasicum* Leenhouts, 1952, 159, *nom. illeg.* — *non Canarium australasicum* Bentham and Mueller, 1863, 377 (= *Canarium australianum* F. Muell.).

Type: Queensland, Moreton Distr., Eumundi, May 1892, *J. F. Bailey & Simmonds s.n.*, fr. (K).

Tree, up to 40 m high. *Branchlets* 3—4½ mm thick, youngest parts ferruginously tomentose, glabrescent; pith without vascular strands. *Leaves* (unifoliolate to) 1(—3)-jugate, ferruginous-pubescent when young, glabrescent. *Leaflets* obovate to oblong or lanceolate, (4—)7—9(—14) by (1½—)3—4(—6½) cm, coriaceous; base more or less broadly cuneate, often slightly oblique, decurrent; margin entire; apex shortly, broadly, and bluntly acuminate to blunt or rounded; midrib not infrequently splitting up into 2 or 3 veins near the apex; nerves (6—)8(—12) pairs (angle 50—65°), straight to faintly curved, distinctly interarching near the margin; veins and veinlets usually nearly invisible. *Inflorescences* (♀ unknown) terminal or pseudoterminal, narrowly and laxly thyrsoid, 4—11 cm long, with additional axillary ones, few-flowered, more or less densely tomentose, partial inflorescences mostly subsessile. *Flowers* (♀ unknown) *c.* 4 mm long, glabrous, the receptacle slightly hollowed. *Calyx* 1 mm. *Stamens* 6, free, inserted on the disk, glabrous. *Disk* partly adnate to the recepacle, the undulated, free margin ½ mm high, fleshy, glabrous. *Pistil* in ♂ flowers strongly reduced, glabrous (also in a possibly ♀ flower), 3-celled. *Infructescences* rarely more than 8 cm long, usually with 3—4 fruits; calyx not enlarged. *Fruits* globular, faintly 3-angular at the base, 8—9 mm in diam., glabrous; pyrene 3-keeled. *Seed* 1, sterile cells slightly reduced.

Distribution: Coastal regions of Queensland and Northern New South Wales.

QUEENSLAND. Fraser Island: *Petrie 18; White 1218.* — Moreton District: *Bailey & Simmonds s.n.* (type *Bursera australasica* F. M. Bailey).
NEW SOUTH WALES. Clarence District: *De Beuzeville 390-36-11, 36-66.*

Ecology: Rain-forests. *Fl.* March—Nov., *fr.* March—May.

Notes. The identity of this species has long been mysterious, since the only specimens quoted — *J. F. Bailey and J. H. Simmonds s.n.* and *F. M. Bailey s.n.* — are more or less anomalous, the fruits and part of the flowers being 4-merous. In particular, the fruits of *De Beuzeville 390-36-11* clearly show the *Canarium* type. The nearest relationship of this species seems to be with *C. oleiferum* from New Caledonia and *C. muelleri* from Queensland.

The name *C. australasicum* (F. M. Bail.) Leenh. had to be rejected in accordance with Intern. Rules of Nomencl. ed. 1956, art. 64 (2).

71. Canarium muelleri F. M. Bailey, 1890, 106; 1899, 224; 1909, 86; Francis, 1951, 432; Leenhouts, 1955a, 41.

Type: Queensland, Johnstone River, *Bancroft s.n.*, ♂ (BRI).

Tree, 20—30 m high, 30—60 cm diam., with large buttresses. *Branchlets* 4—6 mm thick, sparsely tomentose when young, soon glabrescent, greyish-brown; pith coarse, without vascular strands, but with some resiniferous ducts. *Leaves* 2—3-jugate, glabrous. *Leaflets* elliptic to ovate or lanceolate, 5½—10 by 2—4½ cm, thin-coriaceous to stiff-herbaceous; base oblique, cuneate, faintly decurrent; margin entire; apex rounded to acuminate, acumen short, broad, and blunt; nerves 8—12 pairs (angle 50—70°), straight to faintly curved, distinctly interarching at some distance from the margin; veins laxly reticulate, intermediate ones more or less distinctly developed. *Inflorescences* axillary, narrowly thyrsoid, *c.* 10 cm long. *Flowers* (seen only in bud) *c.* 4 mm, glabrous or minutely pubescent. *Calyx* 1—1½ mm. *Stamens* 6, glabrous, in ♀ flowers apparently inserted on the margin of the disk. *Disk* in ♀ flowers adnate to the slightly hollowed receptacle, rim free, thin and fleshy, glabrous; ♂ unknown. *Pistil* densely and shortly tomentose, in ♂ flowers minute. *Infructescences* and *fruits* still unknown.

Distribution: Australia (Queensland).

QUEENSLAND. *F. M. Bailey s.n.; Bancroft s.n.; Francis s.n.; Fraser s.n.; Gleghorn s.n.; Unknown coll. 47.*

Uses: The timber is recommended for cabinet-making, plywood, and lining. For the composition of the resin see Jones & Smith, Proc. R. Soc. Queensl. 37, 1926, 92.

Note. Taxonomy. Closely related to *C. baileyanum;* mainly different from the latter in the following characters: conspicuous intermediate veins; leaves almost as constantly 3-jugate as they are 1-jugate in *C. baileyanum;* petioles flattened above (cylindrical in *C. baileyanum*); leaflets thinner, greyish-green when dry (olive brown in *C. baileyanum*); number of secondary nerves slightly larger.

72. Canarium oleiferum Baillon, 1871—1872, 341; Engler, 1883, 135, t. 3 f. 23; Leenhouts, 1955a, 41, f. 18. — *Canariellum oleiferum* Engler, 1896, 242, f. 137; 1931, 450, f. 214; Guillaumin, 1909a, 250, f. 31; 1911d, 114; Mezger, 1926, 8, t. 8; Däniker, 1932, 205; Guillaumin, 1938, 21; 1941, 323; 1948b, 170.

Type: New Caledonia, Drobio, Febr. 1872, *Balansa 3458,* ♂ and fr., lectotype (P).

Tree, *c.* 20 m high. *Branchlets* 4—7 mm thick, young parts ferruginously tomentose, older ones covered by the reticular remainder of the tomentose epiderm; pith without vascular strands. *Leaves* unifoliolate (to 2-jugate), the petioles densely ferruginously (later greyish-brown) tomentose. *Leaflets* elliptic (to oblong-ovate), 5—13½(—17) by 3½—7½(—9½) cm, coriaceous, shortly ferruginously tomentose, mainly on the nerves, to greyishly papillose beneath; base broadly cuneate (to rounded), decurrent; margin entire; apex broadly rounded to emarginate or shortly and bluntly acuminate; midrib more or less distinctly bifurcate towards the apex if the latter is not acuminate; nerves 4—8 pairs (angle 55—65°), faintly

S-shaped to straight, more or less distinctly arching near the margin. *Inflorescences* terminal, 15—20 (♀ up to 25) cm long, branches up to 8 cm, ferruginously tomentose, ♂ flowers clustered; in the lower part of the inflorescences a few unifoliolate, small (apical ones 1 by ½ cm, petioles 1 cm long) leaves. *Flowers* ♂ 5—6 mm long, ♀ 6—7 mm. *Calyx* 2—3 mm. *Corolla* outside densely shortly tomentose. *Stamens* 6, free, glabrous. *Disk* cupular, margin undulate to truncate, ½—1 mm high, fleshy, glabrous, specially in ♂ flowers rather variable. *Pistil* in ♂ flowers slightly to totally reduced, in ♀ flowers densely shortly ferruginously tomentose, 2(—3)-celled. *Infructescences* unknown. *Fruits* subovoid, 5 by 3½ cm, glabrous; pericarp hard, lacunar; pyrene smooth, faintly 2-ribbed; lids 4 mm thick, axial intrusion not clearly distinguishable. *Seed* 1, the sterile cell more or less reduced.

Distribution: New Caledonia.

NEW CALEDONIA. *d'Alleizette in herb. L 951.54—150; Balansa 481* (paratype), *3011, 3458* (lectotype); *Bierrou 7; Cribs 1549; Franc s.n. (herb. Bonati 241), Franc 1595 A, 1918; Pancher 19; Le Rat 212, 442, 742, 1082, 2985; Vieillard 4* (paratype), *692.*

Ecology: Forests at low and medium altitudes. *Fl.* Dec.—Febr., *fr.* Febr.

Uses. The oily seeds are eaten.

Note. Engler (1896, 242) based his genus *Canariellum* mainly on the two-celled fruits, the unifoliolate leaves, and the absence of vascular bundles in the medulla of the branchlets. None of these three characteristics is completely differential, as each is found occasionally in other *Canarium* species, especially New Caledonian ones, whose insertion in the genus is beyond doubt. Among these, *C. baileyanum* is most closely related to *C. oleiferum.*

73. Canarium trifoliolatum Engler, 1883, 124; Guillaumin, 1911d, 114; 1948b, 171; Leenhouts, 1955a, 49, f. 21.

Type: New Caledonia, Mt Pénari, alt. 200 m, Febr. 1872, *Balansa 3550,* ♂ (P; isotype in L).

Small tree, 6—8 m high. *Branchlets* 7 mm thick, youngest parts densely shortly greyish brown tomentose, glabrescent; pith without vascular strands. *Leaves* trifoliolate (to 2-jugate), fulvously tomentose when young, glabrescent. *Leaflets* ovate, 8—10½ by 5—6 cm, coriaceous; base, especially in older leaves, very oblique, rounded; margin entire; apex tapering acuminate, acumen *c.* 1 cm long, blunt; nerves 8—9 pairs (not infrequently one nerve more at one side of the leaflet then at the other) (angle 70—80°), bifurcating near the margin and arching with intermediate veins. *Inflorescences* (♀ unknown) axillary, branched, 7 cm long, shortly and thinly greyish tomentose, branches up to 1 cm long. *Flowers* (♀ unknown) *c.* 2 mm long, with a slightly hollowed receptacle. *Calyx* 1½ mm, minutely puberulous. *Stamens* 6, free, glabrous. *Disk* cupular with irregularly undulated margin ¼ mm high, fleshy, glabrous. *Pistil* not strongly reduced, glabrous. *Infructescences* and *fruits* unknown.

Distribution: New Caledonia.

NEW CALEDONIA. *Balansa 3550* (type).

Ecology: Alt. 200 m. *Fl.* Febr.

74. Canarium balansae Engler, 1883, 117; Guillaumin, 1909a, 222—224, f. 10, 22[18], 23[8,9]; 1911d, 114; 1943, 218; 1948b, 171; Leenhouts, 1955a, 48, f. 20.

Type: Loyalty Islands, Lifu, Chépénéhé, July 1869, *Balansa 2324*, young fl. & fr., lectotype (P; isotypes in K, L).

Tree, 15—20 m high. *Branchlets* ½ cm thick, thinly, shortly, and fulvously puberulent; pith with a peripheral cylinder of amphivasal vascular strands with large resiniferous ducts, central part with some scattered conspicuous large parenchymatic cells. *Leaves* whorled in threes, 2—3-jugate (some unifoliolate ones near the inflorescences), fulvously tomentose when young, glabrescent. *Leaflets* elliptic (basal ones ovate), usually slightly oblique, 7—14 by 4½—7 cm, (basal ones 5½ by 3½—4 cm, unifoliolate ones near the inflorescences 4 by 2 cm), coriaceous; base oblique, (rounded to) subcordate; margin entire; apex gradually acuminate, acumen short, broad, and blunt; nerves 7—9(—12) pairs (angle from base to apex 60—50°), straight to slightly (near the margin strongly) curved, not distinctly arching. *Inflorescences* (♀ unknown) axillary, much branched, probably not very large, glabrous. *Flowers* (♀ unknown) glabrous, the receptacle slightly hollowed, the buds globose, 1½ mm in diam. *Stamens* 6. *Disk* partly adnate to the receptacle. *Pistil* strongly reduced, glabrous. *Infructescences* axillary, up to 9 cm long, with 1—3 fruits; calyx faintly 3-lobed, 3 mm in diam. *Fruits* compressed elliptical, acute at apex, acuminate at base, 2½—3½ by 1¾—2 by 1.2—1.6 cm, glabrous; pyrene somewhat gibbous; lids 1 mm thick; 1 or 2 cells well-developed and fertile, the third one strongly to entirely reduced. *Cotyledons* dark green, herbaceous.

Distribution: Loyalty Islands.

LOYALTY ISLANDS. *Balansa 2324* (lectotype); *Deplanche 55* (paratype).

75. Canarium whitei Guillaumin, 1926, 91; 1948b, 171; Leenhouts, 1955a, 41, f. 17.

Type: New Caledonia, Rio des Pirogues, Oct. 27, 1923, *White 2255*, fr. (P; isotypes in A, BRI, L).

Medium-sized tree. *Branchlets* angular, *c.* 1 cm thick, brown tomentose, glabrescent; pith with scattered small sclerenchymatic strands without resiniferous ducts. *Leaves* 5—8-jugate, brown tomentose when young, glabrescent. *Leaflets* oblong to (basal and terminal ones) elliptic, 6—14 by 2½—4 cm, coriaceous; base cuneate, decurrent; margin entire; apex abruptly acuminate, acumen long (6—9 mm), narrow, and blunt; nerves from 8—9 in basal to 11—13 pairs in terminal leaflets (angle from base to apex 50—90°), gradually curved, arching at some distance from the margin. *Inflorescences* and *flowers* unknown. *Infructescences* axillary, racemose, probably short and with only a few fruits; calyx 3-lobed, 1½ cm in diam., glabrous without, inside shortly fulvous-tomentose, remainder of disk annular, reddish-brown pilose. *Fruits* obovoid, slightly compressed, 4¾ by 3.4 by 2½ cm, glabrous; pyrene smooth; lids 4 mm thick; 2 cells, one slightly reduced.

Distribution: New Caledonia.

NEW CALEDONIA. *White 2255* (type).

Ecology: Rain forest. *Fr.* Oct.

N o t e. As has been remarked by Guillaumin, this species is related to *C. balansae*. There is a striking resemblance in the shape of the fruit, which has been found in no other species.

DOUBTFUL SPECIES

Canarium decipiens H. J. Lam, 1932a, 209; 1932b, 447, t. 9 f. 56.

The type specimen of this species (*unknown coll. 296* in BO) is very poor and the locality is unknown. In my opinion it is possibly related to or even conspecific with *C. fusco-calycinum* Stapf.

Canarium engleri H. J. Lam, 1932a, 208; Leenhouts, 1956, 279. — *Pimela oleosa* Loureiro, 1790, 408; 1793, 496; Blume, 1850, 221; Merrill, 1935, 227. — *C. oleosum* (*non* Engl.) Guillaumin, 1911c, 710.

According to Loureiro's description this species probably belongs to a quite different genus or even to a different family. I was not able to identify it with any of the Indo-Chinese species known to me.

Canarium mansfeldianum Engler, 1910, 137; 1915, 782.

This species is based upon the specimen *Mansfeld 27* from Ossidje or Ossidinge, Cameroons. I did not see the type specimen or any other bearing this name. According to the description it can hardly be synonymous to *C. schweinfurthii*, but, as only sterile material was known, and as nothing is said about the stipules, it might very well belong to the genus *Dacryodes (Pachylobus)*. Possibly the vernacular name *edjum* will be of some value for the definite interpretation.

EXCLUDED SPECIES

Canarium aneityense Guillaumin, 1933, 54 = *Haplolobus floribundus* (K. Sch.) H. J. Lam.

Canarium angulatum Ridley, 1931, 493 = *Dacryodes incurvata* (Engl.) H. J. Lam.

Canarium angustifolium (Bl.) Miquel, 1869, 117; Lam, 1932b, 479, t. 11 f. 71d, *sub C. rigidum* Zippelius. — *Pimela angustifolia Blume*, 1850, 226. — *Canariopsis angustifolia* Miquel, 1859, 653 = *Meliosma sp. (Sabiac.)*.

Canarium articulatum Engler *ex* Koorders, 1903, 97, *nom. nud.* = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium brunneum Beddome, 1869, t. 127 = *Scutinanthe brunnea* Thwaites.

Canarium buettneri Engler, 1892, 101 = *Dacryodes buettneri* (Engl.) H. J. Lam.

Canarium caudatifolium Merrill, 1915c, 315 = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium connarifolium Perkins, 1904, 92 = *Protium connarifolium* (Perk.) Merrill.

Canarium costatum (Benn.) Ridley, 1930, 82 = *Dacryodes costata* (Benn.) H. J. Lam.

Canarium crassifolium Merrill, 1915b, 274 = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium cuspidatum (Bl.) Merrill, 1921, 316 = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium edule (G. Don) Hooker f., 1849, 285 = *Dacryodes edulis* (G. Don) H. J. Lam.

Canarium eupteron Miquel, 1859, 648 = *Santiria oblongifolia* Blume.

Canarium expansum Ridley, 1930, 83 = *Dacryodes expansa* (Ridl.) H. J. Lam.

Canarium fragile Engler, 1883, 138 = *Dacryodes laxa* (Benn.) H. J. Lam.

Canarium furfuraceum Lauterbach, 1920, 325 = *Haplolobus floribundus* (K. Sch.) H. J. Lam.

Canarium gilvescens Miquel, 1859, 650, *nom. illeg.* = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium hirtipetalum Ridley, 1930, 84 = *Santiria mollis* Engler.

Canarium incurvatum Engler, 1883, 138 = *Dacryodes incurvata* (Engl.) H. J. Lam.

Canarium kadondon A. W. Bennett, 1875a, 535 = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium korthalsii Miquel, 1859, 645 = *Santiria tomentosa* Blume.

Canarium laevigatum (Bl.) Miquel, 1859, 648 = *Santiria laevigata* Blume.

Canarium laxum A. W. Bennett, 1875a, 535 = *Dacryodes laxa* (Benn.) H. J. Lam.

Canarium macrophyllum Oliver, 1868, 327 = *Dacryodes macrophylla* (Oliv.) H. J. Lam.

Canarium mahassan Miquel, 1861, 526 = *Triomma malaccensis* Hooker *f.*

Canarium micrantherum Stapf *ex* Ridley, 1930, 82 = *Santiria tomentosa* Blume.

Canarium minahassae Koorders, [1898, 376, *nom. nud.*] 1903, 96, *descr.* = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium montanum (Bl.) Korthals *ex* Miquel, 1859, 649 = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium moultonii Ridley, 1930, 83 = *Dacryodes rugosa* (Bl.) H. J. Lam.

Canarium mubafo Ficalho, 1881, 611 = *Dacryodes edulis* (G. Don) H. J. Lam.

Canarium nitens Merrill, 1915a, 24 = *Dacryodes incurvata* (Engl.) H. J. Lam.

Canarium oblongifolium Miquel, 1859, 645 = *Santiria oblongifolia* Blume.

Canarium pachypodum Lauterbach, 1920, 324 = *Haplolobus acuminatus* (K. Sch.) H. J. Lam.

Canarium parciflorum Ridley, 1930, 80 = *Santiria apiculata* Bennett.

Canarium planchoni (Benn.) King, 1894b, 240 = *Santiria rubiginosa* Blume.

Canarium reticulatum Ridley, 1930, 83, *nom. illeg.* = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium rostriferum Miquel, 1861, 526 = *Dacryodes rostrata* (Bl.) H. J. Lam.

Canarium rubiginosum A. W. Bennett, 1875a, 535 = *Dacryodes rubiginosa* (Benn.) H. J. Lam.

Canarium rubiginosum (Bl.) Miquel, 1859, 651 = *Santiria rubiginosa* Blume.

Canarium rufescens (Bl.) Miquel, 1859, 650 = *Santiria laevigata* Blume.

Canarium rugosum (Bl.) Miquel, 1859, 649 = *Dacryodes rugosa* (Bl.) H. J. Lam.

Canarium saphu Engler, 1893, 99, t. 3 = *Dacryodes edulis* (G. Don) H. J. Lam.

Canarium virgatum (Bl.) Miquel, 1859, 650 = *Dacryodes rugosa* (Bl.) H. J. Lam.

Canarium vrieseo-teysmannii H. J. Lam, 1932a, 216 = *? Aphanamixis sp. (Meliac.).*

Canariopsis angustifolia (Bl.) Miquel, 1859, 653, see *Canarium angustifolium* (Bl.) Miquel.

Pimela angustifolia Blume, 1850, 226, see *Canarium angustifolium* (Bl.) Miquel.

Pimela caryophyllacea Blume, 1850, 222; Merrill, 1917, 305. — *Canarium tengio cana* Rumphius, 1741, 154.

The identity of this species is not clear to me, but in my opinion it does not belong to the genus *Canarium.*

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Index [1])

[1]) Synonyms are printed in *italics*; the number between brackets refers to the species to which they are reduced.

Canarium *fissistipulum Miq. (21)*
— *flavum Ridl. (1)*
— *fragile Engl. (excluded)*
— *fulvum Laut. (61)*
— *furfuraceum Laut. (excluded)*
— fusco-calycinum Stapf *ex* Ridl. 53
— *fuscum Engl. (21)*
— *gawadaense Baker (17)*
— *giganteum Engl. (1)*
— *gilvescens Miq. (excluded)*
— *glaucum Bl. (1)*
— gracile Engl. 38
— *grandiflorum Benn. (40)*
— grandifolium H. J. Lam 30
— *grandistipulatum Laut. (16)*
— *greshoffii Koord. (54)*
— *gutur De Mikl.-Macl. (62)*
— *harami Bojer (27)*
— harveyi Seem. 14
— *heterophyllum Merr. (61)*
— hirsutum Willd. 54
— *hirtellum Benn. (40)*
— *hirtipetalum Ridl. (excluded)*
— *hispidum Bl. (54)*
— *incurvatum Engl. (excluded)*
— indicum L. 16
— intermedium H. J. Lam 49
— *juglandifolium Perk. (61)*
— *kadondon Benn. (excluded)*
— kaniense Laut. 17
— karoense H. J. Lam 22
— *kerrii Craib (45)*
— *khiala Chev. (28)*
— kinabaluense Leenh. 7
— kipella Miq. 50
— *kitengo Miq. (50)*
— *koordersianum Engl. ex Hochr. (61)*
— *korthalsii Miq. (excluded)*
— kostermansii Leenh. 39
— *kunstleri King (21)*
— *laciniatum Elm. (21)*
— *laevigatum Miq. (excluded)*
— *lagunense Merr. (61)*
— lamii Leenh. 10
— latistipulatum Ridl. 2
— *laxiflorum Decne (34)*
— *laxum Benn. (excluded)*
— *ledermannii Laut. (58)*
— *leeuwenii H. J. Lam (63)*
— *legitimum Miq. (61)*
— *leytense Elm. (61)*
— *lian H. J. Lam (8)*
— *liebertianum Engl. (27)*
— *lineistipula K. Schum. & Laut. (63)*
— *linguistipulum Leenh. (66)*
— littorale Bl. 1
— *longiflorescens Elm. (54)*
— *longiflorum Zipp. ex Miq. (63)*

Canarium *longissimum Hochr. (35)*
— *lucidum Perk. (61)*
— *luxurians Engl. (61)*
— luzonicum A. Gray 18
— macadamii Leenh. 64
— *macrophyllum Oliv. (excluded)*
— madagascariense Engl. 27
— *mafoa Christ. (14)*
— *mahassan Miq. (excluded)*
— maluense Laut. 8
— manii King 24
— mansfeldianum Engl. (doubtful)
— *mauritianum Bl. (26)*
— megacarpum Leenh. 9
— megalanthum Merr. 23
— *mehenbethene Gaertn. (16)*
— *melioides Elm. (19)*
— merrillii H. J. Lam 41
— *micrantherum Stapf ex Ridl. (excluded)*
— *microcarpum Willd. (34)*
— *microphyllum Merr. (37)*
— *minahassae Koord. (excluded)*
— *minutiflorum Engl. (61)*
— *molle Engl. (61)*
— *moluccanum Bl. (16)*
— *montanum Korth. ex Miq. (excluded)*
— *motleyanum Engl. (40)*
— *moultonii Ridl. (excluded)*
— *mubafo Fic. (excluded)*
— muelleri Bail. 71
— *multifidum H. J. Lam (20)*
— *multiflorum Engl. (27)*
— *multijugum H. J. Lam (54)*
— *multipinnatum Llanos (54)*
— *nervosum Elm. (54)*
— *nigrum Engl. (43)*
— *nigrum Roxb. (63)*
— *nitens Merr. (excluded)*
— *nitidum Benn. (4)*
— *nungi Guill. (16)*
— *oblongifolium Miq. (excluded)*
— *obtusifolium S. Elliot (27)*
— *occidentale Chev. (28)*
— odontophyllum Miq. 20
— *odoriferum hirsutum Rumph. (54)*
— *odoriferum leve Rumph. (35)*
— *ogat Elm. (61)*
— oleiferum Baill. 72
— oleosum Engl. 34
— *oliganthum Merr. (18)*
— ovatum Engl. 19
— *oxygonum Quis. & Merr. (54)*
— *pachyphyllum Perk. (19)*
— *pachypodum Laut. (excluded)*
— *palawanense Elm. (20)*
— *palawense Laut. (54)*
— paniculatum Benth. *ex* Engl. 26
— *papuanum H. J. Lam (61)*
— *parciflorum Ridl. (excluded)*

Canarium *parvifolium Benn. (4)*
— parvum Leenh. 44
— patentinervium Miq. 4
— *pauciflorum Ridl. (5)*
— *paucinervium Merr. (37)*
— *perkinsae Merr. (37)*
— perlisanum Leenh. 3
— piloso-sylvestre Leenh. 12
— pilosum Benn. 40
— *pimela Koen. (43)*
— pimela Leenh. 43
— *planchoni King (excluded)*
— *poeloetimbeo Engl. ex Hochr. (35)*
— *polyanthum Perk. (18)*
— *polyneurum Perk. (61)*
— polyphyllum K. Schum. 58
— *pruinosum Engl. (1)*
— *pseudocommune Hochr. (1)*
— pseudodecumanum Hochr. 32
— pseudopatentinervium H. J. Lam 29
— pseudosumatranum Leenh. 55
— *pulchre-bracteatum Guill. (27)*
— *purpurascens Benn. (1)*
— *purpureum Elm. (37)*
— *quadrangulare H. J. Lam (8)*
— *racemosum Merr. (54)*
— *radlkoferi Perk. (54)*
— *ramosii Merr. (37)*
— *reticulatum Merr. (61)*
— *reticulatum Ridl. (excluded)*
— *reziniferum Brace ex King (47)*
— *riedelianum Engl. (54)*
— rigidum Zipp. *ex* Miq. 57
— *robustum Merr. (54)*
— *rooseboomii Hochr. (35)*
— *rostratum Zipp. ex Miq. (63)*
— *rostriferum Miq. (excluded)*
— *rotundifolium Guill. (45)*
— *rubiginosum Benn. (excluded)*
— *rubiginosum Miq. (excluded)*
— *rufescens Miq. (excluded)*
— *rufum Benn. (1)*
— *rugosum Miq. (excluded)*
— salomonense Burtt 13
— *samarense Merr. (61)*
— samoense Engl. 69
— *sanchezii Merr. (61)*
— *saphu Engl. (excluded)*
— *sapidum Hemsl. (14)*
— schlechteri Laut. 62
— schweinfurthii Engl. 28
— *secundum Benn. (1)*
— *serricuspe Miq. (1)*
— *serrulatum Miq. (1)*
— *shortlandicum Rech. (16)*
— *sibulanense Elm. (60)*
— *sibuyanense Elm. (61)*
— *sikkimense King (47)*
— *simplicifolium Engl. (11)*

Canarium *sinense Cana Rumph. (42)*
— *sinense Tsjacana Rumph. (43)*
— smithii Leenh. 67
— *solo Engl. ex Koord. (61)*
— *spectabile Miq. (21)*
— *stachyanthum Perk. (61)*
— *stenophyllum Merr. (37)*
— strictum Roxb. 47
— *subcordatum Ridl. (54)*
— *subrepandum Miq. (4)*
— *subtruncatum Engl. (16)*
— subulatum Guill. 45
— *subvelutinum Elm. (61)*
— sumatranum Boerl. & Koord. 56
— sylvestre Gaertn. 11
— *sylvestre Willd. (11)*
— *sylvestre alterum Rumph. (11)*
— *tamborae Laut. (61)*
— *tengio cana Rumph. (excluded)*
— *thollonicum Guill. (28)*
— *thorelianum Guill. (45)*
— *thyrsoideum Perk. (61)*
— *todayense Elm. (37)*
— *tomentosum Bl. (1)*
— *tongcalingii Elm. (60)*
— *tonkinense Engl. (42)*
— *treubianum Engl. ex Koord. (61)*
— *triandrum Engl. (18)*
— trifoliolatum Engl. 73
— trigonum H. J. Lam 36
— *unifoliolatum Merr. (61)*
— *urdanetense Elm. (61)*
— *valetonianum Engl. ex Hochr. (61)*
— vanikoroense Leenh. 66
— *velutinum Guill. (28)*
— *venosum Craib (45)*
— *villosiflorum Elm. (60)*
— *villosum Benth. & Hook. f. ex F.-Vill. (61)*
— *virgatum Miq. (excluded)*
— vitiense A. Gray 68
— *vittatistipulatum Guill. (45)*
— vrieseanum Engl. 60
— *vrieseo-teysmannii H. J. Lam (excluded)*
— vulgare Leenh. 15
— *vulgare Rumph. prima et secunda species (16)*
— *vulgare Rumph. tertia et quarta species (15)*
— *warburgianum Perk. (54)*
— *wenzelii Merr. (61)*
— whitei Guill. 75
— *williamsii Rob. (60)*
— *zephyrinum Rumph. (16)*
— zeylanicum Bl. 25
— *zollingeri Engl. (61)*

Colophonia mauritiana DC. (26)
— *zeylanica Paxt. (25)*

Dacryodes scandens Huss. (40)

Dammara nigra Rumph. (63)
— *nigra legitima Rumph. (61)*
Hearnia balansae DC. (42)
Kaekuriaghaha Herm. (25)
— *odorata Burm. (25)*
Lipara nigra Lour. ex Gom. (43)
Marignia acutifolia DC. (63)
Nanarium minimum sive oleosum Rumph. (34)
Pimela acutifolia Bl. (63)
— *alba Lour. (42)*
— *altissima Bl. (54)*
— *angustifolia Bl. (excluded)*
— *caryophyllacea Bl. (excluded)*
— *decumana Bl. (33)*
— *denticulata Bl. (61)*
— *dichotoma Bl. (52)*
— *glabra Bl. (35)*
Pimela hirsuta Bl. (54)
— *hispida Bl. (54)*
— *kipella Bl. (50)*
— *kitengo Bl. (50)*
— *laxiflora Bl. (63)*
— *legitima Bl. (61)*
— *luzonica Bl. (18)*
— *nigra Lour. (43)*
— *oleosa Lour. (doubtful)*
— *paucijuga Bl. (35)*
— *rigida Bd. (57)*
— *stricta Bl. (57)*
— *villosa Bl. (61)*
Protium australasicum Sprag. (70)
Rhus dhuna Buch.-Ham. ex Wall. (47)
Santiria serrulata Engl. (31)
Sonzaya australiana March. (51)
Trigonochlamys grandifolia Ridl. (30)