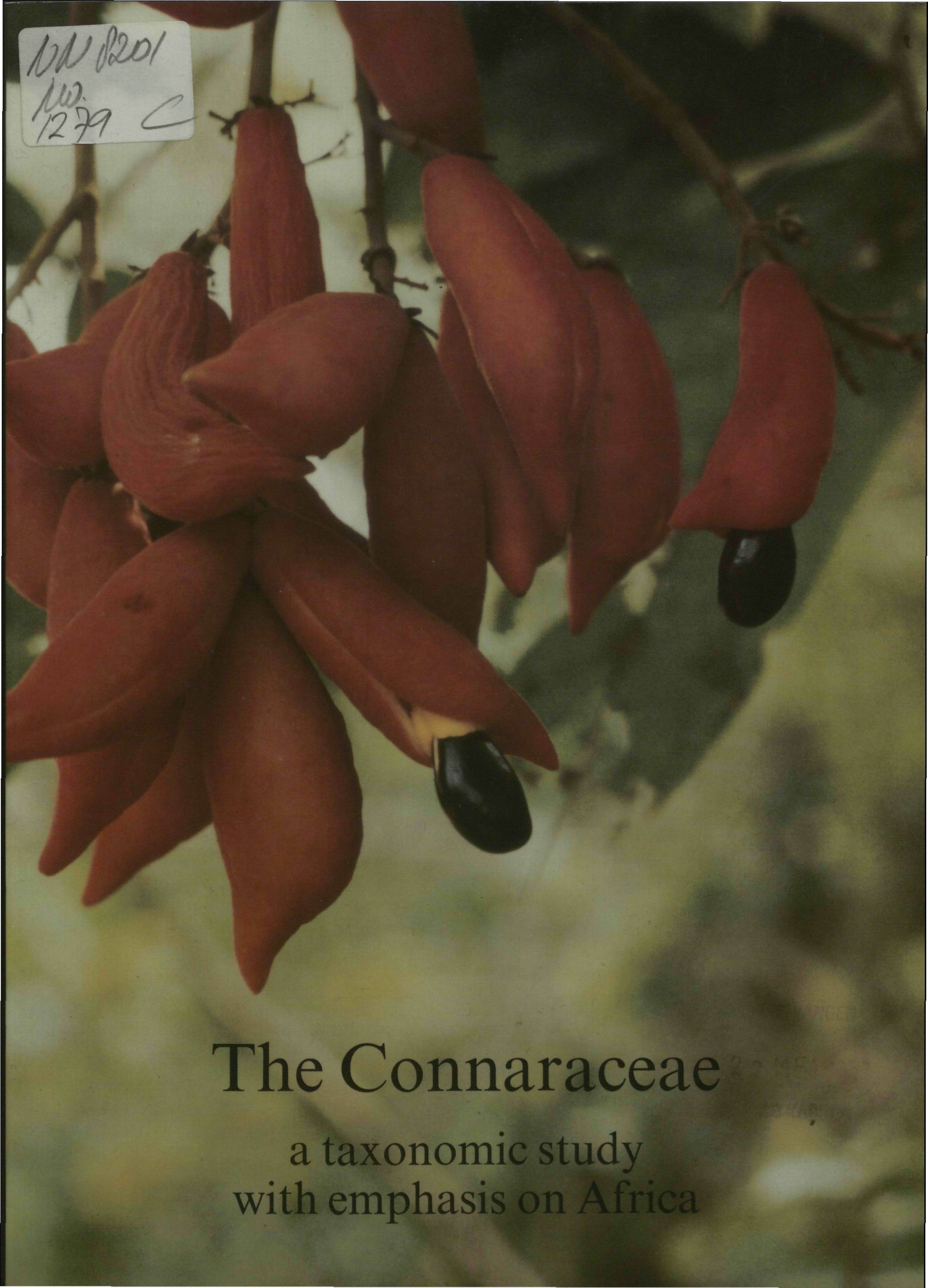

The Connaraceae

a taxonomic study with emphasis on Africa

THE CONNARACEAE
a taxonomic study with special emphasis on Africa.

C.C.H. JONGKIND

Indumentum, stomata, fruit, seedlings, phylogeny of the genus Rourea, and a revision of the genera Agelaea, Manotes, and Rourea.

R.H.M.J. LEMMENS

Geography, heterostyly, pollen morphology, phylogeny and a revision of the genera Cnestis, Connarus and Ellipanthus

Proefschrift
ter verkrijging van de graad van
doctor in de landbouwwetenschappen,
op gezag van de rector magnificus,
dr. H.C. van der Plas,
in het openbaar te verdedigen
op vrijdag 2 juni 1989
des namiddags te 14.45 uur in de aula
van de Landbouwuniversiteit te Wageningen

STELLINGEN

I

De verwantschappen binnen *Connaraceae* duiden op de kust van Tanzania en Kenya als plaats waar Madagascar zou hebben vastgezeten aan Gondwanaland, zoals verondersteld door Wild.

Wild, H. 1975. Phytogeography and the Gondwanaland position of Madagascar. Boissiera 24: 107-117.

II

Gezien het feit dat binnen sommige genera de soorten van Afrika en Azië nauwelijks van elkaar verschillen, moet de familie der *Connaraceae* als een oude groep worden beschouwd, die, althans ten dele, sinds lang weinig is geëvolueerd.

III

Heterostylie en andere bestuivingssystemen zijn sterk adaptief, hetgeen de grote variatie in vormen bij *Connaraceae* en sommige andere families verklaart.

Vuilleumier, B.S. 1967. The origin and evolutionary development of heterostyly in the *Angiosperms*. Evolution 21: 210-226.

IV

Het genus *Jollydora* neemt een aparte plaats in binnen de *Connaraceae* op basis van veel meer kenmerken dan Schellenberg aanvoert.

Schellenberg, G. 1938. *Connaraceae*. Engler, Das Pflanzenreich 103 (4, 127): 18.

V

Het niet onderwerpen van een gerevideerde plantengroep aan fylogenetische beschouwingen moet voor de systematiek als een gemis en voor de botanicus als een gemiste kans worden beschouwd.

VI

Een scheiding van taxonomie en fylogenie als aparte disciplines moet worden gezien als een kunstmatige classificatie.

VII

De vermelding van geavanceerde apparatuur op een aanvraag voor subsidie van wetenschappelijk onderzoek verhoogt de kans op toewijzing aanzienlijk.

VIII

Natuurbeschermings-programma's voor ontwikkelingslanden dienen op andere gebieden dan de natuurbescherming grote voordelen te bieden voor de bevolking willen ze enige kans van slagen hebben.

IX

Kalksteengroeven in Zuid-Limburg kunnen korte tijd na het beeindigen van de exploitatie-activiteiten bijzonder waardevol zijn in natuurwetenschappelijk opzicht. Wanneer hiermee beter rekening zou worden gehouden bij het maken van bestemmings- en inrichtingsplannen voor afgewerkte groeven, zoals op de St. Pietersberg, dan zou kalksteenwinning op het plateau van Margraten onder bepaalde voorwaarden ook door natuurbeschermers in een ander licht kunnen worden gezien.

X

Voor een verbetering van de samenwerking met andere vakgebieden dan de biologie en voor meer inspraak in multi-disciplinaire projekten is het voor veel biologen van groot belang dat zij eindelijk hun 'geitenwollensokken-image' verliezen.

XI

Het afschaffen van het gemengd dubbel in de landelijke tenniscompetitie zou een negatieve invloed hebben op het spelpeil van de vrouwelijke spelers.

R.H.M.J. Lemmens
The Connaraceae
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Geography, heterostyly, pollen morphology,
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Cnestis, Connarus and Ellipanthus

Wageningen, 2 juni 1989

STELLINGEN

I

Het feit dat alleen *Connaraceae* soorten met een grote ecologische amplitude op verafgelegen vulkanische eilanden groeien maakt het aannemelijk dat niet de afstand maar het milieu op die eilanden de belangrijkste beperkende faktor voor vestiging is.

II

De verwantschappen binnen de *Connaraceae* wijzen erop dat het kontakt tussen tropisch Zuid Amerika en Afrika veel eerder verbroken werd dan dat tussen tropisch Azië en Afrika en niet anders om zoals de recente uitwerking van Wegener's theorie door Dietz en Holden doet vermoeden.

R.S. Dietz & J.C. Holden
The breakup of Pangea
Scientific American 223, 4: 30-41 (1970)

III

Dat de *Connaraceae*, althans ten dele, evolutionair beslist nog in beweging zijn, wordt bewezen door het bestaan van soorten die onderverdeeld zijn in vele blijkbaar genetisch gedeeltelijk geïsoleerde microspecies ', zoals *Agelaea pentagyna* en *Cnestis corniculata*.

IV

De onderdrukking van de ontwikkeling tot zaad van het tweede ovulum bij bijna alle *Connaraceae* soorten, is waarschijnlijk een aanpassing aan de manier van openen van de deelvruchten. Bij de enige soort die regelmatig twee zaden per deelvrucht heeft, *Jollydora duparquetiana*, blijven de vruchten dan ook gesloten.

V

Als andere families op het gebied van huidmondjes en andere epidermisstrukturen net zo veel soort- of genusspecifieke kenmerken opleveren als de *Connaraceae*, dan loont het zeker de moeite deze gegevens in kaart te brengen. Dit zou ondubbelzinnige identificatie van vegetatief materiaal mogelijk maken.

VI

Tegenover een toenemende belangstelling van het Nederlandse publiek voor het tropisch regenwoud staat een afnemende zorg van de overheid voor het behoud van dit regenwoud, hetgeen tot uiting komt in de afnemende mate waarin het wetenschappelijk onderzoek dat hiervoor nodig is wordt gesteund.

VII

De schijnbare grotere soortenrijkdom aan paddestoelen in de bossen in onze streken in vergelijking met de bossen aan de evenaar, wordt waarschijnlijk eerder veroorzaakt door de gebrekkige inventarisatie van het tropisch bos dan door een werkelijk verschil in soortenrijkdom.

VIII

Het streven van moderne dierentuinen om de dieren in een benadering van hun natuurlijk milieu aan het publiek te tonen, levert een beter begrip voor de ingewikkeldheid van ekosystemen en daardoor ook meer algemeen begrip voor een verantwoorde natuurbescherming op.

IX

Schone auto valse hoop: alleen drastische beperking van het privé autoverkeer kan ons land leefbaar houden (weer leefbaar maken).

X

Het veelvuldig gebruik van ingewikkelde ordeningsapparatuur als computers door onderzoekers leidt er veelal toe dat diens inventiviteit zich meer richt op de middelen dan op het doel.

XI

Het gefaseerd terugdringen van schadelijke drijfgassen voor spuitbussen is te vergelijken met de situatie waarin een gevaarlijk misdadiger, bij arrestatie, nog eerst de resterende patronen in zijn vuurwapen in het wilde weg mag afschieten, alvorens dit in te leveren.

C. C. H. Jongkind
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Indumentum, stomata, fruit, seedlings, phylogeny of the genus Rourea, and revision of the genera Agelaea, Manotes, and Rourea.

Wageningen, 2 juni 1989

Abstract

C. C. H. Jongkind

In the general part of this work the author of this thesis treats the leaves, flowers and fruits of *Connaraceae*. Additional chapters reflect upon the phylogeny of the genus *Rourea*, the phytochemistry of the family, and the relationship of *Connaraceae* with other families.

In the taxonomic part a description of the family is presented together with keys to the genera. A revision of the genera *Agelaea*, *Manotes*, and *Rourea* is presented with special emphasis on Africa, including descriptions of the genera and differential keys to the species.

In the revision of the genus *Agelaea* six species are recognized including the Asiatic species.

Manotes is only found in Africa and comprises five species.

The genus *Rourea* is revised for Africa only, twelve species are recognized for this area. The American and Asiatic species are studied but not revised. New combinations are made for American and Asiatic species that are transferred to this genus. The American species are classified into clusters. In this work *Rourea* also includes *Bernardinia*, *Byrsocarpus*, *Jaundea*, *Roureopsis*, *Santaloidella*, *Santaloides*, *Spiropetalum*, and *Paxia*, formely recognized as separate genera.

The treatment of the African species comprises full synonymy, literature, diagnosis, a distribution map, and ecological notes. In most cases an illustration is presented as well.

The author studied and collected most species of *Agelaea*, *Manotes*, and *Rourea* on location in the rain forest in Gabon.

Samenvatting

C. C. H. Jongkind

In het algemene deel van het boek behandelt de auteur van dit proefschrift de bladeren, bloemen en vruchten van de *Connaraceae*. Tevens beschrijft de auteur wat er bekend is over de fytochemie en de verwantschap van *Connaraceae* met andere families. Ook wordt de fylogenie van het genus *Rourea* gerekonstrueerd.

In het taxonomische deel wordt een beschrijving gegeven van de familie, gevolgd door sleutels tot de genera. Tevens worden de genera *Agelaea*, *Manotes* en *Rourea* behandeld als onderdeel van de komplete revisie van de *Connaraceae* met nadruk op Afrika. Hierbij wordt een beschrijving van de drie genera gegeven samen met sleutels tot de soorten.

Het genus *Agelaea* wordt voor zijn gehele verspreidingsgebied gerevideerd, dit verspreidingsgebied omvat Afrika en Azië. In dit genus worden zes soorten onderscheiden.

Het genus *Manotes* is beperkt tot Afrika, telt vijf soorten en wordt hier in zijn geheel gerevideerd.

Het genus *Rourea* wordt alleen voor Afrika bewerkt en omvat daar twaalf soorten. De niet-Afrikaanse soorten zijn wel bestudeerd. Nieuwe kombinaties worden gemaakt voor Amerikaanse en Aziatische soorten die naar dit genus zijn overgebracht. De Amerikaanse soorten worden in clusters ingedeeld. Het genus *Rourea* omvat hier ook de veelal als aparte genera erkende *Bernardinia*, *Byrsocarpus*, *Jaundea*, *Roureopsis*, *Santaloidella*, *Santaloides*, *Spiropetalum* en *Paxia*. Een nieuwe sectie-indeling is uitgewerkt voor het gehele genus.

De behandeling van alle Afrikaanse soorten omvat de synonymie, literatuur, een diagnose, verspreidingskaart en, voor zover bekend, ekologische gegevens. Van bijna alle soorten is een tekening bijgevoegd.

De auteur heeft gedurende twee maanden veldstudies verricht in Gabon en in die tijd de meeste van de door hem behandelde soorten verzameld.

Abstract

R. H. M. J. Lemmens

In the general part of this work the author of this thesis treats the geography, habit, morphology of stems and branches, and inflorescences of *Connaraceae*. The phenomenon of heterostyly, its expression and evolutionary developments are dealt with in a separate chapter. Additional chapters reflect upon the phylogeny of the genera within the family and on mutual relations of the species in the genus *Cnestis*. The author has assembled what is known about the pollen morphology, and provides supplementary original information.

In the taxonomic part a revision of the genera *Cnestis*, *Connarus*, and *Ellipanthus* is presented, with special emphasis on Africa, including descriptions of the genera and differential keys to the species. Additional keys are presented for plants that are either exclusively flowering or fruiting.

In the genus *Cnestis* 13 species are recognized, including the Asiatic *C. palala* and two new species, *C. bomiensis* and *C. uncata*. Compared to Schellenberg's monograph on *Connaraceae* (1938) the number of species is extensively reduced.

Connarus comprises seven species in Africa, including the new species *C. gabonensis*, while *Ellipanthus* has two African species, of which one was collected only once on Madagascar.

The treatment of each species comprises its full synonymy, literature, diagnosis, an illustration, a distribution map, and ecological and botanical notes.

The author studied and collected five species of *Cnestis*, and two species of *Connarus* on location in the rain forest in Gabon.

Samenvatting

R. H. M. J. Lemmens

In het algemene deel van het boek behandelt de auteur van dit proefschrift de geografie en voorts de habitus, de stengels en takken en de bloeiwijzen van *Connaraceae*. Het verschijnsel heterostylie bij *Connaraceae* wordt besproken, evenals de ontwikkelingen hierbinnen. In een kort hoofdstuk vat de auteur samen wat bekend is over de pollenmorfologie, aangevuld met eigen waarnemingen. Er wordt een reconstructie gemaakt van de fylogenie van de genera binnen de familie en van de soorten binnen het genus *Cnestis*.

In het taxonomisch deel worden de genera *Cnestis*, *Connarus* en *Ellipanthus* behandeld als onderdeel van de complete revisie van de *Connaraceae* met speciale nadruk op Afrika. Bij deze drie geslachten worden een genusbeschrijving en determinatiesleutels tot de soorten gegeven. Bij *Cnestis* en *Connarus* zijn drie sleutels opgenomen: respectievelijk voor planten met bloemen én vruchten, voor bloeiende en voor vruchtdragende planten.

In het genus *Cnestis* worden dertien soorten behandeld, inclusief de Aziatische *C. palala* (de enige niet-Afrikaanse soort) en twee nieuwe soorten: *C. bomiensis* en *C. uncata*. De reductie van het aantal soorten is aanzienlijk in vergelijking met de monografie van Schellenberg (1938).

Connarus omvat in Afrika zeven soorten, inclusief *C. gabonensis*, een nieuwe soort. *Ellipanthus* heeft twee Afrikaanse soorten, één in Oost Afrika en één op Madagascar.

De behandeling van elke soort omvat de synonymie, literatuur, een diagnose, tekening, verspreidingskaart en, voor zover bekend, oecologische en gebruiksgegevens. In de meeste gevallen zijn opmerkingen toegevoegd.

De auteur verrichtte veldstudies en heeft herbariummateriaal verzameld van vijf *Cnestis*- en twee *Connarus*-soorten in het tropisch regenwoud van Gabon.

Curriculum vitae

Carel Christiaan Hugo Jongkind werd op 9 januari 1954 geboren te 's-Gravenhage. Hij behaalde in 1974 zijn Atheneum B diploma aan het Haags Montessori Lyceum. Daarna studeerde hij biologie aan de Landbouwuniversiteit te Wageningen, alwaar hij in 1984 zijn doctoraal examen met goed gevolg aflegde met als hoofdvakken vegetatiekunde en plantentaxonomie. Tijdens zijn studie vervulde hij van september 1975 tot juni 1977 zijn vervangende dienst aan het Rijks Instituut voor Natuurbeheer in Leersum. Van maart 1987 tot maart 1989 was hij in tijdelijke dienst als assistent in opleiding (A.I.O.) bij de vakgroep Plantentaxonomie van de Landbouwuniversiteit.

Roeland Hendrikus Maria Julien Lemmens werd op 14 november 1954 geboren te Maastricht. Na het Gymnasium B diploma aan het Henric van Veldeke College in zijn geboortestad behaald te hebben, studeerde hij biologie aan de Landbouwuniversiteit te Wageningen. In 1984 legde hij het doctoraal examen met goed gevolg af, met als hoofdvakken natuurbeheer en vegetatiekunde en als bijvak plantentaxonomie. Tevens behaalde hij de aantekening onderwijsbevoegdheid in de biologie. In hetzelfde jaar was hij werkzaam bij de Stichting tot Instandhouding van Kleine Landschapselementen te Roermond. Vanaf september 1984 tot maart 1989 werkte hij bij de vakgroep Plantentaxonomie van de Landbouwuniversiteit als wetenschappelijk assistent. Vanaf januari 1988 is hij bovendien werkzaam als taxonoom bij het PROSEA-project, eveneens verbonden aan de Landbouwuniversiteit.

Contents

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List of new names and taxa published in this work

Introduction

In 1938 Schellenberg published his monograph of the pantropical family *Connaraceae*. In his treatment the family comprises 24 genera and 385 species. In Africa it is very well represented by 16 genera and 154 species. Asia and America are not so rich, having respectively 9 genera with 142 species and 5 genera with 89 species. Most African floras are based on Schellenberg's work and, as it seems, without very much alteration of the genus and species concept.

Leenhouts undertook a thorough revision of Schellenberg's work when he prepared the contribution for Flora Malesiana (1958b). His revision led to a considerable reduction of the number of species and also to a substantial reduction of genera: 9 genera and 142 species for Asia and adjacent areas in Schellenberg, 6 genera and 36 species for Malesia in Leenhouts treatment. Although Asia and adjacent areas contain some more species than Malesia alone, the reduction is nevertheless very significant.

A similar result is experienced in the revision of the African species: a reduction from 154 species in 16 genera in Schellenberg to 49 species in 10 genera now. The most significant reduction on the specific level is found in *Agelaea* (including *Castanola*): from 58 to 6 species (Africa + Asia). On the generic level the reduction in the number of genera is most apparent when considering *Rourea*: 9 separate genera in Schellenberg are now referred to synonymy. It is interesting to note that this last reduction does not involve a high number of new combinations in *Rourea*. Only 9 (4 for Africa, 4 for Asia, 1 for America) were necessary, as most species were originally described in *Rourea*!

Forero's recent (1983) treatment of the American representatives does not demonstrate the same result as experienced with the Asiatic and African treatments viz. a great reduction in the number of taxa. Where Schellenberg accepted for America 89 species in 5 genera, Forero treats 101 species in the same 5 genera. As a result the American continent now ranks first in species diversity (see table 1). In our opinion this is most likely due to a different species concept and does not necessarily reflect a greater diversity of species.

The present revision, which was initially undertaken to revise the African representatives only, now deals with the family in a much wider context. As in Africa 10 out of the 12 genera occur, a complete revision of the family on the generic level was undertaken, which resulted in a new subdivision of the family in 4 tribes. For genera with their main distribution in Africa the extra African species are revised as well (e.g. *Agelaea*, *Cnestis*). The heterostyly phenomenon which is so well represented in this family, is thoroughly investigated and so are the leaf epidermis and the wood anatomy.

The taxonomic part of Eimunjeze's publication on the genus *Hemandradenia* (1976) is reprinted in this work with some additional information on new collections.

Finally it may be observed that only 3 new species are described, two based on rather recently collected material, the third, also on old material which was overlooked by previous authors. This may prove that Africa, at least as far as *Connaraceae* are concerned, is rather well explored.

Wageningen, February 1989 F.J. Breteler

GENERAL PART

1. History of the family

by F.J. Breteler

The genus *Connarus* was published by Linnaeus in 1753. He classified it in *Monadelphia Decandria*. Aublet (1775) used the same system to classify his new genus *Rourea*. When A.L. de Jussieu (1789) described *Cnestis*, he placed it in his *Terebintaceae* under 'Genera Terebintaceis affina', together with genera which are now placed in families like *Rutaceae and Sapindaceae*. The genera *Connarus* and *Rourea* were, apparently, considered as true Terebintaceous. Robert Brown (1818) was the first author to separate the three known genera from the *Terebintaceae*, placing them together in the new family *Connaraceae*. *Omphalobium* of Gaertner (1788) is considered by him a synonym of *Connarus*. Brown's concept of the family is essentially the same as ours.

De Candolle (1825) did follow De Jussieu rather than Brown in placing the genera of *Connaraceae*, treated as a tribe, in *Terebintaceae*. The generic concept of *Connarus* is expanded to accommodate Aublet's *Rourea*, a genus with 5 instead of 1 carpel per flower. Next to *Connarus* Gaertner's genus *Omphalobium* is maintained, accommodating like *Connarus*, 5-carpellate as well as 1-carpellate species. This confusing situation ended when Planchon in 1850 reinstalled *Connaraceae* as a distinct family, reducing *Omphalobium* unambiguously into a synonym of *Connarus* by making the necessary new combinations. Planchon (l.c.) also added five new genera: *Agelaea*, *Bernardinia* (now treated as a synonym of *Rourea*), *Cnestidium*, *Manotes*, and *Roureopsis* (now also in *Rourea*). He divided the family in two tribes, the *Connareae* and the *Cnestideae*, based on differences in the aestivation of the sepals and the presence of endosperm. J.D. Hooker (1862) followed Planchon in his generic treatment of the family. Four genera were added: *Ellipanthus* and *Taeniochlaena* of himself, *Tricholobus* Blume (1850), and *Troostwykia* Miquel (1860). Of these only *Ellipanthus* is maintained here.

When Gilg (1891) made his treatment for 'Die Natürlichen Pflanzenfamilien' he maintained Planchon's tribes. Radlkofer's genus *Pseudoconnarus*, published in 1886, was added. In his supplements to this work of 1891, 1894, and 1897 the family was enriched with the genera *Paxia* Gilg (1891), *Spiropetalum* Gilg (1891), *Jaundea* Gilg (1894), *Dinklagea* Gilg (1897), and *Jollydora* of Pierre (1896). In his third supplement Gilg divided the *Connaraceae* in two subfamilies, *Connaroideae* and *Jollydoroideae*, to underline the separate position of *Jollydora*, while Planchon's tribes are maintained.

Schellenberg (1910) made a new subdivision of the family. Two subfamilies were distinguished namely *Connaroideae* (including *Jollydora*) and *Cnestoideae*. The *Connaroideae* are divided in two tribes the *Connareae* and the *Roureeae*. The latter tribe is further divided into two subtribes. It is interesting to note that the fundamental difference within *Connaraceae* of flowers having five or a single carpel is not used by Schellenberg in this new subdivision as both subfamilies consist of a mixture of 5-carpellate and 1-carpellate genera. In 1938 Schellenberg reverts to Gilg's subdivision into two subfamilies *Connaroideae* and *Jollydoroideae*. Again one or five carpels per flower is not considered to be fundamentally important by him (see also paragraph 10.1 and Fig. 54). In this last treatment of Schellenberg the number of genera has reached 24. Subsequently this number was reduced by Leenhouts (1958 b) and even further in the present work, to half this amount (see also the introduction).

2. Geographical distribution

by R.H.M.J. Lemmens

Connaraceae are almost exclusively found in the tropics. They are largely restricted to lowland rain forest. More rarely they are found in mountain or savanna vegetations, where they usually grow in thickets or in remnants of forest. Only a few species surpass the 20th degrees of latitude, e.g. *Cnestis polyphylla* in southern Africa and some *Connarus* species on the Asiatic mainland, and some *Rourea* species in all continents.

Table 1 shows that the largest number of genera, representing all 4 tribes, is found in Africa, followed by Asia and then America, each with 2 tribes. Only a few genera represented in Africa have many species in Asia and/or South America, i.e. *Connarus*, *Rourea* (both in Asia and South America), and *Ellipanthus* (Asia).

In Africa the main centre of distribution is Central Africa, as shown in table 2. In West Africa (Gambia to Nigeria) 29 species in 7 genera are found. East and South Africa (Kenya, Uganda, Tanzania, and further south) have 12 species in 7 genera. In Central Africa (the remaining part of the continent south of the Sahara) 40 species in 7 genera occur, of which 36 are found in Cameroun and Gabon. When the part of Nigeria east of the Niger River is added to Central Africa, the number for West Africa is reduced to 20 species in 6 genera. In Central Africa representatives of all 4 tribes are found.

Table 1. Distribution of *Connaraceae*

Genus	Africa	Asia *	America **
Agelaea	4	2	0
Burttia	1	0	0
Cnestidium	0	0	2
Cnestis	12	1	0
Connarus	7	ca 19	51
Ellipanthus	2	ca 4	0
Hemandradenia	2	0	0
Jollydora	3	0	0
Manotes	5	0	0
Pseudoconnarus	0	0	5
Rourea	12	ca 16	43 ***
Vismianthus	1	1	0
Total species	49	ca 43	101
genera	10	6	4

* mainly based on Leenhouts (1958b), and including Australia and Melanesia
** based on Forero (1983)
*** including the only species of the former *Bernardinia*

Table 2. Distribution of *Connaraceae* in Africa

	Number of species	Number of genera	Number of tribes
Area of FWTA	29	7	4
W of Niger River	20	6	3
Central Africa (E of Niger River)	40	7	4
E and S Africa	12	7	2
Madagascar	5	4	2
Total for Africa	49	10	4

In Madagascar 5 species in 4 genera occur, of which only a single species, *Ellipanthus madagascariensis*, is endemic (see also note under this species). According to Dietz & Holden (1970) and Wild (1975, on phytogeographical grounds) Madagascar, prior to the fragmentation of Gondwanaland, is supposed to have been joined to the Somalia-Kenya-Tanzania coast. This could explain the pattern of distribution of *Cnestis polyphylla* linked to its morphological variation, i.e. the intermediate position of the Kenya material between the distinct populations of Madagascar and those of Southeast Africa. At the separation of Madagascar from the African continent possibly a major part of the genepool remained on this island, resulting in the wide variation within this species. It is not likely that the comparatively large seeds of *Cnestis polyphylla* have come across the Mozambique channel, but it cannot be excluded either, as the species is also found on Reunion and Mauritius, islands of volcanic origin at a distance of more than 700 km from Madagascar. The distance between Madagascar and South Mozambique is ca 900 km, while Madagascar and South Kenya lie almost 1400 km apart. The genus *Ellipanthus* shows a comparable distribution: *E. hemandradenioides* along the coast in Kenya and Tanzania and *E. madagascariensis* in NW Madagascar. Another species with a more or less comparable area of distribution to *Cnestis polyphylla* is *Rourea orientalis*.

Some species inhabit a very large area in Africa, e.g. *Agelaea pentagyna*, *A. paradoxa*, *Manotes expansa*, *Rourea thomsonii*, *R. coccinea*, *Cnestis corniculata*, and *C. ferruginea*. *Rourea minor* is even found outside Africa in Malaysia and on islands in the Indian Ocean and in the Pacific. In several genera as *Agelaea*, *Connarus*, *Ellipanthus*, *Rourea*, and *Vismianthus* very closely related species are found in Africa and Asia.

Apparently evolution in these species has been very slow since the separation of the continents, as their large seeds are not likely to be dispersed over long distances, and they are not likely to have been distributed by man. Possibly this also applies to some species from East Africa and Madagascar, as discussed above.

The relations between the taxa of the African and American tropics are less close. While not a single genus is restricted to Asia, two of the four genera are endemic to South and Central America, i.e. *Pseudoconnarus* and *Cnestidium*. However it must be noted that some American *Connarus* species show a remarkable resemblance with some African and Asiatic species.

Africa and the Indian plate drifting northward, were possibly connected for a comparatively long time by islands in the Indian Ocean, that allowed some exchange between populations. The rupture of South America and Africa is supposed to have taken place later than the breakup of the eastern part of Gondwana (see Dietz & Holden, 1970), but it was more abrupt, limiting the possibilities for exchange.

Some species are very restricted in their distribution. In the same area often a closely related species is found, with a much larger area of distribution. This is the situation in *Cnestis yangambiensis* and *C. corniculata*, *C. uncata* and *C. urens*, *C. bomiensis* and *C. racemosa*, *Jollydora pierrii* and *J. duparquetiana* respectively.

Disjunct distributions are found in *Cnestis macrantha*, *Manotes macrantha*, *Hemandradenia mannii*, and *Connarus congolanus*. The last three species occur in Liberia and/or Ivory Coast, as well as in Central Africa, but not in a large area in between: Ghana, Togo, Benin, and often also West Nigeria. Possibly these species once had a large area of distribution. In times with a more dry climate they became confined to refuges from which they migrated again when the climate became moister. This may also have been the case in *Rourea solanderi* and *Agelaea paradoxa*. The disjunct distribution is in these species less marked as the gap in their distribution is less wide. However, it cannot be ruled out completely that some species may be present in the distributional gap, but that they simply have not been collected there. This is not likely, as the area from Ghana to Nigeria is comparatively well-collected.

3. Systematic position of the family

by C.C.H. Jongkind

Unambiguous relationships of *Connaraceae* with other families have not been demonstrated so far. Most often close relationship with *Leguminosae* and *Rosaceae* has been postulated, as was advocated by Planchon (1850: 411), Bentham & Hooker (1862: 430), Gilg (1891: 63), Schellenberg (1938: 16, 17), and Dickinson (1971: 81, 86; 1972: 129, 136; 1973: 137). Affinities with other families, not necessarily in conflict with this rather classic view, were proposed by some of these authors as well. Planchon (1850: 411), Bentham & Hooker (1862: 430), and Schellenberg (1938: 17) considered *Oxalidaceae* to be affiliated, while Bentham & Hooker (1862: 430) also took *Anacardiaceae* into account. This was by no means a new point of view as de Jussieu in 1789 classified the genera of *Connaraceae* known by him in the affinity of his *Terebinthaceae*, a taxon that included among others present-days *Anacardiaceae*. Hutchinson's opinion (1964: 162), emphasizing a link with *Dilleniaceae*, should not be disregarded either.

If views of these authors on the affinities of *Connaraceae* are supported by specific characters at all, they are invariably limited in number. Pinnate leaves and apocarpous, pod-like, fruits support their relationship with *Leguminosae* while the exstipulate leaves and the presence of a sarcotesta emphasize affinities with *Sapindaceae*.

In 1976 Corner thoroughly analyzed the carpels and seeds of species of many different families and among them ten species of *Connaraceae*. The results of his investigations combined with the pinnate, exstipulate character of the *Connaraceae* leaves led him to consider affinity with *Meliaceae*.

When *Connaraceae* are regarded to form a link between *Rosales* and *Sapindales* they may be placed in the latter order, as was done by Cronquist (1968: 263-266). In harmony with the view of the first authors mentioned in this paragraph they are often referred to *Rosales* as did Thorne (1976). Hutchinson, however, eventually preferred to classify them in *Dilleniales*.

Any preference expressed as to the position of *Connaraceae* in any of the orders mentioned, leaves them with part of their characters in disagreement with that position. This led Takhtajan (1969: 224) to place them into an order of their own, the *Connarales*.

Recently Dickinson (1978: 36-45) tried to sort out the systematic position by means of all available anatomical and morphological data, but he did not arrive at a simple conclusion. In this work Dickinson mentioned heterostyly as one of the important characters in order to determine possible relationships between families. Therefore it is remarkable that he did not consider *Oxalidaceae*, as one of the possible related groups. This family is similar to *Connaraceae* in showing heterostyly and also shares other characters. *Oxalidaceae* resemble

Connaraceae to such an extent that a American species of *Rourea*, *R. blanchetiana*, was first described in *Oxalidaceae*.

The present revision did not reveal any important new characters for the classification of the family. It is possible that future phytochemical research may produce more information. However, the results of further research on larger and more variable families as *Leguminosae*, *Sapindaceae*, and *Rosaceae* is indispensable in order to elucidate the affinities of *Connaraceae*.

4. Morphology

4.1 Habit and growth

by R.H.M.J. Lemmens

Many species of Connaraceae are lianescent, but *Ellipanthus, Hemandradenia, Vismianthus, Burttia, Jollydora,* some species of *Rourea* and *Connarus,* and possibly a single *Cnestis* species do not show any lianescent tendencies, and are usually shrubs. Some Asiatic *Ellipanthus* species are recorded by Leenhouts (1958b) as medium-sized trees, up to 30 m high and 50-60 cm in diameter. Also some *Connarus* species from Asia can have a tree-like habit, up to 17 m high.

Fig. 1. *Cnestis corniculata*: liana in forest (*van der Maesen 5612*; phot. L.J.G. van der Maesen).

Fig. 2. *Cnestis corniculata*: young shoot (phot. L.J.G. van der Maesen).

Forero (1983) describes the habit of some South American *Connarus* species as a small tree, sometimes up to 20 m high. In Africa *Hemandradenia mannii* is occasionally a small tree up to 15 m, and *Ellipanthus hemandradenioides* up to 10 m. *Jollydora* shows the habit of a small, usually unbranched treelet, up to 7 m high.

When found in savannas that are regularly burned off, *Rourea coccinea* and *R. orientalis* develop rhizomatous shrublets with often strongly suberized bark. Moreover, in savannas both species are deciduous, like *Rourea fluminensis* from South America, while most other species of the family are evergreen.

Burttia prunoides and *Vismianthus punctatus* are also deciduous shrubs with leaves crowded at the end of the otherwise often aphyllous shoots, resembling certain *Prunus* species in appearance.

Many species are polymorphic. For instance, *Cnestis ferruginea*, probably due to environmental conditions, may be either a shrub or small tree, or a large forest liana.

In the undergrowth of rain forest in Gabon small shrubs of several species, particularly of *Agelaea*, are common. These plants often hardly show any growth for many years (Caballé, 1986). When the canopy of the forest opens they produce long shoots rapidly and become lianas. The same phenomenon is reported for other lianescent species, e.g. *Dichapetalum* (Breteler, 1973).

The lianas usually employ the winding end of young branches for attachment. In *Manotes macrantha* however, the reduced leaves, transformed to woody hooks, support the winding stems. According to Caballé (1986) some *Rourea* species use small, hook-like lateral branches for climbing and *Cnestis* and *Manotes* occasionally employ the swelling of the pulvinus at the base of the petiole for this purpose in bringing the leaf rachis in a hook-like position.

4.2 Stems and branches

by R.H.M.J. Lemmens

Among the lianescent species the main stem varies in shape in cross section. Usually it is (sub)cylindrical (fig. 3), but in *Rourea parviflora* and *R. minor* it

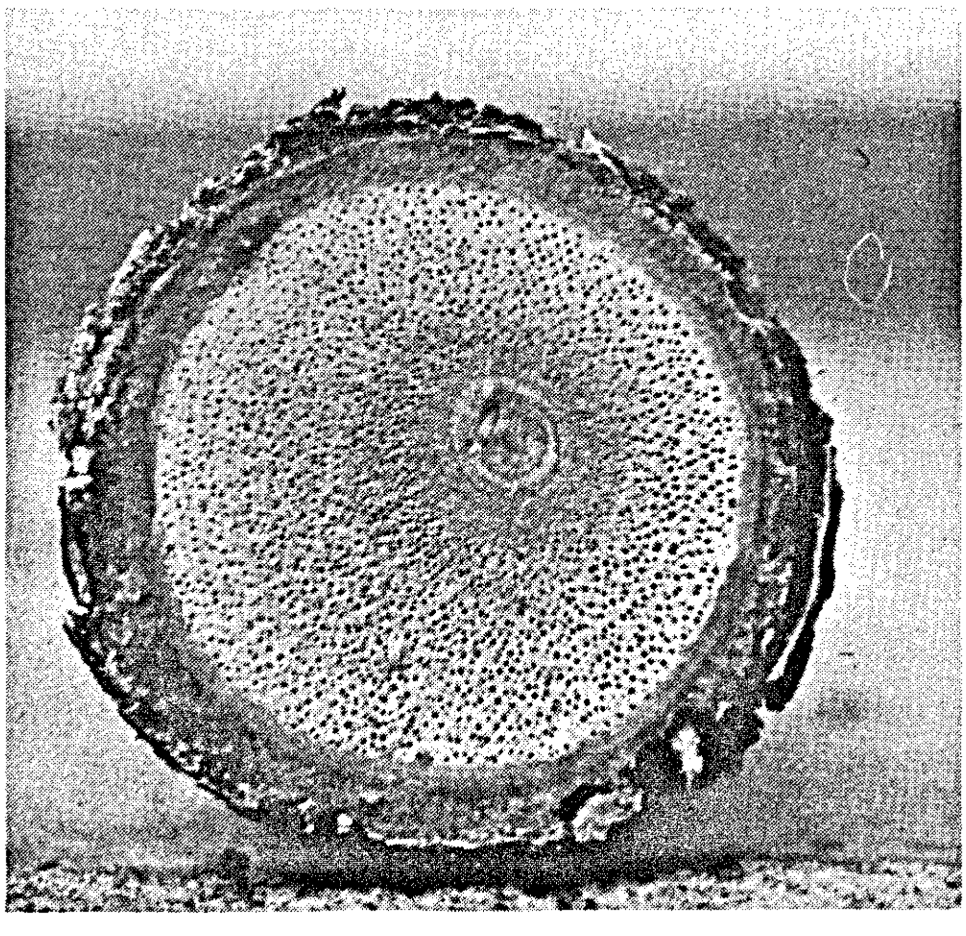


Fig. 3. *Manotes griffoniana*: cross section of main stem, 3 cm diam. (*Breteler 1708*; phot. F.J. Breteler).

is often strongly ridged and these ridges show a number of concentric rings (see also Caballé, 1986: fig. 44 and 45). These species have included phloem, as occasionally found in other species, e.g. *Agelaea pentagyna.*

Sometimes partition-like structures in the main stem are present, as is reported by Caballé for *Agelaea paradoxa.*

Main stem and shoots are occasionally strongly intertwined.

The bark is usually smooth, more rarely fissured and in some species sometimes strongly suberized (*Rourea coccinea, R. orientalis,* and the Asiatic *Connarus suberosus*). Lenticels are usually present on the branchlets. They are conspicuous in many *Connarus* species and particularly so in *Rourea orientalis.*

In *Connarus* wounded phloem produces a sticky, reddish exudate, like some papilionoid lianas. Some other species, e.g. *Rourea myriantha* and *R. solanderi,* exude a pale slime. Latex tubes are present in the wood of *Connarus* (see chapter on wood anatomy).

Wood samples have been scarcely collected and the characters mentioned for them cannot always reliably be extrapolated for the species they represent. A more comprehensive study of the wood anatomy has been made by den Outer & van Veenendaal (see chapter 8).

4.3 Indumentum

by C.C.H. Jongkind

In *Connaraceae* six different types of hairs can be distinguished, two glandular and four non-glandular. These six types are described below and their presence is indicated.

1. Multi-cellular glandular hair, consisting of a stalk-like part and a usually strikingly coloured head. The stalk is one to many cells long and one cell wide. The head is one to three cells wide and one to four cells long. This hair type is found in the genera *Cnestis, Connarus, Jollydora, Manotes,* and *Rourea.* The hairs very variable in shape and size (fig. 4.1-3). In *Cnestis mannii* the hair is a chain of about twelve cells long of which the upper two cells form the head. In *Rourea callophylla* it has the shape of a very tiny mushroom with a short stalk of about two cells and a large flat head of about six cells.

2. The second type of glandular hair is uni-cellular and very small with a little globular top. This type is only found in all *Manotes* species (fig. 4.4).

3. The most common non-glandular hair is an often thick-walled uni-cellular hair with an acute apex. It is found in all genera except in *Jollydora.* It varies in shape from an erect, straight, one-armed hair to an appressed hair with two unequal or equal opposite arms (fig. 4.5-4.12 & 5.1-5.2). The one-armed form is most common. The two-armed form can be observed readily in *Burttia, Connarus, Hemandradenia* and *Vismianthus* and in some species of *Rourea.* In *Agelaea* section *Agelaea* the one-armed form is often fascicled in four (fig.5.3). The

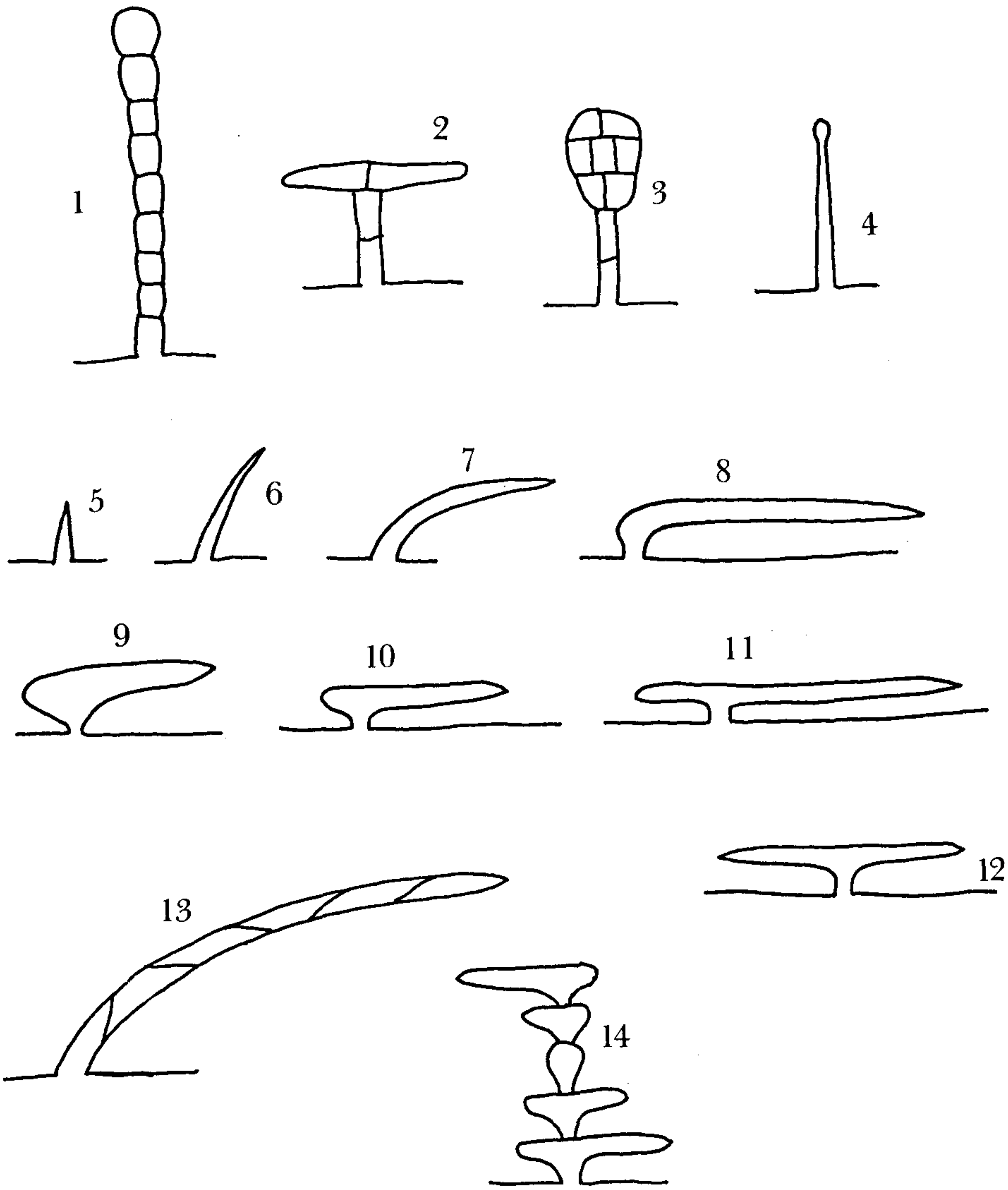


Fig. 4. Different hairtypes: 1-3. multi-cellular glandular hairs; 4. uni-cellular glandular hair; 5-12. uni-cellular non-glandular hairs; 13,14. multicellular non-glandular hairs.

long stinging hairs on the fruits of *Cnestis* species and the smaller ones on the fruits of *Agelaea borneensis* are a modification of this hair type. These stinging hairs differ from the usual hairs by their more rigid cell wall and their decreasing diameter from the middle down to the base.

4. A hair type consisting of a chain of the above mentioned two-armed unicellular hairs is exclusively found in many *Connarus* species (fig. 4.14). It resembles a miniature spiral staircase. This hairtype has not been observed in African *Connarus* species.

5. The fifth type is a multicellular hairs of one cell wide that looks like the one-armed form of type 3 (fig. 4.13). The walls between the cells are perforated and are orientated in sharp angles to the direction of the hair. The indumentum of *Jollydora* consists of this type mixed with type 1.

6. This type consists of more than a hundred cells and it is many cells wide and long. The cells are stretched lengthwise. It is up to a few cm long and is usually flattened. It stands erect on branches, petioles, and rachis, and it is exclusively found in *Rourea parviflora* (see note 2 under this species).

4.4 Leaves

by C.C.H. Jongkind

Connaraceae are evergreen or deciduous. The leaves are always alternate, exstipulate, and exstipellate. Most genera and species have pinnate leaves. In *Agelaea*, *Pseudoconnarus*, and in some species of *Connarus* the leaves are trifoliolate, and unifoliolate leaves are characteristic for *Burttia*, *Ellipanthus*, *Hemandradenia*, and *Vismianthus*. The petiole is always pulvinate at the base and the petiolules are entirely so. In the unifoliolate species this implies that petioles have a pulvinus at the base and at the apex. The leaflets are always entire, and they may be opposite or not. They are chartaceous to coriaceus. In many species the apex is mucronate, and in *Hemandradenia*, *Vismianthus*, and many species of *Connarus* glands can be found in the surface. The nervation is open except in *Manotes* where it terminates in a closed pattern of very fine parallel veinlets.

4.5 Leaf epidermis and stomatal patterns

by C.C.H. Jongkind

4.5.1 Introduction

In *Connaraceae* the pattern of the stomata in the epidermis is a useful additional taxonomic character. It is often rather easy to recognize and it enables us, in combination with other leaf characters, to identify sterile samples down to species or at least to genus level (see tab. 23). It has been an important tool in the clustering of the South American species of *Rourea* (presented on pag. 368). It also reflects affinities between the taxa.

Apart from the stomata the leaf epidermis of *Connaraceae* provides four other characters of taxonomical value that are used in this revision.

First and most frequent is the presence of a papillose lower epidermis in many species of *Cnestis*, *Pseudonnarus* and *Rourea.*

Second are the mucous cells that may be present in the upper epidermis. In living specimens they are often difficult to observe, but in herbarium specimens they show as small pits in the surface. If the pits are densely distributed they are easy to recognize. They may be readily observed in the species of *Agelaea* section *Troostwykia* and in some species of *Rourea* such as *R. erythrocalyx* and less often in *R. solanderi* or *R. thomsonii.*

Third is the occurrence of a pattern of more or less parallel lines in the lower epidermis (fig. 5.4 & 6.1). This pattern is only visible through a microscope.

Fourth is a pattern of numerous small pits in the outer cell walls of the lower epidermis. They may number about a score on a single wall of one epidermis cell.

The lower epidermis of most species in the family has been investigated with the exception of a number of *Connarus* species and a few rare species of *Rourea*: *R. laurifolia*, *R. omissa*, and *R. pseudospadicea*. In *Connarus* 35 species representing all continents have been studied. As these do not show much difference in their epidermis structure, it is felt that in the other species not much differences can be expected either.

The four epidermis characters will be discussed hereafter with exception of the occurrence of mucous cells, this is macroscopical in character and is presented in the description of the species.

4.5.2 Methods

Small fragments of the leaflets of herbarium specimens were rehydrated in boiling water. Manually prepared sections were made from the lower surface. These sections were then bleached in diluted household bleach. The resulting preparations were not conserved, but of 90 preparations photographs were taken. Specimens from which such sections were photographed are indicated by !. The photographs remain available in the photograph collection of the Laboratory of Plant Taxonomy (WAG).

4.5.3 Results

The stomatal patterns encountered in *Connaraceae* are of diverse nature. The terminology by Wilkinson (1979) is used to describe the stomata. A paracytic pattern is found in *Cnestis* and some species of *Rourea*, anisocytic including helicocytic in *Agelaea*, *Cnestidium*, and some species of *Rourea*, anomo-cyclocytic in *Burttia*, *Connarus*, *Ellipanthus*, *Hemandradenia*, *Manotes*, *Vismianthus*, and again some species of *Rourea*, and bicyclic in *Jollydora* (fig. 6-14). *Rourea* is the only genus with a wide variation in stomatal patterns, therefore the results for *Rourea* are not given for the genus but in detail for sections or for particular species.

Apart from the stomatal pattern the size of the vestibule as expressed by the size of the outer ledge of the stomata can also be an important character. This ledge is particularly large and very conspicuous in all *Connarus* species and in *Rourea* section *Roureopsis*.

Within the *Connaraceae* it seems that the sequence from primitive to advanced

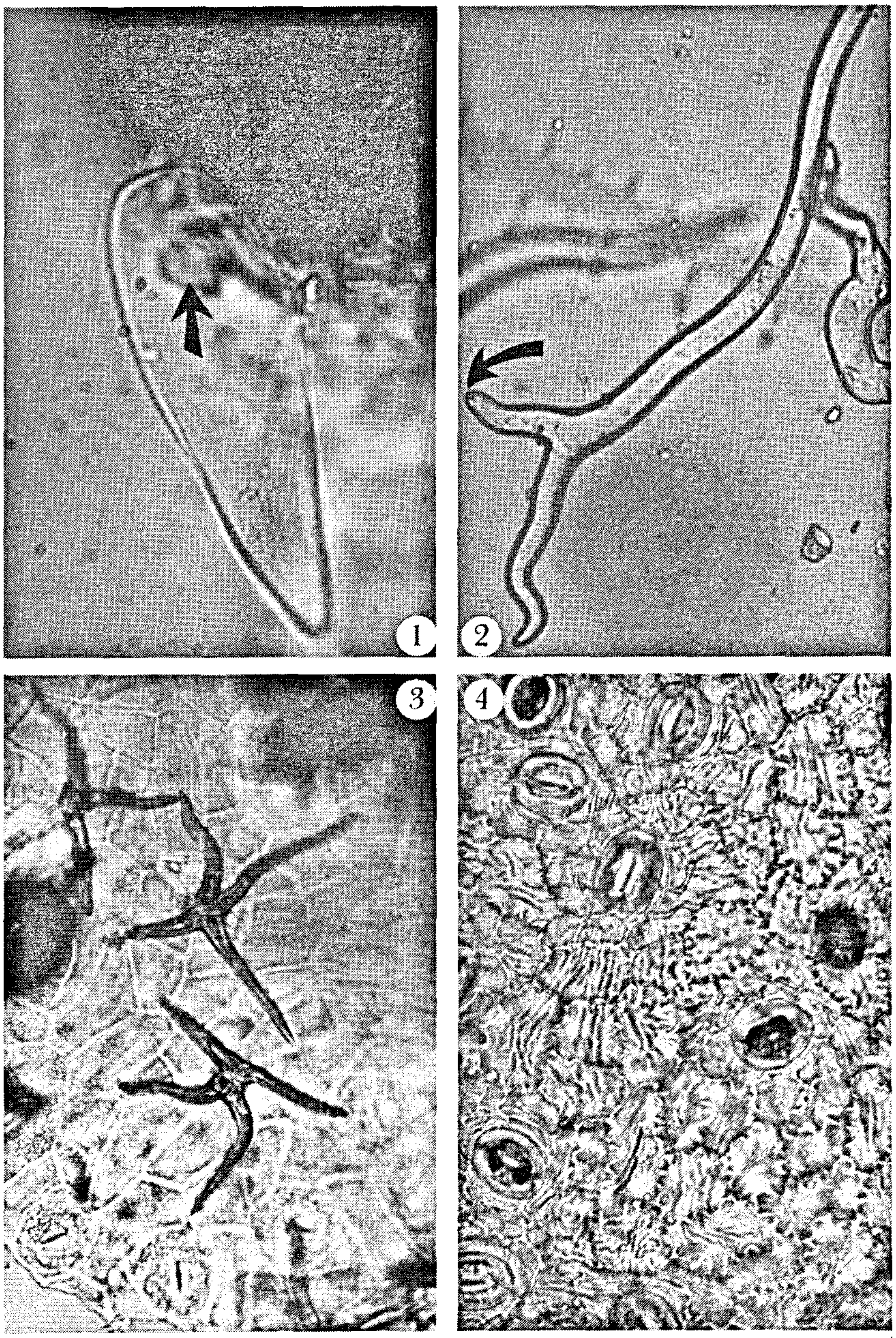


Fig. 5. Hairs and leaf epidermis: 1. *Connarus griffonianus*, unequal two armed hair (arrow pointing at the base), × 950; 2. *Connarus culionensis*, unequal two armed hair (arrow pointing at the base), × 270; 3. *Agelaea pentagyna*, fascicled hairs, × 380; 4. *Rourea calophylla*, cuticula with more or less parallel lines, × 380. (1. *J.J. de Wilde 625*; 2. *Elmer 12877*; 3. *Bos 5346*; 4. *Zenker 1963*).

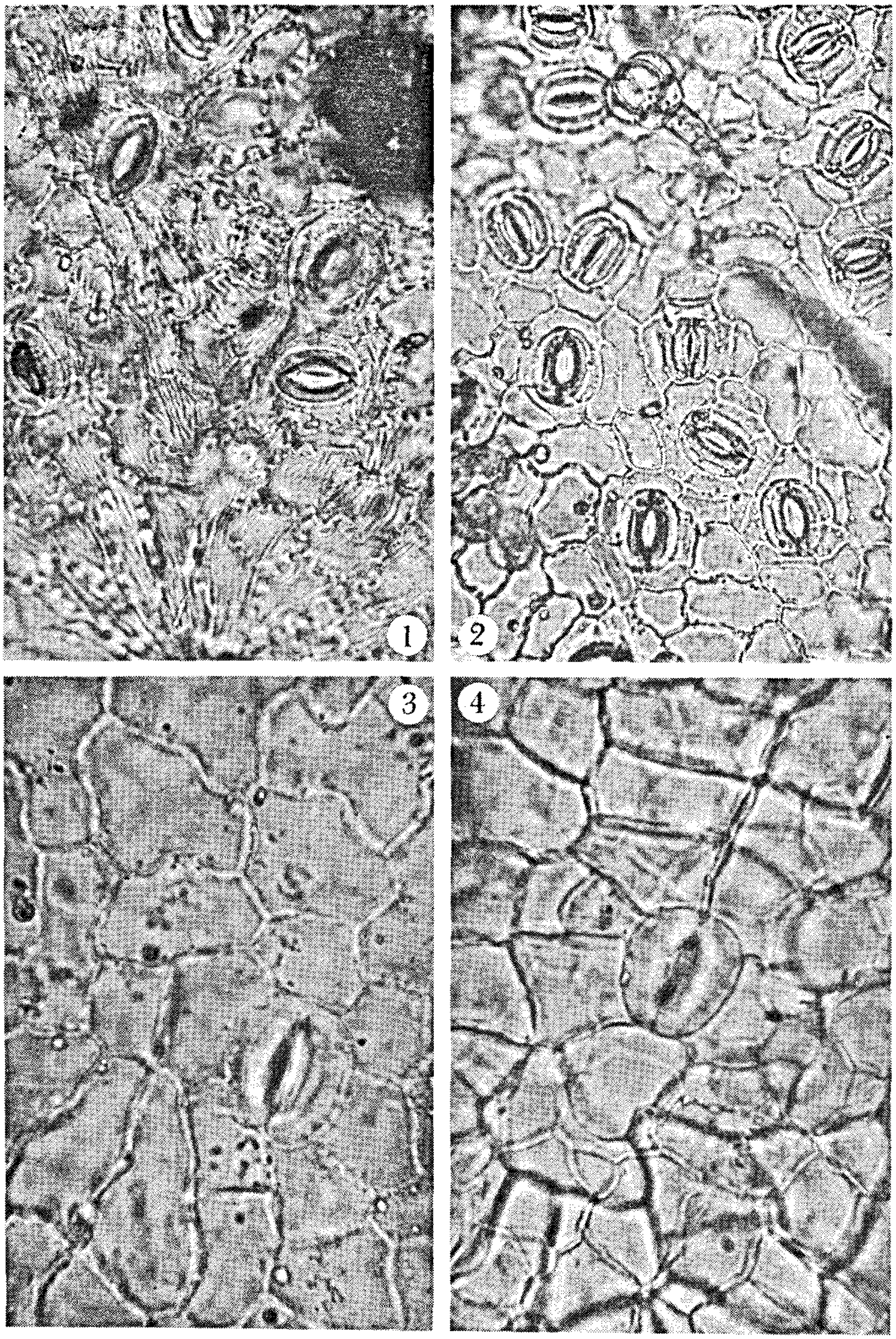


Fig. 6. Hairs, leaf epidermis, and stomata: 1. *Manotes macrantha*, cuticula with many more or less parallel lines, × 380; 2. *Manotes expansa*, stomata and glandular hair, × 380; 3. *Vismianthus punctatus*, stoma, × 950; 4. *Burttia prunoides*, stoma, × 950. (1. *Reitsma 1728*; 2. *Breteler & Lemmens 8377*; 3. *Semsei 647*; 4. *Peter 34193A*).

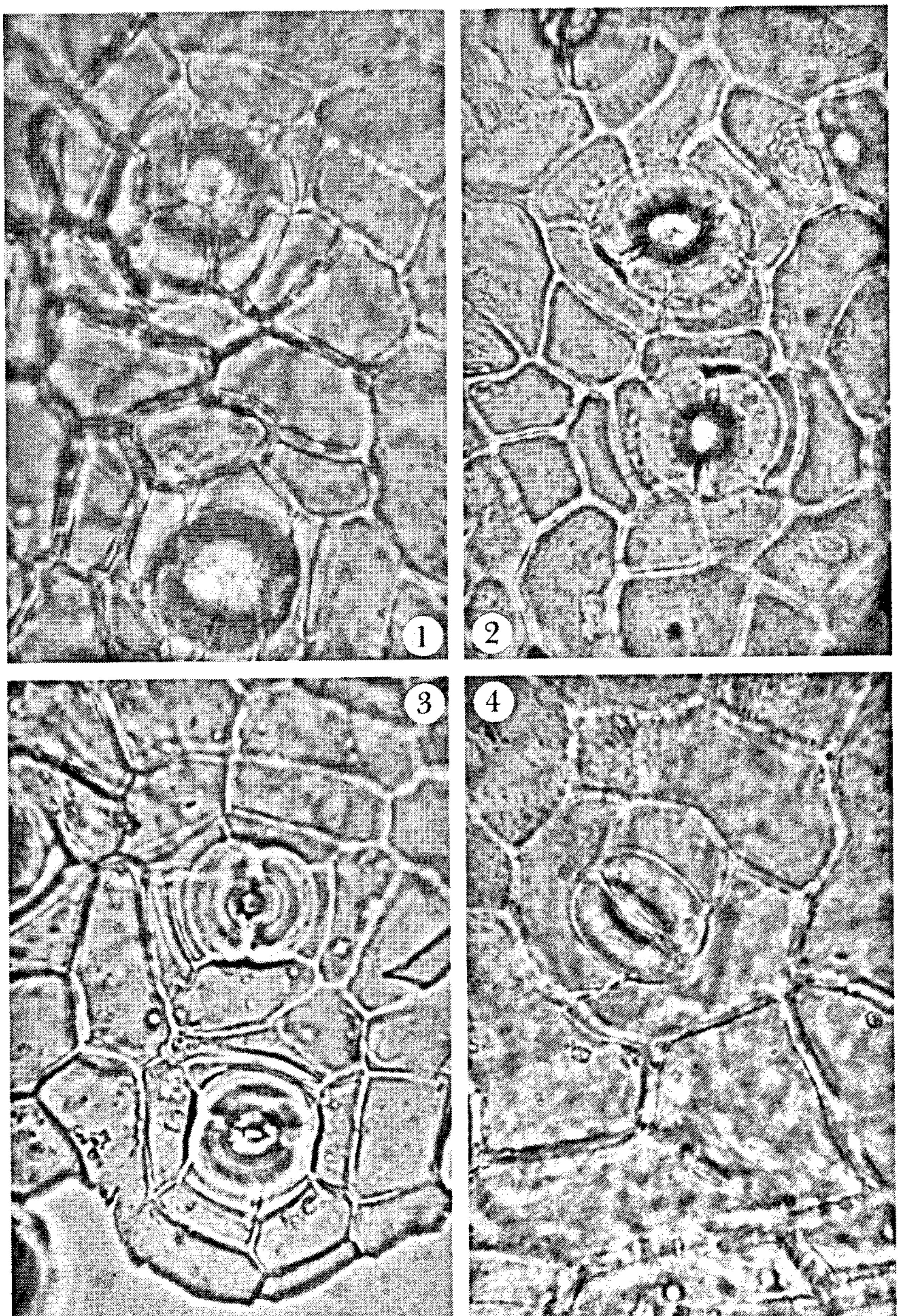


Fig. 7. Stomata: 1. *Hemandradenia mannii*, × 950; 2. *Ellipanthus hemandradenoides*, × 950; 3. *Jollydora duparquetiana*, × 950; 4. *Agelaea paradoxa*, × 950. (1. *J.J. de Wilde 8321*; 2. *Faulkner 2109*; 3. *Bos 6730*; 4. *Breteler & Lemmens 8192*).

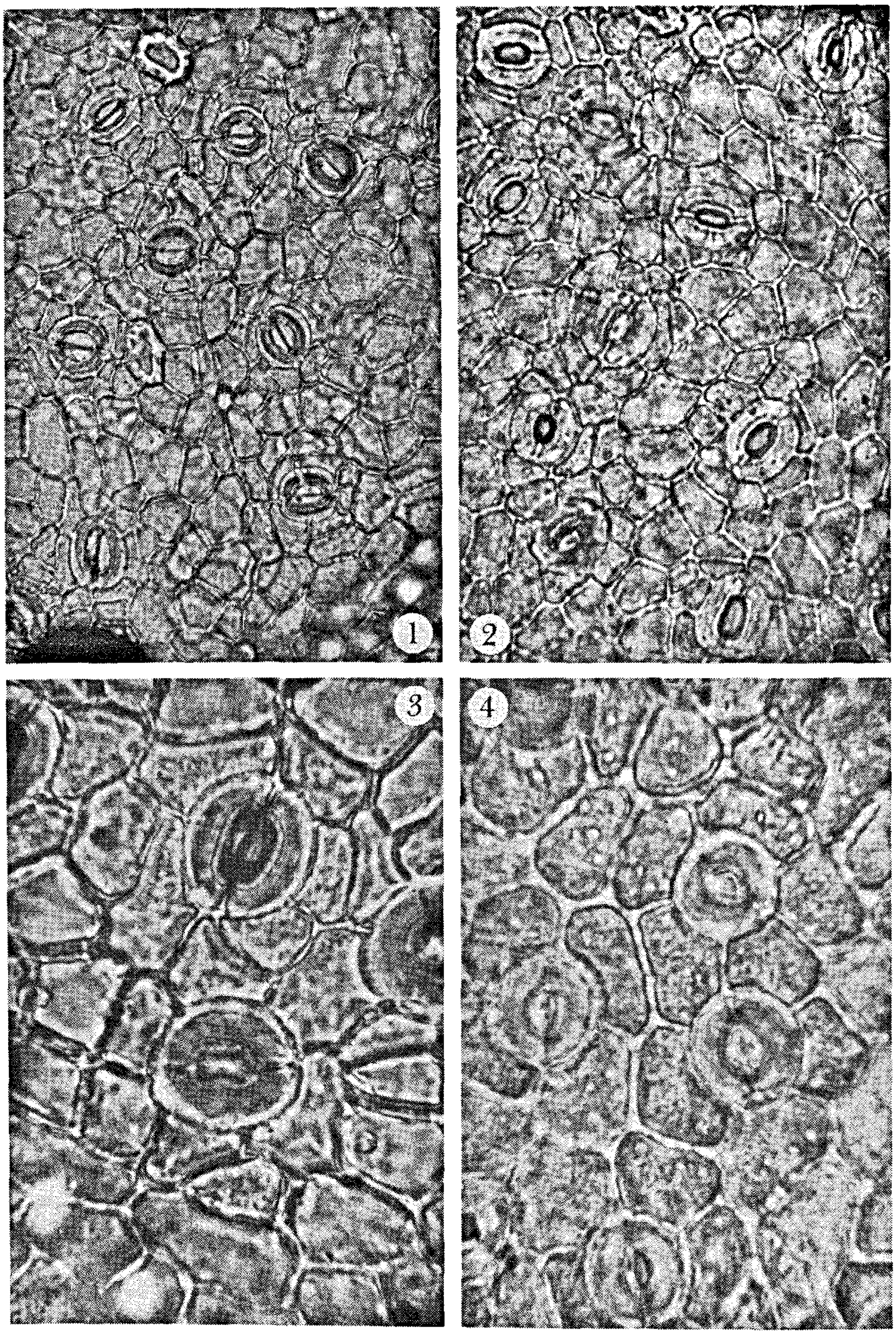


Fig. 8. Stomata: 1. *Connarus congolanus*, × 380; 2. *Connarus longistipitatus*, × 540; 3. *Connarus griffonianus*, × 950; 4. *Connarus incomptus*, × 950. (1. *Leeuwenberg 5091;* 2. *van Meer 1822;* 3. *Tisserant 1586;* 4. *Maas & Westra 3654)*.

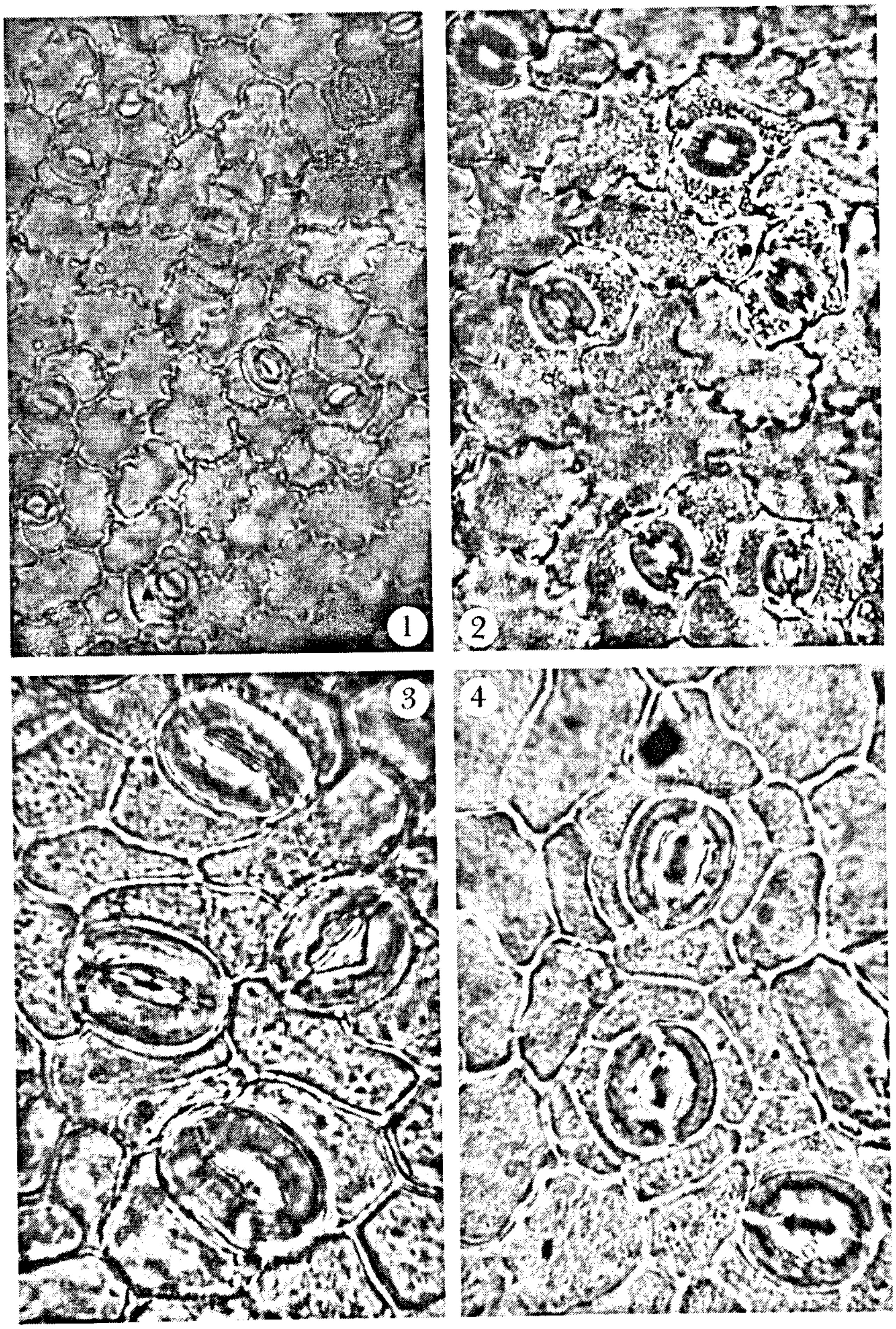


Fig. 9. Stomata: 1. *Rourea obliquifoliolata*, × 380; 2. *Rourea acutipetala*, × 540; 3. *Rourea myriantha*, × 950; 4. *Rourea calophylloides*, × 950. (1. *Breteler & Lemmens 8356*; 2. *Cockburn FRI 8493*; 3. *De Giorgi 1377*; 4. *Le Testu 5444*).

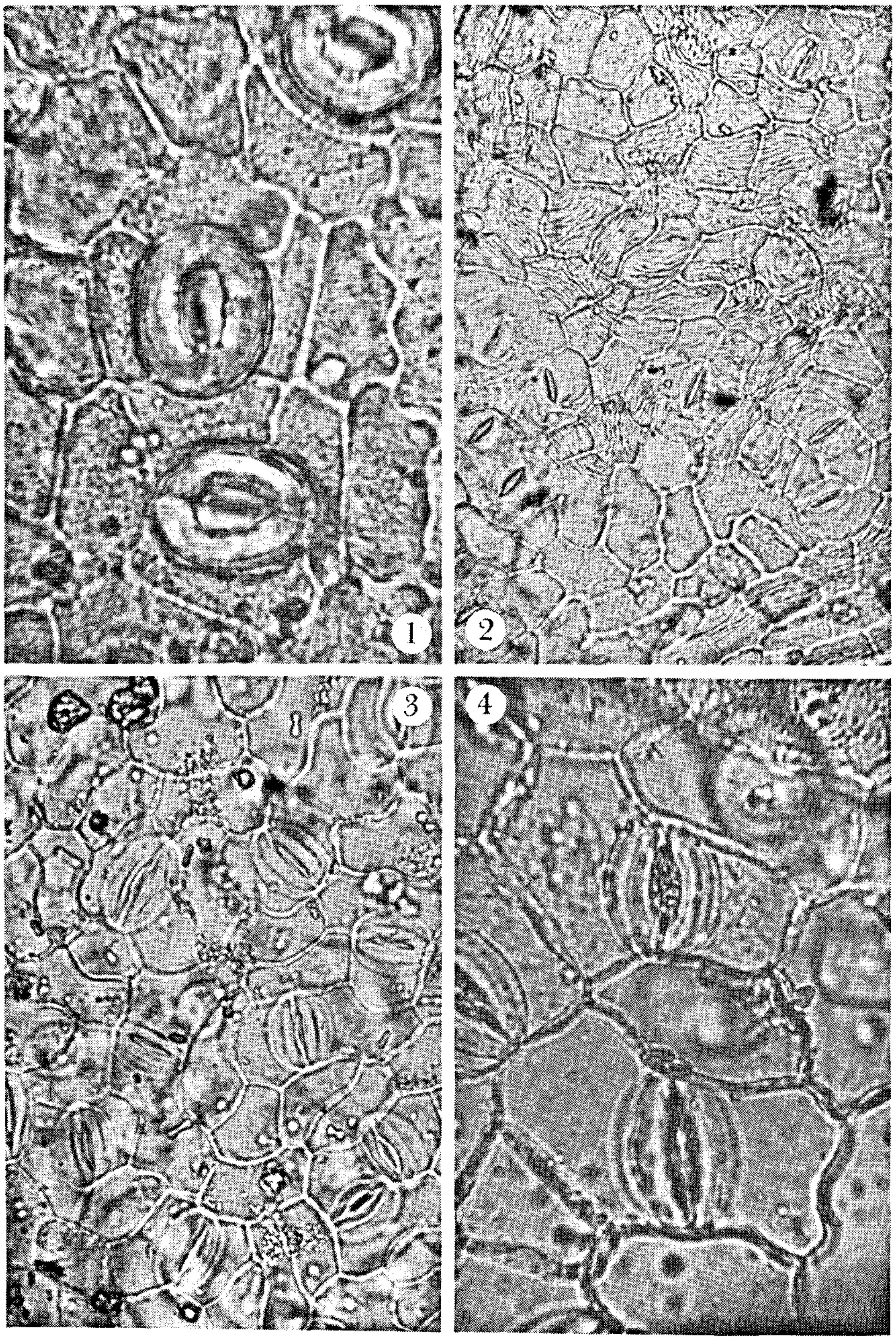


Fig. 10. Stomata and leaf epidermis: 1. *Rourea erythrocalyx*, × 950; 2. *Rourea camptoneura*, cuticula with many more or less parallel lines, × 380; 3. *Rourea fluminensis*, × 540; 4. *Rourea coccinea* subsp. *coccinea* var. *coccinea*, × 950. (1. *Reitsma 1488*; 2. *Ule 5056*; 3. *Kuhlmann 2350*; 4. *Jansen 2620*).

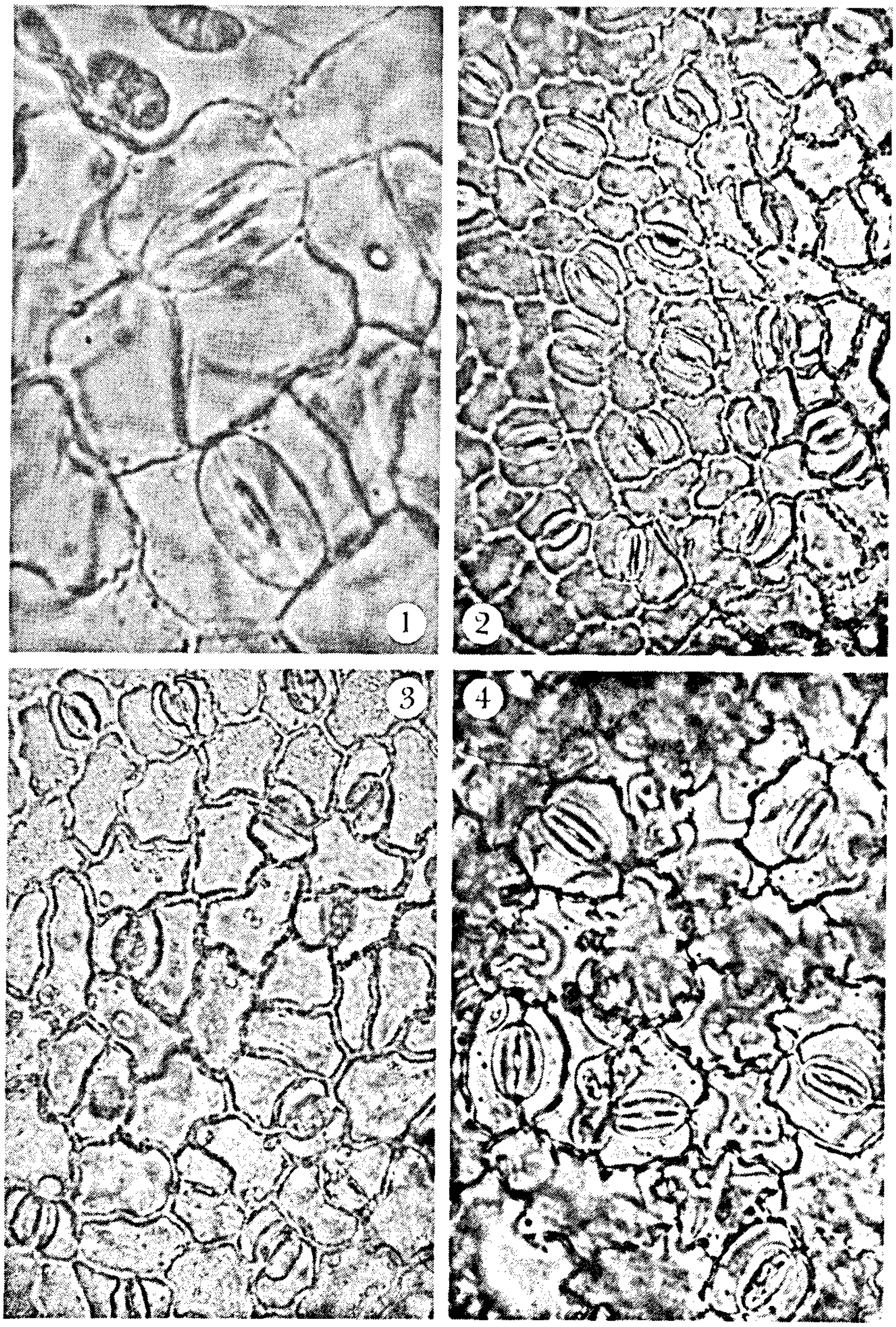


Fig. 11. Stomata: 1. *Rourea orientalis*, × 1350; 2. *Rourea minor* (Philippines), × 380; 3. *Rourea minor*, (Thailand), × 380; 4. *Rourea minor*, (Cameroun), × 540. (1. *Peter 20165*; 2. *Ramos 39603*; 3. *BKF 57548*; 4. *Bos 4940*).

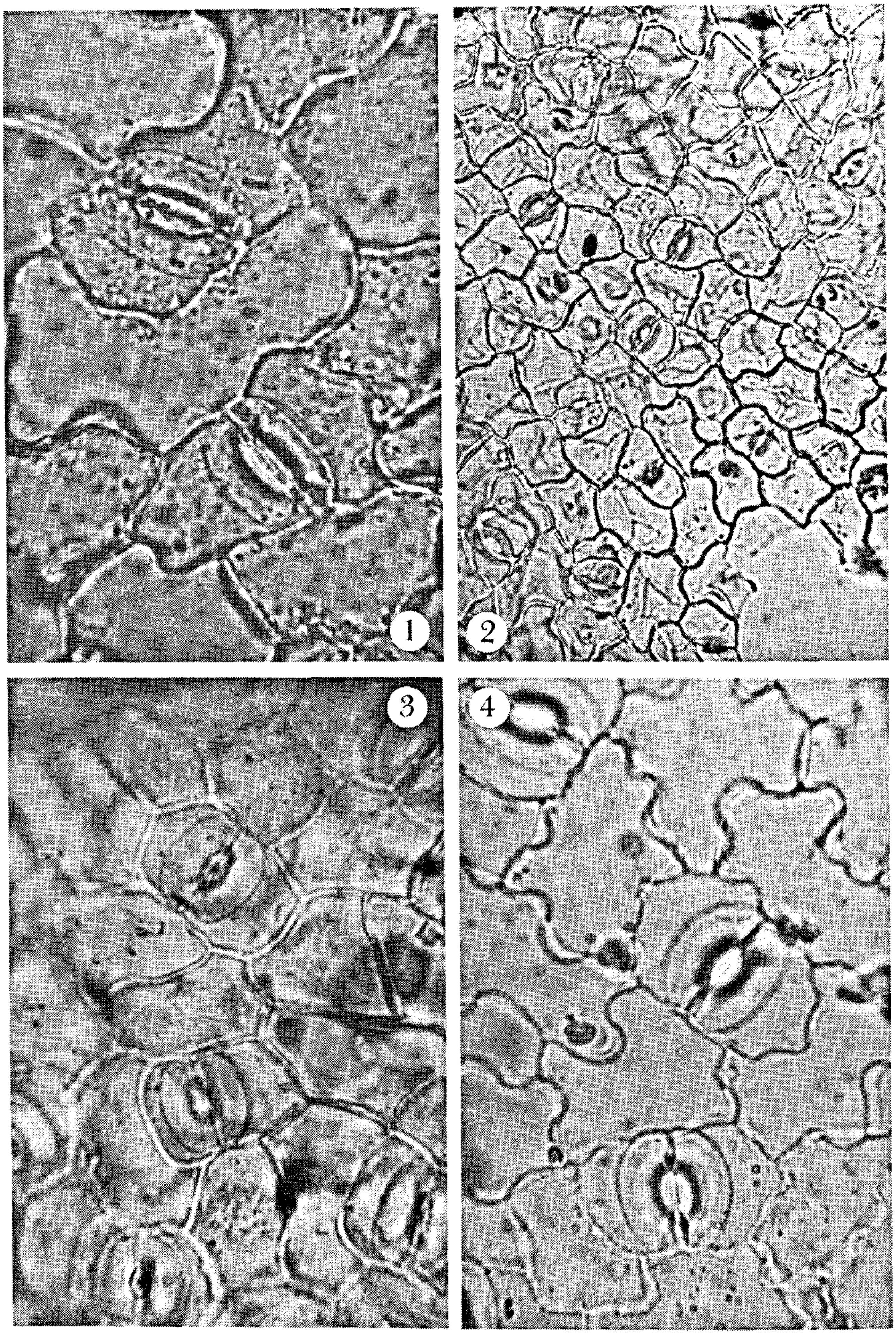


Fig. 12. Stomata: 1. *Rourea parviflora*, × 950; 2. *Cnestis racemosa*, × 380; 3. *Cnestis polyphylla*, × 950; 4. *Cnestis corniculata*, × 950. (1. *Breteler & Lemmens 8141*; 2. *Baldwin 10779*; 3. *Rakato 2907*; 4. *J. Louis 2556*).

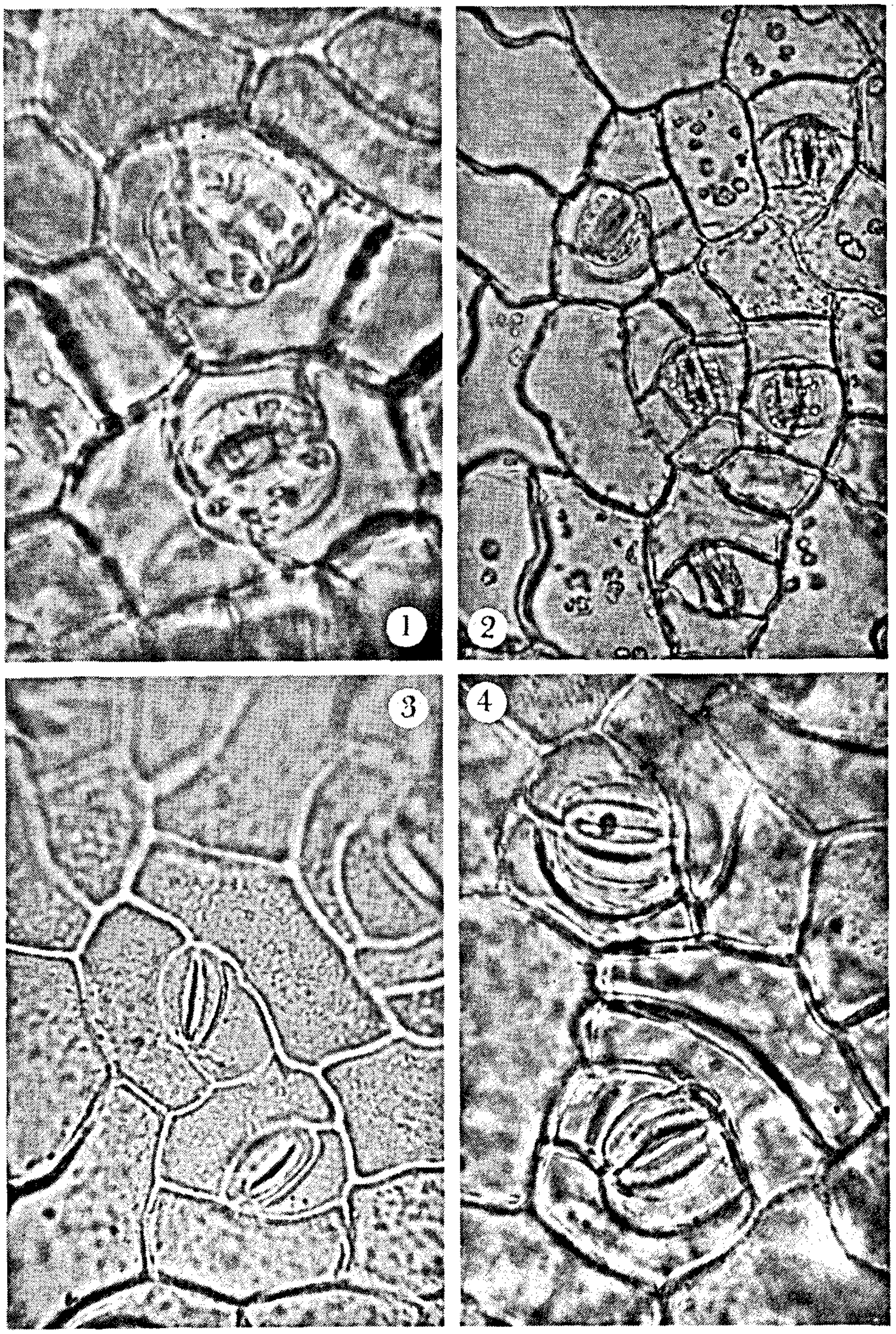


Fig. 13. Stomata: 1. *Cnestidium guianense*, × 1350; 2. *Rourea adenophora*, × 540; 3 & 4: *Rourea adenophora*, × 950. (1. *Borsboom 12265*; 2. *Dodson et al. 10001*; 3. & 4. *Croat 8447*).

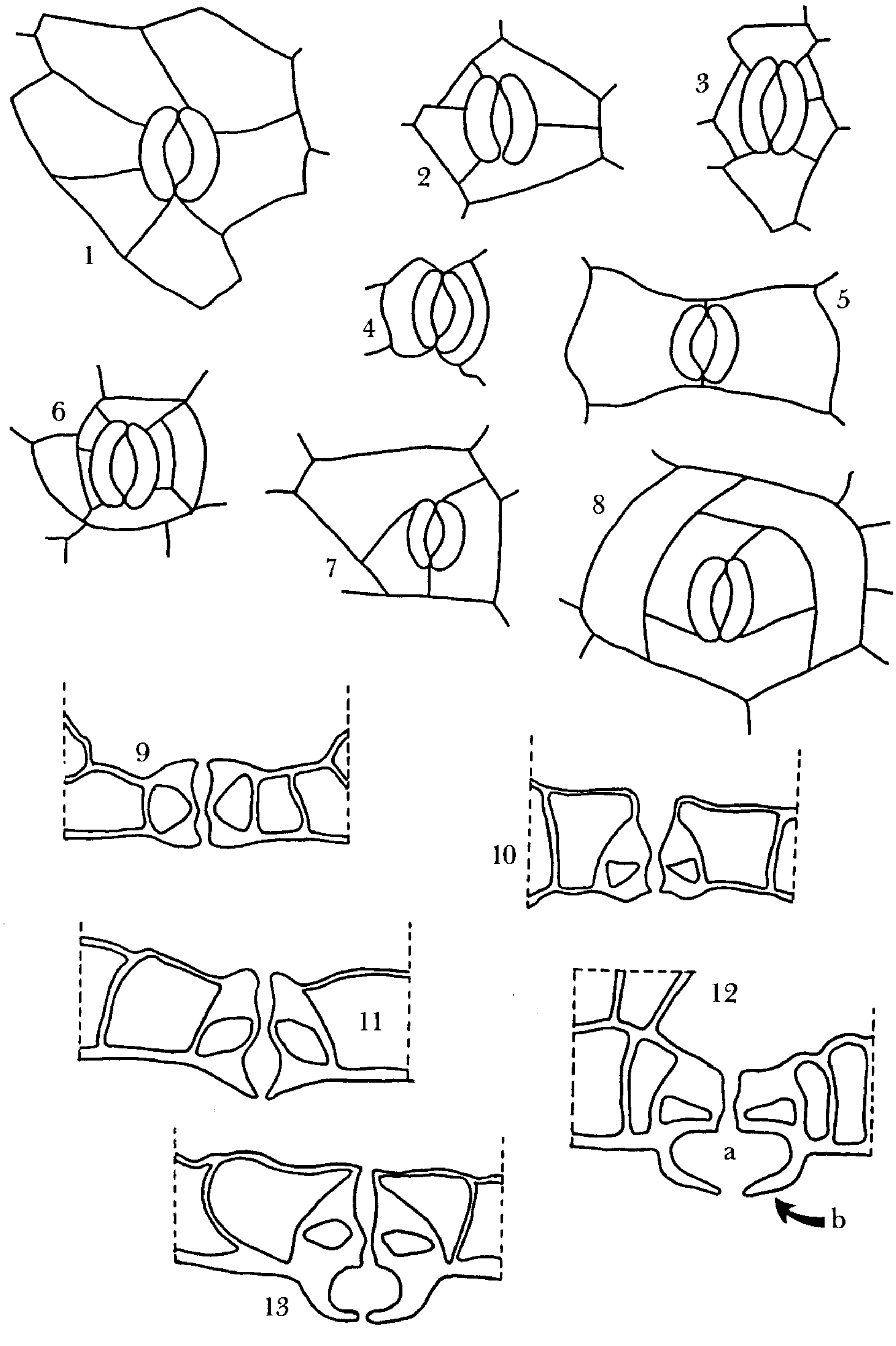


Fig. 14. Stomatal types: 1. actinocytic; 2. anomocytic; 3. cyclocytic; 4-5. paracytic; 6. bicyclic; 7. anisocytic; 8. helicocytic.

Stomata in transverse section (after Schellenberg 1910): 9. *Rourea coccinea* (*Byrsocarpus coccineus*); 10. *Cnestis ferruginea*; 11. *Manotes expansa* (*M. sanguineo-arillata*); 12. *Rourea myriantha* (*Paxia scandens*), a. vestibule, b. outer stomatal ledge; 13. *Hemandradenia mannii*.

stomata types is either from anomo-cyclocytic to bicyclic or from anomo-cyclocytic via paracytic to anisocytic and helicocytic.

The presence of a papillate lower surface is not always of taxonomical significance. This character constitutes a generic difference between *Connarus* and *Pseudoconnarus*, but in *Cnestis* and *Rourea* some species are quite indifferent regarding this character.

A pattern of more or less parallel lines in the lower epidermis has only been found in two species of *Rourea*, *R. calophylla* and *R. camptoneura* and in *Manotes macrantha*.

The taxonomical value of the pattern of many microscopical pits in the outer cell walls of the lower epidermis is still obscure. It is only found in the leaves of *Rourea prancei*, at present exclusively represented by its type specimen.

If only a single stomata type is reported, it means that 95-100% of the observed stomata of this taxon is of that type.

If appropriate the origin of herbarium specimens and species is indicated with Af. for Africa, Am. for America, and As. for Asia.

Agelaea: Stomata anisocytic, often in majority helicocytic (fig. 7.4 & 14.7-8). Vestibule small with a narrow outer stomatal ledge.

Burttia: Stomata actino-cyclocytic (fig. 6.4 & 14.1-2). Vestibule small with a narrow outer stomatal ledge.

Cnestidium: Stomata in majority anisocytic (fig. 13.1 & 14.7). Vestibule small with a narrow outer stomatal ledge.

Cnestis: Stomata almost pure paracytic (fig. 12.2 & 14.5). Vestibule small with a narrow outer stomatal ledge (fig. 14.10). Lower epidermis smooth to strongly papillate, apparently without taxonomical significance at species level.

Connarus: Stomata surrounded by 4-7 epidermal cells, which can be larger than, equal to, or smaller than the other epidermal cells (actino-, anomo- or cyclocytic) (fig. 8 & 14.1-3). It is not clear whether the shape of these cells may have any taxonomical significance for the Asiatic or American species of the genus, for the African it has not. All species studied have a wide outer stomatal ledge enclosing a spacious vestibule.

Ellipanthus: Stomata (anomo-)cyclocytic (fig. 7.2 & 14.2-3). Outer stomatal ledge medium, in size between those of *Connarus* and those of most other genera e.g. *Cnestis*.

Hemandradenia: Stomata cyclocytic with very distinctly submerged subsidiary cells (fig. 7.1 & 14.3). Outer stomatal ledge large and conspicuous, enclosing a spacious vestibule (fig. 14.13).

Jollydora: The only genus of the *Connaraceae* with pure bicyclic stomata (fig. 7.3 & 14.6). Outer stomatal ledge medium, in size between those of *Connarus* and those of most other genera e.g. *Cnestis*.

Manotes: Stomata irregularly cyclocytic, cell walls between subsidiary cells thinner than the walls between other epidermal cells (fig. 6.1, 6.2, & 14.3). Outer stomatal ledge medium in section *Manotes* (fig. 14.11). Outer stomatal ledge large in section *Dinklagea*. Epidermal cuticula of *M. macrantha* with many more or less parallel lines (fig. 6.1).

Pseudoconnarus: Stomata probably paracytic but very hard to discern because the lower epidermis cells are always strongly papillate.

Rourea section **Bernardinia** (Am.): Stomata in majority paracytic, other part anomo- cyclocytic (fig. 10.4 & 14.4-5). Vestibule small with a narrow outer stomatal ledge.

Rourea section **Byrsocarpus** (Af.): Stomata 75-100% paracytic other part anomocytic (fig. 10.4, 11.1 & 14.4-5). Vestibule small with a narrow outer stomatal ledge (fig. 14.9).

R. cassioides has a papillate lower leaf epidermis.

Rourea section **Rourea** (Af., Am., and As.): Stomata anomo-cyclocytic, paracytic, anisocytic, or partly or entirely intermediate between these three patterns (fig. 12.1, 13.2-4, & 14.2-5). Vestibule small with a narrow outer stomatal ledge. Taxa:

Rourea accrescens: Stomata 50-80% paracytic, other wise anomo-cyclocytic.

Rourea acropetala: Stomata 50-75% paracytic, other wise anomo-cyclocytic. Lower epidermis strongly papillate in the collections from Sumatra and not papillate in the collections from the continent.

Rourea blanchetiana: Stomata probably anomocytic with a strong tendency to paracytic. Cellwalls fragile and easily destroyed. Lower epidermis papillate.

Rourea camptoneura cluster: Stomata 30-70% paracytic, other part anomo-cyclocytic. Epidermis cuticula often with a pattern of more or less parallel lines (fig. 10.2).

Rourea frutescens cluster: Stomata anisocytic to anomo-cyclocytic with a strong tendency to anisocytic (fig. 13.2-4).

Rourea gardneriana cluster: Stomata 40-95% paracytic and other part anomo-cyclocytic with a tendency to paracytic.

Rourea induta cluster: Stomata anomo-cyclocytic mixed with paracytic in varying proportions.

Rourea krukovii: Stomata paracytic. Lower epidermis cells papillate.

Rourea martiana cluster: Stomata in majority paracytic, the other part anomocytic, or anomocytic with 3-6 subsidiary cells with a tendency to paracytic. Lower epidermis often papillate. Walls between epidermis cells always thin.

Rourea parviflora: Stomata paracytic (fig. 12.1).
Rourea pinnata: Stomata paracytic.
Rourea prancei: Stomata ca 80% paracytic. Epidermis with a pattern of many microscopical pits, ca 20 per epidermis cell.
Rourea pubescens: Stomata paracytic.
Rourea revoluta cluster: Stomata paracytic. Lower epidermis often papillate.
Rourea suerrensis cluster: Stomata anomo-cyclocytic.

Rourea section **Roureopsis** (Af., As.): Stomata 75-100% paracytic, other part anomo-cyclocytic in *R. acutipetala*, *R. asplenifolia*, *R. confundens*, *R. dictyophylla*, *R. emarginata*, *R. stenopetala* (fig. 9.2). Stomata cyclocytic with a strong tendency to paracytic in *R. calophylla*, *R. erythrocalyx*, *R. myriantha*, *R. obliquifoliolata*, *R. solanderi* (fig. 9.1, 9.4, & 10.1). Or stomata cyclocytic with a tendency to bycyclic and paracytic in *R. calophylloides* (fig. 9.4). All species have stomata with a large and conspicuous outer stomatal ledge enclosing a spacious vestibule (fig. 14.12).

Epidermal cuticula of *R. calophylla* with many more or less parallel lines (fig. 5.4).

Rourea section **Santaloides** (Af., As.): Stomata 90-100% paracytic (fig. 11.2-4 & 14.4-5). Vestibule small with a narrow outer stomatal ledge.

Some species with a papillate lower leaf surface like in *R. balansea*, *R. harmandiana*, *R. mimosoides*, and *R. prainiana* or without in *R. minor* and *R. rugosa*. *R. fulgens* and *R. radlkoferiana* papillate or not.

Vismianthus: Stomata anomo-cyclocytic (fig. 6.3). Vestibule small with a narrow outer stomatal ledge.

Connaraceae spec. nov. (Af.): Stomata anomo-cyclocytic.

4.5.4. *Specimens examined* (! = photograph in WAG)

Agelaea borneensis (As.): Au & Chai S.24131 (L); Axelius 382 (L).
Agelaea macrophylla (As.): Cockburn FRI 7538 !(L); Leeuwenberg 13241 (WAG).
Agelaea paradoxa (Af.): Bokdam 3348 (WAG); Breteler 1889 !(WAG); Breteler & Lemmens 8192 !(WAG).
Agelaea pentagyna (Af.): Bos 3534 (WAG); 5346 (WAG); Breteler 1738 (WAG); Chase 432 (SRGH); Decary s.n. anno 1926 (L); J.J. de Wilde et al. 247 !(WAG); Dummer 1265 (Z); Goldsmith 64-61 (SRGH); Gossweiler 8098 (COI); Lam & Meeuse 5308 (L); 5552 (L); 5838 (WAG); Leeuwenberg 11246 (WAG); Stoop v.d. Kasteele 207 (WAG); Welwitsch 4641 (K); Zenker 2271 (WAG).
Agelaea poggeana (Af.): Arends et al. 659 !(WAG); Bos 5514A (WAG); N.Hallé 1190 (P); Raimond et al. 479 (LISC); Young 454 (BM).
Agelaea rubiginosa (Af.): Breteler 1749 (WAG); Letouzey 14061 (WAG); Liben 2285 !(BR); Louis et al. 499 !(WAG); 686 (WAG); Stam 131 (L); Zenker 545 (WAG); 2543 (BR).
Burttia prunoides: Burtt 1978 (EA); Peter 34193 !(B).
Cnestidium guianense: Borsboom 12265 !(WAG); Breteler 3773 !(WAG).
Cnestidium rufescens: Coelingh 880 (U); de Bruijn 1779 (WAG).
Cnestis bomiensis (Af.): Jansen 2288 (WAG).

Cnestis corniculata (Af.): Bos 5183 (WAG); 6896 (WAG); Claessens 473 (BR); Dewevre 715B (BR); W. de Wilde 2822 (WAG); de Wit 7543 (WAG); d'Orey 386 !(COI); Leeuwenberg 4010 (WAG); 8281 (WAG); Liben 2916 (BR); J. Louis 2556 !(BR); 6957 (BR); 10516 (BR); Morton & Gledhill SL 504 (K); Mildbraed 4208 (HBG); Mullenders 2051 (BR); Pynaert 168 (BR); Sapin s.n. (Gombé) (BR); Stoop v.d.Kasteele 255 (WAG); Vanderyst 22988 (BR); van der Zon 296 (WAG); Wingfield & Lucas 1949 (K); Zenker 2157 (WAG).

Cnestis ferruginea (Af.): Bos 4252 (WAG); Breteler 1041 !(WAG); W. de Wilde 1622A (WAG); de Wit & Morton A2856 (WAG); Risopoulos 648 (BR); Thijssen 100 (WAG); van der Zon 300 (WAG); van Meer 1566 (WAG).

Cnestis macrantha (Af.): Binuyo 45402 (P); D. Thomas 3326 (WAG).

Cnestis macrophylla (Af.): Leroy s.n. (P); Zenker 947 (K).

Cnestis mannii (Af.): Binyo & Daramolo FHI 35455 (P); J.J. de Wilde et al. 253 (WAG); Le Testu 8378 !(BM); Mann 2264 (K); Talbot 1707 (K).

Cnestis mildbraedii (Af.): Dummer 5422 !(K); Eggerling 1553 (BR).

Cnestis palala (As.): Clemens 3805 (L); W. de Wilde 14512 (L); Gaudichaud 93 (L); Geesink & Hiepko 7867 (L); Griffith 1255 (L); B.Hussin S18514 (L); Shah & Samsuri MS 1738 !(L).

Cnestis polyphylla (Af.): Boivin 1888 (P); s.n. (*C. boiviniana*) (P); s.n. (*C. lurida*) (P); Faden & Faden 72/68 (EA); Rakoto 2907 !(K); Rakotozafy & Nicoll 4004 (WAG); Rudatis 1119 (WAG); van der Schijf 6217 (PRE).

Cnestis racemosa (Af.): Baldwin 10779 !(WAG); Bos 2578 (WAG); Jansen 2475 (WAG).

Cnestis uncata (Af.): Breteler & Lemmens 8304 (WAG).

Cnestis urens (Af.): Bequaert 2004 !(BR).

Cnestis yangambiensis (Af.): J. Louis 13623 (BR); Mandango 1457 !(BR).

Connarus africanus (Af.): Bos 2574 (WAG); 5347 (WAG); de Koning 5541 !(WAG); Jansen 1525 (WAG); Morton SL 616 !(WAG).

Connarus agamae (As.): Sinanggul 57255 (L).

Connarus brachybotryosus (Am.): Tuerckheim 4027 (U).

Connarus championii (As.): Waas 1919 (L).

Connarus cochinchinensis (As.): Geesink 6349 (L); Teyse 6016 (L).

Connarus conchocarpus (As.): Irvine 846 (L).

Connarus congolanus (Af.): Leeuwenberg 5091 !(WAG); Sapin D24 (BR).

Connarus coriaceus (Am.): Maas et al. 3483 (U); Schultz 7610 (U); N.T. Silva 1879 (U); A.C. Smith 3572 (U).

Connarus culionensis (As.): Elmer 12877 !(L); Leighton 102 (L).

Connarus detersus (Am.): Harley 15653 (U).

Connarus erianthus (Am.): Croat 20754 (U); Oldenburger et al. 331 (U); Pires et al. 51100 (U); Vilhena et al. 217 (U).

Connarus euphlebius (As.): James et al. S35074 (L).

Connarus fasciculatus (Am.): Prance et al. 16044 (U).

Connarus ferrugineus (As.): Lewis 128 (L).

Connarus gabonensis (Af.): Breteler & de Wilde 494 !(WAG).

Connarus grandis (As.): Elmer 14888 (L).

Connarus griffonianus (Af.): J.J. de Wilde 625 !(WAG); Gilbert 14202 (BR); Tisserant 1586 !(WAG); 1668 (WAG).

Connarus incomptus (Am.): Maas & Westra 3654 !(U).

Connarus lambertii (Am.): Cuatrecuasas 14076 (U); Lundell 19044 (U).

Connarus longistipitatus (Af.): A. Léonard 2816 (BR); van Meer 1822 !(WAG).

Connarus marlenei (Am.): Prance et al. 11242 (U).

Connarus monocarpus (As.): Kostermans 24846 (L); 28060B (L); Robyns 6974 (L).

Connarus odoratus (As.): Chai S19704 (L); Elmer 21058 (L).

Connarus ovatifolius (Am.): Harley 17399 (U).

Connarus paniculatus (As.): Geesink et al. 6787 (L).

Connarus perrotteti (Am.): Prance et al. 25769 (U); A.C. Smith 2817 (U).

Connarus punctatus (Am.): N.T. Silva 2411 (U).

Connarus regnellii (Am.): Mendes Magalhaes 19264 (U).

Connarus reticulatus (Am.): Howard 5848 (U).
Connarus rigidus (Am.): Steyermark & Bunting 102467 (U).
Connarus ruber (Am.): Croat 20017 (U).
Connarus salomoniensis (As.): Kajewski 2017 (L); Whitemores collectors BSIP 2881 (L).
Connarus semidecandrus (As.): Elsener H90 (L); Langlasse 248 (L); Maxwell 75-509 (L); Sörzing 5272 !(L).
Connarus staudtii (Af.): Klaine 1961 !(P); Leeuwenberg 5622 (WAG).
Connarus suberosus (Am.): Fosberg 43291 (U); Hunt 6119 (U).
Connarus thonningii (Af.): Warnecke 446 !(K).
Connarus winkleri (As.): Elmer 13411 !(L); Leopold & Kodoh SAN 81387 (L).
Connarus spec. Nw Guinea: Pullen 8266 (L).
Ellipanthus beccarii (As.): J. Singh SAN 22777 (L).
Ellipanthus hemandradenoides (Af.): Faden 74/292 (WAG); Faulkner 2109 !(BR).
Ellipanthus tomentosus (As.): Koorders 24160B (L).
Hemandradenia chevalieri: de Wit 9020 (WAG).
Hemandradenia mannii: J.J. de Wilde 8321 !(WAG); Koufani 153 (WAG); Léonard 583 (WAG); Raynal 10751 (YA); Wagemans 1543 (BR).
Jollydora duparquetiana: Bos 6730 !(WAG); J.J. de Wilde 309 (WAG); Zenker 3438 (E).
Jollydora glandulosa: Letouzey 13416 (P).
Jollydora pierrei: Klaine 2884 (P).
Manotes expansa: Allard 212 (BR); Breteler & Lemmens 8377 !(WAG).
Manotes griffoniana: Louis et al. 1088 (WAG).
Manotes lomamiensis: Delvaux 341 (BR); Gillardin 213 (BR).
Manotes macrantha: Breteler et al. 8715 (WAG); Breteler 9012 (WAG); de Wilde & Jongkind 9330 (WAG); Jansen 2400 !(WAG); Reitsma 1728 !(WAG).
Pseudoconnarus macrophyllus: Wessels Boer 2336 (U).
Pseudoconnarus rhynchosioides: Krukoff 8304 (NY).
Rourea accrescens (Am.): Krukoff 6795 (U); Mori et al. 9091 (K); Prance et al. 2853 (NY).
Rourea acropetala (As.): Bartlett 8161 (L); Chevalier 37426 (P); Clemens 3365 (P); Rahmat si Toroes 2342 (L); 4912 (L); Harmand in Herb. Pierre 3292 (L).
Rourea acutipetala (As.): Cockburn FRI 8493 !(L); P. Sangkhachand 1221 (L).
Rourea adenophora (Am.): Allen 887 (K); Croat 8447 !(MO); Dodson et al. 10001 !(MO).
Rourea amazonica (Am.): Prance et al. 59302 (U); Ule 5054 (L).
Rourea antioquensis (Am.): Metcalf & Cuatrecasas 30045 (MO).
Rourea araguaensis (Am.): Agostini & Farinas 29 (U).
Rourea asplenifolia (As.): Korthals in Herb. Bogor 1920 (L); H.Wiriadinata 707 (L).
Rourea bahiensis (Am.): Pinheiro 1656 (NY).
Rourea balansea (As.): McKee 4443 (L).
Rourea blanchetiana (Am.): Salzmann s.n. (P).
Rourea calophylla (Af.): Breteler et al. 8634 (WAG); Klaine 3319 (P); Le Testu 6415 (WAG); Zenker 1963 !(WAG).
Rourea calophylloides (Af.): Le Testu 5444 !(BM).
Rourea camptoneura (Am.): Boom 4034 (U); Krukoff 1660 (U); 4899 (U); 4906 (U); 6289 (U); 7004 (U); Prance et al. 12933 (U); 13360 (U); 13704 (U); Rushby 1360 (K); 1370 !(K); Spruce 2168 (K); Ule 5056 !(K).
Rourea cassioides (Af.): Compere 1160 (BR); W. de Wilde 2637 (WAG); Jongkind 707 (WAG); Le Testu 4645 (WAG); Lisowski 40462 !(BR).
Rourea chrysomalla (Am.): Irwin & Soderstrom 6001 (K); Mori et al. 10532 (K).
Rourea cnestidifolia (Am.): Warming 1849 (K).
Rourea coccinea ssp. *coccinea* var. *coccinea* (Af.): de Koning 6974 (WAG); Jansen 2620 !(WAG); Morton SL 1329 (WAG).
– ssp. *coccinea* var. *viridis* (Af.): Leeuwenberg 11426 !(WAG); Lisowski 17404 !(BR); A.Louis et al. 1325 (WAG).
– ssp. *boiviniana* (Af.): Gomes & Sousa 4638 (WAG); 4680 !(WAG); Kuchar 13484 (EA); Musyoki & Hansen 1022 (EA).

Rourea confundens (As.): Larsen et al. 32221 (L).
Rourea cuspidata (Am.): Bamps 5388 (BR); Krukoff 8375 (U); Prance et al. 2508 (U); 15034 (U); Spruce 1901 (K); 1924 (K); 2036 (K); 2376 (K); 3273 (K).
Rourea dictyophylla (As.): King 5425 (L).
Rourea discolor (Am.): Duarte 6118 (NY); Riedel s.n. anno 1821 (NY).
Rourea doniana (Am.): Don 41 (BR); Moore 291 (BM).
Rourea duckei (Am.): Pires et al. 50895 (K).
Rourea emarginata (As.): Bakhuizen v.d. Brink 7697 !(L); Boerlage s.n. (L); Rahmat si Toroes 3369 (L).
Rourea erythrocalyx (Af.): Breteler et al. 7696 (WAG); Le Testu 6081 (BM); 7651 (WAG); Reitsma 1488 !(WAG); Toussaint 242 (BR).
Rourea fluminensis (Am.): J.G. Kuhlmann 2350 !(NY); Pires & Black 3242 (U); Ule 2405 !(U).
Rourea frutescens (Am.): Broadway 5791 (K); De La Cruz 2719 (K); Maguire & Fanshawe 22910 (U); Melinon anno 1842 (U); Prance et al. 1688 (U); Steyermark 87419 (U).
Rourea fulgens (As.): Falconer 560 (L); Y.C. Chan FRI 18183 (L).
Rourea gardneriana (Am.): Gardner 962 (K); Ratter et al. 4496 (K).
Rourea glabra (excl.S Brasil) (Am.): Aristeguieta 7051 (U); de Bruijn 1399 (WAG); Ekman 10428 (K); 17387 (K); Gentle 636 (K); 7615 (BM); Harris 11981 (K); Holm & Iltis 266 (K); Howard 5625 !(U); Jellez 1926 (BM); I. Johnston 485 (U); Mc Fadyem s.n. (K); Mexia 9248 (U); Novelo et al. 211 (U); Proctor et al. 24862 (U); 27238 (U); 36267 (U); Steyermark & Allen 17175 (U).
Rourea glabra (S Brasil only): Luschnath s.n. (H.Fl.Br. 1267) !(BR).
Rourea glazioui (Am.): Simard in Herbarium Glaziou 3625 (P).
Rourea gracilis (Am.): Hatschbach 20829 (WAG); 26944 (K).
Rourea grosourdyana (Am.): Eiten & Eiten 8496 (K); Prance et al. 9152 (U); 9563 (K); A. Smith 3149 (U); Ule 7898 (K).
Rourea harmandiana (As.): Harmand in herb. Pierre 6371 (L).
Rourea induta (Am.): Argent R.6781 (U); Argent et al. 6518 (U); Burchell 8394 (K); Goldsmith 125 (K); Irwin et al. 10542 (U); 16637 !(K); Prance et al. 18852 (U).
Rourea kappleri (Am.): Oldenburger et al. 1264 (U).
Rourea krukovii (Am.): Maguire et al. 56706 (U); Prance et al. 10658 (K).
Rourea latifoliolata (Am.): Allen & Allen 5242 (MO); Kennedy 2006 (MO).
Rourea ligulata (Am.): Archer 7920 (K); Burchell 9449 (K); 9981 (K); Rosa et al 4103 (U); Tutin 357 (K).
Rourea martiana (Am.): Rose & Russell 19932 (NY).
Rourea mimosoides (As.): Beumée 6728 (L); Hansen & Smitinand 12489 (L); Maxwell 82/203 (L).
Rourea minor (Af.): Bos 4940 !(WAG); De Graer 157 (BR); Espirito Santo 2674 (WAG); Lisowski 51507 (BR); Pierlot 840 (BR); Quarre 5820 (BR). (As.): BKF 57548 !(L); Kostermans 28060A (L); Ramos 39603 !(L); Vidal 720 (P).
Rourea myriantha (Af.): De Giorgi 1377 !(BR); de Wilde et al. 8071 (WAG); Donis 2140 (BR); Germain 4743 (BR); J. Louis 12097 (BR); Zenker 3720 (P).
Rourea neglecta (Am.): Spruce 2952 (BR).
Rourea obliquifoliolata (Af.): Badre 147 (WAG); Breteler & Lemmens 8356 !(WAG); J.J. de Wilde 8438A (WAG); Louis et al. 515 (WAG); 938 (WAG).
Rourea orientalis (Af.): Malaisse 11181 (BR); Pawek 5057 !(SRGH); Peter 20165 !(B).
Rourea paraensis (Am.): Campbell et al. P22419 (U); Prance et al. 1835 (U); 22903 (U).
Rourea parviflora (Af.): Breteler & Lemmens 8141 (WAG); A. Léonard 2879 (WAG); Louis et al. 1497 (WAG); J. Louis 2722 (BR); Mann 1795 (P); Tisserant 1555 (BM); Zenker 540 (WAG).
Rourea pinnata (As.): Ramos 1485 (L).
Rourea pittieri (Am.): Alonzo et al. 5105 !(MO); Duke 15710 !(MO); Sullivan 670 !(MO).
Rourea prainiana (As.): Sinclair 38691 (L); Whitemore FRI 12903 (L).
Rourea prancei (Am.): Prance & Silva 58625 (NY).
Rourea psammopphila (Am.): Burchell 7880 (K).
Rourea puberula (Am.): Croat 19242 (WAG); Krukoff 1655 (K); Maguire 56884 (K); Steinbach 6735 !(U); 7608 (U).

Rourea pubescens (Am.): Sagot s.n. (K); Talbot s.n. (K).
Rourea radlkoferiana (As.): Hollrung 766 (L).
Rourea revoluta (Am.): V. Graham 458 (K); Schomburgk 125 (K).
Rourea rugosa (As.): Everett FRI 14229 (L).
Rourea schippii (Am.): Peck 889 (K); Schipp 1168 (K).
Rourea solanderi (Af.): Baldwin 11310 (WAG); Bos 5238 (WAG; 5274 !(WAG); 6156 (WAG); de Koning 3457 (WAG); Jansen 776 (WAG); Stoop v.d. Kasteele 219 (WAG); Zenker 2540 (WAG).
Rourea sprucei (excl.var. *rondonensis*) (Am.): Krukoff 8719 (U); Prance et al. 3256 (K); 10072 (K); Spruce 2760 !(BR).
Rourea sprucei var. *rondonensis* (Am.): Prance et al. 8458 (K); 8951 (K).
Rourea stenopetala (As.): Beusekom 2930 (L); Geesink et al. 5337 (L); 6783 (L).
Rourea suerrensis (Am.): Pittier 16103 (BM); Smith 6466 (K).
Rourea surinamensis (Am.): Breteler 4963 (WAG); Broadway 1891 (K); de Bruijn 1650 (WAG); Eggers 1246 (K); Ekman 11109 (K); Florschutz & Maas 2757 (U); Howard & Nevling 15486 (U); Lindeman et al. 730 (U); Maas et al. 5553 !(U); Sandwith 183 (U); Sintenis 5728 (WAG); Steyermark 88447 (U).
Rourea tenuis (Am.): Pohl s.n. (BR).
Rourea thomsonii (Af.): Bos 4579 (WAG); de Koning 2857 !(WAG); J. de Wilde 405 !(WAG); Schlieben 2794 (B).
Vismianthus punctatus: Schlieben 5757 (B); Semsei 647 !(K).
Vismianthus sterculiaefolius: Prain s.n. anno 21 Nov. 1889 (BM).
Connaraceae spec. nov. (Af.): Hallé 1727 !(P) see imperfectly known species (pag. 375)

4.6 Inflorescences

by R.H.M.J. Lemmens

The inflorescences of *Connaraceae* are basically axillary panicles. They are often located in the axils of rudimentary or very young leaves situated towards the apex of young branches. This often gives the impression of a compound terminal inflorescence, particularly in *Manotes* (fig. 15), *Agelaea*, *Pseudoconnarus*, *Connarus*, and some *Cnestis* and *Rourea* species (Fig. 16 A).

In many *Connarus* species the upper leaves of the main and lateral branches are reduced, forming a very large, strongly compound pseudoterminal inflorescence. The actual inflorescences are small and few-flowered. The leaves situated at the base rarely develop more or less normally, showing the true nature of this inflorescence, as in a specimen of *Connarus africanus*, *Roberty 10749* (Fig. 16 B).

Terminal inflorescences, as described by Schellenberg (1938) for many species in the larger part of the genera, and by Leenhouts (1958b) for *Connarus* and *Agelaea*, are not found in *Connaraceae*. Branches resembling a terminal inflorescence are always ending in a vegetative bud, that sometimes continues the branch after flowering, but it usually shrivels. Schellenberg (1938) considered the position of the inflorescence, either axillary or terminal, as very important in order to distinguish genera and even tribes in *Connaraceae*. The absence of true terminal inflorescences in the family seriously undermines Schellenberg's classification in tribes (see also paragraph 10.1 on phylogeny of the family).

Fig. 15. *Manotes griffoniana*: branch with axillary panicles (*J. de Wilde & Jongkind 9589*; phot. C.C.H. Jongkind).

In *Ellipanthus*, *Hemandradenia*, *Burttia* and *Vismianthus* the inflorescences are always located in the axils of normal developed leaves, in the last two genera more particularly at the apex of the branchlets (Fig. 16 C).

The panicles are often reduced to pseudoracemes, e.g. in some *Cnestis* species. In *Cnestis urens* and *C. uncata* this reduction even results in single-flowered inflorescences. Occasionally the peduncle and axis of the panicle are so strongly reduced in length that the flowers form glomerules, as in *Hemandradenia mannii* and *Rourea obliquifoliolata*. In the latter species the glomerules are located particularly on the very long whip-like extremities of branches without well-developed leaves (Fig. 16 D).

In many species apparently more than one inflorescence is located in a single leaf axil. In some species this may be interpreted as a single panicle with a

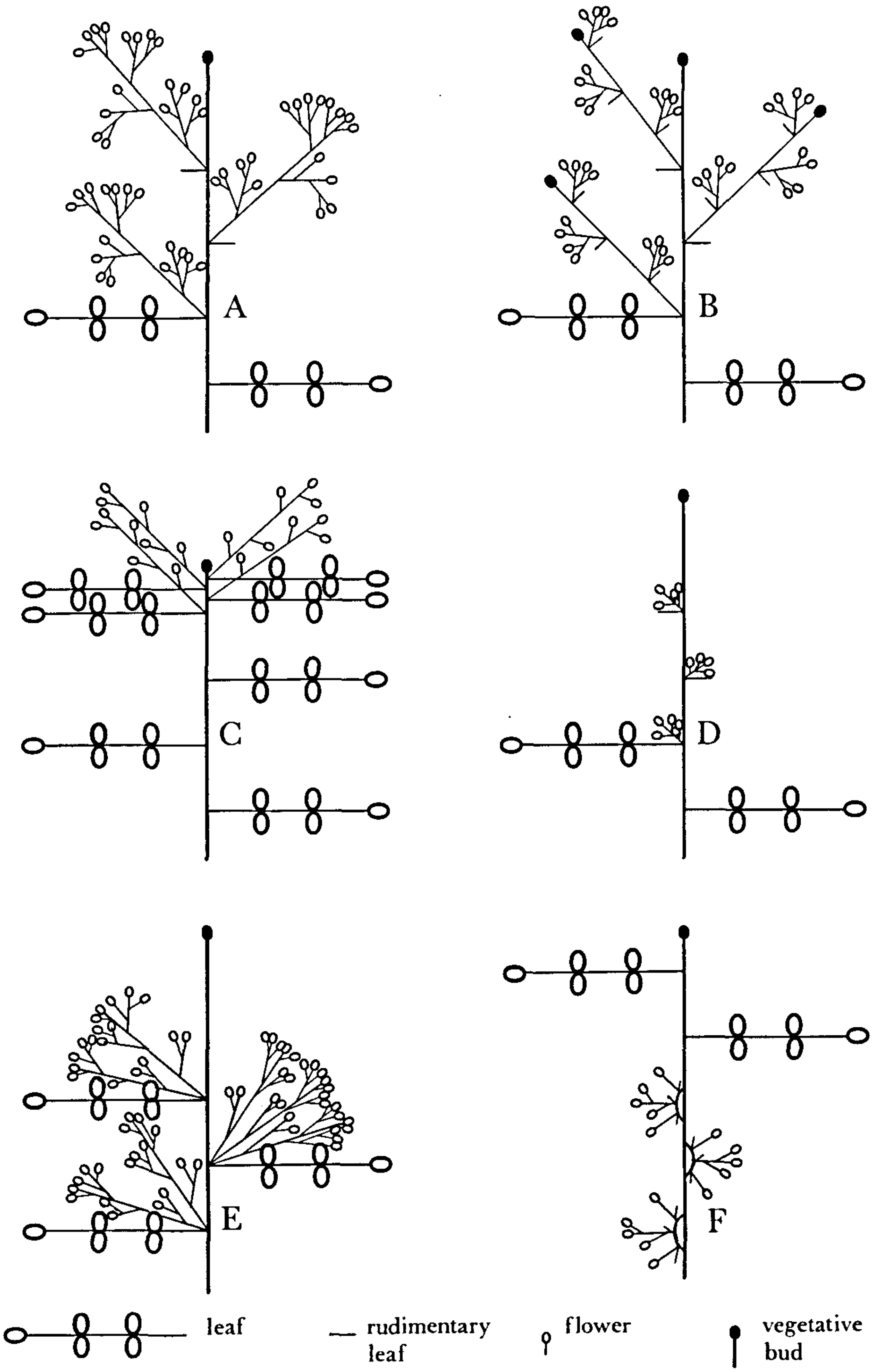


Fig. 16. Different types of inflorescences in *Connaraceae*. For explanation see text.

strongly reduced peduncle and axis, while the developed branches look like separate inflorescences, e.g. *Rourea minor* and *Ellipanthus hemandradenioides*. In other species this may be the result of the reduction of an entire lateral branch maintaining its inflorescences in the axils of reduced leaves, e.g. *Cnestis* and *Rourea* species (Fig. 16 E).

In cauliflorous species such completely reduced lateral branches produce the inflorescences. This is also known in other cauliflorous species such as *Cercis* (*Leguminosae*) and is found in *Jollydora*, *Cnestis urens*, *C. uncata*, *C. corniculata*, *Rourea calophylloides*, and *Manotes macrantha*. As flowering in these species occurs each year again on the same spot, large nodose proliferations are formed, that bear the flowers (Fig. 16 F).

In *Cnestis* large pseudoterminal panicles are considered as primitive, while cauliflory is advanced (see also paragraph 10.2 on phylogeny of *Cnestis*).

4.7 Flowers

by C.C.H. Jongkind

Connaraceae have flowers with five sepals, five petals, ten stamens in two whorls and either one or five carpels. All species are probably sweet scented and pollinated by insects (H.G. Baker, 1962: 208; Schellenberg, 1938: 11). Most species have a jointed pedicel.

The sepals are glabrous or hairy on one or both sides. They are valvate in *Manotes* and more or less in species of *Cnestis, Connarus, Ellipanthus* and *Hemandradenia*. They are imbricate in all other species. In *Rourea solanderi* they are almost entirely united, in all other species of the family the sepals are free or nearly free. They are quite often persistent and in *Rourea* and *Manotes* they are accrescent in fruit.

The petals are glabrous or hairy on the outside or on both faces. They may have glandular hairs and in *Connarus*, *Manotes* and *Vismianthus* they can have sessile glands on the surface. They are usually imbricate, they can be lorate and inrolled as well in *Cnestis* and *Rourea*. In *Agelaea*, *Connarus*, *Hemandradenia*, and *Rourea* they are often (strongly) connivent near base or middle.

A distinct androgynophore is found only in species of *Manotes*.

The inner, epipetalous whorl of stamens is shorter or subequal to the outer episepalous whorl. It is staminodial in *Ellipanthus*, *Hemandradenia*, and in some species of *Connarus* (see chapter about heterostyly).

The filaments have some kind of indumentum in *Connarus*, *Ellipanthus*, *Hemandradenia*, and *Manotes* but they are glabrous in all other genera.

The carpels are partly to entirely hairy in most species of the family, sometimes also with glandular hairs as in *Manotes griffoniana*. In some species like *R. minor* and *R. emarginata* they are almost glabrous.

As a rule there are two ovules per carpel.

The ovules are usually hemitropous but in *Burttia prunoides* they are anatropous.

4.8 Fruits and seeds

by C.C.H. Jongkind

When there are five carpels present in flowers of *Connaraceae*, they usually do not develop collectively into five follicles. Usually some remain small while in many *Rourea* species only a single follicle is produced.

Connaraceae have two ovules in each carpel and in most species only one of them develops into seed. In *Jollydora duparquetiana* usually both ovules mature, while exceptionally there may be two seeds per carpel in *Agelaea paradoxa*, *Ellipanthus hemandradenoides*, and *Rourea solanderi*.

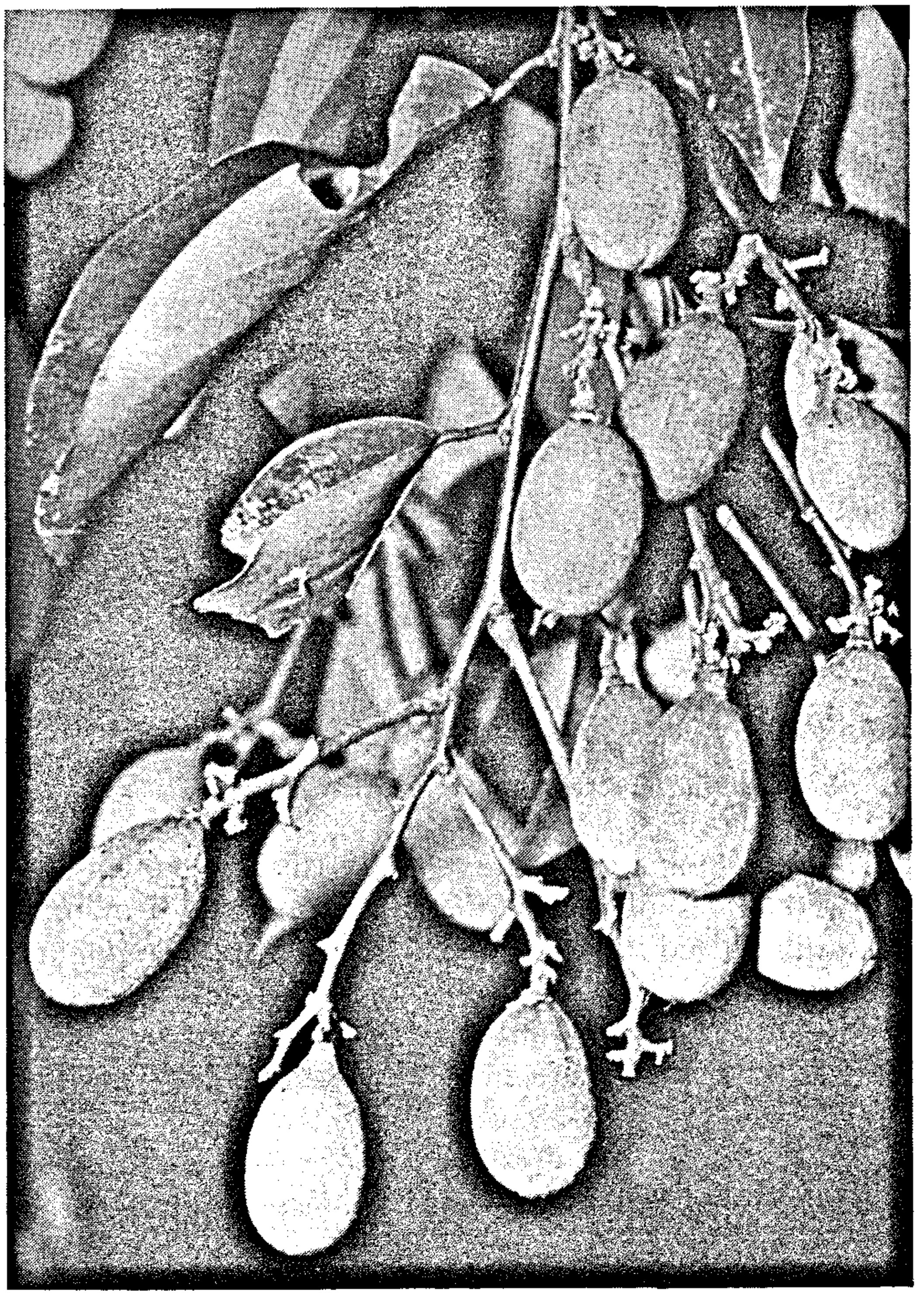


Fig. 17. Fruits of *Hemandradenia chevalieri* (phot. H.C.D. de Wit).

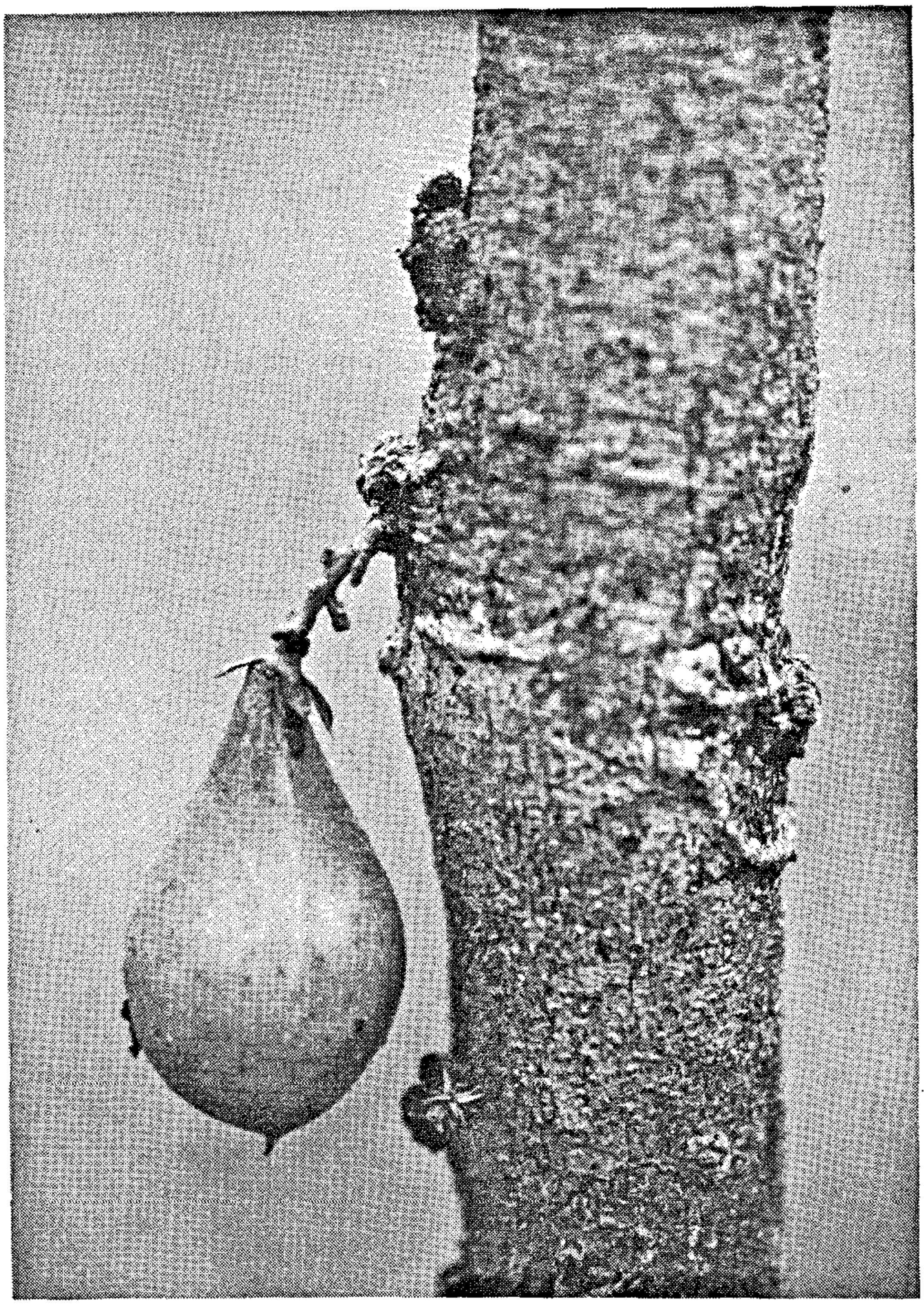


Fig. 18. Fruit of *Jollydora duparquetiana* (*de Wilde & Jongkind 9462*, phot. C.C.H. Jongkind).

The fruits are usually dehiscent and orange to red, advertising the often two-coloured seeds to birds who are responsible for their dispersion. At the moment of dehiscing the funiculus is severed from the seed. The fruits of *Jollydora* and *Hemandradenia* are indehiscent. This is linked with an other rare feature in *Connaraceae* as they are both not lianas or savanna shrubs but understory treelets in the rain forest. Their seed coat is almost entirely fleshy and lacks contrasting colours while it remains hidden in the indehiscent follicle that are produced in often cauliflorous situations. Birds will readily detect the often abundant colourfull fruits on savanna shrubs or lianas of the canopy, but those of the understory treelets may escape their attention and these are more likely to be detected and harvested by small mammals, assuming the responsability for their dispersal instead.

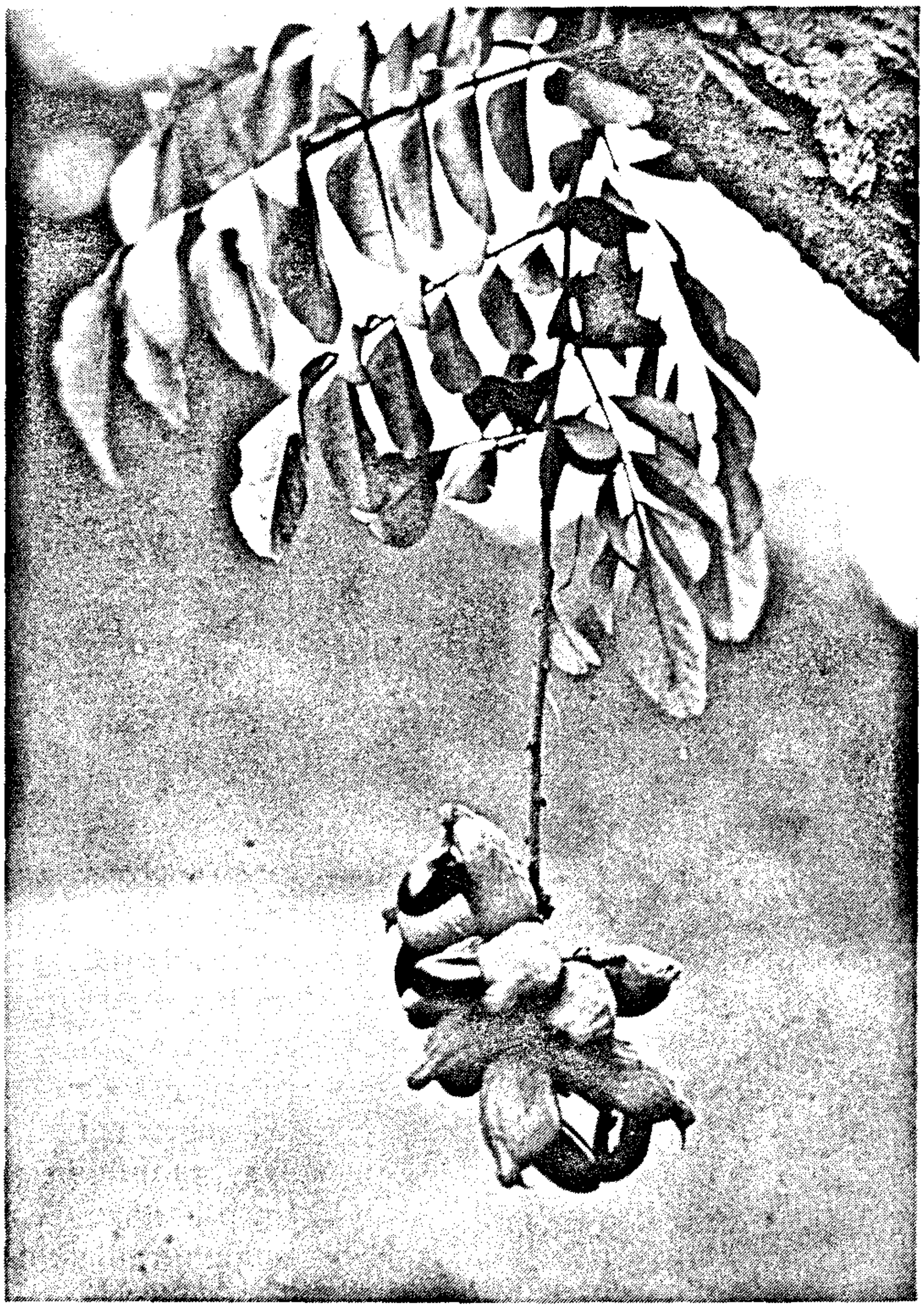


Fig. 19. Fruits of *Rourea obliquifoliolata* (*Breteler & Lemmens 8111*, phot. R.H.M.J. Lemmens).

The fruits of *Cnestis* and those of many *Connarus* species are hairy on the inside, but they are glabrous inside in all other genera. In *Connarus* these hairs may be partly glandular, or even exclusively so.

A striking character all *Connarus* species share is the stage in fruit development where the follicle is already fully expanded including a developing seed that is still not much bigger than a pin's head.

One of the characters all *Connaraceae* have in common is the at least partially fleshy character of their seed coat. The fleshy part is usually situated at the chalaza, positioned at the lower end of the seed as observed in the follicle. The colour of the sarcotesta is often strongly contrasting with the thin part of the testa as well as with the exocarp of the fruit. In *Agelaea*, *Burttia*, *Cnestis*, and

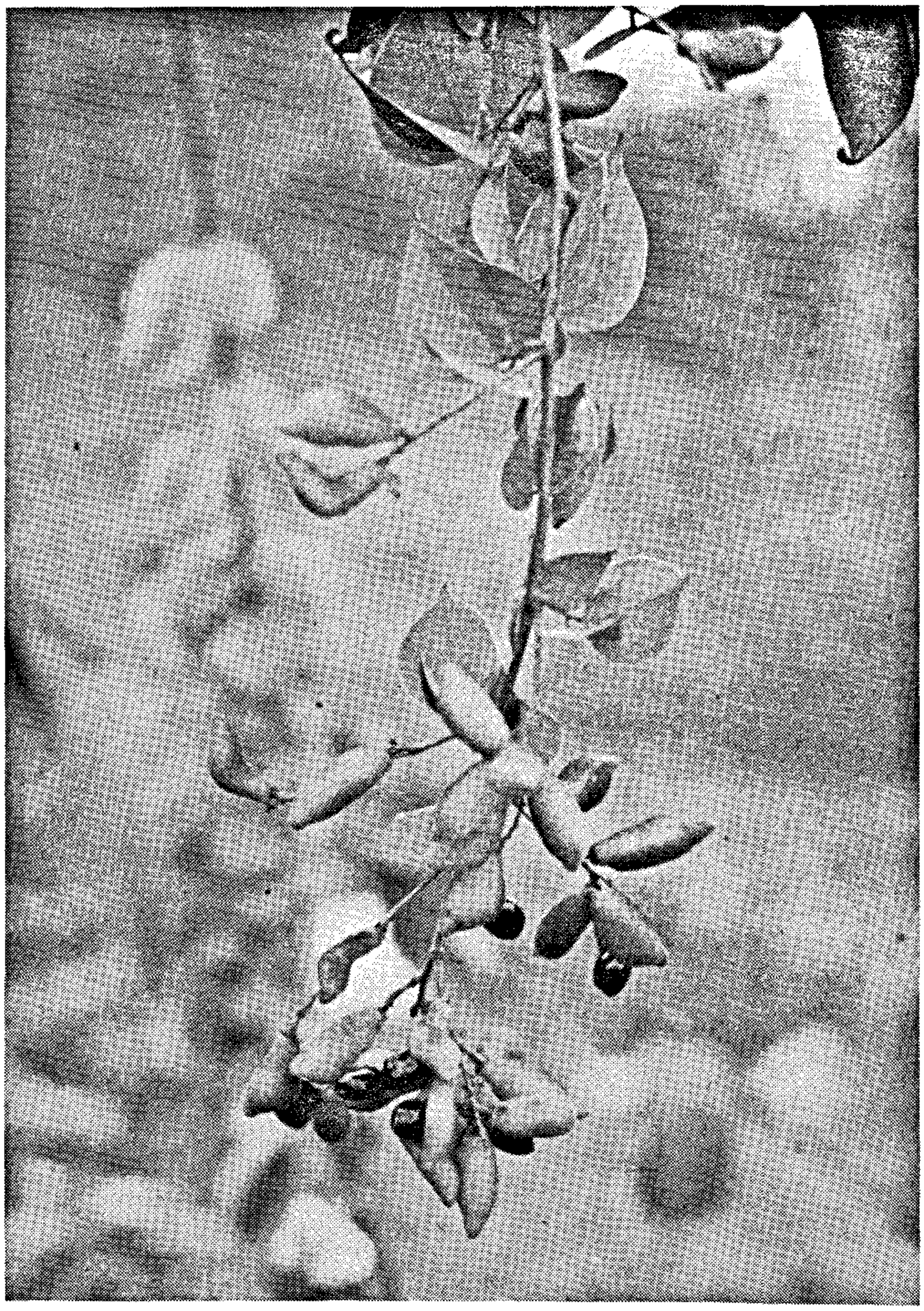


Fig. 20. Fruits of *Agelaea pentagyna* (*Breteler & Lemmens 8359*, phot. R.H.M.J. Lemmens).

many species of *Rourea* ca 3/4 of the seed is squeezed out of the follicle that retains a firm grip on the part that remains inside. In *Manotes* and *Vismianthus* the seed is almost completely released from the follicle, dangling near the base of it. It remains attached to the endocarp by means of a threadlike appendix of the sarcotesta. The apex of this apendage remains wedged in the narrowly funnel shaped bottom part of the follicle. These two genera are also the only ones in which endocarp and exocarp separate from each other at maturity.

In 1976 Corner published an excellent description of the fruits and seeds of ten *Connaraceae* species. In the present revision no distinction is made between the term sarcotesta for the fleshy part entirely fused with the seed and the term aril for the free part of the arilloid as Corner did. For both the term sarcotesta

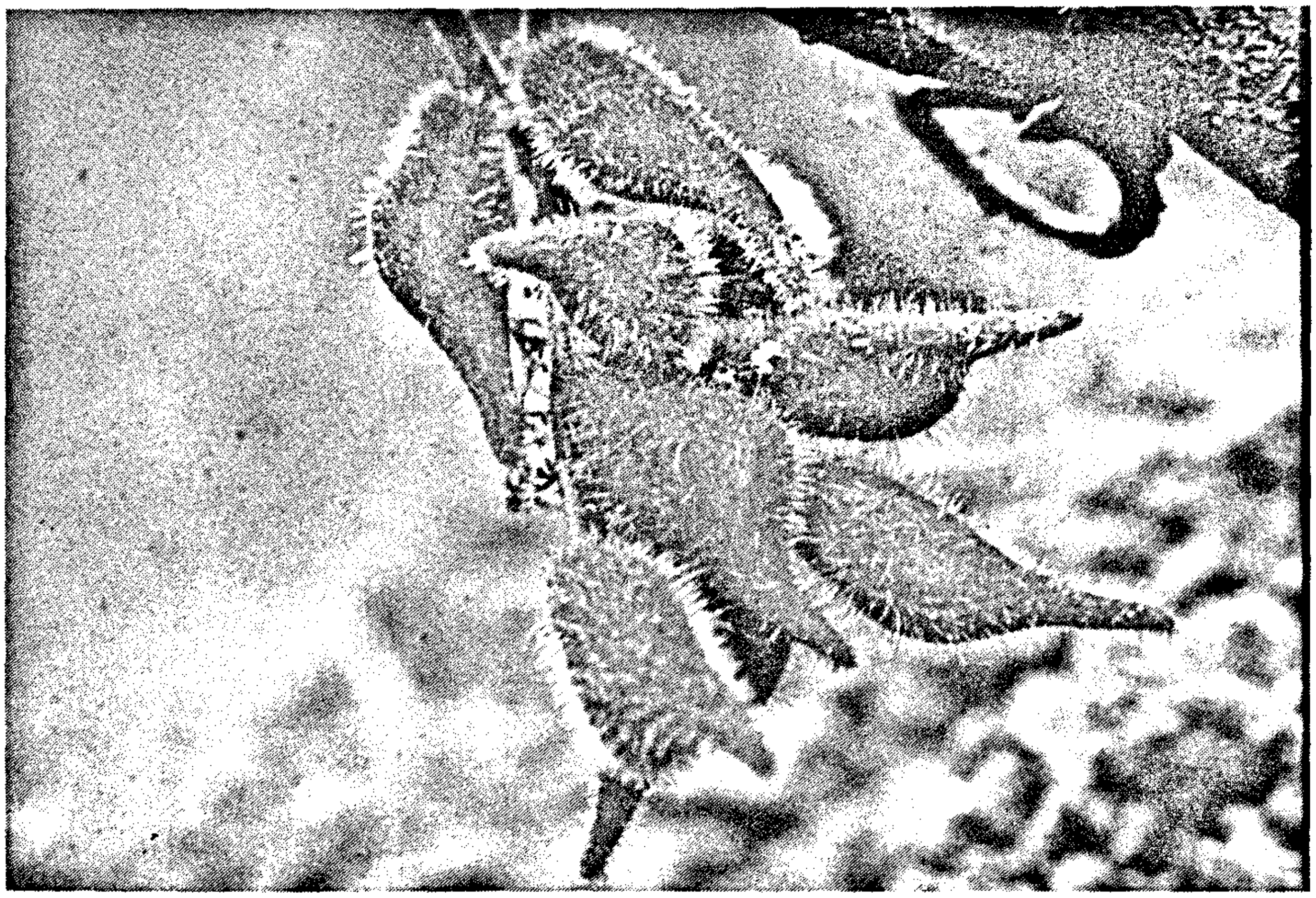


Fig. 21. Fruits of *Cnestis corniculata* (*Breteler, Lemmens, & Nzabi 8154*, phot. R.H.M.J. Lemmens).

is preferred here because the arilloid is clearly continuous, exclusively produced by the testa and, except in a few cases (see below) well separated from the hilum.

As Corner did not deal with fruits of all genera, his family diagnosis based on only ten species needs some modifications. Evidently he was not familiar with the seeds of *Rourea orientalis* or *Rourea cassioides* where the testa is fleshy except for a very small area around the hilum and the micropyle, and *Manotes macrantha* with an entirely fleshy testa. These three species also lack a thin testa along the preraphal side as is the case in species with a comparable large sarcotesta like *Rourea thomsonii* or *Jollydora duparquetiana*.

Many African *Connaraceae* have large seeds compared to those of other continents. The largest seeds ever found are from *Rourea thomsonii* measuring up to 4 × 3 cm. Other examples of African *Connaraceae* with big seeds are *Agelaea paradoxa* with seeds up to 3 × 1.5 cm, *Connarus congolanus* measuring 3.4 × 2.5 cm, *C. staudtii* up to 3.5 × 2 cm, and *Rourea solanderi* reaching dimensions of 3 × 2 cm. Only a few Asiatic *Connarus* species have comparable large seeds like *C. agamae* and *C. grandis* with seeds that may measure up to 3.5 × 2 cm. All American *Connaraceae* have distinctly smaller seeds. *Connarus congolanus*, *C. staudtii*, and *Rourea solanderi* seems to have invariable big seeds, but in *Agelaea paradoxa* and *Rourea thomsonii* the largest seeds are found in Cameroun and Gabon while in other parts of Africa they produce seeds of strikingly smaller dimensions. The reason why in these species such big fruits are restricted to Cameroun and Gabon is still unknown as well as the general situation of large seeds being produced particularly in Africa.

The structure of the seeds concerning endosperm and cotyledons is very variable. It varies from seeds with small, thin, and flat cotyledons embedded in abundant endosperm in *Manotes* and some species of Cnestis to planoconvex cotyledons without endosperm in the seeds of *Agelaea*, *Connarus*, *Jollydora*, and *Rourea*. Intermediary combinations are represented by *Burttia*, *Pseudoconnarus*, and some species of *Cnestis* with flat but slightly fleshy cotyledons, embedded in abundant endosperm and planoconvex cotyledons with scarce endosperm in *Cnestidium*, *Ellipanthus*, *Hemandradenia*, and *Vismianthus*.

A character which is not mentioned by Corner is the position of the radicle. It seems to be generally assumed that the radicle is located near the micropyle, but in *Connaraceae* this is not always so. In part of the species of *Rourea* and *Connarus* the radicle is more or less ventrally or dorsally situated while the micropyle is found apically like it is in all other *Connaraceae*. In *Connarus staudtii* and *C. congolanus* the situation is otherwise, there the radicle is found in the centre of the seed and quite hidden between the peltate cotyledons, the radicle pointing more or less dorsally. These characters enable the segregation of groups of African species from their nearest relatives in Africa or Asia. Such groups are represented by *Rourea erythrocalyx* & *R. obliquifoliolata*, *R. coccinea* & *R. thomsonii*, and *R. solanderi*, *R. myriantha*, *R. calophylla*, & *R. calophylliodes*. Each of these three groups is characterized by a ventral position of the radicle in the seed, away from the apical micropyle. A fourth group of African species comprising *Connarus africanus*, *C. congolanus*, and *C. staudtii*, respectively, is characterized by a gradual transition of the position of the radicle, from dorsal in the first to central in the last two species. Moreover *C. africanus* has a close relative in Asia, *C. monocarpus*. There the position of the radicle is intermediate between the dorsal position in *C. africanus* and the apical position of the radicle found in all other *Connarus* species (see also pag. on *C. africanus*). In Asiatic *Connarus* species with oblique fruits and almost round seeds it is sometimes difficult to establish the apical position. Fortunately the micropyle and the radicle are still located at the same spot in these species. These abberrant positions of the radicle in the seeds of *Connaraceae* are phenomena that are almost exclusively restricted to Africa. In not-African species only *Connarus monocarpus* and *Rourea minor* have their radicles in not exactly apical position. There seems to be no obvious explanation for these abberant positions, but they might be linked with the behaviour of some seed eating animals.

4.9 Seedlings

by C.C.H. Jongkind

Classification of the seedlings of *Connaraceae* has been rather neglected so far, probably due to lack of suitable conserved material. At present seedling material is available for most genera and an attempt is made to classify it according to de Vogel (1980: 56).

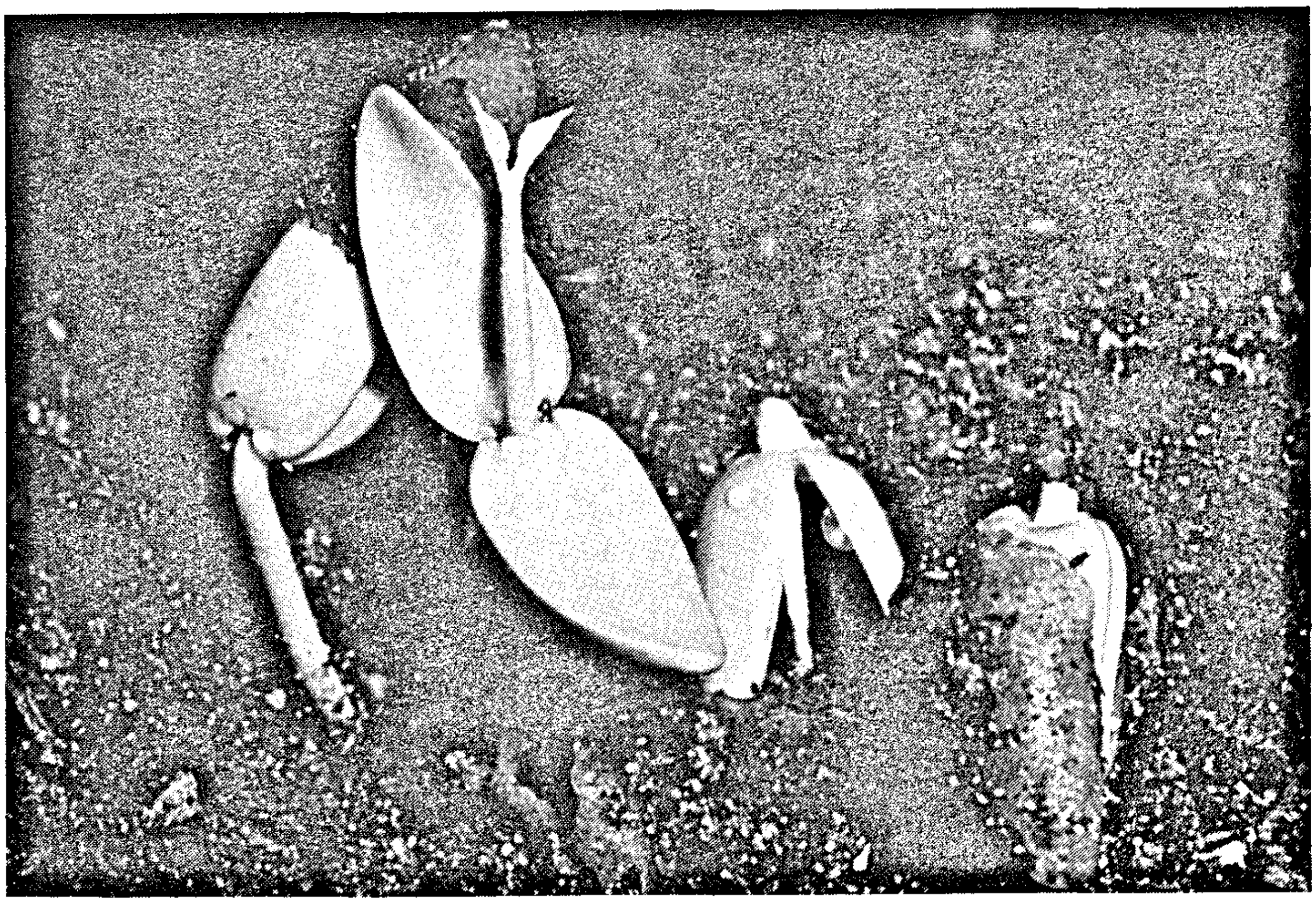


Fig. 22. Seedlings of *Hemandradenia chevalieri* (*Eimunjeze s.n.*, phot. H.C.D. de Wit).

In genera where seedling collections of more than one species are available, differences between them proved to be very limited. Therefore a general seedling description is given for each genus, often based on only part of its constituent species. It is felt there will be a fair chance that seedlings of species that have not yet been investigated will prove to match these descriptions eventually. With each of the genera treated hereafter, all species to which the investigated seedlings were referred are listed. The pertinent conserved seedling material is cited with the taxonomic treatment of the relevant species.

De Vogel's key appeared to over emphasize the importance of the persistance of the testa when applied to *Connaraceae*. For instance in *Rourea* the single difference between the seedlings of various closely related species is persistance or deciduousness of the testa on the cotyledons. In de Vogel's classification these seedlings represent widely diverging types.

Agelaea

Primary root well developed. Hypocotyl only slightly elongated. Cotyledons sessile, at most slightly spreading, without testa, fleshy, glabrous. First leaves scalelike.

Sloanea type, Palaquium subtype.

Species: *A. paradoxa* (fig. 25.1), *A. pentagyna*.

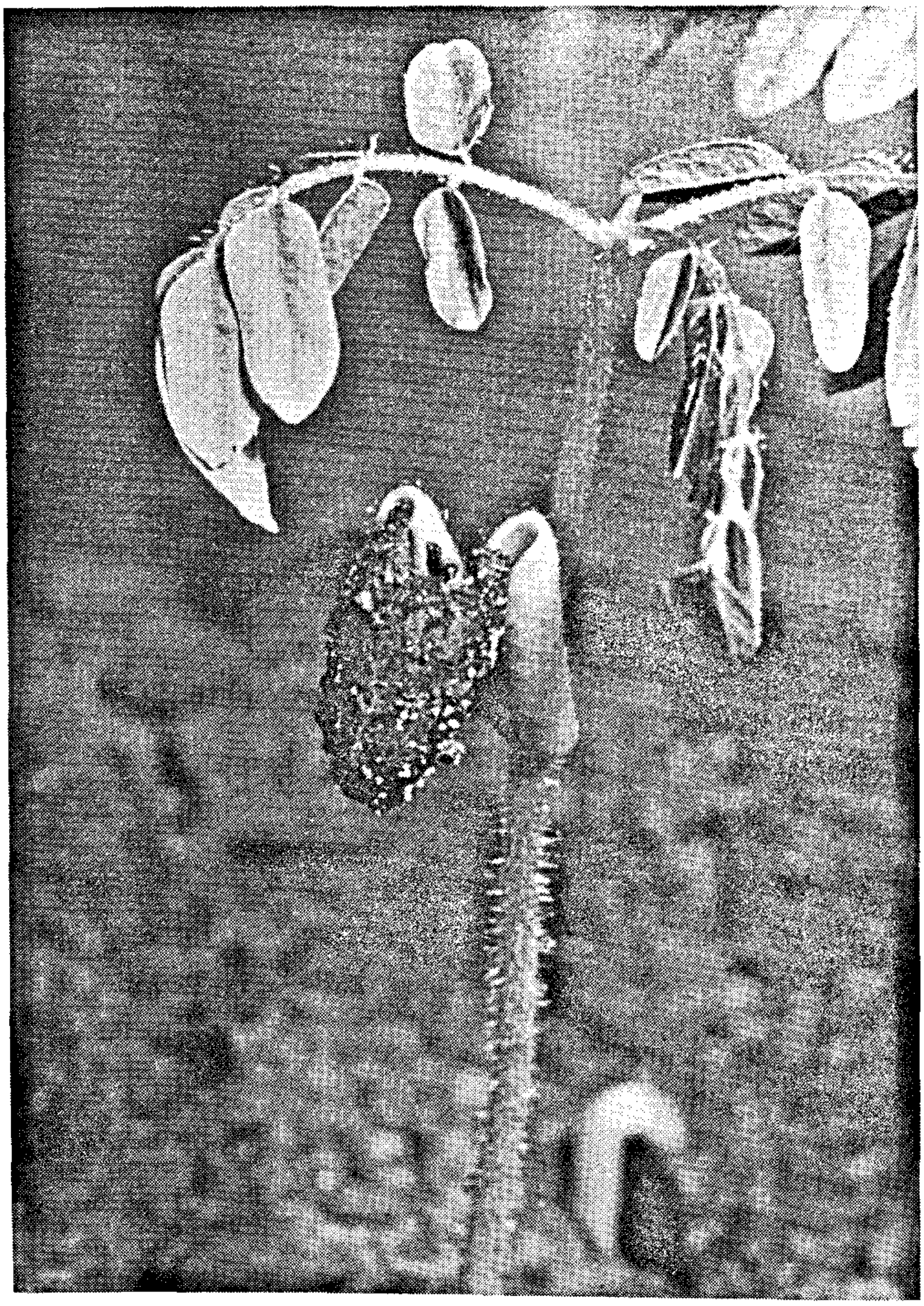


Fig. 23. Seedling of *Cnestis ferruginea* (seed from *Bos 2952*, phot. H.C.D. de Wit).

Cnestidium

Primary root well developed. Hypocotyl only slightly elongated. Cotyledons with a short petiole, remaining hidden in testa and endosperm. First leaves scale-like.

Horsfieldia type, Horsfieldia subtype.

Species: *C. rufescens* (fig. 26.1).

Cnestis

Primary root well developed. Hypocotyl strongly elongated, velutinous. Coty-

Fig. 24. Seedlings of *Cnestis ferruginea* (seeds from *Louis et al. 186*, phot. H.C.D. de Wit).

ledons sessile, flat, coriaceus, horizontal spreading, nervation clearly visible, hairy above. First leaves opposite or in a whorl of three, pinnate.

Sloanea type, Sloanea subtype.

Species: *C. corniculata*, *C. ferruginea* (fig. 23, 24, & 26.5).

Connarus

Primary root well developed. First internode sometimes with accessory roots. Hypocotyl usually only slightly but sometimes clearly elongated. Cotyledons sessile, at most slightly spreading, fleshy, glabrous, the testa persistent entirely or in parts. First leaves opposite and unifoliolate or scalelike.

Sloanea type, Sloanea or Palaquium subtype or Endertia type, Endertia subtype.

Species: *C. africanus* (fig. 26.6), *C. grandis* (de Vogel, 1980: 217-219), *C. griffonianus*, *C. odoratus* (de Vogel, 1980: 219-221), *C. panamensis* (Duke, 1969: 148).

Note: In my opinion de Vogel's seedling type for *C. odoratus* is artificial, as in this case the entire fruit was collected from the plant. Without interference by man only individual seeds are dispersed (see chapter on fruit).

Hemandradenia

Primary root well developed. Hypocotyl strongly elongated, velutinous. Coty-

Fig. 25. Seedlings, 2/3 ×: 1. *Agelaea paradoxa*; 2. *Rourea coccinea* subsp. *coccinea* var. *coccinea*; 3. *Rourea surinamensis*. (1. *de Koning 5752* (WAG); 2. *de Koning 5953* (WAG); 3. *N.M. Heyde 703* (U)).

Fig. 26. Seedlings, 2/3 ×: 1. *Cnestidium rufescens*; 2. *Rourea parviflora*; 3. *Hemandradenia chevalieri*; 4. *Manotes griffoniana*; 5. *Cnestis ferruginea*; 6. *Connarus africanus*. (1. *de Bruijn 1779A* (WAG); 2. *Doyle Mc Key 6* (YA); 3. *Eimunjeze s.n.* (WAG); 4. *Jongkind 688* (WAG); 5. *van Veldhuizen 984* (WAG); 6. *de Koning 551* (WAG)).

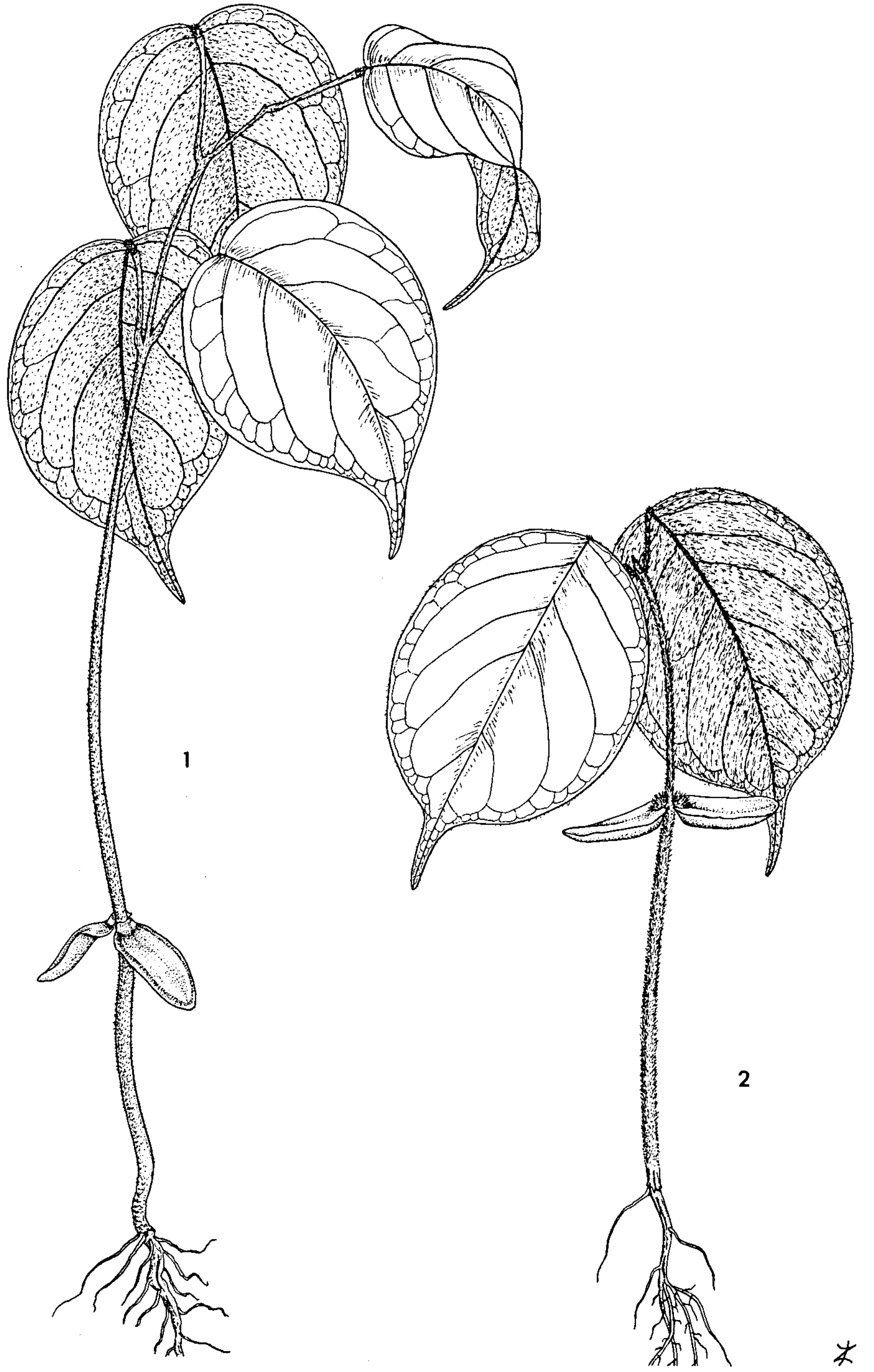


Fig. 27. Seedlings, 2/3 x: 1. *Hemandradenia chevalieri*; 2. *Hemandradenia mannii*. (1, *Eimunjeze s.n.* (WAG); 2, *de Bruijn 2038* (WAG)).

ledons sessile, fleshy, glabrous or hairy at base, horizontally spreading. First leaves opposite, unifoliolate (like all leaves of *Hemandradenia*).

Sloanea type, Sloanea subtype.

Species: *H. chevalieri* (fig. 22, 26.3, & 27.1), *H. mannii* (fig. 27.2) (the only two species of the genus).

Manotes

Primary root hardly developed, many accessory roots developing instead. Hypocotyl strongly elongated and somewhat thickened at base, velutinous. Cotyledons with a short petiole, remaining within the testa with the endosperm, soon caducous. First leaves opposite, uni- or trifoliolate.

Horsfieldia type, Pseuduvaria subtype.

Species: *M. expansa*, *M. griffoniana* (fig. 26.4).

Rourea

Primary root well developed. Hypocotyl only slightly elongated. Cotyledons sessile, at most slightly spreading, fleshy, glabrous, testa sometimes persistent. First leaves opposite, sometimes unifoliolate but usually scalelike.

Sloanea type, Palaquium subtype or Horsfieldia type and subtype.

Species: *R. coccinea* (fig. 25.2), *R. minor* (de Vogel, 1980: 221-223), *R. obliquifoliolata*, *R. solanderi*, *R. surinamensis* (Duke, 1965:332) (fig. 25.3), *R. thomsonii*.

An exceptional case is *R. parviflora* (fig. 26.2), with aberrant seedlings that look more like those of *Cnestis* or *Manotes*: No primary root, only accessory roots growing from the base of the hypocotyl. Hypocotyl strongly elongated. Cotyledons sessile, horizontally spreading, succulent, no nervation visible, glabrous. First leaves in a whorl, pinnate.

5. Heterostyly

by R.H.M.J. Lemmens

5.1 Introduction

In *Connaraceae*, heterostyly was first reported by Burck (1887) in some of the Asiatic species of *Connarus*. However, heterostyly was already noticed by Thonning who annotated specimens he collected in Ghana to that effect. When Schumacher dealt with these specimens he concluded that they represented two distinct species: *Byrsocarpus coccineus* with short styles and *B. puniceus* with long styles. They represent in fact the two types of styles of a single species: *Rourea coccinea*. It is peculiar that Schellenberg (1938) hardly pays attention to heterostyly in his monograph on *Connaraceae*. He pointed out that as a rule trimorphic flowers are found. Hemsley (1956) reports a well-marked dimorphy in the East African species. Leenhouts (1958b) only mentioned the fact that in the entire family the flowers are distinctly heterostylous. Finally, Baker (1962) discussed heterostyly in *Connaraceae*, with special reference to *Byrsocarpus coccineus*. He questions the existence of heterotristyly in the family.

Some species are reported to be dioecious or to 'represent a stage in a trend towards dioecism' (Hemsley). This is done by Hemsley (1956) for the East African species, and by Schellenberg (1938) and Leenhouts (1958b) for *Ellipanthus* (including *Pseudellipanthus*).

Leenhouts (1958b) and Baker (1962) stated that in order to solve the questions concerning heterostyly and dioecism, observations of living material within the tropics should provide the most reliable data. This may be true, but I think that detailed investigation of a sufficient amount of herbarium specimens may give a great deal of information about these breeding systems as well.

5.2 Types of heterostyly in *Connaraceae*

The length of pistils and stamens was accurately measured in almost all of the African species. In addition some Asiatic and South American species were selected in order to either represent the non-African genera, or types of heterostyly absent in Africa, and these were measured also. The result is reproduced in fig. 28, each diagram representing a species. The number of specimens investigated varies from 33 in much collected species as *Cnestis corniculata*, to 2 in rare species as *Vismianthus punctatus*. In each diagram, the specimens are arranged according to increasing pistil length. All flowers of a single specimen invariably are of the same type.

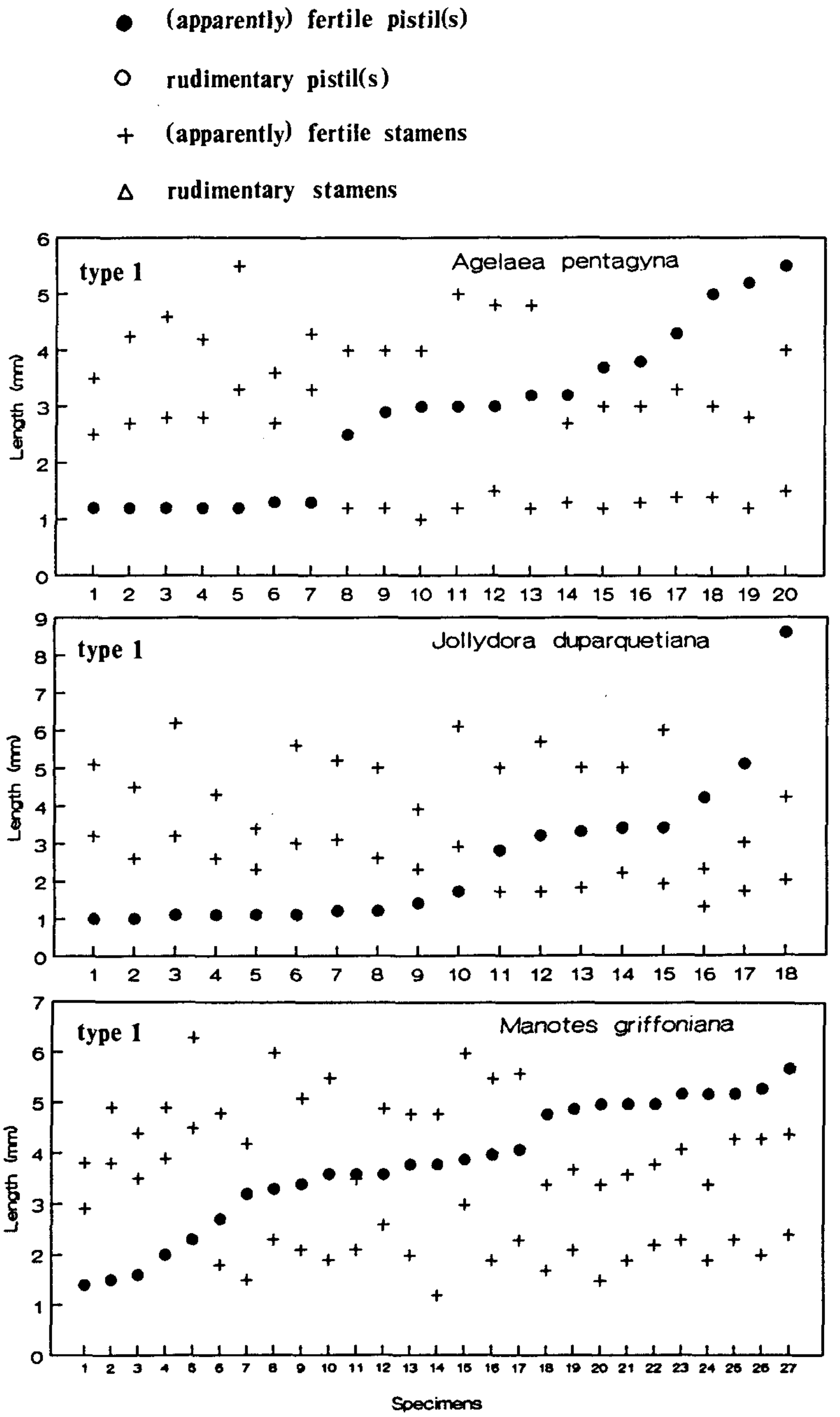
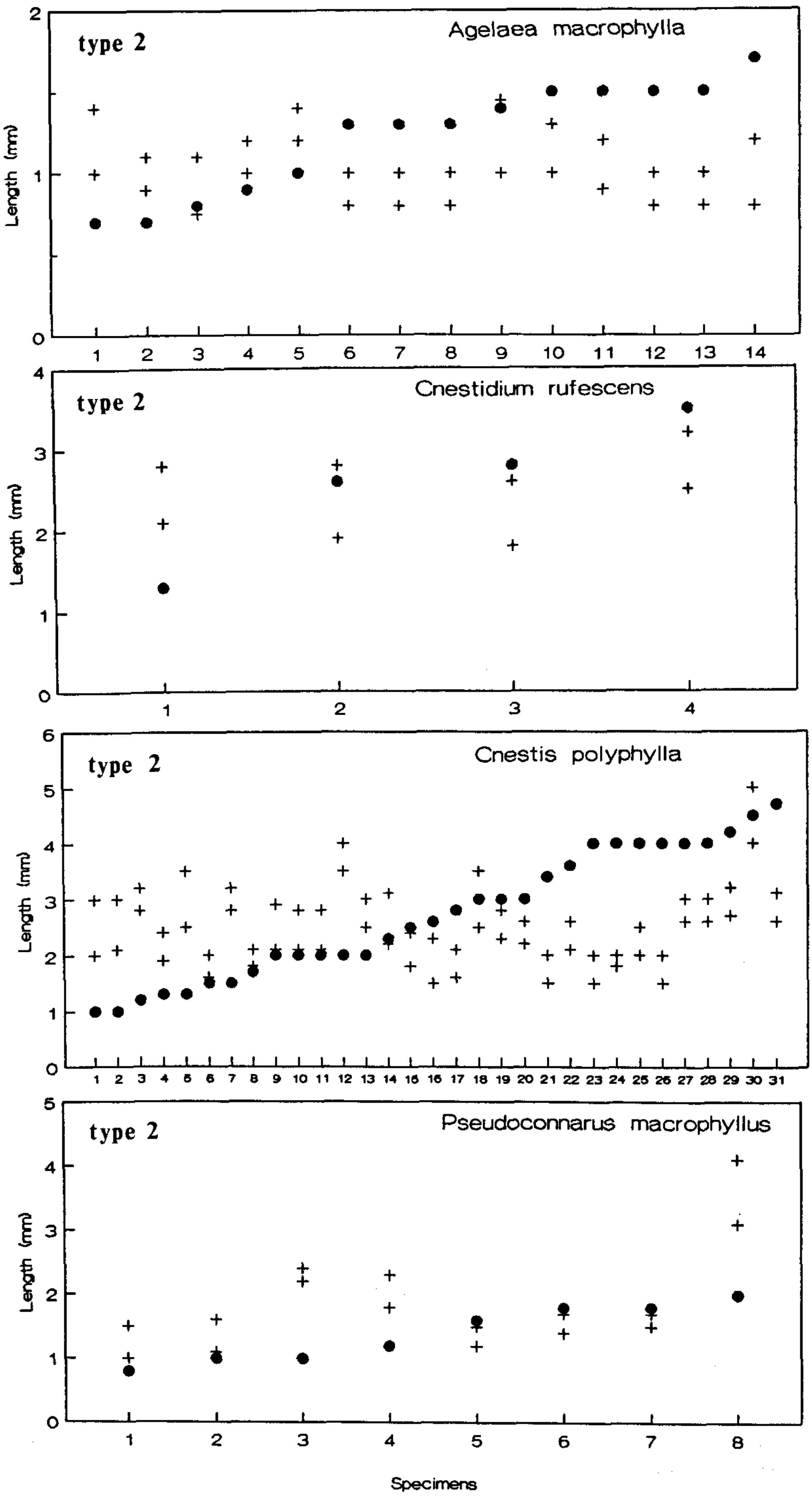
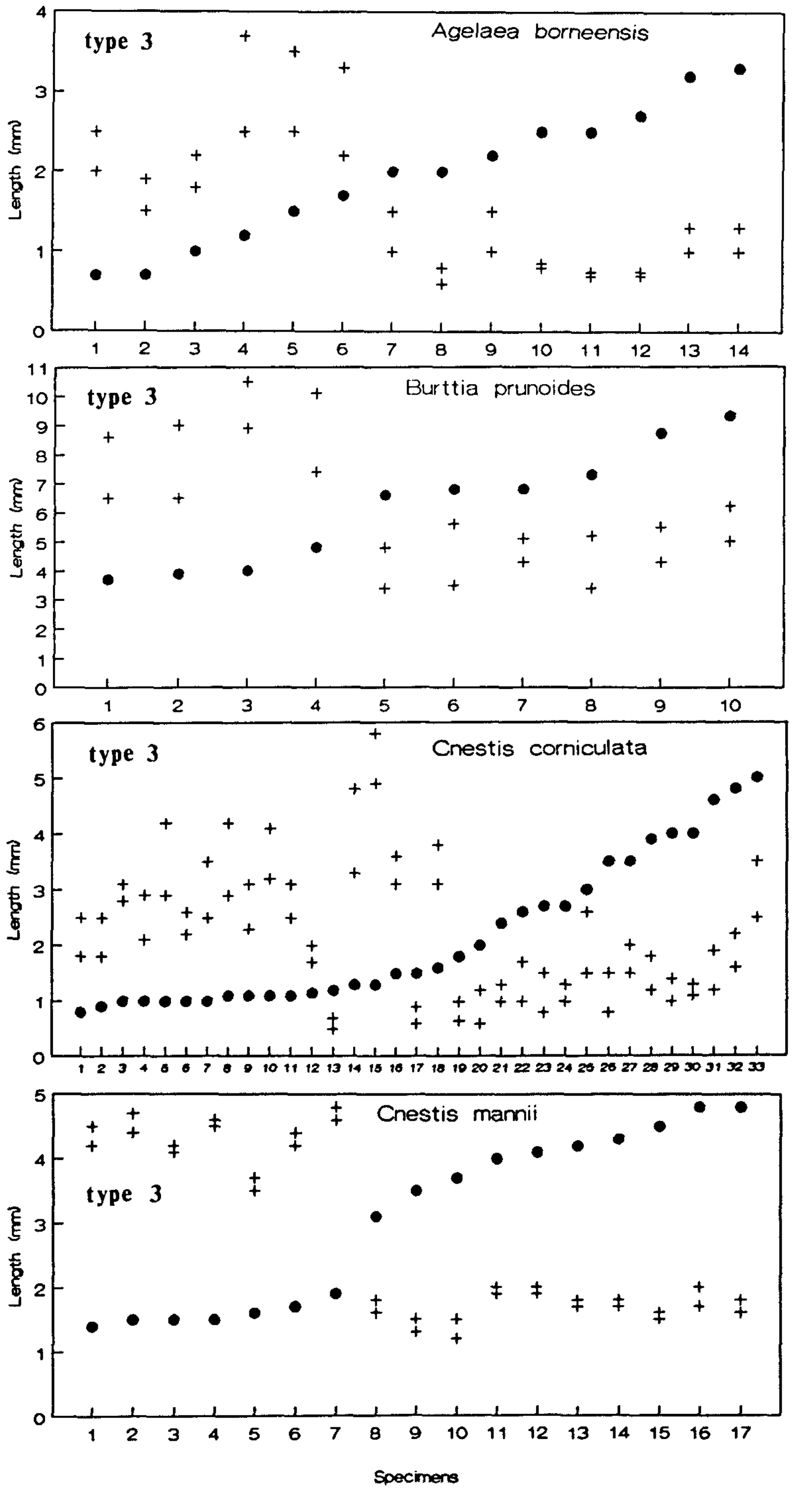
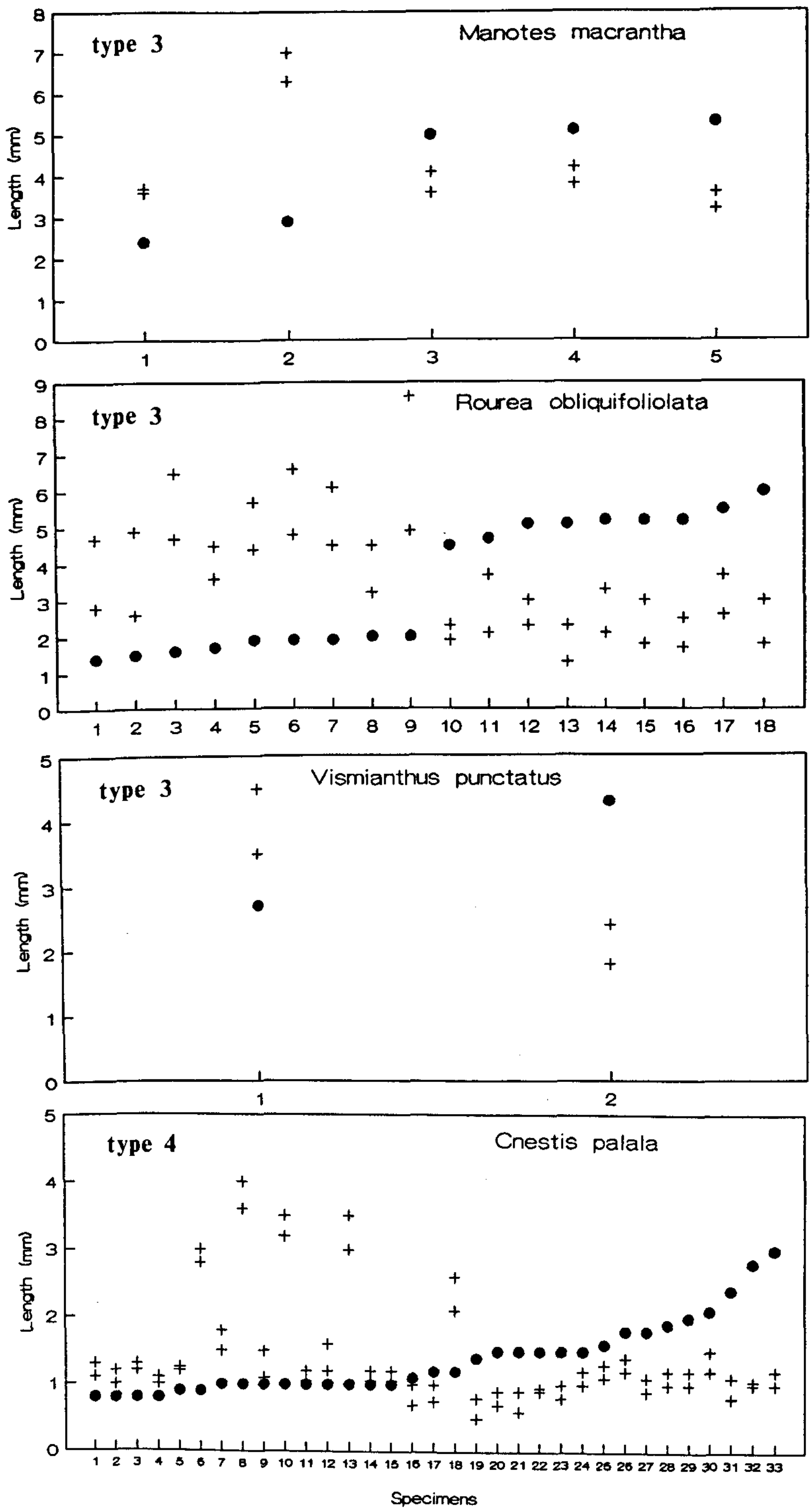
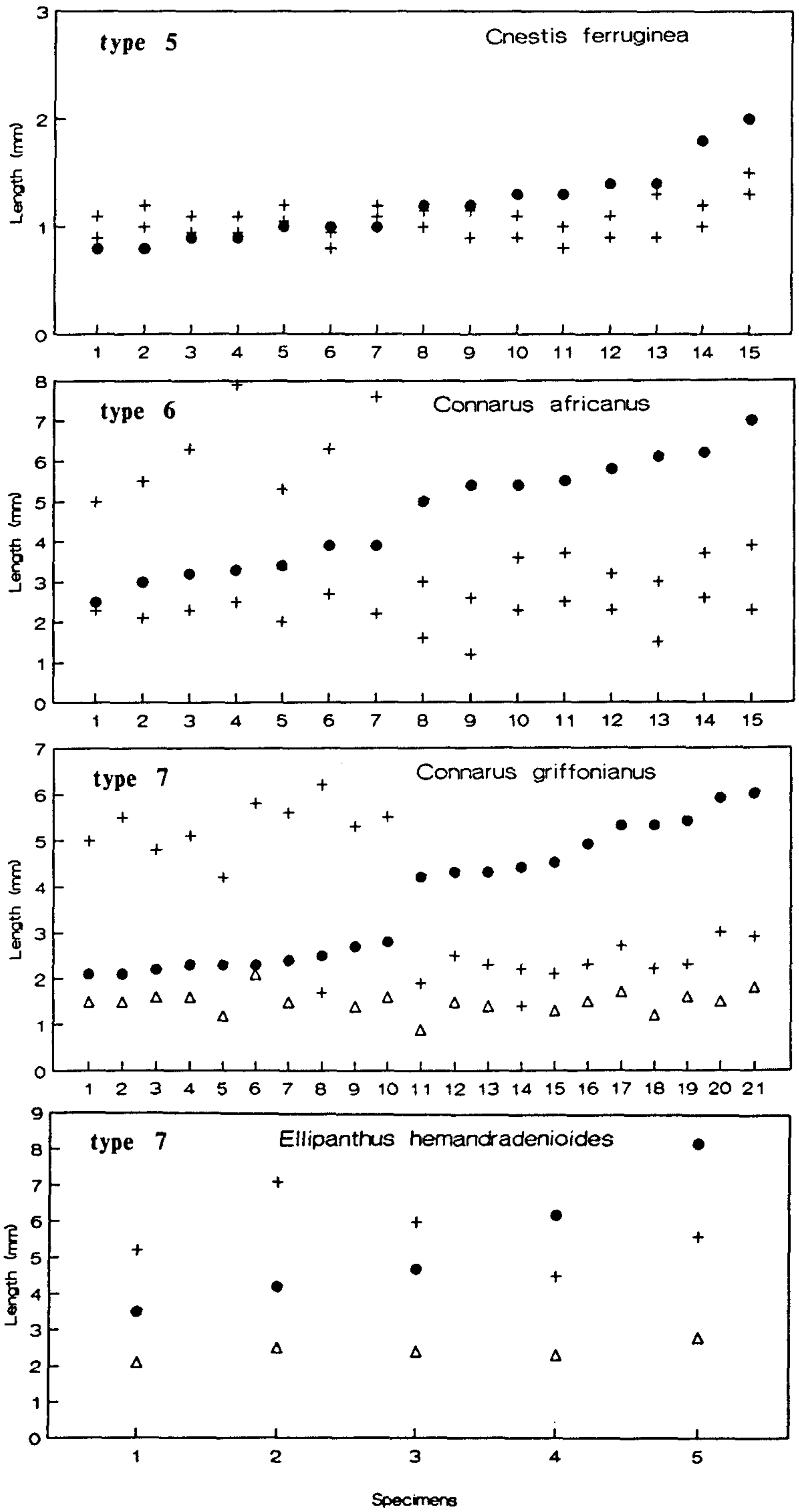


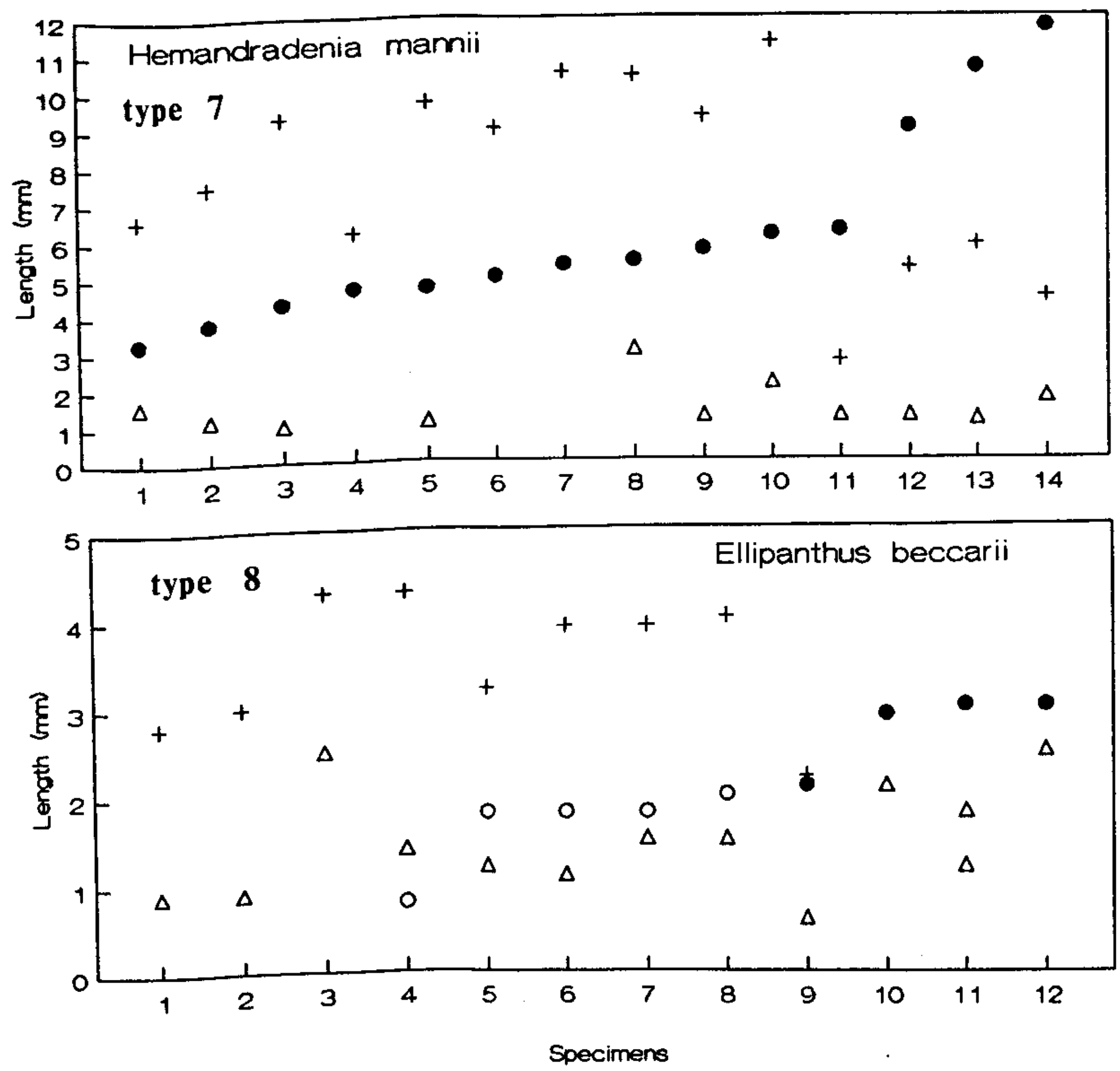
Fig. 28. Diagrams of 21 species of *Connaraceae*, showing the pistil and stamen lengths of the specimens investigated. In each diagram the specimens are arranged according to increasing pistil length. For explanation see text.


type 2
Agelaea macrophylla
Length (mm)
type 2
Cnestidium rufescens
Length (mm)
type 2
Cnestis polyphylla
Length (mm)
type 2
Pseudoconnarus macrophyllus
Length (mm)
Specimens


type 3
Agelaea borneensis
type 3
Burttia prunoides
type 3
Cnestis corniculata
Cnestis mannii
type 3
Length (mm)
Specimens


type 3
Manotes macrantha
type 3
Rourea obliquifoliolata
type 3
Vismianthus punctatus
type 4
Cnestis palala
Length (mm)
Specimens


type 5
Cnestis ferruginea
type 6
Connarus africanus
type 7
Connarus griffonianus
type 7
Ellipanthus hemandradenioides
Length (mm)
Specimens


Hemandradenia mannii
type 7
Length (mm)
12
11
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Ellipanthus beccarii
type 8
Length (mm)
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
11
12
Specimens

Heterostyly in *Connaraceae* can be classified in 8 different types, as shown in fig. 29 and 30.

1. Heterotristyly

Species in several genera are heterotristylous. This is the case in most *Agelaea* species (fig. 31), excepting some from Asia, in all *Manotes* species except *M. macrantha*, in *Jollydora duparquetiana* and probably also in the other *Jollydora* species. Thus, true heterotristyly is found in two 5-carpellate genera and in one 1-carpellate genus.

In all heterotristylous species, the number of individuals of each type (a, b and c) is roughly equal, except in *Jollydora duparquetiana*, where the number of short-styled specimens is larger than the numbers of medium- and long-styled ones. However, statistically this difference is not significant, as the distribution of the numbers does not differ significantly from an equal distribution of the three types. The larger number of short-styled specimens may be due to chance. However, as is demonstrated by Breteler & van Ziel in their treatise on *Jollydora*, short-styled plants only rarely produce fruits. Additionally, functionally male plants do flower more frequently, which could explain the larger number of short-styled plants collected.

2. Heterostyly, transitional between heterotristyly and heterodistyly

Several species of 4 different genera show a type of heterostyly, that can be considered neither as true heterodistyly, nor as true heterotristyly. It is found in *Cnestis polyphylla*, *C. racemosa*, *Cnestidium rufescens*, *Pseudoconnarus macrophyllus*, and *Agelaea macrophylla*.

In these species flowers occur that have pistils about as long as the stamens of one whorl (d and e), called semi-homostyly by Ganders (1979), pistils that are longer or shorter than the stamens (a and c), or sometimes pistils of intermediate length (in between the lengths of the stamens from the two whorls; b). This type is only found in 5-carpellate species.

3. Heterodistyly with 10 fertile stamens and short or long styles

This is the most common type of heterostyly in *Connaraceae*. It is found both in 1-carpellate species (*Burttia prunoides*, *Vismianthus punctatus*), and in 5-carpellate species (*Rourea*, most *Cnestis* species, *Manotes macrantha*, *Agelaea borneensis*).

It is characterized by pistils and stamens clearly differing in length while the two whorls of stamens are subequal. It is possibly derived from heterotristyly by loss of the medium-styled form.

4. Heterodistyly with rare extreme forms

In this type of heterodistyly stamens and pistils are frequently almost equal in length (h and i) while in more rare cases they do differ distinctly (f and g). It is found in the Asiatic *Cnestis palala*.

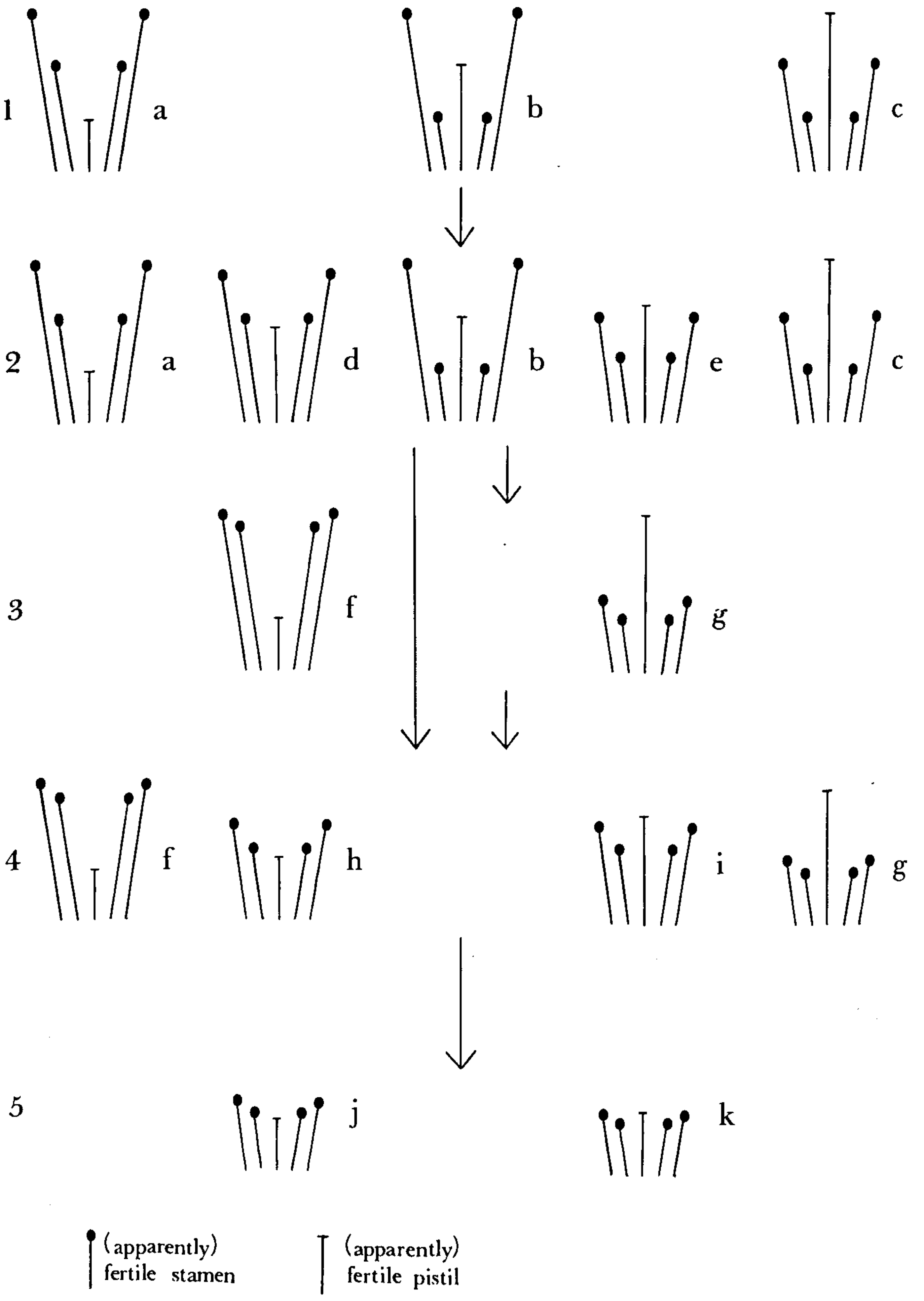


Fig. 29. The hypothetical evolution of heterostyly in 5-carpellate *Connaraceae*. For explanation see text. The numbers and letters correspond to the types of heterostyly discussed in the text.

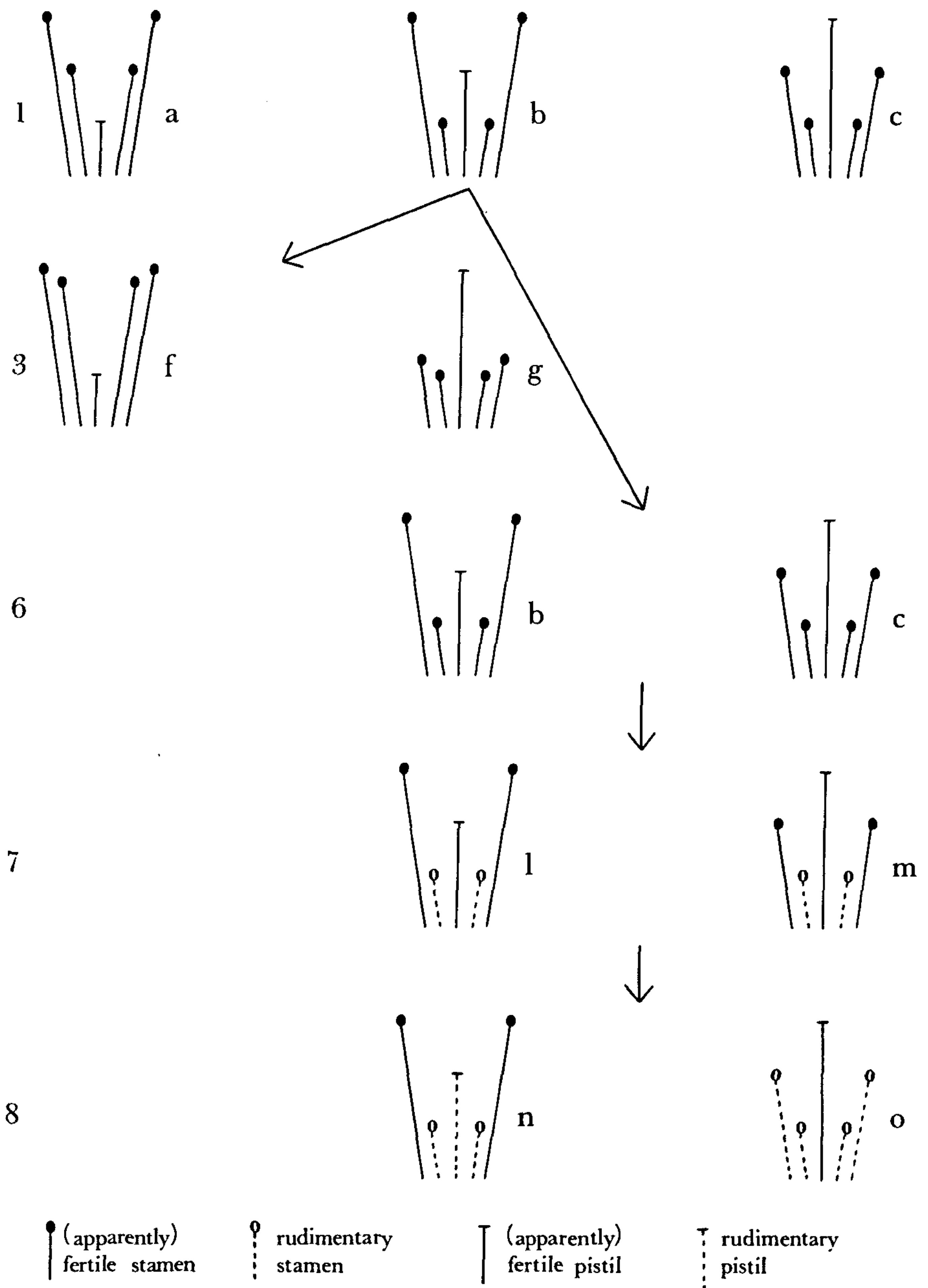


Fig. 30. The hypothetical evolution of heterostyly in 1-carpellate *Connaraceae*. For explanation see text. The numbers and letters correspond to the types of heterostyly discussed in the text.

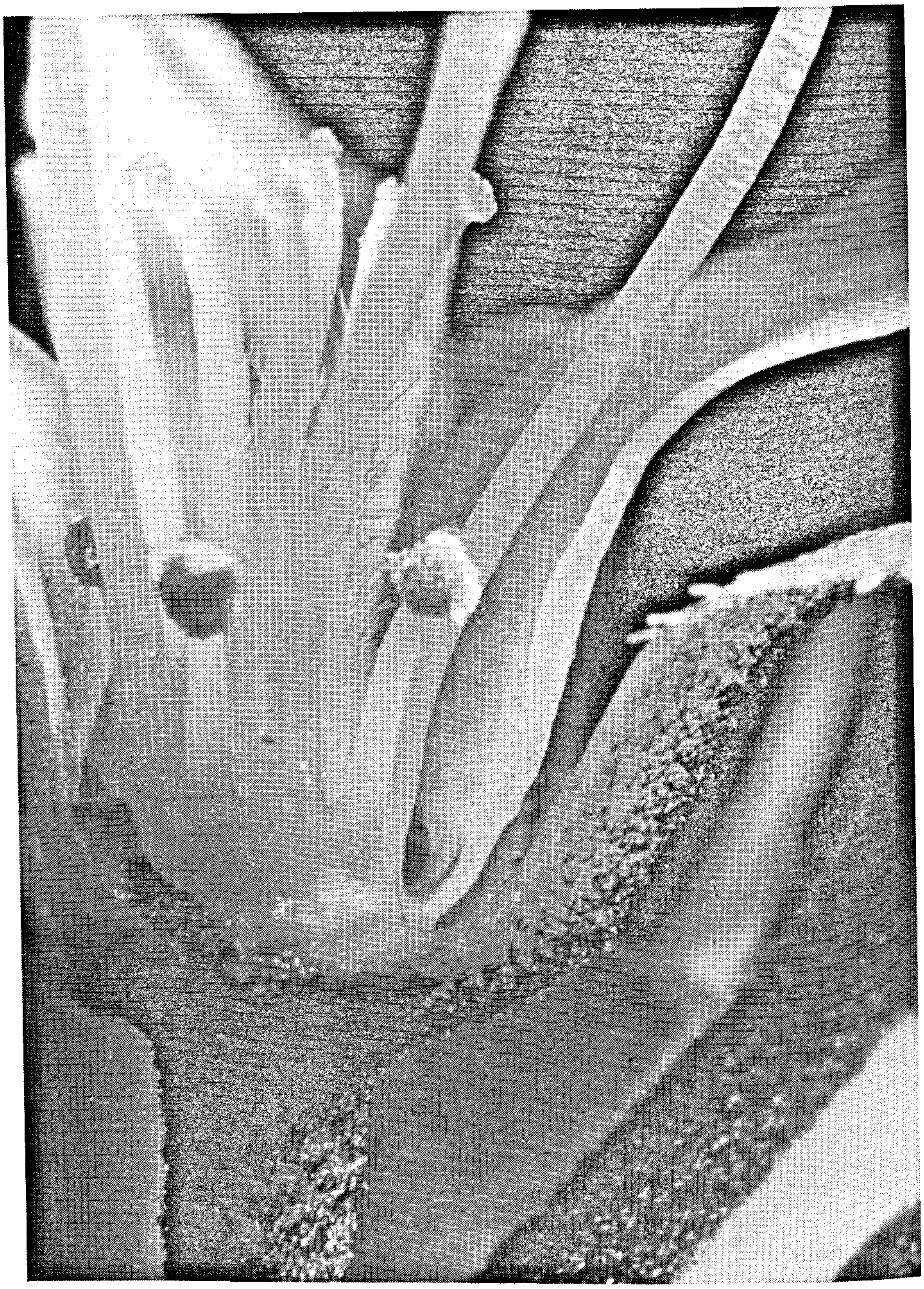


Fig. 31. *Agelaea pentagyna*: medium-styled flower (phot. H.C.D. de Wit).

5. Homostyly

Cnestis ferruginea always has flowers that have both whorls of stamens and the pistils approximately equal in length (fig. 32). The stamens may be slightly longer as well as slightly shorter than the pistils (j and k).

When the pistils are longer than the stamens, the styles are curved towards the anthers. Compared to other *Cnestis* species the flowers are small.

6. Heterodistyly with 10 fertile stamens, and a medium or long style

In some African and Asiatic species of *Connarus* a type of heterodistyly is found with 10 apparently fertile stamens. The pistil is either intermediate between the lengths of the stamens of both whorls (b), or it is longer than the stamens (c). This type is thought to be derived from heterotristyly by loss of the short-styled form. It is limited to the 1-carpellate representatives *Connarus africanus*, *C. congolanus*, *C. longistipitatus* and many Asiatic *Connarus* species.

It should be noted that in American *Connarus* species the short-styled form is still present.

7. Heterodistyly with 5 fertile stamens

In 1-carpellate species such as *Connarus staudtii*, *C. griffonianus*, *C. thonningii*, some Asiatic *Connarus* species, *Hemandradenia mannii*, *H. chevalieri*, *Ellipanthus hemandradenioides*, *E. madagascariensis*, and *E. tomentosus*, heterodistyly with 5 fertile and 5 rudimentary stamens is found.

This may have evolved from the type discussed under 6. Sometimes it is almost impossible to establish whether the short stamens are fertile or not. Burck (1887) pointed out already that in Asiatic *Connarus* the short stamens are apparently fertile but they do not open.

8. Dioecism

Ellipanthus beccarii, an Asiatic species, is dioecious. Male plants have 5 fertile stamens, 5 rudimentary ones and at most a rudimentary pistil. Female plants have 5 sterile stamens (lacking pollen), 5 rudimentary stamens and a fertile pistil. This situation is probably derived from heterodistyly with 5 fertile stamens and a fertile pistil, as found in other *Ellipanthus* species.

In American *Connarus* species there also seems to occur a tendency towards dioecism.

5.3 The hypothetical evolution of heterostyly in *Connaraceae*

Heterotristyly is found in *Jollydora*, *Manotes* and *Agelaea*. These genera are considered as comparatively primitive while they are not closely related to each other. For this reason heterotristyly may be considered a plesiomorphic character-state in *Connaraceae* while all other types of heterostyly may be derived from it.

Heterostyly in general in *Connaraceae* seems to have evolved in two directions:

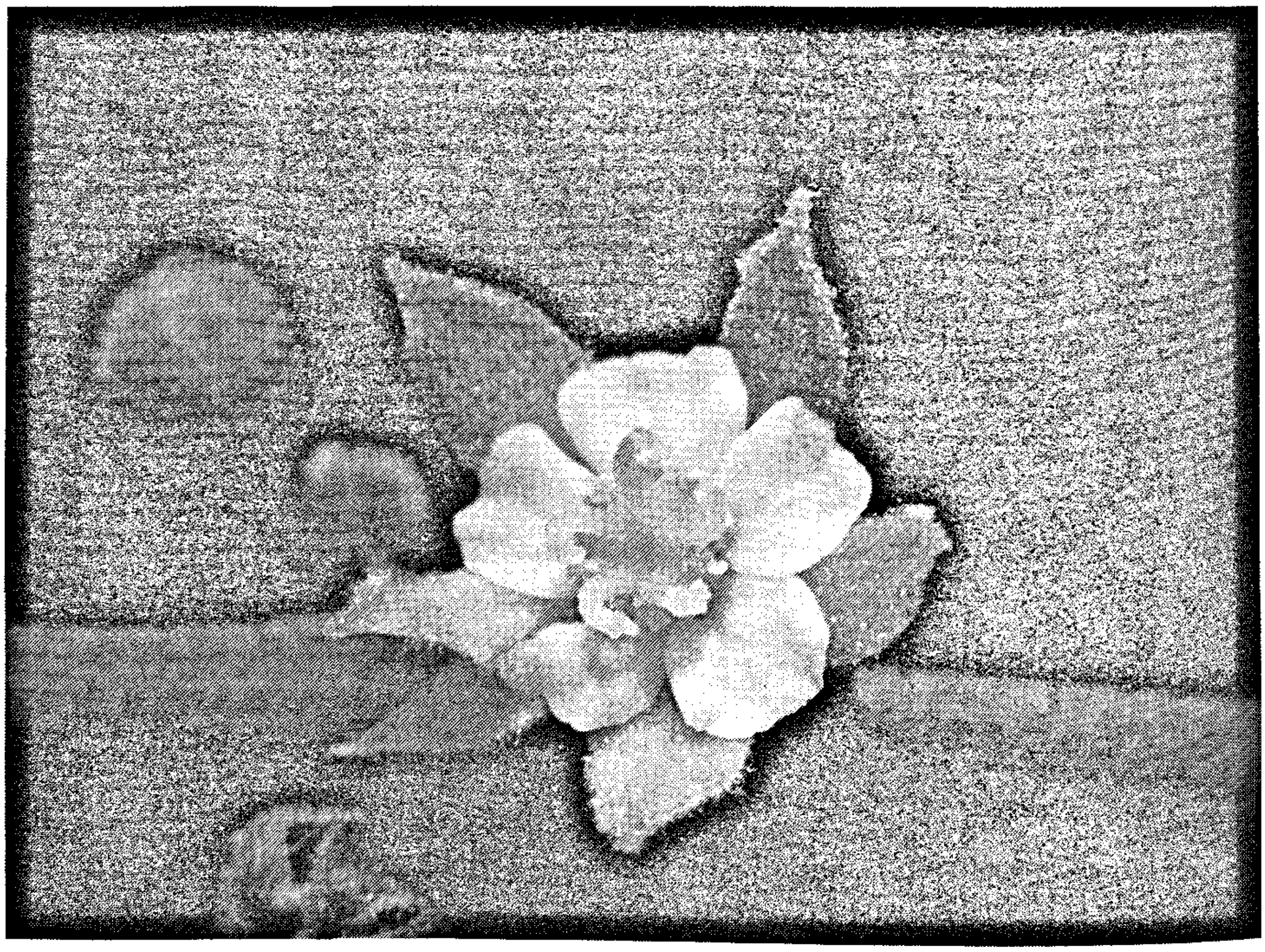


Fig. 32. *Cnestis ferruginea*: flower showing small stamens and curved styles (phot. H.C.D. de Wit).

one towards dioecism in 1-carpellate *Connaraceae*, and the other towards homostyly in 5-carpellate *Connaraceae*. Thus, in 1-carpellate and in 5-carpellate *Connaraceae* the evolution seems to have followed, at least partly, a different course. See fig. 30 and 29. In both pathways heterodistyly, either with 10 or 5 fertile stamens, is an intermediate stage.

The two most advanced types of heterostyly are discussed below.

a. Dioecism

In *Connaraceae* dioecism is rare. Only the Asiatic *Ellipanthus beccarii* is unquestionably dioecious. However, in this species seemingly bisexual flowers may occur as well, while in other Asiatic, usually bisexual *Ellipanthus* species, unisexual flowers may be present (e.g. the closely related *E. tomentosus*). In several South American *Connarus* species unisexual flowers are found as well, but this was not sufficiently investigated as there was not much material available. Functionally female flowers often seem to possess normally developed long stamens, but the anthers are empty or they contain poorly developed pollen only. Functionally male flowers may have a carpel that is either distinctly rudimentary or only somewhat reduced in size, i.e. with a somewhat smaller ovary and a poorly developed stigma. Leenhouts (1958b) remarked that 'in the protandrous *E. tomentosus* var. *gibbosus* it is sometimes difficult to establish whether the stamens have been or the pistil will be fertile'. It is sometimes difficult to establish whether flowers are uni- or bisexual.

b. Homostyly

A situation close to homostyly is found in one species only: *Cnestis ferruginea*. It resembles the situation called quasi-homostyly by Ganders (1979). Possibly *Cnestis ferruginea* is self-compatible. Wyatt (1983, as modified from Ornduff, 1969) published a list of characteristics that often differ between outcrossing species and their selfing derivates. Table 3 shows the character-states, found in *C. ferruginea* that may indicate autogamy, and outcrossing respectively, compared to the list of Wyatt. This species shows rather many characteristics, that are usually found in autogamous plants and that consequently indicate possible self-compatibility.

As a rule, plants with homostyly, as derived from heterostyly, are self-compatible and self-pollinating (Ganders, 1979).

It is curious, however, that a plant grown in the greenhouse in Wageningen flowers regularly, but it never sets fruit. Possibly some activity by insects is necessary in order to accomplish pollination, as is known in some other autogamous plants.

5.4 Comparison of heterostyly and dioecism in *Connaraceae* with other families

Heterostyly is known in plants of many different families, that are not necessarily related (table 4). Consequently, heterostyly must have evolved independently on several occasions. According to Vuilleumier (1967), breeding systems are adaptive or flexible under different environmental conditions. This could explain the convergent evolution of heterostylous breeding systems, and the many different types of heterostyly, found in some families, like *Connaraceae*. For a survey see Ganders (1979).

Considering heterostyly as a polyphyletic breeding system, it is rather surprising that heterostylous species in different families show many similar structures,

Table 3. Character-states of *Cnestis ferruginea* indicating possible outcrossing and autogamy respectively, as compared to the list of Wyatt (1983)

outcrossing
Flowers many
autogamy
Petals small
Anthers adjacent to stigma
Pistils short
Stamens equal in length to pistil
Many follicles maturing per flower
Wide distribution

Table 4. Families with heterostylous species

Heterodistylous species	Heterotristylous species
Boraginaceae	
Clusiaceae	
Connaraceae	*Connaraceae*
Erythroxylaceae	
Gentianaceae	
Iridaceae	
Leguminosae	
Linaceae	*Linaceae*
Loganiaceae	
Lythraceae	*Lythraceae*
Menyanthaceae	
Olacaceae	
Oleaceae	
Oxalidaceae	*Oxalidaceae*
Plumbaginaceae	
Polygonaceae	*Pontederiaceae*
Primulaceae	
Rubiaceae	
Santalaceae	
Saxifragaceae	
Sterculiaceae	
Turneraceae	

tendencies, and developments. In many aspects *Connaraceae* agree with other heterostylous families, as illustrated below.

1. Like in all other heterostylous species with two whorls of stamens, the inner (epipetalous) stamens of *Connaraceae* are shorter than the outer (episepalous) stamens.

2. The morphological differences in pistils and stamens shown by heterostylous flowers are usually related to a physiological self-incompatibility system. In *Connaraceae*, information about this system is scarce. According to Baker (1962) *Rourea coccinea* is largely, but not completely, self-incompatible. Seed setting usually followed 'legitimate' cross-pollination (long × short and vice versa).

3. Heterotristyly is rare and found only in a few species in *Pontederiaceae*, *Lythraceae*, *Oxalidaceae*, *Linaceae*, and *Connaraceae*. In all these families, closely related di- or monomorphic species, are found. The trimorphic species are usually regarded as primitive. Lewis (1975) found a situation comparable with *Connaraceae* in *Pemphis* (*Lythraceae*), as did Ornduff (1964), while Weller & Denton (1976) did so in *Oxalis*.

4. Just as the transition of tristyly towards distyly is commonplace, according to Vuilleumier (1967) a development towards dioecy and homostyly occurs just as frequently.

Darwin (1877) was the first to suggest that a dioecious species (*Rhamnus cathand articus*) had a heterostyled ancestor. Later, more examples of evolution of dioecy from heterostyly (usually distyly) have been reported. See Bawa (1980) for a survey.

In all dioecious taxa that have evolved from distylous ancestors, male flowers apparently are derived from short-styled and female from long-styled flowers. Bawa also states that unisexuality is often found in taxa with large, few-seeded, animal-dispersed fruits. These phenomena occur in *Connaraceae*.

5. Compared to their heterostylous relatives, the homostyles often inhabit a larger area of distribution (Weller & Denton, 1976; Ganders, 1979) and they often have a more 'weedy' character (Ornduff, 1964; Vuilleumier, 1967). *Cnestis ferruginea*, the only *Connaraceae* that is approximately homostylous, is widespread, and is one of the most common species of *Connaraceae* in many countries, often found on formerly cultivated places and in secondary regrowths.

6. Ganders (1979) reconstructed pathways by which on the one hand distyly and on the other tristyly may have evolved into other breeding systems. According to Ganders the evolutionary breakdown of heterodistyly leads to homostyly, monomorphy, and dioecy, and that of heterotristyly results in quasi-homostyly, semi-homostyly, monomorphy, and distyly. It is surprising how well the schematic representation of the hypothetical evolution of heterostyly in *Connaraceae* fits in Gander's diagrams. In fact, it combines both diagrams, illustrating the enormous diversity of heterostyly in this family.

Connaraceae differ in some other aspects from most other heterostylous families.

1. The stigmas of the floral morphs may differ in shape, size or, more commonly, in the size of the stigmatic papillae. In many species of *Connaraceae* such differences in the stigmas are found, but they are not or hardly related to the length of the style, except in species with functionally unisexual flowers. Andreas & Prop (1954) observed differences in the stigmas of *Cnestis palala*, but these also were not distinctly related to the style length.

2. Heterostylous species usually show differences in pollen size and number of pollen grains produced by each anther and each flower. Less frequently differences in pollen shape, colour or exine sculpturing are observed. Normally, pollen of long stamens is larger. However, in *Connaraceae* differences in pollen size and shape are not found. In 6 specimens of different species pollen grains from different whorls of stamens were measured (see table 5 and 6). Baker (1962)

Table 5. Mean diameter in µm of pollen grains in some heterotristylous species of *Connaraceae*

	short stamens	medium stamens	long stamens
Agelaea paradoxa		28.3 × 26.2	27.0 × 24.1
Agelaea rubiginosa	24.4 × 23.3		25.8 × 22.8
Manotes expansa	20.2 × 16.4	21.3 × 18.3	
Manotes griffoniana	22.3 × 18.9	23.8 × 20.3	

Table 6. Mean diameter in μm of pollen grains in some heterodistylous species of *Connaraceae*

	short stamens	long stamens
Connarus africanus (long-styled)	30.0 × 22.7	31.0 × 22.2
Rourea thomsonii (short-styled)	21.0 × 21.7	21.6 × 20.4

found no differences in pollen size in *Rourea coccinea*. Burck (1887) did find differences in pollen size in long and short stamens of medium-styled specimens of *Connarus falcatus* (= probably *C. monocarpus* ssp. *malayensis*). But he also observed that the anthers of the short stamens never open: evidently pollen of the short stamens is not fertile.

There is no family in which such a diversity in forms of heterostyly is known. This would be a stimulus for experimental research, but the habit of the plants (large forest lianas, shrubs or small trees) does not permit simple cultivation in a greenhouse. However difficult, further investigations are most desirable, particularly in genetics, compatibility, pollination, and fertility of pollen.

6. Pollen morphology

by R.H.M.J. Lemmens

Pollen of some species of *Connaraceae* has already been described by Erdtman (1952). Forero (1976) studied pollen of a number of South American species, while Eimunjeze (1976) compared pollen of *Hemandradenia* and *Ellipanthus* species. In 1979 Dickison made a survey of the pollen morphology of *Connaraceae*. Mondal & Mitra (1982) recorded biaperturate pollen to occur along with the normal triaperturate ones in some specimens of *Rourea minor* (as *R. santaloides*).

Pollen grains of some, mainly African, representatives of most genera were studied by the present author (see table 7).

Table 7. Selected pollenmorphological features of *Connaraceae*

	1	2	3	4	5	6
Agelaea paradoxa	28 × 25	1.12	PS	3-c.	fr	2.0
A. rubiginosa	25 × 23	1.09	PS	3-c.	fr	2.1
Cnestis corniculata	22 × 20	1.10	PS	3-c.	fr*	1.3*
C. polyphylla	25 × 21	1.19	SP	3-c.	r	1.4
C. racemosa	22 × 20	1.10	PS	3-c.	fr	1.6
Connarus africanus	31 × 23	1.35	P	3-c.	r	1.8
C. griffonianus	30 × 23	1.30	SP	3-c.	r	2.6
C. monocarpus ssp. *malayensis*	30 × 25	1.20	SP	3-c.	r	2.4
C. monocarpus ssp. *monocarpus*	39 × 31	1.26	SP	3-c.	r	2.4
C. semidecandrus	32 × 28	1.14	SP	3-c.	r	2.5
C. staudtii	31 × 28	1.11	PS	3-c.	r	3.0
C. thonningii	34 × 28	1.21	SP	3-c.	r	2.3
Ellipanthus hemandradenioides	33 × 35	0.94	OS	3-c.	r	2.6
E. tomentosus	30 × 30	1.00	S	3-c.	r	2.7
Jollydora duparquetiana	38 × 53	0.72	O	4-c.	cr	2.9
J. pierrei	41 × 62	0.66	O	4-c.	cr	3.0
Manotes expansa	21 × 17	1.24	SP	3-c.	fr	1.5
M. griffoniana	23 × 20	1.15	SP	3-c.	fr	1.8
Rourea myriantha	22 × 24	0.92	OS	3-c.	fr	1.9
R. solanderi	21 × 22	0.95	OS	3-c.	fr	1.5
R. thomsonii	21 × 21	1.00	S	3-c.	fr	1.6

1. Average pollen grain size in equatorial view (μm) P x E
2. Ratio of polar to equatorial axes P/E
3. Shape classification: O = oblate; OS = oblate spheroidal; S = spheroidal; PS = prolate spheroidal; SP = subprolate; P = prolate
4. Aperture type: 3-c. = 3-colporate; 4-c. = 4-colpate
5. Sculpturing type: fr = finely reticulate; r = reticulate; cr = coarsely reticulate
6. Average wall thickness

* In the specimen *J. de Wilde 8058* aberrant pollen with large bulges is found, comparable with pollen from a specimen of *Penianthus zenkeri* (Engl.) Diels (*Menispermaceae*) as found by Dekker (1983).

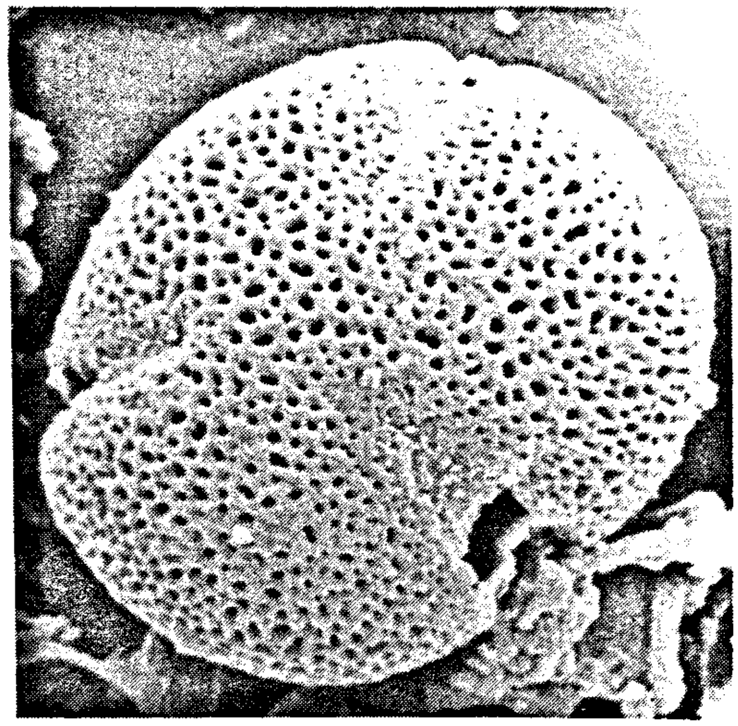


Fig. 33. Scanning electron micrograph of tricolporate pollen of *Hemandradenia mannii* (× 1500; phot. V.E. Eimunjeze).

Preparations were made according to Erdtman's acetolysis method (1952) with minor modifications as described by Arends (1989, in press), and subsequently mounted in glycerine jelly. They were studied by means of a light microscope.

Dickison (1979) studied pollen of all genera, except *Hemandradenia*, of which pollen was investigated by Eimunjeze (1976). Dickison found that pollen of *Connaraceae* is rather uniform, with the exception of that of *Jollydora*. He also described some characters that show some evolutionary advancement. Of these characters, grain size and shape can be studied already by means of a light microscope.

According to Dickison evolutionary advancement is demonstrated by increase in grain size. This trend has been described in a number of unrelated families by various authors. Pollen is comparatively small in the 5-carpellate genera *Manotes*, *Rourea*, *Cnestis*, and *Agelaea*, and according to Dickison also in *Cnestidium* and *Pseudoconnarus*. But he described very large pollen in *Rourea martiana* from South America. In the 1-carpellate genera pollen grains are usually distinctly larger, but according to Dickison some *Connarus* species from South America have small pollen, just as *Schellenbergia sterculiifolia* (now a synonym of *Vismianthus sterculiifolius*) from Asia. In the preliminary stages of our *Connaraceae* programme van den Berg made an investigation of pollen of *Vismianthus sterculiifolius*. He found no differences with the rather large pollen of *Vismianthus punctatus* and that of *Burttia prunoides*. Pollen is largest in *Jollydora*.

Dickison considered sphaerical and subsphaeroidal to be primitive, and oblate or prolate as advanced. Both last states are rare, oblate is only found

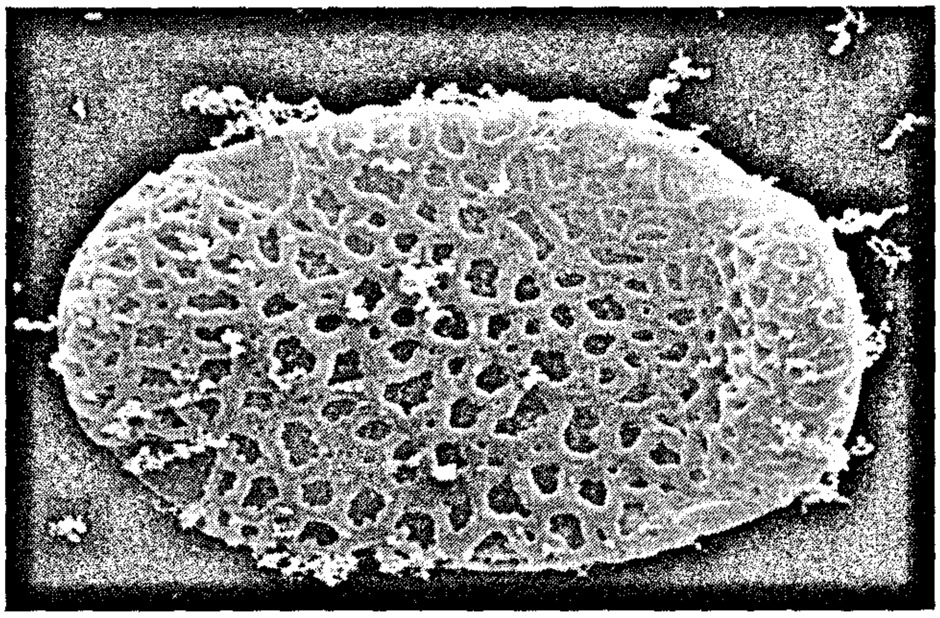


Fig. 34. Scanning electron micrograph of tetracolpate pollen of *Jollydora duparquetiana* (× 1500, phot. R.G. van den Berg).

in *Jollydora*, while prolate occurs only in some *Connarus* species and, according to Dickison and Forero (1976), in some *Rourea* species from South America as well.

Generally it can be stated that pollen in the tribes *Cnestideae* and *Manoteae* is sphaerical or subsphaeroidal and small, with a thin wall and a finely reticulate ornamentation. In *Connareae* it is suboblate to subprolate and larger, with a thicker wall, and more coarsely reticulate (fig. 33). *Jollydora* (*Jollydoreae*) shows a completely different pollen type compared to the other genera of the family. Its pollen is large, oblate and tetracolpate, with a thick wall and a coarse reticulum (fig. 34). This most unusual type is not found in any other genus of *Dicotyledons* with the single exception of *Impatiens* (Erdtman, 1952; Dickison, 1979). Combined with other characters unique in *Connaraceae*, such as habit and number of seeds per carpel (see paragraph 10.1 on phylogeny of the family), this justifies the separate position of *Jollydora* in the family.

Pollen of *Manoteae* and *Cnestideae* is probably primitive. In *Connareae* and particularly in *Jollydora*, it is considered to be advanced. Within the tribes and genera evolutionary advancement, as described by Dickison, is sometimes found as well.

With the exception of *Jollydora*, the study of pollen grains does not provide a useful delimitation of the genera but it does support the assumed relationships of the genera in the family as well as the proposed classification in tribes.

7. Chromosome numbers

by J.C. Arends

The 2n chromosome numbers as found in the various species are presented in Table 8. At present, there is karyological information on African taxa only. The information pertains to 10 out of 50 species and 6 out of 10 genera recognized in this study.

The numbers indicate that there are two groups, one group comprises taxa with 2n = 32 and the other 2n = 28 or, in a single case 2n = 26.

In 1976 I presented evidence that *Hemandradenia chevalieri* has 2n = 32 (see Eimunjeze, 1976). At that time it was suggested that there might be infraspecific

Table 8. Chromosome numbers in species of *Connaraceae*

	2n	Reference
1. *Agelaea paradoxa* Gilg [as *Castanola paradoxa* (Gilg) Schellenb.]	28	Mangenot*
2. *A. pentagyna* (Lam.)Baill. [as *A. obliqua* (P. Beauv.)Baill.]	28	Mangenot*
idem coll. de Koning 615, Ivory Coast	28	#
3. *Cnestis ferruginea* Vahl ex DC.	28	Mangenot*
4. *Connarus griffonianus* Baill. coll. Breteler 9011, Gabon	c. 32	# #
5. *Hemandradenia chevalieri* Stapf	28	Mangenot*
idem	32	Arends**
6. *Manotes expansa* Sol. ex Planch. [as *M. longiflora* Baill.]	26	Mangenot*
7. *M. griffoniana* Baill. coll. Breteler 8537, Gabon	28	# #
8. *Rourea coccinea* (Thonn. ex Schum.)Benth. [as *Byrsocarpus coccineus* Schum. et Thonn.]	28	Mangenot*
idem, coll. Breteler 8542, Gabon	c. 28	#
9. *R. minor* (Gaertn.)Alston [as *Santaloides afzelii* (R. Br.)Schellenb.	28	Mangenot*

\# = new data, # # = species investigated for the first time
* = Mangenot & Mangenot, 1962; ** = Arends in Eimunjeze, 1976

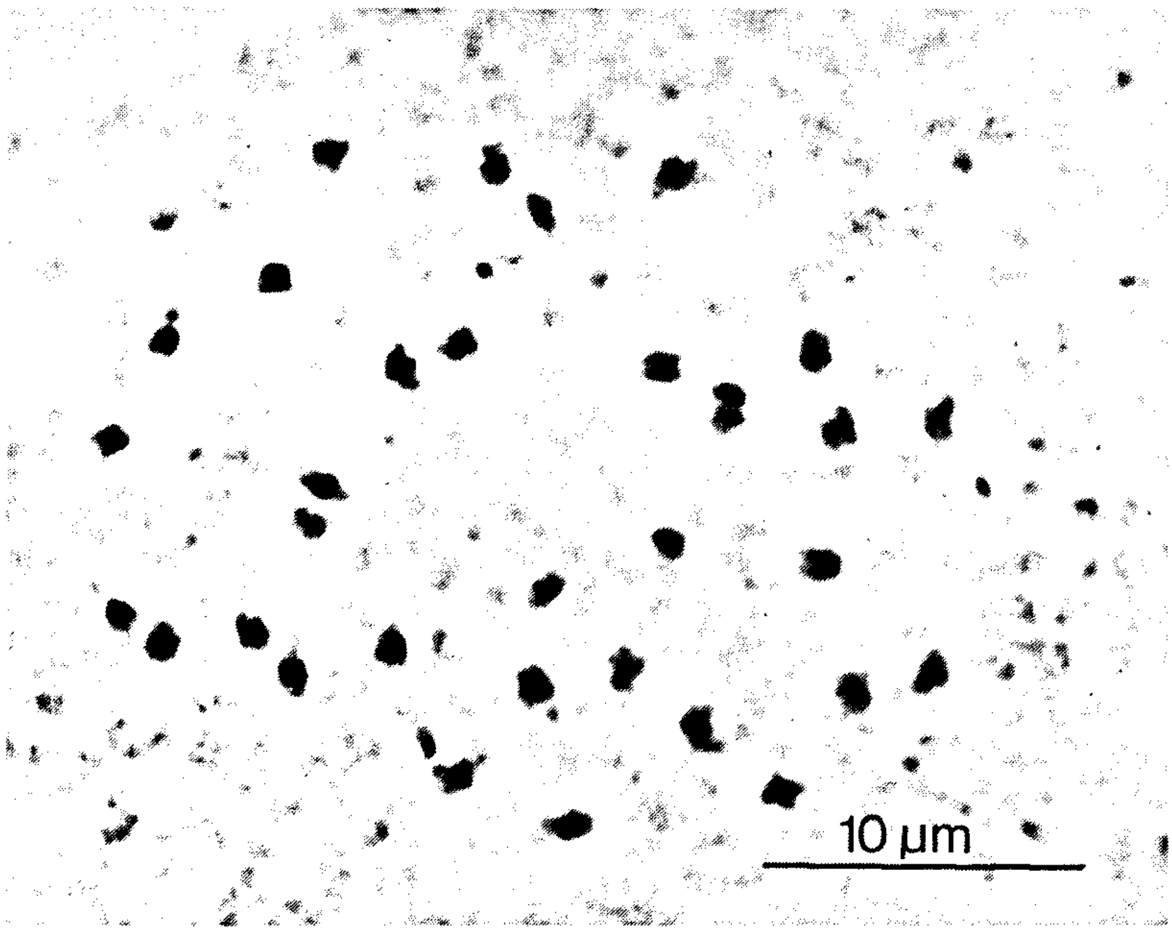


Fig. 35. *Hemandradenia chevalieri*: Metaphase plate in root tip cell, 2n = 32.

chromosomal variation in that species, as Mangenot & Mangenot (1959, 1962) reported 2n = 28. *H. chevalieri* belongs to the tribe *Connareae*, of which *Connarus griffonianus* has 2n = 32 as well. It is possible that the count of 2n = 28 by Mangenot & Mangenot (op. cit.) is either a misinterpretation of the cells analyzed, or has been found in a seedling of another species. This cannot be verified as these authors did not refer to any collection. In the two root tips of a single young seedling of *Connarus griffonianus* 2n = 31 and 2n = 34 has been counted as well. The preparation was rather difficult of analysis, and further material is needed before it can be ascertained that its chromosome number is 2n = 32 indeed.

The remainder of the species listed in the Table belong to either the tribe *Manoteae* or *Cnestideae*. These sections are characterized by 2n = 28.

The somatic chromosomes of the *Connareae* have a length ranging from c. 0.5 to 1 µm (see Fig. 35), reproduced from Eimunjeze, 1976), whereas those seen in the present study in the *Manoteae* and *Cnestideae* range from c. 1 to 2 µm. Thus it appears that the karyotype in the *Connareae* differs from that in the other tribes in both number and length of the chromosomes.

Although the present evidence is far from conclusive, it could be postulated that 2n = 32 represents a derived chromosomal condition, as it is found in the tribe that is characterized by quite a few other advanced character states (see paragraph 10.1). Further investigation is needed to support this hypothesis.

8. Wood anatomy

by R.W. den Outer and W.L.H. van Veenendaal

8.1 Summary

The secondary xylem of 54 species belonging formerly to 19 genera of *Connaraceae* was studied, in order to contribute to a natural classification and generic delimitation in the family.

A general wood anatomical description is given of the family, based on our investigations and measurements made by Veenendaal (1964). Separate generic descriptions are also presented. Dickison's (1972) wood anatomical data on this family have been incorporated in the descriptions and discussion. Wood anatomically four groups of genera are recognized, mainly based on the composition of the ground tissue. Two of these groups are divided into smaller subgroups. These groups of genera are:

A. *Manotes*;

B. 1. *Rourea* with *Byrsocarpus*, *Jaundea* and *Paxia*; 2. *Santaloidella*, *Santaloides*, *Spiropetalum* and *Pseudoconnarus*; 3. *Cnestidium*, *Cnestis* and *Bernardinia*. The first two genera of subgroup 3 cover a wide range of wood anatomical characters;

C. *Agelaea* with *Castanola*;

D. 1. *Connarus* with *Ellipanthus* and *Hemandradenia*; 2. *Jollydora* and *Burttia*.

In the series mentioned above *Manotes* has the most primitive wood structure, *Connarus* with *Burttia* as an extreme has the most advanced wood anatomy. Within each group the genera resemble each other in many aspects. The reduction however of all group genera to the representing group genus (*Manotes*, *Rourea*, *Agelaea and Connarus*, respectively), based on wood anatomical characters only, is not justified. On the other hand support can be found in wood characters to place some genera in synonymy under the representative one, e.g. the reduction of *Byrsocarpus* to *Rourea* and *Castanola* to *Agelaea*. Also the genera *Santaloidella*, *Santaloides* and *Spiropetalum* can be reduced to a single genus, and *Hemandradenia* placed in *Ellipanthus*.

8.2 Introduction

All members of the homogenous, natural, pantropical family *Connaraceae* are woody. There are 16 (Heywood, 1979) to 24 (Record, 1947; Stoffers, 1982) genera of usually small trees, erect or scandent shrubs, climbers and lianas. Several plant taxonomists feel that the large number of genera has to be reduced. Wood anatomical evidence is often useful in matters of generic delimitation.

Metcalfe and Chalk (1950) have summarized the earlier wood anatomical literature on the family. Dickison's study of 1972 is the most comprehensive account of wood anatomical diversity to date. Since he mainly discussed the taxonomic relationships of the family *Connaraceae* as a whole and not or only to a minor extent generic delimitation, the present investigation was undertaken. The samples used by Dickison and by us are almost entirely different. We mainly studied African samples, whereas Dickison (1972) has used material from South America and Asia. Data from both studies may give a more representative wood anatomical description of the family and provide more reliable differences between the genera.

8.3 Materials and methods

This investigation is mainly based on material from tropical Africa but also some material from tropical South America was used. The species studied are listed below, arranged alphabetically, viz. 99 samples belonging to 54 species and 19 genera. The Uw (v) material was investigated by Veenendaal (1964; 34 samples belonging to 20 species and 9 genera); the results of his measurements were used in this study. The results of the measurements by Dickison (1972; table II of his publication) were added to our general wood anatomical descriptions. Dickison (1972) investigated 81 samples, belonging to 45 species and 13 genera (*Manotes* excluded). Only 8 samples of these are the same as those used by us.

Anatomical features were studied in transverse, radial and tangential sections and macerations. All sections were embedded in Kaiser's gelatin-glycerin. Means and ranges of the different characters are based on at least twenty-five individual measurements. Tangential vessel diameters are given and vessel-member length was measured including the tails. In the wood description quantitative data are given as mean values between extremes, usually followed by the range of means. We have used the definition of libriform fibres and fibre-tracheids given by Reinders (1935) and Janssonius (1940), viz.:

Fibre-tracheid. Moderately elongated; commonly with thick and apparently somewhat swollen walls, rarely with mucilaginous layers; hardly ever septate; never containing starch; rather often annularly or spirally thickened; having rather large bordered pits with lenticular to slit-like apertures. The pits are comparatively numerous in the tangential walls, in many instances outnumbering those in the radial. When such fibres constitute the ground tissue, the pits towards the vessels ordinarily have borders of much the same size as those of pits in the walls of contact of two vessels.

Libriform woodfibre. Much elongated; mostly with relatively thick walls, without swollen appearance and rather often with mucilaginous layers; hardly ever annularly or spirally thickened; sometimes septate by very thin, commonly unpitted partition walls formed after secondary thickening of the fibre walls, the septate and non-septate types often occurring together; often containing starch (in sapwood) or crystals; having simple pits or pits with narrow borders and slit-like apertures (or rarely both kinds). In the tangential walls, pits are commonly much less numerous than in the radial and may be entirely lacking; in the parts of the wall adjacent to vessels they are absent or few. The bordered pits leading to parenchyma cells are often more numerous and their borders somewhat larger than those to fibres of the same kind.

List of studied material

Each name is followed by an abbreviation of the location of wood sample and herbarium voucher, collector and number, geographical origin, and habit. Lw = state herbarium University of Leiden; Uw = systematic botany, University of Utrecht; Uw(v) = systematic botany, University of Utrecht (slides and measurements made by Veenendaal were used); WLw = department of Plant Cytology and Morphology, Agricultural University, Wageningen; WTw = Plant Taxonomy, Agricultural University, Wageningen; — = name adopted in this revision (arguments are only partly based on wood anatomical characters, except in three cases indicated by *, which are entirely based on Forero's (1983) Flora treatment).

Agelaea pentagyna (Lam.) Baill.: Uw(v), *Breteler 1777*, Cameroun, liana, syn. *A. dewevrei* De Wild. et Dur.; WTw and Uw(v), *Breteler 1351* and *1738*, Cameroun, liana, syn *A. floccosa* Schellenb.; WLw, *Versteegh and Jansen 767*, Liberia, liana, syn. *A. nitida* Sol. ex Planch.; WLw, *Versteegh and Den Outer 140*, Ivory Coast, shrub, syn. *A. obliqua* (P. Beauv.) Baill.; Uw(v), *Breteler 1280, 2330* and *2949*, Cameroun, liana, syn. *A. obliqua* (P. Beauv.) Baill.

Agelaea rubiginosa Gilg: WTw and Uw(v), *Breteler 1749*, Cameroun, liana.

Agelaea poggeana Gilg: WTw, *Bos 5514A*, Cameroun, liana.

Bernardinia fluminensis (Gardn.) Planchon var. *fluminensis*: WTw, *De Saint-Hilaire Cat. C2, no27*, Brazil, – *Rourea fluminensis* (Gardn.) Jongkind.

Burttia prunoides Bak. f. et Exell: WTw, *Burtt 3035*, Tanzania, shrub.

Byrsocarpus coccineus Thonn. ex Schum.: WLw, *Versteegh and Den Outer 238*, Ivory Coast, liana, – *Rourea coccinea* (Thonn. ex Schum.) Benth. ssp. *coccinea* var. *coccinea*.

Byrsocarpus maximus Baker: Uw, *Schlieben 5454*, Tanzania, small tree, – *Rourea coccinea* (Thonn. ex Schum.) Benth. ssp. *boiviniana* (Baill.) Jongkind.

Byrsocarpus orientalis (Baill.) Baker: Uw, *Schlieben 5444*, Tanzania, small tree, – *Rourea orientalis* Baill.

Byrsocarpus viridis (Gilg) Schellenb.: WTw and Uw(v), *Breteler 2831*, Cameroun, liana, – *Rourea coccinea* (Thonn. ex Schum.) Benth. ssp. *coccinea* var. *viridis* (Gilg) Jongkind; Uw(v), *Breteler 2961*, Cameroun, liana, – *Rourea coccinea* (Thonn. ex Schum.) Benth. ssp. *coccinea* var. *viridis* (Gilg) Jongkind.

Castanola paradoxa (Gilg) Schellenb. ex Hutch. et Dalz.: WLw, *Versteegh and Den Outer 651*, Ivory Coast, liana, – *Agelaea paradoxa* Gilg; WTw and Uw(v), *Breteler 1889*, Cameroun, liana, – *Agelaea paradoxa* Gilg.

Cnestidium guianense (Schellenb.) Schellenb.: Uw, *Stahel and Gonggrijp 269*, Suriname, liana; Uw, *Van Donselaar 3077*, Suriname, liana; WTw, *Breteler 3773*, Venezuela, liana.

Cnestis corniculata Lam.: WTw, *Breteler 8154*, Gabon, liana; WTw, *Breteler 8286*, Gabon, lianescent treelet.

Cnestis ferruginea Vahl ex DC.: Uw(v) and WTw, *Breteler 868*, Cameroun, liana; WLw, *Versteegh and Jansen 806*, Liberia, shrub.

Cnestis cf. *longiflora* Schellenb.: WLw, *Versteegh and Den Outer 124*, Ivory Coast, shrub, – *C. corniculata* Lam.

Cnestis polyphylla Lam.: WLw, *Van Veenendaal and Den Outer 1182*, Madagascar, shrub.

Cnestis uncata Lemmens: WTw, *Breteler 8304*, Gabon, lianescent shrub.

Connarus africanus Lam.: WTw, *Leeuwenberg 5091*, Cameroun, liana, – *C. congolanus* Schellenb.

Connarus coriaceus Schellenb.: Uw and Uw(v), *Lanjouw and Lindeman 1870*, Suriname, liana.

Connarus erianthus Benth. ex Baker var. *stiptatus* Forero: Uw and Uw(v), *Krukoff 6042*, Brazil, small tree.

Connarus fasciculatus (DC.) Planchon spp. *fasciculatus*: WTw, *Wessels Boer 1569*, Suriname, small tree.

Connarus fasciculatus (DC.) Planchon spp. *pachyneurus* (Radlk.) Forero: Uw, *Krukoff 6240*, Brazil, syn. *C. klugii* Standley.

Connarus griffonianus Baill.: Uw(v), *Breteler 846*, Cameroun, liana; Uw(v) and WTw, *Breteler 1850*, Cameroun, liana.

Connarus klugii Standley: Uw(v), *Krukoff 6240* and *6977*, Brazil, small tree, – **C. fasciculatus* (DC.) Planchon ssp. *pachyneurus* (Radlk.) Forero.

Connarus lambertii (DC.) Sagot: Uw, exchange Florence (Italy), South America, liana.

Connarus marlenei Forero: Uw, *Prance and Maas 11242*, Brazil, shrub.

Connarus nervatus Cuatr.: Uw, *Cuatrecasas 17349*, Colombia, liana, syn. *C. spucei* Baker.

Connarus patrisii (DC.) Planchon: Uw, *Lindeman and Heyde 90*, Suriname, liana.

Connarus perrottetii (DC.) Planchon var. *perrottetii*: Uw, *Maguire et al. 51504*, Brazil, liana.

Connarus perrottetii (DC.) Planchon: WTw, *Breteler 3873*, Venezuela, liana, – **C. perrottetii* (DC.) Planchon var. *angustifolius* Radlk.; Uw(v), *Maguire and Stahel 24897*, Suriname, liana, – **C. perrottetii* (DC.) Planchon var. *perrottetii*; Uw(v), *Lanjouw and Lindeman 2043*, Suriname, shrub- liana.

Connarus punctatus Planchon: Uw and Uw(v), *Lanjouw and Lindeman 1409*, Suriname, liana- shrub.

Connarus rostratus (Vell.) L.B. Smith: Uw and Uw(v), *Reitz 14896*, Brazil, liana-shrub.

Connarus spec.: Uw(v), *Lindeman 5116*, Suriname, liana, – **C. punctatus* Planchon.

Ellipanthus tomentosus Kurz var. *luzoniensis* Vidal: Lw, *Van Balgooy 3950*, Celebes (Sulawesi, Indonesia), tree.

Hemandradenia mannii Stapf.: WTw, *De Wilde 8321*, Cameroun, tree.

Jaundea pubescens (Baker) Schellenb.: WTw, *Bos 5421*, Cameroun, liana-small tree, – *Rourea thomsonii* (Baker) Jongkind.

Jollydora duparquetiana (Baill.) Pierre: WTw, *Leeuwenberg 5039*, Cameroun, tree; WTw, *Louis et al. 1256*, Gabon, treelet; WTw, *Louis et al. 1332*, Gabon, treelet.

Manotes expansa Sol. ex Planch.: WLw, *Versteegh and Den Outer 549*, Ivory Coast, shrub, syn. *M. longiflora* Baker; WTw, *Breteler 8078*, Gabon, lianescent shrub.

Manotes griffoniana Baill.: WTw and Uw(v), *Breteler 1677*, Cameroun, liana, syn. *M. zenkeri* Gilg ex Schellenb.; Uw(v), *Breteler 1276*, *1302* and *1708*, Cameroun, liana, syn. *M. zenkeri* Gilg ex Schellenb.

Paxia myriantha (Baill.) Pierre: WTw, *De Wilde et al. 511*, Gabon, liana, – *Rourea myriantha* Baill.

Pseudoconnarus agelaefolius Cuatr.: Uw, *Cuatrecasas 17334*, Colombia, liana.

Pseudoconnarus rhynchosioides (Standley) Prance: Uw, *Krukoff 8304*, Brazil, liana.

Pseudoconnarus subtriplinervis (Radlk.) Schellenb.: Uw, *Van Donselaar 2363*, Suriname, liana.

Rourea accrescens Forero: Uw and Uw(v), *Krukoff 6795*, Brazil, liana, syn. *R. rectinervia* A.C. Smith.

Rourea calophylloides (Schellenb.) Jongkind: WTw, *Breteler 8007*, Gabon, liana.

Rourea cf. *cuspidata* Benth. ex Baker: Uw(v), *Lindeman 6891*, Suriname.

Rourea frutescens Aubl.: Uw, *Irwin et al. 47891*, Brazil, liana- shrub.

Rourea krukovii Steyerm.: Uw, *Maguire et al. 56706*, Brazil, liana.

Rourea paraensis Forero: Uw, *Van Donselaar 3502*, Suriname, liana.

Rourea puberula Baker: Uw, *Maguire et al. 56884*, Brazil, liana.

Rourea pubescens (DC.) Radlk. var. *spadicea* (Radlk.) Forero: Uw, *Van Donselaar 3502*, Suriname, liana; Uw(v), *Lindeman 4807*, Suriname, liana.

Rourea surinamensis Miq.: Uw(v), *Lindeman 6857*, Suriname, liana; Uw, *Van Donselaar 3794*, Suriname, liana.

Rourea thomsonii (Baker) Jongkind: WTw, *Breteler 8096*, Gabon, liana.

Santaloidella gilletii Schellenb.: WTw and Uw(v), *Breteler 1649*, Cameroun, liana, – *Rourea parviflora* Gilg; Uw(v), *Breteler 1304*, Cameroun, liana, – *Rourea parviflora* Gilg.

Santaloides afzelii (R. Br. ex Planch.) Schellenb.: WLw, *Versteegh and Den Outer 468*, Ivory Coast, small tree-liana, – *Rourea minor* (Gaertn.) Alston.

Santaloides spec.: Lw, *Jacobs 9634*, West New-Guinea, liana, – *Rourea minor* (Gaertn.) Alston.

Spiropetalum heterophyllum (Baker) Gilg: WTw and Uw(v), *Breteler 1217*, Cameroun, liana, – *Rourea solanderi* Baker.

Spiropetalum reynoldsii (Stapf) Schellenb.: WLw, *Versteegh and Den Outer 79*, Ivory Coast, liana, – *Rourea solanderi* Baker.

8.4 Results

A general description of the secondary xylem of the *Connaraceae* is given below. The wood appears to be comparatively uniform. Yet in our opinion four groups of genera can be distinguished, viz. a *Manotes* (A)-, *Rourea* (B)-, *Agelaea* (C)- and *Connarus* (D)-group. A short description of these four genera, mainly based on differences from the general description, and the genera belonging to these groups are also given. A summary of characters of the investigated genera is represented in table 9; furthermore an identification key is given for the genera or groups of genera in table 10. See also figs.36-51.

General family description

Growth rings are generally present (absent in *Manotes* and *Hemandradenia*) but not always distinct, often marked by smaller radial diameters of the late wood fibres and/or crystals in the late wood fibres; wood diffuse-porous.

Vessels exclusively solitary or solitary, in short radial multiples and in clusters, very rarely in chains (some *Agelaea* and *Cnestis* species); variable in size (medium-sized vessels next to small ones), number and arrangement even in the same specimen (in lianous members two distinct patterns of xylem development may be present, see Dickison, 1972); round to oval in cross section; average number per square mm 26 (range of means 3-410 per square mm); tangential diameter (15-)125(-420) µm (range of means 25-215 µm); thin-walled (2-3 µm). Vessel-member length (140-)535(-1250) µm (range of means 220-910 µm); perforations exclusively simple, slightly oblique to transverse; spiral thickenings occasionally present in vessel ligules (*Hemandradenia*, *Spiropetalum heterophyllum*); inter-vessel (tracheal) pits bordered (vestured in *Santaloides afzelii*), not crowded, usually alternate, main horizontal diameter 7 µm (range of means 4-11 µm). Besides with rays, vessels usually in contact with tracheids, often also with libriform fibres, sometimes with axial parenchyma. Vessel-ray pitting very distinctive, simple, sometimes half bordered, horizontal diameter 10 µm (range of means 6-20 µm); vessel-axial parenchyma pits are also conspicuous and mostly simple. Tyloses rather common (in 35% of the samples), but very changeable. Gum-like substances present in vessels of *Spiropetalum*.

Ground tissue usually libriform fibres together with fibre-tracheids (in the surroundings of vessels) and/or vasicentric tracheids, sometimes only fibre-tracheids (*Manotes*), or only libriform fibres (*Connarus*, *Jollydora*, *Hemandradenia*, *Burttia* and *Ellipanthus*).

Libriform fibres usually moderately thin-walled, mean wall-thickness 4 µm (range of means 3-4 µm), septate (in *Connarus marlenei* partly septate and in *Cnestidium guianense* non-septate); with simple, sometimes minutely bordered pits with slit-like inner apertures, equally infrequent on both radial and tangential walls; length (220-)760(-1280) µm (range of means 340-1085 µm); often chambered and crystalliferous; very rarely with spiral thickenings (*Hemandradenia*, *Spiropetalum heterophyllum*, *Connarus griffonianus*, *Agelaea*). Regularly two types of libriform fibres present, viz. one type with thick walls, outline in cross section more or less rectangular, without intercellular spaces or with narrow spaces, without starch; the other type with thinner walls, outline in cross section circular, with large intercellualr spaces between them and/or differing in contents (often starch). In transverse sections these thin-walled fibres resemble bands or patches of axial parenchyma.

Fibre-tracheids with large bordered pits on both radial and tangential walls, somewhat shorter than libriform fibres; occasionally with spiral thickenings; no contents.

Parenchyma (axial) absent or very scanty diffuse, diffuse in aggregates and paratracheal (*Agelaea, Castanola*); only in *Manotes* rather abundant, often banded. Sometimes in long crystalliferous strands among the fibres, for instance in *Ellipanthus* (cf. Janssonius, 1918).

Rays exclusively uniseriate or with a few biseriates, in *Agelaea*, *Castanola* and *Burttia* (1-)2(-3)-seriate, in *Connarus lambertii* (1-)2(-4)-seriate, in *Connarus klugii* (1-)3(-5)-seriate; heterocellular (only in 9% of the samples homocellular), but rather often composed of predominantly square or upright cells (52% of the samples; only in 5% of the samples composed of predominantly procumbent cells); height (1-)11(-80) cells (range of means 4-22 cells) or 275(-2450) μm (range of means 125-650 μm; (2-)15(-25) per tangential mm (range of means 4-20 per tangential mm); often filled with brown, gummy substances, sometimes with silica globules (*Connarus, Agelaea, Santaloidella, Rourea*) or crystals; sheath cells only found in *Connarus klugii*; pits to vessels large (see under vessels).

Crystals often present (in 68% of the samples), usually in crystalliferous fibres, less frequently in axial parenchyma, seldom in ray parenchyma cells; rare or absent in *Rourea*, *Byrsocarpus*, *Spiropetalum* and *Pseudoconnarus*; exclusively solitary, prismatic or pyramidal in shape.

Silica grains occur in the parenchymetous tissues of neotropical genera *Pseudoconnarus* and *Rourea*, none were observed in *Cnestidium* and *Connarus*; the African species *Connarus griffonianus*, unlike the neotropical species of this genus, contains silica in the ray cells (Ter Welle, 1976). According to Mennega and Veenendaal (unpublished results; Ter Welle, 1976) all samples of *Agelaea* from Cameroun show the same silica distribution pattern as *Pseudoconnarus*, *Byrsocarpus*, *Jaundea* and *Rourea*.

Latex tubes (or mucilage canals) longitudinal and/or radial, observed in *Connarus*.

Pith flecks regularly present (in 19% of the samples), rather often in *Agelaea*, *Byrsocarpus*, *Jaundea* and *Rourea*.

Intercellular canals of the vertical type often present in libriform tissue of the second type with thin-walled fibres.

Included phloem of the concentric type often present in *Agelaea*, *Santaloidella* and *Santaloides*.

Description of the four group representatives

A. **Manotes**

Growth rings indistinct.

Vessels exclusively solitary; average number per square mm 11 (range of means 7-31 per square mm); tangential diameter (15-)190(-415) μm (range of means 70-215 μm). Vessel-member length (255-)730(-960) μm (range of means 385-865 μm); inter-vessel pits 7 μm (range of means 6-8 μm). Besides with ray parenchyma, vessels in contact with fibre-tracheids and axial parenchyma. Main horizontal diameter vessel-ray pits 11 μm (range of means 10-13 μm). Tyloses absent.

Ground tissue, composed of fibre-tracheids; length (560-)895(-1280) μm (range of means 745-945 μm); mean wall thickness 5 μm (range of means 4-6 μm).

Parenchyma in long tangential bands, 4-8 cells wide, (1-) often 3 per radial mm; also aliform; chambered crystalliferous cells often present.

Rays 1(-2)-seriate, heterocellular with predominantly square and upright cells; height (1-)15(-52) cells (range of means 12-18 cells) or 340(-1295) μm (range of means 320-355 μm); (11-)18(-20) per tangential mm (range of means 13-19 per tangential mm).

Crystals always present.

B. **Rourea**

Growth rings fairly distinct.

Vessels solitary but sometimes also in radial multiples and clusters; average number per square mm 10 (range of means 6-14 per square mm); tangential diameter (25-)165(-400) μm (range of means 110-210 μm), Dickison's measurements (26-)124(-323) μm (range of means 53-199 μm). Vessel-member length (200-)600(-1040) μm (range of means 400-825 μm), Dickison's measurements (145-)609(-1024) μm (range of means 474-673 μm); diameter inter-vessel pits 7 μm (range of means 6-8 μm). Besides with ray parenchyma, vessels usually in contact with fibre-tracheids. Vessel-ray pits simple, mean horizontal diameter 11 μm (range of means 8-20 μm).

Ground tissue libriform fibres and up to 40% fibre-tracheids (and/or vasicentric fibre-tracheids). Mean wall thickness of libriform fibres 4 μm (range of means 3-6 μm); length (320-)850(-1120) μm (range of means 705-1010 μm), Dickison's measurements (242-)739(-1131) μm (range of means 603-857 μm); libriform often in two types: one with large intercellular spaces in earlywood and/or lumina of fibres of 16-20 μm, and the other with small intercellular spaces in latewood and/or fibre lumina of 8-12 μm.

Parenchyma absent or rare.

Rays 1(-2)-seriate, often exclusively uniseriate; heterocellular without domination of a certain cell type; height (1-)11(-50) cells (range of means 7-17 cells) or 300(-1120) μm (range of means 200-445 μm), Dickison's measurements

(1-)9(-32) cells (range of means 8-11 cells); (9-)15(-20) per tangential mm (range of means 14-17 per tangential mm); ray cells regularly with silica bodies.

Crystals usually rare; when present in chambered crystalliferous cells with up to 25 compartments.

Pith flecks sometimes present.

In *Byrsocarpus* the arrangement of the vessels is more in radial multiples; tangential vessel diameters are smaller (80 against 165 μm), but the number per square mm is larger (49 against 10 per square mm); vessel-member length and libriform fibre length are shorter (420 against 600 μm and 550 against 850 μm respectively); crystals are absent. The same trends are found in *Paxia, Jaundea, Cnestis, Cnestidium* and *Bernardinia* with the exception that in *Cnestis* and *Cnestidium* the arrangement of the vessels is the same as in *Rourea*, and crystals are more abundant in the last three mentioned genera. Also in *Spiropetalum* the tangential vessel diameters are slightly smaller (135 against 165 μm), the number per square mm larger (21 against 10 per square mm), and the vessel-member length and libriform fibre length shorter (485 against 600 μm and 695 against 850 μm); in *Spiropetalum heterophyllum* (*Bret. 1217*) moreover, spiral thickenings, vertical latex ducts and patches included phloem are present. The genera *Santaloidella* and *Santaloides* too resemble *Rourea* in many aspects; only in *Santaloidella* included phloem is always present and crystals are more common, whereas in *Santaloides* included phloem is usually present and crystals absent.

In *Pseudoconnarus* the vessel-member length is shorter (450 μm against 600 μm); ground tissue libriform fibres are slightly shorter (805 against 850 μm) but fibre-tracheids comprise 50% of the axial system; crystals are absent.

C. **Agelaea**

Growth rings fairly distinct, boundaries often marked by smaller radial lumina of the fibres (regularly fibre-tracheids) and more chambered crystalliferous cells.

Vessels usually exclusively solitary, sometimes some radial multiples present; average number per square mm 13 (range of means 10-16 per square mm); tangential diameter (20-)150(-340) μm (range of means 80-210 μm), Dickison's measurements (32-)146(-323) μm (range of means 86-204 μm). Vessel-member length (195-)550(-1250) μm (range of means 410-910 μm), Dickison's measurements (204-)577(-945) μm (range of means 495-658 μm); inter-vessel pits bordered, alternate, mean horizontal diameter 5 μm (range of means 4-7 μm). Besides with ray parenchyma, vessels in contact with fibre-tracheids and very seldom with axial parenchyma. Vessel-ray pitting simple, mean horizontal diameter 10 μm (range of means 6-12 μm).

Ground tissue libriform fibres and up to 20-30% fibre-tracheids (and/or vasicentric fibre-tracheids). Libriform fibres thin-walled, mean wall thickness 4 μm; length (395-)710 (-1120) μm (range of means 520-960 μm), Dickison's measurements (296-)804 (-1644) μm (range of means 722-965 μm); sometimes with spiral thickenings, contents often starch, intercellular canals present.

Parenchyma rare or absent.

Rays (1-)2(-4)-seriate, heterocellular, often composed of more than three storeyes; height (1-)12(-65) cells (range of means 7-22 cells) or 220 (-1110) μm (range of means 145-360 μm), Dickison's measurements (1-)17(-56) cells (range of means 8-50 cells); (8-)15(-20) per tangential mm (range of means 12-18 per tangential mm); regularly filled with globular silica grains, gum and/or brown deposits.

Crystals always present, usually in crystalliferous fibres.

Pith flecks sometimes present.

Included phloem of concentric type, often present.

Latex ducts only present in one sample of *A. pentagyna* (*Bret. 1280*).

In *Castanola* the tangential vessel diameter is slightly smaller (125 against 150 μm), but the number of vessels per square mm is larger (31 against 13 per square mm); also the diameter of the inter-vessel pits is somewhat larger (7 against 5 μm). The libriform fibre walls are slightly thicker (6 against 4 μm). The main difference between *Castanola* and *Agelaea* is the absence of included phloem in *Castanola*; also spiral thickenings are absent from the fibre walls.

D. Connarus

Growth rings fairly distinct, boundaries often marked by chambered crystalliferous cells.

Vessels in radial multiples of often more than 4 vessels and in clusters; average number per square mm 22 (range of means 3-50 per square mm); tangential diameter (15-)105(-330) μm (range of means 35-180 μm), Dickison's measurements (15-)94(-307) μm (range of means 39-156 μm). Vessel-member length (200-)530(-1040) μm (range of means 360-720 μm), Dickison's measurements (210-)575(-997) μm (range of means 398-711 μm); mean horizontal diameter of inter-vessel pits 9 μm (range of means 5-11 μm). Besides with ray parenchyma, vessels usually in contact with libriform fibres and for a smaller part with fibre-tracheids. Vessel-ray pitting simple, horizontal diameter 11 μm (range of means 6-17 μm). Tyloses sometimes present.

Ground tissue usually exclusively libriform fibres; fibre-tracheids absent or rare and vasicentric. Wall thickness of libriform fibres 4 μm (range of means 3-6 μm); libriform fibres partly septated in *C. marlenei* (*Prance et Maas 11242*); length (380-)755(-1180) μm (range of means 560-1040 μm), Dickison's measurements (237-)743(-1293) μm (range of means 517-980 μm). Libriform fibres usually in two (sometimes three) types, viz. alternating bands of earlywood fibres with large intercellular spaces, large fibre lumina, starch or brown deposits, associated with latex tubes, and bands of latewood fibres with small intercellular spaces, smaller fibre lumina, without starch, brown substances or latex tubes. Spiral thickenings sometimes present, e.g. in *C. griffonianus* (*Bret. 1850*).

Parenchyma rare or absent, in *C. lambertii* (exchange Florence) more abundant, vasicentric and even confluent.

Rays exclusively uniseriate, only in *C. lambertii* (exchange Florence) (1-)2(-6)-seriate; cells predominantly square or upright, regularly homocellular (no procumbent cells at all); height (1-)10(-44) cells (range of means 4-19 cells) or 285(-1040) μm (range of means 140-495 μm), Dickison's measurements (1-)7(-28) cells (range of means 5-10 cells); (3-)15(-20) per tangential mm (range of means 4-20 per tangential mm).

Crystals always present, often abundant.

Latex tubes always present, vertical and/or horizontal ones (in rays), sometimes only in rays.

In *Jollydora*, *Hemandradenia*, *Ellipanthus* and *Burttia* the tangential vessel diameters are smaller (35, 50, 50 and 25 μm respectively against 105 μm) than in *Connarus*, but the number of vessels per square mm is larger (47, 45, 34 and 410 respectively against 22 per square mm). The vessel-member length in *Ellipanthus* is also shorter (390 against 530 μm), in *Burttia* (220 μm) much shorter. Libriform fibre length is longer in *Jollydora* (960 against 755 μm) and much shorter in *Burttia* (340 against 755 μm). Both in *Jollydora* and *Burttia* the libriform fibres are not arranged in alternating tangential bands and are partly non-septate. In *Burttia* the rays are (1-)2(-3)-seriate. The main difference however between *Connarus* and the other mentioned genera is the presence of latex tubes in *Connarus*, and the absence in the other genera.

8.5 Discussion

The secondary xylem of the *Connaraceae* is anatomically rather uniform and moderately highly specialized according to standards given by Tippo (1938, 1946), Koek-Noorman and Hogeweg (1974), Carlquist (1975) and others (see also Dickison, 1972). This rather high level of evolutionary advancement is partly caused by the fact that many species of the family are climbers or lianas. Lianous species in general show trends of specialization or phylogenetic advancement, like wider and shorter vessel elements, which are not present in species of the same family with the habit of a shrub, treelet or tree.

In spite of the homogeneity of the family, it is possible to arrange the taxa into four groups. These groups mainly differ in the composition of the ground tissue; however, also characters mentioned in Table 11 and the habit of the genera, are involved in our considerations about the group composition and arrangements. Ground tissue composition as main characteristic for the arrangement of the taxa, is also based on phylogenic views about parallel development or reversion within the family in relation to habit (liana or non-liana) transformation given by Dickison (1972). The ground tissue may consist only or nearly only of fibre-tracheids (*Manotes* group), of fibre-tracheids and libriform fibres in which case libriform fibres usually dominate (*Rourea* and *Agelaea* group) and can be composed only or nearly only of libriform fibres (*Connarus* group). In this last mentioned group a differentiation has taken place in the libriform tissue, viz. libriform fibres with thin walls, circular outline, large intercellular spaces and/or with distinct contents (starch) and libriform fibres with thick walls, rectangular outline, and without intercellular spaces or starch. These four groups can be placed in the above mentioned sequence in three successive organization levels of the hydro-system proposed by Braun (1970), namely the *Manotes* group in Braun's organization level II (Fibre-tracheid-Vessel level), the *Rourea* and *Agelaea* group in III (limited Fibre-tracheid-Vessel level) and the *Connarus* group in Braun's organization level IV (Vessel-Libriform fibre level). The average ray width in all groups is 1-seriate, only in the *Agelaea* group 2-seriate and in the genus *Burttia* as a member of the *Connarus* group. *Burttia* occupies an extreme position in comparison with the other genera, not only concerning wood anatomical characters. The parenchymatous primary cortex contains sclereids in varying number in all genera investigated by Dickison (1973b), except in *Burttia* (and *Vismianthus*). In addition most parenchyma cells contain dark-staining deposits in all genera except *Burttia* (Dickison, 1973b).

A comparison of the measurements performed by Dickison (1972; calculated from his table II) and those obtained by us, reveals that Dickison's vessel-member lengths and fibre lengths are somewhat longer, the tangential vessel diameters about equal or somewhat smaller (except *Jaundea* which is much larger) than ours (table 9). From table 9 and 11 it is clear that several wood anatomical characters gradually change if one considers the series *Manotes*, *Rourea*, *Agelaea*, *Connarus* and *Burttia*. For instance the vessel-member length and fibre length decrease, as do the percentage fibre-tracheids of the ground tissue, ray height (also the number of cells per ray) and average number of rays per tangential mm. Also the tangential vessel diameter decreases within the series mentioned above, but the number of vessels per square mm increases. This means that the vulnerability index (diameter of vessels divided by the number of vessels per square mm; Carlquist, 1977) decreases. According to criteria summarized among others by Koek-Noorman et al. (1974) and Carlquist (1975 and 1977) all characters mentioned in table 11, with the exception of tangential vessel diameter and amount of axial parenchyma, indicate that within the series *Manotes* and *Connarus* (*Burttia*) constitute the extremes, *Manotes* having the most primitive wood structure and *Connarus* (*Burttia*) the most advanced wood. The number of carpels per flower (five in the groups A, B and C and one in group D) are not opposed to the above mentioned statement. Also on bases of leaf anatomy (Dickison, 1973a) *Connarus* (and *Jollydora* but also *Bernardinia*) is considered to be more derived with multilacunar nodes. In all other more primitive genera the fundamental nodal pattern in both compound and simple-leaved genera, is trilacunar, three-traced.

On the basis of all wood anatomical characters investigated, the remaining genera of the family can be arranged, with the above mentioned group representatives, into groups of genera viz. A, B, C and D in a sequence with in each case a higher degree of evolutionary development. Group B is subdivided into three, group D into two separate smaller subgroups (see results). These genera groups are:

A. *Manotes*;
B. 1. *Rourea* with *Byrsocarpus*, *Jaundea* and *Paxia*; 2. *Santaloidella*, *Santaloides*, *Spiropetalum* and *Pseudoconnarus*; 3. *Cnestidium*, *Cnestis* and *Bernardinia*. The first two genera of subgroup 3 possess wood anatomical characters with a large variation and might be placed elsewhere;
C. *Agelaea* with *Castanola*;
D. 1. *Connarus* with *Ellipanthus* and *Hemandradenia*; 2. *Jollydora* and *Burttia*. This despite the fact that only *Connarus* possesses latex tubes.

Though all genera of a group present many similarities, the successive groups being more specialized, this does not mean that within a group the genera can be placed in all cases in synonymy under the group representative. Especially *Cnestis* and *Cnestidium* within the *Rourea* group take a somewhat exceptional position, like *Burttia* in the *Connarus* group.

For several authors there are no objections against some reductions of the number of genera. For instance Dickison (1972) does not find wood characters which are in contradistinction to the reduction of *Santaloides* and *Jaundea* to *Rourea*; for *Byrsocarpus* this is less certain. Veenendaal (1964) had the same opinion about *Byrsocarpus*, and even suggest to arrange the genus under *Agelaea*. Leenhouts (1958b) on the other hand placed *Byrsocarpus* in *Rourea*. We too find many similarities between these latter two genera, but also between *Rourea* and *Jaundea* together with *Paxia*. In our opinion also *Spiropetalum*, *Santaloidella* and *Santaloides* can be reduced to a single genus.

Veenendaal (1964) and Dickison (1972) find support in wood characters for the reduction of *Castanola* to *Agelaea*. Also from our findings it is clear that both genera resemble each other in great extent, despite the fact that included phloem is often present in *Agelaea* and absent in *Castanola*. Dickison (1973b) and Leenhouts (1958b) support the opinion that the genus *Hemandradenia* should be placed in *Ellipanthus*. Also in our point of view the last two mentioned genera could be combined, but not placed in synonymy under *Connarus* since latex tubes are absent.

Legends to figures 36-51.

Transverse sections of the secondary xylem of *Connaraceae*; 10 mm on the photographs represents 150 μm.
Position cambium near the top side of the photographs.
→ = growth-ring boundary; L = libriform fibres; Lg = libriform fibres with gelatinous layers; Ll = libriform fibres with large lumina and intercellular canals; Lt = latex tubes; P = metatracheal parenchyma; T = fibre-tracheids; V = vessels, — = name adopted in this revision.

Fig. 36. *Manotes griffoniana* Baill. (*Breteler 1677*). Growth-ring boundaries indistinct to absent. Vessels exclusively solitary. Ground tissue fibre-tracheids; metatracheal parenchyma bands only present in this genus.

Fig. 37. *Pseudoconnarus subtriplinervis* (Radlk.) Schellenb. (*Van Donselaar 2363*). Growth-ring boundaries fairly distinct. Vessels exclusively solitary. Ground tissue libriform fibres and a large number of vasicentric fibre-tracheids. Ray-parenchyma cells with brown deposits. Notice tyloses formation.

Fig. 38. *Rourea frutescens* Aubl. (*Irwin et al. 47891*). Growth-ring boundaries fairly distinct; three present on the photograph. Ground tissue like in *Pseudoconnarus* but much less fibre-tracheids.

Fig. 39. *Byrsocarpus maximus* Baker (*Schlieben 5454*) — *Rourea coccinea* (Thonn. ex Schum.) Benth. ssp. *boiviniana* (Baill.) Jongkind. Growth-ring boundaries fairly distinct. Vessels solitary but also in radial multiples and clusters. Ground tissue libriform fibres; some vasicentric fibre-tracheids.

Fig. 40. *Jaundea pubescens* (Bak.) Schellenb. (*Bos 5421*) — *Rourea thomsonii* (Bak.) Jongkind. Ground tissue libriform fibres with large lumina and intercellular canals; fibre-tracheids scarcely present, vasicentric but above all terminal.

Fig. 41. *Paxia myriantha* (Baill.) Pierre (*De Wilde et al. 511*) — *Rourea myriantha* Baill. Vessels exclusively solitary only in the first growth-ring. Ground tissue libriform fibres.

Fig. 42. *Cnestidium guianense* (Schellenb.) Schellenb. (*Van Donselaar 3077*). Growth-ring boundaries indistinct. Ground tissue (non-septate) libriform fibres, partly with gelatinous layers.

Fig. 43. *Cnestis polyphylla* Lam. (*Van Veenendaal and Den Outer 1182*). Growth-ring boundaries fairly distinct. Vessels usually solitary, sometimes in chains. Ground tissue libriform fibres.

Fig. 44. *Bernardinia fluminensis* (Gardn.) Planchon var. *fluminensis* (*De Saint-Hilaire Cat. C2, no 27*) — *Rourea fluminensis* (Gardn.) Jongkind. Vessels arranged in radial multiples but also in radial or oblique chains. Ground tissue libriform fibres; some vasicentric fibre-tracheids.

Fig. 45. *Agelaea pentagyna* (Lam.) Baill. (*Breteler 1351*). Growth-ring boundaries fairly distinct; four present on the photograph. Vessels exclusively solitary. Ground tissue libriform fibres; vasicentric fibre-tracheids present.

Fig. 46. *Castanola paradoxa* (Gilg) Schellenb. ex Hutch. et Dalz. (*Breteler 1889*) — *Agelaea paradoxa* Gilg. Growth-ring boundaries fairly distinct. Vessels exclusively solitary. Ground tissue libriform fibres; some vasicentric fibre-tracheids.

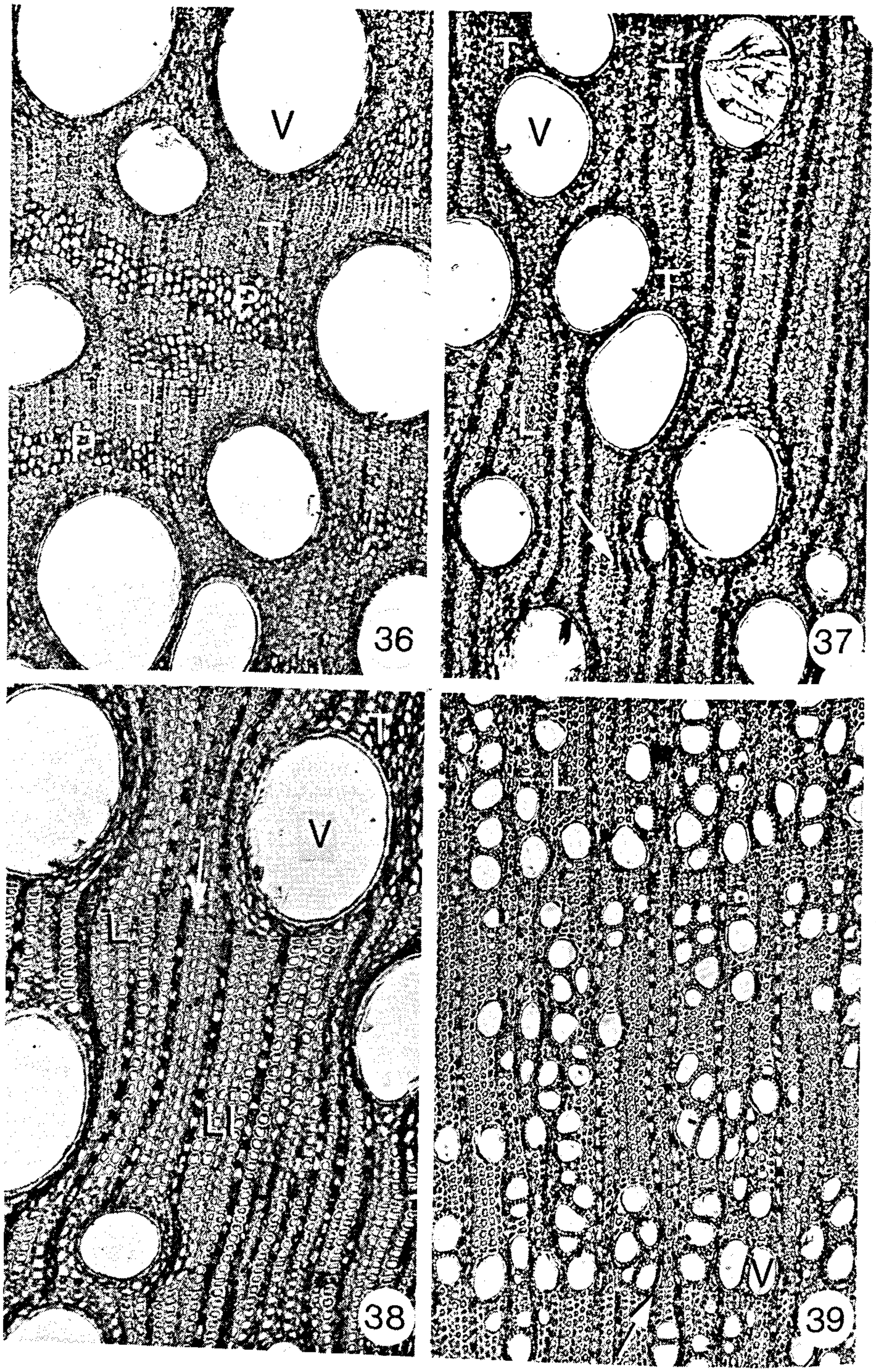
Fig. 47. *Connarus perrottetii* (DC.) Planchon var. *angustifolius* Radlk. (*Breteler 3873*). Growth-ring boundaries distinct; five present on the photograph. Ground tissue libriform fibres; fibre-tracheids absent. Notice latex tubes and tyloses formation.

Fig. 48. *Hemandradenia mannii* Stapf. (*De Wilde 8321*). Growth-ring boundaries absent. Ground tissue libriform fibres, arranged in more or less alternating tangential bands with large intercellular canals, large fibre lumina, and bands without or small intercellular canals and small fibre lumina; vasicentric fibre-tracheids absent.

Fig. 49. *Ellipanthus tomentosus* Kurz var. *luzoniensis* Vidal (*Van Balgooy 3950*). Growth-ring boundaries indistinct. Ground tissue arranged like in *Hemandradenia.*

Fig. 50. *Jollydora duparquetiana* (Baill.) Pierre (*Leeuwenberg 5039*). Growth-ring boundaries distinct; four present on the photograph. Ground tissue libriform fibres; fibre-tracheids absent.

Fig. 51. *Burttia prunoides* Baker f. et Exell (*Burtt 3035*). Growth-ring boundaries fairly distinct. Many, very small vessels in radial multiples and solitary. Ground tissue libriform fibres, partly non-septate; vasicentric fibre-tracheids almost absent. Rays often 2-seriate.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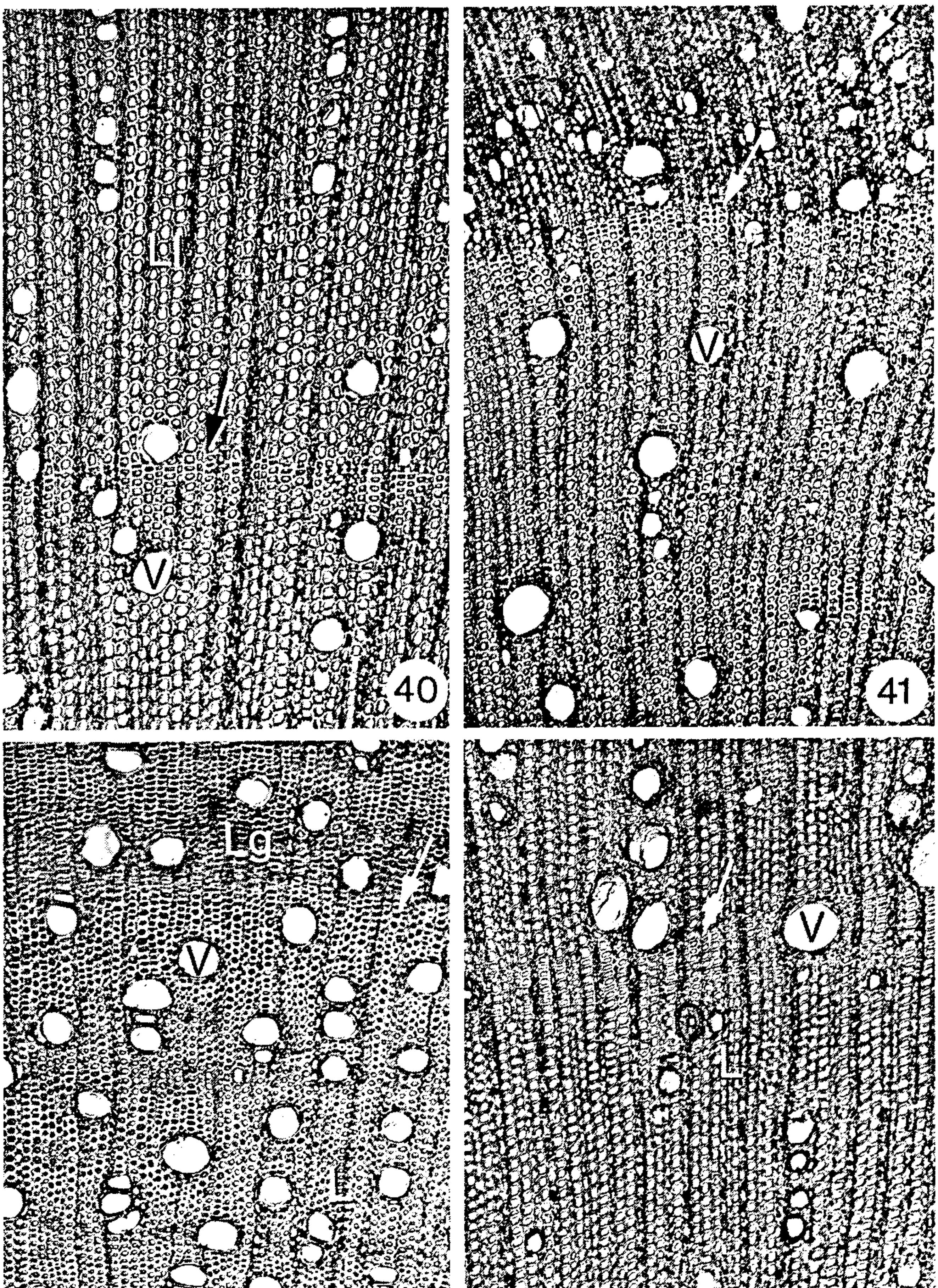
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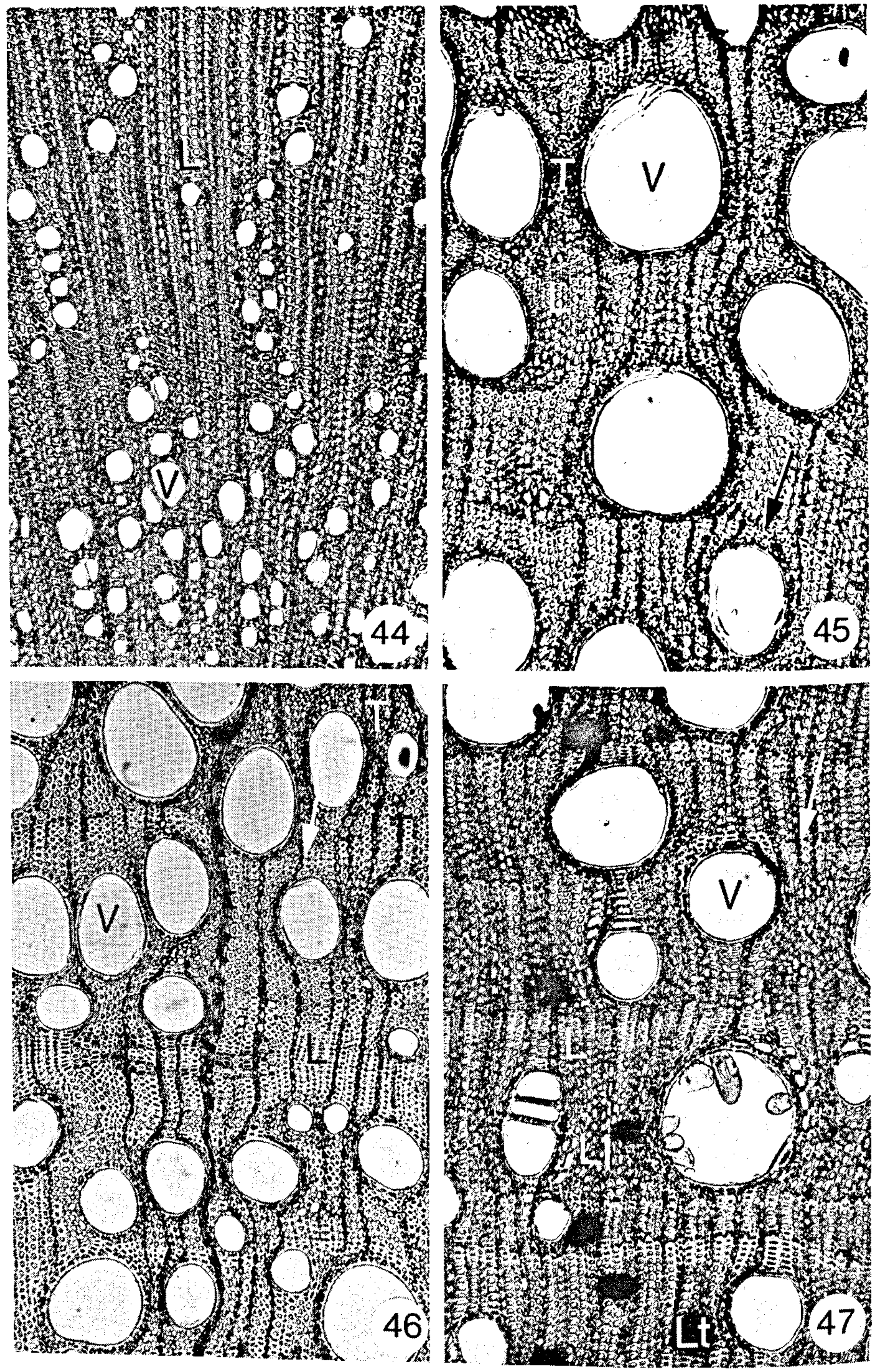

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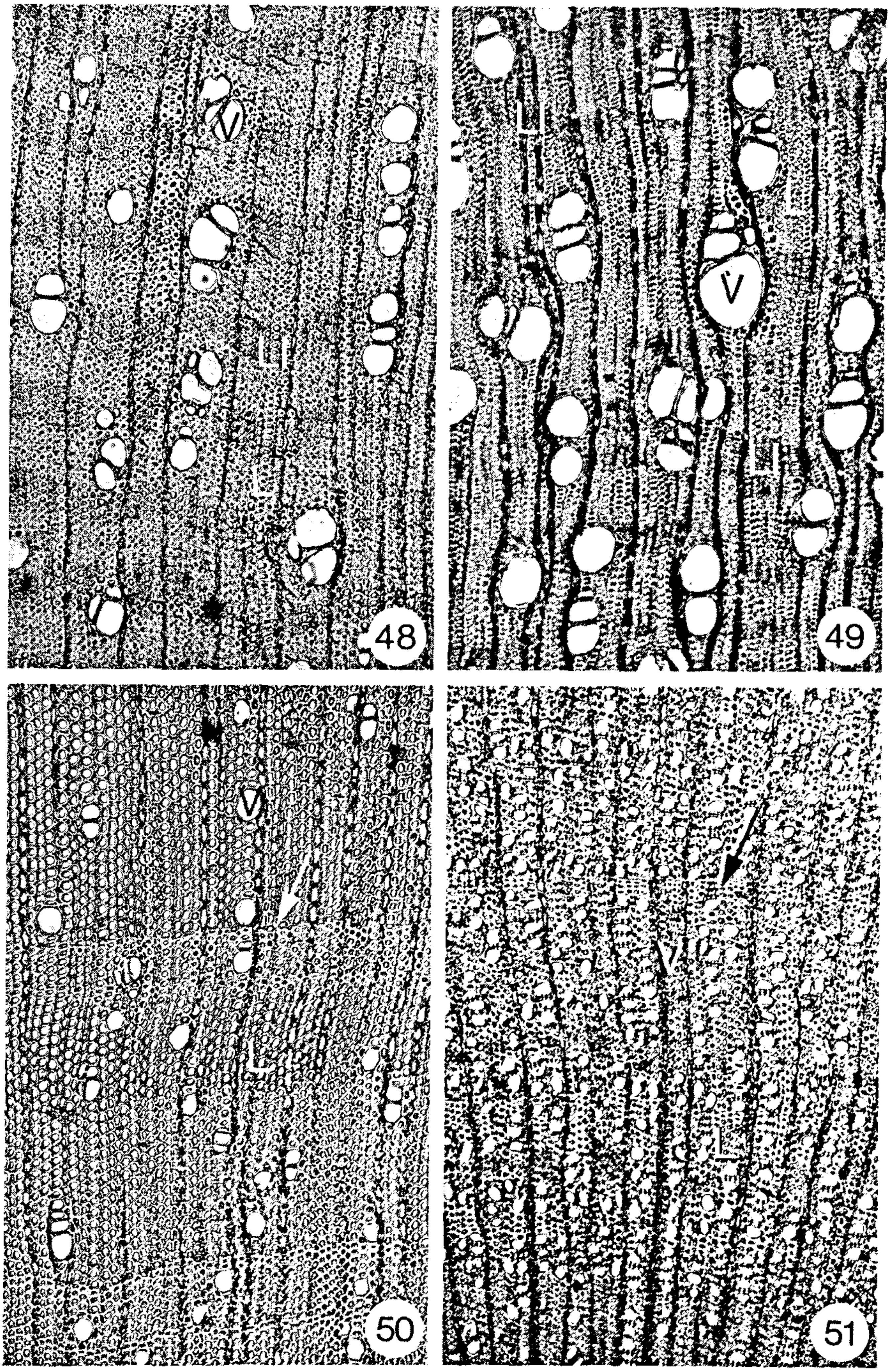
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Table 9. Secondary xylem characters of the investigated genera

genera studied	growth rings	vessels							
		arrange-ments	tg diam. in µm		number per sq mm	diam. interv. pits in µm	tylo-ses	member length in µm	
Manotes	–	exs		190	11	7	–		730
Rourea	±	exs or rdm	165	145	10	7	±	600	605
			124					609	
Byrsocarpus	±	rdm	80	70	49	7	–	420	454
			42					555	
Jaundea	+	rdm	45	120	32	7	–	490	595
			159					649	
Paxia	+	rdm or exs		50	70	7	–		425
Santaloidella	±	rdm or exs		185	15	7	–		590
Santaloides	±	exs	130	140	12	6	–	525	550
			156					603	
Spiropetalum	±	exs		135	21	8	±		485
Pseudoconnarus	±	exs	175	175	11	7	±	480	490
			177					517	
Cnestidium	±	exs or rdm	100	130	19	6	–	505	525
			161					544	
Cnestis	±	exs, ch	85	90	36	7	–	410	440
			99					603	
Bernardinia	+	rdm		45	55	7	–		410
Agelaea	±	exs	150	150	13	5	±	550	550
			146					577	
Castanola	±	exs	125	120	31	7	±	595	565
			116					512	
Connarus	±	rdm, cl	105	100	22	9	–	530	550
			94					575	
Ellipanthus	±	cl, rdm	70	50	45	9	–	390	565
			54					606	
Hemandradenia	–	rdm		50	34	8	–		490
Jollydora	+	rdm	35	35	47	7	–	580	660
			33					743	
Burttia	+	rdm		25	410	8	–		220

Symbols and abbreviations in table 9:

+ = present; - = absent; + = scarcely present; aggr. = aggregates; av. = average; ch = chain; cl = cluster; comp. = composed; diam. = diameter; diff. = diffuse; exs = exclusively solitary; gel. = gelatinous layer; incl. = included; int. = intercellular canals; interv. = intervessel: l = non-septate libriform fibres; ls = septate libriform fibres; ls(2) = septate libriform fibres in two types, viz. with and without intercellular canals and/or brown substances, usually arranged in alternating tangential bands; muc. = mucilage; mult. = multiseriate; pred. = predominant; rdm = radial multiples; s = simple crystals, generally in chambered crystalliferous cells, except in *Spiropetalum* and only partly in *Rourea*. In these genera crystals are usually rare; sq = square; tg = tangential; th. = thickness; tr = fibre-tracheids; vas. = vascular.

(Table 9 continued)

fibres					rays				
ground tissue	length in µm		wall th. in µm	also pre- sent	av. height in cells		av. height in µm	seriate	comp. of > 3 storeyes
tr		895	5	–		15	340	1(–2)	–
ls(2)	850 739	790	4	tr	11 9	10	300	1(–2)	–
ls	550 610	575	3	tr	11 13	12	260	1(–2)	–
ls	730 738	735	4	tr	16 11	12	360	1(–2)	–
ls		730	3	tr		12	350	1	–
ls		910	4	tr		7	175	1(–2)	–
ls	910 954	855	4	tr	8 8	8	195	1(–2)	–
ls		695	3	tr		13	295	1(–2)	–
ls	805 735	785	3	tr		11	230	1	–
l(ls)	690 717	705	4	± tr	12 9	10	450	1(–2)	–
ls	645 727	660	4	tr	15 9	13	275	1(–2)	±
ls		580	3	tr		17	400	1	–
ls	710 804	735	4	tr	12 17	15	220	(1–)2(–3)	+
ls	765 776	770	6	tr	13 12	12	270	(1–)2(–3)	+
ls(2)	755 743	750	4	– (tr)	10 7	8	285	1	–
ls(2)	670 769	750	3	–	4 5	5	125	1	–
ls(2)		685	6	–		8	225	1	–
ls/l	960 883	920	5	–	7 10	9	220	1(–2)	–
ls/l		340	3	–		14	280	(1–)2(–3)	–

Wood-ray type: I = uniseriate rays and multiseriate rays with long uniseriate tails; II = uniseriate rays and multiseriate rays with short uniseriate tails; III = only uniseriate rays present; He = heterogeneous, procumbent and upright and/or square cells are present; Ho = homogeneous, only procumbent or only upright and/or square cells are present.

165 145 = the first column gives the average tg vessel diameter obtained by our measurements (165), followed by the one calculated from Dickison's (1972) table II (124); the second column represents the average tg diameter of all measurements, or only ours if those of Dickison were not available (145).

(Table 9 continued)

genera studied	rays				axial parenchyma		
	pred. cell type	type	number per tg mm	diam. pits to vessels in μm	rare or absent	diff. or diff. in aggr.	mult. tg bands
Manotes	sq, up	He I (III)	18	11	–	–	+
Rourea	–	He III	15	11	+	–	–
Byrsocarpus	–	He III	14	11	+	–	–
Jaundea	–	He III	16	8	+	–	–
Paxia	sq, up	He III	15	9	+	–	–
Santaloidella	–	He III	12	11	+	–	–
Santaloides	–	He I/III	16	10	+	–	–
Spiropetalum	–	He III	14	12	+	–	–
Pseudoconnarus	sq, up	He III	15	11	+	–	–
Cnestidium	sq, up	Ho III	14	9	+	–	–
Cnestis	–	He I/III	15	10	+	–	–
Bernardinia	sq, up	He III	16	7	+	–	–
Agelaea	–	He I/II	15	10	+	–	–
Castanola	–	He I/II	17	7	+	+	–
Connarus	sq, up	He(Ho) III	15	11	+	–	–
Ellipanthus	sq, up	He III	12	9	+	–	–
Hemandradenia	sq, up	He III	14	11	+	+	–
Jollydora	sq, up	He III	9	14	+	+	–
Burttia	–	He I	14	5	+	–	–

(Table 9 continued)

crystals	miscellaneous			further information
type	pith flecks	latex, oil, muc. canals	incl. phloem	
s	–	–	–	tg. par. bands 4–8 cells wide, (1) often 3/rd mm, also aliform
s	±	–	–	tr. vas.; crystals abundant in Lind. 4807
–	±	–	–	tr vas.; int. between ls
–	+	–	–	tr vas. and terminal; int. mainly in early wood ls; crystals in pith
–	–	–	–	tr vas.; int. between ls; secretory cells in pith
s	–	–	+	tr vas. 40%; ray cells with silica grains
–	–	–	+	tr vas. (very few); vestured vessel pits in V. and 0.468
s	–	–	–	tr vas. 30%; int. between ls; Bret. 1217 aberrant (vertical latex ducts, spiral thickenings and incl. phloem present)
–	–	–	–	tr 50%, mainly in late wood; large int. between early wood ls
s	–	–	–	l with gel. layer; vestured vessel pits in Van Dons. 3077
s	–	–	–	tr vas.; int. between ls; somewhat ring-porous in V. and 0.1182
s	–	–	–	tr vas. and terminal; very small int. between ls
s	±	–	+	tr vas.; int. between ls; ray cells with gum and silica grains
s	–	–	–	tr vas.; int. between ls; vert. gum canals in Bret. 1889
s	–	+	–	
s	–	–	–	vessel pits with coalescent apertures
s	–	–	–	spiral thickenings in vessel tails and ls ends
s	–	–	–	int. between ls (not always septate)
s	–	–	–	tr absent or rare; 30% l; small int. in l

Table 10. Key to the investigated *Connaraceae* genera

		sensu Schellenberg (1938)	sensu Breteler (1989)
1a	Ground tissue fibre-tracheids, libriform fibres absent or very sparce; axial parenchyma rather abundant, often banded	*Manotes*	*Manotes*
b	Ground tissue libriform fibres or libriform fibres with fibre-tracheids; axial parenchyma absent or scanty diffuse, diffuse in aggregates and/or paratracheal	2	
2a	Ground tissue libriform fibres; fibre-tracheids more or less abundant	3	
b	Ground tissue libriform fibres; fibre-tracheids absent or almost absent	10	
3a	Ground tissue libriform fibres, but fibre-tracheids comprise about 50% of the axial system	*Pseudoconnarus*	*Pseudoconnarus*
b	Ground tissue libriform fibres; fibre-tracheids less frequent (maximal 40%), usually only vasicentric	4	
4a	Latex-tubes present	*Connarus*	*Connarus*
b	Latex-tubes absent	5	
5a	Wood rays 1(-2)-seriate	6	
b	Wood rays (1-)2(-3)-seriate	9	
6a	Included phloem present	*Santaloidella* *Santaloides* *Spiropetalum heterophyllum*	*Rourea*
b	Included phloem absent	7	
7a	Crystals, usually in chambered crystalliferous cells, abundant	*Cnestis* *Cnestidium* *Bernardinia*	*Cnestis* *Cnestidium* *Rourea*
b	Crystals, usually in chambered crystalliferous cells, absent to rare	8	
8a	Average tangential vessel diameter smaller than 100 μm; number of vessels per square mm more than 30	*Byrsocarpus* *Paxia* *Jaundea*	*Rourea*
b	Average tangential vessel diameter larger than 100 μm; number of vessels per square mm less than 30	*Rourea* *Spiropetalum*	*Rourea*
9a	Vessels on average less than 20 per square mm; axial parenchyma rare or absent; included phloem often present	*Agelaea*	*Agelaea*-section *Agelaea*
b	Vessels on average more than 20 per square mm; axial parenchyma diffuse or diffuse in aggregates; included phloem absent	*Castanola*	*Agelaea*-section *Troostwykia*

(Table 10 continued)

10a	Latex-tubes present	*Connarus*	*Connarus*
b	Latex-tubes absent	11	
11a	Tangential bands libriform fibres without intercellular spaces, alternate with tangential bands with intercellular spaces	12	
b	Not so	13	
12a	Average wall thickness libriform fibres 6 µm; average wood ray heigth 8 cells	*Hemandradenia*	*Hemandradenia*
b	Average wall thickness libriform fibres 3 µm; average wood ray heigth 4 cells	*Ellipanthus*	*Ellipanthus*
13a	Average number of vessels per square mm about 50	*Jollydora*	*Jollydora*
b	Average number of vessels per square mm about 400	*Burttia*	*Burttia*

Table 11. Some secondary xylem characters of the group representatives and *Burttia*. (M = *Manotes*, R = *Rourea*, A = *Agelaea*, C = *Connarus* and B = *Burttia*).

Characters	Decreasing in the sequence	Increasing in the sequence
vessel-member length	MRACB	
fibre length	MRCAB	
ratio fibre-tracheids/libriform fibres	MRACB	
average ray height (in µm)	MRCBA	
average number of rays per tangential mm	MRACB	
vulnerability index (vessel diameter/number of vessels per square mm)	MRACB	
vessel area percentage of cross surface	MABCR	
tangential vessel diameter	MARCB	
amount of axial parenchyma	MRACB	
number of vessels per square mm		MRACB

9. Phytochemistry

by C.C.H. Jongkind

Hegnauer (1964) reported that the phytochemistry of *Connaraceae* has been rather neglected, probably in want of species that have the interest of the pharmaceutical industry. Although this revision does by no means compensate for this lack of knowledge, there are indications that many species of the family contain phytochemically interesting substances. The seeds of many species from different parts of the tropics are reported to be very poisonous. Most of these are used as dog-poison and they seem to be poisonous for other animals like sheep, goats, and rats as well (Burkill, 1985: 523). Species that have been cited for such qualities are *Burttia prunoides* (see pag.), *Cnestis palala* (Vidal, 1962: 14), *Cnestis polyphylla* (Schellenberg, 1938: 17), *Connarus ferruginea* (Leenhouts, 1958: 531), *Rourea fluminensis* (Schellenberg, 1938: 17, as *Bernardinia*), *Rourea glabra* (Forero, 1976: 28), *Rourea minor* (Vidal, 1962: 37), *Rourea orientalis* (Schellenberg, 1938: 17, as *Byrsocarpus*), and *Rourea thomsonii* (Troupin, 1952: 86, as *Jaundea pubescens*). The seeds of *Connarus africanus* are reported to be an anthelmintic drug (Burkill, 1985: 522).

The roots of many species are reported to be poisonous as well, although less vehemently than the seeds. Some are also used as dog-poison. Diluted in small doses, many are used as medicine against stomach-ache and dysentery. Such species are *Agelaea macrophylla* (Leenhouts, 1958: 504, as *A. trinervis*), *Cnestis ferruginea* (Burkill, 1985: 520), *Rourea coccinea* (Burkill, 1985: 518, as *Byrsocarpus*), *Rourea glabra* (Hegnauer, 1964: 546), *Rourea fulgens* (Leenhouts, 1958: 519), *Rourea minor* (Leenhouts, 1958: 516), and *Rourea rugosa* (Leenhouts, 1958: 514).

Miscellaneous literature and herbarium labels give indications of medical applications of leaves, bark, and sometimes even flowers of a number of species, but the substances responsible for their curative effects remain unknown.

10. Phylogeny

10.1 Phylogeny of the family

by R.H.M.J. Lemmens

10.1.1 Introduction

According to Stuessy (1987) there are three principal approaches to biological classification: cladistics, phenetics, and evolutionary classification. 'Cladistics is the determination of branching patterns of evolution, phenetics is classification by overall similarity, without regard for evolutionary considerations. Evolutionary classification attemps to consider all meaningfull aspects of phylogeny and to use these as a basis for making a classification. This latter approach has always been done intuitively, i.e. without explicit methods'.

One of the fundamental and laudable aims of botanists practising numerical taxonomy (phenetics) as well as cladists is to decrease the amount of subjectivity and intuition. In that sense, an attempt is made here to reconstruct the phylogeny of *Connaraceae*, and to designate the similarities and relations between the genera, using more or less generally customary methods. A taxonomic division of the family above the genus level is based on the result.

Two different ways of classification are practised here, one based on overall similarity (phenetics), the other on phylogeny. These are discussed and compared.

All characters useful for the phenetic classification are discussed below. Often, but not always, these characters could also be used for the phylogenetic classification. In such cases, the determination of polarity is discussed.

10.1.2 The characters

1. *Habit*. The family comprises shrubs or treelets as well as lianas. Many genera have always a shrub- or tree-like habit, others are (nearly) always lianescent. Some genera are polymorphic in habit, like *Rourea* and *Connarus*. The habit is not phylogenetically useful, because of its variability in some genera and since the direction of its evolution is questionable, although many authors consider lianas as derived.

2. *Leaves*. Pinnate leaves occur as well as trifoliolate and unifoliolate ones. Only in *Connarus* and, more rarely, in *Rourea* both pinnate and trifoliolate leaves may be present. It is highly probable that the direction of the evolution is from pinnate towards tri- and unifoliolate.

3. *Veinlets*. In all genera the fine veinlets of the leaflets are reticulate, but

in *Manotes* they are distinctly parallel. Because the latter character-state is probably a specialization and as it is found only in *Manotes*, it is considered here as derived.

4. *Inflorescences*. In some genera the flowers are arranged in large, often pseudoterminal panicles, in others they occur in small panicles, racemes or fascicles, often cauliflorous. Variation in inflorescence type within several genera occurs to such an extent that this character is not useful for the phylogeny (see also paragraph 4.6 on inflorescences).

5. *Heterostyly*. This is discussed in chapter 5. Although many types are distinguished, only two character-states are used here: heterotristyly versus all other types. Heterotristyly is considered as primitive.

6. *Androgynophore*. An androgynophore is only found in *Manotes* and it is here considered as a similar evolutionary development as the parallel venation in this genus.

7. *Sepals*. Imbricate sepals are common, valvate ones occur in *Manotes* and sometimes in *Cnestis*, *Cnestidium*, *Connarus* and *Ellipanthus*. Because of the often intermediate or variable state of this character in the latter four genera it is not considered phylogenetically useful.

8. *Petals*. Free petals are most common, coherent ones are found in several species in some genera. Because of this the character has not been used in phylogeny.

9. *Hairs and glands on petals and/or filaments*. Pilose or glandular filaments and/or petals are found in 4 genera. In the other genera they are (almost) glabrous. Pilose and glandular is considered as a primitive condition, glabrous as derived. The evolutionary line is supposed to be directed towards loss of hairs.

10. *Number of fertile stamens*. Usually 10 fertile stamens are present, but in some genera there are only 5. In *Connarus* both character-states occur, but most often 10 (apparently) fertile stamens are found. Reduction of the 5 epipetalous stamens clearly indicates the direction of evolution, as discussed in chapter 5 on heterostyly.

11. *Number of carpels*. Six genera have 5 carpels to a flower, the other six have only a single carpel. Here a reduction in number indicates the evolutionary line.

12. *Shape of follicle*. In many genera the follicle has the recognizable shape of a leaf-like carpel, i.e. distinctly narrowed at the base and at the apex. In other genera the follicle is different in shape, often rounded at the base and often at the apex as well. The latter condition is considered as derived.

13. *Dehiscence of follicle*. Mostly the follicle is dehiscent, but in *Jollydora* and *Hemandradenia* it is indehiscent. Indehiscence is probably derived, in accordance with the views of various authors on this situation in other families.

14. *Indumentum of follicle*. The follicle is often pilose outside, but in several genera it is glabrous. In some genera both states occur, as in *Connarus*, where the follicles are often initially pilose, but they become glabrous later. Because of the intermediate or variable state of this character in some genera, it is not used in phylogenetical considerations here.

15. *Indumentum of endocarp.* Usually the endocarp is glabrous, but in *Cnestis* it is always densely pilose, while in *Connarus* it is often either pilose or glandular. Glabrous is considered here as derived, in accordance with the loss of hairs in other parts of the plants, like petals, filaments and the surface of follicles. However, this remains debatable. It cannot be ruled out that a pilose endocarp is in fact derived, i.e. a specialized condition, especially in *Cnestis*, where the endocarp is provided with many, long, often caducous and more or less stinging hairs.

16. *Separating endocarp.* In *Manotes* and *Vismianthus* the endocarp separates from the pericarp. It is striking that this is combined with the presence of a long appendix to the sarcotesta. This condition is considered as specialized and consequently derived.

17. *Number of seeds.* Usually *Jollydora* has two seeds in each carpel, all other genera have one seed, only very rarely two. The reduction in number indicates the direction of evolution.

18. *Place of attachment of seed.* The seed is attached either to the ventral side of the follicle, or (almost) to the base. The latter condition is considered as derived (see also paragraph 4.8 on fruits and seeds). In *Burttia* seeds are attached near the top of the follicle. This is considered as equivalent to a ventral attachment, as the place of attachment is merely shifted somewhat towards the apex.

19. *Endosperm.* In several genera endosperm is abundant, in others it is absent. In some genera, particularly in *Cnestidium* and *Ellipanthus*, endosperm is often present, but only in a thin layer, while the cotyledons are thick. It is generally accepted that the presence of abundant endosperm is primitive, while absence of endosperm and thick cotyledons are considered as derived conditions. A thin layer of endosperm is also considered as derived.

Two characters that can only be studied using a microscope are added to the morphological characters:

20. *Epidermis cells adjacent to stomata.* These cells may be different from the other epidermis cells in shape and position. Uniformity is considered as primitive, while all other deviating conditions are derived. See also paragraph 4.5.

21. *Pollen. Jollydora* has pollen that is completely different from the pollen of all other genera. This is considered by various authors as derived (see also chapter 6). In other genera apart from *Jollydora* the pollen is variable, but this variation more or less represents a continuum in which different character-states cannot be distinguished.

Characters of wood anatomy are not used. These are discussed in chapter 8, as well as their phylogenetical significance.

10.1.3 Classification by overall similarity (see table 12 and 13)

For the construction of a phenogram the 21 characters discussed above are used, each with two character-states, A and B. Only in the character 'number of leaflets' three character-states, A, B, and C, are distinguished. An intermediate

Table 12. Characters and character-states of the genera of *Connaraceae* used for the construction of phenograms

		A	B	C
1.	Habit	Shrubs or treelets	Lianas	
2.	Leaves	Pinnate	3-foliolate	1-foliolate
3.	Fine venation	Reticulate	Parallel	
4.	Flowers	In large panicles	In small panicles, racemes or fascicles	
5.	Heterostyly	Trimorphic	Dimorphic or different	
6.	Androgynophore	Absent	Present	
7.	Sepals	Imbricate	Valvate	
8.	Petals	Free	Coherent	
9.	Petals and/or filaments	Pilose	Glabrous	
10.	Number of fertile stamens	10	5	
11.	Number of carpels	5	1	
12.	Follicle	Carpel-shaped	Different	
13.	Follicle	Dehiscent	Indehiscent	
14.	Follicle	Pilose outside	Glabrous outside	
15.	Endocarp	Pilose	Glabrous	
16.	Endocarp	Not separating	Separating	
17.	Seeds per carpel	Often 2	Usually 1	
18.	Attachment of seed	Ventral	Basal	
19.	Endosperm	Present	Absent	
20.	Epidermis cells adjacent to stomata	Different in shape	Not different in shape	
21.	Pollen	Small, 3-colporate	Large, 4-colpate	

state is noted as AB. Basically all characters useful for the determination of the genera, were to be used, but an exception was made for those characters that did not allow to distinguish only two or three character-states. For this reason characters of the sarcotesta and the position of the radicle within the seed were not considered. These characters are extremely variable, showing a very large number of conditions.

In table 14 the overall similarity is calculated by comparing each genus with all other ones. The numbers of shared character-states are filled in. In this calculation, 0.5 is scored when in one of two genera compared an intermediate character-state (AB) is present.

High figures indicate that the compared genera share many character-states. The highest scoring genera are the first to be entered in the phenogram (fig. 52 A and B). These are *Cnestis* and *Cnestidium* scoring 18.5. Next the level of

Table 13. Matrix of character-states in the genera of *Connaraceae*. The numbers correspond to the characters discussed in the text and table 12.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Ag	B	B	A	A	A	A	A	AB	B	A	A	A	A	A	B	A	B	B	B	B	A
Bu	A	C	A	B	B	A	A	A	B	A	B	B	A	A	B	A	B	A	A	A	A
Cm	B	A	A	A	B	A	AB	A	B	A	A	B	A	A	B	A	B	B	AB	B	A
Cn	B	A	A	AB	B*	A	AB	A	B*	A	A	AB	A	A	A	A	B	B	A	B	A
Co	AB	AB	A	A*	AB	A	A	AB	A	AB	B	A	A	AB	AB	A	B	A	B	A	A
El	A	C	A	B	AB	A	AB	A	A	B	B	A	A	A	B	A	B	A	AB	A	A
He	A	C	A	B	B	A	A	AB	A	B	B	B	B	A	B	A	B	A	A*	A	A
Jo	A	A	A	B	A*	A	A	B	B	A	B	A	B	B	B	A	A	A	B	B	B
Ma	B	A	B	A	A*	B	B	A	A	A	A	A	A	A	B	B	B	A	A	AB	A
Ps	B	B	A	A	B	A	A	A	B	A	A	A	A	B	B	A	B	B	A	B	A
Ro	AB	A*	A	AB	B	A	A	AB	B	A	A	B	A	AB	B	A	B	B	B	B	A
Vi	A	C	A	B	B	A	A.	A	B	A	B	A*	A	B	B	B	B	A	B*	A	A

AB = intermediate character-state or both character-states present
* = alternative or intermediate character-state rarely present
Ag = *Agelaea*; Bu = *Burttia*; Cm = *Cnestidium*; Cn = *Cnestis*; Co = *Connarus*; El = *Ellipanthus*; He = *Hemandradenia*; Jo = *Jollydora*; Ma = *Manotes*; Ps = *Pseudoconnarus*; Ro = *Rourea*; Vi = *Vismianthus*

connection in the phenogram is calculated as a quotient, i.e. the number of shared character-states divided by the total number of characters considered: $18.5/21 = 0.88$. In this way the genera are grouped in the phenogram and their level of connection is indicated. Where a group of genera is to be compared either with another group or with a single genus two different methods have been followed. When the average of the shared characters in the group is used this leads to group-average clustering as is shown in fig. 52 A. But when the highest number of shared character-states within the group is considered this leads to single-linkage clustering as was done in fig. 52 B.

Table 14. Summation of character-states shared between the genera of *Connaraceae*

	Ag	Bu	Cm	Cn	Co	El	He	Jo	Ma	Ps	Ro	Vi
Ag		11.5	16.5	15	14	11	9	11.5	12	17.5	16.5	11.5
Bu			14	14	13	16.5	17.5	11	9.5	13	14	17
Cm				18.5	11.5	11.5	10.5	9	12.5	17	18	11
Cn					11	11	10	8.5	12	16.5	16.5	10.5
Co						15.5	13.5	11.5	11	12.5	13.5	14
El							17	10.5	11	10.5	10.5	15.5
He								10.5	8	9.5	11.5	13.5
Jo									6.5	10	12	13
Ma										11.5	9.5	9.5
Ps											16	13
Ro												13
Vi												

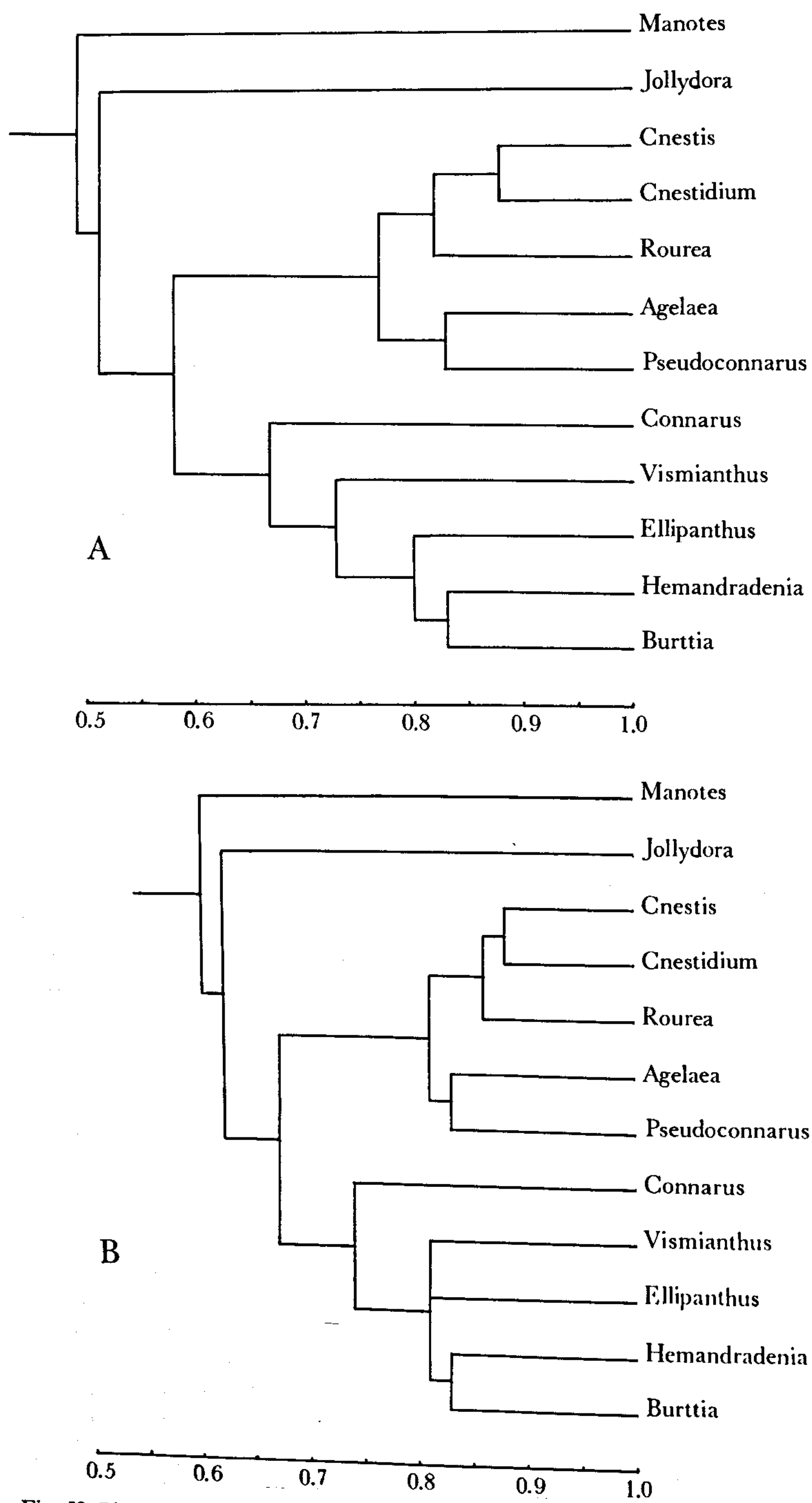


Fig. 52. Phenograms for the genera of *Connaraceae*, using group average clustering (A) and single-linkage clustering (B). For explanation see text.

Discussion

The phenograms fig. 52 A and fig. 52 B resulting from group-average and single-linkage clustering respectively, are slightly but not fundamentally different. Four groups can be distinguished. *Manotes* is the single representative of a group, as is *Jollydora*. The other two groups consist of the remaining 5-carpellate and of the remaining 1-carpellate genera, respectively.

It should be noted that some genera, particularly *Connarus*, show many intermediate character-states. Several characters that hardly vary in other genera, are strongly variable in *Connarus*.

10.1.4 Phylogenetic classification

For the construction of a cladogram, 16 characters, each with two character-states, have been considered. For each character the polarity was determined, as discussed before (table 15). An apomorphic character-state is noted in the matrix (table 16) as 1. The characters are the same as used for the classification by overall similarity, but 5 of them had to be omitted, either because no decision about the polarity could be made, or because one or more genera show an intermediate character-state. This is also discussed under the characters.

The Wagner Groundplan-Divergence Method was used for the construction of the cladograms. The procedure followed was taken from Cronquist, 1987, p. 47:

'1. Delimited and characterize the species by normal taxonomic methods.

2. Remove species of hybrid origin from the set. These may be reinserted later, after the basic cladogram has been produced.

3. Determine polarity of characters, from whatever evidence is available, including but not limited to outgroup-comparison.

Table 15. Polarity of characters of the genera of *Connaraceae* useful for phylogenetic classification and selected from table 12

		Plesiomorphic	Apomorphic
a	Leaves	pinnate	tri- or unifoliolate
b	Parallel venation in leaflets	absent	present
c	Heterostyly	trimorphic	dimorphic or different
d	Androgynophore	absent	present
e	Petals and/or filaments	pilose	glabrous
f	Number of fertile stamens	10	5
g	Number of carpels	5	1
h	Follicle	carpel-shaped	different
i	Follicle	dehiscent	indehiscent
j	Endocarp	pilose	glabrous
k	Endocarp	not splitting apart	splitting apart
l	Seeds per carpel (usually)	2	1
m	Place of attachment of seed	ventral	basal
n	Endosperm	present	absent
o	Epidermis-cells adjacent to stomata	not different	different
p	Pollen	small, tricolporate	large, tetracolpate

Table 16. Apomorphic character-states in the genera of *Connaraceae*. The letters correspond to the characters cited in table 15. An apomorphic character-state is noted in the matrix as 1.

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
Ag	1				1					1		1	1	1	1	
Bu	1		1		1		1	1		1		1				
Cm			1		1			1		1		1	1	*	1	
Cn			1		1			*				1	1		1	
Co	1*		1*			*	1			*		1		1		
El	1		1*			1	1			1		1		*		
He	1		1			1	1	1	1	1		1				
Jo					1		1		1	1				1	1	1
Ma		1		1						1	1	1			1*	
Ps	1		1		1					1		1	1		1	
Ro			1		1			1		1		1	1	1	1	
Vi	1		1		1		1			1	1	1		1		

* = alternative or intermediate character-state rarely present

4. Hypothesize a common ancestor primitive (plesiomorphic) in all characters considered. This putative ancestor represents the groundplan.

5. Set up a chart (familiarly called Wagner's bull's-eye) with concentric semicircles about a common base-point that represents the groundplan. Occasionally there may be an actual existing species at this base-point. The first semicircle (nearest the base-point) represents divergence from the groundplan in one character; the second represents divergence in two characters, etc.

6. Following a relatively simple set of logical rules explained by Wagner, and starting with the species that diverge the least from the groundplan, manually construct the most parsimonious cladogram. Branch-points on the cladogram may be represented by existing species or extinct hypothetical species. Species that have diverged in the fewest characters from the groundplan appear on the semicircle(s) nearest the base-point. Species that have diverged in more characters appear on progressively remote semicircles. All species are eventually connected by lines to the base-point (representing the groundplan) on an assumption of maximum parsimony in the evolution of individual apomorphics. Thus both the cladistic relationships and the degree of evolutionary advancement are shown on the chart, which limits the number of acceptable taxonomic arrangements but does not proscribe the acceptance of paraphyletic groups.

All this can be done manually if relatively few species are to be considered, and if parallelisms and reversals are not numerous...'

Discussion

The important subjective component in the construction of a cladogram consists chiefly of two separate choices. The first of these is which character is used and which is ignored. The second one is the determination of polarity. The methods used by cladists to determine polarity are the following:

1. Outgroup-comparison. The outgroup should preferably be the sister group of the group under study, i.e. the most closely related natural taxon. If only one of a pair of character-states under consideration is found in the outgroup, that state is considered to be plesiomorphic in the ingroup.

2. Correlation of transformation series. Wiley (1981) cites Hennig's criterion of the correlation of several series of transformation: 'if two characters each with three or more progressive states in allied taxa are always correlated (a with b, a' with b', a'' with b''), and if polarity can be established for one of the series, it will be the same for the correlated series'.

3. Fossil record. When fossils are known in the group under study and when the characters under consideration can be studied in them, it may be possible to determine polarity from those fossils.

4. Geography. Occasionally the geographical distribution can be useful to determinate polarity.

5. Adaptation. Specialization and adaptation in characters is often recognizable and is of course considered as derived.

According to Cronquist (1987) we should use whatever evidence we may find in order to establish polarity, and such evidence is not necessarily restricted to the methods enumerated above.

In *Connaraceae*, the determination of polarity was often problematic. Outgroup-comparison was not possible, because the position of the family is uncertain as a closely related family is not available, nor are fossils. In some characters a reduction of organs is thought to indicate the polarity, e.g. number of leaflets, fertile stamens, carpels, and number of seeds per carpel. In other characters a trend, generally observed in *Angiosperms*, is assumed, e.g. dehiscence of the follicle, presence or absence of endosperm, shape and position of epidermis-cells adjacent to stomata and characters of the pollen. In the remaining characters an even more subjective choice for the establishment of polarity is made. For instance the polarity of the indumentum of the inside of the follicle is uncertain, as discussed before (under this character). In general, pilose is considered as plesiomorphic, glabrous as apomorphic. Finally, the presence of apparently specialized structures, only found in a single genus or sometimes in two genera, is considered as an apomorphic condition, e.g. presence of a parallel venation in the leaflets and of an androgynophore in the flowers of *Manotes*, and the separating endocarp in *Manotes* and *Vismianthus*.

Hutchinson (1964, 1969) considered pinnate leaves, 5 carpels, imbricate sepals, and a dehiscent follicle as primitive, and tri- and unifoliolate leaves, 1 carpel, valvate sepals, an indehiscent follicle, cauliflory, and unisexual flowers as advanced. My views agree with these assumptions, and also with the major evolutionary trends as supposed by Dickison (1981).

The two cladograms presented (fig. 53 A and 53 B) show only dichotomous branching, and they are the most parsimonious ones that could be constructed. Two more equally parsimonious cladograms can be constructed, when the position of the branch(es) comprising *Cnestis*, *Cnestidium*, and *Rourea* is inter-

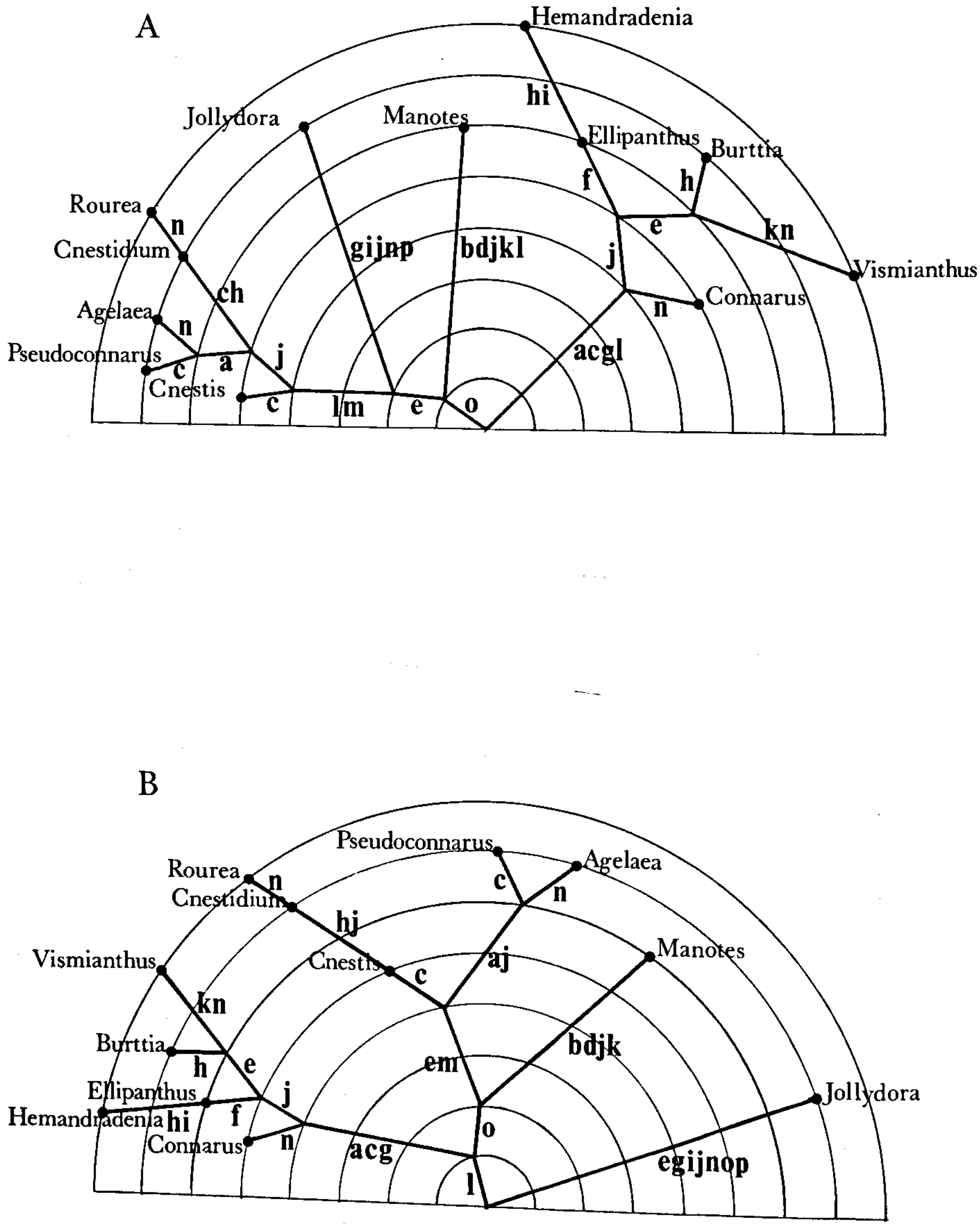


Fig. 53. Two of the most parsimonious cladograms for the genera of *Connaraceae*. The letters indicate apomorphic character-states and correspond to the characters cited in table 15. For explanation see text.

changed between the two cladograms. The cladograms show an equal number of parallelisms and this number is high, 19 in 10 characters. Cronquist (1987) states: 'There is so much evolutionary parallelism among the *Angiosperms* that we should not balk at accepting something more than the absolute minimum number of steps if the additional parallelism (or avoided reversals) make sense in other respects...'. However, when accepting also cladograms with a slightly larger number of parallelisms, the number of cladograms strongly increases. For that reason only two of the most parsimonious cladograms are taken into consideration here. Cronquist also states that when two or more equally parsimonious cladograms are available, the cladist must choose the one he intuitively prefers, or he must accept only those features that are common to the other or most of the others of these parsimonious cladograms, leaving the remaining decisions unresolved.

According to Cronquist it must be taken into account that 'cladograms of higher-level taxa are almost always oversimplifications of evolutionary history'. Still, 'such an extrapolation of the method is not fatal nor even inherently improper'. In fact, Wagner himself has used his method for genera. In practice, the utility at the higher levels is progressively limited.

The cladograms show that all genera have many apomorphic character-states and that no genus can be considered as very primitive and close to the common ancestor.

Ellipanthus is ancestral to *Hemandradenia* and *Cnestidium* is it to *Rourea*, while *Cnestis* can be considered ancestral to *Cnestidium* and *Rourea.* Cronquist (1987) states that in most current cladistic theories, no existing species can be ancestral to any other existing species. In the process of producing two descendant species, the ancestral species must cease to exist. He considers this as palpably untrue. It is generally accepted that many new species arise as geographically peripheral isolates of other species. The acceptance of an existing species to be ancestral to another must be considered as an advantage. Wagner accepts existing species as ancestral to other and according to Cronquist, Wagner avoids the most important errors in cladistic theory and practice by casting a wider net for data bearing on polarity of characters, and most importantly in his acceptance of paraphyletic taxa.

Cronquist's assertion that in most current cladistic theories an extant species cannot be ancestral to another calls for comment. In fact, the cladograms resulting from the Wagner Groundplan Divergence Method and those resulting from most other cladistic methods, do not differ as much as Cronquist suggests. The ancestral taxon is situated in a different position in both types of cladograms. In Wagner's 'bull's-eye' it is situated on the main axis, in other cladograms it terminates a distinct branch. This difference in the position of ancestral taxa does not imply that only Wagner's method accepts the existence of an ancestral taxon. Whether this ancestral taxon is situated on the main axis or its situation is represented in a terminal position on its own branch is not relevant. The main issue is the presence of apomorphic character-states on the branch of the cladogram between the positions of the ancestral and the descendant taxon.

10.1.5 Comparison of phenetics and cladistics

The resulting cladograms and phenograms are to a certain extent in agreement with each other. In both, *Jollydora* and *Manotes* are clearly separated from the other genera. The remaining 5-carpellate as well as the remaining 1-carpellate genera are clustered together. Yet, the two methods are directed toward different ends. The phenogram is intended to show similarities, without regard to phylogeny, whereas the cladogram is intended to show phylogeny, with only secondary attention to phenetic features. Of course, it must be kept in mind that usually similarities are largely the result of relations.

10.1.6 Arrangement in tribes

In his monograph Schellenberg (1938) made a phylogenetic classification of *Connaraceae*, which is reproduced in fig. 54. Apparently he did this after he had established the infrafamiliar taxa above the genus level. So Schellenberg first delimited his subfamilies and tribes and placed these in the phylogenetic tree afterwards. He considered certain characters of primary importance. For instance, the fact that *Jollydora* often has two seeds per carpel was important enough to him to distinguish *Jollydora* from all other *Connaraceae* and to place it in a separate subfamily *Jollydoroideae*. Schellenberg placed *Cnestis* in the tribe *Cnestideae* as a primitive group at the base of the phylogenetic tree of *Connaroideae*. For the construction of the tree he considered the type of inflorescence as very important, terminal or axillary. Proceeding from the point of furcation near *Cnestis*, the tree shows four main branches, each considered as a tribe by Schellenberg. They are *Agelaeeae* with the genera *Agelaea*, *Manotes* and *Hemandradenia*; *Connareae* with *Cnestidium*, *Rourea* and *Connarus*; *Byrsocarpeae* with *Pseudoconnarus*, *Vismianthus*, *Burttia* and 8 other genera, now placed in *Rourea*, and finally *Castanoleae* with *Ellipanthus*, *Schellenbergia* (now placed in *Vismianthus*), *Castanola* (now in *Agelaea*) and *Taeniochlaena* (now in *Rourea*). It should be noted that Schellenberg in three separate instances referred parts of what is in our view a single genus, to different tribes! This concerns the genera *Agelaea*, *Rourea*, and *Vismianthus*.

It is remarkable that Schellenberg did not assess characters such as the number of carpels and the number of leaflets.

The classification by overall similarity and the phylogenetic classification, as presented here, are based on the genera and their differentiating characters. The following division of the family in tribes is based on these classifications. The main characters are summarized, and the constituent genera are listed.

1. *Connareae*, first used by Planchon, 1850: 411; Gilg, 1897: 64; Schellenberg, 1938: 191.

Lianas, shrubs or small trees with unifoliolate leaves (except *Connarus* with trifoliolate or pinnate leaves), a single carpel, a dehiscent follicle with 1 seed,

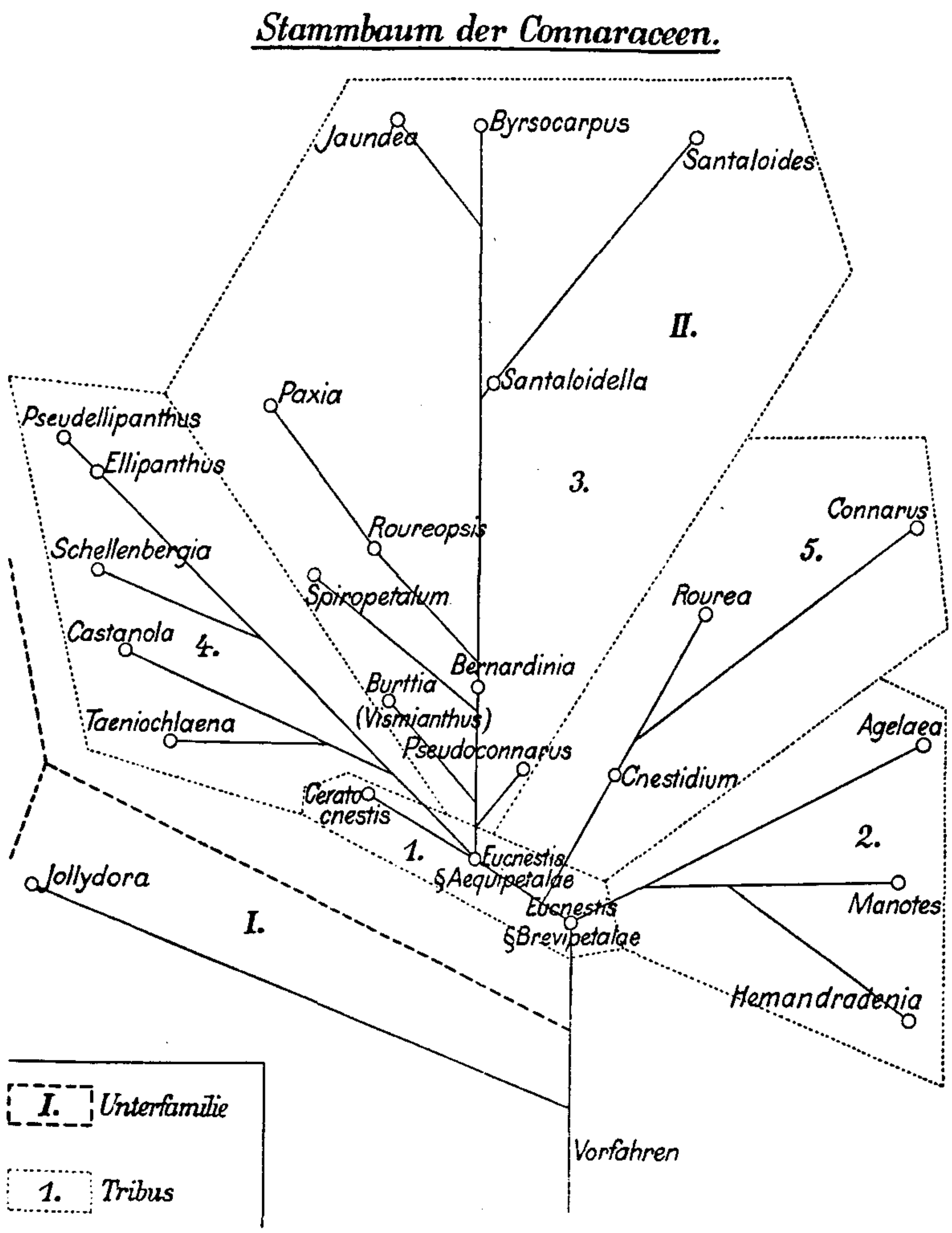


Fig. 54. Schellenberg's phylogenetic tree. Copied from Schellenberg (1938) p. 19.

ventrally attached, tricolporate pollen. Type: *Connarus. Burttia, Connarus, Ellipanthus, Hemandradenia*, and *Vismianthus.*

2. *Jollydoreae* (Gilg) Lemmens, comb. & stat. nov.

Jollydoroideae Gilg, 1897: 189; Schellenberg, 1938: 24.

Usually unbranched treelets with large, pinnate leaves, a single carpel, an indehiscent follicle with often 2 seeds, ventrally attached, tetracolpate pollen. Type: *Jollydora*, the only genus.

3. *Manoteae* Lemmens, trib. nov.

Liana. Folia imparipinnata, foliola striata. Flos androgynophoro. Carpella 5. Folliculi dehiscentes. Semen in carpidio solitarium, hilo ventrali.

Lianas with pinnate leaves and striately nerved leaflets, an androgynophore, 5 carpels, dehiscent follicles with 1 seed, ventrally attached, tricolporate pollen. Type: *Manotes*, the only genus.

4. *Cnestideae* Planchon, 1850: 438; Gilg, 1897: 67; Schellenberg, 1938: 28.

Lianas or shrubs with pinnate or trifoliolate leaves, 5 carpels, dehiscent follicles with 1 seed, basally attached, tricolporate pollen. Type: *Cnestis. Agelaea, Cnestidium, Cnestis, Pseudoconnarus*, and *Rourea.*

This subdivision of the family differs widely from the one given by Schellenberg. Only the distinct position of *Jollydora* in the family is maintained, although at a lower level.

10.2 Phylogeny of the genus *Cnestis*

by R.H.M.J. Lemmens

10.2.1 Introduction

In analogy to the pertinent chapter concerning the phylogeny of the family, the different approaches discussed there to arrive at a classification have been applied on the genus *Cnestis*. All characters useful for the phenetic classification are discussed below. Often, but not always, these characters could also be used for the phylogenetic classification. In such cases, the determination of polarity is discussed.

The methods used in order to designate similarities and phylogenetics of the species of the genus, are the same as discussed in paragraph 10.1 on phylogeny of the family. The determination of polarity in some characters is also discussed in this paragraph.

10.2.2 The characters

Characters that are considered useful for phylogeny, are compared with those of *Manotes*, which is chosen as the outgroup (see 10.2.4).

1. *Habit*. Only *C. mildbraedii* is probably always a shrub or small tree. All other species show lianescent tendencies, dependent on environmental condi-

tions. Usually a shrubby or tree-like habit is considered as primitive, a lianescent habit as derived.

2. *Number and size of leaflets.* Leaflets are few and large or numerous and small. However, the number and shape of the leaflets varies strongly within several species. For that reason this character is phylogenetically not useful.

3. *Apex of leaflets.* The leaflets are often acuminate, sometimes rounded at the apex. Again some species are variable and therefore this character cannot be used in phylogenetical considerations.

4. *Petiolules. C. macrophylla* has very long petiolules. It could be supposed that long petiolules are derived, as they are not found in the outgroup and only in a single *Cnestis* species. In other characters of the leaves *C. macrophylla* seems to be primitive. The direction of evolution of petiolule-length is uncertain, and as such this character seems not to be useful phylogenetically.

5. *Inflorescences.* Three types of inflorescences can be distinguished: often pseudoterminal large panicles, rather small (pseudo)racemes, and glomerules of flowers on old branches and stems. Large pseudoterminal inflorescences are considered as primitive, small ramiflorous ones as derived. A reduction of the inflorescence from paniculate to racemose and to glomerulate flowers is also assumed, the last two conditions thus being derived. The outgroup, *Manotes*, has large, pseudoterminal panicles, except for *M. macrantha.*

6. *Flowers.* These can be comparatively large or small. But there is so much variation within several species, that this character is not useful phylogenetically.

7. *Heterostyly.* In *Cnestis* many types of heterostyly are found, as discussed

Table 17. Characters and character-states of the species of *Cnestis* used for the construction of phenograms

		A	B	C
1.	Habit	Shrubs	Lianas	
2.	Leaflets	Large, few	Small, numerous	
3.	Leaflets	Acuminate at apex	Rounded at apex	
4.	Petiolules	Short (< 6 mm)	Long (> 6 mm)	
5.	Flowers	In large panicles	In small racemes	In fascicles
6.	Flowers	Large	Small	
7.	Heterostyly	Dimorphic	Obscurely heterostylous	Almost homostylous
8.	Sepals	Not reflexed	Reflexed	
9.	Sepals	Pilose inside	Glabrous inside	
10.	Petals	Shorter than sepals	About as long as sepals	Longer than sepals
11.	Glandular hairs	Present	Absent	
12.	Follicle	Small	Large	
13.	Follicle	Distinctly stiped at base	Not distinctly stiped at base	
14.	Follicle	Short-rostrate (-obtuse)	Long-rostrate	
15.	Follicle	With soft, short hairs outside	With hispid, long hairs outside	

Table 18. Matrix of character-states in the species of *Cnestis*. The numbers correspond to the characters discussed in the text and table 17.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
bo	B	B	B*	A	B	B	A	B	B	C	B*	B	AB	AB	A
co	B	AB	A	A	B	AB	AB	B*	B	BC	B*	AB	A	B	B
fe	AB	AB	A	A	A	B	C	A	A	A	A	AB	B	B	A
mc	B*	B	B	A	A	A	A	A	A	A	A	B	B	B	A
mp	B	A	A	B	B	A	AB	A	B	B	B	AB	A	B	B
mn	B	A	A	A	A	A	A	A	A	A	B*	B	A	B	A
mi	A	AB	A	A	B	A	B	A	B*	B	B	AB	A	B	A
pa	AB	B	AB	A	B	AB	BC	A	A	AB	A	AB	A	AB	A
po	AB	AB	AB	A	B	AB	B	B	AB	B	B	A	B	A	A
ra	AB	A	A	A	B	B	B	B	B	B	B	A	A	A	A
un	B*	AB	A	A	C	A	A	B	B	C	B	AB	A	B	B
ur	B	B	B	A	C	A	A	B	B	C	B*	AB	A	B	B
ya	B	B	A	A	B	B	AB	B	B	C	B	A	B	A	B

* = alternative or intermediate character-state rarely present
bo = *C. bomiensis*; co = *C. corniculata*; fe = *C. ferruginea*; mc = *C. macrantha*; mp = *C. macrophylla*; mn = *C. mannii*; mi = *C. mildbraedii*; pa = *C. palala*; po = *C. polyphylla*; ra = *C. racemosa*; un = *C. uncata*; ur = *C. urens*; ya = *C. yangambiensis*

in chapter 5. Three types are distinguished here for the classification by overall similarity: heterodistyly, a type possibly intermediate between heterodistyly and -tristyly, and an almost homostylous type, only found in *C. ferruginea*. For phylogenetical considerations only the last type is assumed to be derived.

8. *Sepals*. These are either reflexed or not. Outgroup-comparison leads to the assumption that non-reflexed, i.e. slightly spreading, is a primitive condition, and thus reflexed sepals are derived.

9. *Inner side of sepals*. The sepals can be pilose or glabrous inside. In accordance with several characters regarding the indumentum, the evolutionary line is supposed to be directed towards loss of hairs.

10. *Length of petals*. Petals can be distinctly shorter than the sepals, about as long, or distinctly longer. It proved that the second condition was correlated with primitive character-states of other characters, especially of flowers and inflorescences. For that reason petals as long as sepals is considered as the most primitive condition, both other situations derived.

11. *Glandular hairs*. Glandular hairs are usually present in three species, particularly on inflorescences, pedicels and sepals. They are less common in some other species. In *Manotes* glandular hairs are always present and consequently this condition is considered as primitive.

12. *Size of follicle*. The follicle may be large or small, but an intermediate state occurs in many species. As such this character is not useful for phylogenetical considerations.

13. *Base of follicle*. A distinct stipe is often present, but several species have a follicle rounded at the base. It is assumed that the latter condition is derived,

as discussed in the paragraph 10.1, where the 'carpel-shaped' follicle is considered as primitive.

14. *Apex of follicle.* A distinct beak is present in most species. A short beak is found in some species, sometimes only a short mucro is present, resembling the follicles of *Manotes*, rarely the follicle is obtuse or rounded, as sometimes found in *C. polyphylla.* Shortly beaked, mucronate and obtuse or rounded follicles are considered as primitive, because they resemble the follicles of *Manotes*.

15. *Indumentum of follicle.* On the outside the follicle is provided with either soft and rather short hairs, or with hispid and long hairs. The latter character-state is specialized and not found in the outgroup, and is consequently considered as derived.

10.2.3 Classification by overall similarity (see table 17 and 18)

For the construction of phenograms, 12 characters with two character-states (A and B), and 3 with three character-states (A, B, and C) are used. In the matrix (table 18) an intermediate state is noted as AB, BC, or AC.

In table 19 the highest scoring species are *C. urens* and *C. uncata* with 13.5. These species are connected in the phenogram at the level 13.5/15 = 0.90, i.e. the quotient of number of shared character-states and the number of characters taken into consideration.

The resulting phenograms are figured in fig. 55 A and 55 B, using group-average and single-linkage clustering respectively, as discussed in the paragraph on phylogeny of the family.

Discussion

The phenograms resulting from group-average and single-linkage clustering, fig. 55 A and fig. 55 B respectively, are somewhat different, especially as regards the position of *C. mildbraedii*, *C. macrophylla* and *C. bomiensis.* In both pheno-

Table 19. Summation of character-states shared between the species of *Cnestis*

bo	co	fe	mc	mp	mn	mi	pa	po	ra	un	ur	ya
bo	9.5	5.5	8	6	7	7	7.5	8.5	8.5	9	10	10
co		6	5	11.5	8	10.5	8	9	10	12.5	11	11
fe			10.5	5	9.5	7.5	10	7	6	5.5	4	5.5
mc				5	11	6	9	5.5	2.5	6	7.5	4.5
mp					9	11	7	6.5	8.5	10	8.5	7.5
mn						9	8	5.5	6.5	9	7.5	4.5
mi							9.5	9.5	10.5	9	7.5	6.5
pa								9	8	5.5	6	6
po									12	6.5	6	10
ra										7.5	6	10
un											13.5	9.5
ur												9
ya												

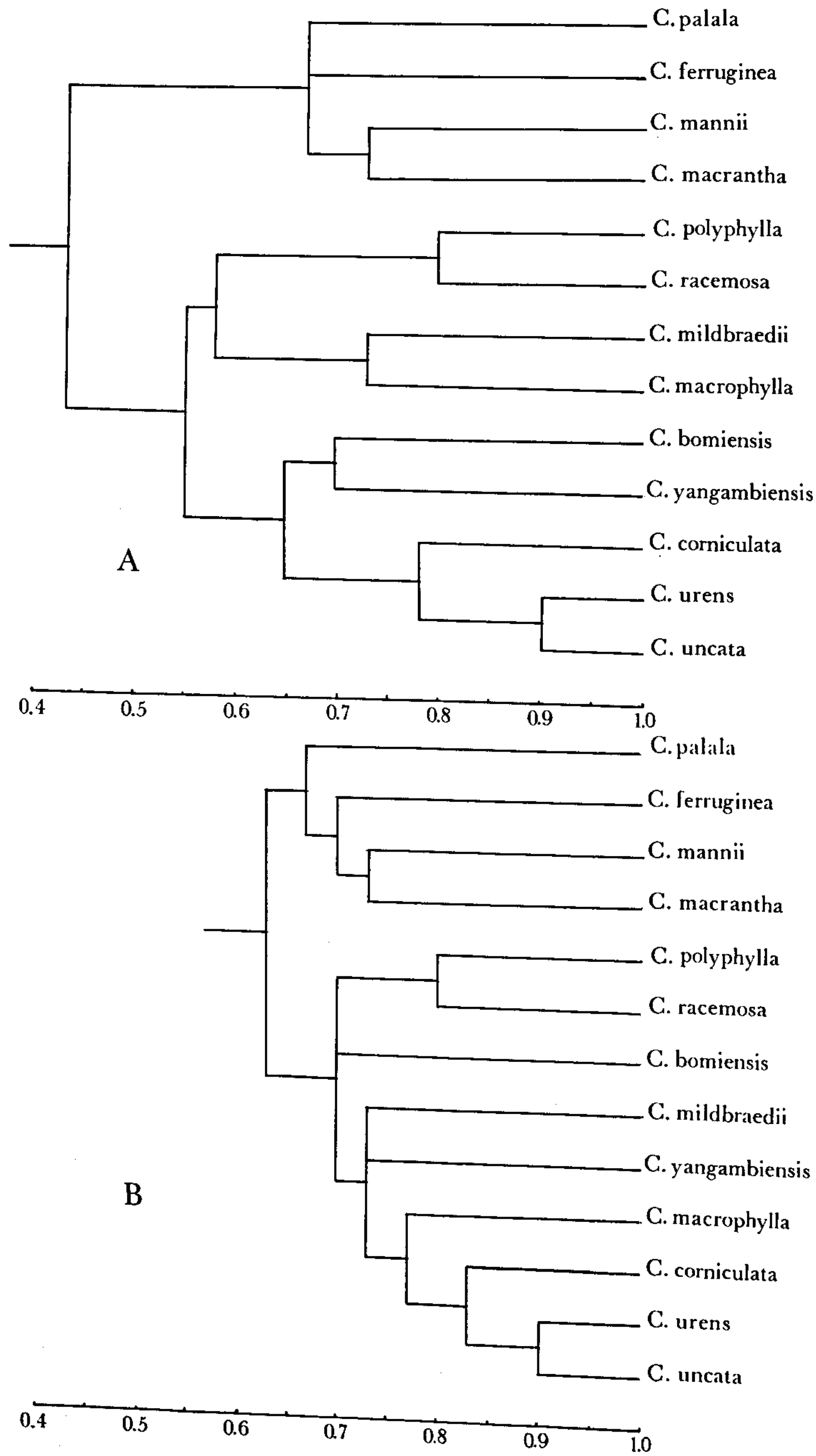


Fig. 55. Phenograms for the species in *Cnestis*, using group average clustering (A) and single-linkage clustering (B). For explanation see text.

grams three groups of species can be distinguished, the first of which comprises *C. palala*, *C. ferruginea*, *C. mannii* and *C. macrantha*, the second *C. polyphylla* and *C. racemosa*, and the third *C. corniculata*, *C. urens* and *C. uncata*.

It should be noted that three species, i.e. *C. polyphylla*, *C. palala*, and *C. corniculata*, show many intermediate character-states. They are strongly variable, as is discussed in the taxonomic treatment of these species.

10.2.4 Phylogenetic classification

For the construction of cladograms, 11 characters, each with two character-states, have been considered. After determination of the polarity (table 20), as discussed under 'the characters' and by using *Manotes* as an outgroup, an apomorphic character-state is noted in table 21 as 1. The characters are the same as those used for the classification by overall similarity, but 4 of them are omitted, either because no decision about the polarity could be made, or because one or more species show an intermediate character-state. This is also discussed under 'the characters'.

For the construction of the cladograms the Wagner Groundplan-Divergence Method is used once again.

Two of the most parsimonious cladograms (fig. 56 A and fig. 56 B) are presented here. They differ in the position of the group of *C. macrantha*, *C. ferruginea* and *C. mannii*, that of *C. mildbraedii*, while the positions of *C. corniculata* and *C. uncata* have been switched. Two more equally parsimonious cladograms can be constructed, when the positions of the four species within the group of *C. corniculata* are interchanged between the two cladograms. In this group exclusively dichotomous branching was not possible.

Discussion

As discussed in paragraph 10.1 on the phylogeny of the family, determination of polarity is often problematic. For the genus *Cnestis* outgroup-comparison

Table 20. Polarity of characters of the species of *Cnestis* useful for phylogenetic classification and selected from table 17

		Plesiomorphic	Apomorphic
a	Habit	shrub	liana
b	Inflorescences	large, pseudoterminal	small, ramiflorous
c	Flowers	in panicles or racemes	in fascicles
d	Flowers	heterostylous	almost homostylous
e	Sepals	not reflexed	reflexed
f	Sepals	pilose inside	glabrous inside
g	Petals	as long as sepals	shorter or longer than sepals
h	Glandular hairs	present	absent
i	Base follicle	distinctly stiped	not distinctly stiped
j	Apex follicle	indistinctly or short-rostrate	long-rostrate
k	Follicle	with short, soft hairs	with long, hispid hairs

Table 21. Apomorphic character-states in the species of *Cnestis*. The letters correspond to the characters cited in table 20. An apomorphic character-state is noted in the matrix as 1.

	a	b	c	d	e	f	g	h	i	j	k
bo	1	1			1	1	1	1	1*		
co	1	1			1	1	1*	1		1	1
fe	1*			1			1		1		
mc	1						1		1		
mp	1	1				1		1		1	1
mn	1						1	1		*	
mi		1				1		1		*	
pa	1*	1		*			*				
po	1*	1			1	*		1	1		
ra	1*	1			1	1		1			
un	1	1	1		1	1	1	1			1
ur	1	1	1		1	1	1	1		1	1
ya	1	1			1	1	1	1	1		1

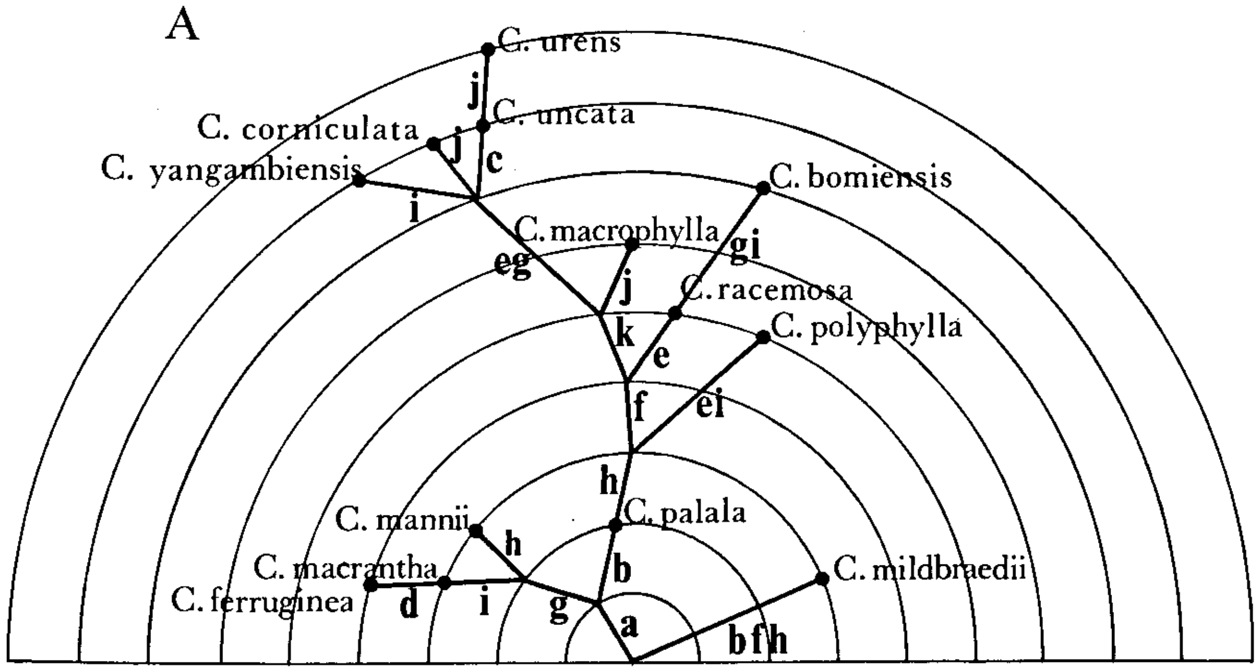
* = alternative or intermediate character-state rarely present

became possible when the phylogeny of the family was reconstructed and the relations of the genera were designated. Three different choices for the outgroup were considered: *Manotes*, *Jollydora*, and a genus from the group of 5-carpellate genera. As a result *Manotes* is considered as the sistergroup of *Cnestis*, and consequently it is used as the outgroup. *Manotes* is primitive in many characters and probably more closely related to *Cnestis* than *Jollydora*, although it should be noted that this is debatable, as is demonstrated by one of the cladograms dealing with the genera of the family. The other 5-carpellate genera are considered to be distinctly more derived than *Cnestis*. Because of that they were not chosen as the outgroup, although these genera are probably more closely related to *Cnestis* than *Manotes* is. For most of the characters, polarity is determined by comparison with *Manotes*. The character-states found in the sister group are considered to be plesiomorphic. For two characters (habit and length of petals) it proved that a character-state, not found in *Manotes*, is always correlated with plesiomorphic character-states of other characters. In these cases the character-state concerned is also considered to be plesiomorphic. By using an outgroup, the determination of polarity within *Cnestis* possibly has been more objective than it was when treating the genera of the family. On the other hand, for the reconstruction of the phylogeny of the family a larger number of characters could be used.

The number of characters used to construct the cladograms of *Cnestis* was 11. It should be kept in mind that errors made, for instance in the determination of the polarity, can have great consequences for the position of species in the cladograms, particularly when a limited number of characters is used.

In the most parsimonious cladograms the number of parallelisms is not as high as was found for the genera: 13 parallelisms in 7 characters.

The cladograms show that *C. palala* and *C. mildbraedii*, and the group consist-



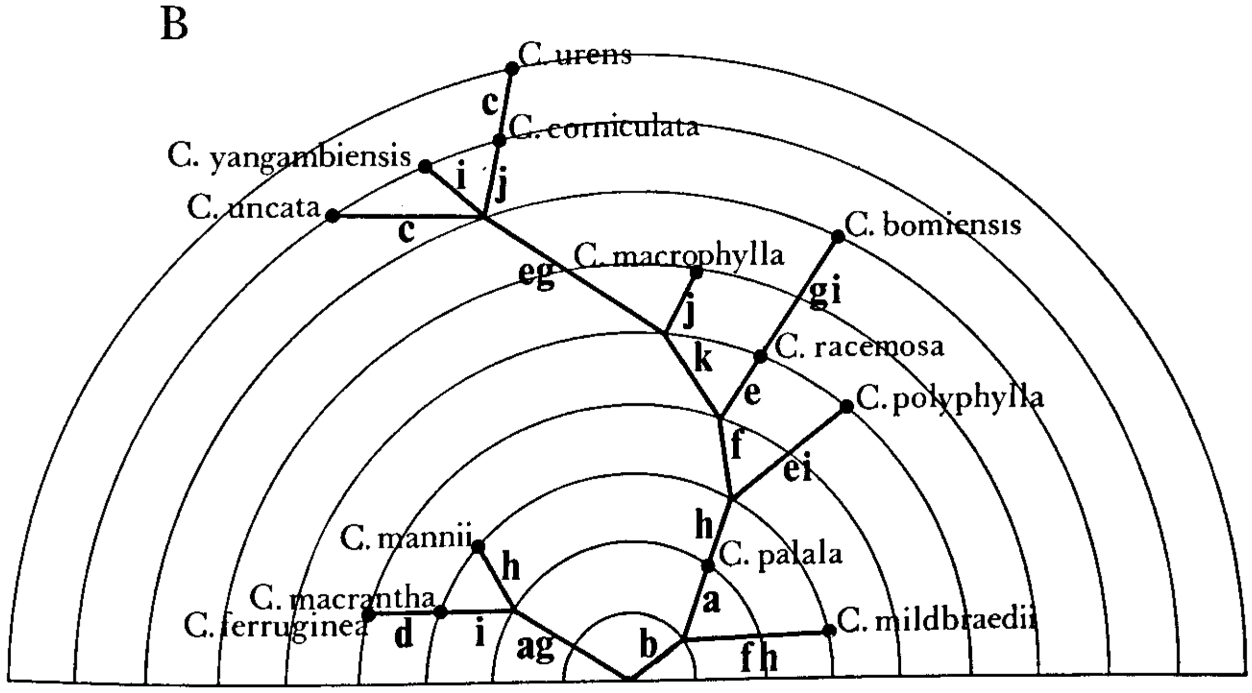


Fig. 56. Two of the most parsimonious cladograms for the species in *Cnestis*. The letters indicate apomorphic character-states and correspond to the characters cited in table 20. For explanation see text.

ing of *C. ferruginea*, *C. macrantha* and *C. mannii* can be considered as comparatively primitive and close to the common ancestor. The group comprising *C. yangambiensis*, *C. corniculata*, *C. uncata*, and *C. urens* is apparently derived. *C. palala* is in both cases ancestral to 8 other species, while either *C. uncata* or *C. corniculata* is the ancestor of *C. urens*.

A remark should be made about the position of *C. macrophylla*. As discussed in the taxonomic treatment, *C. macrophylla* only differs in the long petiolules from a form of *C. corniculata*. This character, however, is not used in the phylogeny. *C. macrophylla* has spreading sepals and petals as long as the sepals, conditions considered as primitive. *C. corniculata* only rarely shows these character-states and is considered as derived in regard to the sepals and petals.

10.2.5 Comparison of phenetics and cladistics

The resulting cladograms and phenograms are in agreement with each other to a certain extent. In both, *C. ferruginea*, *C. mannii* and *C. macrantha* are situated closer to each other than to the other species. *C. palala* is clearly separated from the other species, while *C. polyphylla* and *C. racemosa* are clustered together.

However, the cladograms and phenograms distinctly differ in the position of some other species. *C. mildbraedii* is distinctly separated from the other species in the cladograms, but not in the phenograms. The separate position of this species in the cladograms is particularly due to its habit. *C. mildbraedii* is either a shrub or a small tree, while all other species are basically lianas. It should be noted however, that material of *C. mildbraedii* is scarce and that notes on the habit of the plants collected are not always available.

The species having follicles with stinging hairs, i.e. *C. macrophylla*, *C. corniculata*, *C. yangambiensis*, *C. urens*, and *C. uncata*, are situated together in the cladograms. In the phenograms some other species, particularly *C. mildbraedii* and *C. bomiensis*, are clustered together with 'the stinging species'.

The phenograms show two distinct groups, the first of which comprises *C. palala*, *C. ferruginea*, *C. mannii*, and *C. macrantha*, the second consists of the remaining species. These groups are not found in the cladograms, although the four species of the first group are situated close to each other at the base of the tree.

However, as was discussed in the paragraph on phylogeny of the family, cladograms and phenograms are hardly comparable. The cladograms are based on the relations of the species, the phenograms only partly so. Overall similarity can also be the result of adaptation and specialization, independently originated in several species and due to environmental conditions.

No subdivision of the genus based on the classification in the phenograms and cladograms is proposed above the species level. One could consider to distinguish two separate groups, the first comprising *C. ferruginea*, *C. mannii*, *C. macrantha*, and *C. palala*, the second consisting of the remaining species. But then the position of *C. mildbraedii* remains dubious. Besides this, the first group of species would be paraphyletic, because the descendants of *C. palala* are excluded from the group. Finally, the groups are not as distinctly separated as are the groups of genera in the family, that are accepted as tribes.

10.3 Phylogeny of the genus *Rourea*

by C.C.H. Jongkind

After dealing for over four years with the African species of *Rourea* it is felt that the evolutionary relationship between these species is better reflected upon without employing special cladistic methods. Such methods require the expression of character states in a contrasting numerical manner that does not sufficiently allow for subtle distinctions in value. This does not imply that I do not see possibilities for a fruitful application of cladistics in order to reveal the phylogeny of other taxa. My approach towards the phylogeny on *Rourea* has resulted in a diagram (fig. 57) reflecting the possible course of evolution in this genus.

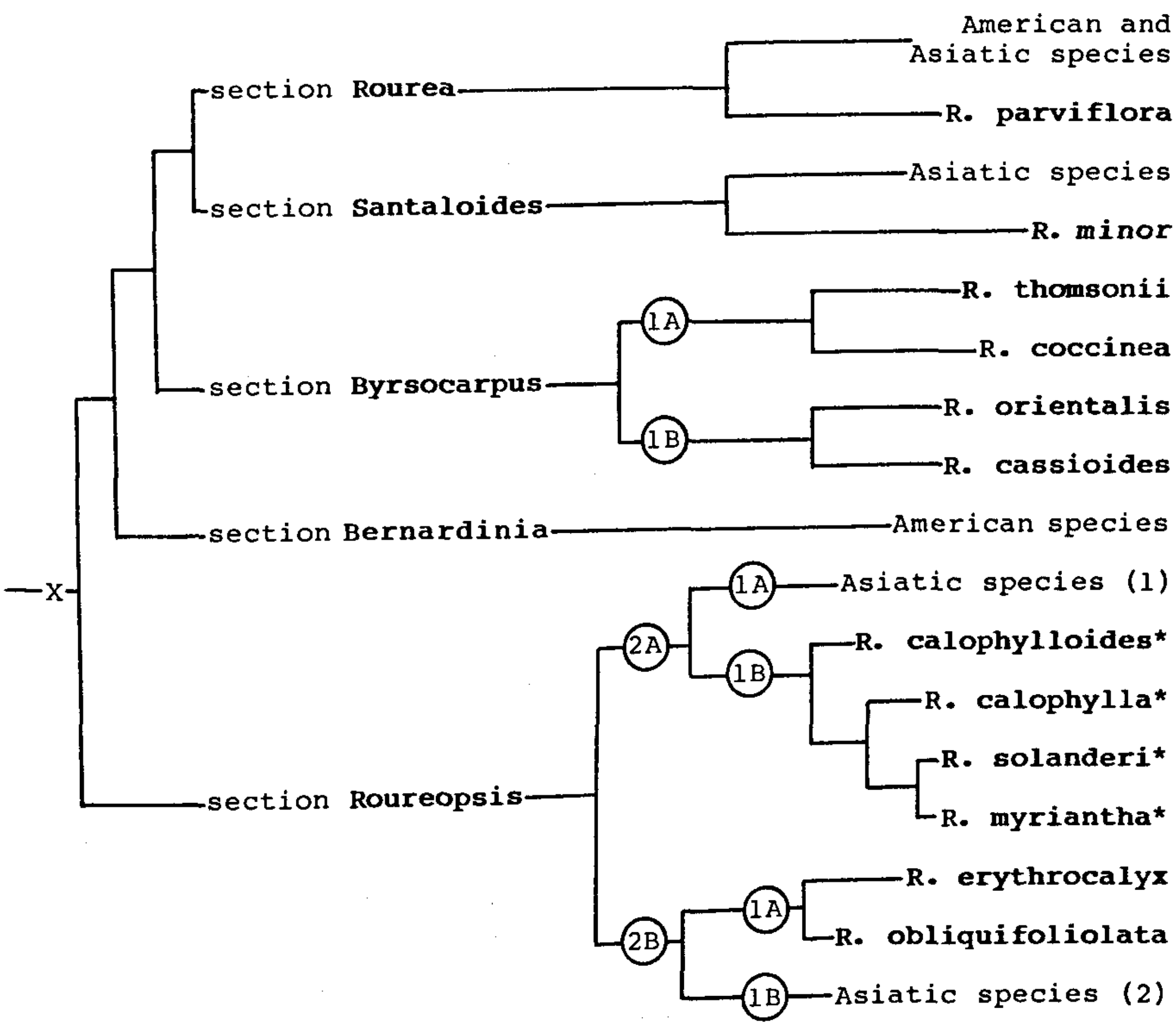


Fig. 57. Phylogeny of the genus *Rourea*

	Stomatal pattern	Petals	Calyx in fruit	Number of follicles	Indumentum of the follicles	Shape and size of the sarcotesta	Place of the radicle in seed
Roureopsis	±	+	+	±	±	+	±
Bernardinia	–	–	+	+	–	+	+
Byrsocarpus	–	±	–	–	–	–*	±
Santaloides	–	–	–	–	–	–*	+
Rourea	±	–	–	–	–	+	+

Table 22. Comparison of the sections of *Rourea* with the 'ancestral species'. + : This character is in all species the same as in the ancestral species; ± : in some species the same as in the ancestral species; – : in all species different from the ancestral species; –* : in all species different from the ancestral species but not equal to that in other aberrant section.

The length of the branches in this diagram are without value, only the bifurcations are important.

The ancestral species, X in this diagram, was probably a liana with anomocytic stomata in its leaves, and flowers with inrolled petals. The calyx was not clasping the fruit. More than one follicle developed per flower, and the fruit was velutinous. The testa was fleshy for ca 1/4 and the seed had an apical radicle.

The characters for the ancestral species have been selected after comparison of *Rourea* with the other genera of *Connaraceae* and establishment of the pattern of distribution of the character states among the species of the genus.

1. All species of *Rourea* are lianas or scandent shrubs so it is plausible that the ancestral species was a liana.

2. The only stomata pattern that is found in both five-carpellate and one-carpellate *Connaraceae* is the cyclocytic pattern. This pattern is also found in some species of *Rourea*, so this seems to be the primitive pattern in this genus.

3. Flowers with inrolled petals are found in the sections *Roureopsis* and *Byrsocarpus* in *Rourea* and also in some species of *Cnestis*. I suppose this character state to have been developed only once in a common ancestor of *Cnestis* and *Rourea* and therefore to have been present in the ancestral species of *Rourea*.

4. The only genus beside *Rourea* with five-carpellate flowers and an accrescent calyx is *Manotes*, and there this calyx is not at all clasping the fruit (see fig. 147.7), so this seems to be the primitive state.

5. In some species of *Rourea* and in all other genera with five carpellate flowers more than one follicle usually developes into fruit, one developed follicle per flower clearly is a derived character state.

6. Velutinous indumentum is the most common indumentum on the fruits of this family. It is found in most genera in the five-carpellate group and it is common in the genera in the one-carpellate group as well. Therefore it is considered to be primitive. Other kinds of indumentum such as an indumentum of glandular hairs or long sometimes stinging hairs mixed with short velutinous hairs are considered to be derived just as the glabrous fruits.

7. A testa that is fleshy for ca 1/4 is found in most species of *Rourea* and in all other genera with five-carpellate flowers with the exception of *Manotes*. Because *Rourea* is clearly more related to five-carpellate genera like *Cnestis* or *Agelaea* than to *Manotes*, the character state as found in the first two is considered to be primitive for *Rourea*.

8. The radicle is apical in seed in almost all *Connaraceae* (see chapter 4.8) so a ventral or dorsal radicle is considered to be a derived character state.

Other characters of *Rourea* are either not variable or hard to segregate in a primitive and a derived state.

The different sections are classified according to the amount of differences with this ancestral species and the amount of similarities with each other. In tab. 22 the sections are compared with the ancestral species. The characters to distinguish the sections are given on pag. 313. Key characters for the first bifurcations within the sections are the place of the radicle in the seed: ventral (1A) or apical (1B), and the indumentum of the fruit: velutinous (2A) or glabrous (2B).

The only African species in section *Rourea* is *R. parviflora*. Except for dimensions there is no character in flower or fruit that separates this species from all other species in this section. This maybe the only species in this section with deeply furrowed branches, but this could not yet be verified in some of the other species.

In section *Santaloides* the Afro-Asiatic species *R. minor* can be separated from the others on leaf characters only. However, in several divisions of its area of distribution these may be reinforced by some fruit characters as well.

R. orientalis and *R. cassioides* of section *Byrsocarpus* are very similar, the only important difference between these species is the location of the inflorescence. The other two species in this section, *R. thomsonii* and *R. coccinea*, are not hard to separate. *R. thomsonii* is distinct from *R. coccinea* in the shape of the petals and in the shape of the sarcotesta.

The Asiatic species of section *Roureopsis* are situated on two different branches, one for the species with velutinous fruits (1) and one for the species with glabrous fruits (2).

The group of four species marked with an asterisk need some special explanation. They are located at the end of a branch that started with the character of velutinous fruits (2A), but the fruits of *R. myriantha* are glabrous and those of *R. calophylla* have only glandular hairs. However, because of the similarity in the shape of the follicles and of the calyx in fruit, it is felt that these two species are close relatives of *R. solanderi*, a species with velutinous fruits. Their position in the diagram implying repeated instances of a relapse towards loss of indumentum is preferred over an alliance with species with glabrous fruits and subsequent acquisition of indumentum. Within this group of four species *R. calophylloides* is branched off first because the follicle and calyx in fruit are more like those of the Asiatic species with velutinous fruits rather than those of the remaining three species. Flower or fruit characters do not provide terms for a further phylogenetical classification of these three species. *R. calophylla* is branched off first by means of distinct vegetative characters. The remaining two species are almost impossible to separate when sterile.

R. erythrocalyx and *R. obliquifoliolata* differ mainly in the shape of the inflorescence, the dimensions of the calyx in fruit, and the shape of the leaves.

TAXONOMIC PART

Description of the family and keys to the genera

by C. C. H. Jongkind

Description of the family

Lianas climbing by means of the winding ends of young branches, sometimes additionally provided with reduced leaves transformed into woody hooks, less often shrubs or small trees. Stems may be deeply furrowed to fluted, lenticellate or not. Wood sometimes with interxylary phloem. *Leaves* alternate, imparipinnate, trifoliolate or unifoliolate, exstipulate, exstipellate; petiole pulvinate at base; petiolules entirely so; leaflets entire, opposite or not. *Flowers* in axillary panicles, racemes or rarely in fascicles; often numerous inflorescences grouped together towards the end of a branch accompanied by strongly reduced leaves suggesting a single large terminal inflorescence, sometimes partly cauliflorous or uniformly so. Pedicel usually jointed. Flowers bisexual or rarely unisexual, pentamerous or rarely tetramerous, actinomorphic. *Sepals* imbricate or valvate, free or united at base, or almost entirely fused in bud (Rourea solanderi), caducous to persistent and sometimes somewhat accrescent in fruit to strongly so. *Petals* imbricate, free to connivent near the base. Androgynoecium usually heterodistylous or heterotristylous; *Stamens* in two whorls, free or united at base, the outer episepalous, longer than the inner epipetalous ones, the latter staminodial in a limited number of species; anthers dorsifixed, dehiscing lengthwise, introrse. *Carpels* superior, free, either one or five present, of the five carpels often only a reduced number develops into ripe follicles, in many species even only a single one; ovules two, collateral, nearly basal to nearly apical, anatropous to hemitropous; micropyle always directed upwards. *Fruits* dry or more-or-less fleshy, usually dehiscing by a ventral suture, sometimes along the dorsal side as well, rarely circumscissile at the base, or indehiscent, Two or more follicles of a single flower sometimes connate at base. *Seed* one or two per follicle, with or without endosperm; hilum lateral to basal; testa partly to entirely fleshy, sarcotesta sometimes partly free; cotyledons thin and flat to planoconvex; radicle central covered by the cotyledons or situated at their margin, apical, ventral, or dorsal. *Seedlings* hypogeal or epigeal.

A circumtropical family with twelve genera and 110-200 species depending on the species concept used (see Introduction).

Three keys to the genera are presented. For the first one, the general key, flowers and fruits are needed for identification. In this key all 12 genera are covered. The second and the third key are for identification of flowering and fruiting material respectively. These two keys are made for the African genera only. Identification with these keys, i.e. of material with either flowers or fruits,

	Agelaea	Burttia	Cnestidium	Cnestis	Connarus	Ellipanthus	Hemandradenia	Jollydora	Manotes	Pseudoconnarus	Rourea	Vismianthus
Habit												
Tree or treelet		+			+	+	+	+				+
Shrub	+	+	+	+	+				+	+	+	+
Liana	+		+	+	+				+	+	+	
Bark exudate												
Turning red					+							
Staying colourless	+	+	+	+		+	+	+	+	+	+	+
Indumentum												
Glandular hairs:												
Unicellular									+			
Multicellular				+	+			+	+		+	
Non-glandular hairs:												
Unicellular	+	+	+	+	+	+	+		+	+	+	
Unicellular fascicled in three or four	+											
Multicellular, straight								+				
Multicellular, branched ("spiral staircase")					+							
Leaves												
Unifoliolate		+				+	+					+
Trifoliolate	+				+					+		
Pinnate			+	+	+			+	+		+	
Nervation												
Open	+	+	+	+	+	+	+	+		+	+	+
Closed (ending in a pattern of tiny parallel nerves)									+			
Leaf epidermis												
Papillate			+	+						+	+	
Non-papillate	+	+		+	+	+	+	+	+		+	+
Stomata:												
Anomo-cyclocytic		+			+	+	+		+		+	+
Bicyclic								+				
Paracytic				+						+?	+	
Anisocytic	+										+	
Outer-stomatal ledge:												
Inconspicuous	+	+	+	+			+	+		+	+	+
Distinct					+	+			+		+	

Table 23. Vegetative characters of the genera of *Connaraceae*. + : character present in one or more species of the genus.

is more difficult than of complete material, especially so when only flowers are present.

For sterile material table 23 may be a useful help to determine the genus. In this table vegetative characters of all 12 genera are presented.

General key to the genera

1a Flowers with five carpels. . . . . –2
 b Flowers with one carpel only. . . . . –8
2a Follicles (nearly) glabrous. . . . . –3
 b Follicles covered with a continuous indumentum of (sometimes glandular) hairs. . . . . –4
3a Seed with abundant endosperm. Leaves always trifoliolate. (America) . . . . **Pseudoconnarus**
 b Seed (almost) without endosperm. Leaves pinnate (branches with unifoliolate or trifoliolate leaves may occur). (circumtropical) . . . . . . **Rourea**
4a Flowers with a distinct androgynophore. (Africa) . . . . **Manotes**
 b Flowers without a distinct androgynophore . . . . –5
5a Follicles hairy inside. (Africa, Asia) . . . . **Cnestis**
 b Follicles glabrous inside. . . . . –6
6a Sepals in fruit strikingly accrescent. (circumtropical) . . . . **Rourea**
 b Sepals in fruit inconspicuous or caducous.. . . . . –7
7a Leaves trifoliolate. (Africa, Asia) . . . . **Agelaea**
 b Leaves with more leaflets. (America) . . . . **Cnestidium**
8a Leaves unifoliolate. . . . . –9
 b Leaves with more than one leaflet. . . . . –12
9a Follicles glabrous. (Africa, Asia) . . . . **Vismianthus**
 b Folicles velutinous. . . . . –10
10a Petals glabrous. Fruits dehiscent. Seeds with abundant endosperm; cotyledons thin and flat. (Africa) . . . . **Burttia**
 b Petals hairy. Fruits dehiscent or not. Seeds with or without endosperm; cotyledons flat to planoconvex. . . . . –11
11a Follicles dehiscent. Testa for about 1/4 fleshy. (Africa, Asia) . **Ellipanthus**
 b Follicles indehiscent. Testa almost entirely fleshy. (Africa) . . . . **Hemandradenia**
12a Understory treelet. Petals and filaments glabrous. Follicles indehiscent. 1-2-seeded. (Africa) . . . . **Jollydora**
 b Treelet, shrub or liana. Petals and/or filaments with many (sometimes glandular) hairs. Follicles dehiscent, 1-seeded. (circumtropical) . . . **Connarus**

Key to the African genera based on flowering material

1a Flowers with five carpels. . . . . –2
 b Flowers with one carpel only. . . . . –8
2a Flowers with a distinct androgynophore. . . . . **Manotes**

b Flowers without a distinct androgynophore. . . . . –3
3a Leaves trifoliolate. Most hairs fascicled and sepals fringed with multicellular hairs, or leaflets at the uppersurface with many mucous cells (look like small pits in herbarium specimens). . . . . **Agelaea**
b Plants otherwise or mature leaves not available. . . . . –4
4a Sepals longer than petals and/or reflexed when flowering. . . . . **Cnestis**
b Sepals shorter than petals and not reflexed when flowering. . . . . . . –5
5a Petals connivent and/or twice or more times as long as sepals. . . . . . –6
b Petals not connivent and shorter than twice the sepals. . . . . –7
6a Sepals ca three times as long as wide, never entirely covered with glandular hairs outside; petals twice as long as sepals or longer, never connate. Petiole more than 1 cm long. **Cnestis corniculata**
b Plants otherwise. . . . . **Rourea**
7a Inflorescences on older, full-grown branches, sometimes together with young shoots. . . . . **Cnestis**
b Inflorescences on young shoots in the axil of immature or reduced leaves. . . . . **Rourea cassioides**
8a Leaves unifoliolate. . . . . –10
b Leaves with more than one leaflet. –9
9a Understory treelet. Petals and filaments glabrous. . . . . **Jollydora**
b Small tree, shrub or liana. Petals and/or filaments with many (sometimes glandular) hairs. . . . . **Connarus**
10a Petals glabrous. Petiole about half the length of leaf-lamina or longer. –11
b Petals hairy. Petiole considerably shorter. . . . . –12
11a Lower surface of leaflet with many small glandular dots. . . **Vismianthus**
b Lower surface of leaflet without glandular dots. . . . . **Burttia**
12a Petals with many hairs inside. East Africa & Madagascar. . . **Ellipanthus**
b Petals (almost) glabrous inside. West & Central Africa. . **Hemandradenia**

Key to the African genera based on fruiting material.

1a Follicles (nearly) glabrous outside. –2
b Follicles covered with a continuous indumentum of (sometimes glandular) hairs. . . . . –5
2a Understory treelet. Follicles indehiscent, never more than one per flower, often with two seeds. Central Africa. . . . . **Jollydora**
b Lianas or shrubs. Follicles dehiscent, one to five per flower, rarely with more than one seed. . . . . –3
3a Shrub. Leaves unifoliolate, crowded at the top of the shoot. East Africa. . . . . **Vismianthus**
b Lianas or shrubs. Leaves pinnate (branches with unifoliolate leaves may occasionally occur), leaves more or less evenly distributed, not confined to the apex of shoots. Whole tropical Africa. . . . . –4
4a Seed attached basally in the follicle. . . . . **Rourea**
b Seed attached ventrally in the follicle. . . . . **Connarus**

5a Seed (almost) without endosperm; cotyledons planoconvex. . . . . . . –6
b Seed with abundant endosperm; cotyledons flat. . . . . –10
6a Seed attached basally in the follicle. . . . . –7
b Seed attached ventrally in the follicle. . . . . –8
7a Calyx in fruit inconspicuous or caducous. Leaves always trifoliolate. Follicles always velutinous. . . . . **Agelaea**
b Calyx in fruit accrescent and reddish, never inconspicuous. Leaves rarely trifoliolate. Follicles velutinous or not. . . . . **Rourea**
8a Leaves unifoliolate. . . . . –9
b Leaves with more leaflets. . . . . **Connarus**
9a Follicles dehiscent. East Africa & Madagascar. . . . . **Ellipanthus**
b Follicles indehiscent. West & Central Africa. . . . . . . **Hemandradenia**
10a Follicles hairy inside. . . . . **Cnestis**
b Follicles glabrous inside. . . . . –11
11a Leaves unifoliolate. Shrub or treelet. . . . . –12
11b Leaves with more leaflets. Shrub or liana. . . . . **Manotes**
12a Follicles indehiscent. West & Central Africa. . . . . . . **Hemandradenia**
12b Follicles dehiscent. East Africa. . . . . **Burttia**

Revision of the genera in alphabetical order

Agelaea Sol. ex Planchon

by C. C. H. Jongkind

History of the genus

Agelaea was first published by Planchon in 1850 and based on three species, two in Africa and one in Madagascar. In the present work they are considered to be conspecific and they are placed in *Agelaea pentagyna* (Lam.) Baill.

The genus *Castanola* was published by Llanos in 1859 based on *C. trinervis* from the Philippines. When Llanos described *Castanola trinervis* he noticed its similarity with *Connarus pentagynus* Lam. (= *Agelaea pentagyna* (Lam.) Baill.) from Madagascar. He clearly was ignorant of *Agelaea* published nine years earlier by Planchon. In the next year two almost identical new genera *Hemiandrina* Hooker fil. and *Troostwykia* Miquel were described. These only differ from *Castanola* in the number of sepals and/or ovaries, and are obviously based on collections with deformed flowers. *Castanola, Hemiandrina*, and *Troostwykia* have been separated from or included in *Agelaea* at various occasions. When the name *Agelaea* was generaly accepted, many species from the '*Castanola*' group were described in the genus *Agelaea* (see Leenhouts 1958). In 1908 and 1918 Merrill transferred the *Castanola/Hemiandrina* species names known to him to *Agelaea* and in 1910 Schellenberg proposed *Agelaea* subgenus *Troostwykia* for this group of species.

In his monograph of the *Connaraceae* (1938) Schellenberg changed his mind and he removed the genus *Castanola* with twelve species from *Agelaea*. He even referred *Castanola* to another tribe, based on the axillary inflorescences of *Castanola* species. The axillary inflorescences of *Agelaea* were interpreted by him as terminal ones. Leenhouts (1958) rejected this separation and he moved a strongly reduced '*Castanola*' group back into *Agelaea* again.

The number of published species in *Agelaea* was growing rapidly when De Wildeman (1900-1911) and later Schellenberg (1923) described many new species, most of them on vegetative characters only. In the present work all those names are reduced into synonyms. In Schellenberg's monograph of the family (1938) *Agelaea* comprises forty-six African species apart from *Castanola* with another twelve species for Africa and Asia. From 1938 till now another six *Agelaea* species have been described.

The present work recognizes a species described by Gilg in 1895, *A. poggeana*, as the most recent new discovered species.

Delimitation of the genus

Among *Connaraceae* with five carpellate flowers *Agelaea* is sharply delimitated by a combination of the following characters: trifoliolate leaves, no androgynophore, follicles glabrous inside and velutinous outside, sepals inconspicuous or caducous in fruit, and seeds without endosperm.

Description of the genus

Agelaea Solander ex Planchon, 1850: 437; Bentham & Hooker, 1862: 432; Baker, 1868: 453; Baillon, 1870: 18; Gilg, 1890: 65; Schellenberg, 1910: 60,132; 1923: 200; 1938: 65; Troupin, 1952: 97; Hemsley, 1956: 9; Keraudren, 1958: 9; Leenhouts, 1958: 500; Hutchinson, 1964: 167; Mendes, 1966: 616; Mendes, 1969: 3; Liberato, 1980a: 8; 1980b: 9.

Type species: *A. villosa* Solander ex Planchon (illegitimate name for *Cnestis trifolia* Lamarck = *A. trifolia* (Lam.) Baill. = *A. pentagyna* (Lam.) Baill.).

Omphalobium section 2 De Candolle, 1825: 86.

Castanola Llanos, 1859: 505; Schellenberg, 1938: 169; Troupin, 1952: 113; Hutchinson, 1964: 167. Type species: *C. trinervis* Llanos (= *Agelaea macrophylla* (Zoll.) Leenh.).

Hemiandrina Hooker f., June 1860: 171,tab.28. Type species: *H. borneensis* Hooker f. (= *Agelaea borneensis* (Hook.f.) Merr.).

Troostwykia Miquel, November 1860: 531; Bentham & Hooker, 1862: 434; Gilg, 1890: 69. Type species: *T. singularis* Miquel (= *Agelaea borneensis* (Hook.f.) Merr.).

Large lianas. *Branches* cylindric to deeply furrowed, often ending in a tendrilloid tip. Some species frequently with interxylary phloem. *Leaves* 3-foliolate; leaflets entire, symmetric or asymmetric; tertiary venation more or less clearly showing a pattern of very small squares and crosses (fig. 58). *Inflorescence* axillary, paniculate, usually many flowered, frequently several inflorescences grouped in the same axil and often one or more together at the end of a leafy branch, thus resembling a terminal inflorescence, the supporting leaves rudimentary. *Flowers* pentamerous, heterotristylous or heterodistylous, sweet scented; pedicel always with a distinct joint. *Sepals* nearly free, imbricate in bud, never accrescent in fruit. *Petals* as long as or longer than the sepals, free or connivent near the base, white, often with a trace of yellow or red, glabrous. *Stamens* in two whorls, shortly united at base, filaments glabrous, the five stamens opposite the sepals longer than the five opposite the petals. *Carpels* five, free. Fruit a follicle, one to five per flower, pyriform or ellipsoid with a constricted base, beaked or not, with many coarse protuberances or not, orange to red, velutinous, dehiscing by a ventral suture. *Seed* solitary subovoid or ellipsoid; testa partly fleshy and yellow to red (sarcotesta), other part of the testa thin, black and shiny; hilum basal; endosperm absent; cotyledons planoconvex, glabrous; radicle apical.

A genus of six species, four in tropical Africa and two in Asia. In Africa ranging from Guinea Bissau to S Sudan and southwards to Mozambique, Angola and Madagascar.

Note 1: Leenhouts who found no evidence to maintain *Castanola* as a separate genus is followed.
Note 2: The protuberances on the follicles of some species have nothing to do with fungi as Schellenberg (1923: 205) stated. The presence or absence of this character is clearly genetically determined.

Sectional arrangement

Schellenberg (1910: 67) divided *Agelaea* in two subgenera. The subgenus *Troostwykia* has mucous cells in the upper surface of the leaflets and the subgenus *Agelaea* has fascicled hairs. These subgenera are identical to the sections *Troostwykia* (Miq.) Jongkind and *Agelaea* in the present work. The section *Troostwykia* is also identical to *Castanola*. A character Schellenberg ignored but that proved to be valuable is the fringed edge of the sepals in species of the section *Agelaea*. The section *Agelaea* is represented in the present work by the African species *A. pentagyna*, *A. poggeana*, and *A. rubiginosa* while the section *Troostwykia* comprises the Asiatic *A. borneensis* and *A. macrophylla*, and *A. paradoxa* from Africa (see also paragraph on the Asiatic species of this genus).

Section **Troostwykia** (Miq.) Jongkind **comb. & stat. nov.**
Basionym: *Troostwykia* Miq. as a genus.
Type species: *T. singularis* Miq. (= *Agelaea borneensis* (Hook.f.) Merr.).
Synonym: *Castanola* Llanos, *Hemiandrina* Hook.f.

Key to the sections and the African species

1a Sepals 1.5-2 mm long, not fringed with multicellular hairs. Leaflets with many mucous cells in the upper surface. Those mucous cells look like small pits in dried material. Hairs not fascicled. Section . . . . **Troostwykia: A. paradoxa**
b Sepals (2.5-)3-4(-5) mm, fringed with multicellular hairs. Mucous cells on leaflets absent. Most hairs fascicled, 3 or 4 together. Section **Agelaea** . . –2
2a Follicles with many coarse protuberances. Hairs on branchlets at most 0.5 mm long. Adult leaflets glabrous or with some remnants of indumentum on the midrib (on Principe the lower surface with small hairs). The basal pair of main lateral nerves of the terminal leaflet always longer than the others. Central and Eastern W Africa. . . . . **A. rubiginosa**
b Follicles without coarse protuberances but sometimes wrinkled when dry. Branchlets sometimes also with hairs much longer than 0.5 mm. Adult leaflets glabrous to hairy. The basal pair of main lateral nerves of the terminal leaflet either shorter or longer than the others. Africa and Madagascar. . –3

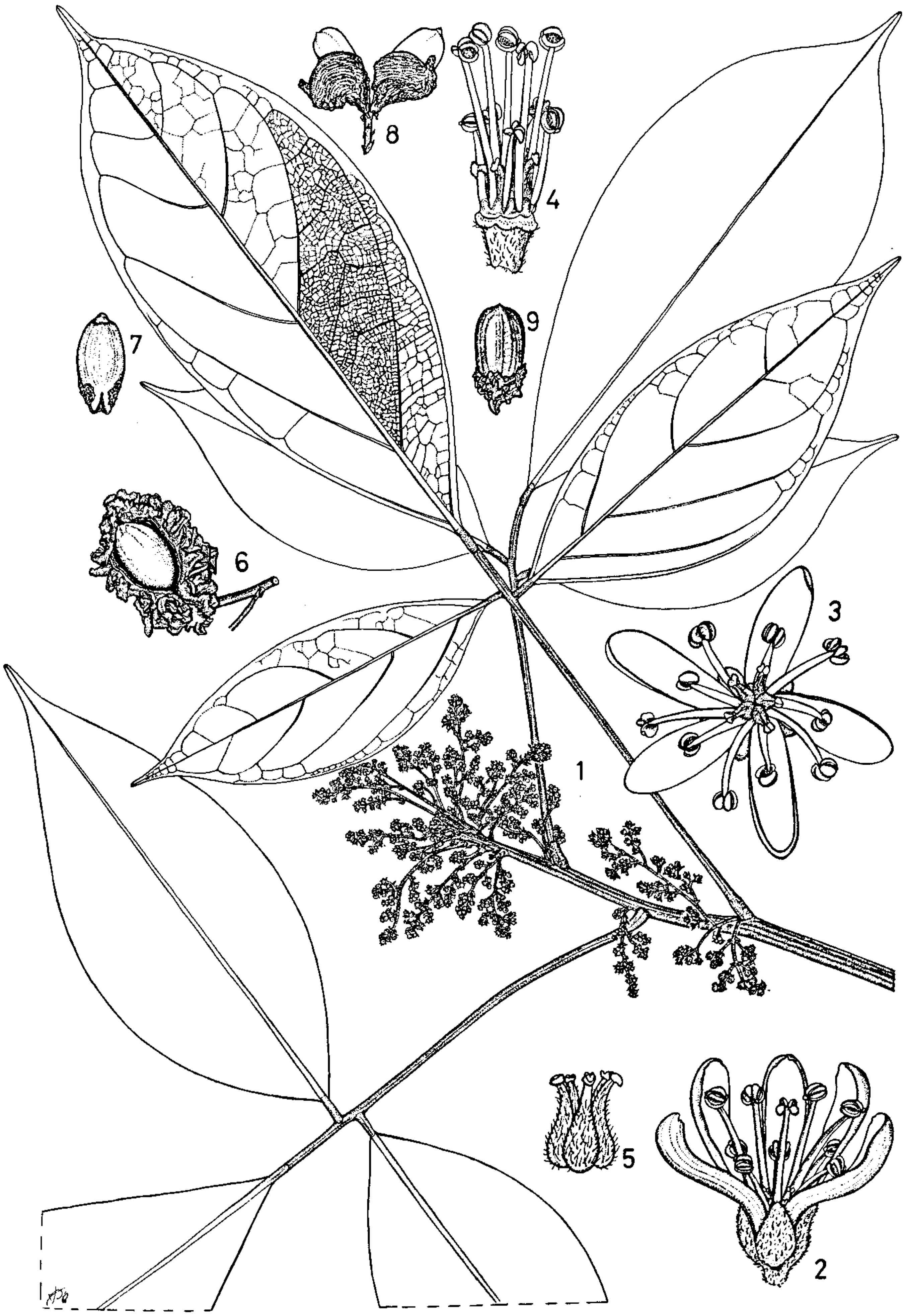


Fig. 58. *Agelaea paradoxa* var. *paradoxa*: 1. flowering branchlet, 2/3 ×; 6. open follicle, 2/3 ×; 7. seed, ventral side, showing the hilum and small part of the sarcotesta, 2/3 ×.

Agelaea paradoxa var. *microcarpa*: 2-3. flower, 8 ×; 4. stamens and pistils of a short-styled flower, 8 ×; 5. pistils, 14 ×; 8. open follicles, 2/3 ×; 9. seed, dorsal side, showing sarcotesta, 2/3 ×. (1. *A.Louis 514*; 2-5. *de Koning 2072*; 6-7. *A.Louis 556*; 8-9. *Bamps 2146*).

3a Terminal leaflet always with a pinnate venation; the basic pair of main lateral nerves always distinctly smaller than the next. Young leaflets entirely covered by a white and slightly shining arachnoid indumentum; older leaflets glabrous on both sides or with some remnants of arachnoid indumentum on the midrib. Rachis 0.1-1 cm. . . . . **A. poggeana**

b Terminal leaflet usually with a palmate but sometimes with a pinnate venation; the basal pair of main lateral nerves never distinctly smaller than the others. Young leaflets rarely with an arachnoid indumentum, old leaflets glabrous to hairy. Rachis up to 4 cm. . . . . **A. pentagyna**

Agelaea paradoxa Gilg **Fig. 58-60**

For literature, synonyms and typification see under the varieties.

Large liana up to 40 m long. *Branchlets* puberulous to nearly glabrous. Wood usually without interxylary phloem, xylem furrowed. *Petiole* 4-19 cm long; rachis 0.5-5 cm long; petiolules 2-7 mm long; *leaflets* elliptic to ovate, puberulous to glabrous, on the upper surface with many mucous cells, looking like small pits in dried material, 3-5 pairs of main lateral nerves; apex acuminate; terminal leaflet 4-26 × 2-13 cm; lateral leaflets asymmetric, 2.5-24.5 × 1-11 cm. *Inflorescence* up to 6(-15) cm long, often more than one in the axil of a sometimes rudimentary leaf, puberulous to glabrous. Flowers heterotristylous. Pedicel above the joint ca 1 mm long. *Sepals* 1.5-2 × 0.7-1 mm, velutinous outside. *Petals* 4-5 × 1.5 mm, concave, glabrous. Long *stamens* 1.5-4.5 mm long, short stamens 0.5-3 mm long. *Pistil* 0.5-3.5 mm long, unequal to the stamens; style sparsely hairy; ovary pubescent. Developed *follicles* one to five per flower, 20-45 × 10-28

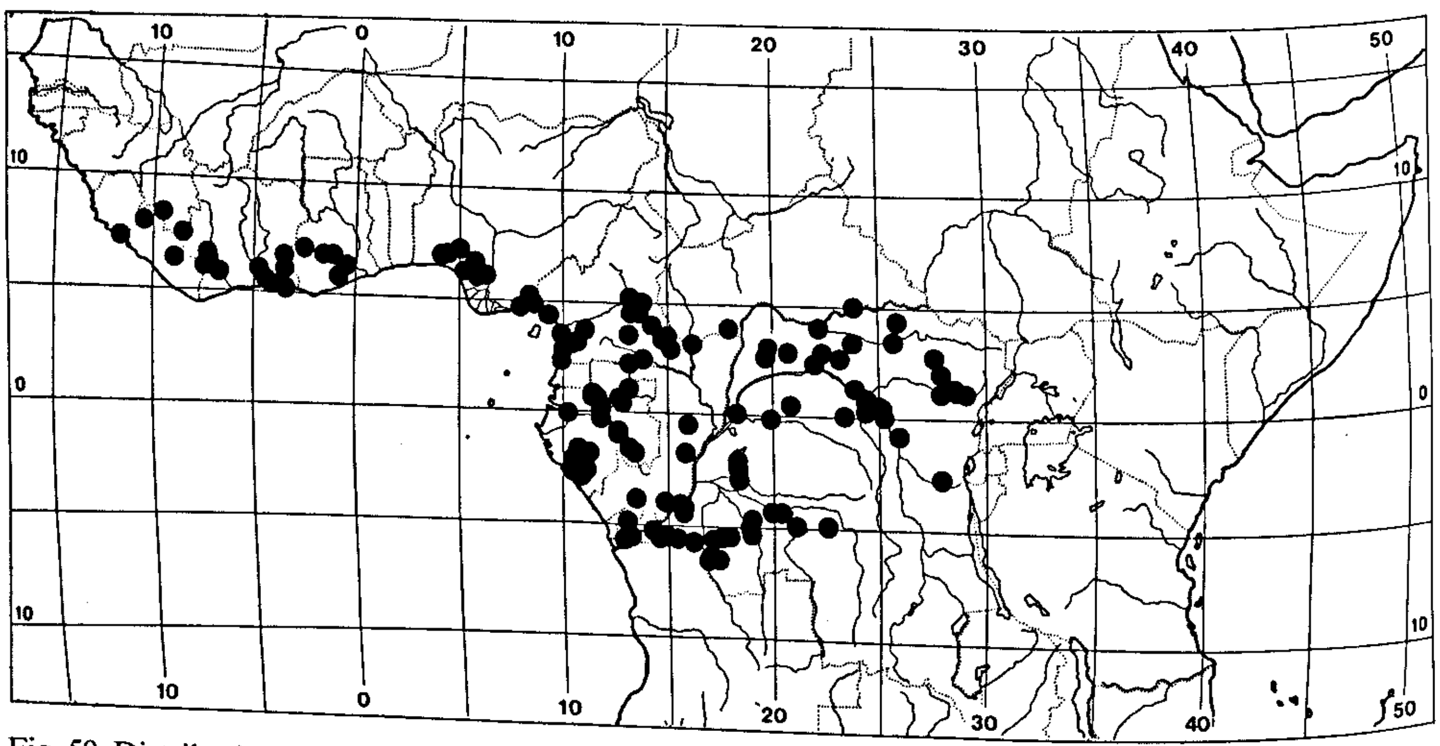


Fig. 59. Distribution of *Agelaea paradoxa*.

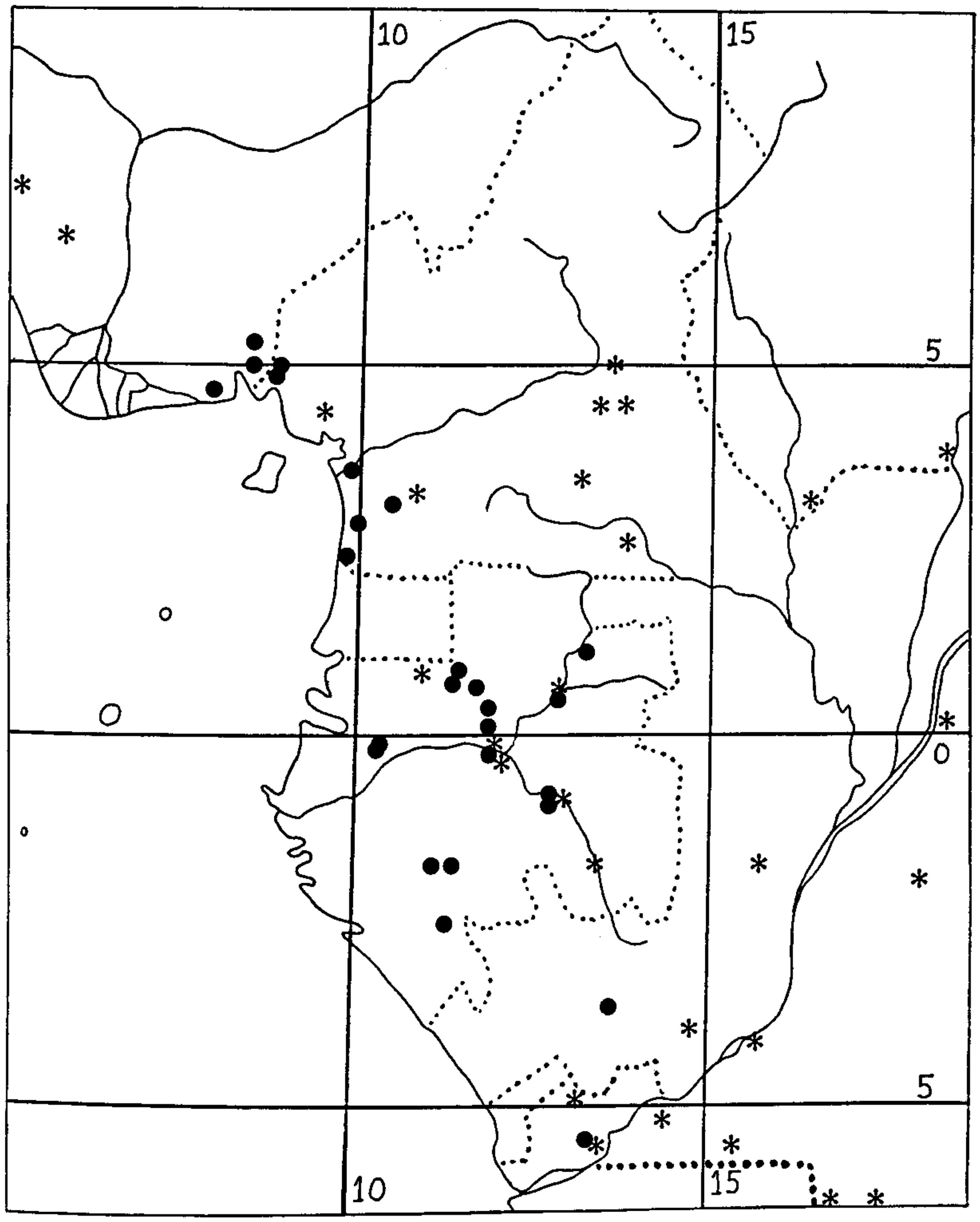


Fig. 60. Distribution of *Agelaea paradoxa* var. *paradoxa* in combination with distribution of *A. paradoxa* var. *microcarpa* in the same area. Dots: var. paradoxa. Asterisks: var. microcarpa.

mm, sometimes with many coarse protuberances, velutinous, beaked. *Seed* 15-30 × 7-14 mm; testa for ca 1/4 fleshy and yellow to red. *Seedling* hypogeal; first pair of leaves opposite and usually scalelike or abortive; first fully developed leaves unifoliolate.

Distribution: From Senegal to E Zaire.

Key to the varieties

1a Follicles smooth or rugulose, ca 20 × 10 mm. **A. paradoxa** var. **microcarpa**
1b Follicles with many coarse protuberances, ca 35 × 20 mm. . . . . **A. paradoxa** var. **paradoxa**

Agelaea paradoxa Gilg var. **paradoxa**

A. paradoxa Gilg, 1891b: 318; Schellenberg, 1910: 67; 1923: 205 p.p.
Type: Cameroun, sin. loc., *J.Braun 52* (holo: B†; lecto: M; iso: B).
Castanola paradoxa (Gilg) Schellenberg ex Hutchinson & Dalziel, 1928: 516).p.; Schellenberg, 1929: 550 p.p.; 1938: 174 p.p.; Troupin, 1952: 113 p.p.; Hep-)er, 1958: 746 p.p.; Irvine, 1961: 570 p.p.; Mangenot, 1965 p.p.; Adam, 1971: ;67 p.p.; Burkill, 1985: 519 p.p; Caballé, 1986: 216,228. Basionym: *A. paradoxa* 3ilg (see above).

Follicles up to 45 × 28 mm but usually ca 35 × 20 mm, with many coarse)rotuberances. *Seed* up to 30 × 14 mm.

Distribution: E Nigeria, Cameroun, Gabon, SW Congo and SW Zaire.
Ecology: Rain forest and gallery forest, from sealevel up to 760 m alt.

Selection of 42 examined specimens:

Nigeria: Oban (fl.) *Talbot 1300* (K, Z).
Cameroun: Lake Tissongo, 16 km ESE Mouanko (fr. Sept.) *Asonganyi 700* (P, YA); 11 km from ‹ribi (fl. Oct.) *Bos 5538* (K, P, WAG); 45 km S of Kribi (y.fr. Dec.) *Letouzey 15329* (P); Bipindi y.fr.) *Zenker 1601* (B, G, GOET, K, L, M, P, WAG, Z).
Gabon: region de l'estuaire (fr. Sept.) *Floret et al. 1479* (P); La Nke (fr. Oct.) *Floret et al. 1769* P); Belinga (fr. Nov.) *N.Hallé 3711* (P); between Mouila and Saint Martin (fr. Sept.) *Le Testu :021* (BM, BR, P, WAG); Guidouma (fl. Nov.) *Le Testu 5069* (BM, BR, P); Liyanga (fl., fr. Nov.) *.e Testu 7692* (BR, P); Lastoursville (fl., fr. Nov.) *Le Testu 8502* (BR, K, P, WAG); 35 km SW Ndende (fr. Dec.) *Louis et al. 1148* (LBV, WAG); Oveng (fr. May) *Reitsma 906* (WAG).
Congo: Moussoumou (fr. Aug.) *Farron 4477* (P).
Zaire: Gimbi, Fuka valley (fr. Dec.) *Toussaint 713* (BR).

\gelaea paradoxa Gilg var. **microcarpa** Jongkind **var.nov.**

Type: Ivory Coast, Morokro, 12 km N of N'Douci, *Oldeman 985* (holo: WAG; so: B, BR, K, MO, P).
A. fragrans Gilg, 1896: 209. Type: Cameroun, Lolodorf, *Staudt 378* (holo: 3†; lecto: K; iso: E, G, Z).
A. brevipaniculata Cummins, 1898: 73. Type: Ghana, Kumasi, *Cummins 30a* (holo: K).
Castanola paradoxa (Gilg) Schellenberg ex Hutchinson & Dalziel, 1928: 516).p.; Schellenberg, 1929: 550 p.p.; 1938: 174 p.p.; Troupin, 1952: 113 p.p.; Hep-)er, 1958: 746 p.p.; Irvine, 1961: 570 p.p.; Mangenot, 1965 p.p.; Adam, 1971: 367 p.p.; de Koning, 1983: 281; Burkill, 1985: 519 p.p.

Differt at *A. paradoxa* var. *paradoxa* folliculus circ. 20 × 10 mm, interdum rugulosus (non circ. 45 × 28 mm, nec plurituberculatus) et semen maximus 14 × 7 mm (non maximus 30 × 14 mm).

Follicles ca 20 × 10 mm, smooth or rugulose, beaked. *Seed* up to 14 × 7 mm.

Distribution: From Senegal to Gabon and E Zaire.

Ecology: Rain forest, gallery forest and semideciduous forest, from sea level up to 800 m alt.

Selection of the more than 200 examined specimens

Guinea: Macenta (fl. May) *Jacques-Félix 921* (P).

Sierra Leone: Pujehun (fr. Feb.) *N.W.Thomas 8182* (K).

Liberia: Tappita (fl. Aug.) *Baldwin 9115* (K); Vahun (y.fr. Nov.) *Baldwin 10244* (K); Nimba Mts (fl. July) *Leeuwenberg & Voorhoeve 4635* (B, P, WAG).

Ivory Coast: Tienkula (fr. March) *Bernardi 8393* (G, K, M, WAG); Banco F.R. (fr. Dec.) *de Koning 5061* (WAG); W of Soubré (fl.b. June) *W.de Wilde 294* (P, WAG, Z); Mbaso (fl. July) *Oldeman 224* (B, P, WAG); Morokro (fr. Feb.) *Oldeman 985* (B, BR, K, MO, P, WAG, type).

Ghana: Bobisi F.R. (fl. June) *Andoh 5574* (B, BR, K); Asukese F.R. (fr. March) *Enti FE 1288* (BR, K); Asamankese (fl. Aug.) *Howes 936* (K); Begoro fall (fr. Jan.) *Morton A2676* (K).

Nigeria: Okomu F.R. (fr. Feb.) *Brenan 9093* (BR, P); Omo F.R. (fl. Aug.) *Okeke & Binuyo FHI 36900* (K, WAG); 8 mls NE of Ute Enugu (fl.b. Aug.) *Onochie FHI 33427* (K).

Cameroun: Banga F.R. (fr. March) *Binuyo & Daramola FHI 35622* (P); logging road Asia-Bedoumo (fr. April) *Letouzey 3910* (P, WAG); near Nteigne (fr. Jan.) *Letouzey 11870* (BR, K, P, WAG).

Central African Republic: 35 km NE of Bayanga, *Caroll 113* (WAG); Boukoko (fr. Jan.) *Equipe Tisserant 621* (BR, P, WAG); Haut Sangha (fl. Sept.) *Tisserant s.n.* (P, WAG); Mbomou R. (fl. Sept.) *Tisserant 3668* (BM, BR).

Gabon: 23 km Moanda-Franceville (fl., fr. Oct.) *Breteler 6769* (WAG); M'Passa (fr. June) *Hladik 2346* (P); Mont de Casque, ca 20 km NW of Booue (fl., y.fr. May) *Reitsma et al. 3393* (WAG).

Congo: Gamboma (fl. June) *Descoings 6933* (P); near Owando (Fort Rousset) (fl.b. July) *Descoings 8670* (P); Louhoulou Forest along the road M'Poka-Meya (fr. July) *Sita 2927* (P).

Zaire: Penghe (fr. Feb.) *Bequaert 2237* (BR); Lubutu-Kirundu (fl. Feb.) *Bequaert 6880* (BR); Bambesa (fl. Oct.) *Gerard 5058* (BR, WAG); Bombo R. (fr. Dec.) *Breyne 3160* (BR); Maduda (fr. Nov.) *Breyne 4517* (BR); Kakuluba (fr. Sept.) *Callens 4278* (BR); Eala (fl. Feb.) *Corbisier 1294* (B, BR); Dundusana (fl. June) *De Giorgi 1041* (BR); INEAC Boketa (fr. Feb.) *Evrard 196* (BR, M); Bulumbu (y.fr. April) *A.Léonard 3756* (BR); between Lubire and Bena-Makinia (fl. May) 1910 *Sapin s.n.* (BR).

Cult.: Seedlings, *de Koning 5743, 5752*, and *5977* (WAG).

Note 1: Of the two related species *A. paradoxa* and *A. borneensis* with comparable variable fruit shape only *A. paradoxa* has been divided in two varieties. The differences in fruitshape in the African *A. paradoxa* are greater than in the Asiatic *A. borneensis* and there are almost no intermediates. In *A. borneensis* intermediates are as common as the extremes.

Note 2: There are some small differences in the texture of the leaflets of the two subspecies. It seems not practicable to describe these differences, but they make it possible to refer part of the flowering collections to the varieties by comparing them with already named fruiting collections.

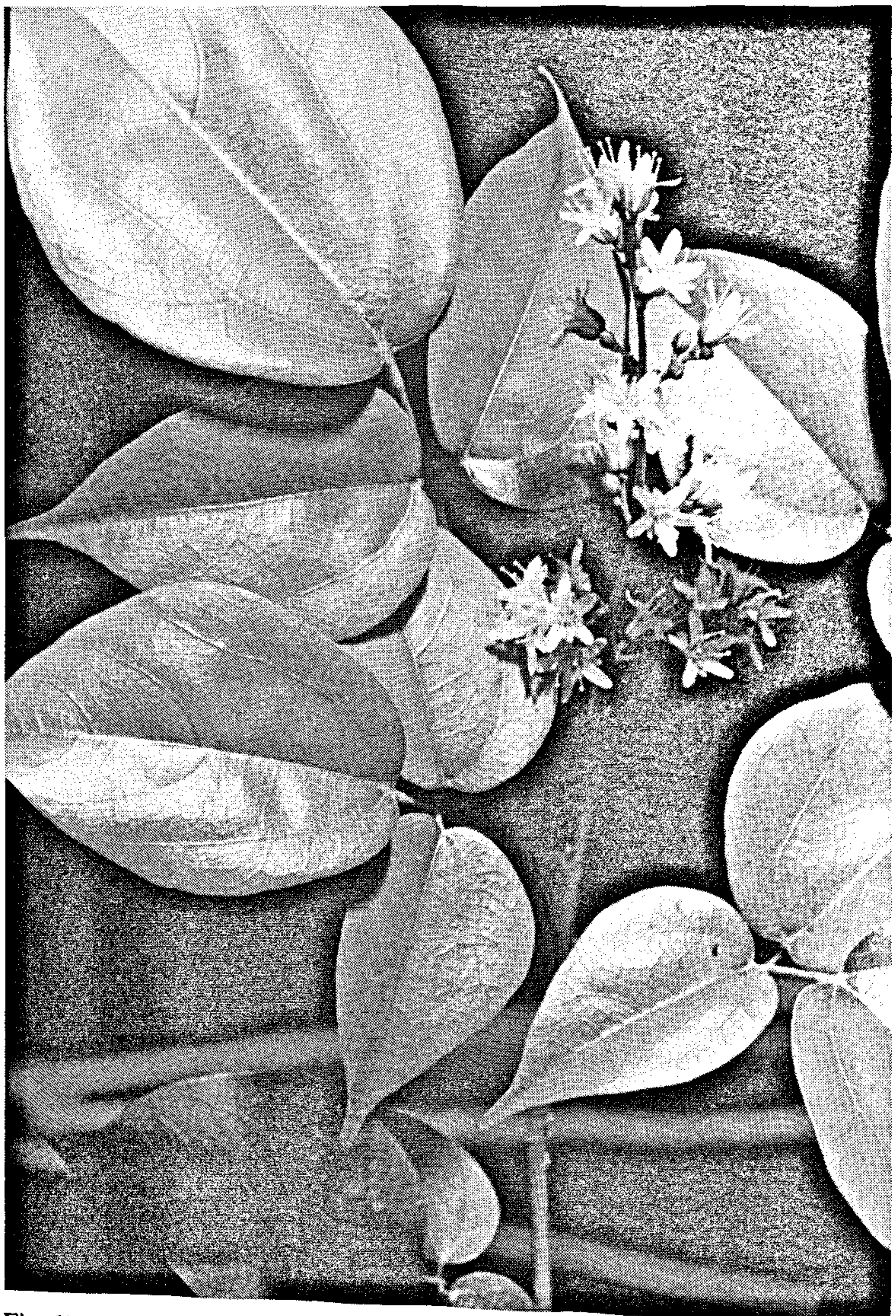


Fig. 61. *Agelaea pentagyna*: flowering branchlet (phot. H.C.D. de Wit).

Agelaea pentagyna (Lam.) Baill. **Fig. 20, 61-65**

A. pentagyna (Lam.) Baillon, 1882: 345; Drake de Castillo, 1902: 31; Schellenberg, 1910: 63; 1923: 220; 1938: 89; Keraudren, 1958: 13, fig. 3.
Basionym: *Connarus pentagynus* Lamarck, 1786: 95.
Type: Madagascar, sin. loc., *Commerson s.n.* (holo: P).
A. trifolia (Lam.) Baillon, 1867: 237; Schellenberg, 1938: 83; Hepper, 1958: 745; Irvine, 1961: 568; Adam, 1971: 865; Berhaut, 1975: 15; Liberato, 1980a:

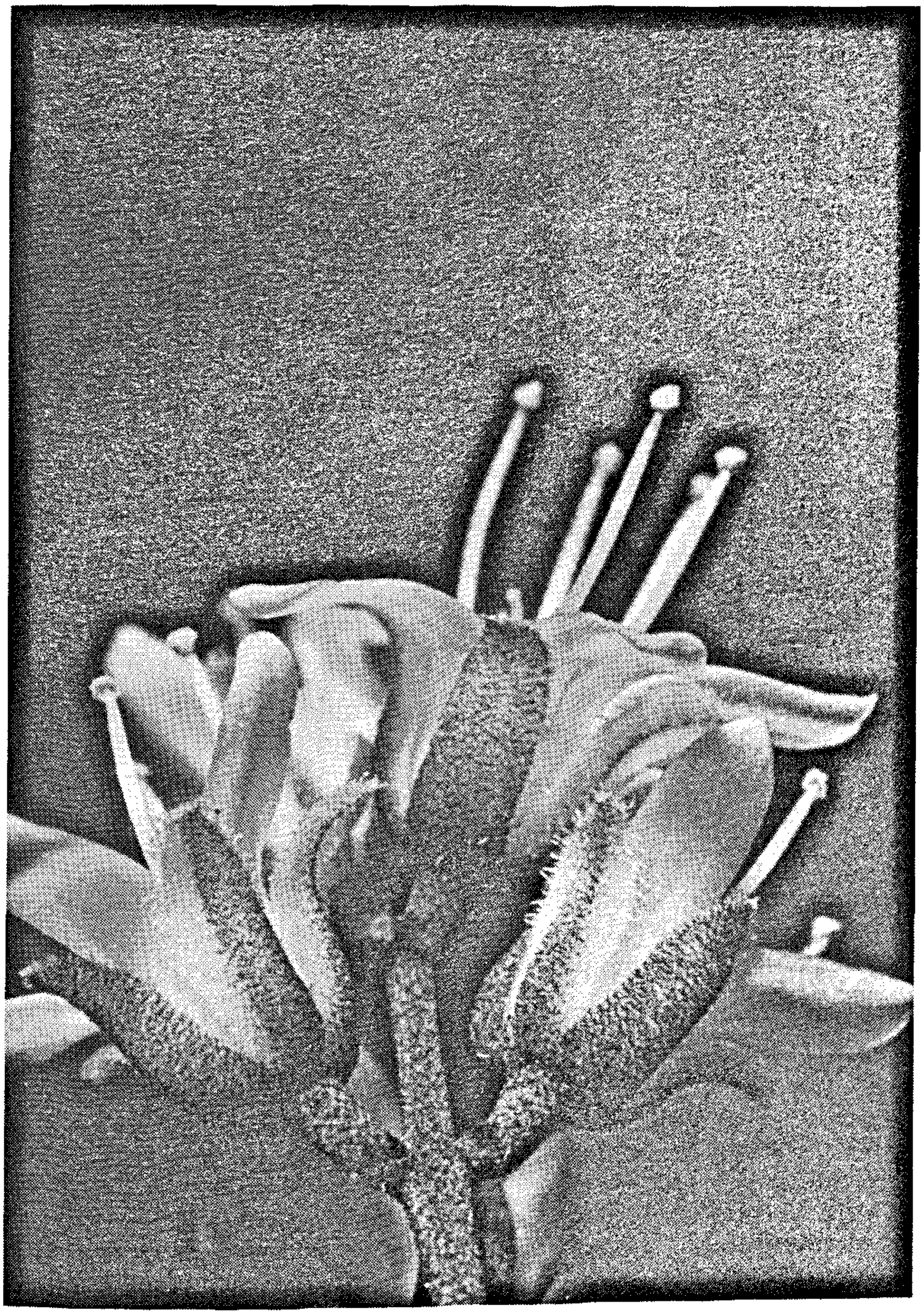


Fig. 62. *Agelaea pentagyna*: detail from fig. 61, showing fringed sepals (phot. H.C.D. de Wit).

8; Hall & Swaine, 1981: 117; de Koning, 1983: 278; Burkill, 1985: 517. Basionym: *Cnestis trifolia* Lamarck, 1789: 24. Type: Sierra Leone, sin. loc., *Smeathmann s.n.* (holo: BM).

A. villosa (DC.) Solander ex Planchon, 1850: 438 (nom. ill. superfl.); Baker, 1868: 454; Schellenberg, 1910: 65. Basionym: *Omphalobium villosum* De Candolle, 1825: 86; G.Don, 1832: 91. Type: the same as for *A. trifolia* (Lam.) Baill. above.

A. obliqua (P.Beauv.) Baillon, 1867: 238; Baker, 1868: 454; Schellenberg, 1910:

62; 1923: 217; 1938: 90; Hepper, 1958: 745; Aubréville, 1959: 13; Irvine, 1961: 567; Adam, 1971: 863; Berhaut, 1975: 14; Hall & Swaine, 1981: 115; Ern, 1984: 164; Burkill, 1985: 516. Basionym: *Cnestis obliqua* Palisot de Beauvois 1804: 97; G.Don, 1832: 91. Type: Nigeria, Oware, *Palisot de Beauvois s.n.* (holo: G).

A. obliqua (P.Beauv.) Baill. var. *usambarensis* Gilg, 1895a: 192. Type: Tanzania, Usambara, Nderema, *Holst 2234* (holo: B†; lecto: K).

A. obliqua (P.Beauv.) Baill. var. *cordata* (Schellenb.) Exell, 1944: 148; Hepper, 1958: 745; Liberato, 1980b: 8. Basionym: *A. cordata* Schellenb. (see below).

A. lamarckii Planchon, 1850: 438; Baker, 1868: 453; 1877: 64. Type: the same as for *A. obliqua* (see above).

A. nitida Solander ex Planchon, 1850: 437; Hiern, 1896: 188; Schellenberg, 1923: 217; 1938: 88; Hepper, 1958: 745; Adam, 1971: 863; Hall & Swaine, 1981: 115; Burkill, 1985: 516. Type: Sierra Leone, sin. loc., *Afzelius s.n.* (holo: BM).

A. emetica Baillon, 1887: tab.15; 1867: 239; Schellenberg, 1910: 62. Lectotype: Baillon, 1887: tab.15.

A. thouarsiana Baillon, 1867: 240; Schellenberg, 1938: 70; Keraudren, 1958: 10, fig. 2. Type: Madagascar, sin. loc., *Du Petit-Thouars s.n.* (holo: P).

A. koneri O. Hoffmann & Hildebrandt ex O. Hoffmann, 1881: 321. Type: Madagascar, Lokobé, *Hildebrandt 2943* (syn: B†; lecto: P).

A. heterophylla Gilg, 1895b: 66; Schellenberg, 1910: 62; 1938: 75; Hemsley, 1956: 11, fig. 4; Mendes, 1966: 618, 619; Mendes, 1969: 4; Troupin, 1978: 361; Troupin, 1982: 223. Type: Tanzania, Morogoro, Uluguru Mts, *Stuhlmann s.n.* anno 1894 (holo: B†). Neotype: Tanzania, Lushoto, *Proctor 3387* (holo: BR; iso: EA).

A. preussii Gilg, 1896: 210; Schellenberg, 1910: 64; 1923: 217; 1938: 86. Type: Cameroun, Victoria-Bimbia, *Preuss 1277* (holo: B†). Neotype: Cameroun, 6 km SW of Masok, *Leeuwenberg 5370* (holo: WAG; iso: B, C, LISC, MO, P).

A. punctulata (Hiern) Schellenberg, 1938: 88; Troupin, 1952: 103. Basionym: *Connarus* (?) *punctulatus* Hiern, 1896: 189. Type: Angola, Quetta, *Welwitsch 6685* (holo: BM). Flowers from *Agelaea pentagyna* (Lam.) Baill. (*Welwitsch 6685a*), leaves from a non *Connaraceae* species (*Welwitsch 6685b*).

A. dewevrei De Wildeman & Durand, 1899b: 190; Schellenberg, 1938: 73; Troupin, 1952: 104, fig. 8; Hepper, 1958: 745; Burkill, 1985: 516. Type: Zaire, Lufu R., *Dewèvre 435* (holo: BR).

A. demeusei De Wildeman & Durand, 1900c: 61. Type: Zaire, Bangala, *Demeuse 213* (holo: BR).

A. duchnesnei De Wildeman & Durand, 1900c: 59; Schellenberg, 1910: 61; 1923: 210; 1938: 78; Troupin, 1952: 107. Type: Zaire, Umangi, *Duchnesne 26* (holo: BR).

A. hirsuta De Wildeman, 1909: 100, tab. 25; Schellenberg, 1923: 205; 1938: 67; Troupin, 1952: 100; Hepper, 1958: 745; Adam, 1971: 863; Burkill, 1985: 516. Type: Zaire, Lukolela, *Pynaert 185* (holo: BR).

A. hirsuta De Wildem. var. *likimensis* De Wildeman, 1911: 257. Type: Zaire, Likimi, *Malchair s.n.* anno 1910 (holo: BR).

A. hirsuta De Wildem. var. *malchairi* De Wildeman, 1911: 257. Type: Zaire, Likimi, *Malchair 173* (holo: BR).

A. leopoldvilleana De Wildeman, 1909: 102, tab.12; Schellenberg, 1938: 82; Troupin, 1952: 109.Type: Zaire, Kinshasa (= Leopoldville), *M.Laurent 466* (lecto: BR), *460* (para: BR).

A. lescrauwaetii De Wildeman, 1909: 103, tab.12; Schellenberg, 1938: 81; Troupin, 1952: 109; Exell & Mendonça, 1954: 144. Type: Zaire, Lubi, *Lescrauwaet 201* (holo: BR).

A. pynaertii De Wildeman, 1909: 104, fig.12. Type: Zaire, Lukolela, *Pynaert 175* (holo: BR).

A. sublanata De Wildeman, 1909: 105. Type: Zaire, Lukolela, *Pynaert 175b* (holo: BR).

A. tricuspidata Gilg ex Schellenberg, 1910: 64; 1923: 206; 1938: 68. Type: Cameroun, Bipindi, *Zenker 3447* (holo: B†; lecto: MO; iso: BM, BR, E, G, GOET, M, Z).

A. claessensii De Wildeman, 1911a: 256; Schellenberg, 1938: 70; Troupin, 1952: 102.Type: Zaire, Katako-Kombe, *Claessens 408* (holo: BR).

A. glandulosissima Gilg, 1911: 231; Troupin, 1952: 102; Exell & Mendonça, 1954: 144.Type: Zaire, Beni-Irumu, *Mildbraed 2848* (holo: B†). Neotype: Zaire, sin. loc., *van der Gucht s.n.* anno 1912 (holo: BR).

A. mildbraedii Gilg, 1911: 230; Schellenberg, 1938: 70; Troupin, 1952: 101; Burkill, 1985: 516. Type: Zaire, Bomili-Panga, *Mildbraed 3264* (holo: B†). Neotype: Zaire, Kinshasa (Leopoldstad), *Achten 207b* (holo: BR).

A. annobonensis Schellenberg, 1923: 207; 1938: 72. Type: Annobon, Quiveo, *Mildbraed 6680* (holo: B†). Neotype: Annobon, Ambo, *Wrigley & Melville 232* (holo: K; iso: BM).

A. australis Schellenberg, 1923: 218; Exell & Mendonça, 1954: 143; Liberato: 1980b: 10. Type: Angola, Golungo Alto, Queta, *Welwitsch 4641* (syn: B†; lecto: COI; iso: BM, C, G, K).

A. conraui Schellenberg, 1923: 207; 1938: 73. Type: Cameroun, Bangwe, *Conrau 268* (holo: B†). Neotype: Gabon, 30 km SE of Doussala, *Reitsma 1677* (holo: WAG).

A. cordata Schellenberg, 1923: 222; 1938: 92. Type: Sao Tomé, on the beach, *Quintas 76*. (syn: B†; lecto: K).

A. elegans Schellenberg, 1923: 213; 1938: 84. Type: Cameroun, Bodje on Mt Cameroun, *Lederman 307* (holo: B†). Neotype: Cameroun, 6 km S of Kribi, *Bos 5240* (holo: WAG; iso: K, P).

A. floccosa Schellenberg, 1923: 210; 1938: 79; Hepper, 1958: 745. Type: Cameroun, Abonando, *Rudatis 64* (holo: B†; lecto: Z; iso: G).

A. grisea Schellenberg, 1923: 208; 1938: 73; Hepper, 1958: 745. Type: Cameroun, Bipindi, *Zenker 3022* (holo: B; iso: G, GOET, M, MO, WAG, Z).

A. longecalyculata Schellenberg, 1923: 208; 1938: 77. Type: Cameroun, Songolong near Ribau, *Ledermann 2109*, on Lake Tibati, *Ledermann 2421* (syn: B†). Neotype: Cameroun, Station de Cacaoyer de N'Koemvone, *J.J.de Wilde 8112* (holo: WAG).

A. longifoliolata Schellenberg, 1923: 212. Type: Zaire, Kwa Muera near Fort Beni, *Mildbraed 2282*, near Irumu in the direction of Ngombe-Nyama, *Mild-*

braed 2871 (syn: B†). Neotype: Zaire, Haut Uele, Ikela, *Jespersen 6* (holo: BR).

A. lucida Schellenberg, 1923: 217; 1938: 87. Type: Gabon, Sibange Farm, near Libreville, *Soyaux 27* (holo: B†; lecto: Z; iso: GOET, P).

A. macrocarpa Schellenberg, 1923: 214; 1938: 85. Type: Liberia, Fishtown, *Dinklage 1866* (holo: B; iso: WAG).

A. marginata Schellenberg, 1923: 221; 1938: 92; Troupin, 1952: 110. Type: Zaire, Kimuenza, *Mildbraed 3551* (syn: B†; lecto: BR); Zaire, sin. loc., *Gillet s.n.* anno 1901 (syn: B†; iso: BR).

A. neglecta Schellenberg, 1923: 211; 1938: 81. Type: Cameroun, Mbo's-Sardi, *Mildbraed 8544* (holo: B†). Neotype: Gabon, sin. loc., *Klaine 1934* (holo: B; iso: P).

A. obovata Schellenberg, 1923: 215; 1938: 86. Type: Cameroun, Mimfia near Bipindi, *Zenker 4664* (syn: B†; lecto: MO; iso: BR, G, GOET, L, Z).

A. oligantha Gilg ex Schellenberg, 1923: 214; 1910: 63; 1938: 85; Hepper, 1958: 745. Type: Liberia, Gran Bassa, Fishtown, *Dinklage 1711* (holo: B).

A. ovalis Schellenberg, 1923: 218; 1938: 87. Type: Annobon, ascending at the Quioveo, *Mildbraed 6679*, on the upper rim of the Northern Crater, *Mildbraed 6606* (syn: B†). Neotype: Gabon, Oveng, *Louis et al. 416* (holo: WAG; iso: LBV).

A. phaseolifolia Gilg ex Schellenberg, 1923: 220; 1938: 90. Type: Cameroun, Bipindi, *Zenker 4202* (lecto: B; iso: BM, E, G, GOET, K, L,M, MO, Z).

A. pseudobliqua Schellenberg, 1923: 216; 1938: 86; Troupin, 1952: 108; Adam, 1971: 865. Type: Cameroun, Kribi, *Winkler 790* (syn: B†; lecto: Z).

A. setulosa Schellenberg, 1923: 211; 1938: 81; Hemsley, 1956: 12, fig.4. Type: Tanzania, Useguha, Makinjubi am Pangani, *Scheffler 247* (holo: B†; lecto: K; iso: BR, Z).

A. ugandensis Schellenberg, 1923: 219; 1938: 81; Andrews, 1952: 353; Hemsley, 1956: 12, fig.4; Mendes, 1966: 618. Type: Uganda, sin. loc., *Scott Eliot 7397* (lecto: K); Uganda, Entebbe, *Dawe 271* (para: K).

A. ustulata Schellenberg, 1923: 212; 1938: 82; Adam, 1971: 865. Type: Cameroun, on Njui R. near Jukaduma, *Mildbraed 4647* (holo: B†). Neotype: Congo, Oubangui, *Thollon s.n.* anno 1889 (holo: P; iso: B, K).

A. zenkeri Schellenberg, 1923: 215; 1938: 86. Type: Cameroun, Bipindi, *Zenker 2271* (holo: B; iso: BM, G, GOET, M, MO, WAG, Z).

A. baronii Schellenberg, 1938: 79; Keraudren, 1958: 12, fig.2. Type: Madagascar, sin. loc., *Baron 5591* (holo: K).

A. mayottensis Schellenberg, 1938: 74; Keraudren, 1958: 16,fig.3. Type: Mayotte, *Boivin s.n.* (holo: P).

A. pilosa Schellenberg, 1938: 83; Hepper, 1958: 745; Burkill, 1985: 517. Type: Nigeria, Degema, *Talbot 3670* (holo: K; iso: BM).

A. coccinea Exell, 1944: 147; Liberato, 1980b: 10. Type: Principe, SW of Esperanca, *Exell 669* (holo: BM).

A. phaeocarpa Exell, 1944:148; Liberato, 1980b:9. Type: Principe, Oquê Pipi, *Exell 489* (holo: BM).

A. reticulata Exell, 1944: 150; Liberato, 1980b: 12. Type: Principe, Oquê Pipi, *Exell 488* (holo: BM).

A. katangensis Troupin, 1951: 366; 1952: 106. Type: Zaire, Katanga, Karavia, *Quarré 3679* (holo: BR).

Omphalobium pentagynum (Lam.) De Candolle, 1825: 86; G.Don, 1832: 91. Type the same as for *A. pentagyna* (Lam.) Baillon.

Omphalobium nervosum G.Don, 1832: 90. Type: Sierra Leone, sin. loc., *Afzelius s.n.* (holo: BM).

Connarus pinnatus auct. non Lamarck, De Candolle, 1825: 86 syn. *Omphalobium pentagynum,* sphalm.

Cnestis obliqua Bojer, 1837: 84 (Ill. name) non P.Beauv. Type: Mauritius, Grand Port, *Bojer s.n.* herb. Hooker (holo: K).

Large liana up to 25 m. Wood frequently with interxylary phloem. *Branches* sometimes deeply furrowed; *branchlets* glabrous to tomentose. *Petiole* 1-26 cm; rachis 0.1-9 cm; petiolules 1-9 mm; *leaflets* elliptic to ovate or cordate, glabrous to tomentose, 3-8 pairs of main lateral nerves, the basal ones are as long as or longer than the next ones, they usually originate at the very base of the leaflet, tertiary nerves sometimes in a distinct parallel pattern; apex acuminate; terminal leaflet 2.2-30 × 1.5-17 cm; lateral ones 1.8-24 × 1.4-12,5 cm usually asymmetric. *Inflorescence* up to 35 cm, glabrous to tomentose. Flowers heterotristylous. Pedicel ca 1 mm long. Sepals 2.5-5 × 1 mm, fringed with multicellular hairs, velutinous outside; petals 3-5.5 × 1 mm, often connivent near the base, glabrous. Long *stamens* 2.5-6 mm long, short stamens 1-4.5 mm long. *Pistil* 2-5.5 mm long, unequal to the stamens; style hairy; ovary velutinous. Developed *follicles* one to five per flower, 15-25 × 8-16 mm, pyriform and usually not beaked, never with coarse protuberances. *Seed* 10-15 × 5-10 mm; testa for ca one fourth fleshy and yellow to red.

Distribution: West, Central and East Africa, Fernando Poo, Principe, Sao Tomé, Annobon, Archipel Des Comores, Madagascar and Mauritius.

Ecology: In all kinds of forests, from the seashore to montane forest and from primary rain forest to forest patches in the savanna, from sea level up to 2100 m alt.

Selection of the more than 1000 examined specimens:

Senegal: Oussouye, *Adam 18235* (K); Kaeme, *Berhaut 6947* (BR); Kaheme (fl. March) *Berhaut 7261* (BR).

Guinea Bissau: Cacine (fl., fr. Aug.) *Espirito Santo 610* (COI, LISJC); Fulacunda (fl., fr. May) *Espirito Santo 2038* (COI, K, LISC); Pobreza (fl., fr. June) *Espirito Santo 3211* (COI, LISC, LISJC); Cadabe (fr. Jan.) *Raimundo & Guerra 819* (LISC).

Guinea: Macenta, *Adam 4169* (K); Between La Santa and Limbo (fl. March) *Chevalier 12585* (P); Kindia (fl.b. March) *Chevalier 13110* (P); Friguiagbe-Telinkowie (y.fr. May) *Chillon 1964* (P); Nunez R. (fr.) *Heudelot 730* (G, K, P); Pongo (fl., fr.) *Heudelot 894* (G); M'Zerekore (fl. Sept.) *Jacques-Félix 1131* (P); Kakoulima (fr. April) *Roberty 17664* (G).

Sierra Leone: Makeni (fl. Dec.) *Morton SL281* (WAG); Lungi (fl. April) *Morton SL1233* (WAG); Freetown (fr. July) *Morton SL1374* (WAG); Ronietta (fl.b. Nov.) *N.W.Thomas 5374* (K, Z); sin. loc. (fr.) *N.W.Thomas 6239* (K, Z); Magbile (fl.) *N.W.Thomas 6308* (K, Z).

Fig. 63. *Agelaea pentagyna*: 1. flowering branchlet, 2/3 ×; 2-3. leaves, 2/3 ×; 4. sepal, 8 ×; 5. fruit, 2 ×; 6. length section follicle, showing a cotyledon and the apical radicle, 2 ×; 7. seed, showing sarcotesta and hilum, 2 ×. (1. *Hart 448*; 2. *de Kruif 127*; 3. *da Silva 2266*; 4. *van Veldhuizen 762*; 5-7. *Bos 3534*).

Liberia: Ganta (fl., y.fr. Sept.) *Baldwin 9213* (K, WAG); Chien (fl., fr. Jan.) *Bos 2829* (WAG); Fishtown (fl. Aug.) *Dinklage 1711* (B, type *A. oligantha*); (fr. Oct.) *Dinklage 1866* (B, WAG, type *A. macrocarpa*); N of Bomi Hills (fr. Nov.) *Jansen 2287* (WAG); Gola N.F.R. (fl. Aug.) *Stoop v.d. Kasteele 207* (WAG); Grand Bassam (seedlings) Toilliez 314 (BR, P); NE of Suacoco Gbarnge (fl. Sept.) *Traub 286* (BR, G); Gola N.F.R. (fl. Aug.) *Voorhoeve 57* (WAG, Z); Zorzor area (fl., fr. March) *Woelfel 32* (WAG).

Ivory Coast: Mt Tonkoui (fl. March) *Aké Assi 9934* (BR); between Tate and Tabou (fr. Aug.) *Chevalier 19823* (P); Iringou R. (fl. Feb.) *Geerling & Bokdam 2033* (K, MO, WAG); between Port Bouet and Grand Bassam (fl., fr. May) *de Koning 615* (WAG); Banco F.R. (fl. March) *de Koning 3412* (WAG); (fr. Jan.) *de Koning 5112* (WAG); 7 km W Abidjan (fl. Oct.) *J.J.de Wilde 3131* (K, WAG); Grand Bassam (fl., fr. Feb.) *Leeuwenberg 2664* (K, WAG, Z); 25 km SW Gueyo (fr. March) *Leeuwenberg 3761* (B, WAG); Kokodi (fr. Oct.) *Roberty 12381* (G, Z).

Ghana: Axim (fl. Nov.) *Hall 1803* (K); U.S.T. Kumasi (fl. Nov.) *Obeng-Darko 5669* (BR, WAG); Cape Coast Castle (fl. Oct.) *Roberty 12827* (G, Z); Abesi (fl. Jan.) *de Wit & Morton 2843* (WAG).

Togo: Apeyeme (fl.b. Dec.) *Ern 2718* (B, K); Avetonou (fl. Dec.) *Ern 2740* (B, K); Tomegbe near Badou (fr. Dec.) *Ern 2816* (B); N of Kpalime (fr. May) *Hakki et al. 801* (B); near Lome (fl. Aug.) *Mahoux s.n.* (L).

Benin: Abomey (fl. Feb.) *Chevalier 23139b* (BR, K); Banigbe (fr. March) *Froment 1171* (BR); Adjohon (fl., fr. Dec.) *v.d. Zon 299* (WAG).

Nigeria: Akwaijantar Forest (fl. Feb.) *Chapman 5274* (K); Abinsi (fl., fr. April) *Dalziel 780* (Z); a few km from dispensary Iba (fr. June) *Daramola & Osanyiniusi FHI 90124* (WAG); near Dogo Kusmi (fr. May) *Lawton 1844* (K); Ilashe (fl. April) *Leeuwenberg 11344* (WAG); 20 km S of Obubra (fr. April) *Pilz 2029* (B, WAG);

Cameroun: Kribi (fr. Dec.) *Bos 3534* (K, P, WAG); (fr. April) *Bos 4253* (P, WAG); (fl. May) *Bos 4478* (K, P, WAG); (fl. Aug.) *Bos 5240* (K, P, WAG, type *A. elegans*); Bertoua (fl., fr. April) *Breteler 1280* (K, LISC, WAG); (fr. April) *Breteler 2769* (B, K, M, WAG); Masok (fl. April) *Leeuwenberg 5370* (B, C, LISC, MO, P, WAG, type *A. preussii*); 20 km W Yokadouma (fl. July) *Leeuwenberg 6180* (K, LISC, WAG); Abonando (fl.) *Rudatis 64* (G, K, Z, type *A. floccosa*); Deng Deng Forest (fr. June) *Satabié 763* (P, YA); Bipindi (fl. Feb.) *Zenker 237* (B, C, G, WAG); (fl. April) *Zenker 544* (BR, C, G, MO, WAG); (fr. May) *Zenker 578* (B, C, G, MO, WAG).

Central African Republic: Mpoko R. (fr. Sept.) *Breyne 1529* (BR); Camp Koumbala (fl. March) *Fay 4347b* (K); Yalinga (fl. Jan.) *Le Testu 4490* (BM, BR, P, WAG); (fl.) *Le Testu 4508* (BM, BR, P, WAG); Boukoko (fl. Jan.) *Equipe Tisserant 1346* (BM, BR); (fr. July) *Equipe Tisserant 1519* (BR, P, WAG); (fl.b. April) *Equipe Tisserant 2092* (BR, P, WAG); (fr. March) *Equipe Tisserant 2401* (BR, WAG); (fr. June) *Equipe Tisserant 2540* (BR, P, WAG).

Sudan: Valley of Yei R. near source (fl. Feb.) *Dandy 515* (BM); Imatong Mts (fl. Nov.) *Friis & Vollesen 362* (C, K); Gilo (fl. Feb.) *Friis & Vollesen 927* (C, K); Talanga, *Friis & Vollesen 1056* (C, K); Iwatoka (fr. March) *Hoyle 811* (BM); Yei R. (fr. Oct.) *Sillitoe 376* (K).

Equatorial Guinea: Rongui R. (fl. Sept.) *Mann 1820* (K); Annobon (fl., fr. Aug.) *Wrigley & Melville 232* (BM, K, type *A. annobonensis*); Fernando Po, Moka (fr. Sept.) *Wrigley 638* (K).

Sao Tomé & Principe: Sao Tomé, Monte Mario-Porto Alegre (fl. Jan.) *J.J.de Wilde 247* (WAG); Sao Tomé, Mt Cafe (y.fr. Jan.) *Espirito Santo 184* (LISJC); Sao Tomé, Pinheira (fr. April) *Espirito Santo 4385* (LISJC); Principe, Oque Pipi (fr.) *Exell 488* (BM, type *A. reticulata*); Principe, SW Esperanca (fr.) *Exell 669* (BM, type *A. coccinea*); (fr. Dec.) *Exell 672* (BM); Principe, sin. loc. (fl.) *Mann s.n.* anno 1861 (K); Sao Tomé, Prainha (fl., fr.)*Quintas 1418* (BM, COI, K, LISJC, LISU, Z).

Gabon: W of Belinga (y.fr. July) *Bos & v.d. Laan 10710* (LBV, WAG); between Mouila and Yeno (fl. Sept.) *Breteler & Lemmens 8022* (LBV, WAG); road Libreville-Kango (fr. Oct.) *Breteler & Lemmens 8359* (LBV, WAG); Fernan-Vaz Lake (fl. Sept.) *Fleury 26494* in herb. *Chevalier* (P, WAG); Mts de Cristal, 40 km E SEF (fl. Sept.) *Leeuwenberg & Persoon 13586* (LBV, WAG); Lastoursville (fl. Nov.) *Le Testu 7598* (BM, BR, WAG); Bitam (fl. April) *Le Testu 9561* (BR, P, WAG); 45 km S of Doussala (fl. Oct.) *Reitsma 1742* (WAG).

Congo: Isle facing Pikounda (fr. Aug.) *Bouquet 1697* (P); Zemio Rd (fl.b. Dec.) *Descoings 12247* (P); Bonga on the Sanga R. (fl. July) *Schlechter 12653* (Z); Chaillu (fl. Oct.) *Sita 3977* (P).

Zaire: Damaga (fr. July) *Bamps 259* (BR, K); Penghe (fl. Jan.) *Bequaert 2204* (BR); Bambesa (fr. June) *du Bois 308* (BR); ETSAV Reserve (fr. Dec.) *Bokdam 4405* (WAG); Basoko (fl. July)

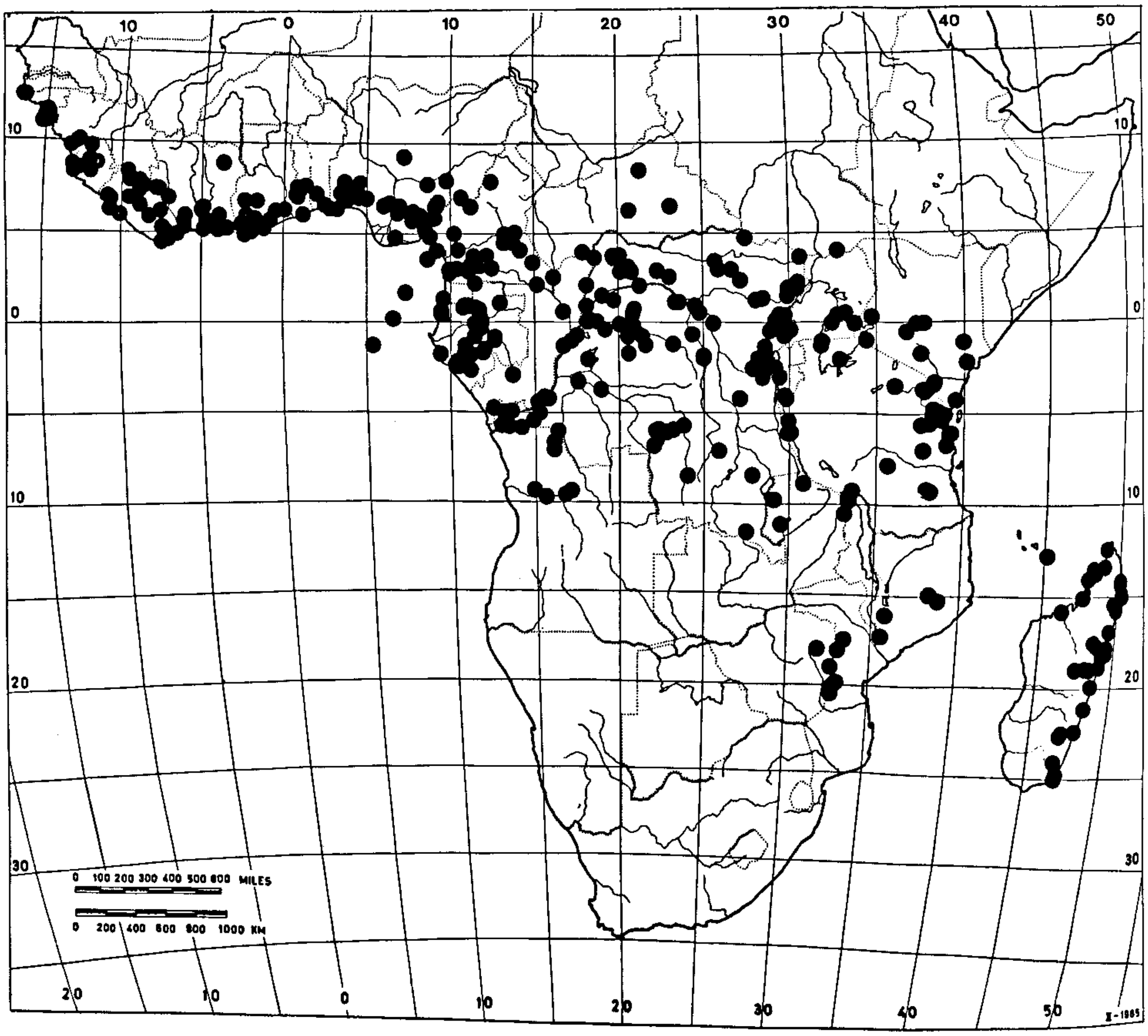


Fig. 64. Distribution of *Agelaea pentagyna*

Claessens 676 (BR); Bangala (fl. Feb.) *De Giorgi 273* (BR); Boende (fr. Aug.) *Dubois 902* (BR); Bombura (fr. May) *Evrard 873* (BR); Ngondo on the Ngiri R. (fl. March) *Evrard 5876* (BR, K); Ikela (fl. June) *Germain 7343* (BR); Likimi (fl. March) *Goossens 4162* (BR); Nyabibwe (fl. Sept.) *Gutzwiller 3272* (BR, WAG); Mumvu Gallery (fl. June) *Herman 2164* (BR); Ibali (fl. Nov.) *E.& M.Laurent s.n.* (BR); Mwenga, *A.Léonard 4959* (BR); Wamaza (fl. Aug.) *A.Léonard 5731* (BR); Lubi (fr. Sept.) *Lescrauwaet 201* (BR, type *A. lescrauwaetii*); Kamukugwi (fl.b. July) *Liben 3337* (BR, WAG); Yangambi (fr. July) *Louis 5604* (B, BR); (fl. Sept.) *Louis 11103* (B, BR); Kimuenza (fl. Oct.) *Mildbraed 3710* (HBG); Lutendele (fr. March) *Pauwels 4924* (BR, WAG); Makengo (fl. Feb.) *Pogge 728* (K); Lukolela (fl. July) *Pynaert 175* (BR, type *A. pynaertii*); Karavia (fl. Dec.) *Quarré 3679* (BR, type *A. katangensis*); Gimbi (fl. Sept.) *Toussaint 490* (BR); Lazaret S.Jules (fl. Sept.) *Vanderyst 2207* (BR).

Angola: Melange (fr. Sept.) *da Silva 225* (LISC, WAG); Pungo Andongo (fr. Aug.) *da Silva 2133* (COI, LISC); Zavula Zalazar (fr. Jan.) *da Silva 2266* (LISC); Mt Belo (y.fr.) *Gossweiler 5424* (BM, COI, LISJC, LISU); Quetta (fr.) *Gossweiler 5571* (BM, COI, LISJC, LISU); N' Dalatando, *Gossweiler 5951* (BM, COI, K, LISJC, LISU); Cabinda, Buca Zau (fl.) *Gossweiler 6706* (BM, COI, LISJC, LISU); Cabinda, Seva (fl.) *Gossweiler 8098* (BM, COI, LISJC, LISU); Ponta de Quiombe (fl. April) *Gossweiler 8665* (BM, K); Quela (fl.) *I.Nolde 312* (BM); Ikoka (fl. Aug.) *Raimundo et al. 843* (LISC, WAG); between Buenga Sul and Buenga Norte (fl. Sept.) *Raimundo et al. 914* (LISC); Queta (fl.) *Welwitch 4641* (BM, C, COI, G, K, type *A. australis*).

Rwanda: Nyongwe (fl. Oct.) *Troupin 11215* (BR); Uwinka (fl. July) *Troupin 12417* (BR).
Burundi: Makamba, *Lewalle 1318* (BR); Bubanza (fr.) *Lewalle 6507* (BR, WAG); Bubanza (fr. Jan.) *Reekmans 1480* (BR); Munini-Kumuyange (fl. Sept.) *Reekmans 3621* (BR).
Uganda: Mukono Hill (fl. Nov.) *Dummer 1265* (Z); Namauve Forest (fr. April) *Eggeling 585* (EA); Lolui I. (fl. May) *Jackson u36* (K); Entebbe (fl. March) *Liebenberg 748* (K); Bugoma Forest (fl. Feb.) *Purseglove 1247* (EA, K); Ishasha Gorge (fl. May) *Purseglove 3410* (BR, EA, K); Buambara (fl. Nov.) *Purseglove 3523* (EA); Kalinzu (fr. Nov.) *Synnott 427* (EA); Kimaka Hill (fl. Aug.) *Wood 324* (EA, K).
Kenya: Tana R. N.F.R. (fr. Oct.) *Adamson 164* (EA, G); Mt Kenya (fl., fr.) *Battiscombe 691* (EA, K); Kuja R. (fl. April) *Glasgow 46/33* (EA); Mbololo Hill (fl. Oct.) *Joana 9079* (EA); Kitondu Hill (fr. March) *Mhauton 1797* (EA).
Tanzania: Amani (fr. March) *Braun 693* (EA); (fl., fr. Oct.) *Braun 1405* (B, EA); Ukerewe I. (fr.) *Conrads 6033* (EA, K); Mlinga Peak (fl.b. March) *Drummond & Hemsley 1436* (B, BR, K); Bukoba (fl. July) *Eggeling 6240* (EA, K); Kibsha (fl. July) *Harris et al. 5819* (EA); Njala-Usangi (fl. Feb.) *Peter 14240* (B); Kiwanda (fr. Feb.) *Peter 19344* (B); Lushoto (fl. Dec.) *Proctor 3387* (BR, EA, type *A. heterophylla*); Derema (fl.) *Scheffler 144* (BR, EA, K, P, Z); Iringi (fl. Oct.) *Schlieben 1347* (B, BM, BR, G, HBG, Z); Kyimbila (fr.) *Stolz 1796* (K, Z); Zanzibar (fl. Oct.) *Vaughan 1626* (EA, K); (fr.) *Vaughan 1994* (EA).
Zambia: near Kawambwa (fr. Oct.) *Angus 689* (BR, K); Makutus (fl. Oct.) *Fanshawe 11544* (K, SRGH); Samfya (fr. Nov.) *Mutimushi 1166* (BR); Kambole escarpment (fl. Sept.) *Richards 13226* (SRGH).
Zimbabwe: Chirinda Forest (fr. Jan.) *Chase 432* (SRGH); Ngosima Reserve (fr. Jan.) *Chase 8229* (BR, SRGH); Vumba Mts., *Drummond 5079* (BR, PRE); Gungunyanga F.R. (fl. Aug.) *Goldsmith 64/61* (K, M, SRGH); (fl. Nov.) *Goldsmith 121/67* (BR, M, SRGH); Kasipiti (fl. Sept.) *Loveridge 1160* (B, BR, K); Mt Maruma (fl. Oct.) *Swynnerton 640* (K, SRGH, Z).
Malawi: Misuku Forests (fl.b. Sept.) *Chapman 251* (BR, K); Misuku Hills (fr. Dec.) *Pawek 3232* (K); Mughesse (fr. Jan.) *Pawek 7767* (P, SRGH, WAG); (fr. Jan.) *Pawek 13505* (BR, K, SRGH, WAG).
Mozambique: Milange, serra do Chierone (fr. April) *Correia & Marques 2443* (WAG); Morrumbala (fr. 30 Dec. 1858) *Kirk s.n.* (K); Manica e Sofala, base of Mt Tchianganhi (fr. Nov.) *Pereira & Marques 795* (SRGH); Manica e Sofala, Mossurize (fr. Oct.) *Torre 6158* (COI, K, LISC, PRE, SRGH); Mozambique, Ribáuè (fr. Jan.) *Torre & Paiva 10219* (COI, K, LISC, SRGH); Manica e Sofala, Bàruè, (fr. Dec.) *Torre & Correia 13603* (COI, LISC, SRGH, WAG); Mozambique, serra Mepálué (fr. Dec.) *Torre & Correia 16368* (LISC).
Comores: Mayotte (fr.) *Boivin s.n.* (P, type *A. mayottensis*).
Madagascar: Nossi-Bé (fr. Dec.) *Bernardi 11819* (G, P); Moramanga (fr.) *Decary 15318* (B, P); Foulpointe (fr.) *Decary 17000* (K, P); N of Mananjary (fr. March) *Dorr et al. 3900* (MO, WAG); Nossi-Bé (fr. Sept.) *Hildebrandt 3194* (BM, G, K, P); (fl. Sept.) *Hildebrandt 3198* (G, GOET, K, M, P); Roussettes at Ankazobe, *Homolle 158* (P), *183* (P); between Sakamalaza and Anonokambo (fr. Jan.) *Homolle & Cours 2648* (BR); Ivohimbe (fl. Nov.) *Humbert 3379* (B); pass at Fitana, *Humbert 6034* (P); Antongondriha, *Humbert 23961* (P); Sambava (fr. Nov.) *Humbert 24441* (G, P); Andlazazaolea(?) Forest (fr. March) *Keraudren 1763* (G, P); Soanierana-Antasibé (fl. Dec.) *Lam & Meeuse 5838* (BR, K, L, WAG); beach 26.2 km N of Tampolo (fr. Nov.) *Leeuwenberg & Ralimanana 4406* (MO, WAG); Maroa (fl.b.) *Mocquerys 42* (G); (fl.) *Mocquerys 76* (G); Matinanana, *Perrier 6257* (P), *6318* (P); Fort Dauphin (fl. Oct.) *Reserve Nat. 3426* (BR, P); Ambodiriana (fl.) *Reserve Nat. 4526* (K, P); Tamatave (fl. Nov.) *Schlieben 8011* (B, BR, G, M).
Mauritius: sin. loc. (y.fr.) *Bouton s.n.* before 1864 (K); sin. loc. (fl., fr.) *Carmichael s.n.* anno 1813 (K); Bassin Blanc, *Lorence & Edgerly 2701* (K, MO); sin. loc. (fl.) *Neraud s.n.* (G); sin. loc. (fl.) *du Petit-Thouars s.n.* (K).
Culta: Wageningen in greenhouse (fl.) *van Veldhuizen 762* (WAG, alc.), seeds from *de Koning 615* (Ivory Coast).

Note 1: In my view *A. pentagyna* is a complex of many micro species or forms which seem to be partly genetically isolated. In the field one can find two or

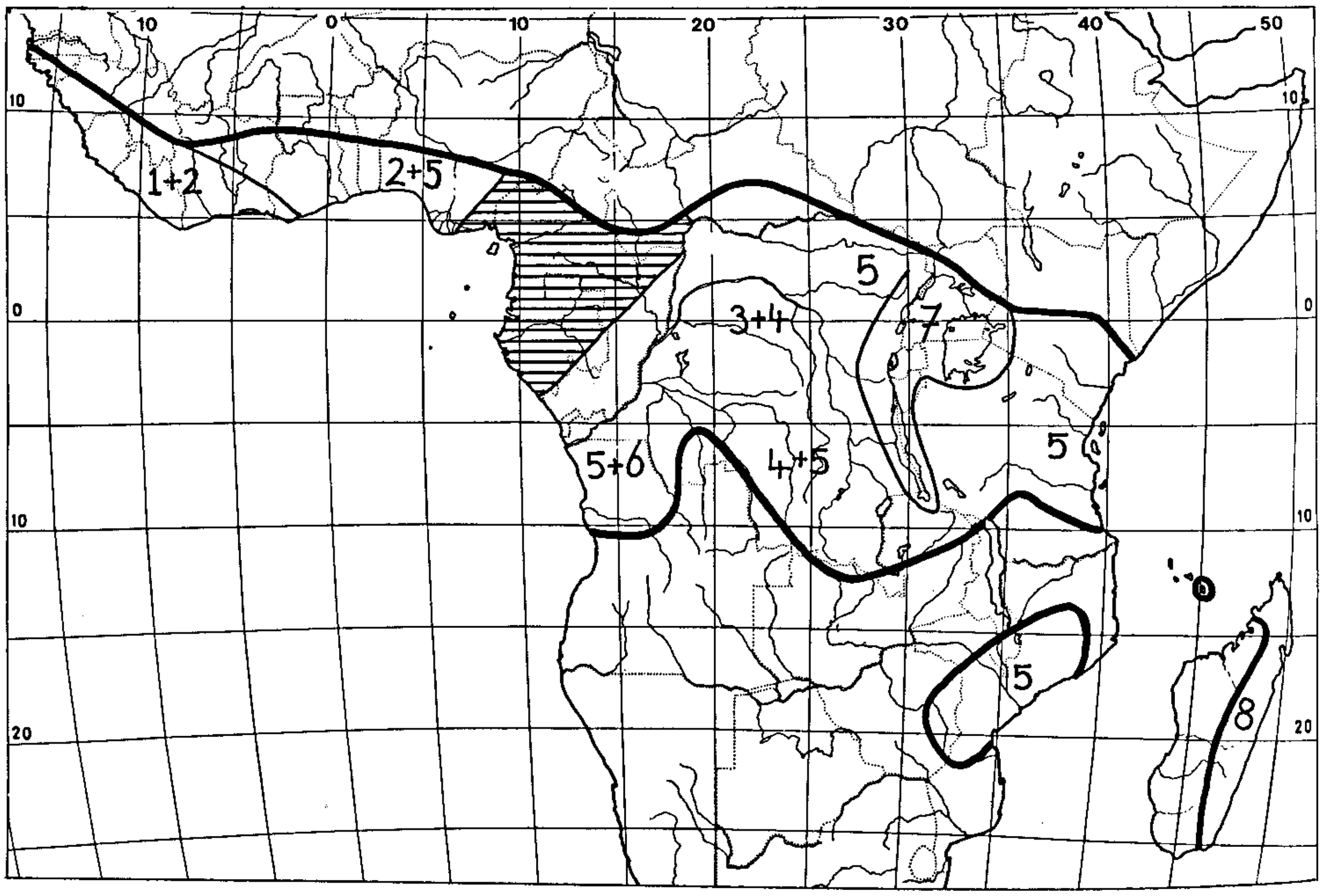


Fig. 65. *Agelaea pentagyna*. A: area of distribution. The numerals indicate prevalent occurence of corresponding shapes of the top leaflet (fig. 65B). In the shaded area no such prevalence was detected.
B: Shape of the top leaflet, 1-9 each represent one or more of the former *Agelaea* species: 1. *A. trifolia*; 2. *A. obliqua* & *A. grisea*; 3. *A. duchnesei*; 4. *A. hirsuta* & *A. dewevrei*; 5. *A. heterophylla*; 6. *A. australis*; 7. *A. ugandensis*; 8. *A. pentagyna s.s.*; 9. *A. zenkeri*.

more forms together while most of their offspring (often very abundant on the forest floor) looks very similar to the parent. As heterostylous species usually have a strong barrier against self-fertilization, this could lead to the conclusion that consequently this would result in the description of such species based on differences in leaf shape and/or indumentum as Schellenberg did (1923: 200; 1938: 65), flowers and fruits are all similar. The resulting list of species will prove to be nearly endless because each new accession, especially those from Gabon and Cameroun, will represent 'new species' with new combinations of characters often virtually bridging the gap between already described taxa. Therefore, although there are many partly isolated forms, they constitute in my opinion only a single variable species: *A. pentagyna*. In this way, out of more than forty species recognized by Schellenberg in his revision of 1938, only two more species are retained here: *A. rubiginosa* and *A. poggeana* (see notes under these species).

Note 2: See fig. 65 for an impression of the variability of the leaflet shape of this species.

Note 3: The neotypes for *A. glandulosissima*, *A. mildbraedii*, and *A. longifoliolata* were designated by Troupin in 1951 in the herbarium of Brussel. They are published here for the first time.

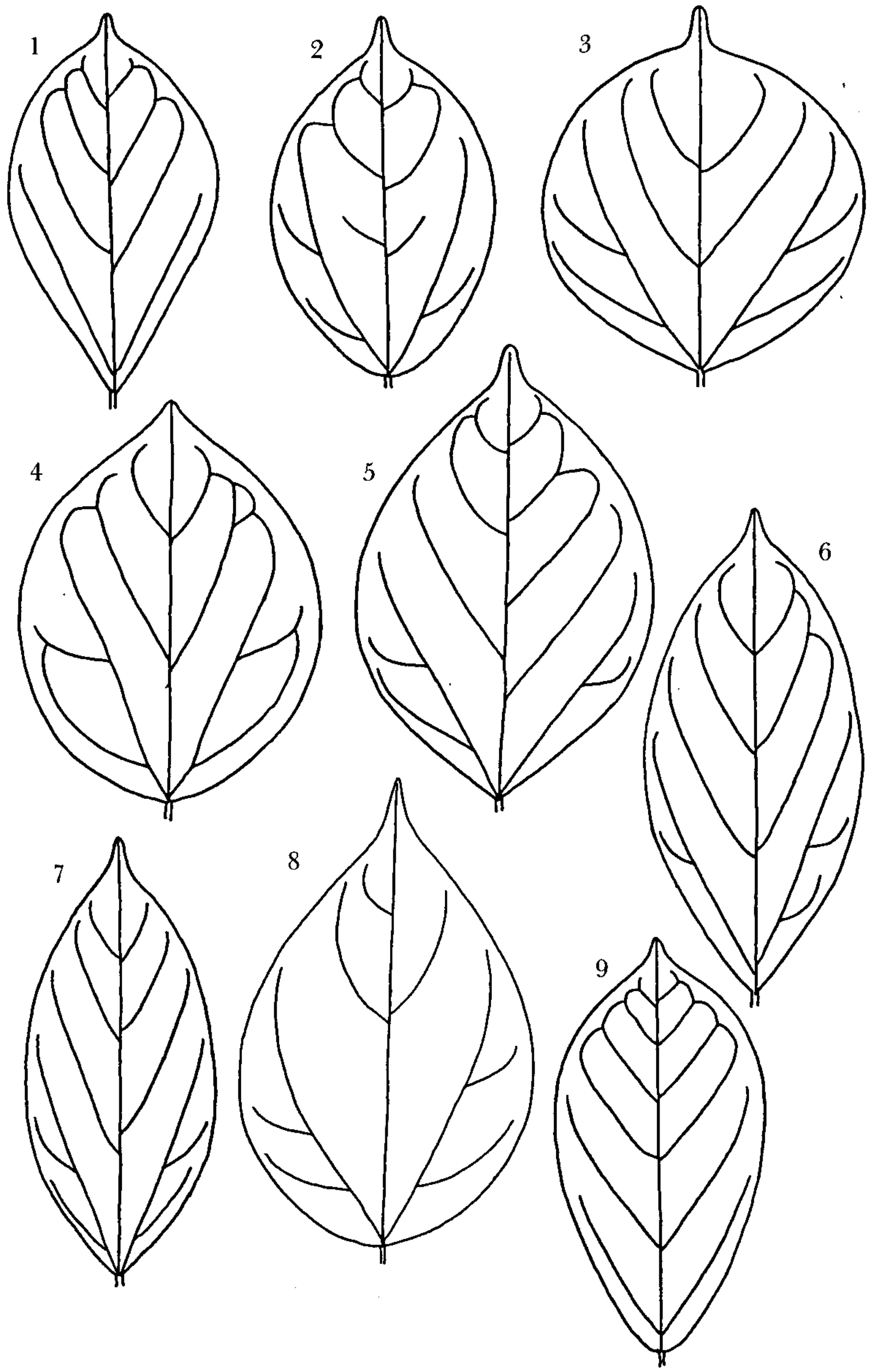


Fig. 65b.

Note 4: In the region of Sierra Leone and Guinea the leaflets of this species have sometimes prominent galls caused by a *Cecidomyiidae* species. They are ca 1 cm in diameter and have a velutinous indumentum. They are well developed on *Adam 27501* (BR), *Schnell 7548* (P), and *N.W.Thomas 4531* (K).

Agelaea poggeana Gilg **Fig. 66-69**

A. poggeana Gilg, 1895b: 65; Schellenberg, 1923: 209; 1938: 78; Troupin, 1952: 110.

Type: Zaire, Mukenge, *Pogge 726 & 734* (syn: B†).

Neotype: Zaire, Mbau, *Vanderyst 16371* (holo: BR).

A. ferruginosa De Wildeman, 1909: 99. Type: Zaire, Lac Foa, *Lescrauwaet 218* (holo: BR).

A. tenuinervis Schellenberg, 1923: 209; 1938: 78. Type: Equatorial Guinea, Makonanam near Nkolentangan, *Tessmann 425* (holo: B†). Neotype: Gabon, W flank of Mt Doudou, *Arends et al. 659* (holo: WAG; iso: LBV).

A. villosiflora Schellenberg, 1923: 206; 1938: 68; Troupin, 1952: 100. Type: Zaire, Kimuenza, *Mildbraed 3542* (syn: B†; lecto: BR).

Large liana up to 20 m. Wood often with interxylary phloem. *Branches* glabrous, often clearly furrowed; *branchlets* with a white arachnoid indumentum sometimes mixed with long simple hairs. *Petiole* 1-20 cm; rachis 0.1-1 cm; petiole and rachis with the same indumentum as the young branches but more persistent; petiolules 1-4 mm; *leaflets* ovate or oblong-ovate to elliptic with a pinnate nervation; 5-8 pairs of main lateral nerves, the basal pair never the largest; young leaflets with arachnoid indumentum (sometimes mixed with long simple hairs?);

Fig. 66. *Agelaea poggeana*: young branchlet showing white arachnoid indumentum (*Breteler et al. 8780*; phot. C.C.H. Jongkind).

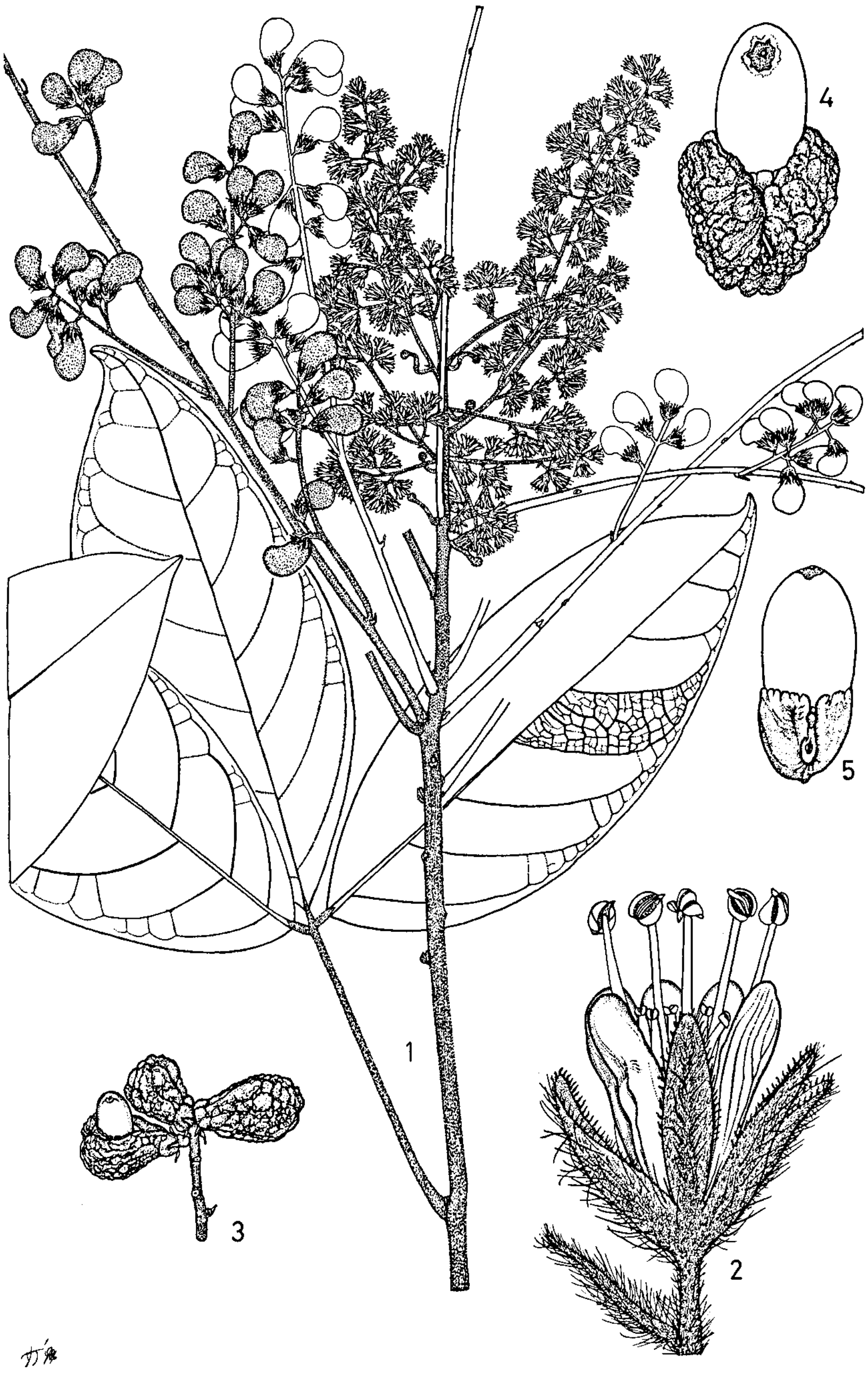


Fig. 67. *Agelaea poggeana*: 1. branchlet with flowers and fruits, 2/3 ×; 2. flower, 8 ×; 3. follicles, one showing seed, 2/3 ×; 4. follicle seen from above, showing seed, 2 ×; 5. seed, showing sarcotesta (darker part) and hilum surrounded by sarcotesta, 2 ×. (1. *Gilbert 14515*; 2. *Tisserant 569*; 3-5. *Arends et al. 659*).

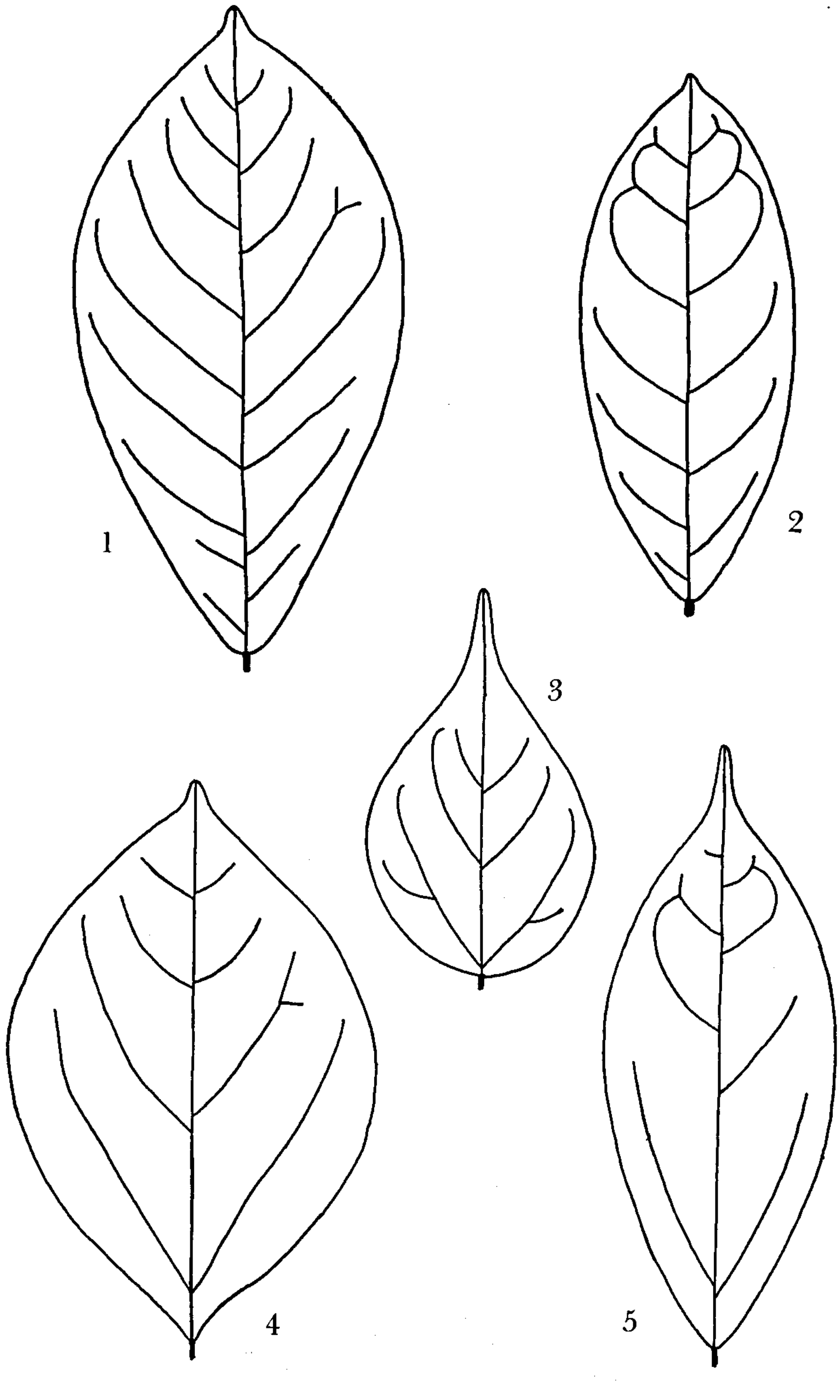


Fig. 68. Variation in terminal leaflet in *Agelaea*: 1,2. *Agelaea poggeana*; 3-5. *Agelaea rubiginosa*.

old leaflets glabrous or with some remnants of indumentum on the midrib; apex rounded to acuminate; terminal leaflet 1.8-25 × 1.2-8.5 cm; lateral leaflets 1.6-17.5 × 1-7.5 cm, asymmetric. *Inflorescence* up to 20 cm, often one or more together at the end of a leafy branch and resembling a terminal inflorescence, puberulous to tomentose. *Flowers* heterotristylous. *Sepals* ca 4 × 1 mm, fringed with multicellulair hairs. *Petals* ca 4.5 × 1 mm, glabrous. Long *stamens* 2.5-5.5 mm long, short stamens 1-4 mm long. *Pistil* 2-5.5 mm long, unequal to the stamens; style hairy; ovary velutinous. Developed follicles one to five per flower, 12-18 × 6-8 mm, pyriform without coarse protuberances. *Seed* ca 10 × 5 mm; testa for ca 1/4 fleshy and yellow to red, the thin part black and shiny.

Distribution: Central Africa.
Ecology: Rain forest and gallery forest from sea level up to 850 m alt.

Specimens examined:

Nigeria: Uri? (fl.) 1909 *Kitson 109* (BM).
Cameroun: 15 km from Kribi, *Bos 5514b* (WAG).
Central African Republic: Boukoko (fl. Dec.) *Equipe Tisserant 569* (BM, P, WAG); (fl. Dec.) *Equipe Tisserant 1962* (BM, P, WAG).
Gabon: W flanc Mt Doudou (fr. Dec.) *Arends et al. 659* (LBV, WAG, type *A. tenuinervis*); ca 24 km N of Koumameyong, *Breteler et al. 8565* (LBV, WAG); 35 km NE of St Germain, *Breteler et al. 8780* (WAG); 15 km N of Doussala, *de Wilde & Jongkind 9472* (LBV, WAG); 10 km S of Makokou, *Florence 1397* (P); *Florence 1975* (P); Makokou, *Hallé 1190* (P); 40 km SW of Doussala (y.fr. Aug.) *Reitsma 1363* (WAG); Lopé Reserve (fr. Nov.) *Reitsma 2626* (WAG).
Congo: Djoumouna Forest (fl., y.fr. Sept.) *Bitsindou 411* (P, WAG); 25 km W Sibiti, *Farron 4490* (P); Plateaux Batékés, *Farron 5127* (P).
Zaire: Kimbuba (fr. Feb.) *Callens 4774* (BR); Bomandja (fl. Feb.) *Evrard 3494* (BR, K); Bokone/s/ Tshuapa (fl. Jan.) *Evrard 5622* (BR); Ndjili-Brasserie (fl. Aug.) *Evrard 6374* (BR); Panza (fl., fr. July) *Gilbert 14515* (BR); Kimuenza, *Gillet s.n.* (BR); Lutendele (fr. Oct.) *Jans 94* (BR); Lac Foa (fr. Sept.) *Lescrauwaet 218* (BR, type *A. ferruginosa*); Musoko (fl., y.fr. Aug.) *Liben 3517* (BR); Kimuenza (fl. Sept.) *Mildbraed 3542* (BR, type of *A. villosiflora*); Kimbuba (fr. Sept.) *Pauwels 403*

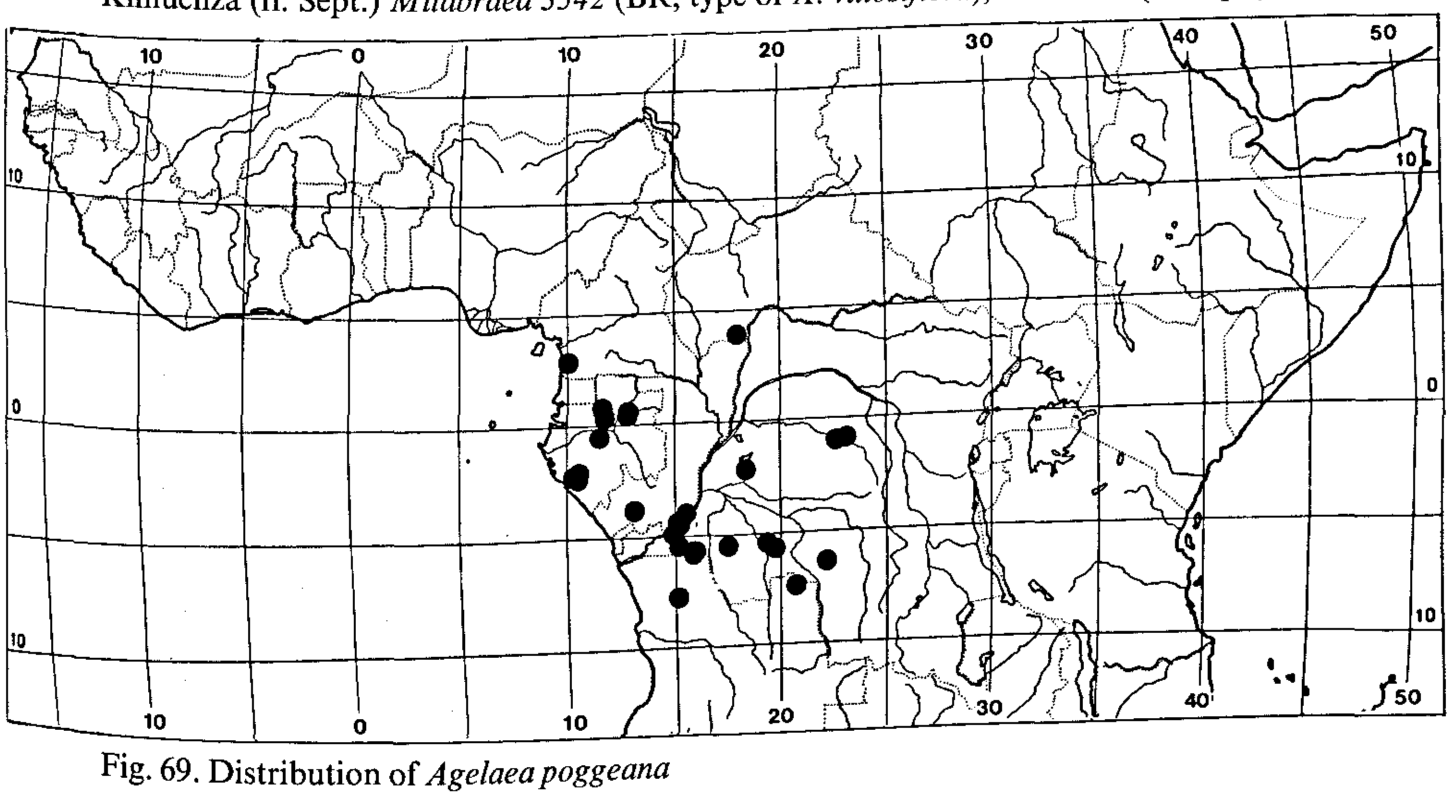


Fig. 69. Distribution of *Agelaea poggeana*

Sapin s.n. (BR); Mbau (fl.) *Vanderyst 16371* (BR, type); (fl.) *Vanderyst 16386* (BR); Sanga, *Vanderyst 25396* (BR).

Angola: Rio Zadi-Beu (fr. Oct.) *Raimondo et al. 479* (LISC); Dundo (fl. Aug.) *Young 454* (BM, COI).

Note: *A. poggeana* is the only species kept separate from *A. pentagyna* on the basis of vegetative characters only, because this is the only one with a combination of leaf and indumentum characters that have no clear intermediates to one or more forms of *A. pentagyna*. Characters such as the shiny arachnoid indumentum and the small first main lateral nerves have not been observed in *A. pentagyna*.

Agelaea rubiginosa Gilg **Fig. 68, 70-72**

A. rubiginosa Gilg, 1891b: 319; Schellenberg, 1910: 64; 1923: 210; 1938: 79; Troupin, 1952: 111.

Type: Zaire, Monbuttu-land, Kibali, *Schweinfurth 3537* (holo: B†). Neotype: Zaire, Doruma, *De Graer 587* (holo: BR).

A. schweinfurthii Gilg, 1891b: 319. Type: Zaire, Niamniam-land, Dingbe, *Schweinfurth 3099* (syn: B†; lecto: K).

A. laurentii De Wildeman, 1909: 101,tab.12. Type: Zaire, Eala, *Pynaert 463* (lecto: BR); *M.Laurent 897* (para: BR).

A. macrophysa Gilg ex De Wildeman, 1909: 102; Schellenberg, 1910: 62. Type: Cameroun, Bipindi, *Zenker 2543* (holo: BR; iso: B, E, G, GOET, K, L, M, MO, Z).

A. gracilis Schellenberg, 1923: 213; 1938: 84. Type: Equatorial Guinea, Bebai, *Tessmann 580* (holo: B†; lecto: HBG; iso: K).

A. vanderystii Schellenberg, 1938: 73; Troupin, 1952: 107. Type: Zaire, Kikwit, *Vanderyst 10047* (holo: BR).

A. principensis Exell, 1944: 148, fig.7c; Liberato, 1980b: 11. Type: Principe, Oquê Pipi, *Exell 491* (holo: BM; iso: BR, COI).

A. kivuensis Troupin, 1951: 367; 1952: 110. Type: Zaire, Walikale-Kalehe, *Lebrun 5251* (holo: BR; iso: K).

Large liana up to 20 m long and in diameter up to 9 cm. Wood often with interxylary phloem. *Branches* glabrous, often clearly furrowed; branchlets puberulous. *Petiole* 2-15 cm; rachis 0.5-5 cm; petiolules 2-8 mm; *leaflets* ovate to elliptic with a more or less palmate venation, full-grown leaflets glabrous or nearly so; 3-5 pairs of main lateral nerves, basal pair longer than the others but not always originating at the very base of the leaflet; apex (slightly) acuminate; terminal leaflet 5-23 × 2.5-11 cm; lateral leaflets 3.5-23 × 2-11 cm, more or less asymmetric. *Inflorescence* up to 15(-35) cm, often one or more together at the end of a leafy branch and resembling a terminal inflorescence, puberulous. *Flowers* heterotristylous. *Sepals* 3-4.5 × 1 mm, fringed with multicellular hairs, puberulous outside. *Petals* 3.5-5 × 1 mm, often connivent near base. Long *sta-*

Fig. 70. *Agelaea rubiginosa*: branchlet showing leaf from beneath (*Breteler et al. 8774*, phot. C.C.H. Jongkind).

mens 3-5 mm long, short stamens 1-2.5 mm long. *Pistil* 1-4.5 mm long, unequal to the stamens; style hairy; ovary velutinous. *Follicles* one to five per flower, 15-20 × 8-10 mm, with many coarse protuberances, red velutinous. *Seed* 10-15 × 7 mm; testa for ca 1/4 fleshy and yellow to red, the thin part black and shiny.

Distribution: Central Africa and Principe.
Ecology: Rain forest and gallery forest from sea level up to 1000 m alt.

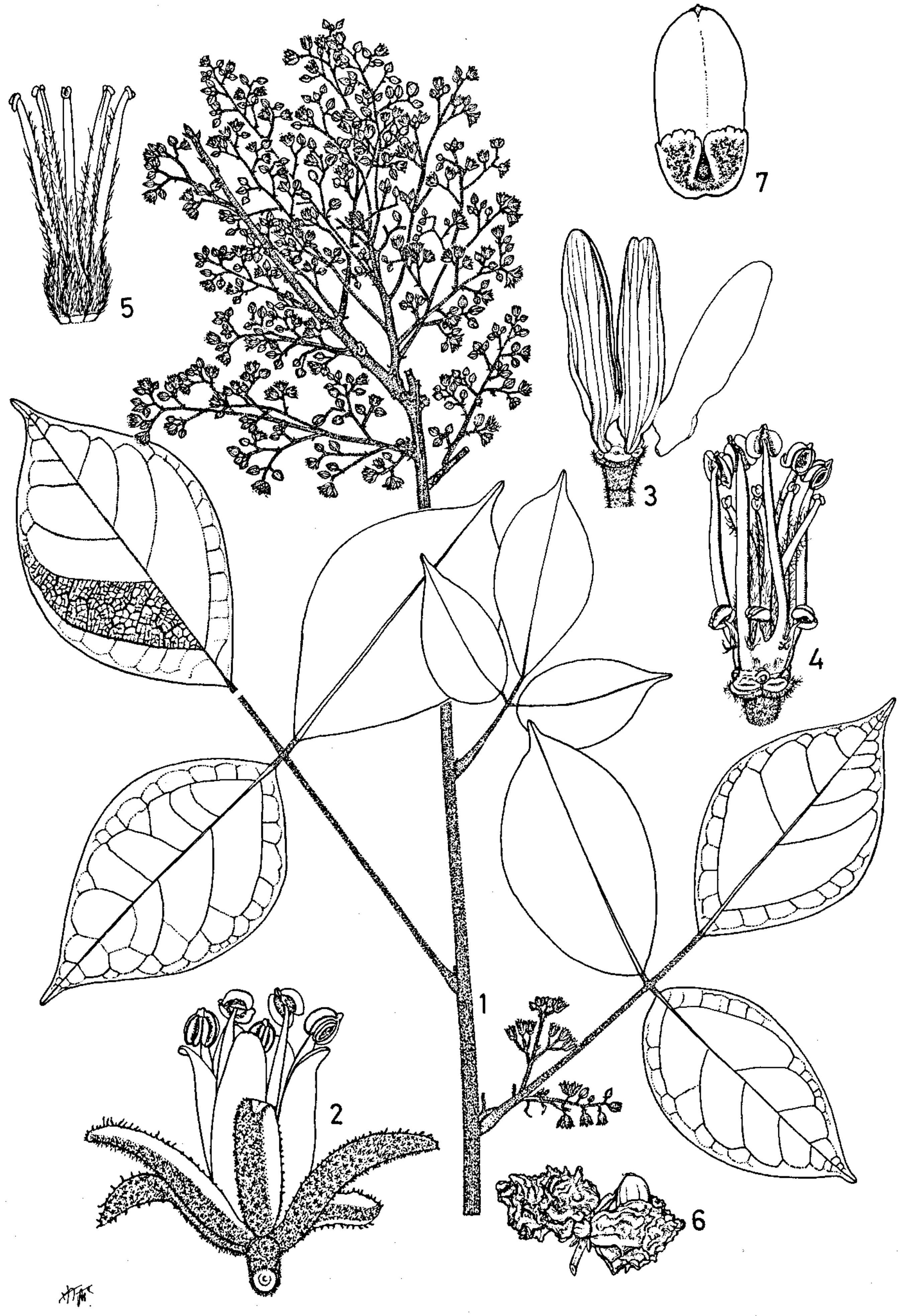


Fig. 71. *Agelaea rubiginosa*: 1. flowering branchlet, 2/3 ×; 2. flower, 6 ×; 3. flower partly, showing connivent petals, 6 ×; 4. stamens and pistils, 6 ×; 5. pistils, 8 ×; 6. follicles, one showing seed, 2/3 ×; 7. seed, showing sarcotesta (dark part) and hilum surrounded by the sarcotesta, 2 ×. (1-5. *A.Louis et al. 499*; 6-7. *A.Louis et al. 1211*).

Specimens examined:

Nigeria: Oban, *P.A.Talbot s.n.* anno 1911 (BM).

Cameroun: Bitye (fl.b.) *Bates 1331* (BM); 8 km SW Bertoua (fr. Aug.) *Breteler 1749* (WAG); 12 km NE Akwaya (fr. July) *Letouzey 14061* (BR, P, WAG); 250 km NE Yaounde (fl. March) *Mildbraed 8785* (K); Bipindi (fl.) *Zenker 1779a* (G); (fr.) *Zenker 2543* (B, BR, E, G, GOET, K, L, M, MO, Z, type *A. macrophysa*); (fl. May) *Zenker 545* (B, BR, C, G, MO, WAG).

Central African Republic: reg. Bambari (fl. April) *Tisserant 498* (P); Boukoko (fl. Feb.) *Equipe Tisserant 2390* (BR).

Equatorial Guinea: sin.loc. (fl.) *Tessmann 580* (HBG, K, type *A. gracilis*).

Sao Tome & Principe: Principe, Oquê Pipi (fr. Dec.) *Exell 491* (BM, BR, COI, type *A. principensis*); Principe, SW Esperanca (fr. Dec.) *Exell 670* (BM); sin.loc. (fl.) 1861 *Mann s.n.* (P).

Gabon: Mouila-Yeno (fl. Sept.) *Breteler & Lemmens 8046* (LBV, WAG); ca 24 km N of Koumameyong, *Breteler et al. 8571* (WAG); ca 10 km SE of Mitzic, *Breteler et al. 8774* (WAG); near Cape Esterias, 20 km NNW of Libreville, *de Wilde & Jongkind 9651* (WAG); sin.loc. (fl.) *Duparquet 52* (P); 10 km S of Makokou, *Florence 781b* (P); Lastoursville (fl.) *Le Testu 7549* (BR, P); Oveng (fl. Nov.) *Louis et al. 499* (LBV, WAG); reg. Abeilles (fl. Nov.) *Louis et al. 686* (LBV, WAG); 23 km SE of Sindara (fr. Dec.) *Louis et al. 1211* (LBV, WAG); 30 km SW of Lastoursville (fr. Nov) *van der Maesen & de Bruijn 5813* (WAG).

Zaire: Yangambi (fr. Aug.) *Bamps 661* (BR); Yanange (fl. July) *Bolangi Bo Yanguma 30* (BR); Yangambi (fl. March) *Bolema 478* (BR); Amboko (fl. April) *Claessens 442* (BR); Makanza (Nouvelle Anvers) (fl.) *De Giorgi 572* (BR); Doruma (fr. June) *De Graer 587* (BR, type); Kelembe R. (fr. May) *De Graer 869* (BR); Bangala (fl.) *Demeuse 419* (BR); Kiyaka-Kwango (fl. July) *Devred 2194* (BR); N.P. Albert (fr. July) *J.de Wilde 558* (BR); Bas-Uele (fl. April) *Dewulf 789* (BR); Lake Kwada (fl. April) *Evrard 721* (BR); Popolo (fr. Aug.) *Evrard 1602* (BR); Boende (fl. April) *Evrard 4020* (BR); Makayoba R. (fr. June) *Fredericq 9525* (BR); Tukpwo (fr. Sept.) *Gerard 4063* (BR); Bambesa (fl. April) *Gerard 4883* (BR, WAG); Kimuenza (fr.) *Gillet 1936* (BR); Bomaneh (fl.) *Goossens 1665* (BR); Eala (fl. May) *M.Laurent 897* (BR); Bantoï/Ruki (fr. June) *Lebrun 526* (BR); Bokuma (fl.) *Lebrun 1291* (BR); Walikale-Kalehe (fl. April) *Lebrun 5251* (BR, K, type *A. kivuensis*); Yangambi (fr. July) *A.Léonard 942* (BR); Nsadi-Kalende (fr. Jan.) *Liben 2285* (BR, WAG); Yangambi (fr.) *Louis 2720* (BR), (fr.) *Louis 4145* (B, BR, K); (fr.) *Louis 4357* (BR, K); (fl.) *Louis 8796* (BR, K); (fr.) *Louis 10551* (BR, K); (fr.) *Louis 11292* (BR, K); (fl., fr.) *Louis 13168* (BR, K); (fl.) *Louis 14380* (BR, K); (fl.) *Louis 14616* (BR); (fr.) *Louis 15842* (BR, C, K); (fr.) *Louis 16953* (BR); Banga-N Shabunda (fl. Sept.) *Paquay 18* (BR); Eala (fl. Sept.) *Pynaert 463* (BR, type *A. laurentii*); (fl. Sept.) *Pynaert 1679* (BR); Dingbe (fl. Dec.) *Schweinfurth 3099* (K, type *A. schweinfurthii*); Gangala (fr. July) *Stam 131* (L); N.P. la Garamba, *Troupin 2160* (BR); Kikwit (fl.) *Vanderyst 10047* (BR, type *A. vanderystii*); sin.loc. (fr.) *de Witte 9525* (BR).

Angola: Lunda (fr. Dec.) *Cavaco 1326* (P, WAG); Maiombe, Bélize (fr.) *Gossweiler 7621* (COI, K, LISU).

Note: Differs from *A. pentagyna* not only in the shape of the follicles (protuberances) but also in the shape and texture of the leaflets. Because these leaf characters are very hard to describe one can hardly identify flowering or sterile material of this species without comparing it with previously identified specimens.

Agelaea in Asia

As the only African species of the former genus *Castanola*, *A. paradoxa* is rather similar to the 4 Asiatic relatives accepted by Leenhouts, it was necessary to make a careful comparison with these species. When studying the material of *A. paradoxa*, the limited number of collections with intermediary fruit characters contributed to the decision to recognize two varieties within this species.

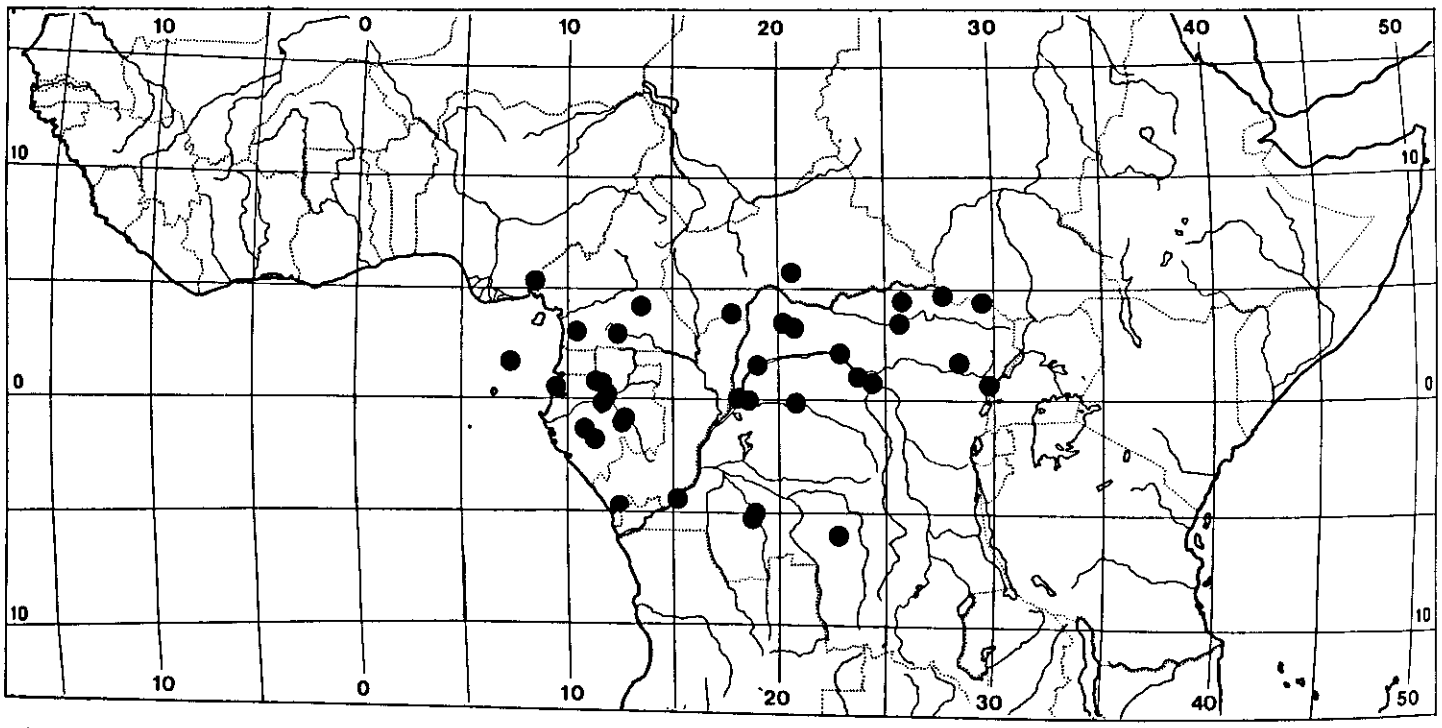


Fig. 72. Distribution of *Agelaea rubiginosa*

The Asiatic material of the related species shows a similar cline on fruit characters, but here both extremes are recognized as separate species. Recent collections in the herbaria of Kew, Leiden and Paris contain many specimens that cannot be identified by means of the key in Flora Malesiana (Leenhouts, 1958: 500) as their fruit characters are too variable to match properly. In my opinion the distinguishing characters have to be sought in the flowers rather than in the fruits. There is a clear difference in the length of style and stamens of *A. macrophylla* and *A. trinervis* at one hand and *A. borneensis* and *A. insignis* at the other. Further distinction between the two species of each pair according to the characters given in Leenhouts key proves impossible. These characters concern the shape of the leaflets and they are not tenable on many recent collections that demonstrate the variability of them. This leads to the conclusion that there are only two different species of *Agelaea* in Asia.

Some examples of intermediates between formerly recognized Asiatic species are shown in fig. 73.

In Africa the plants with the different fruit shapes have an almost complementary distribution, but in Asia they have a more diffuse geography. On Sumatra, the Malay Peninsula and on Borneo one can find all different fruit shapes together. In other parts of the area one can only find plants with either smooth or rugulose fruits.

Key to the Asian species

1a Twigs, petioles and leaves at least in the young parts densely pubescent. Pistils 2-3.5 mm in pistil-dominant flowers. Long stamens 2-4 mm in stamen-dominant flowers. Follicles smooth to tuberculate, protuberances sometimes almost doubling the diameter of the follicle. . . . **A. borneensis**

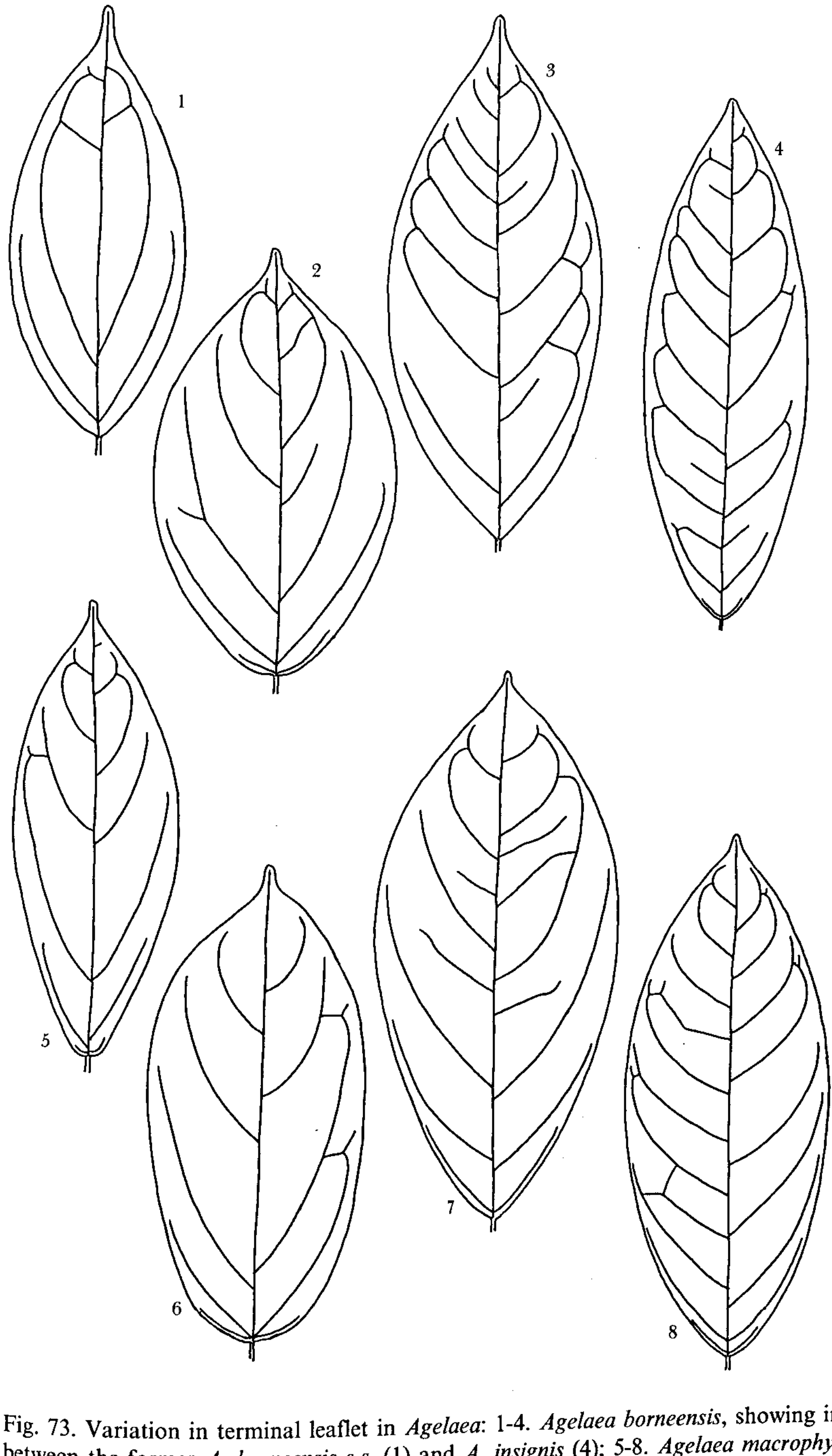


Fig. 73. Variation in terminal leaflet in *Agelaea*: 1-4. *Agelaea borneensis*, showing intermediates between the former *A. borneensis s.s.* (1) and *A. insignis* (4); 5-8. *Agelaea macrophylla*, showing intermediates between the former *A. trinervis* (5) and *A. macrophylla s.s.* (8). (1. *Loh FRI 13432*; 2. *Bumée 6756*; 3. *Diepenhorst s.n.* Sumatra; 4. *Ploem s.n.* Java; 5. *Kostermans 5333*; 6. *Meijer SAN 28867*; 7. *Fedilis & Sumbing SAN 88426*; 8. *Chai S.34668*)

b Twigs, petioles and leaves puberulous to glabrous. Pistils 1.3-1.7 mm in pistil-dominant flowers. Long stamens 1-1.5 mm in stamen-dominant flowers. Follicles smooth to rugulose, sometimes also with some small warts. . . . . **A. macrophylla**

Agelaea borneensis (Hook. f.) Merr. **Fig. 73**

A. borneensis (Hook. f.) Merrill, 1909: 127; Schellenberg, 1910: 65; Leenhouts, 1958: 503.

Basionym: *Hemiandrina borneensis* Hooker f., 1860: 171.

Type: N Borneo, Labuan I., *Lobb s.n.* (holo: K).

A. insignis (Schellenb.) Leenhouts, 1958: 504. Basionym: *Hemiandrina insignis* Schellenberg, 1924: 26. Type: Sarawak, Kuching, *Haviland 867* (holo: K).

Castanola insignis (Schellenb.) Schellenberg, 1938: 176. Basionym: *Hemiandrina insignis* Schellenb. (see above).

For more literature and synonyms see Leenhouts 1958: 503,504.

Large lianas. *Petiole* up to 11 cm long; rachis up to 3 cm long; *leaflets* oblong-elliptic to ovate, at least the younger ones tomentose, upper surface with many mucous cells looking like small pits in dried material, 4-11 pairs of main lateral nerves; apex acuminate; terminal leaflet 6-33 × 3.5-14 cm; lateral leaflet asymmetric to nearly symmetric, 3-32 × 1.5-13 cm. *Inflorescence* up to 5 cm long, often more than one in the axil of a sometimes rudimentary leaf, tomentose. *Flowers* heterodistylous. *Sepals* 1.3-3 × 0.5-1 mm, 2.5-4 times as long as wide, puberulous outside and inside; *petals* 2.8-6 × 0.4-1.2 mm glabrous. Long *stamens* 0.7-1.5 mm or 2-3.5 mm long; short stamens 0.6-1 mm or 1.5-2.5 mm long. Long *pistils* 2-3.5 mm long; short pistils 0.7-1.7 mm long; ovary pubescent. Developed *follicles* one to five per flower, beaked, smooth to tuberculate, protuberances sometimes almost doubling the diameter of the follicle, velutinous indumentum usually mixed with many larger somewhat stinging hairs.

Distribution: (Burma see note,) Thailand (Peninsula), Malaysia (Peninsula, Sarawak, Sabah), Indonesia (Sumatra, Java, Kalimantan), Philippines.

Ecology: In all kinds of forests, from sea level up to 700 m (1300 m ?) alt.

Selection of examined specimens:

Thailand: Sungei Kolok, Nikom Waeng (fr.) *Larsen & Larsen 32925* (AAU, L); Narathiwat, Waeng (fl. Nov.) *Sankhachand BKF 47646* (BKF, L).

Malaysia: Peninsula: Johore, Kuala Sedili new road (fr. June) *Kadim & Noor 168* (A, K, L, LAE, SING); 6 mls S of Kg. Aur Pahang (fr. Feb.) *T.Suppiah FRI 14772* (L).

Malaysia: Sarawak: Semengoh F.R. Arboretum (fr. Oct.) *Banyeng ak Nudong Benang ak Bubong S.26296* (L, SAR); Sg. Chipidi (fr. Aug.) *P.Chai S. 34668* (L, K, KEP, MO, SAN).

Malaysia: Sabah: Benawod logging area (fr. July) *Fedelis & Sumbing SAN 88427* (K, L, SAR); logging area mile 26 Luasong (fl. Feb.) *Fedelis & Sumbing SAN 89721* (L, SAN); Sg. Kinabatangan (fl. Sept.) *L.Madani San 78702* (AA, K, L, SAR, SING); Ulu Sg. Kebulu (fl. March) *Sundaling SAN 93146* (K, KEP, L, SAN, SAR, SING).

Singapore: Nee Soon swampy forest (fl. Feb.) *Axelius 382* (L, WAG).
Indonesia: Sumatra: Palembang (fl., fr. May) *Dumas 1572* (BO, L); Upper Riauw, Tenajan R. (fl. Aug.) *Soepadmo 248* (BO, L).
Indonesia: Java: Banjar (fr. Dec.) *Backer s.n.* (BO, L); Nusa Kambangan I. (fr.) *Valenton 90* (BO, L).
Indonesia: Kalimantan: G. Tepian Lobang (fl. June) *Kostermans 5333* (BO, L).
Philippines: Sibuyan I., Mt. Giting-Giting (fr. May) *Elmer 12479* (L); Luzon I., Irosin (fl. Aug.) *Elmer 16822* (U); Polillo I., Karlagan (fr. March) *Fox PNH 9230* (L, PNH); Samar I., Mt Mahagna (fl., fr. May) *Sulit PNH 14578* (L, PNH).

Note: Probably also in Burma (Leenhouts, 1958: 505; Schellenberg, 1938: 174), but the involved herbarium collections have not been examined for the present revision.

Agelaea macrophylla (Zoll.) Leenhouts **Fig. 73**

A. macrophylla (Zoll.) Leenhouts, 1958: 502.
Basionym: *Erythrostigma macrophylla* Zollinger, 1857: 174.
Type: Java, Bogor (Buitenzorg) *Zollinger 3277* (holo: L).
A. trinervis (Llanos) Merrill, 1918: 164; Leenhouts, 1958: 502. Basionym: *Castanola trinervis* Llanos, 1859: 503. Type: Philippines, Luzon, Mt. Maquiling, Merrill: *Species Blancoanae No.1059* (lecto: L).
Castanola macrophylla (Zoll.) Schellenberg, 1938: 171. Basionym: *Erythrostigma macrophylla* Zoll. (see above).
For more literature and synonyms see Leenhouts 1958: 502.

Large lianas. *Petiole* up to 15 cm long; rachis up to 4.5 cm long; *leaflets* ovate to elliptic-oblong, puberulous to glabrous, upper surface with many mucous cells looking like small pits in dried material, 4-11 pairs of main lateral nerves; apex acuminate; terminal leaflet 7-34 × 2.5-14 cm; lateral leaflets asymmetric to nearly symmetric, 4-30 × 2-14 cm. *Inflorescence* up to 5 cm long, often more than one in the axil of a sometimes rudimentary leaf, puberulous. *Flowers* more or less heterodistylous. *Sepals* 1.5-2.2 × 0.7-1.3 mm, 1.5-2 times as long as wide, puberulous inside and outside; *petals* 4-6 × 0.9-1.5 mm, glabrous. Long *stamens* 1-1.4 mm long; short stamens 0.8-1.2 mm long. Long *pistils* 1.3-1.7 mm long, short pistils 0.7-1 mm long; ovary pubescent. Developed *follicles* one to five per flower, smooth or rugulose sometimes with small warts, beaked or not, velutinous indumentum never mixed with longer hairs.

Distribution: Thailand, S Laos, Cambodia, S Vietnam, Malaysia (Peninsula, Sarawak, Sabah), Indonesia (Sumatra, Java, Bali, Moluccas, Kalimantan), Philippines.
Ecology: In all kinds of forests, from sea level up to 700 m alt.

Selection of examined specimens:

Thailand: Newng Chik, Krabi (fl. March) *A.F.G.Kerr 18618* (K, L).

Laos: Bords du Mekong, fl. *Harmand 9* (P).
Cambodia: Siêm Réap, *Harmand 5* in Herbarium Pierre 6543 (P).
Vietnam: ca 100 km S of Hue, *Clemens 4338* (U).
Malaysia: Malay Peninsula: Tg. Penawar (fr. Feb.) *P.F.Cockburn FRI 7583* (L); Ulu Telemong F.R. (fr. Sept.) *H.S.Loh FRI 13432* (L); Tg. Penawar (fr. Feb.) *P.F.Cockburn FRI 7583* (L); Ulu Telemong F.R. (fr. Sept.) *H.S.Loh FRI 13432* (L).
Malaysia: Sarawak: Semengoh Arboretum (y.fr. Oct.) *Paie S.37717* (K, L, SAN, SAR, UA).
Malaysia: Sabah: Merutai Besar (fr. July) *Gibet 37139* (K, L); Lahad Datu (fr. July) *Talip SAN 70952* (K, L).
Singapore: near Bukit Kallang Reservoir (fl. Aug.) *Maxwell 81-203* (L, SING).
Indonesia: Sumatra: Gunung Leuser N.R. (fr. July) *de Wilde et al. 18690* (L); Lampung (fr. Feb.) *Mochtar 84a* (G, L).
Indonesia: Java: Musa Barung I. (fr. May) *Jacobs 4783* (A, BO, K, L, LAE, PNH, SING); 19 km E of Pameungpeuk (fl. April) *Leeuwenberg 13241* (WAG); Dungus Irvul Nat. Reserve (fl. Sept.) *van Steenis 11528* (BO, L).
Indonesia: Bali: G. Kelatakan (fr. Aug.) *Sarip 155* (BO, L).
Indonesia: Moluccas: Sula Ils, Sula Sanana (fl. July) *Bloembergen 4316* (BO, L); Seram, Wai Minawat (fr. Feb.) *Kornassi 1035* (BO, L); W Seram, Kairatu, Gemba (fr. June) *Kuswata & Soepatmo* (BO, K, L).
Indonesia: Kalimantan: E Kutai (fl. Aug.) *Leighton 1089* (BO, DAV, L).
Philippines: Mindanao I., Mt Urdaneta (fr. July) *Elmer 13404* (L); Luzon I., Mt Maquiling (fr. June-July) *Elmer 17870* (L); Samar I., sin. loc. (fl. April) *Ramos 1659* (L); Biliran I., Mt Suiro (fl. April-May) *Sulit PNH 21659* (L, PNH); Leyte I., *Wenzal 422* (L, MO).

Burttia Bak. f. & Exell

by F.J. Breteler & J. Brouwer

History of the genus

Burttia with its only species *B. prunoides* was first described by Baker and Exell (1931) and named in honour of its collector, Mr. B.D. Burtt. The authors discussed the systematic position of the genus within the *Connaraceae* but were undecided. They looked to place it near *Ellipanthus*. This genus and also *Hemandradenia* both share with *Burttia* the unifoliolate leaves and the unicarpellate flowers, but unlike it have only 5 fertile stamens. In this respect the later described unifoliolate and unicarpellate *Vismianthus* seems more closely related as its species have ten fertile stamens like *Burttia*. However, the differences in fruit and seed characters between *Burttia* and *Vismianthus* are considerable. Therefore *Burttia*'s taxonomic position remains rather isolated.

Schellenberg (1938: 98) kept *Burttia* and *Vismianthus* separate because of the presence of bifurcate hairs and of dark resinous glands in the flowers and leaves of *Vismianthus*, whose fruit and seed were unknown to Schellenberg. *Burttia*, however, also has bifurcate hairs, which is demonstrated by Fig. 14 no. 8 in Schellenberg's revision!

Description of the genus

Burttia Baker and Exell, 1931: 249; Schellenberg, 1938: 96; Brenan and Greenway, 1949: 167; Hemsley, 1956: 5; Mendes, 1966: 620.

Type species: *B. prunoides* Bak.f. & Exell.

Shrub or small tree. *Leaves* unifoliolate, long-petioled. *Hairs* two-armed. *Inflorescence* racemose. *Flowers* heterodistylous. *Sepals* 5, imbricate in bud, persisting in fruit. *Petals* 5, free. *Stamens* 10, shortly connate at base. *Carpel* solitary; ovary hairy, ovules anatropous; stigma (sub)capitate, papillose. *Fruit* a pubescent, 1-seeded follicle, dehiscent by ventral suture. Sarcotesta raphal, all along one side of seed, partly free, spreading laterally, slightly lobate. Cotyledons long and narrow, embedded in copious endosperm.

Distribution: Tanzania, Zambia, Mozambique.

Burttia prunoides Bak.f. & Exell — **Fig. 74, 75**

B. prunoides Baker and Exell, 1931: 249; Schellenberg, 1938: 97; Brenan and Greenway, 1949: 167; Hemsley, 1956: 5; Mendes, 1966: 620.

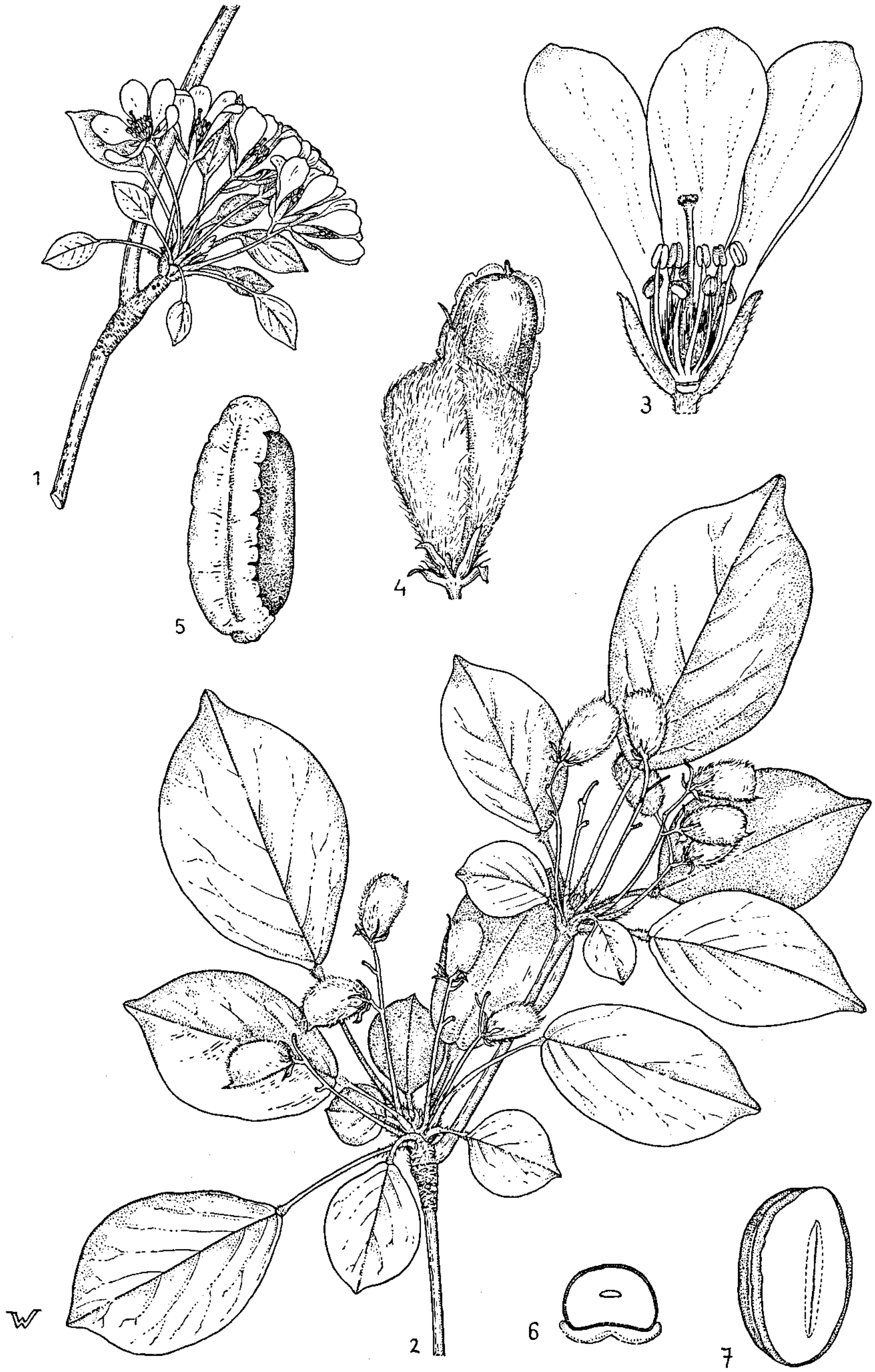


Fig. 74. *Burttia prunoides*: 1. flowering branchlet, 2/3 ×; 2. fruiting branchlet, 2/3 ×; 3. flower, sepals and petals partly removed, 3 ×; 4. dehiscing fruit with seed, 2 ×; 5. seed with sarcotesta, 2 ×; 6. transverse section of seed, 2 ×; 7. section of seed lengthwise, sarcotesta removed, 2 ×. (1. *Bullock 1340*; 2. *Burtt 5148*; 3. *Newman 59*; 4-7. *Greenway & Pohlhill 11446*).

Type: Tanzania, Singida District, Itigi-Saranda-Kasikasi area, *Burtt 532* (holo: BM; iso: EA).

Shrub or small tree, up to 4(8) m, branching subradially. *Branches* pale grey, smooth to fibrous, with many lenticels; slash very dull orange yellow. *Branchlets* greyish brown, pubescent when young, hairs ferruginous with unequal arms, becoming glabrous. *Leaves* crowded at end of shoots, sometimes also spread out along shoots. *Petiole* 1.5-4.5 cm long, very slender, channeled, densely ferruginously pubescent when young with unequally two-armed hairs especially at base of leaflet, glabrescent with age, articulate apically; blade herbaceous to thinly coriaceous, ovate-subcircular to elliptic-obovate, sometimes transversely elliptic, from 2.5 × 2.5 cm to 10.5 × 9 cm, apex acuminate to broadly acute, acumen to 0.3 cm, base rounded to retuse; densely ferruginously pubescent-pilose when young, especially beneath, becoming glabrous with age, longer persistent along main and secondary nerves beneath; secondary nerves 6-8 pairs, generally quite prominent both sides. *Inflorescence* simple, 1-3 flowered raceme; bracts elliptic-oblong to lanceolate, rounded-apiculate, keeled, up to 5 × 1-2.5 mm, densely pubescent, (partly) caducous; peduncle 1.5-5 cm long, densely tomentose to pilose, glabrescent; bracteoles filiform, 2-3.5 × 0.2-0.3 mm, caducous. *Flowers* (4)5-merous, 9-18 mm long; pedicel 0.5-2 mm long, articulate, ferruginously villose-sericeous. *Sepals* (sub)equal, elliptic-oblong to lanceolate, 3.5-7 × 1.5-3 mm, very shortly connate, apex obtuse to truncate, ferruginously villose-sericeous, especially at the apex and along centre, imbricate. *Petals* white, sometimes pink (*Richards 2259*), (sub)equal, spatulate, 6.5-17 × 3-8 mm, free, apex obtuse, base narrowly cuneate, glabrous. *Stamens* 10, the five episepalous ones 4-6 mm long in long-styled flowers and 6.5-9 mm long in short-styled ones, the five epipetalous stamens 2.5-5 mm and 6.5-7.5 mm long respectively; filaments filiform, somewhat flattened, glabrous (rarely sparsely sericeous), shortly (0.3-1 mm) connate at base, sometimes so in pairs to 3.5 mm from base; anthers ovoid, 0.5-1mm long, dorsiversatile. *Pistil* 6-8 mm in long-styled flowers, 3-4.5 mm in short-styled flowers; style filiform, glabrous; stigma (sub)capitate, more or less bilobed, 0.4-0.7 mm diameter, papillose; ovary sessile 1-2 mm long, obliquely ovoid-lenticular, densely sericeous, hairs with two unequal arms; ovules 2, only 1 developing, attached above middle of ventral suture, anatropous. *Fruit* a flattened follicle with persistent calyx (and stamens), 14 × 6 – 18 × 8 mm, hardly stalked with up to 3 mm long rostrum, densely brown-pilose-pubescent when young, becoming greyer with age, dehiscing along ventral suture. *Seed* solitary, attached near top of ventral suture, narrowly ovoid, 11 × 3 – 18 × 8 mm, black and shining with large fleshy, verrucose, slightly lobate crimson raphal sarcotesta, covering whole length of seed on one side.

Distribution: Central and western Tanzania, northern Zambia, Mozambique.
Ecology: Thickets and woodlands on sandier soils, often among rocks, at altitudes of 800 to 1500 m. Found in association with *Cassipourea*, *Grewia holstii*,

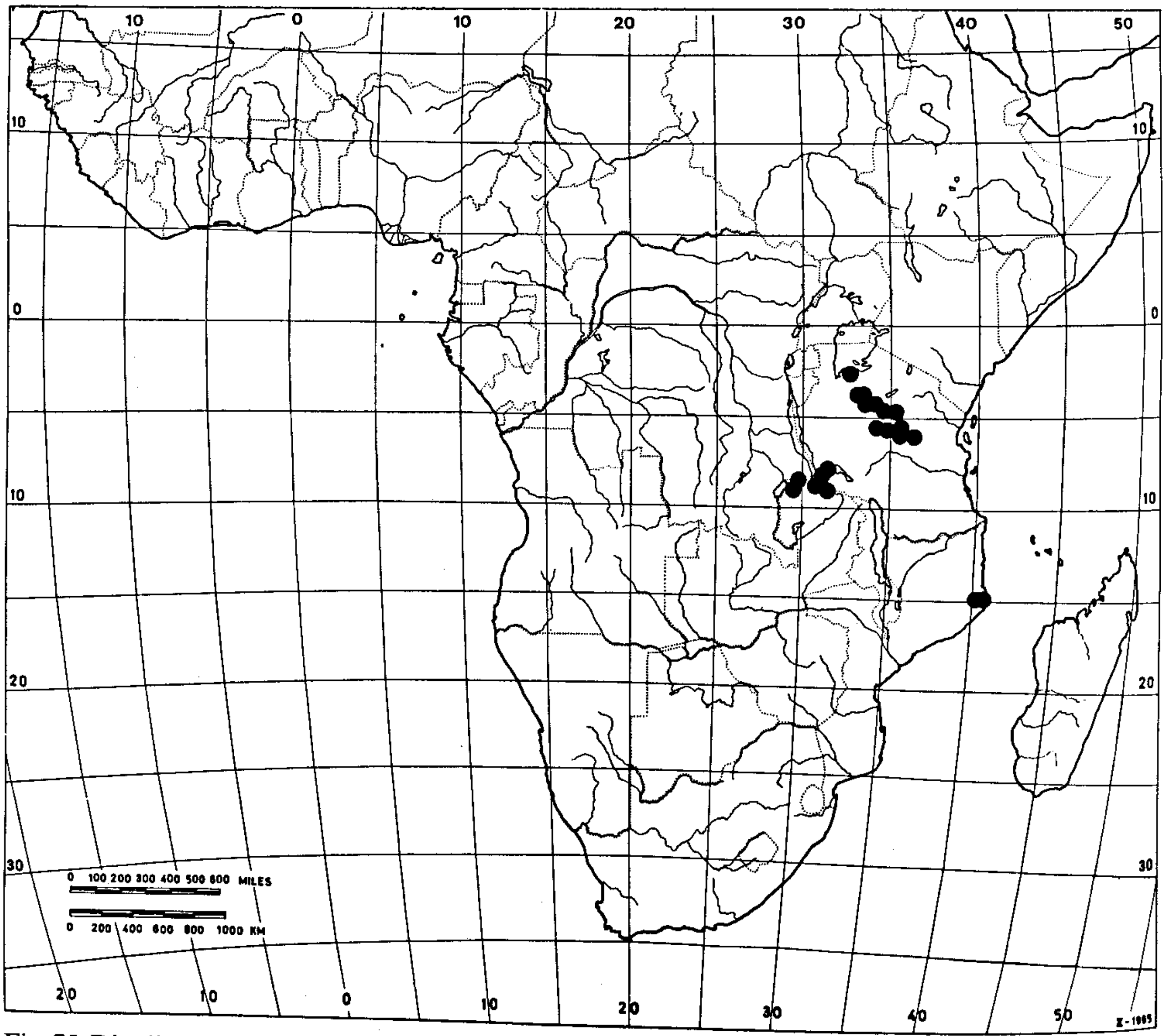


Fig. 75. Distribution of *Burttia prunoides*

Acacia, Baphia, Landolphia, Combretum, Brachystegia, Isoberlinia, Commiphora and *Euphorbia*.

Specimens examined:

Tanzania: Mayoni District, Itigi-Saranda-Kasikasi (fl. Dec.) *Burtt 532* (BM, type); Kondoa District, Thlawa (fl. Feb.) *Burtt 846* (K); Dodoma District, Kondoa Rd (fr. March) *Burtt 1800* (BM, BR, EA, G, K); Kondoa District, Sambala (fr. March) *Burtt 1978* (BM, EA, K); Shinyanga District, Tinde Hills, *Burtt 2383* (BM, EA, K); Dodoma District (fr. March) *Burtt 3035* (EA); Manyoni District, between Mkwese & Kunguya (fl. Dec.) *Burtt 3521* (BM, EA, K); Manyoni District, Hika (fl. Dec.) *Burtt 3522* (BM, K); sin.loc., *Burtt 3818* (K); Manyoni District, Kazikazi, *Burtt 4439* (BM); *4440* (BM); (fl. Dec.) *Burtt 4939* (BM, BR); (fl. Dec.) *Burtt 4961* (BM, BR); Shinyanga (fr. Feb.) *Burtt 5148* (BM, BR, EA, K); *5149* (BM, BR, EA, K); Manyoni (fl. Dec.) *Burtt 5402* (BM, BR, K); Shinyanga District, Tinde Hills, *Burtt 6409* (BM, BR, K, P); Nindo F.R. (fl. Oct.) *Carmichael 845* (EA, K); Mayoni District, E. of Itigi Station (fr. April) *Greenway & Polhill 11446* (K); Singida District, *Jiwa s.n.* (EA); Tabora Region, *Lawton 2142* (K); (fr. Nov.) *Lawton 2153* (K); Shinyanga, *Lindeman 539* (BM, EA, K); Singida (fl. Dec.) *Michelmore 832* (EA, K); Gonga, *Newman 18* (EA); Tumbakose (fl. Dec.) *Newman 59* (BR, EA); Dodoma Mt. (fr. Dec.) *Peter 33087* (B);

Uyansi (fr. Jan.) *Peter 34193* (B); W of Dodoma, *Peter 45686* (B); (fr. Dec.) *Peter 45719* (B, K); Sandawe (fr. Feb.) *Phillips in Burtt 1480* (BM); Mangoloma (fr. Feb.) *Phillips in Burtt 1801* (EA, K); Chenene (fr. Jan.) *Polhill & Paulo 1249* (B, BR, K, P); Kongwa, *Regional Plant Pathologist s.n.* (EA); Sumbawanga (fr. Dec.) *Richards 7398* (K); Kasanga, *Richards 10151* (K); Chenene, *Ruffo 1152* (K); Chaya (fl. Nov.) *Semsei 3435* (K); Singida District (fr. Dec.) *Shabani 1213* (K); Kikuye near Dodoma (fr. Jan.) *Wigg 200* (EA).

Zambia: Kasanga (fr. Dec.) *Bredo 6407* (BR); Bulaya-Mwewe District (fl. Oct.) *Bullock 1340* (BR, K, SRGH); Abercorn, *Burtt* 5996 (BM, BR, K, P); Lake Tanganyika between Kalambo R. and Mpulungu, *Burtt 5997* (BM, BR, EA, K); Great Kalambo, *Burtt 5998* (BM, BR, K); Museshia, *Fanshawe 4870* (K, WAG); (fl. Oct.) *Fanshawe 4880* (K); near Mpulungu (fl.) *Richards 2259* (BR, K, SRGH); Mwenda, *Richards 9585* (K); Abercorn District (fl. Nov.) *White 3693* (BM, BR, K).

Mozambique: Nampula, Monapo (fr. Feb.) *de Koning c.s 9603* (WAG); Nampula, Mossuril (fr. Feb.) *de Koning c.s. 9746* (WAG).

Notes: The young leaves are salmon pink to crimson and copper beach or silvery and brown veined or pale green and covered with soft, short white hairs, the mature leaves are dark green above, paler below, brilliant in autumn. Flowers and leaves appear with the first rains (Oct-Dec.), the fruits are mature about March.

The 'aril' is sweet and edible, the seeds are used for poisoning animals (*Burtt 1978*). The wood is reported to be of little value (Brenan & Greenway, 1949: 167; *Burtt 4439*).

For observations on the pollen grains see under *Vismianthus*.

In literature (e.g. Hemsley, 1956: 5) heterostyly is mentioned for *B. prunoides*. The herbarium material examined showed all to be heterodistylous, having long- as well as short-styled flowers. A statement by Mendes (1966: 620) to the effect that the six known gatherings of flowers of *B. prunoides* in the area of the Flora Zambesiaca concerned either 'short-staminate' flowers or flowers with an 'intermediate stamen-style relationship', is to be doubted. Examination of the three gatherings mentioned explicitly by Mendes showed one to be long-styled and one to be short-styled, while *Bullock 1340* (BR) is long-styled and *Bullock 1340* (K) is short-styled. The measurements reported by Mendes (1966) himself (long-staminate i.e. short-styled: stamens up to 10 and 7 mm, pistil up to 5 mm; short-staminate i.e. long-styled: stamens up to 7 and 5 mm, pistil up to 9 mm) also lead to the conclusion that only short- and long-styled specimens are in play. The absolute length of the pistils of short-styled flowers as reported by Mendes, 5 mm, is however intermediate between the absolute lengths of the styles of the long- and short-stamened (short- and long-styled) flowers mentioned by Hemsley (1956) (up to 3 and up to 6 mm respectively; ovary up to 2 mm long); this may explain the confusion.

According to Baker and Exell (1931: 249), followed by Schellenberg (1938: 96), Hemsley (1956: 7) and Mendes (1966: 620), there are in *B. prunoides* sometimes either one or three ovules. This could not be confirmed after the examination of all the herbarium material available for this study.

The ovules in *B. prunoides* are not erect, as mentioned by Schellenberg (1938: 96) nor are they hemitropous, as might be deduced from the illustrations in Hemsley (1956: 6; also in Mendes 1966: 621).

Cnestis Juss.

by R.H.M.J. Lemmens

History and subdivision of the genus

De Jussieu published *Cnestis* in 1789, based on Commerson-collections from Madagascar, without citing any species. A few months later Lamarck described 4 species, 2 from Madagascar, and 2 from W Africa, one of which belongs to *Agelaea*. De Candolle (1825) proposed another 7 species, four in *Cnestis*, two now placed in *Rourea*, and one in *Agelaea*. By the end of the 19th century the number of African species had strongly increased particulary due to new species proposed by Gilg. Some 20 years later this was repeated by Schellenberg. In 1938 Schellenberg cites 37 species in his monograph, including 2 Asiatic ones. In 1951 Troupin published another 5 species from Zaire.

Schellenberg (1910) divided the genus *Cnestis* initially into two subgenera: *Eucnestis* (= subgenus *Cnestis*) and *Ceratocnestis*, based on differences in shape and indumentum of the follicle and in petal length. In *Eucnestis* the follicle is obtuse at the apex and provided with short hairs, in *Ceratocnestis* it is beaked and provided with short and long, rigid hairs. The petals in *Eucnestis* are at most as long as the sepals, in *Ceratocnestis* they are generally longer, and if they are equal, the sepals are petaloid.

In 1938 Schellenberg reduced his subgenera to sections and divided each section into two subsections: *Eucnestis* in *Brevipetalae* and *Aequipetalae*, and *Ceratocnestis* in *Longipetalae* and *Macrosepalae*. His illegitimate lectotype species *C. corniculata* Lam. was placed in *Ceratocnestis* and this is not correct as the type-section of a genus, i.e. *Eucnestis* (= section *Cnestis*), should at least contain the type-species. As Schellenberg did not typify his infrageneric taxa, a formal lectotypification is presented here.

C. urens Gilg lectotypifies subgenus and section *Ceratocnestis* as well as subsection *Longipetalae*, that should consequently be named subsection *Ceratocnestis*. *C. congolana* De Wild. is the lectotype of the other subsection *Macrosepalae*. Subgenus and section *Eucnestis* as well as the subsection *Aequipetalae* are typified by the legitimate lectotype species *C. polyphylla* Lam., while all these infrageneric taxa should be called *Cnestis*. The last subsection *Brevipetalae* has *C. ferruginea* as lectotype.

In my opinion this subdivision cannot be supported as more varied combinations of the characters occur than Schellenberg allows in his sections. Some species have follicles with short indumentum combined with a distinct beak (*C. mildbraedii*, *C. mannii*), while *C. bomiensis* has follicles with short indumentum and flowers with petals longer than the sepals. Finally *C. yangambiensis* produces a follicle with a rigid indumentum but lacking a rostrum.

As it does not seem possible to distinguish well delimitated natural groups of species within *Cnestis*, I refrain from proposing any infrageneric classification above the species level (see also paragraph 10.2 on phylogeny of the genus *Cnestis*).

Description of the genus

Cnestis A.L. de Jussieu, Aug. 1789: 374; Lamarck, Oct. 1789: 23; Gmelin, 1791: 729; De Candolle, 1825: 86; Don, 1832: 91; Blanco, 1837: 385; Planchon, 1850: 440; Sonder, 1860: 527; Hooker f., 1862: 433; Baker, 1868: 460; Hooker f., 1876: 54; Baker, 1877: 64; Gilg, 1891a: 67; Lecomte, 1908: 43; Schellenberg, 1910: 10, 92; 1915: 318; 1938: 28; Troupin, 1952: 114; Hemsley, 1956: 2; Hepper, 1958: 742; Leenhouts, 1958b: 497; Keraudren, 1958: 16; Vidal, 1962: 12; Mendes, 1966: 615; 1969: 2; Liberato, 1980a: 6; 1980b: 6.
Type species: *C. polyphylla* Lam. See note.
Spondioides Smeathman, nomen in sched.; Lamarck, 1789: 23 (in syn.).
Thysanus de Loureiro, 1790: 284; De Candolle, 1825: 91. Type species: *T. palala* Lour. (= *Cnestis palala* (Lour.) Merr.).

Lianas, shrubs (usually climbing) or rarely small trees. *Branches* cylindric, sometimes ending in a tendrilloid tip. *Leaves* imparipinnate; leaflets opposite or not, entire, often asymmetric and often also acuminate. *Inflorescences* axillary, usually more than one together in the axil of a single leaf, sometimes pseudoterminal (then in axils of rudimentary leaves). *Flowers* in panicles, racemes or fascicles on the main stem, pentamerous, heterostylous, often heterodistylous, rarely more or less homostylous (*C. ferruginea*). *Pedicels* with a distinct joint, but not so in species with flowers in fascicles. *Sepals* more or less free, imbricate (mostly narrowly) or valvate in bud. *Petals* shorter, as long as or longer than sepals, free, white, yellowish or red tinged, imbricate in bud, glabrous or with some hairs outside near the base. *Stamens* 10 (two times 5), epipetalous ones mostly shorter than episepalous ones; filaments shortly united at base or free, glabrous. *Carpels* 5, free; styles often pilose at base. *Follicles* 1-5 in fruit, reddish, opening lengthwise along the ventral suture, densely tomentose, sometimes also with long rigid hairs outside, velutinous, sometimes with rigid hairs inside, beaked or not. *Seeds* solitary, attached to the base of the follicle, ovoid, with a yellow to red sarcotesta at base, surrounding the hilum; testa usually black and shiny; endosperm present, abundant; radicle apical; cotyledons thin, nervate.

A genus of 13 species restricted to tropical Africa, but one species in tropical Asia, usually found in rain forest, sometimes in savanna.

Note: Schellenberg (1938) has chosen *C. corniculata* Lam. as the type species of the genus. This choice is not legitimate. In the protologue of the genus de Jussieu cited exclusively material from Madagascar and Reunion (Commerson), that belongs in *C. polyphylla* Lam. Consequently the type species of the genus is *C. polyphylla* Lam.

Keys to the species

Three keys are presented here. Specimens are best identified when complete material, i.e. with flowers and fruits, is available. Material with either flowers or fruits is sometimes difficult to identify.

A. Key to specimens with flowers and fruits

1a Follicle outside with very short, spinelike hairs and long, easily caducous, stinging hairs 2
b Follicle outside with rather short, not stinging hairs 6
2a Flowers clustered in fascicles on nodose thickenings on the branches . 3
b Flowers in panicles or racemes on the stems and branches 4
3a Leaves 6-10-jugate; terminal leaflet 4.5-7.5 × 2-3.5 cm; leaflets glabrous above, except the midrib; follicle hook-shaped, with broad beak **C. uncata**
b Leaves 12-21-jugate; terminal leaflet 2-3 × 0.5-1 cm; leaflets scattered pilose above; follicle not hook-shaped, with slender beak . . . . **C. urens**
4a Petiolules 8-11 mm long, blackish . . . . **C. macrophylla**
b Petiolules up to 5 mm long, usually not blackish 5
5a Follicle with distinct 5-30 mm long beak . . . . **C. corniculata**
b Follicle without a beak, apex obtuse or somewhat acute **C. yangambiensis**
6a Inflorescences all or at least partly on older branches (ramiflorous), a few to many in the same axil of (fallen) leaves; petals (ob)ovate or elliptic to narrowly oblong, (much) shorter to somewhat longer than sepals; anthers without an appendix. Species from Asia . . . . **C. palala**
b Above characters not associated. Species from Africa 7
7a Petals circular, elliptic or (ob)ovate, at most half as long as the sepals . 8
b Petals (ob)ovate to narrowly oblong, (much) more than half as long as the sepals 10
8a Petals circular to very broadly obovate; anthers with an appendix at base; follicle rounded or truncate at base . . . . **C. ferruginea**
b Petals obovate or elliptic; anthers without an appendix at base; follicle cuneate or rounded at base 9
9a Leaves 2-5-jugate . . . . **C. mannii**
b Leaves 10-17-jugate . . . . **C. macrantha**
10a Follicle up to 3 cm long, not beaked or with a short, up to 4 mm long beak 11
b Follicle 3-6.5 cm long, beak longer than 4 mm (very rarely shorter), slender and distinct or broad and less sharply distinct 12
11a Leaves 1-2-, rarely 3-jugate; lateral leaflets circular to ovate, with 2-5 nerves on each side of the midrib. W African species . . . . **C. racemosa**
b Leaves 4-14-jugate; lateral leaflets (narrowly) ovate, elliptic or oblong, with 6-12 nerves on each side of the midrib. E African species . . **C. polyphylla**
12a Sepals reflexed; petals distinctly longer than sepals; follicle with an indistinct, broad beak. Species of Liberia . . . . **C. bomiensis**

b Sepals not reflexed; petals about as long as sepals. Follicle with a distinct, slender beak. Species from the eastern part of central Africa **C. mildbraedii**

B. Key to flowering specimens

1a Flowers clustered in fascicles on nodose thickenings on the branches . 2
b Flowers in panicles or racemes on the stems, branches or pseudoterminal 3
2a Leaves 6-10-jugate; terminal leaflet 4.5-7.5 × 2-3.5 cm; leaflets densely pilose with curled hairs beneath, glabrous above except for the midrib . . . . **C. uncata**
b Leaves 12-21-jugate; terminal leaflet 2-3 × 0.5-1 cm; leaflets densely pilose with erect hairs beneath, scattered pilose above . . . . **C. urens**
3a Petiolules 8-11 mm long, blackish . . . . **C. macrophylla**
b Petiolules up to 5(-6) mm long, usually not blackish 4
4a Petals circular, elliptic or (ob)ovate, at most half as long as the sepals . 5
b Petals (ob)ovate to narrowly oblong, (much) more than half as long as the sepals 8
5a Petals circular to very broadly obovate, anthers with an appendix at the base . . . . **C. ferruginea**
b Petals obovate or elliptic, anthers without an appendix 6
6a Inflorescences all or at least partly on older branches (ramiflorous), a few to many in the same axil of (fallen) leaves; species from Asia . . **C. palala**
b Inflorescences only on the apical part of young branches, single in the axils of young or reduced leaves; species from central Africa 7
7a Leaves 2-5-jugate; inflorescence a large panicle, up to 40 cm long . . . . **C. mannii**
b Leaves 10-17-jugate; inflorescence a raceme or panicle, up to 25 cm long . . . . **C. macrantha**
8a Sepals not reflexed 9
b Sepals reflexed 11
9a Sepals pubescent inside, pilose outside, usually with many glandular hairs; species from Asia . . . . **C. palala**
b Sepals glabrous inside, rarely minutely pubescent, but then outside lacking glandular hairs; species from Africa 10
10a Liana or lianescent shrub; bracts 1-2 mm long; pedicel short, articulation 0-2 mm below the calyx; petals obtuse or indistinctly retuse at top . . . . **C. corniculata**
b Shrub; bracts 2.5-3 mm long; pedicel longer, articulation 2-3 mm below the calyx; petals distinctly retuse at top; species from the eastern part of central Africa . . . . **C. mildbraedii**
11a Leaves 1-2-, rarely 3-jugate; lateral leaflets circular to ovate, with 2-5 nerves on each side of the midrib . . . . **C. racemosa**
b Leaves 3-20, rarely 2-jugate; lateral leaflets ovate to narrowly oblong, with 5-15 nerves on each side of the midrib 12

12a Petals obovate, somewhat shorter than sepals, often with some hairs outside at base; species of Madagascar, SE Africa and S Kenya **C. polyphylla**
b Petals narrowly obovate to narrowly oblong, at least as long as, but mostly longer than sepals; petals glabrous 13
13a Leaflets (thinly) coriaceous, tertiary nerves prominent above; Liberian species . . . . **C. bomiensis**
b Leaflets papery, tertiary nerves usually not prominent above 14
14a Leaves (2-)3-13-, rarely more jugate . . . . **C. corniculata***
b Leaves 13-20-jugate; species only collected near Yangambi (Zaire) . . . . **C. yangambiensis***

*Flowering specimens of *C. corniculata* and *C. yangambiensis* collected near Yangambi cannot be separated with complete certainty.

C. Key to fruiting specimens

1a Follicle outside with very short, spinelike hairs and long, easily caducous, stinging hairs 2
b Follicle outside with rather short, not stinging hairs 6
2a Follicles in fascicles; fruit-stalk attached to nodose thickenings on the branches 3
b Follicles in racemes, rarely in panicles 4
3a Follicle hook-shaped, beak broad, 10-13 mm long, strongly curved towards the ventral side of the follicle; leaves 6-10- jugate, terminal leaflet 4.5-7.5 × 2-3.5 cm, leaflets densely pilose beneath with curled hairs, glabrous above, except the midrib . . . . **C. uncata**
b Follicle not hook-shaped, beak slender, (8-)12-30 mm long, curved or involute at apex only; leaves 12-21-jugate, terminal leaflet 2-3 × 0.5-1 cm, leaflets densely pilose with erect hairs beneath, scattered pilose above **C. urens**
4a Petiolules 8-11 mm long, blackish . . . . **C. macrophylla**
b Petiolules up to 5 mm long, usually not blackish 5
5a Follicle with distinct 5-30 mm long beak; leaves (2-)3-13-, rarely more jugate . . . . **C. corniculata**
b Follicle without a beak, apex obtuse or somewhat acute; leaves 13-20-jugate . . . . **C. yangambiensis**
6a Specimens from SE Asia . . . . **C. palala**
b Specimens from Africa 7
7a Follicle up to 3 cm long, not beaked or with a short, up to 4 mm long beak 8
b Follicle (2-)3-6.5 cm long, beak longer than 4 mm (very rarely shorter, but then follicle longer than 3 cm), slender and distinct or broad and less sharply distinct 9
8a Leaves 2-3-jugate, lateral leaflets circular to ovate with 2-5 lateral nerves on each side of the midrib . . . . **C. racemosa**
b Leaves 4-21-jugate, lateral leaflets ovate to narrowly oblong with (5-)6-15

lateral nerves on each side of the midrib . . . . **C. polyphylla**
9a Leaves 6-10-jugate, leaflets coriaceous, 2-8 × 1-2.5 cm, with distinct tertiary nerves above; follicle 3-3.5 × 1.5 cm, cuneate to somewhat rounded at base, with an indistinct beak; species of Liberia . . . . . . **C. bomiensis**
b Above characters not associated 10
10a Follicle truncate or rounded at base, with a broad, blunt, indistinct beak 11
b Follicle cuneate at base, usually with a rather slender, distinct beak . . 12
11a Leaflets pilose above with scattered, whitish hairs; sepals 5-6.5 mm long; bracts 3-5 mm long . . . . **C. macrantha**
b Leaflets usually glabrous above, except midrib, rarely all over pilose; sepals 2-4 mm long; bracts 1-2 mm long . . . . **C. ferruginea**
12a Leaves 2-5-jugate, lateral leaflets ovate to elliptic, glabrous above, but midrib often pilose . . . . **C. mannii**
b Leaves 6-21-jugate, lateral leaflets ovate to narrowly oblong, often pilose above (especially when young) . . . . **C. mildbraedii**

Cnestis bomiensis Lemmens **sp. nov.** **Fig. 76, 77**

Frutex scandens vel liana ramulis juventute pubescentibus demum glabrescentibus. Folia imparipinnata, 6-10-juga. Foliola coriacea, lateralia inferiora elliptica, superiora anguste oblonga, 2-8 × 1-2.5 cm, basis rotundata vel subcordata; foliolum terminale obovatum vel ellipticum, 3-8 × 1.5-3 cm, basi cuneatum vel rotundatum; foliola supra nitida, glabra (sed costa pilosa), subtus dense pilosa. Inflorescentia racemosa, 1.5-2.5 cm longa. Pedicelli articulati. Sepala reflexa, triangulata vel oblonga, 2-2.5 × 0.8-1 mm, extra pilosa, intra glabra. Petala anguste obovata, 3.5-4.5 × 0.6-0.8 mm, glabra. Stamina subaequalia. Folliculus 3-3.5 × 1.5 cm, rostro lato indistincto, extus pubescens, intus hispidus.

Type: Liberia, 9 km E of Yoma, 20 km NE of Bomi Hills, *Leeuwenberg 4885* (holo: WAG).

Liana. *Branches* cylindric, branchlets densely brown-pilose, later glabrescent. *Leaves* 6-10-jugate; petiole 2.5-5.5 cm, rachis 4-19 cm long, brown-pilose. Leaflets leathery, lateral ones opposite or nearly so, elliptic to narrowly oblong, 2-8 × 1-2.5 cm, rounded to subcordate and not or hardly unequal at base, terminal one obovate or elliptic, 3-8 × 1.5-3 cm, rounded or cuneate at base; all leaflets acute, obtuse or retuse, glabrous (except the midrib) above, densely brown-pilose beneath, midrib impressed above, prominent beneath, with 8-15 lateral nerves on each side, tertiary nerves reticulate, distinct on both sides; petiolules very short, up to 1 mm long, densely pilose. *Racemes* 1-3 per leaf-axil on young branches, 1.5-2.5 cm long, sometimes the supporting leaves reduced resulting in a compound pseudoterminal inflorescence, 5-10-flowered, densely brown-pilose. Bracts ovate to (narrowly) triangular, 1-2 mm long. *Pedicels* indistinctly articulated 0-1 mm below the calyx, brown-pilose. *Sepals* reflexed, valvate to

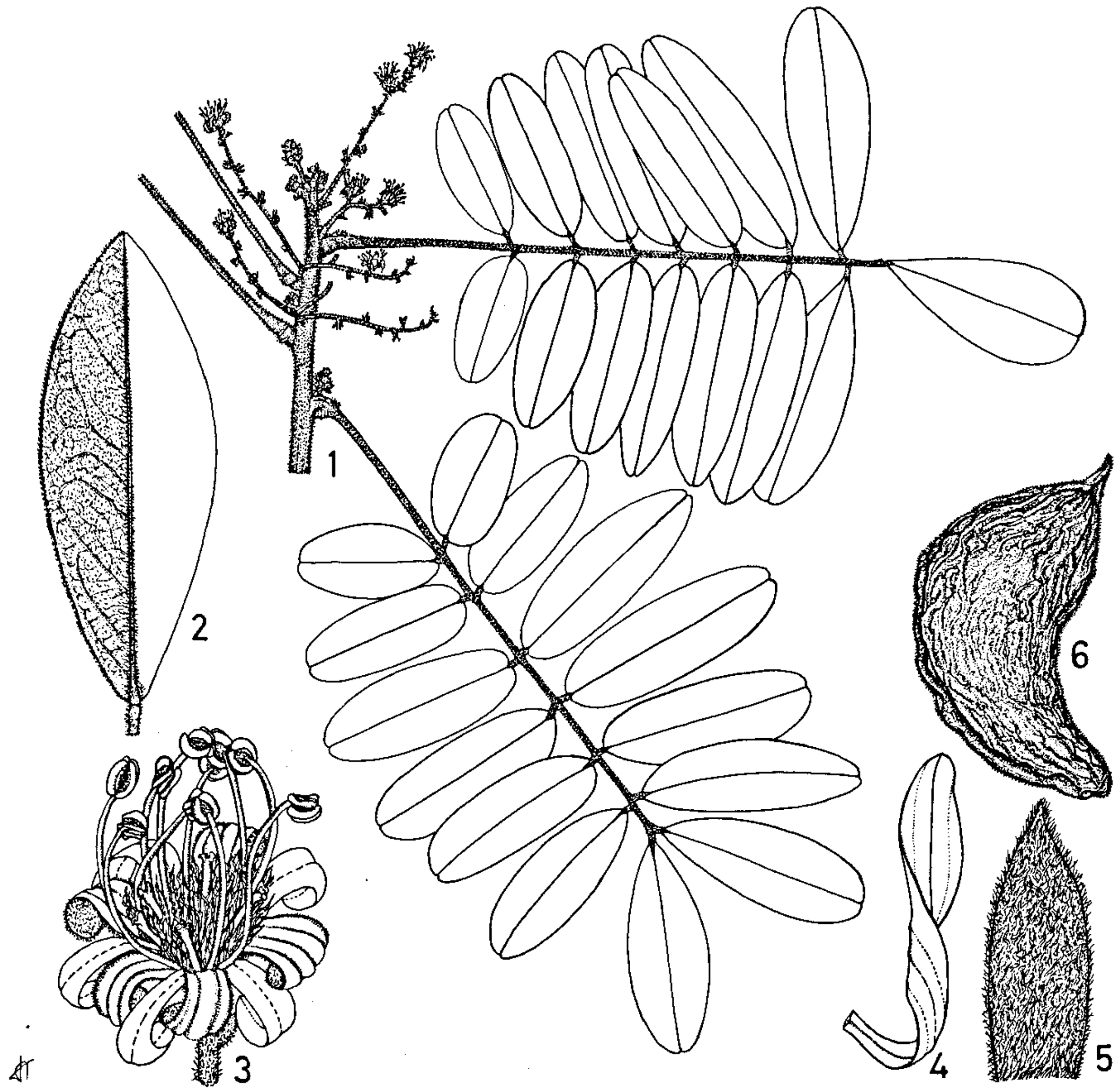


Fig. 76. *Cnestis bomiensis*: 1. flowering branch, 2/3 ×; 2. leaflet beneath, 2/3 ×; 3. flower, 6 ×; 4. petal, 10 ×; 5. sepal, 10 ×; 6. follicle, 1 × (1,3-5. *Leeuwenberg 4885*; 2,6. *Jansen 2288*).

narrowly imbricate in bud, triangular to oblong, 2.0-2.5 × 0.8-1.0 mm, acute at top, densely brown-pilose also with glandular hairs outside, glabrous inside. *Petals* valvate or narrowly imbricate in bud, narrowly obovate, 3.5-4.5 × 0.6-0.8 mm, cuneate at base, obtuse to retuse at top, glabrous. *Stamens* free, subequal, 3-4 mm long, anthers 0.3 × 0.2 mm. *Pistils* 1.1-1.4 mm long; ovaries ca 0.5 mm long, brown-pilose; styles straight, pilose at base; stigmata oblique, indistinctly 2-lobed. *Follicles* oblique-ellipsoid, 3-3.5 × 1.5 cm, cuneate at base; beak broad and indistinct, 2-5 mm long; pericarp velvety outside, with long, stiff, deciduous, yellowish brown hairs inside. *Seeds* (ob)ovoid, 15-20 × 7-11 mm, sarcotesta 6 mm long.

Distribution: Liberia.

Ecology: Secondary rain forest. Flowering around August, fruiting a few months later.

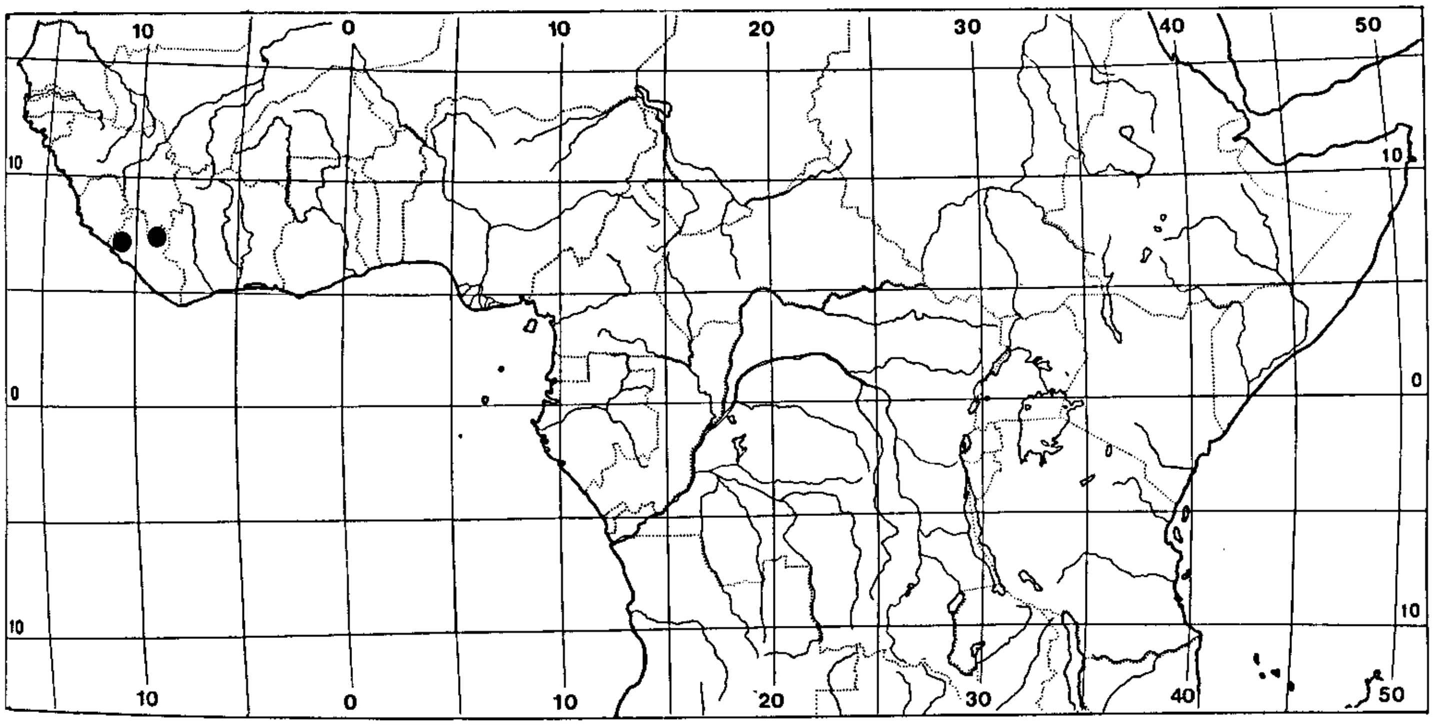


Fig. 77. Distribution of *Cnestis bomiensis*

Specimens examined:

Liberia: Ganta (fr. Nov.) *Adam 30209* (K); 5 miles N of Bomi Hills (fr. Nov.) *Jansen 2288* (WAG); 9 km E of Yoma, 20 km NE of Bomi Hills (fl. Aug.) *Leeuwenberg 4885* (WAG, type).

Notes: 1. This species is very well characterized by the combination of relatively long petals and follicles lacking stinging hairs. Three other species are found in Liberia: *C. racemosa*, *C. corniculata*, and *C. ferruginea*. From *C. racemosa* it can be easily distinguished by its more numerous, narrower leaflets, from both the other species by its leaves being of a more leathery nature and showing distinct tertiary nerves. It differs from *C. ferruginea* by the distinctly longer petals and follicles with an obvious cuneate base, and from *C. corniculata* by the absence of stinging hairs.

2. It is not known whether heterostylous flowers occur in this species, as in the specimens examined only a single type of flowers is found.

Cnestis corniculata Lam. **Fig. 78-82**

C. corniculata Lamarck, 1789: 23; De Candolle, 1825: 87; G. Don, 1832: 91; Hooker, 1849: 290; Planchon, 1850: 440; Walpers, 1852: 306; Baillon, 1867: 241; Baker, 1868: 461; De Lanessan, 1886: 794; Hiern, 1896: 190; Schellenberg, 1910: 15; 1915: 320; Chevalier, 1920: 166; Schellenberg, 1938: 48; Hepper, 1958: 743; Adam, 1971: 868, pl.404; Berhaut, 1975: 25; Liberato, 1980a: 7.

Type: Sierra Leone, *Smeathman s.n.* (lecto herb. de Jussieu: P; iso: BM). See note 2.

C. grisea Baker, 1868: 461; Gilg, 1891a: 67, fig. 37f; Schellenberg, 1910: 17;

1915: 320; Chevalier, 1920: 167; Schellenberg, 1938: 48; Hepper, 1958: 743; Irvine, 1961: 572. Type: Nigeria, Old Calabar, *Thomson 90* (holo: K; iso: E).

C. ferruginea DC. var. *pilosa* Dewèvre, 1894: 98 (nomen).

C. calocarpa Gilg, 1895b: 192; Schellenberg, 1910: 17; 1915: 320; 1938: 46; Brenan, 1949: 168; Hemsley, 1956: 5. Type: Tanzania, Uzaramo Distr., Mgambo, *Stuhlmann 6388* (holo: B†), neo: Ulanga Distr., Funga, Ifakara, *Haerdi 514/0* (BR, G, K, WAG).

C. confertiflora Gilg, 1895b: 193; Schellenberg, 1910: 17; 1915: 320; 1938: 45; Brenan, 1949: 168; Hemsley, 1956: 4, fig.1. Type: Tanzania, Uzaramo Distr., Kisserawe, *Stuhlmann 6262* (holo: B†), neo: Dar es Salaam, *Peter 44838* (B).

C. confertiflora Gilg f. *macrophylla* Schellenberg, 1938: 45. Type: Tanzania, Pugu Hills, *Holtz 2059* (holo: B†), neo: Pugu Hills F.R., *Wingfield & Lucas 1949* (WAG).

C. grandiflora Gilg, 1895a: 70; Durand & Durand, 1909: 121; De Wildeman, 1912: 407; 1929: 539; Schellenberg, 1938: 50; Troupin, 1952: 125; Exell & Mendonça, 1954: 139. Type: Angola, Lunda, between Chicapa and Luachimo rivers, *Marques 266* (holo: B†; lecto: LISU; iso: BM, COI). See note 3.

C. iomalla Gilg, 1895a: 69; De Wildeman, 1905: 91; 1906: 247; 1909: 96; Durand & Durand, 1909: 121; De Wildeman, 1910b: 188; 1912: 407; Schellenberg, 1915: 320; De Wildeman, 1916: 244; Exell, 1928: 94; De Wildeman, 1929: 539; 1931: 236; Schellenberg, 1938: 50; Gossweiler & Mendonça, 1954: 140. Type: Zaire, Baschilange, Mukenge, *Pogge 930* (holo: B†), neo: Stanley Pool, *Demeuse 227* (BR).

C. iomalla Gilg var. *grandifoliolata* De Wildeman, 1906: 247; Durand & Durand, 1909: 121; De Wildeman, 1910a: 294. Type: Zaire, Madibi, *Lescrauwaet 115* (holo: BR).

C. setosa Gilg, 1895a: 70; Durand & Schinz, 1896: 102; Durand & De Wildeman, 1898: 113; De Wildeman & Durand, 1899b: 18; De Wildeman & Durand, 1901b: 10; De Wildeman & Durand, 1901a: 56; Durand & Durand, 1909: 121; De Wildeman, 1912: 407; 1920: 142, 244. Type: Zaire, Luculla (= Lukula), *Laurent s.n.* (holo: BR).

C. aurantiaca Gilg, 1896: 216; Schellenberg, 1915: 320; 1938: 50; Hepper, 1958: 743. Type: Cameroun, Yaoundé, *Zenker & Staudt 652* (holo: B†; lecto: BM; iso: K).

C. polyantha Gilg, 1896: 215; Durand & Durand, 1909: 121. Type: Zaire, Baschilange, Musumba, *Pogge 147* (holo: B†), neo: Kikwit, *Vanderyst 2892* (BR).

C. riparia Gilg, 1896: 217; Schellenberg, 1910: 17; 1915: 320; 1938: 45; Brenan, 1949: 168. Type: Tanzania, Uluguru Foothills, Luhangulo, *Stuhlmann 8942* (holo: B†), neo: Msalwa Estate, *Carmichael 126* (K; iso: EA). See note 4.

C. emarginata De Wildeman & Durand, 1899d: 81; 1900b: 129, pl.65; 1901: 56. Type: Zaire, near Stanley Pool, *Dewèvre 715b* (holo: BR).

C. lescrauwaetii De Wildeman, 1906: 247; Durand & Durand, 1909: 121; De Wildeman, 1910a: 294; Exell, 1928: 95; De Wildeman, 1929: 540; Schellenberg, 1938: 44; Gossweiler & Mendonça, 1939: 90; Troupin, 1952: 118; Exell & Mendonça, 1954: 139. Type: Zaire, Madibi, *Lescrauwaet 88* (holo: BR).

C. congolana De Wildeman, 1909: 96; Schellenberg, 1915: 319; De Wildeman, 1929: 538; Exell, 1928: 94; Schellenberg, 1938: 52; Gossweiler & Mendonça, 1939: 55; Troupin, 1952: 116; Exell & Mendonça, 1954: 140; Hepper, 1958: 743. Type: Zaire, sin. loc., *Cabra s.n.* (holo: BR).

C. pynaertii De Wildeman, 1909: 98; 1929: 540; Schellenberg, 1938: 47; Troupin, 1952: 124. Type: Zaire, Lukolela, *Pynaert 168* (holo: BR).

C. sapinii De Wildeman, 1909: 98; Schellenberg, 1938: 45; Troupin, 1952: 117. Type: Zaire, Sankuru, *Sapin s.n.* (holo: BR).

C. sapinii De Wild. var. *claessensii* (De Wild.) Troupin, 1952: 118. For type see under *C. claessensii.*

C. leucantha Gilg ex Schellenberg, 1910: 18; 1919: 439; 1938: 47. Type: Cameroun, Bipindi, *Zenker 2157* (holo: B; iso: BM, E, G, K, L, MO, P, WAG, Z).

C. trichopoda Gilg ex Schellenberg, 1910: 18. Type: Cameroun, Bipindi *Zenker 2335* (lecto: B, BM, BR, E, G, K, L, M, MO, P, WAG, Z).

C. claessensii De Wildeman, 1911a: 258; 1912: 406; 1929: 538; Schellenberg, 1938: 44. Type: Zaire, Lokandu, *Claessens 473* (lecto: BR).

C. angolensis Schellenberg, 1915: 320 (nomen).

C. calantha Schellenberg, (1915: 320, nomen) 1919: 439; 1938: 47. Type: Cameroun, Grand Batanga, *Dinklage 814* (holo: B†; lecto: P).

C. cinnabarina Schellenberg, 1919: 438; 1938: 46; Hepper, 1958: 743. Type: Cameroun, Bipindi, *Zenker 1944* (holo: B†; lecto: G; iso: BM, E, K).

C. dinklagei Schellenberg, 1919: 437; 1938: 45; Hepper, 1958: 743. Type: Liberia, Monrovia, *Dinklage 2412* (holo: B). See note 5.

C. gabunensis Schellenberg, 1919: 440; Exell, 1928: 94; De Wildeman, 1929: 539; Schellenberg, 1938: 48; Gossweiler & Mendonça, 1939: 55; Troupin, 1952: 120; Exell & Mendonça, 1954: 139. Type: Gabon, Libreville, Sibange, *Soyaux 143* (holo: B†; lecto: Z; iso: GOET, K, P).

C. longiflora Schellenberg, 1919: 438; 1938: 46; Hepper, 1958: 743; Irvine, 1961: 572. Type: Nigeria, Lagos, Amuge, *Dawodu 194* (holo: B†; lecto: K).

C. zenkeri Schellenberg, (1915: 320, nomen) 1919: 441. Type: Cameroun, Bipindi, *Zenker 2060* (holo: B†; lecto: WAG; iso: E, G, K, L, MO, P, Z).

C. prehensilis Chevalier, 1920: 167 (nomen).

C. leucanthoides Pellegrin, 1923: 109. Type: Gabon, Tchibanga, *Le Testu 1037* (holo: P).

C. agelaeoides Schellenberg, 1938: 52. Type: Gabon, near Libreville, *Klaine 3508* (holo: P).

C. gimbiensis Troupin, 1951: 371; 1952: 125. Type: Zaire, Bas-Congo, Gimbi Valley, *Toussaint 790* (holo: BR).

C. hirsuta Troupin, 1951: 368; 1952: 117. Type: Zaire, Yangambi, *J. Louis 4286a* (lecto: BR). See note 6.

C. mullendersii Troupin, 1951: 370; 1952: 124. Type: Zaire, Bas-Katanga, Tshibonde, *Mullenders 2051* (holo: BR).

C. vanderystii Troupin, 1951: 123. Type: Zaire, Bas-Katange, Merode, *Vanderyst 22988* (holo: BR).

Agelaea pruriens Solander, nomen in sched.; Planchon, 1850: 440 (in syn.).

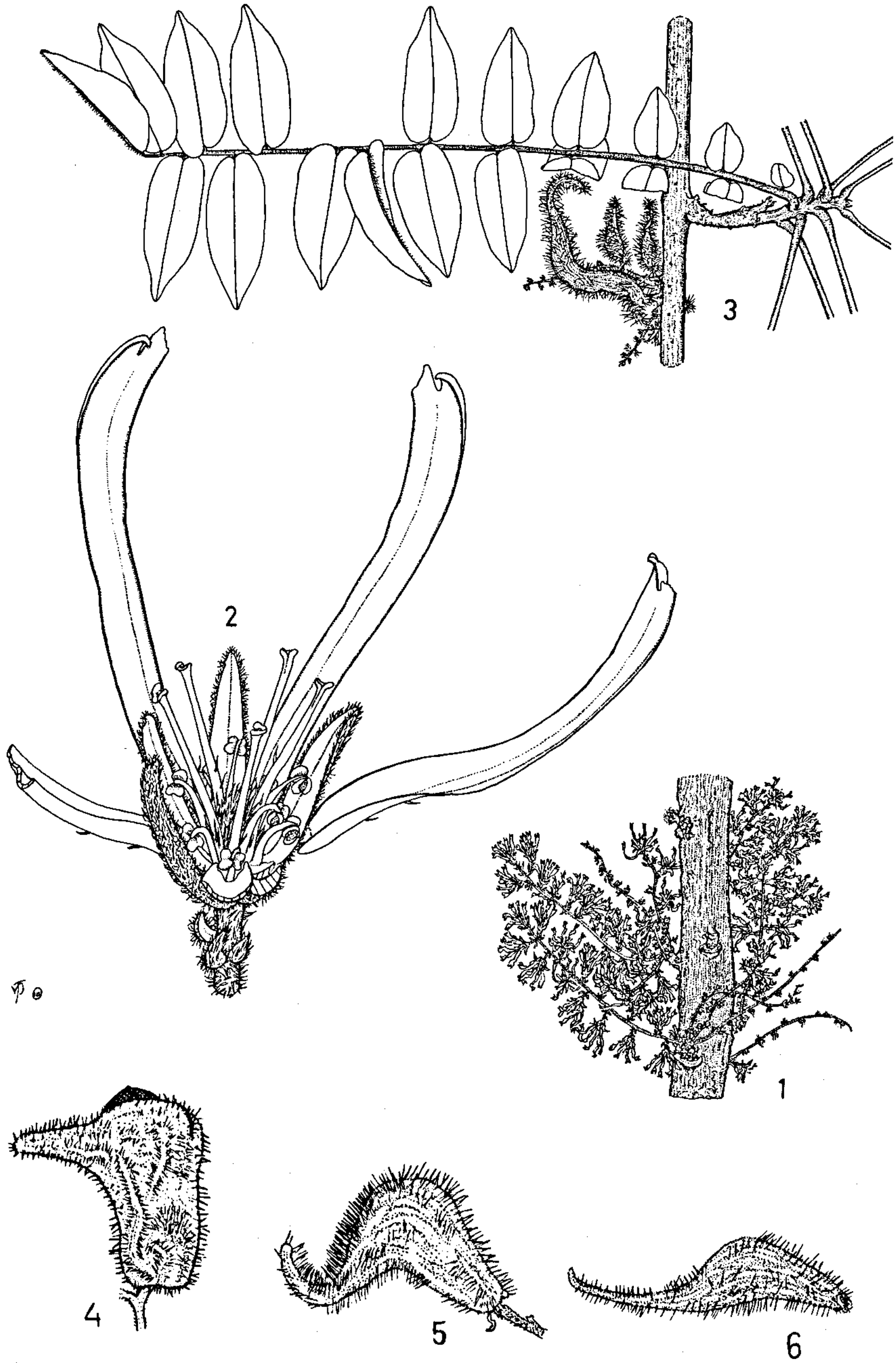


Fig. 78. *Cnestis corniculata*: 1. flowering branch, 2/3 ×; 2. flower partly, 10 ×; 3. branch with immature follicles, 2/3 ×; 4-6. follicles, 1 × (4 former *C. iomalla*, 5 former *C. lescrauwaetii*, 6 former *C. confertiflora*; 1-3. *Breteler & Lemmens 8420*; 4. *Breteler 6404*; 5. *Breyne 2947*; 6. *Mgaza 756*).

Spondioides pruriens Smeathman, nomen in sched.; Lamarck, 1789: 23 (in syn.).

Liana, often small, sometimes up to 20 m long. *Branches* cylindric, branchlets often somewhat angular, brown- or yellow-pilose or more or less glabrous. *Leaves* 2-13(-18)-jugate; petiole 0.2-10(-18) cm, rachis 5-40 cm long, grey-, brown- or yellow-pubescent, later more or less glabrous, often except at base of petiole. Leaflets (stiffly) papery, lateral ones opposite or not, ovate to narrowly oblong, (0.5-)1-15(-30) × 0.5-7.5(-13) cm, rounded or (sub)cordate and usually unequal at base, terminal one (narrowly) ovate or obovate to (narrowly) elliptic, 4-15(-30) × 1.5-7.5(-15) cm, rounded or somewhat cuneate at base; all leaflets acuminate or sometimes obtuse or rounded, glabrous or more or less pilose above, glabrous to densely pilose beneath, midrib impressed above, prominent beneath, with 5-15(-20) lateral nerves on each side; tertiary nerves reticulate, more or less distinct; petiolules 0-5 mm long, pilose or rarely glabrous. *Inflorescences* racemes or rarely panicles, 1-20 per leaf-axil on stem, old or young branches, 1-15(-25) cm long, 5-40-flowered, densely yellowish brown-pilose, rarely also with reddish brown glandular hairs. Bracts ovate to subulate, 1-2 mm long, curved. *Pedicels* articulated 0-2 mm below the calyx, densely pilose. *Flowers* heterodistylous. *Sepals* usually distinctly reflexed (sometimes not), valvate or narrowly imbricate in bud, ovate to subulate or (narrowly) oblong, (2.0-)2.5-6.0(-8.5) × 0.5-1.0(-2.5) mm, acute, sometimes obtuse at top, densely pilose, sometimes also with glandular hairs outside, glabrous inside, often indistinctly up to 5(-10)-veined. *Petals* valvate or narrowly imbricate in bud, (narrowly) oblong to elliptic, sometimes almost linear, 3.0-9.5 × 0.5-1.0(2.0) mm, rounded to cuneate at base, obtuse, rounded or retuse and often inflexed at top, glabrous, distinctly up to 3(-7)-veined. *Stamens* more or less united at base, usually distinctly differing in length in the two whorls, 0.5-5.0(-6.0) mm long, anthers 0.2-0.3 × 0.1-0.2 mm. *Pistils* 1.0-5.0 (but rarely between 2.0 and 3.0) mm long; ovaries ca 0.5 mm long, golden brown-pilose; styles mostly straight, pilose at base; stigmata usually oblique, more or less distinctly 2-lobed. *Follicles* 1-2(-4) in fruit, (narrowly) ellipsoid, more or less oblique, 2.5-4.5(-5) × 0.5-1.2 cm, cuneate, mostly with 5-10 mm long stipe; beak slender, straight or curved, 5-20(-30) mm long; pericarp with very short, red, spinelike hairs and long, easily caducous, stinging hairs outside and with long, slender hairs inside. *Seeds* ovoid, 10-15(-17) × 5-10 mm, sarcotesta 5-8 mm long, ruminate. *Seedling* epigeal.

Distribution: Tropical Africa from S Senegal to E Tanzania, and south to N Angola.

Ecology: Rain forest, semi-deciduous forest, thickets. Flowering in West Africa mainly from May to November, in Cameroun from January to May, in Gabon from August to November, in Zaire during the whole year, but most often from December to February and from June to October, in Angola from December to April and in Tanzania from April to June.

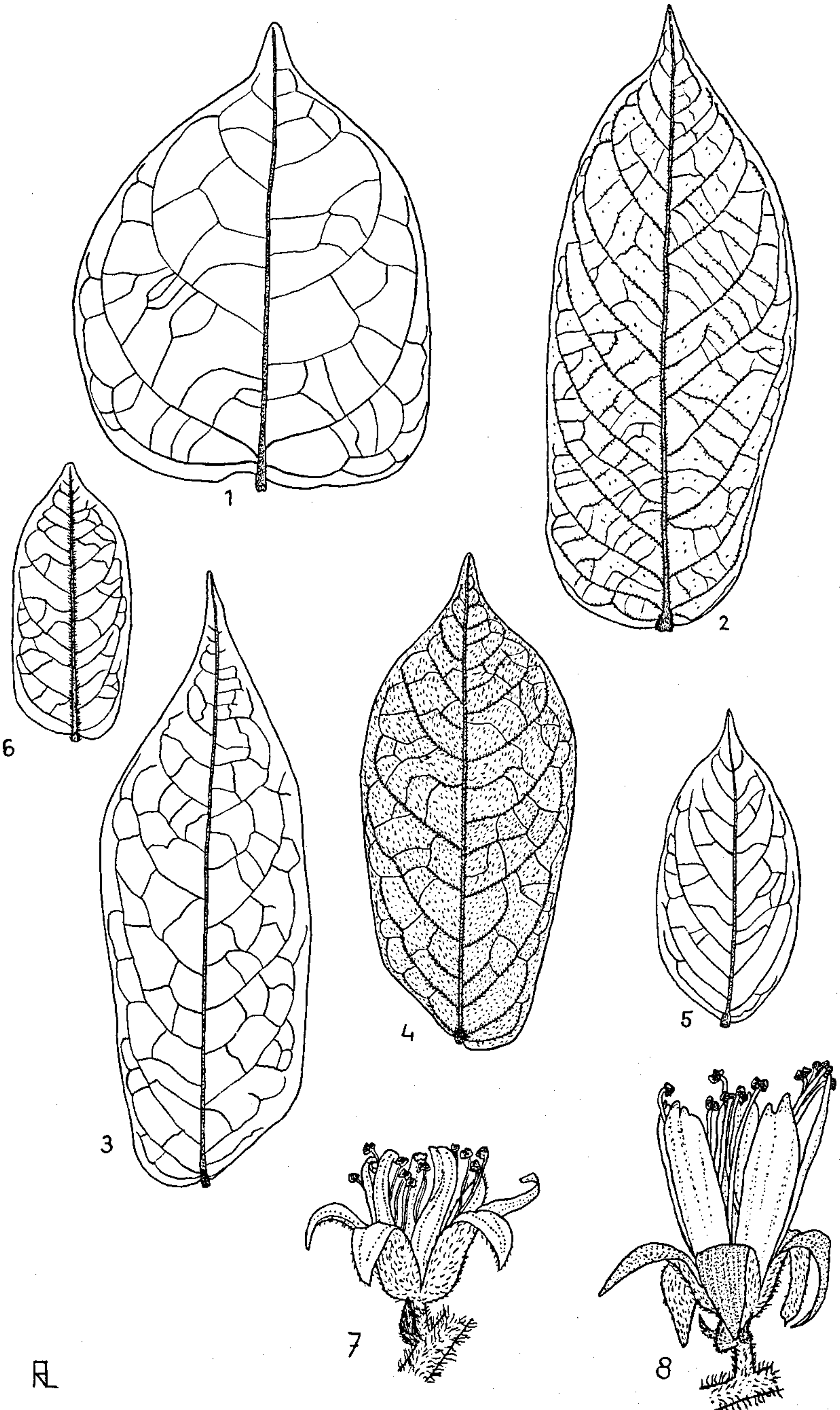


Fig. 79. *Cnestis corniculata*: 1-6. leaflets beneath, 2/3 × (1 former *C. agelaeoides*, 2 former *C. gabunensis*, 3 former *C. sapinii*, 4 former *C. pynaertii*, 5 former *C. cinnabarina*); 7-8. flowers, 6 × (7 former *C. dinklagei*, 8 former *C. aurantiaca*; 1. *Klaine 3508*; 2. *Monteiro & Murta 133*; 3. *Sapin s.n.*; 4. *Pynaert 168*; 5. *Zenker 1944*; 6. *d'Orey 386*; 7. *Leeuwenberg 4010*; 8. *Bos 6896*).

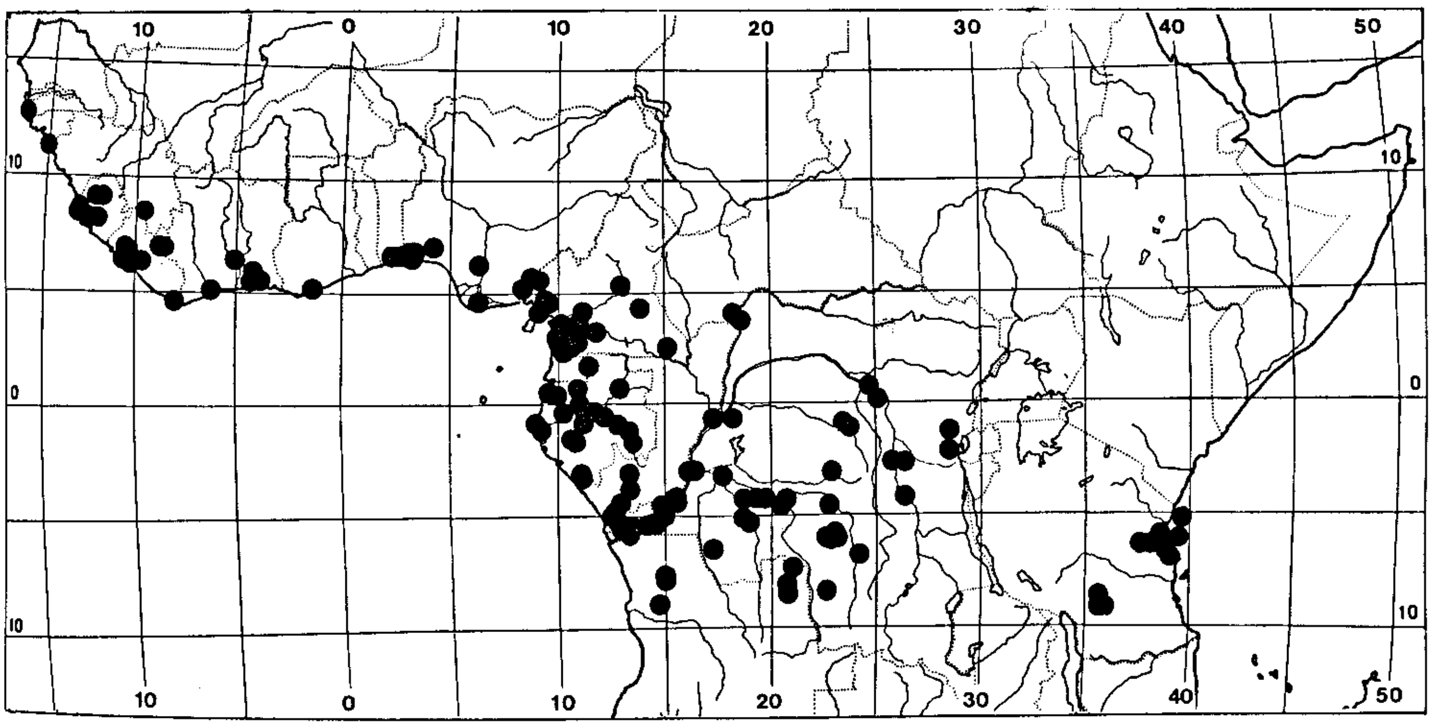


Fig. 80. Distribution of *Cnestis corniculata*

Selection of the ca 600 specimens examined:

Senegal: Basse Casamance, Oussouye (fl. Nov.) *Berhaut 6598* (M); sin. loc. (y.fr.) *Heudelot 650* (G, P).

Guinea-Bissau: Cantanhez (fr. Apr.) *d'Orey 386* (COI, LISC, LISU); Cacine (fl., fr. Sept.) *Esperito Santo 636* (COI).

Guinea: Dyeke (fl. Oct.) *Baldwin 9668* (K); near Macenta (fl. Sept.) *Jacques-Félix 1245* (P).

Sierra Leone: sin. loc., *Afzelius s.n.* (BM); Freetown (fr. Mar.) *Dalziel 1007* (K, P); Lester Peak (fr. Dec.) *Scott Elliot 3831* (BM, K); sin. loc. (fr.) *Smeathman s.n.* (BM, P, type); Mamaha (fl.) *N. Thomas 4527* (K).

Liberia: sin. loc. (fr. Feb.) *Adam 20833* (K); Lamco (fl. Oct.) *Adames 624* (K); Mecca (fr. Dec.) *Baldwin 10796* (K); Brewersville (fl. June) *Barker 1325* (K); Monrovia (fr. Jan.) *Dinklage 2412* (B, type of *C. dinklagei*); Virginia (fl. May) *Dinklage 2712* (B, Z); near Sasala, Gibi Mt (fr. Nov.) *Jansen 1753* (WAG); Gbanga (fr. Sept.) *Linder 652* (K, WAG); Peahtah (fl. Oct.) *Linder 957* (K, WAG).

Ivory Coast: Bouroukrou (fr. Dec) *Chevalier 16884* (K, P); Adiopodoumé, Banco F.R. (fr. Nov.) *de Koning 2849* (WAG); 16 km NW of Sassandra (fl., y.fr. June) *W. de Wilde 227* (WAG); Sassandra (fl. Apr.) *Leeuwenberg 4010* (B, BR, WAG); Toumodi (fr Jan.) *Roberty 13543* (G); 15 km N of Abidjan (fl. May) *Versteegh & den Outer 124* (BR, WAG).

Ghana: near Cape Coast (fr. Sept.) *Hall 1573* (K, P); sin. loc. (fl.b. Apr.) *Hall 2508* (K).

Benin: Porto Novo (fr. Jan.) *Chevalier 22828* (P); Dogboe (fl. Sept.) *Le Testu 201* (BM, P); 8 km S of Adjohon (fr. Dec.) *van der Zon 296* (WAG).

Nigeria: Ibadan (fr. Feb.) *Brenan & Keay 8974* (BM, P); Lagos (fl., fr. Nov.) *Dalziel 1155* (C, E, K, M); Lagos (fl.) *Dawodu 194* (K, type of *C. longiflora*); Benin Prov., Gagbe (fl. Aug.) *Hambler 396* (K); Ibadan (fl. Sept.) *Tamajong FHI 20964* (K, P); Ibadan (fl. Sept.) *Latilo FHI 7923* (K, P); Calabar Prov., Oban Distr., Orem (fl. Mar.) *Onochie FHI 36476* (K); Oban (fl.) *Talbot 507* (BM, K); Degema (fl.) *Talbot s.n.* (BM); Old Calabar (fl.) *Thomson 90* (E, K, type of *C. grisea*); 13 km W of Ilugun (fr. Mar.) *van Meer 670* (WAG).

Cameroun: Bitye, Yaoundé (fl.) *Bates 901* (BM, MO); Kumba Distr., Banga F. R. (fl. Mar.) *Binuyo & Daramola FHI 35605* (K); 6 km S of Kribi (fr. Nov.) *Bos 3216* (K, WAG); 9 km S of Kribi (fl. May) *Bos 4456* (K, WAG); 13 km from Kribi (fr. Oct.) *Bos 5509* (K, WAG); Kribi-Edea, Fifinda (fl. Apr.) *Bos 6722* (K, WAG); Malimba (fr.) *Braun 60* (BM, K); 70 km SW of Eséka (fr. July) *W. de Wilde 2805* (B, BR, K, WAG); Gross Batanga (Dec.) *Dinklage 814* (P, type of *C. calantha*); Goyoum-Kalbe (fl., fr. Feb.) *Letouzey 3357* (P); S of Nyong (fr. July) *Letouzey 7367* (P);

Molundu Distr. (fr. Jan.) *Mildbraed 4281* (HBG); Yaoundé (fl.) *Zenker & Staudt 652* (BM, K, type of *C. aurantiaca*); Bipindi (fr.) *Zenker 1944* (BM, E, G, K, type of *C. cinnabarina*); Bipindi (fl.) *Zenker 2060* (E, G, K, L, M, MO, P, WAG, Z, type of *C. zenkeri*); Bipindi (fl.) *Zenker 2157* (B, BM, E, G, K, L, M, MO, P, WAG, Z, type of *C. leucantha*); Bipindi (fl.) *Zenker 2335* (B, BM, BR, E, G, K, L, M, MO, P, WAG, Z, type of *C. trichopoda*); Bipindi (fl.) *Zenker 2810* (BM, BR, E, G, K, L, MO, WAG, Z).

Central African Republic: Mbaiki (fl. July) *Tisserant 75* (BM).

Gabon: km 6 Moanda-Franceville (fl., fr. Sept.) *Breteler 6404* (WAG); km 40 Mouila-Yeno (fr. Sept.) *Breteler, Lemmens & Nzabi 8154* (LBV, WAG); km 50 Mouila-Yeno (fr. Sept.) *Breteler, Lemmens & Nzabi 8265* (WAG); 25 km NW of Kango (fr. Oct.) *Breteler & Lemmens 8286* (LBV, WAG); km 15 Libreville-Kango (fl.b. Oct.) *Breteler & Lemmens 8355* (LBV, WAG); km 28 Libreville-Kango (fl., fr. Oct.) *Breteler & Lemmens 8420* (LBV, WAG); Belinga (fl. June) *Hallé 3869* (P); Libreville (fl. Oct.) *Klaine 233* (P); near Libreville (fl. Aug.) *Klaine 1617* (P); (fl., y.fr.) *Klaine 2028* (P); (fl.) *Klaine 3508* (K, P, type of *C. agelaeoides*); Tchibanga (fl., fr. June) *Le Testu 1037* (BM, BR, P, type of *C. leucanthoides*); (fl. Oct.) *Le Testu 1184* (BM, BR, K); Lastoursville (fl.) *Le Testu 7144* (P); (fl., y.fr. Apr.) *Le Testu 7181* (BM); (fl. Oct.) *Le Testu 7539* (BM, BR, P); Oyem (fl. July) *Le Testu 9641* (BM, BR, P); SSW of Mougouma, Doussala (fr.) *Reitsma, Breteler & A. Louis 1010* (LBV, WAG); SW of Mitzic (fl. Sept.) *Reitsma 1570* (LBV, WAG); S of Mougouma, Doussala (fr. Oct.) *Reitsma 1748* (LBV, WAG); near Libreville, Sibange (fl., fr. Aug.) *Soyaux 143* (GOET, K, P, Z, type of *C. gabunensis*).

Congo: Foulakari (fl. Oct.) *Bouquet 606* (P); Chaillu, Komono (fl. Nov.) *Sita 4054* (P); Nganchu (fr. June) *Vermoesen 2430* (BR).

Zaire: Moanda (fr. Sept.) *Bequaert 745* (BR); sin. loc. (fr.) *Cabra s.n.* (BR, type of *C. congolana*); Kisantu (fl. Feb.) *Callens 159* (BR); Lokandu (fl.) *Claessens 473* (BR, type of *C. claessensii* and *C. sapinii* var. *claessensii*); Boma (fl., fr. Dec.) *Dacrémont 134* (BR, K); Stanley Pool (fl. Feb.) *Demeuse 227* (BR, type of *C. iomalla*); Rive française (fl. Feb.) *Dewèvre 715b* (BR, type of *C. emarginata*); Luki (fl. Jan.) *Donis 2322* (B, BR); Luculla (fr.) *Laurent s.n.* (BR, type of *C. setosa*); Ubangi, Libenge-Zongo (fl., y.fr. Nov.) *Lebrun 1607* (BR); Yangambi (fl. Aug.) *A. Léonard 1051* (BR, WAG); Kamusuku (fr. Aug.) *A. Léonard 5968* (BR, WAG); Madibi (fl.) *Lescrauwaet 88* (BR; type of *C. lescrauwaetii*); (fr. June) *Lescrauwaet 115* (BR, type of *C. iomalla* var. *grandifoliolata*); Yangambi (fl. June) *J. Louis 4286* (BR, type of *C. hirsuta*); (fr. Jan.) *J. Louis 13496* (BM, BR, K); 17 km S of Leopoldville (fl. Sept.) *Mildbraed 3549* (HBG); Tshibonde-Haut Lomani (fl. Feb.) *Mullenders 2051* (BR, type of *C. mullendersii*); Lukolela (fl. July) *Pynaert 168* (BR, type of *C. pynaertii*); Kasai Distr., Sankuru (fr. Sept.) *Sapin s.n.* (BR, type of *C. sapinii*); Stanley Pool (fl. June) *Schlechter 12545* (BM, G, K, Z); Gimbi (fl. Jan.) *Toussaint 790* (BR, type of *C. gimbiensis*); Nkula V. (fl. Sept.) *Toussaint 2032* (BR); Kikwit (fl. Jan.) *Vanderyst 2892* (BR, type of *C. polyantha*); Ipamu (fl. Feb.) *Vanderyst 8810* (BR); Bas-Katanga, Mérode (fr.) *Vanderyst 22988* (BR, type of *C. vanderystii*); Congo des Lemba (fr.) *Verschueren 761* (BR); Kizu (fl. Mar.) *Wellens 247* (BR).

Angola: Lunda, Chicapa R. (fr. Aug.) *Carisso & Mendonça 145* (BM, COI); Cazengo Distr. (fl.b.) *Gossweiler 569* (BM, K); Cabinda, Buco Zau (fl. Oct.) *Gossweiler 6730* (BM, COI, LISU); Maiombe, Rio Lufo (fl. Jan.) *Gossweiler 7743* (BM, BR, COI, K); Maiombe, Belize (fl. Apr.) *Gossweiler 7976* (BM, BR, COI); Maiombe (fr. Dec.) *Gossweiler 8162* (BM, COI, K); Lunda, valleys of Chicapa and Luachimo (fl.) *Marques 266* (BM, COI, LISU, type of *C. grandiflora*); sin. loc. (fl.) *Welwitsch 4633* (BM, COI, G, K).

Tanzania: Iringa Distr., Msolwa (fr. Sept.) *Carmichael 126* (EA, K, type of *C. riparia*); Pemba I. (fr. Feb.) *Greenway 1457* (K); Ulanga Distr., Funga (fl.) *Haerdi 514/0* (BR, G, K, WAG, type of *C. calocarpa*); Dar es Salaam (fr. Sept.) *Peter 44838* (B, type of *C. confertiflora*); near Manaki, Pugu Hills (fl., y.fr. Sept.) *Vaughan 3139* (BM, EA); Pugu Hills F.R. (fl. Apr.) *Wingfield & Lucas 1949* (WAG, type of *C. confertiflora* f. *macrophylla*).

Cult.: Ivory Coast, Adiopodoumé (seedling) *de Koning 5974* (WAG).

Notes: 1. *C. corniculata* is the most variable species of the genus. Already in 1910 Schellenberg concluded that several species, described by Gilg (i.e. *C. aurantiaca*, *C. grandiflora*, *C. iomalla*, *C. polyantha* and *C. setosa*) are conspecific

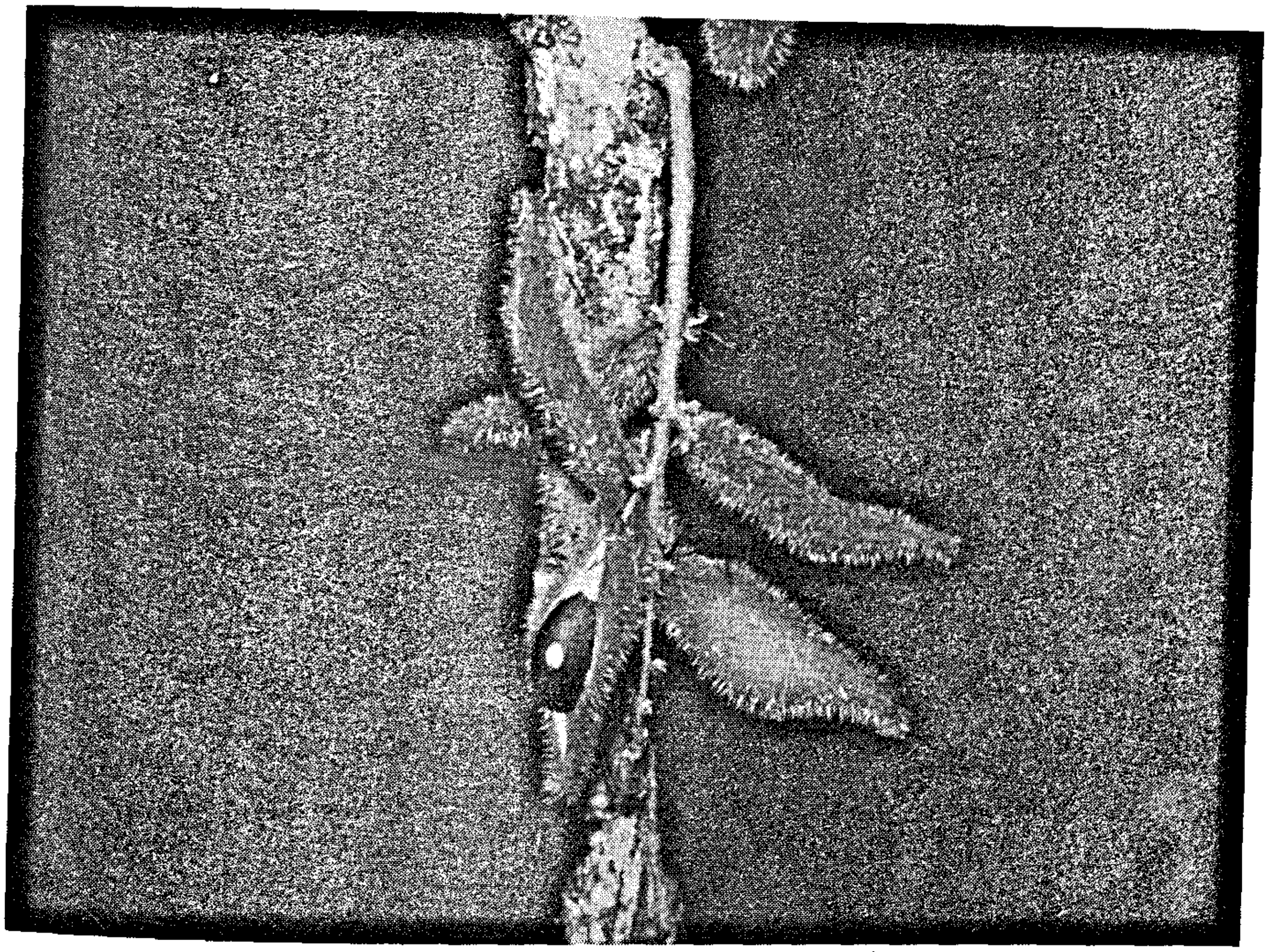


Fig. 81. *Cnestis corniculata*: follicles (*van der Maesen 5590*; phot. L.J.G. van der Maesen).

with *C. corniculata*: '...beim Vergleiche der einzelnen Arten Gilgs findet man allerhand Uebergänge, so dass es mir nicht zweifelhaft erscheint, dass bei noch reichlicherem Materiale jede Unterscheidung dieser Arten, die schon jetzt höchst unsicher ist, zur reinen Unmöglichkeit werden wird.' And further on he states: 'Sehr nahe mit *Cn. corniculata* verwandt und vielleicht ebenfalls nur Formen dieser Art sind die drei folgenden ostafrikanischen Arten...: *C. confertiflora* Gilg, *C. calocarpa* Gilg, *C. riparia* Gilg.' In 1938 Schellenberg revised his opinion and reinstated these species, except *C. polyantha* and *C. setosa*. In the Flora of Tropical East Africa, Hemsley (1956) united some East African species. He placed *C. riparia* Gilg in the synonymy of *C. confertiflora* Gilg and doubted whether *C. calocarpa* is really distinct from them. He also stated that it is difficult to separate material determined as *C. lescrauwaetii* De Wild. from Congo and Angola from *C. confertiflora*.

The most variable characters in *C. corniculata* are:

1. Size and number of leaflets: large and few versus small and numerous.

2. Indumentum of leaflets beneath and of young branches: glabrous or scarcely pilose versus pilose.

3. Length of petals in relation to sepal length: petals as long as or hardly longer than sepals versus much longer.

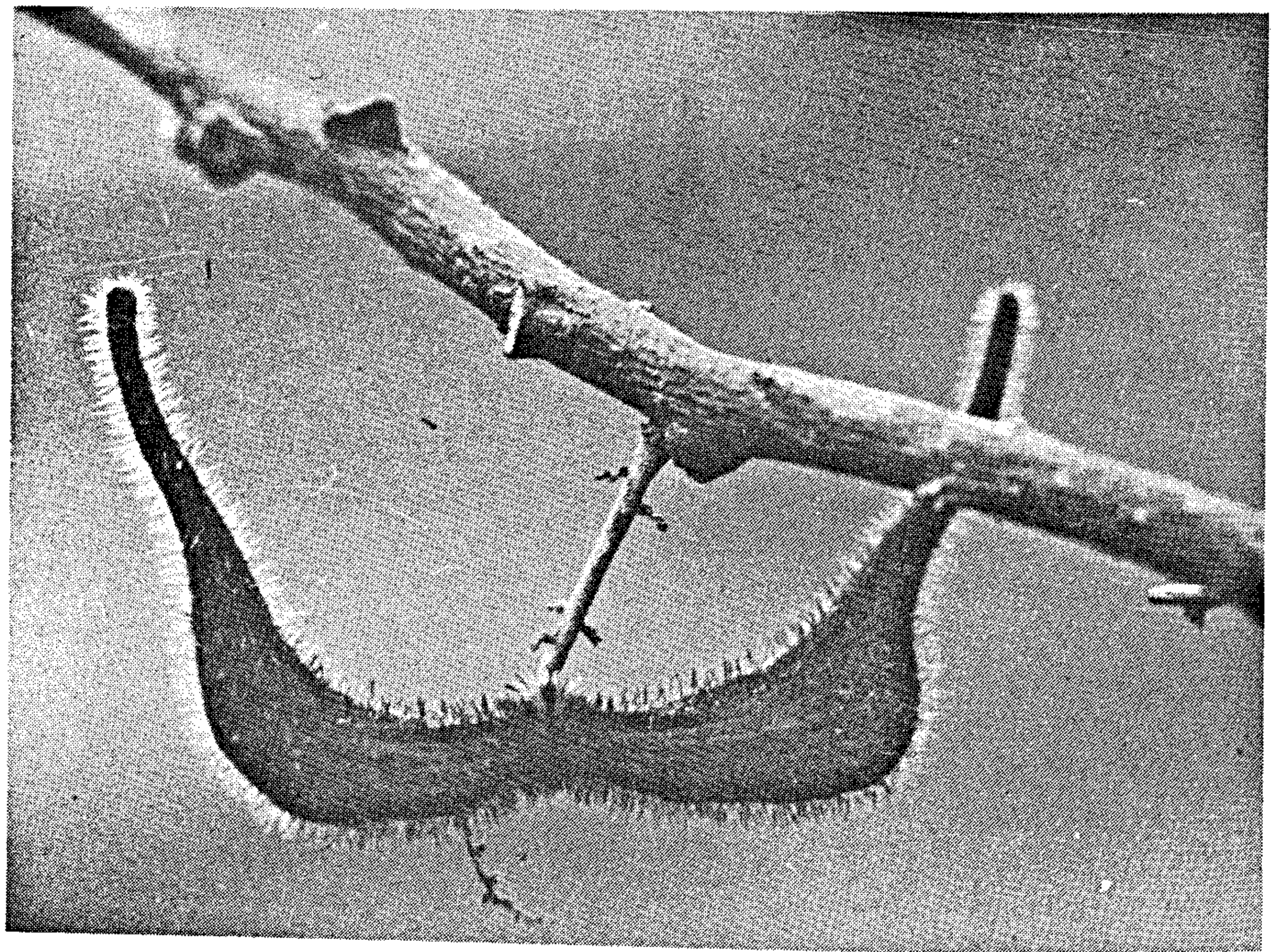


Fig. 82. *Cnestis corniculata*: follicles (*Breteler & Lemmens 8420*; phot. R.H.M.J. Lemmens).

In the following table all combinations of these character-states that were observed, are listed together with the corresponding synonyms of *C. corniculata*.

a. Leaflets large and few, (almost) glabrous beneath; petals as long as sepals or hardly longer. *C. agelaeoides*, *C. cinnabarina*, *C. congolana*.

b. Leaflets large and few, (almost) glabrous beneath; petals much longer than sepals. *C. sapinii*.

c. Leaflets large and few, pilose beneath; petals hardly longer than sepals. *C. gimbiensis*.

d. Leaflets large and few, pilose beneath; petals much longer than sepals. *C. gabunensis*, *C. grisea*, *C. longiflora*, *C. mullendersii*, *C. vanderystii*.

e. Leaflets small and numerous, (almost) glabrous beneath; petals hardly longer than sepals. *C. corniculata s.s.*

f. Leaflets small and numerous, (almost) glabrous beneath; petals much longer than sepals. *C. confertiflora* (often few leaflets!), *C. lescrauwaetii*.

g. Leaflets small and numerous, pilose beneath; petals as long as sepals or hardly longer. *C. aurantiaca*, *C. iomalla*, *C. leucantha*, *C. pynaertii*.

h. Leaflets small and numerous, pilose beneath; petals much longer than sepals. *C. grandiflora*.

This shows that all possible combinations are represented, moreover the pertinent characters vary independently.

The number of leaflets per leaf varies from 5-27 (2-16-jugate), rarely more.

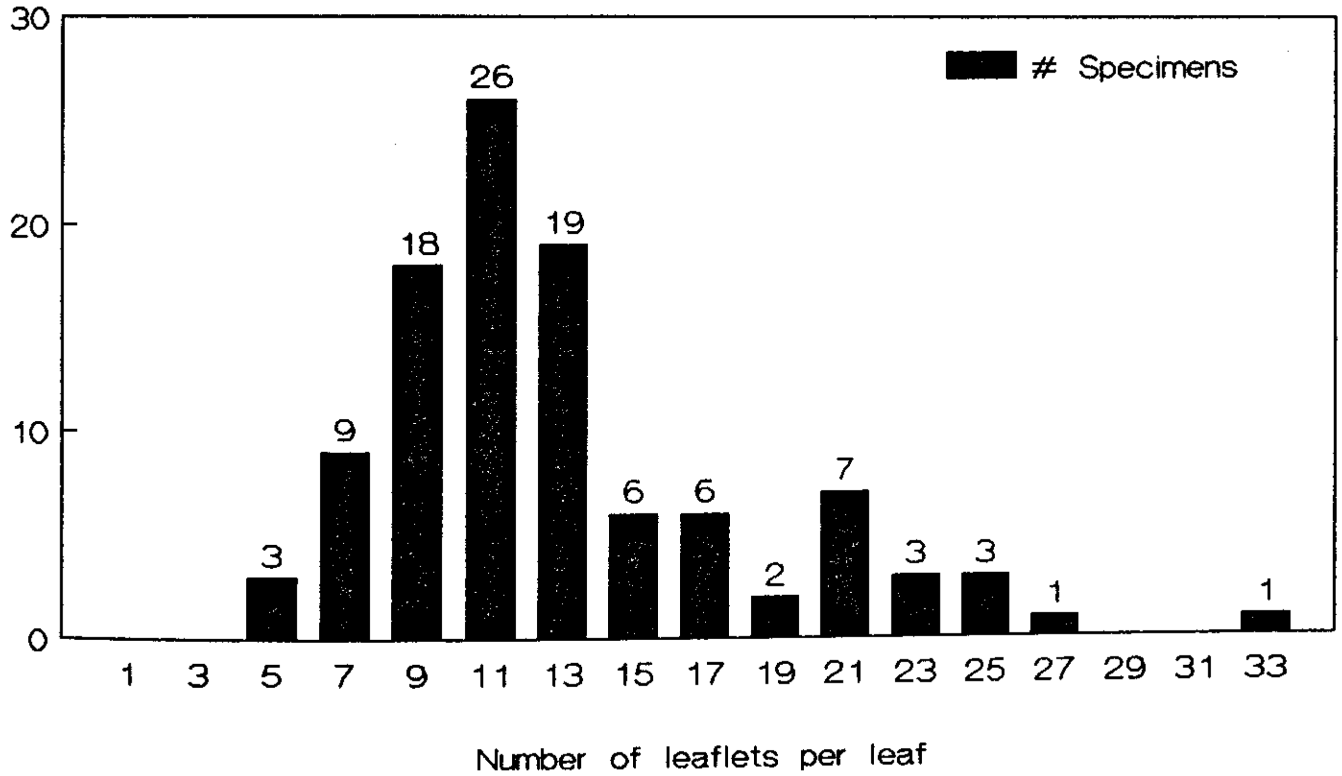


Fig. 83. Frequency distribution of the highest number of leaflets per leaf of 104 specimens of *C. corniculata*.

Fig. 83 shows the frequency distribution of the highest number of leaflets per leaf of 104 specimens.

The length ratio of petals and sepals varies from 0.8-3.5. Fig. 84 shows the frequency distribution of the length ratio, petal length expressed as percentage of sepal length, of 63 specimens.

Considering the entire variation and the way it is distributed, it is, in my opinion, not possible to distinguish separate taxa in *C. corniculata*. Although various populations show a certain uniformity, the characters vary gradually and independently: no sharply defined limits can be established.

The more extreme forms that may be summarized are:

A. '*C. congolana*', characterized by few, large, glabrous leaflets, long inflorescences and broad sepals, about as long as petals. Central Africa (S Nigeria to N Angola).

B. '*C. grisea*', different from '*C. congolana*' by pilose leaflets and narrower sepals, shorter than petals. Central Africa (S Nigeria to N Angola).

C. '*C. grandiflora*', different from '*C. grisea*' by numerous, small leaflets and usually somewhat smaller flowers. Central Africa (Gabon, N Angola, Zaire).

D. '*C. sapinii*', linking up to '*C. congolana*' in the leaves, but to '*C. grisea*' in the flowers. Central Zaire.

E. '*C. cinnabarina*', characterized by small, glabrous leaflets and petals about as long as sepals. S Nigeria and S Cameroun.

F. '*C. aurantiaca*', different from '*C. cinnabarina*' in usually more numerous, small, pilose leaflets. Liberia to W Zaire.

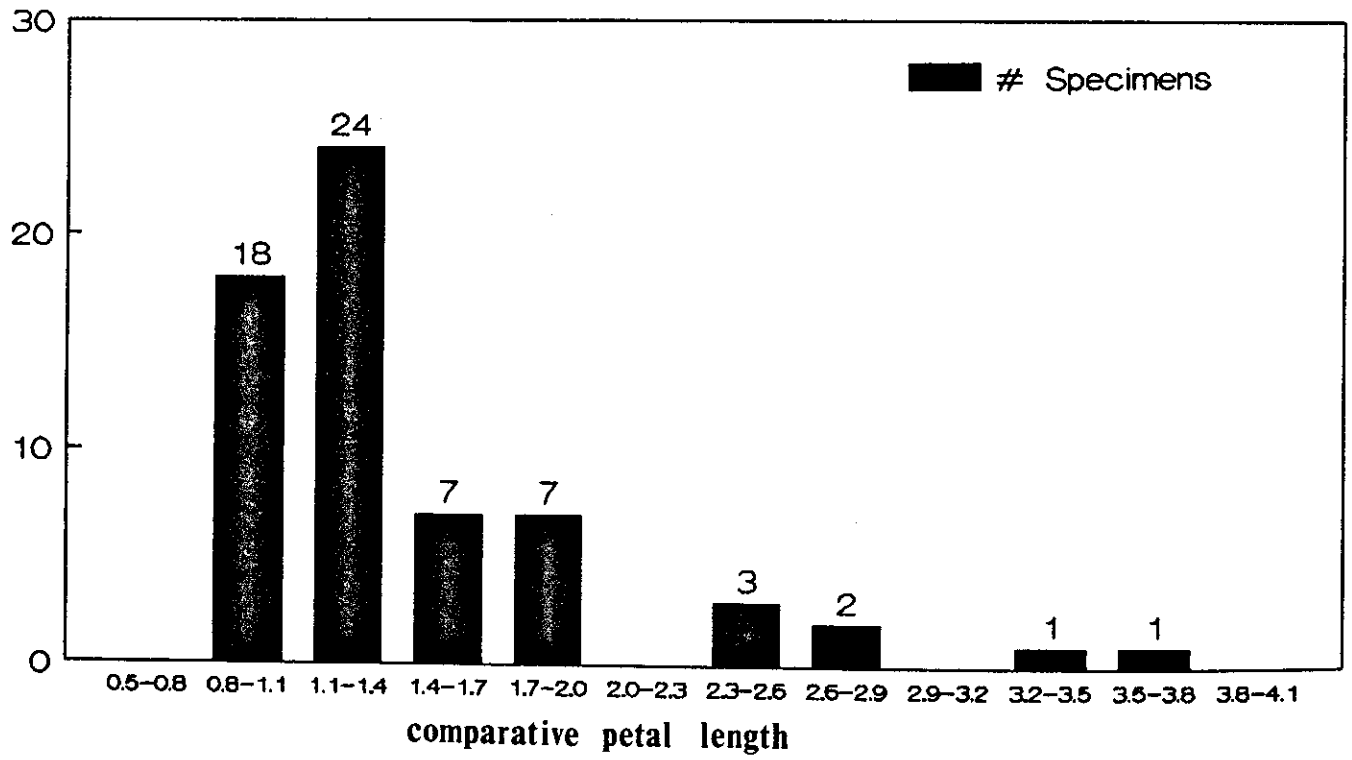


Fig. 84. Frequency distribution of the length ratio, petal length expressed as percentage of sepal length, of 63 specimens of *C. corniculata.*

G. '*C. confertiflora*', very close to '*C. grandiflora*', but with very long petals. E Tanzania.

H. '*C. longiflora*', resembling '*C. aurantiaca*' in the leaves, but differing from this form in the petals being much longer than sepals. SW Nigeria.

I. '*C. corniculata s.s.*', close to '*C. grandiflora*', but differing in the smaller flowers with petals hardly longer than sepals. W Africa, from S Senegal to Ivory Coast.

J. '*C. iomalla*', differing from '*C. corniculata s.s.*' in the leaflets being pilose above and in the young branches and leaf-rachis provided with numerous, long, yellowish hairs. Central Africa (Cameroun, S Central African Republic, Gabon, Zaire, N Angola).

It should be understood explicitely that I do not grant any status under ICBN to these forms as numerous specimens cannot be placed in any single form because they are intermediate between two or more of them. An example to illustrate this is the specimen *Breteler, Lemmens & Nzabi 8154* collected in Gabon which shows leaves with numerous (29), small (1.5-6.5 × 1.0-2.0 cm) leaflets as well as leaves with few (11), much larger (5.0-13.0 × 3.0-4.5 cm) leaflets. This learns that leaf variation within one single plant can be considerable.

A discriminant analysis has been made, using the SPSS X computer programme. The numerical values of 10 variable characters have been scored for 50 specimens of the 10 extremes of *C. corniculata* (A-J), and for 5 specimens of *C. mannii* (X), used as a control (table 24). Six of these characters relate to the leaves, one to the inflorescences, and three to the flowers. *C. corniculata* is strongly variable particularly in the leaves and flowers, as discussed before.

Table 24. Numerical values of 10 characters in 50 specimens of *Cnestis corniculata* and 5 specimens of *C. mannii.*

NO	MLL	MNL	MLF	MWF	HLA	HLB	MLI	MLS	MLP	SRE	GROU
1	30.0	11	12.0	4.2	0	0	5.0	2.8	6.6	1	D
2	35.0	9	12.5	6.0	0	0	6.5	2.7	5.0	1	D
3	21.5	13	5.3	2.6	0	1	3.5	2.3	7.7	1	G
4	24.0	13	8.6	3.1	0	1	3.7	2.2	5.5	1	C
5	21.0	7	10.0	2.2	0	1	2.1	4.2	4.6	1	C
6	22.6	11	9.0	4.0	0	1	2.5	3.2	8.4	1	C
7	34.5	15	9.8	3.8	0	1	2.0	3.3	5.9	1	C
8	39.0	21	9.2	2.7	0	0	2.3	3.4	5.0	1	C
9	18.5	13	4.6	2.8	0	0	8.0	4.6	7.7	1	C
10	21.5	13	5.3	2.6	0	1	3.5	2.3	7.7	1	C
11	15.0	13	3.6	2.1	0	0	2.5	3.0	5.0	1	C
12	26.5	15	7.1	2.8	0	1	3.0	2.1	7.3	1	C
13	20.0	15	5.5	2.5	0	0	3.0	2.3	3.1	1	C
14	23.0	15	7.0	2.5	0	0	3.0	2.2	3.0	0	C
15	31.5	17	8.0	4.1	0	1	5.3	2.9	4.0	0	F
16	25.5	13	5.8	3.4	0	1	3.0	2.7	3.4	0	F
17	28.4	13	7.2	3.6	0	1	5.0	4.4	4.8	0	F
18	24.5	11	8.7	4.0	0	1	3.2	3.9	3.9	0	F
19	38.0	23	8.4	3.6	0	1	4.0	4.0	3.9	0	F
20	28.5	27	7.2	2.4	0	1	7.5	3.9	4.0	0	F
21	28.5	13	10.5	4.0	0	0	3.8	2.6	2.8	0	F
22	34.5	13	11.5	5.4	0	1	8.2	4.1	4.1	1	F
23	40.0	17	13.8	7.2	0	1	4.5	3.6	3.5	0	F
24	30.0	23	8.5	3.5	0	1	4.5	4.5	4.9	1	F
25	40.0	27	8.5	2.6	0	1	6.0	4.6	5.2	1	F
26	44.0	41	8.5	2.5	0	1	4.0	2.8	3.0	1	F
27	34.5	23	8.5	3.0	0	1	5.0	3.0	3.3	0	F
28	42.5	21	7.5	2.5	0	1	3.0	2.8	2.6	1	F
29	28.0	15	6.5	3.0	0	1	2.0	4.0	4.0	0	F
30	22.5	19	5.2	2.2	0	1	2.7	2.8	3.6	1	I
31	18.0	17	4.8	2.3	0	0	4.2	3.0	3.9	1	I
32	30.5	17	7.0	2.5	1	1	3.0	2.6	3.4	1	J
33	29.5	23	5.0	2.3	1	1	2.5	3.7	3.8	1	J
34	35.0	21	7.5	2.7	1	1	2.5	2.8	3.2	1	J
35	28.0	11	10.5	4.5	0	0	3.5	3.0	3.3	1	E
36	24.0	11	6.5	3.0	0	1	5.0	2.8	6.5	1	H
37	37.5	11	15.5	7.2	0	0	9.5	6.4	6.0	0	A
38	37.0	9	17.5	11.5	0	0	9.0	7.0	7.2	0	A
39	44.0	7	17.0	8.5	0	0	20.0	3.3	3.5	1	A
40	37.5	5	15.0	10.0	0	0	8.0	3.3	3.6	1	A
41	32.0	5	14.5	10.5	0	0	8.5	4.9	4.2	0	A
42	35.5	9	14.0	8.0	0	0	18.0	8.0	8.5	0	A
43	47.0	9	17.0	7.5	0	1	9.0	4.5	5.7	0	B
44	34.0	9	11.5	7.0	1	1	7.5	4.6	7.6	1	B
45	50.0	9	18.0	8.5	0	1	9.0	4.2	6.2	1	B
46	62.5	11	23.5	7.5	0	1	6.5	4.0	7.0	1	B
47	29.5	11	7.5	3.0	0	1	4.0	3.9	4.9	1	B
48	50.0	9	25.0	12.5	0	1	7.5	5.5	7.2	1	B
49	74.0	7	27.5	13.0	0	1	4.0	4.3	5.5	1	B
50	59.0	13	17.5	9.0	1	1	11.0	4.5	7.2	1	B

Table 24 (Continued)

NO	MLL	MNL	MLF	MWF	HLA	HLB	MLI	MLS	MLP	SRE	GROU
51	27.0	5	12.0	8.5	0	1	27.5	6.0	1.7	0	X
52	37.0	7	19.0	8.5	0	1	16.5	5.0	2.5	0	X
53	38.0	9	15.0	8.5	0	1	40.0	4.5	2.0	0	X
54	25.5	9	17.0	8.5	0	1	20.5	5.0	2.0	0	X
55	23.5	7	12.0	7.0	0	1	24.0	4.0	1.5	0	X

NO = entry number
MLL = maximum length of leaf (cm)
MNL = maximum number of leaflets per leaf
MLF = maximum length of leaflet (cm)
MWF = maximum width of leaflet (cm)
HLA = hairiness of leaflet above (0 = glabrous; 1 = pilose)
HLB = hairiness of leaflet beneath (0 = glabrous; 1 = pilose)
MLI = maximum length of inflorescence (cm)
MLS = maximum length of sepal (mm)
MLP = maximum length of petal (mm)
SRE = condition of the sepals (0 = not reflexed; 1 = reflexed)
GROU = form of *C. corniculata* in which the specimen could be placed, as discussed in the text; *C. mannii* noted as X.

Three of the characters are qualitative, seven quantitative. Fig. 85 shows the all-groups scatterplot of this analysis. The axes are the discriminant scores calculated from the first two discriminant functions extracted during analysis. The discriminant functions result from the 'direct method', in which all variables are entered simultaneously (see SPSS X User's Guide). The 5 specimens of *C. mannii* are clustered separately but the forms of *C. corniculata* are all found in a single cluster. The scatterplot shows that the '*C. congolana*'-form (A) and '*C. iomalla*'-form (J) are the most extreme forms.

As a whole, this extremely variable species is best characterized by its follicles, that are beaked and possess stinging hairs, in combination with the racemose inflorescences.

2. Lamarck described leaves and follicles. The specimen in the Lamarck herbarium consists of one leaflet only. Therefore the description is probably based on the Smeathman specimen with both leaves and fruits in the De Jussieu herbarium. Consequently, this is the lectotype.

3. Gilg (1895a) cited in the protologue of *C. grandiflora* the specimen *Marques 268*, probably a printing error as the type is *Marques 266*.

4. In the protologue of *C. riparia*, Gilg (1896) reports extremely long petiolules (1 cm). Probably 1 mm was intended as Schellenberg (1910 and 1938) does not mention long petiolules, and I have not seen any over 5 mm long.

5. In the protologue of *C. dinklagei*, Schellenberg (1919) cited the specimen *Dinklage 2312*. This is an error, because the type is *Dinklage 2412*.

6. *J. Louis 4286*, the type of *C. hirsuta* Troupin (1951), is a mixture of *Rourea*

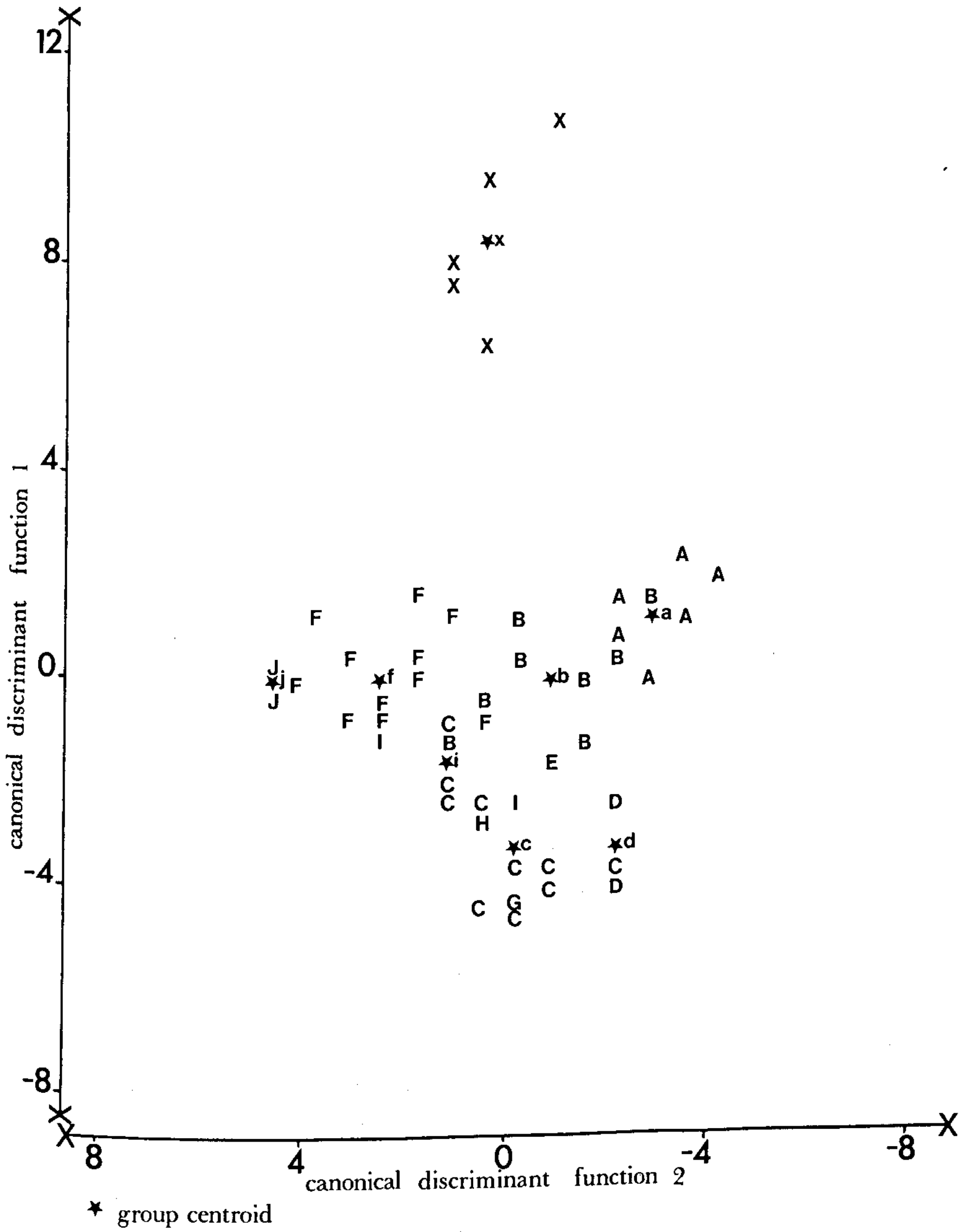


Fig. 85. Scatterplot of 50 specimens of 10 extreme forms (A-J) in *Cnestis corniculata* and of 5 specimens of *C. mannii* (X), resulting from a discriminant analysis (SPSS X computer programme).

parviflora Gilg (leaves and young branches) and *C. corniculata* (flowers and stems). The specimen *Pittery 274*, also cited by Troupin is sterile and represents *Rourea parviflora*. The *C. corniculata* element is separated as *J. Louis 4286a* and here designated as the lectotype of *C. hirsuta* Troupin.

Uses: According to Schellenberg (1938) and Troupin (1952) the leaves are used against blennorrhoea (Zaire), the stems as a rope to climb palm-trees.

Cnestis ferruginea Vahl ex DC. **Fig. 86-89**

C. ferruginea De Candolle, 1825: 87; G.Don, 1832: 91; Planchon, 1850: 440; Walpers, 1852: 306; Baillon, 1867: 241; Baker, 1868: 461; Gilg, 1891a: 68, fig.37; Dewèvre, 1894: 98; Gilg, 1895b: 192; Durand & Schinz, 1896: 102; Hiern, 1896: 190; De Wildeman & Durand, 1900a: 15; De Wildeman & Durand, 1901b: 10; De Wildeman & Durand, 1901a: 56; De Wildeman, 1905: 91; 1906:246; Durand & Durand, 1909: 120; De Wildeman, 1910a: 294; De Wildeman, 1910b: 188; De Wildeman, 1910c: 142, 244; Schellenberg, 1910: 11; De Wildeman, 1911b: 217; Engler, 1911: 632, fig.540; De Wildeman, 1912: 407; De Wildeman, 1914: 83; Gilg, 1914: 229; Schellenberg, 1915: 318; De Wildeman, 1916: 244; Chevalier, 1920: 166; Exell, 1928: 94; De Wildeman, 1929: 538; 1931: 235; Irvine, 1930: 113; Schellenberg, 1938: 30, fig.3; Andrews, 1952: 353, fig.132; Irvine, 1952: 128, fig.115; Troupin, 1952: 118; Exell & Mendonça, 1954: 138; Mangenot, 1957: no.81; Hepper, 1958: 743, fig.201; Irvine, 1961: 570, fig.111; Adam, 1971: 868, fig.405; Berhaut, 1975: 27 + fig.; Liberato, 1980a: 7; 1980b: 6; Ern, 1984: 164. See note 2.

Type: Sierra Leone, *Smeathman s.n.* (holo: G; iso: BM, P).

C. ferruginea DC. var. *fraterna* Baker, 1868: 462. For type see under *C. fraterna.*

C. fraterna Planchon, 1850: 440; Walpers, 1852: 306. Type: Senegal, Nunez R., *Heudelot 660* (lecto: P; iso: G).

C. oblongifolia Baker, 1868: 462; Durand & Schinz, 1896: 102; De Wildeman & Durand, 1901a: 56; De Wildeman, 1906: 248; 1909: 97; Durand & Durand, 1909: 121; De Wildeman, 1910a: 294. Type: Cameroun, Cameroon R. (= Wouri R.), *Mann 753* (lecto: K).

C. togoensis Gilg, 1896: 216. Type: Togo, Misahöhe, *Baumann 526* (holo: B n.v., according to Ern (1984) collection in spirit).

Agelaea ferruginea Solander, nomen in sched.; Planchon, 1850: 440 (in syn.).

Spondioides ferruginea Smeathman, nomen in sched.; De Candolle, 1825: 87 (in syn.).

Liana or shrub. *Branches* cylindric, branchlets often somewhat angular, densely rusty brown-pubescent. *Leaves* 4-16(-19)-jugate; petiole 2-10 cm, rachis 12-27 cm long, densely rusty brown-pubescent. Leaflets papery, lateral ones more or less alternate or sometimes opposite, ovate to narrowly oblong, 2-13 × 1-5 cm, rounded, truncate or subcordate and slightly or not unequal at base, terminal one elliptic or narrowly (ob)ovate, 4-10 × 1.5-5 cm, cuneate at base; all leaflets acuminate or obtuse, glabrous or rarely somewhat pilose above, densely pilose beneath, midrib impressed above, prominent beneath, with 5-12 lateral nerves on each side; tertiary nerves reticulate, usually not distinct; petiolules 1.5-3 mm long, densely brown-pilose. *Inflorescences* panicles or (pseudo-)racemes, 1-10 per leaf-axil on young branches, often the supporting leaves reduced resulting in a compound pseudoterminal inflorescence, 5-20 cm long, up to 100-flowered, densely rusty brown-pilose, also with short glandular hairs.

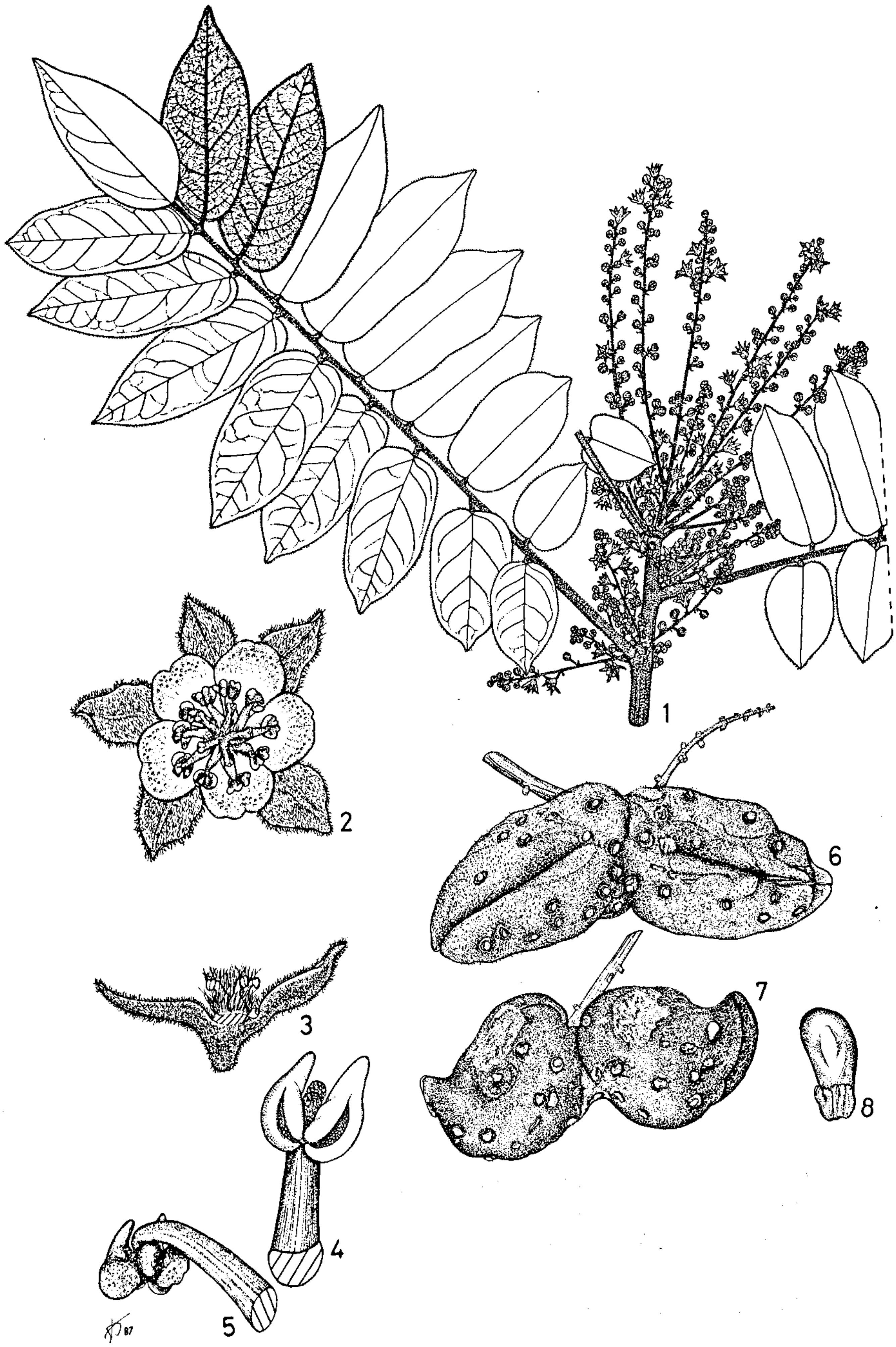


Fig. 86. *Cnestis ferruginea*: 1. flowering branch, 2/3 ×; 2. flower, 6 ×; 3. flower partly, showing pistils, 6 ×; 4-5. stamens, 24 ×; 6. follicles from above, 1 ×; 7. follicles, 2/3 ×; 8. seed, 1 × (1-5. *Leeuwenberg 2397*; 6-8. *Louis et al. 1186*).

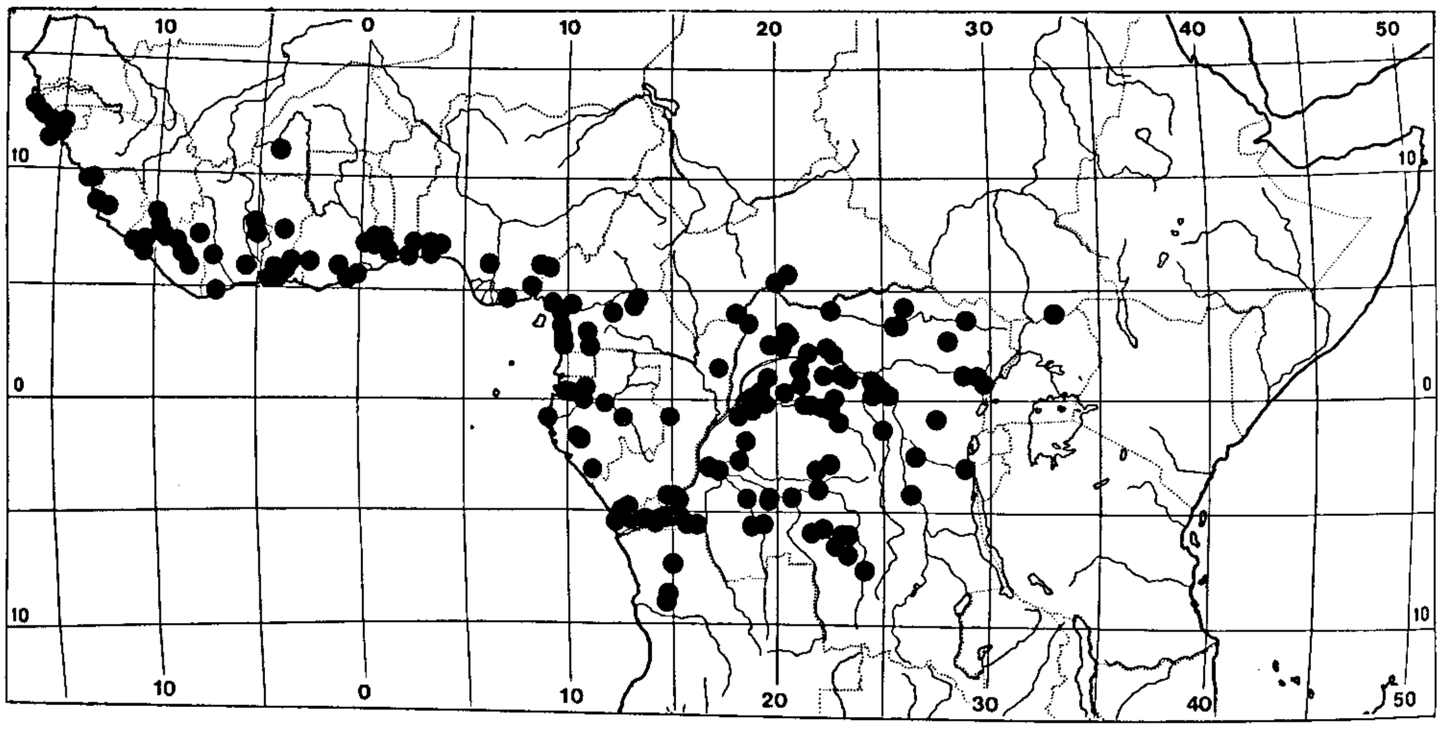


Fig. 87. Distribution of *Cnestis ferruginea*

Bracts ovate to subulate, 1-1.5 mm long. *Pedicels* articulated 1-2.5 mm below the calyx, densely brown-pilose. *Flowers* almost homostylous. *Sepals* never reflexed, imbricate in bud, ovate to narrowly elliptic, 2.0-4.0 × 0.8-1.3 mm, acute at top, densely brown-pilose, usually also with short glandular hairs outside, pubescent inside. *Petals* imbricate in bud, orbicular to broadly obovate, 1.0-2.0 × 1.0-1.5(-2.0) mm, rounded or truncate at base and at top, glabrous (rarely with some hairs outside), usually indistinctly veined. *Stamens* more or less united at base, subequal, 0.7-1.2 mm long, anthers ca 0.3 × 0.2 mm, with an appendix at the base. *Pistils* 0.5-1.5 mm long; ovaries ca 0.5 mm long, brown-pilose; styles often strongly curved towards anthers, pilose; stigmata oblique. *Follicles* 1-5 in fruit, often united at base, ovoid, more or less oblique, 2-4.5(-5) × 1-2.5 cm, rounded or truncate at base; beak blunt and broad, 5-20 mm long, often indistinctly separated; pericarp with short, red hairs outside and with long brownish hairs inside. *Seeds* ovoid, 12-20 × 5-10 mm, sarcotesta 3-7 mm long. *Seedling* epigeal.

Distribution: Tropical Africa, from Gambia to E Zaire and S Sudan, south to N Angola.

Ecology: Rain forest, in bushes in savanna, often in secondary regrowths on farm land, in fences, fringing lagoons and near the beach. Very common in many countries. *C. ferruginea* can be found flowering all the year round.

Selection of the ca 1000 specimens examined:

Gambia: Kotu stream swamp (fl., y.fr. May) *Fox 101* (K); Abuko Nature R. (fr. July) *Starin 12* (K).

Senegal: near Oussouye (fl. Aug.) *Berhaut 6272* (BR); (fl. Nov.) *Berhaut 6586* (BR); Nunez R. (fl., fr.) *Heudelot 660* (G, P, type of *C. fraterna* and *C. ferruginea* var. *fraterna*); Nunez R. (fl.)

Perottet 69 (G); Basse-Casamance, Boukot (fl. Dec.) *vanden Berghen 1495* (BR); Mankagne (fl. July) *vanden Berghen 1940* (BR); Brin (fr. June) *vanden Berghen 5741* (BR); Cap Skirring (fl., fr. Nov.) *vanden Berghen 5936* (BR).

Guinea-Bissau: S Domingos-Sedengal (fl., fr. Jan.) *Alves Pereira 1460* (LISC); Bafate-Bricama (fr. Mar.) *Alves Pereira 1727* (LISC); Cacheu-Bianga (fr. Feb.) *Alves Pereira 3713* (LISC); Bissau Biombo (fl., fr. Dec.) *d'Ory 29* (COI, LISC, LISU); Susana (fl. Dec.) *Raimundo & Guerra 381* (LISC); Cacine (fl., fr. Jan.) *Raimundo & Guerra 733* (LISC).

Guinea: Kouria (fl.) *Chevalier 14809* (BR); Conakry (fl. Oct.) *Maclaud 29* (P); Iles de Los (fl. May) *Pobéguin 1177* (P); Dar Salam (fr. Feb.) *Roberty 10562* (G, Z).

Sierra Leone: Moyamba (fr. Jan.) *Cole & Jarr EAC 84* (WAG); Lungi Penins. (fl. Apr.) *Morton SL 1232* (WAG); sin. loc. (fl.) *Smeathman s.n.* (BM, G, P, type).

Liberia: Tchien, Zwedru-Sinoe (fl. July) *Blyden 925* (WAG); Loffa county, St.Paul R.-Zorzor (fl., fr. Dec.) *Bos 2525* (WAG); Monrovia (fr. Dec.) *Dinklage 2753* (B); King's Farm (fr. Jan.) *Dinklage 2950* (Z); Bomi Hills (fl. Oct.) *Jansen 2235* (WAG); Monrovia (fr.) *Krause 12016* (B); Gbanga (fl., fr. Sept.) *Linder 608* (WAG); Zleh-Monroviatown, Tappita-Tchien (fl. Jan.) *van Harten 248* (WAG); 5 miles N of Ibadan (fl. Sept.) *van Meer 870* (WAG).

Ivory Coast: Yapo F. (fr. Jan.) *Bamps 1863* (BR); Duékoué-Buyo (fl. Mar.) *Bamps 2161* (BR); Man (fr. Feb.) *Declercq s.n.* (BR); Sikensi-Agboville (fr. Jan.) *de Koning 170* (WAG); 10 km N of Dabou (fl., fr. May) *de Kruif E58* (WAG); 7 km E of Bouaké (fl. May) *W. de Wilde 68* (WAG); E of Dabou (fl. Aug.) *Geerling & Bokdam 796* (BR, WAG); 17 km W of Abidjan (fl., fr. Nov.) *Leeuwenberg 1919* (BR, WAG, Z).

Ghana: Aburi Scarp. (fl. Jan.) *de Wit & Morton A 2856* (WAG); sin. loc. (fl.) *Isert s.n.* (C); 4 km NE of Dodowa, NW of Aiyikuma (y.fr. Feb.) *Leeuwenberg 11913* (WAG); N Swedru (fl., y.fr. Apr.) *Morton A 501* (WAG); near Kwapon, 100 km WSW of Kumasi (fl., y.fr.) *Oldeman 769* (BR, WAG); Achimoto, Kumasi (fr. Nov.) *Roberty 12898* (G); sin. loc. (fl.) *Thonning s.n.*; Kpandu (fl. Dec.) *Veldkamp 6097* (L).

Togo: near Palimo (fl. Dec.) *Brunel 1201* (B); *Brunel 4128* (B); Tsevie-Tokpli, Mono R. (fl.b., fr . Nov.) *Ern 2400* (B); Akposso H., 1.5 km S of Kouniohou (fr, Apr.) *Hakki, Leuenberger & Schiers 557* (B); 5 km N of Atakpame (fl. Nov.) *Lejoly s.n.* (BR).

Benin: Porto Novo, Sakété-Pédjilé (fl.b. Feb.) *Chevalier 22907* (BR); 8 km E of Adjohon (fl. Dec.) *van der Zon 300* (WAG); Sogo, near Porto Novo (fr, Feb.) *van der Zon 405* (WAG).

Nigeria: Gambari F. R. (fr. Mar.) *Bernardi 8745* (G); Prov. Benin, Distr. Iyekuselu (fl. Jan.) *Daramola & Emwiogbo 32775* (BR); Lagos (fl. Dec.) *Hagerup 767* (BR, C); Old Calabar (fl., fr. Jan.) *Holland 16* (K); SE St., Distr. Ikom, Ajasso Village (fl. Feb.) *Latilo & Ogumtayo 67665* (WAG); Ibadan (fr, Feb.) *Pilz 2267* (B, WAG); Western Prov., Gambari (fl., y.fr. Jan.) *van Eijnatten 1082* (WAG).

Cameroun: Douala (fl., fr. Dec.) *Baldwin 14002* (MO); Falls of Lobé R. (fr. Jan.) *Bamps 1702* (BR); Batanga (fl. Mar.) *Bates 124* (BR, E, G, Z); Kumba (fl., fr. Feb.) *Binuyo & Daramola 35571* (WAG); 1.5 km S of Kribi (fl., fr. Sept.) *Bos 2952* (BR, WAG); Bertoua (fl. Nov.) *Breteler 691* (BR, WAG); Nkoldjobe Hill, Mbaminkom Mts (fl. Dec.) *Dang 778* (P); Dume Distr., Gandima-Garga (fl. Nov.) *Elbert 48* (B); near Londji (fl., fr. Apr.) *Leeuwenberg 5639* (BR, WAG); Cameroon R. (fl., fr. Jan.) *Mann 753* (K, type of *C. oblongifolia*); Bipindi (fl.) *Zenker 1921* (E, G, L, MO, WAG, Z); (fr.) *Zenker 3055* (BR, E, G, L, MO, WAG, Z).

Central African Republic: Snoussi Land (fl. Jan.) *Chevalier 7272* (BR); Boukoko, Mbaiki (fl. Feb.) *Le Testu 2469* (BR); Ouaka (Feb.) *Tisserant 496b* (P).

Sudan: Bahr el Ghazal Prov., S of Benderi (fl. Mar.) *Dandy 670* (BM); SW Equatorial Prov., Source Yubu (fl.) *Hoyle 700* (K); Niam-Niamland (fl., fr.) *Schweinfurth 2948* (K); Equatorial Prov., Li Yabongo (fr. Mar.) *Wyld 34* (BM).

Equatorial Guinea: Nkolentangan (fl. Mar.) *Tessmann 267* (K); Bebai (fl.b. Sept.) *Tessmann 511* (K).

Sao Tomé & Principé: Principé, sin. loc. (fl.) *Mann s.n.* (P).

Gabon: 15 km N of Kango (fr. Oct.) *Breteler & Lemmens 8303* (LBV, WAG); km 7 Lalara-Ndjolé, than 56 km N (fr. Sept.) *Breteler & J. de Wilde 487* (WAG); Booué (fl. Aug.) *Davies 303* (P); Cap Lopez (fl.) *Debeaux 389* (B); 10 km SW of Ndjolé (fl. May) *Hallé 1986* (P); Lastoursville (fl. Apr.) *Le Testu 7174* (P); near Achouka (fl., fr. Nov.) *A. Louis, Breteler & de Bruijn 573* (WAG); *A. Louis*,

Fig. 88. *Cnestis ferruginea*: flowering branch (*Breteler, Lemmens & Nzabi 7790*; phot. R.H.M.J. Lemmens).

Breteler & de Bruijn 692 (LBV, WAG); near Mougouma, Doussala (fr.) *Reitsma 1356, 1650, 1751* (WAG); Haute Ngounié, St.Martin (fl.b., fr. July) *Walker s.n.* (P).

Congo: Hamon (fr. Aug.) *Bouquet 424* (P); Matoko, 10 km from Epéna (fr. Feb.) *de Nere 1028* (P); near Fort Rousset, 26 km from Ewo (fl. July) *Descoings 8422* (P); Brazzaville (fl. Dec.) *Koechlin 2348* (P).

Zaire: Yaekama, Terr. Isangi (fl.b., fr. Feb.) *Bamps 336* (BR); Kalima (fl.b. Jan.) *Becquet 995* (BR); Lukula (fl. Sept.) *Bequaert 656* (BR); Penghe (fr. Feb.) *Bequaert 2276* (BR); Yangambi (fr. Sept.) *Bolema 5* (BR); Nala, Duambo (fl. June) *Boone 81* (BR); Bambesa (fl. Apr.) *Bredo 4098* (BR); Kisantu (fl.) *Callens 4149* (BR); Ikenge (fr.) *Claessens 692* (BR); Dundusana (fl. June) *De Giorgi 966* (BR); Bangala (fl.) *Demeuse 206* (BR); Coquilhatville (fr. Jan.) *Dewèvre 633* (BR); Yalikungu, Mondombe (fl.b. Dec.) *Evrard 5426* (BR); Bambesa (fl. Dec.) *Gerard 3271* (BR, WAG); Kabumbu, Lumuna-Nuangwe (fl. June) *Germain 7708* (BR); Monsole (fl. July) *Goossens 4210* (BR);

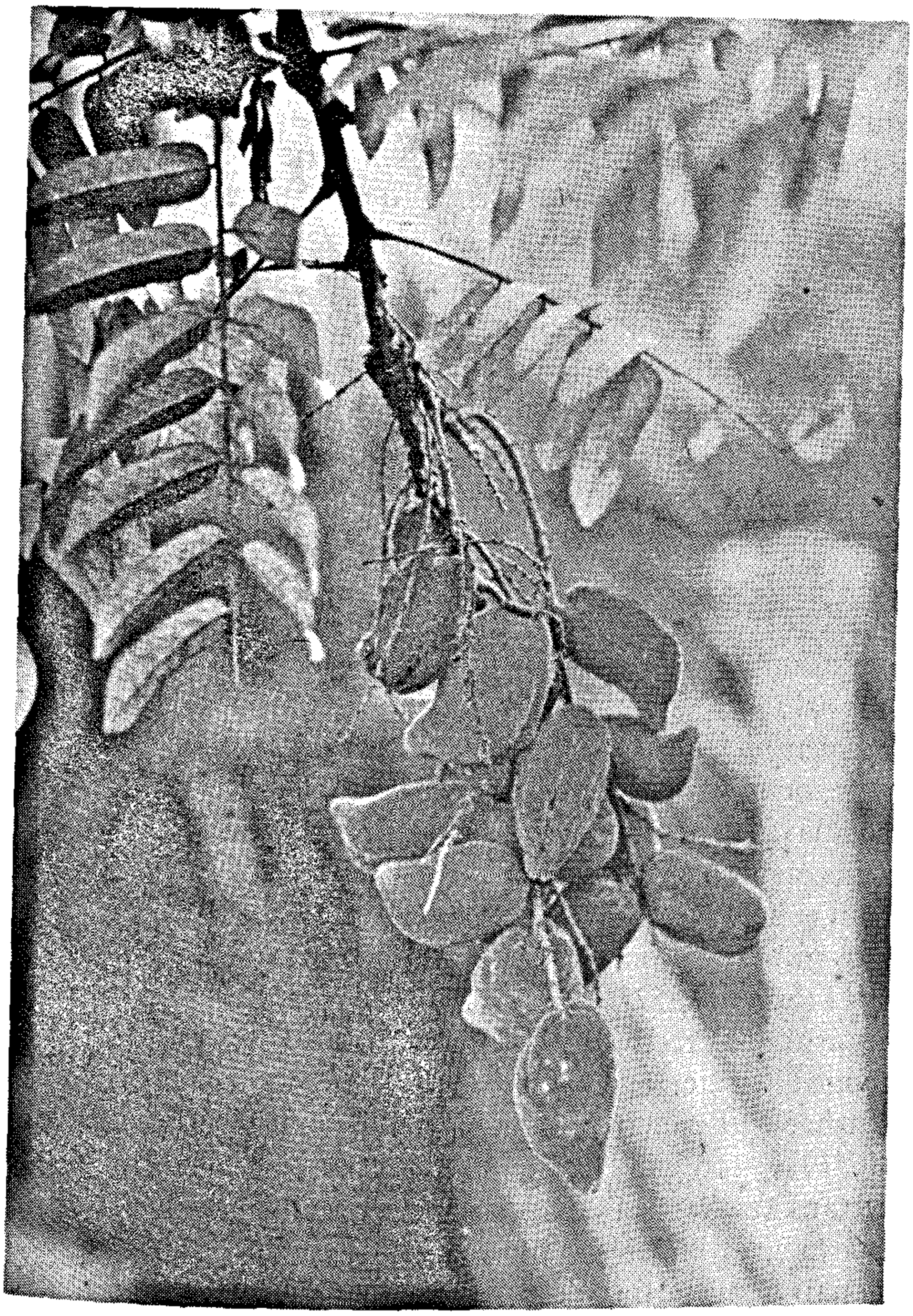


Fig. 89. *Cnestis ferruginea*: fruiting branch (*Breteler & Lemmens 8303*; phot. R.H.M.J. Lemmens).

Epulu, Mambasa (fl. Oct.) *Hart 138* (BR); Bangala (fl. June) *Hens 106* (G, L, Z); Bolima (fl., fr. Oct.) *Hulstaert 429* (BR); Eala (fr. June) *Laurent 854* (BR); Prov. Orientale, Distr. Haut Uele, Dungu (fl. Feb.) *Leclercq 431* (BR, WAG); Madibi (fl. June) *Lescrauwaet 90* (BR); Lubi R., Dibaya (fr. Oct.) *Liben 1664* (BR); Bienge (fr. Oct.) *Sapin s.n.* (BR); Stanley Pool (fl. June) *Schlechter 12550* (Z); Ipamu (fl. May) *Vanderyst 9401* (BR).

Angola: Cuanza Norte, Quiage (fr. Apr.) *Cardoso 131* (COI); Cabinda, Damba (fl.) *Dawe 149* (K); Cuanza Norte, Golungo (fl., fr.) *Exell & Mendonça 3205* (COI, LISC); Cabinda, sin. loc. (fl.) *Gossweiler 4247* (K); Granja de S.Luiz, Cazengo (fl., fr.) *Gossweiler 4411* (COI, K); Loco, Dundo (fl. May) *Gossweiler 13968* (B, BM, K); Cabinda, Buco Zau (fl. Sept.) *Monteiro, Santos & Murta 329* (LISC); sin. loc. (fl., fr.) *Welwitsch 4632* (COI, G, K, P).

Cult.: Wageningen, greenhouse (seedling) *van Veldhuizen 984* (WAG).

Notes: 1. The variability of *C. ferruginea* is little, compared with other species with a large area of distribution. The flowers are not variable at all, the characteristic rusty brown indumentum of leaves and branchlets is always present, while the shape and size of the leaves and follicles show a slight variability.

2. A note in Martin Vahl's hand (see Junghans, 1961) is attached to the Isert specimen in C, giving a description and the name *Cnestis ferruginea*. Vahl died in 1804, and *Cnestis ferruginea* was not published before 1825 by De Candolle. In the De Candolle-Herbarium in G a specimen of *C. ferruginea* is found with a note: 'Vahl 1804'. Possibly Vahl suggested the name *Cnestis ferruginea* to De Candolle and sent a sheet to Geneva in 1804. De Candolle adopted and published this name more than 20 years later. It is remarkable that De Candolle did not cite any specimen collected by Isert or Thonning in Ghana, but only a Smeathman specimen from Sierra Leone. However, in my opinion the complete correct authority of *Cnestis ferruginea* is Vahl ex DC.

Uses: The roots are a remedy for dysentery, syphilis, gonorrhoea, migraine and snakebite, and are said to be purgative. A decoction is an aphrodisiac and prevents abortion and ovarian troubles in women. The powdered bark is rubbed on the gums against pyorrhoea (swellings) according to Ainslie (1937). The leaves can be used as a laxative and against fever. Rubbing with boiled leaves relieves childbirth pains, as well as other kinds of pain (Berhaut, 1975; Irvine, 1961). A leaf decoction is used as an abortive, to fight colds, and the leaf juice is applied as eye-drops in ophthalmia. In Zaire the crushed leaves are used to repare cracks in pots (Troupin, 1952). The fruits, that are said to be bitter and juicy and possibly poisonous (Kerharo, 1971), are used for tooth-brushing (external part) and, boiled in water, against bronchitis, hooping-cough, tuberculosis and wounds. Crushed with rum or palm-wine they are reported as a remedy for snakebite (Ainslie, 1937; Troupin, 1952). On the beaches in Cameroun they are used as bait in traps for cocos-crabs. According to Schellenberg (1938) *Cephalophus maxwelli* (a small antelope) likes to eat the fruits. Various parts of the plant can form part of magic mixtures (Mangenot, 1957).

Cnestis macrantha Baill. **Fig. 90, 91**

C. macrantha Baillon, 1867: 242; Baker, 1868: 462; Schellenberg, 1910: 13; 1938: 34; Hepper, 1958: 743.

Type: Gabon, sin. loc., *Duparquet 53* (lecto design. by Schellenberg, 1938: P). See note 1.

Liana or climbing shrub. *Branches* cylindric, branchlets often somewhat angular, densely yellowish brown-pilose. *Leaves* 10-17-jugate; petiole 0.5-4.5 cm, rachis 11-22 cm long, densely yellowish brown-pilose. Leaflets thinly papery, lateral ones more or less opposite, elliptic or (narrowly) oblong, 1-5 × 1-1.5 cm, rounded, truncate or rarely subcordate and slightly unequal at base, termi-

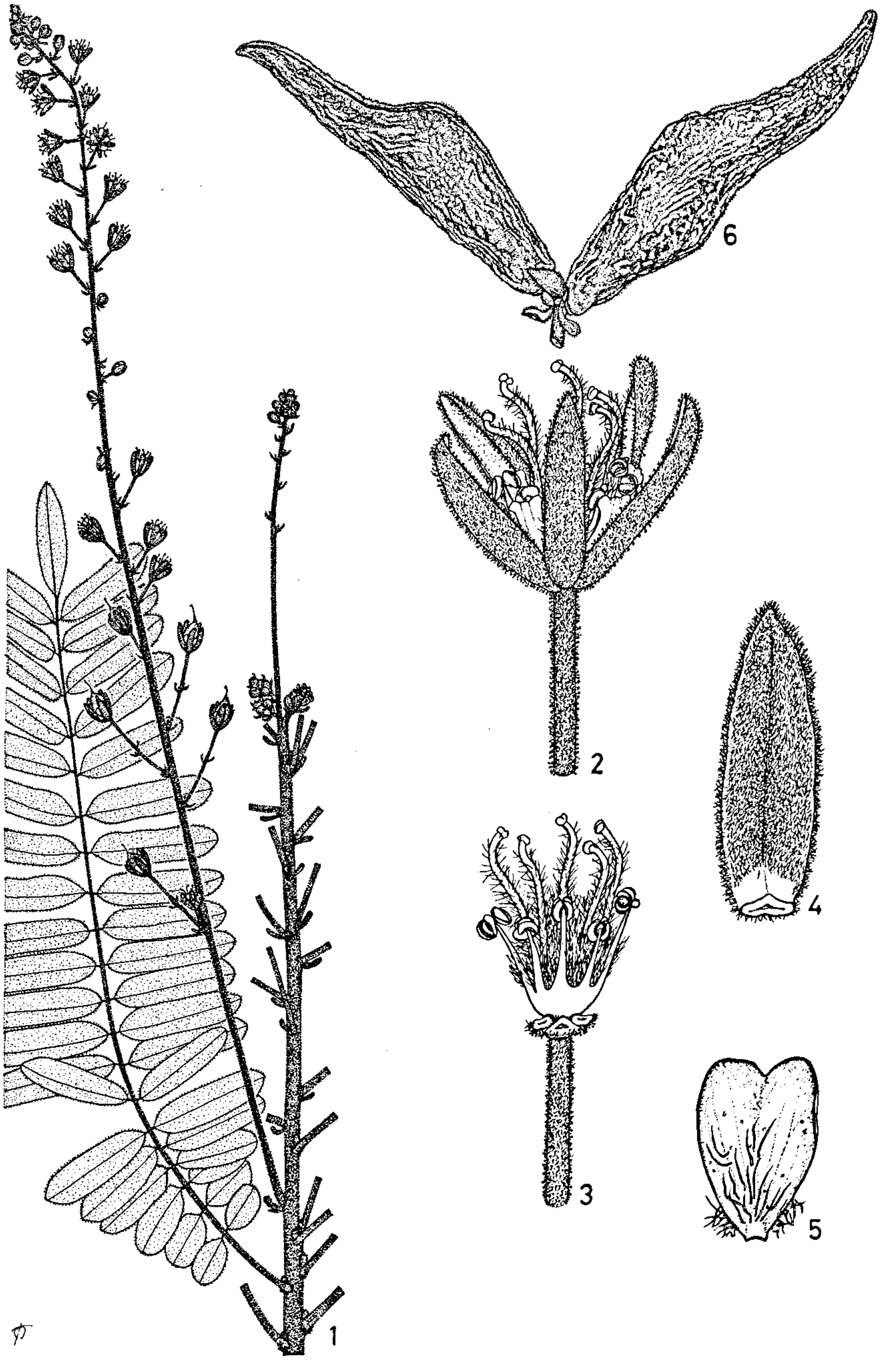


Fig. 90. *Cnestis macrantha*: 1. flowering branch, 2/3 ×; 2. flower, 6 ×; 3. flower partly, showing stamens and pistils, 6 ×; 4. sepal inside, 8 ×; 5. petal outside, 8 ×; 6. follicles, 1 × (1-4. *Binuyo 45402*; 5. *Duparquet 53*; 6. *D. Thomas 3326*).

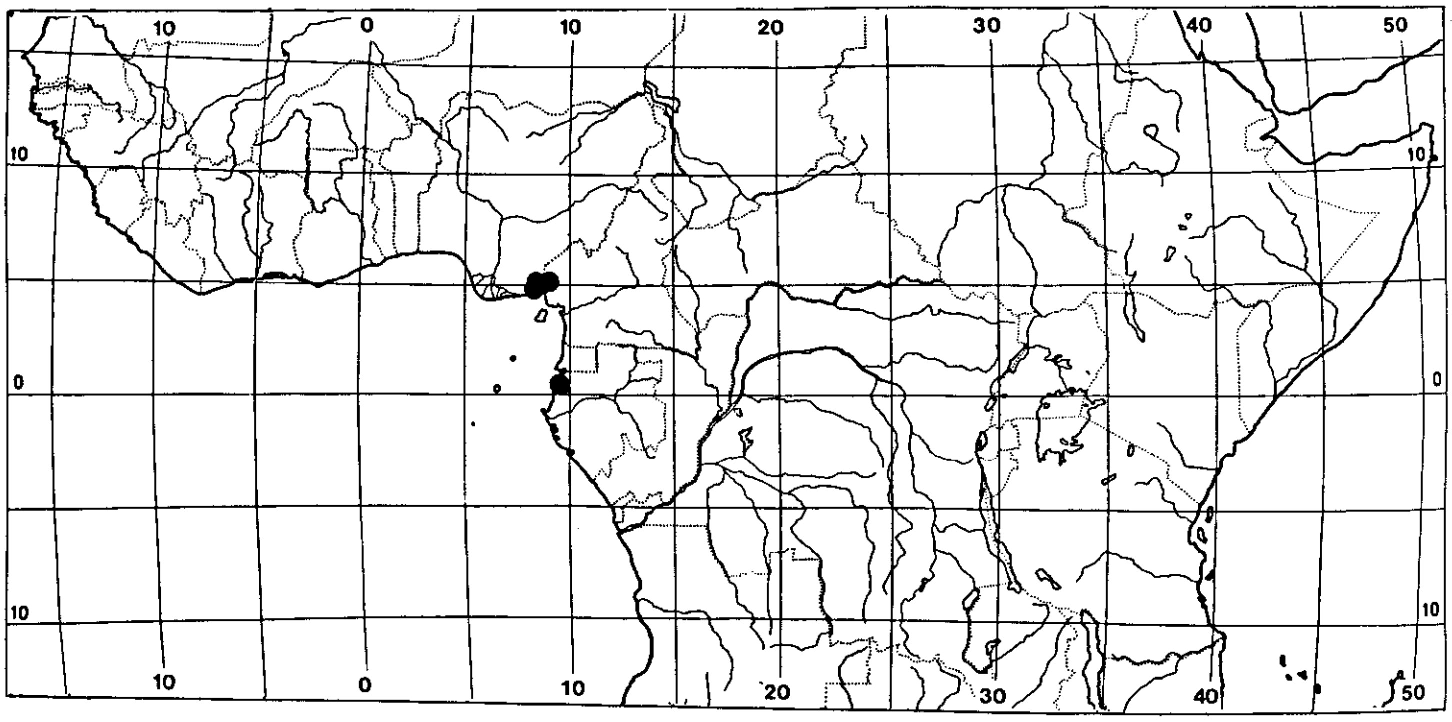


Fig. 91. Distribution of *Cnestis macrantha*

nal one obovate, oblong or elliptic, 2.5-3.5 × 1-1.5 cm, rounded or cuneate at base; all leaflets obtuse or truncate, more rarely retuse or subacute, scattered pilose above, densely pilose with long hairs beneath, midrib impressed above, prominent and densely pilose beneath, with 5-8 lateral nerves on each side; tertiary nerves indistinct; petiolules very short, up to 1 mm long, pilose. *Inflorescences* racemes or panicles, single in leaf-axils on top of young branches, the supporting leaves often reduced or very young resulting in a compound pseudo-terminal inflorescence, 5-24 cm long, up to 40-flowered, densely yellowish brown-pilose, also with short, brown glandular hairs. Bracts subulate or lanceolate, 3-5 mm long, usually curved. *Pedicels* articulated 3-7 mm below the calyx, densely pilose. *Sepals* never reflexed, imbricate in bud, narrowly oblong or narrowly obovate, 5.0-6.5 × 1.5-2.5 mm, obtuse or rounded, densely pilose, with numerous glandular hairs outside, pubescent inside. *Petals* imbricate in bud, obovate or obcordate, 2.0-3.0 × 1.3-2.0 mm, cuneate at base, truncate or retuse at top, with a few hairs in lower half outside, glabrous inside, indistinctly veined. *Stamens* united at base, subequal, 1.5-2.2 mm long, anthers ca 0.4 × 0.3 mm. *Pistils* 4.0-5.0 mm long; ovaries ca 1 mm long, brown-pilose; styles straight or curved in upper part, pilose at base; stigmata oblique, more or less distinctly 2-lobed. *Follicles* 1-4 in fruit, narrowly ovoid or narrowly ellipsoid, somewhat oblique, 4-6 × 1-1.5 cm, rounded at base; beak blunt and broad, 15-20 mm long, indistinctly separated; pericarp with short, red hairs and some longer, yellowish hairs outside and with long yellowish hairs inside. *Seeds* ovoid, 10-20 × 5-8 mm, sarcotesta 2-5 mm long.

Distribution: SE Nigeria, W Cameroun, NW Gabon.
Ecology: Secondary rain forest, thickets.

Specimens examined:

Nigeria: Calabar Prov., Oban Distr., Oban Group F.R. (fl. Nov.) *Binuyo 45402* (K, P); mile 66-67 Calabar-Mamfe road (fl., fr. Feb.) *Latilo 45810* (K, WAG); (fr. Mar.) *Latilo & Oguntayo 70569* (K, WAG); Old Calabar R. (fl.) *Mann 2235* (K, P); Oban F.R., Orem, Mamfe road (fr, Feb.) *Onochie FHI 36409* (K); Oban (fl.) *Talbot 1279* (K); (fl.) *Talbot 1299* (BM); (fl.) *Talbot 1378* (K); (fr.) *Talbot 1706* (BM, K, Z); (fr.) *Talbot s.n.* (BM, K); (fl.) *Talbot s.n.* (BM).

Cameroun: Mamfe (fl., fr. Apr.) *Maitland 1149* (K); SW Prov., Korup National Park, Baro village (fr. Mar.) *D. Thomas 3326* (MO, WAG, YA).

Gabon: near Libreville, Mondah F. (Oct.) *Breteler & Lemmens 8344* (WAG); sin. loc. (fl.) *Duparquet 53* (P, type).

Notes: 1. Attached to the sheet of *Mann 2235* (P) is a small convolute containing parts of leaves and some flowers of a specimen of *C. macrantha.* On this convolute is written in Baillon's hand: *Cnestis, Duparquet n.53,* Gabon. Schellenberg (1938) selected *Duparquet 53* as lectotype. He assumed that this specimen was collected in Calabar, Nigeria, probably because all the other specimens available to him, including *Mann 2235,* came from SE Nigeria. However, Duparquet never collected in Nigeria but in Gabon as correctly stated by Baillon. *Breteler & Lemmens 8344* provides additional evidence that *C. macrantha* occurs in Gabon.

2. It is not known whether heterostylous flowers occur in this species, as in the specimens examined only a single type of flowers is found.

Cnestis macrophylla Gilg ex Schellenb. **Fig. 92, 93**

C. macrophylla Schellenberg, 1910: 18; 1919: 442; 1938: 51.

Type: Cameroun, Bipindi, *Zenker 947* (holo: B †; lecto: G; iso: BM, K, P).

Liana. *Branches* cylindric, branchlets often somewhat angular, brown-pubescent, soon glabrescent. *Leaves* 2-4-jugate; petiole with distinct, blackish articulation at base, 8-13.5 cm, rachis 7.5-19 cm long, glabrous or minutely pubescent. Leaflets stiffly papery, lateral ones more or less opposite, elliptic or (narrowly) obovate, 7-19 × 4-8 cm, cuneate or rounded and slightly or not unequal at base, terminal one (narrowly) obovate, 11-19 × 4.5-8.5 cm, cuneate at base; all leaflets acuminate, glabrous both sides, midrib impressed above, prominent beneath, with 6-8 lateral nerves on each side; tertiary nerves reticulate, distinct on both sides; petiolules 8-11 mm long, blackish when dry, glabrous or minutely pubescent. *Inflorescences* racemes, 3-5 together inserted on the stem (cauliflorous), up to 16.5 cm long, up to 30-flowered, brown-pubescent. Bracts subulate, 1-2 mm long, curved. *Pedicels* articulated 0-2 mm below the calyx, pubescent. *Sepals* spreading or reflexed, narrowly oblong, 5.5-7.5 × 0.8-1.3 mm, acute, pilose outside, glabrous inside, distinctly 3-5-veined. *Petals* narrowly oblong to linear, ca 8 × 0.6-1 mm, inflexed at top, glabrous, distinctly 1-3-veined. *Stamens* with ca 0.2 mm long anthers. *Follicles* 1-3 in fruit, (narrowly) ellipsoid, oblique,

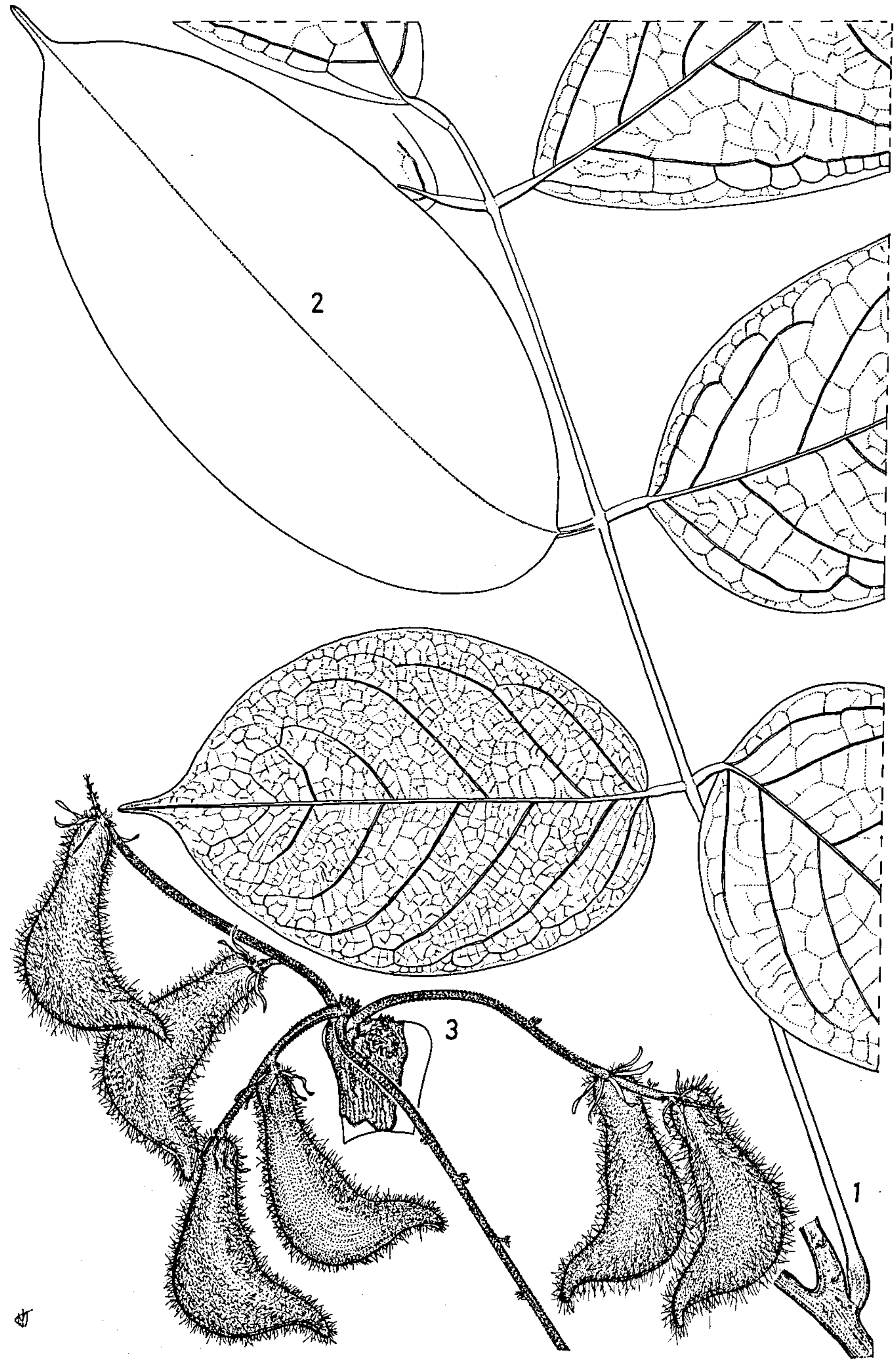


Fig. 92. *Cnestis macrophylla*: 1. branch with leaf, showing leaflets beneath, 2/3 ×; 2. leaflet above, 2/3 ×; 3. infrutescences, 1 × (1-2. *Gentry & Pilz 32759*; 3. *Leroy s.n.*).

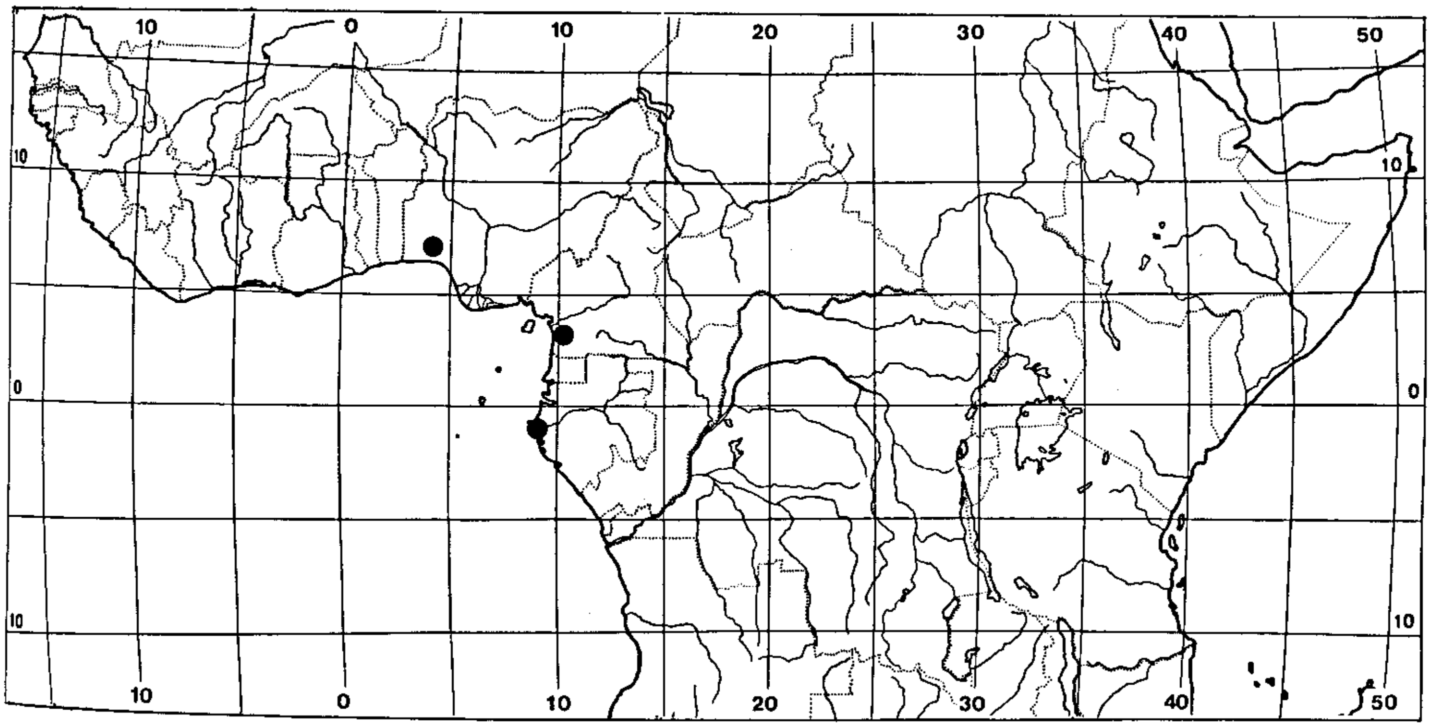


Fig. 93. Distribution of *Cnestis macrophylla*

3.5-4.4 × 0.7-1.1 cm, cuneate, with 7-10 mm long stipe at base; beak more or less slender, distinct, 4-20 mm long; pericarp with very short, red, spinelike hairs and long, easily caducous, stinging hairs outside and with long, slender, yellowish hairs inside. *Seeds* (ob)ovoid, ca 16 × 8 mm, sarcotesta ca 5 mm long.

Distribution: SW Nigeria, W Cameroun and W Gabon.
Ecology: Rain forest.

Specimens examined:

Nigeria: Ogun State, Omo F.R., near Oloji (June) *Gentry & Pilz 32759* (MO, WAG).
Cameroun: Bipindi (y.fr.) *Zenker 947* (BM, G, K, P, type).
Gabon: Ogooué (fr.) *Leroy s.n.* (P).

Note: This species differs from *C. corniculata* only in the very long (8-11 mm) petiolules, that are almost black when dry. In *C. corniculata* the petiolules are up to 5 mm long. In other characters *C. macrophylla* fits comfortably within the wide range of variety of *C. corniculata*, particularly close to the *congolana* type. Only two fruiting specimens have been collected so far and flowers are incompletely known. Although this taxon is maintained here at species level, additional material when available may render it necessary to reduce it into a variety of *C. corniculata*.

Both fruiting specimens consist of separate leaves and fruits, which indicate that the plants are cauliflorous. It cannot be established with complete certainty that the leaves and fruits are collected from the same plant and that possible mixtures of two families are not involved. This is, however, not likely, because the stomata are of the same type as seen in other *Cnestis* species and it is unlikely that in that case the same error would have been made twice by two separate collectors.

Cnestis mannii (Baker) Schellenb. **Fig. 94-96**

C. mannii (Baker) Schellenberg, 1915: 318; 1919: 436; 1938: 34; Hepper, 1958: 743.

Basionym: *Connarus mannii* Baker, 1868: 459.

Type: Nigeria, Old Calabar, *Mann 2264* (holo: K; iso: P).

C. pseudoracemosa (Gilg) Schellenberg, 1919: 436; 1938: 35. Basionym: *Connarus pseudoracemosus* Gilg, 1891b: 317. Type: Gabon, Libreville, Sibange Farm, *Büttner 166* (holo: B†; lecto: P).

C. grandifoliolata De Wildeman & Durand, 1901: 746; Durand & Durand, 1909: 121; Schellenberg, 1910: 13; 1915: 318; Exell, 1928: 94; 1938: 35; Troupin, 1952: 120; Exell & Mendonça, 1954: 138. Type: Zaire, Kisantu, *Gillet 1420* (holo: BR).

C. tomentosa Hepper, 1957: 112; 1958: 743. Type: Cameroun, Kumba Div., near Banga, S Bakundu F.R., *Brenan, Jones, Onochie & Richards 9328* (holo: K; iso: BM, P).

Liana, up to 30 m long. *Branches* cylindric, branchlets somewhat angular, densely brown-pubescent, more rarely glabrous. *Leaves* 2-4(-5)-jugate; petiole 3-12 cm, rachis 5-15 cm long, brown-pubescent, sometimes glabrous. Leaflets thickly papery or leathery, lateral ones opposite or not, (narrowly) ovate or elliptic, 4-18 × 2-9 cm, rounded to subcordate, rarely cuneate, equal, rarely unequal at base, terminal one (ob)ovate or elliptic, 6-19 × 3-12 cm, rounded or rarely cuneate at base; all leaflets acuminate or sometimes acute, glabrous above, brown-tomentose or pubescent, rarely glabrous beneath, midrib impressed above, prominent beneath, with 4-15 lateral nerves on each side; tertiary nerves reticulate, distinct on both sides; petiolules 2-5 mm long, pilose or more rarely glabrous. *Inflorescences* panicles, single in leaf-axils on top of young branches, the supporting leaves usually reduced or very young resulting in a compound pseudoterminal inflorescence, up to 40 cm long, many-flowered, densely yellowish brown-pubescent, sometimes also with short glandular hairs. Reduced leaves at base of inflorescences subulate or linear, up to 12 mm long, bracts very small, 0.5-1 mm long. *Pedicels* articulated 1-2.5 mm below the calyx, densely pubescent. *Flowers* heterodistylous. *Sepals* never reflexed, narrowly imbricate in bud, narrowly ovate or narrowly oblong, 4.0-6.0 × 1.0-1.5 mm, acute, margins inflexed, yellowish brown-pubescent, rarely with glandular hairs outside, puberulus inside. *Petals* very narrowly imbricate in bud, obovate or elliptic, 1.5-3.0 × 1.0 mm, cuneate at base, obtuse or subacute at top, with long hairs in lower half outside, glabrous inside, indistinctly veined. *Stamens* shortly united at base, subequal, 1.5-2.5 or (4.0-)5.0-6.0 mm long, anthers 0.5-0.6 × 0.3-0.4 mm. *Pistils* 1.5-2.5 or 4.5-6.5 mm long; ovaries ca 0.5 mm long, yellowish

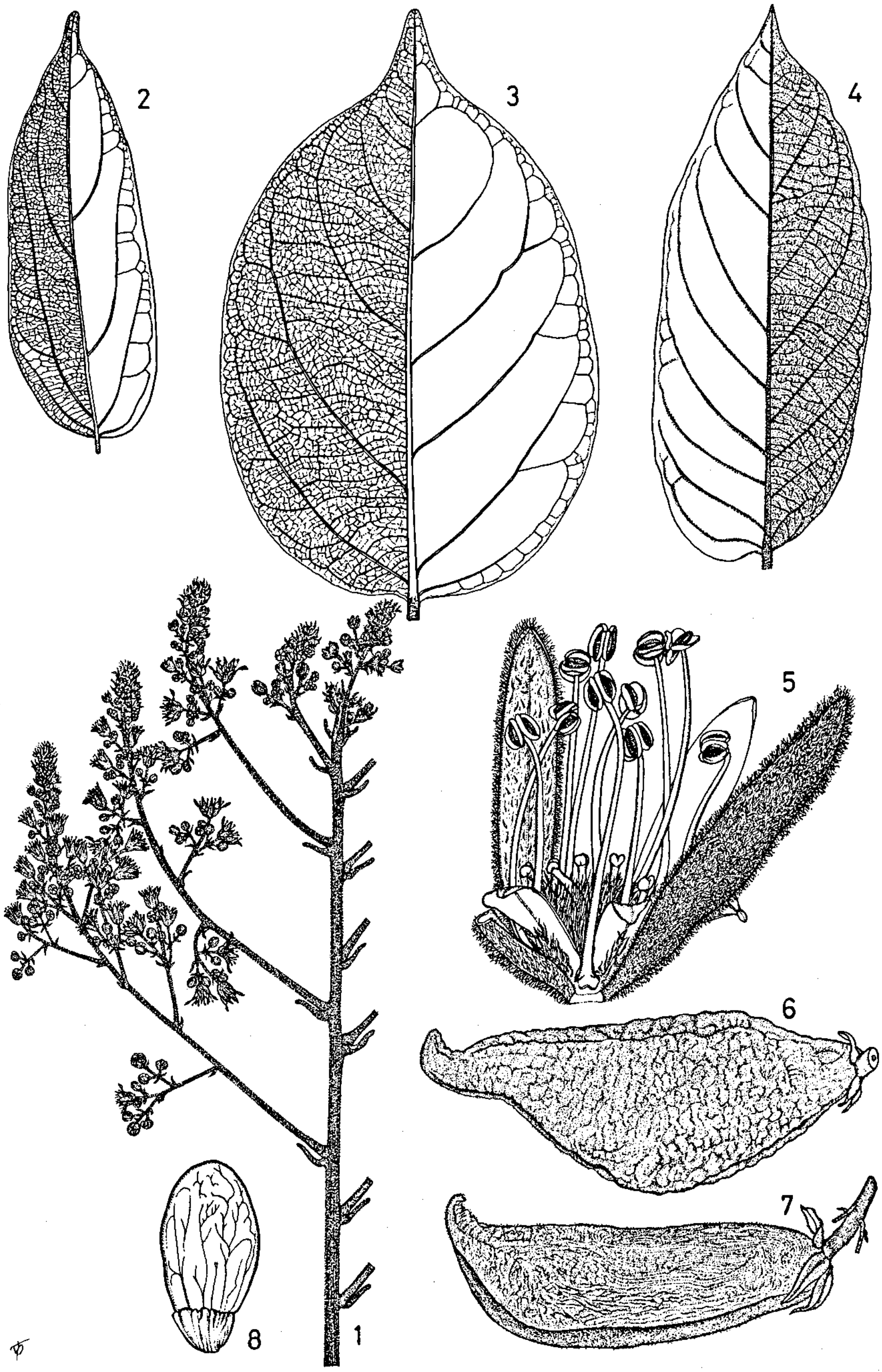


Fig. 94. *Cnestis mannii*: 1. branchlet with inflorescences, 2/3 ×; 2-4. leaflets beneath, 2/3 × (2 former *C. pseudoracemosa*); 5. flower partly, 8 ×; 6-7. follicles, 1 ×; 8. seed, 1 × (1. *Onyeachusim & Latilo 54021*; 2. *Le Testu 8378*; 3,6,8. *J. de Wilde et al. 253*; 4,7. *J. de Wilde et al. 549*; 5. *Vanderyst 25787*).

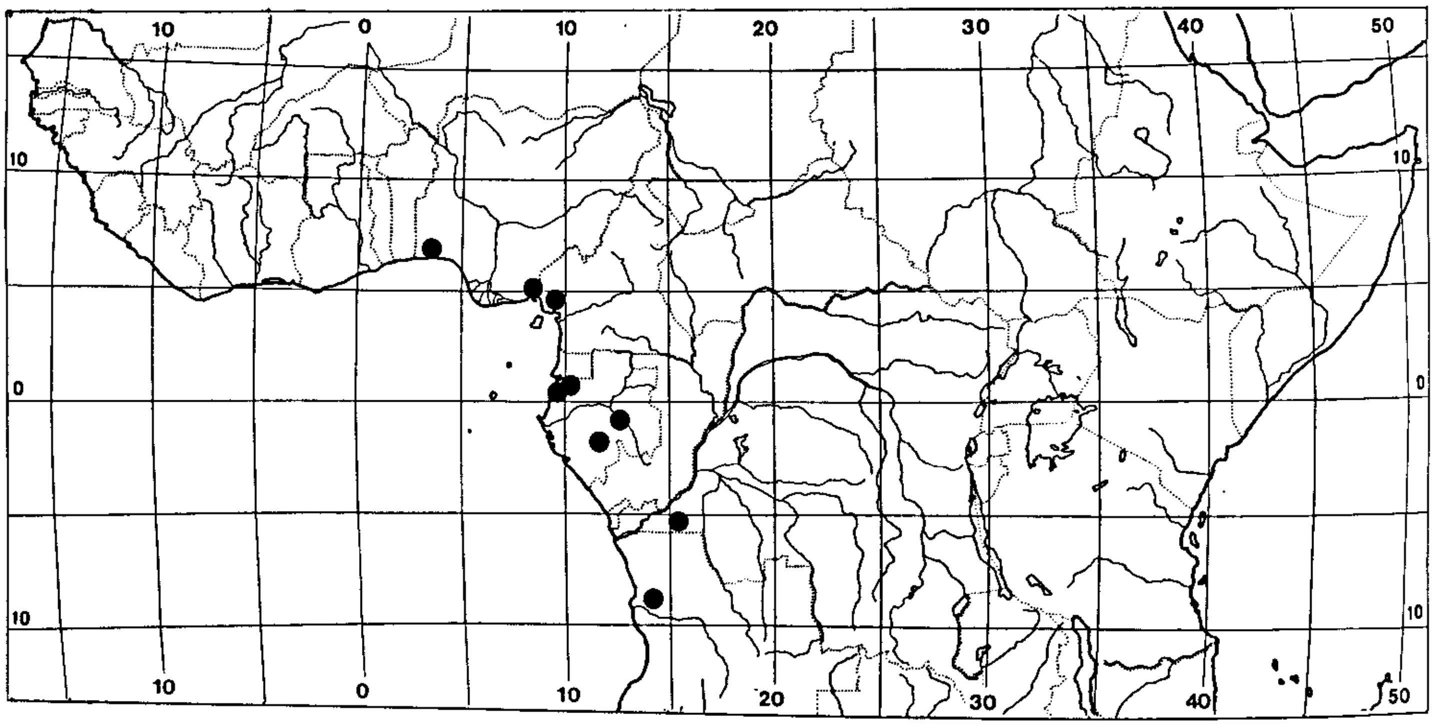


Fig. 95. Distribution of *Cnestis mannii*

pilose; styles straight or curved, pilose at lower half; stigmata more or less oblique, 2-lobed. *Follicles* 1, sometimes 2 in fruit, narrowly ovoid or narrowly ellipsoid, oblique, 3-6.5 × 1-2.5 cm, cuneate, with 5-25 mm long, more or less distinct stipe at base; beak usually rather slender, 5-15(-20) cm long, distinctly separated; pericarp with short, red hairs and some longer, yellowish hairs outside and with long, easily caducous, yellowish hairs inside. *Seeds* ovoid, 20-25 × 10-15 mm, sarcotesta 7-11 mm long, ruminate.

Distribution: S Nigeria, SW Cameroun, Gabon, SW Zaire, NW Angola.

Ecology: Rain forest, occasionally in farmland. Flowering in Nigeria and Cameroun mainly from January to May, in Gabon and Zaire from September to October.

Specimens examined:

Nigeria: Ijebu Distr., Omo F.R. (y.fr.) *Ade-Oni FHI 39585* (K); Omo F.R., near Oloji (June) *Gentry & Pilz 32785* (MO, WAG); Old Calabar R. (fl. Feb.) *Mann 2264* (K, P, type); Ijebu-Ode, Ogun, Omo F.R. (y.fr. May) *Odewo & Adedeji 245* (WAG); mile 52-53 Calabar-Mamfe (fl. Feb.) *Onyeachusim & Latilo 54021* (K, WAG); Ogun, Omo F.R., 3 km S of Alveru (fl.) *Pilz 2384* (K); Ijebu, Shasha F.R. (fl.) *Ross 198* (BM, G); Oban (fl.) *Talbot 1707* (BM, K, Z).

Cameroun: Kumba Distr., Mbalange, S Bakundu (fl. Jan.) *Binuyo & Daramola 35455* (K, P); near Banga, S Bakundu (fl. Mar.) *Brenan, Jones, Onochie & Richards 9328* (BM, K, P, type of *C. tomentosa*); SW Prov., Ejagam F.R. (fr.) *Maruhashi 101* (YA); Johann-Albrechts H. (fl.) *Staudt 916* (BM, G).

Gabon: Libreville, Sibange Farm (fl. Sept.) *Büttner 166* (P, type of *C. pseudoracemosa*); Cristal Mts (fr. Jan.) *J. de Wilde et al. 253* (LBV, WAG); (fr.) *J. de Wilde et al. 549* (LBV, WAG); (fr.) *J. de Wilde et al. s.n.* (WAG, spirit); Ogoué-Ivindo, La Nké (fl. Oct.) *Floret, A. Louis & Moungazi 1733* (LBV); Libreville (fl.b. Sept.) *Klaine 2364, 2365* (P); near Lastoursville (fl. Sept.) *Le Testu 8378* (BM, BR, LISC, P).

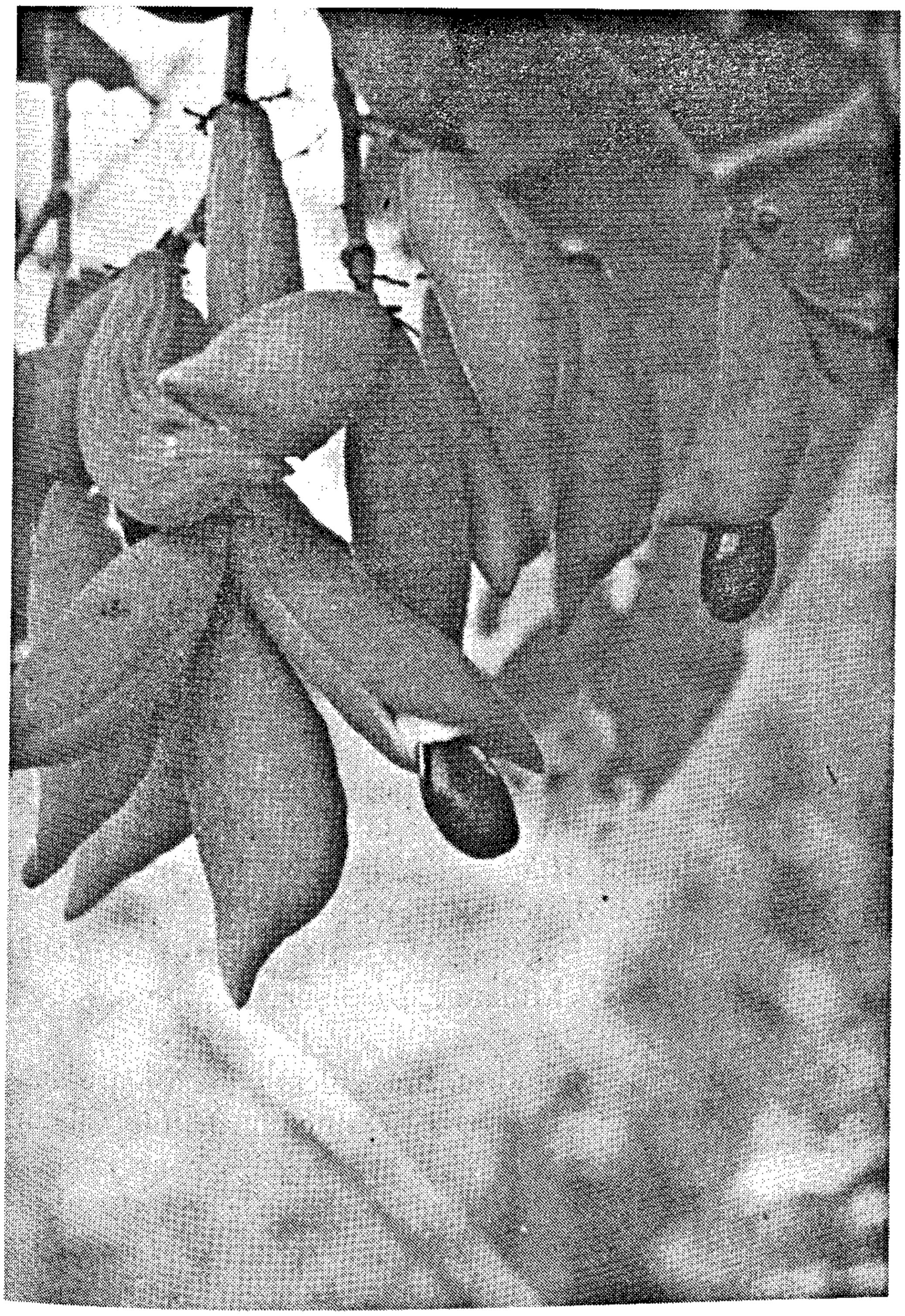


Fig. 96. *Cnestis mannii*: follicles (*J. de Wilde et al. 549*; phot. J.C. Arends).

Zaire: Bas-Congo, Gimbi (fl. Sept.) *Compère 393* (BR, K); Prov. Leopoldville, Thijsville, Kinganga (fl. Oct.) *Compère 684* (BR, K); Mankayi (fl. Oct.) *Devred 866* (BR, K); Kisantu (fl.) *Gillet 1420* (BR, type of *C. grandifoliolata*); Kisantu (fl. Sept.) *Vanderyst 25785, 25787* (BR); (fl.) *Vanderyst 35531, 35637* (BR).
Angola: Cuanza Norte, Loanda (fr.) *Gossweiler 750* (BM, K, P).

Note: The number of leaflets and their shape, size, venation and indumentum show a considerable variation. One form was described by Gilg (1891) as *Connarus pseudoracemosus*, based on a specimen collected in Gabon by Büttner. It is characterized by glabrous, comparatively small leaflets with few secondary nerves. Some other specimens from Gabon are close to this specimen in having glabrous, but larger leaflets (*Klaine 2364, J. de Wilde et al. 253*). *Le Testu 8378*, collected near Lastoursville resembles *Büttner 166* in size and shape of leaflets, but the leaflets are somewhat pubescent beneath. Another more or less extreme form was described by Hepper (1956) as *C. tomentosa*. It is characterized by the comparatively large number of leaflets (up to 11), which are softly tomentose beneath. In fact, in *C. mannii* the indumentum of the leaflets beneath can vary from glabrous to densely pilose, and the hairs can be short to long.

The flowers are quite uniform in comparison to other species.

Only 5 specimens with mature fruits have been collected: 3 in Gabon, one in Cameroun, and one in N Angola. Consequently, the variation in the fruits is insufficiently known. In the few fruiting specimens examined the variation in size and shape of the follicle is considerable.

Under these circumstances it is not possible to maintain the species proposed by Gilg and Hepper.

It is remarkable that this species is apparently rare everywhere in its comparatively large range of distribution; there is not much material available.

Cnestis mildbraedii Gilg **Fig. 97, 98**

C. mildbraedii Gilg, 1911: 229; Schellenberg, 1938: 43; Troupin, 1952: 122. Type: Zaire, between Beni and Irumu, *Mildbraed 2842* (holo: B†), neo: Sudan, Lotti Imatong Mts, *A. Thomas 1759* (BM; iso: BR, K). See note 1.

C. ugandensis Schellenberg, 1938: 44; Eggeling, 1952: 100; Hemsley, 1956: 2. Type: Uganda, Mengo Distr., Mabira F., Mulange, *Dümmer 5422* (holo: K).

Large shrub or small tree. *Branches* cylindric, branchlets with longitudinal grooves, brown-pilose, later glabrescent. *Leaves* 12-18-jugate; petiole 4-8 cm, rachis 26-31 cm long in full-grown leaves, yellowish brown-pubescent. Leaflets papery, lateral ones in basical part of leaf more or less opposite and often full-grown long time before alternate leaflets in apical part, narrowly ovate or narrowly oblong, 3.5-14 × 1.5-3 cm, rounded and (very) unequal at base, terminal one narrowly obovate or narrowly elliptic, 4.5-8 × 1.5-3 cm, cuneate at base; all leaflets obtuse or shortly acuminate, when young pilose but often glabrescent above, rather densely pilose beneath, midrib impressed above, prominent beneath, with 7-12 lateral nerves on each side; tertiary nerves reticulate, indistinct; petiolules 2-2.5 mm long, pubescent. *Inflorescences* racemes or sometimes panicles, 1-20 per leaf-axil on young and older branches, 7-17 cm long, 15-30-flowered, yellowish brown-pilose. Bracts subulate to linear, 2.5-3 mm long. *Pedicels* articulated 2-3 mm below the calyx, densely pilose. *Sepals* never reflexed, narrowly imbricate in bud, narrowly (ob)ovate or narrowly oblong, 5.0-6.0 × 1.5-2.5 mm, obtuse, flat, yellow-pilose outside, glabrous or sometimes minutely pubescent inside. *Petals* narrowly imbricate in bud, elliptic or (narrowly) oblong, 5.5-6.0 × 2.0-3.0 mm, cuneate at base, distinctly retuse at top, glabrous, indistinctly veined. *Stamens* free, distinctly differing in length in the two whorls, 1.0-5.0 mm long, anthers ca 0.4 × 0.3 mm. *Pistils* 1.0-5.2 mm long;

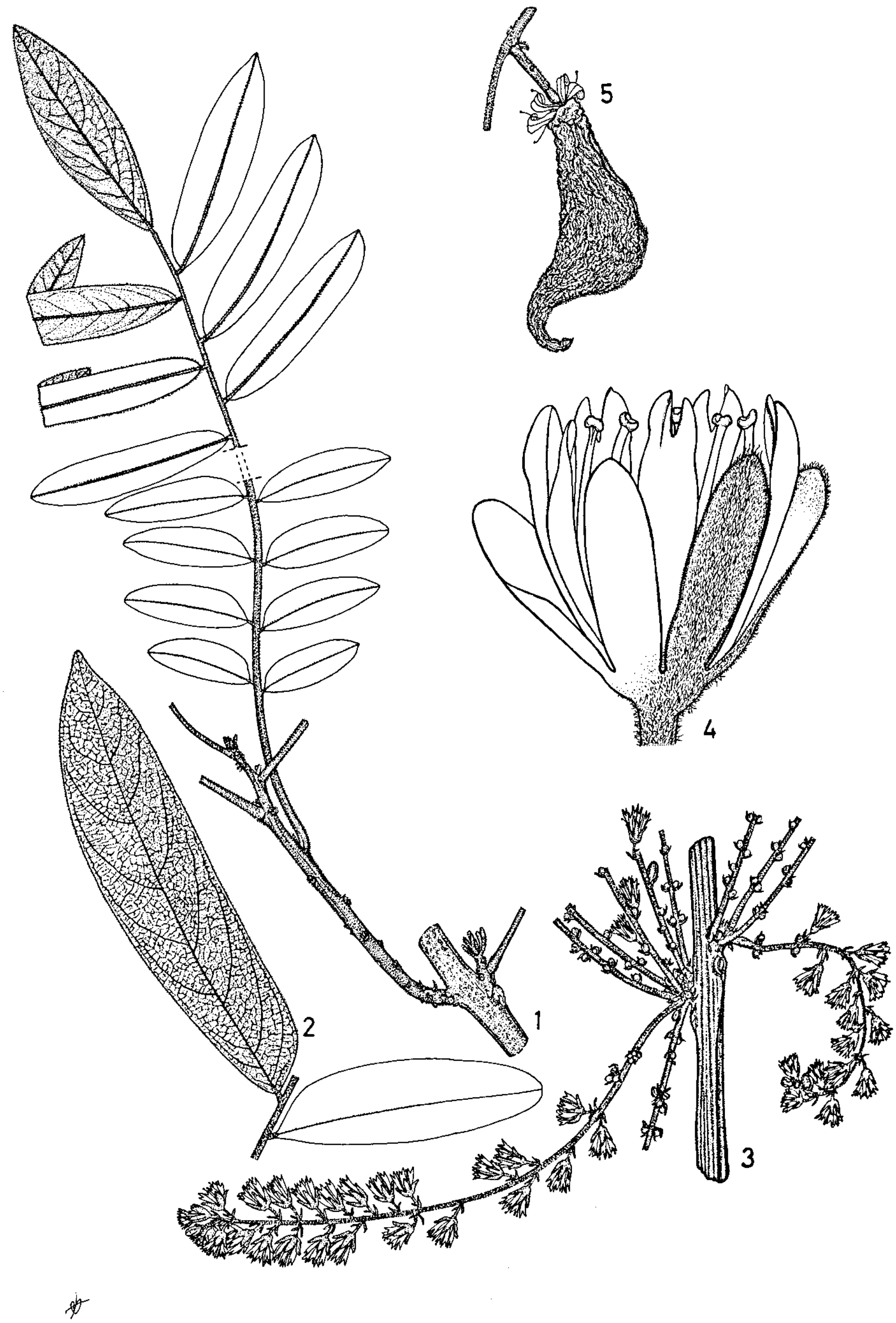


Fig. 97. *Cnestis mildbraedii*: 1. branch with young leaf, 2/3 ×; 2. leaflets beneath of full-grown leaf, 2/3 ×; 3. branch with inflorescences, 2/3 ×; 4. flower, 6 ×; 5. follicle, 1 × (1-2,5. *A. Thomas 1759*; 3-4. *Eggeling 1553*).

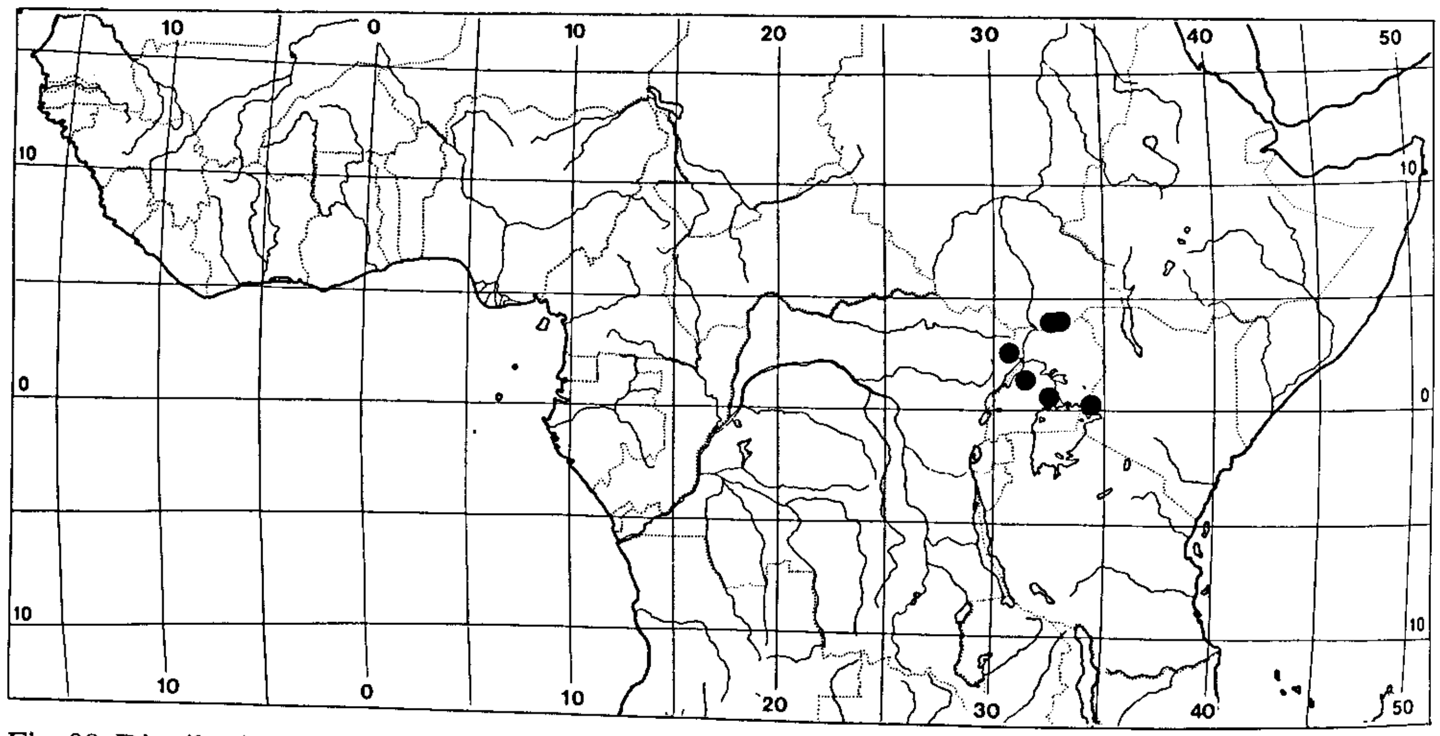


Fig. 98. Distribution of *Cnestis mildbraedii*

ovaries ca 0.7 mm long, yellowish-pilose; styles straight, pilose at lower half; stigmata oblique. *Follicles* 1 in fruit, (narrowly) ellipsoid, oblique, 3-3.5 × 1 cm, cuneate, with ca 5 mm long stipe at base; beak slender, ca 10 mm long, distinctly separated; pericarp with rather short, scarlet hairs outside. *Seeds* not seen.

Distribution: S Sudan, NE Zaire, Uganda, W Kenya.
Ecology: Forest, 1000-2000 m altitude. Flowering from August to December.

Specimens examined:

Sudan: Equatoria, Torit, Lotti F. (fr. Feb.) *Jackson 1020* (B); Lotti Imatong Mts (fr. Dec.) *A. Thomas 1759* (BM, BR, K, type).
Uganda: Mengo Distr., Mabira F., Mulange (fl. Aug.) *Dümmer 5422* (K, type of *C. ugandensis*); Bunyoro Distr., Budongo F. (fl. Dec.) *Eggeling 1553* (= *1468*) (BR, K); Buganda, Infranga F. (July) *Kertland s.n.* (K).
Kenya: Kibiri Block, Kakamega F., S side of Yala R. (Jan.) *Faden 70/29* (EA).

Notes: 1. The holotype of *C. mildbraedii* Gilg was destroyed in Berlin. This was the only specimen cited by Gilg and by Schellenberg. The description of *C. mildbraedii* fits that of *C. ugandensis* Schellenberg as well as the specimens examined. In my opinion, there is no doubt that *C. mildbraedii* and *C. ugandensis* are conspecific. The type locality of *Mildbraed 2842*, the holotype, is linked to the area of distribution of *C. ugandensis* as well.
2. The specimens *Kertland s.n.* (from Uganda) and *Faden 70/29* (from Kenya) are sterile. The leaves of these specimens resemble the leaves of flowering and fruiting material to such an extent that they undoubtedly belong in *C. mildbraedii*. *Faden 70/29* is the first record from Kenya.

3. The flowers are probably heterodistylous, but this is not certain; only two flowering specimens were available.

Cnestis palala (Lour.) Merr. **Fig. 99**

C. palala (Lour.) Merrill, 1922: 201; 1935: 184; Schellenberg, 1938: 36; Andreas & Prop, 1954: 612; Leenhouts, 1958b: 499; Pancho, 1983: 397.

Basionym: *Thysanus palala* de Loureiro, 1790: 284 p.p. (excl. syn. Rumphius).

Type: S Vietnam, Tourane (Da Nang), *Clemens 3805* (neo design. by Merrill, 1935: BM, K, P).

C. palala (Lour.) Merr. subsp. *diffusa* (Blanco) Andreas, 1954: 613; Leenhouts, 1958b: 499. For type see under *C. diffusa*.

C. diffusa Blanco, 1837: 386; Schellenberg, 1938: 38. Type: Philippines, Luzon, *Cuming 951* (neo design. by Schellenberg, 1938: K; iso: BM).

C. platantha Griffith, 1854: 434; Andreas & Prop, 1954: 614; Leenhouts, 1958b: 499. Type: Malay Penins., *Griffith 1256* (lecto design. by Andreas & Prop, 1954: K).

C. annamensis Gagnepain, 1952: 207. Type: N Vietnam, Vinh, *Chevalier 32450* (holo: P).

For complete synonymy and literature see Leenhouts (1958b).

Liana up to 25 m long, large shrub (often climbing) or small tree, up to 10 m high. *Branches* cylindric, branchlets often somewhat angular, densely brown-pilose, later more or less glabrescent. *Leaves* 6-21-jugate; petiole 1-7 cm, rachis 7-30(-38) cm long, densely brown-pilose. Leaflets papery, lateral ones opposite or more or less alternate, (narrowly) ovate or (narrowly) oblong, (1-)1.5-8 × 0.7-2.5 cm, rounded, truncate or subcordate and unequal or not at base, terminal one (narrowly) elliptic or (narrowly) obovate, 3-8 × 1-3 cm, rounded or cuneate at base; all leaflets rounded to acuminate, pilose (especially when young) or glabrous above, densely pilose beneath, midrib impressed above, prominent and densely pilose beneath, with 5-15 often indistinct lateral nerves on each side; tertiary nerves reticulate, usually indistinct; petiolules 0.5-1.5 mm long, pilose. *Inflorescences* racemes or panicles, a few to many per leaf-axil on older branches, 2-8 cm long, 10-35-flowered, densely yellowish brown-pilose, mostly also with glandular hairs. Bracts subulate, 0.5-2 mm long. *Pedicels* articulated 0-6 mm below the calyx, densely pilose, mostly also with glandular hairs. *Flowers* obscurely heterodistylous, often almost homostylous. *Sepals* never reflexed, narrowly imbricate or more or less valvate in bud, narrowly ovate or narrowly oblong, 2.0-5.0 × 0.5-1.0(-1.3) mm, acute or obtuse, often inflexed at top, densely brown-pilose with usually also many glandular hairs outside, pubescent inside. *Petals* imbricate in bud, (ob)ovate or elliptic to narrowly oblong, (0.6-)2.0-4.0(-5.1) × (0.5-)0.8-1.5 mm, cuneate or rounded at base, rounded, truncate or retuse at top, glabrous or with some long hairs in basal part outside, glabrous inside, indistinctly veined. *Stamens* free or very shortly united at base,

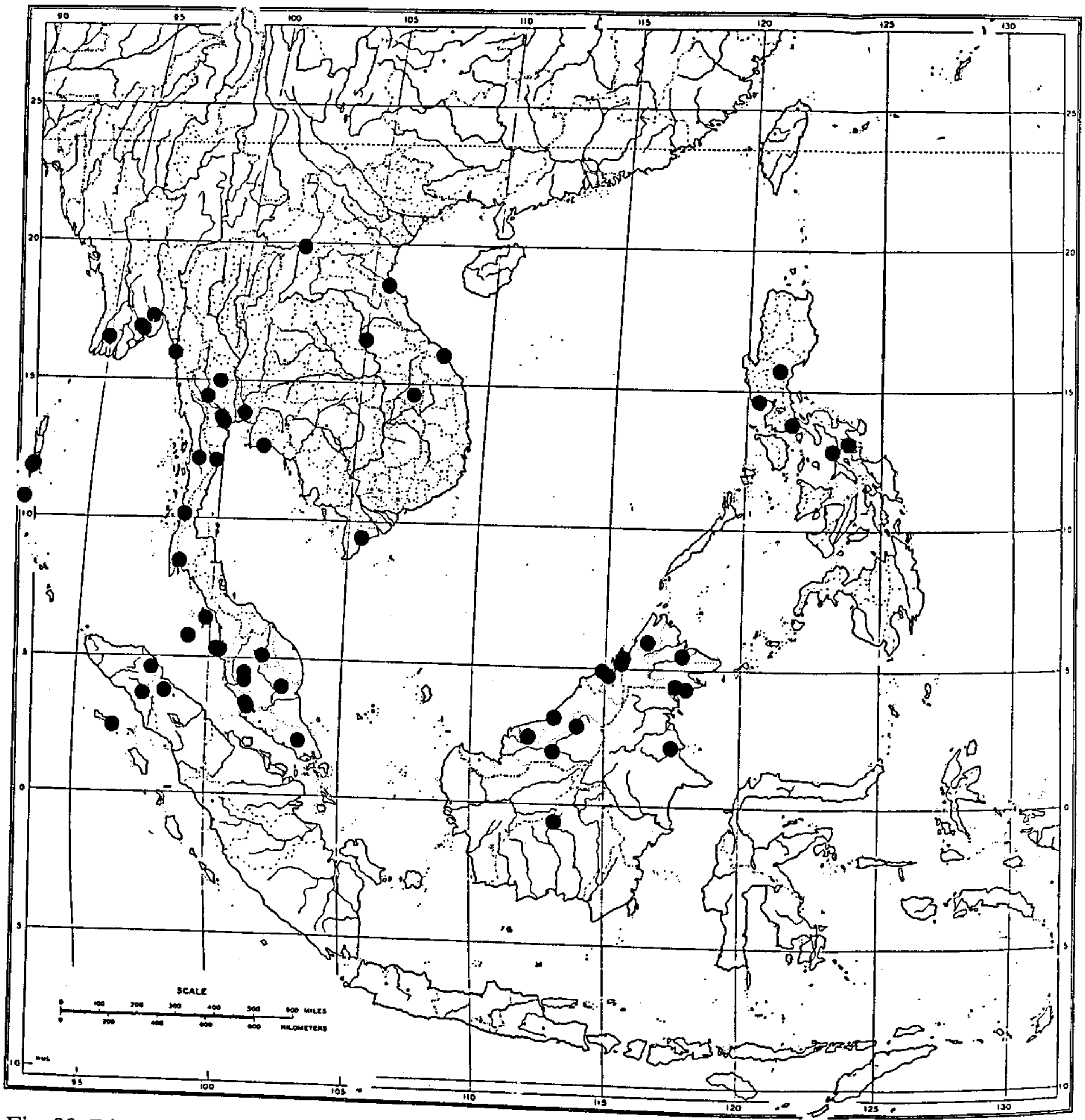


Fig. 99. Distribution of *Cnestis palala*

slightly differing in length in the two whorls, 0.5-2.0(-4.0) mm long, anthers ca 0.2 × 0.2 mm. *Pistils* 1.0-2.0(-3.5) mm long; ovaries ca 0.5 mm long, yellowish brown-pilose; styles straight or curved, often pilose in basical part; stigmata oblique or not, prominent or not, more or less 2-lobed. *Follicles* 1-3 in fruit, ellipsoid, obovoid or pyriform, more or less oblique, 2.5-6 × 1-2.5 cm, cuneate, with short or long (up to 25 mm) stipe at base; apex rounded or with up to 10(-15) mm long, more or less distinctly separated beak; pericarp thick and firm, with fairly long, rather soft, red hairs outside and long yellowish hairs inside. *Seeds* ovoid, sometimes oblique, 15-30 × 8-15 mm, sarcotesta 5-15 mm long, ruminate.

Distribution: S Burma, Thailand, S Laos, Vietnam, N Philippines, Andaman

Islands, Malaysia and Indonesia (Sumatra, Borneo; also recorded by Leenhouts (1958b) from Celebes).

Ecology: Rain forest, primary or secondary; riverain or marsh, sometimes dry forest; occasionally also in thickets. Flowering in Burma, Thailand and Laos mainly from October to January, Vietnam February to October, Philippines mainly January to April, Andaman Islands November to May, Malay Peninsula mainly October to March, Sumatra February to April, Borneo April to September. Fruiting some months later.

Selection of the ca 175 specimens examined:

Burma: Tenasserim, *Falconer 94* (L); (fr.) *Falconer s.n.* (K, L); sin. loc. (fl., fr.) *Griffith 1254* (K, P); Pegu (fr.) *Kurz 1990* (L); Myaungmya Distr. (fr.) *Lace 2988* (K); Amherst Distr. (fr. Feb.) *Lace 5697* (K); Rangoon (fl. Oct.) *Maingay 510/2* (K); Syriam, Ale Ywa (fl. Nov.) *McKee 5800* (K, P).

Thailand: Bangkok, Chak Jai-Sriracha F. (fl.b. Nov.) *Collins 1701* (BM); Phangnga, Khlong nang yon (fr. Apr.) *Geesink & Santisuk 5027* (L); Prov. Rayong, Ban Phe (fl. Dec.) *Geesink & Hiepko 7867* (K, L); Penins. Ranong, Kapur (fl. Dec.) *Indrapong & Smitinand 99* (K, L, P); Doi Dui Dong (fr. Mar.) *Kerr 3157* (BM); Rat Buri (fr. Mar.) *Kerr 10633* (BM, K); Prov. Utai Thani, Ban Rai (fr. Feb.) *van Beusekom & Santisuk 2959* (L, P).

Laos: Attopeu (fl. Jan.) *Harmand 30* (L, P); Central Laos, Mekong R. (fl.) *Harmand s.n.* (L); km 20 Savannakhet-Quangtri (fl., y.fr. Jan.) *Polaine 11689* (K, L); (fl., y.fr.) *Polaine 11862* (K, L).

Vietnam: Tongking, Kiên Khê (fl. Aug.) *Bon 3021* (L); (fr. Dec.) *Bon 4076* (L); Vinh (y.fr.) *Chevalier 32450* (P, type of *C. annamensis*); Tourane (fl. July) *Clemens 3805* (BM, K, P, type); Vinh (fr. May) *Fleury 32450* (P, WAG); Tongking, Cho Ganh (fl. Oct.) *Pètelot 1177* (K, L); (fl. Sept.) *Pètelot 1447* (K, L); Gia Rai (fl. Feb.) *Polaine 2519* (P).

Philippines: Luzon, Prov. Bataan, Lamao R. (fl. Feb.) *Borden 290* (P); Burias I. (y.fr. June) *Clark 20188* (K); Prov. Albay (fl.) *Cuming 951* (BM, K, type of *C. diffusa* and *C. palala* subsp. *diffusa*); Prov. Tayabas (fl. Mar.) *Edaño 26943* (BM, K); Prov. of Laguna, Los Baños (fr. Apr.) *Elmer 8267* (K); Prov. Union, Bauang (fr.) *Fenix 127* (K); Rizal Prov., Antipolo (fl. Jan.) *Merrill 252* (BM, K, L, P); Rizal Prov., Tanay (fr. Mar.) *Merrill 2341* (K); Prov. Bataan, Lamao R. (fr. May) *Whitford 24037* (K).

Andaman Islands: Little Andaman, Hut Bay (fl. Jan.) *Bhargava 3427* (L); S Andaman (fl. May) *Heinig 640* (L); S Andaman, Corbye's Cove (fl. Feb.) *King's Collector s.n.* (BM); North Bay (fl. Jan.) *King's Collector s.n.* (K); Dhani Khari (fl. Nov.) *King's Collector s.n.* (L); Carbyns Cove (fr. Apr.) *Nair 3656* (L).

Malaysia: Malay Penins.: Ulu Selangor, Semangkok F.R. (fr. May) *Chan FRI 13313* (L); Penang (fl. Jan.) *Curtis 145* (K); sin. loc. (fl. Feb.) *Gaudichaud 89* (L, P); (fl. Feb.) *Gaudichaud 93* (P); Selangor, Kepong (fl. Feb.) *Gerus KEP 99476* (L); sin. loc. (fl., fr.) *Griffith 1254* (K, P); (fl.) *Griffith 1256* (K, type of *C. platantha*); Kelantan, Temangan (fr. June) *Khairuddin FRI 31792* (L); Penang (fl. July) *King's Collector 1330* (L); Perak, Larut (fr. Jan.) *King's Collector 3759* (BM, K); sin. loc. (fr.) *Maingay 509* (BM, L); Kedah, Langkawi (fr. Feb.) *Millard KL 1413* (K, L); Johore, Sungei Bantang (fr. May) *Shah & Samsuri MS 1738* (K, L); Perak, road to Cameron Highlands (fr. Aug.) *Stone 7290* (L); Kedah, Langkawi (fr. Mar.) *Stone 15037* (L); Penang (fl., fr.) *Wallich 8529B* (K, P).

Malaysia: Sabah (N.Borneo): Tawau, Kalumpang Balong (fr. June) *Bakar Hussin SAN 18514* (L); Tawau (fl.) *Elmer 20995* (BM, L, P); (fr.) *Elmer 21482* (BM, L); Distr. Lamag, Ulu Sg. Pin (fl. Sept.) *Madani & Saigol SAN 90980* (K, L); Distr. Tawau, Kalabakan (fr. June) *Meyer SAN 19251* (L); Distr. Ranau, Kg. Pinawantai (fr. May) *Shea & Aban SAN 76929* (L); Distr. Beaufort, Ulu Membakut (fr. Sept.) *Talib Bidin & Marsal SAN 86131* (K).

Malaysia: Sarawak (N.Borneo): Distr. Barau, Paku (fr. June) *Anderson 4021* (L); Belaga (fl. Apr.) *Ashton S 18270* (L); Distr. Bintulu, Simalajau (fr. Dec.) *Paie S 15829* (K, L); Melinau, Kapit (fl.b. Aug.) *Paie S 25812* (L); Limbang, Long Amok (fl. Sept.) *Rena George S 43010* (K, L); Limbang (fr. Oct.) *Wright & Ismawi S 32393* (K, L).

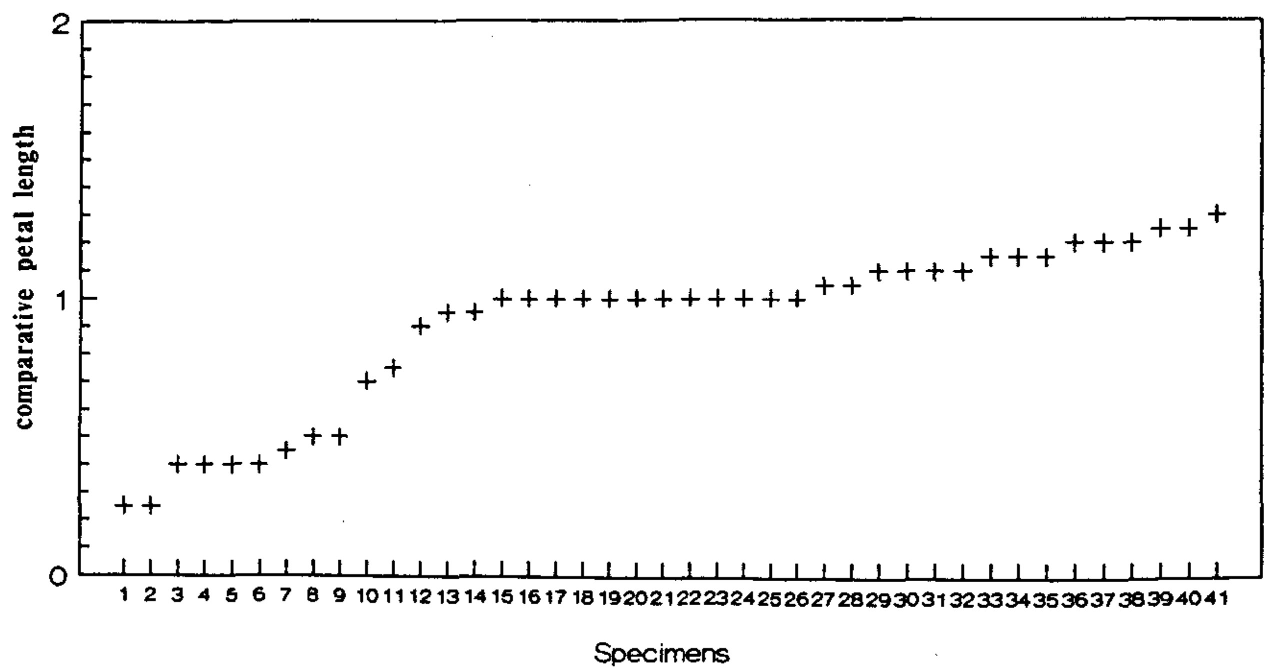


Fig. 100. Comparative petal length, expressed as percentage of sepal length, of 41 specimens of *C. palala*, arranged according to increasing length ratio.

Brunei (N.Borneo): Puteh, Tutong (fr. July) *Ashton BRUN 296* (L); Bangar, Temburong (fr. Sept.) *Ashton BRUN 493* (L).

Indonesia: Sumatra: Simeulue I., Tapah (Feb.) *Achmad 1695* (L); Atjeh, Ketambe, 35 km NW of Kutatjane (fr. July) *W. de Wilde 13929* (K, L); (fl. Feb.) *W. de Wilde 14512* (K, L); (fl. Feb.) *W. de Wilde 14548* (K, L); 75 km WNW of Medan (fr.) *W. de Wilde 19433* (K, L); Lampongs, Sepaetik (fr. Jan.) *Gusdorf 157* (K, L); sin. loc. (fl.b.) *Teysmann 4016* (K, L); sin. loc. (fr.) *Teysmann 4455* (L); Atjeh, from Pendeng via Oreng to Gadjah (fr. Feb.) *van Steenis 9337* (K, L).

Indonesia: Kalimantan (Borneo): S of Kwala Kwajan, S of Permantang (fr. Jan.) *Alston 13338* (BM, L); East Kutei, Mahakam Estuary (fr. July) *Kostermans 12509* (K, L); Berau (fr. Oct.) *Kostermans 21303* (L, P); upper Samba R., 60-80 km NNW of Tumbang Samba (fr. Nov.) *Mogea & W. de Wilde 3564* (L).

Note: Within the area of distribution *C. palala* varies in appearance from the North-West to the South-East. The petals are comparatively long in specimens from Burma to the Malay Peninsula and the Philippines, but short in those from the Malay Peninsula, Sumatra and Borneo. The follicles are often comparatively small and beaked in plants from Burma to the Malay Peninsula, small and not or hardly beaked in the Philippines and large, while they are not or hardly beaked in the Malay Peninsula, Sumatra and Borneo. Leaves are often larger and have more leaflets in Sumatra and Borneo than elsewhere.

Schellenberg (1938) distinguished two species in Asia: *C. palala* and *C. diffusa*, the latter being restricted to the Philippines.

Andreas & Prop (1954) and Leenhouts (1958b) reject Schellenberg's concept. They also propose a division in two species, but *C. diffusa* is merged with *C. palala* while *C. platantha* is considered to be different. This division is based on a discontinuity in the comparative length of petals (expressed as a percentage of sepal lenght).

Fig. 100 shows the distribution of this comparative petal length. The discontinuity between peaks (one at about 0.5 and one at about 1.0) is not as obvious

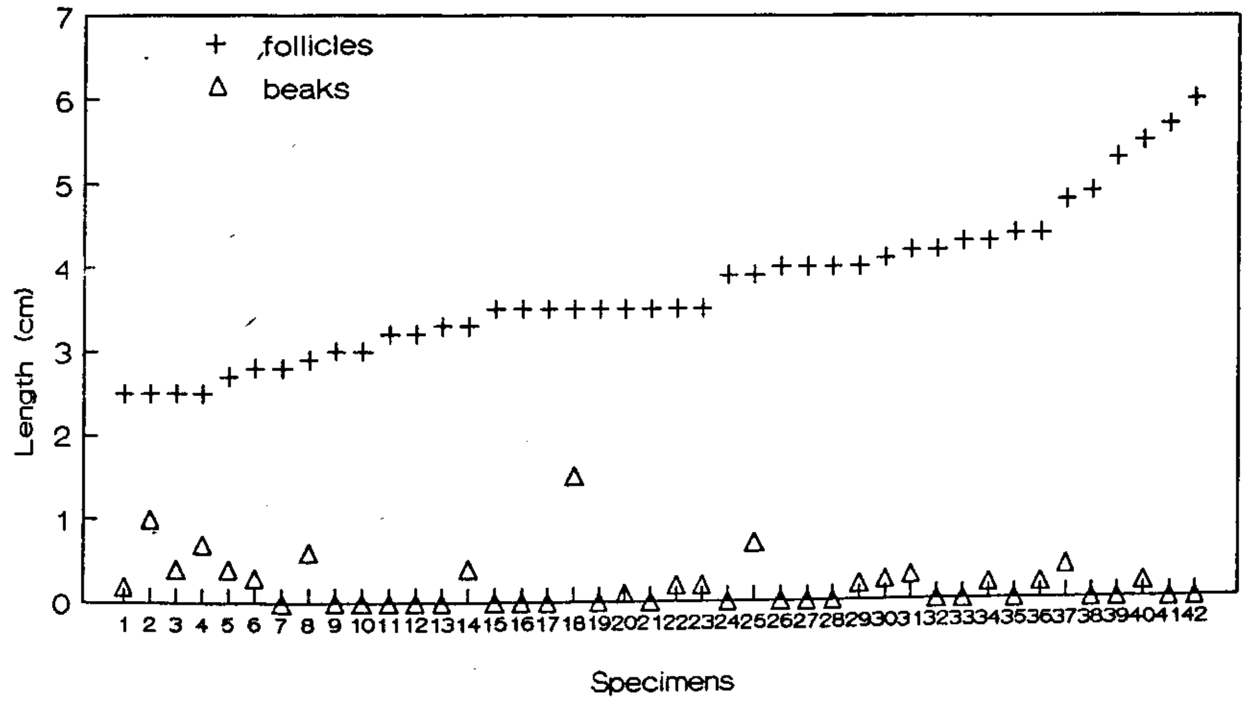


Fig. 101. Follicle and beak length of 42 specimens of *C. palala*, arranged according to increasing follicle length.

as suggested by Andreas & Prop. The difference in comparative petal length is not clear in the Malay Peninsula, as *Gaudichaud 89* and *93* are intermediate.

In his key, Leenhouts (1958b) additionally mentioned a difference in the inflorescences, these being racemose in *C. palala* and paniculate in *C. platantha*. In fact, the inflorescence is always paniculate, but sometimes reduced to a pseudoraceme, especially in specimens from the northern part of the area.

Andreas & Prop divide *C. palala* into two subspecies, subsp. *palala* with small, beaked follicles from the northern part of the area and subsp. *diffusa* with not or hardly beaked follicles from the Philippines and S Malaya, usually large, but small in the Philippines. Leenhouts (1958b) stated that fruiting specimens of *C. palala* subsp. *diffusa* and *C. platantha* cannot be distinguished with certainty. In fact, shape and size of the follicles do not show any discontinuity (see fig. 101), while the geographical segregation of the different forms does not hold. Some specimens from Burma and Thailand show scarcely beaked follicles (e.g. *Kurz 1990*, *Kerr 3157*), some from the Malay Peninsula (e.g. *Stone 15037*, *Maingay 509*) and Borneo (*Meyer SAN 19251*, *Mogea & W. de Wilde 3564*) have distinctly, however short, beaked follicles, while the fruiting specimens from the Philippines show small follicles lacking a distinct beak.

In my opinion this division of the Asiatic material into two species and one of these into two subspecies is not warranted and should not be maintained: it all belongs to one species, *C. palala*.

When compared to the African continent, where most species of *Cnestis* occur, a comparative variation in petal length is seen in *C. corniculata*, and to a lesser extent also in the shape of its fruits.

Uses: A decoction of the roots is drunk against stomach-ache, malaria and after childbirth; external it is used to cure sprains and (possibly) gonorrhoea

(Burkill, 1966). According to Leenhouts (1958b) seeds and possibly also fruits are eaten. But seeds have also been recorded to be poisonous to dogs (notes on herbarium sheets; possibly a confusion with *Rourea sp.* of which seeds are poisonous to carnivorous animals).

Cnestis polyphylla Lam. **Fig. 102, 103**

C. polyphylla Lamarck, 1789: 23, pl.387: fig.2; De Candolle, 1825: 87; G. Don, 1832: 91; Planchon, 1850: 440; Walpers, 1852: 306; Baillon, 1867: 243; Baker, 1877: 65; Baillon, 1882: 346; de Lanessan, 1886: 530; Drake del Castillo, 1902: 33; Palacky, 1907: 57; Schellenberg, 1910: 13; 1915: 318; 1938: 39; Keraudren, 1958: 20, fig.5(2-4); Irvine, 1961: 572.

Type: Madagascar, *Commerson s.n.* (lecto: herb. De Jussieu: P). See note 2.

C. polyphylla Lam. var. *bullata* Baillon, 1867: 243; 1882: 346. Type: Madagascar, St.Marie I., *Boivin 1889* (lecto design. by Baillon, 1882: P).

C. glabra Lamarck, 1789: 23, pl.387: fig.1; De Candolle, 1825: 87; G. Don, 1832: 91; Planchon, 1850: 440; Walpers, 1852: 306; Baillon, 1867: 243; Baker, 1877: 64; Baillon, 1882: 346; de Lanessan, 1886: 530; Baillon, 1887: tab.16a; Drake del Castillo, 1902: 34; Palacky, 1907: 57; Schellenberg, 1910: 13; 1915: 318; 1938: 40; Keraudren, 1958: 22, fig.5(5-7). Type: Mauritius, *Commerson 599* (lecto design. by Schellenberg, 1938: P; iso: L).

C. scandens Gmelin, 1791: 729. Homotypic synonym of *C. glabra*.

C. borbonensis Raeuschel, 1797: 132 (nomen).

C. madagascariensis Raeuschel, 1797: 132 (nomen).

C. natalensis (Hochstetter) Planchon ex Sonder, 1860: 528; Gilg, 1896: 215; Schellenberg, 1910: 14; Baker f., 1911: 50; Schellenberg, 1915: 318; Burtt Davy, 1932: 511; Schellenberg, 1938: 40; Wild, 1953: 65; Mendes, 1966: 616, fig.130; Mendes, 1969: 2. Basionym: *Zanthoxylum natalense* Hochstetter in Krauss, 1844: 304; Sonder, 1850: 24 ; Schellenberg, 1910: 14 (as *Xanthoxylum natalense* in syn.); 1938: 40 (as *Xanthophyllum natalense* in syn.). Type: S African Republic, Natal, between Umlaas R. and Port Natal (Durban), *Krauss 60* (holo: K). See note 3.

C. lurida Baillon, 1867: 244; 1882: 346; Drake del Castillo, 1902: 34; Palacky, 1907: 57; Schellenberg, 1910: 15; 1938: 40; Keraudren, 1958: 17, fig.4(6-10). Type: Madagascar, Nossi-Bé I., *Boivin s.n.* (holo: P).

C. bullata Baillon, 1886: pl.17. For type see under *C. polyphylla* var. *bullata*.

C. boiviniana Baillon (1882: 346, nomen) ex Schellenberg, 1938: 39; Keraudren, 1958: 18. Type: Madagascar, St.Marie I., *Boivin s.n.* (holo: P).

Omphalobium discolor Sonder, 1850: 24 (nomen, in syn.).

Sarmienta cauliflora Sieber, nomen in sched.; Baillon, 1867: 243 (in syn.).

Liana or shrub, usually climbing. *Branches* cylindric, usually distinctly lenticellate, branchlets cylindric, usually densely brown-, rarely grey-pilose, later more or less glabrescent. *Leaves* 4-14-jugate; petiole (0.3-)1-10 cm, rachis 4-25

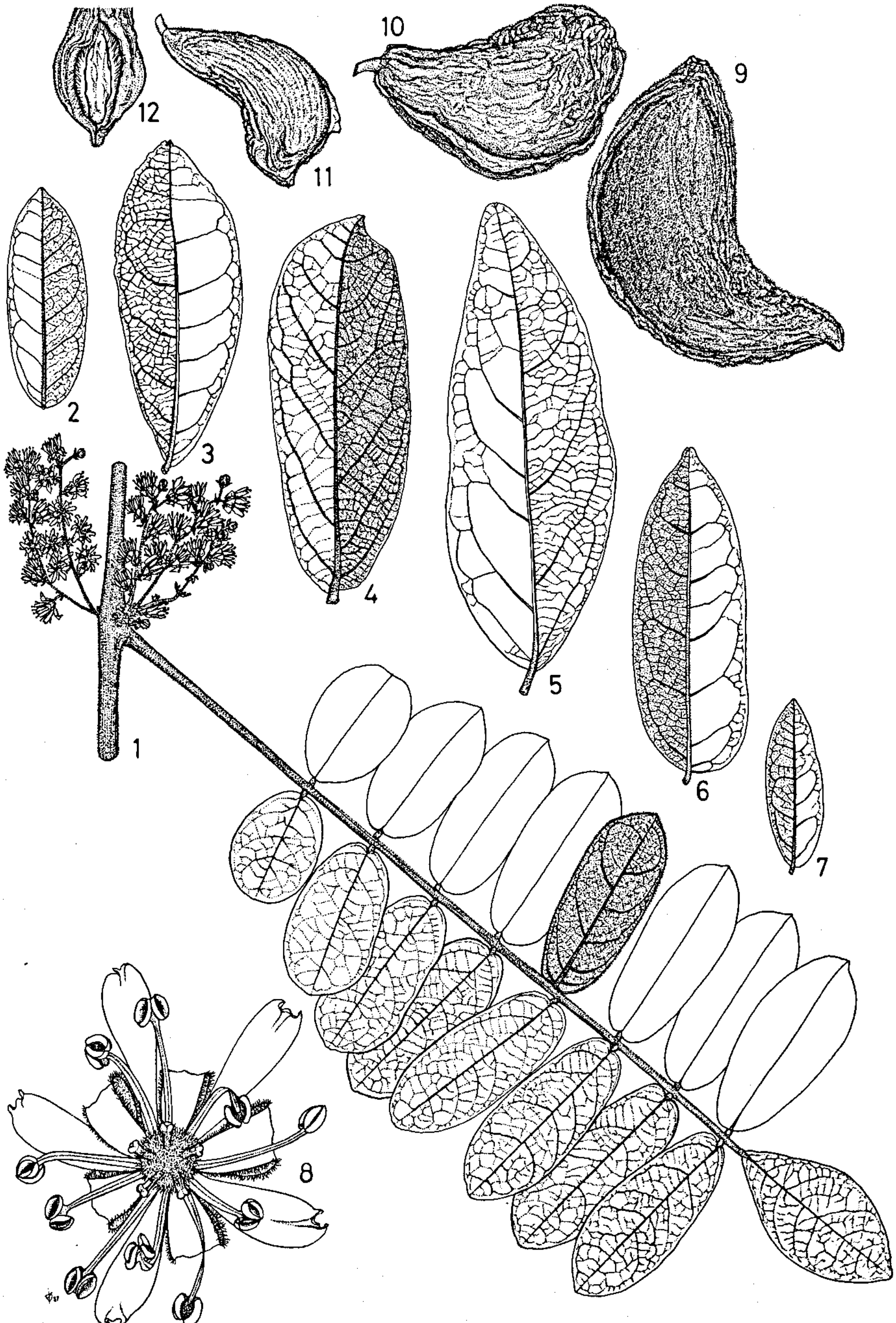


Fig. 102. *Cnestis polyphylla*: 1. flowering branch, 2/3 ×; 2-7. leaflets beneath, 2/3 × (2 former *C. lurida*, 4 former *C. boiviniana*, 5 former *C. glabra*, 7 former *C. natalensis*); 8. flower, 8 ×; 9-12. follicles, 2 × (9 former *C. natalensis*; 1. *Humbert 17574*; 2. *Perrier de la Bathie 6319*; 3. *Humbert 5735*; 4. *Boivin s.n.*; 5. *Commerson s.n.*; 6. *Kokwaro 3920*; 7. *Jalpin 14610*; 8. *Rakstomama 5879*; 9. *Ward 2830*; 10. *Faden 72/68*; 11-12. *Bosser 17013*).

cm long, brown- or grey-pilose, sometimes glabrescent. Leaflets papery or more or less leathery, lateral ones often alternate, (narrowly) ovate, elliptic or oblong, 1-14(-18) × 0.7-4.5(-7.5) cm, cuneate or rounded, sometimes truncate and unequal or not at base, terminal one (narrowly) obovate or elliptic, 2-13(-15.5) × 1-4.5(-7.5) cm, cuneate or rounded at base; all leaflets acuminate, obtuse or retuse, glabrous or rarely somewhat pubescent above, glabrous or more or less densely white-, brown- or sometimes grey-pilose beneath, midrib impressed above, prominent beneath, mostly pilose on both sides, with 6-12 lateral nerves on each side; tertiary nerves reticulate, usually distinct on both sides; petiolules 1-6 mm long, glabrous or pilose. *Inflorescences* racemes or panicles, up to 15 per leaf-axil on older or young branches, more rarely the supporting leaves reduced resulting in a compound pseudoterminal inflorescence, 3-10 cm long, 5-30-flowered, brown-pilose. Bracts ovate to subulate, 1-2 mm long, frequently with long hairs at top. *Pedicels* articulated (0-)1-3(-5) mm below the calyx, pilose. *Flowers* heterostylous, possibly intermediate between heterodi- and heterotristylous. *Sepals* reflexed, imbricate in bud, narrowly ovate, 2.5-5.0 × 1.0-2.0 mm, acute, flat, brown-pilose outside, glabrous or pubescent outside. *Petals* valvate in bud, (narrowly) obovate, (1.5-)2.0-4.0(-4.5) × 0.5-1.5 mm, cuneate at base, obtuse, truncate or retuse at top, glabrous or with some long hairs in basal part outside, glabrous inside, indistinctly veined. *Stamens* free, slightly differing in length in the two whorls, (1.0-)1.5-4.0 mm long, anthers 0.4-0.5 x 0.3-0.4 mm. *Pistils* 1.0-4.5 mm long; ovaries 0.5-1.0 mm long, yellowish pilose; styles straight or curved, pilose in basical part; stigmata more or less prominent, usually oblique, 2-lobed. *Follicles* 1(-5) in fruit, obovoid or ellipsoid, more or less oblique, (1-)1.5-2.5 × 0.7-1.0 cm, cuneate or rounded at base; apex rounded, acute or mucronate, sometimes with a short beak up to 4 mm long; pericarp with short or fairly long, rather soft, red hairs outside and long, easily caducous, stinging, yellowish hairs inside. *Seeds* ovoid, 8-18 × (3-)5-9 mm, sarcotesta 3-9 mm long, ruminate.

Distribution: S Kenya, E Zimbabwe and adjacent Mozambique, the eastern part of the S African Republic, Madagascar, Reunion and Mauritius.

Ecology: Forests, also in shrubby vegetations on rocky slopes, both in wet and in dry places, from 0-2000 m. Flowering mainly from August to December, in Kenya from December to March.

Selection of the ca 150 specimens examined:

Kenya: Kwale Distr., Jadini F., 30 km S of Mombasa (fl., fr. Jan.) *Faden & Faden 72/68* (EA, K); Diani F., 30 km S of Mombasa (fl., fr. Mar.) *Kibuwa 1207* (BR, EA, K); Ukunda-Jadini, 30 km S of Mombasa (fl., fr. Mar.) *Kibuwa 1218* (BR, EA, K); Diani F. (fl. Dec.) *Kokwaro 3920* (BR, EA, K); Jadini-Mombasa (fr.) *Robertson 4366* (EA, K, WAG); (fl.b.) *Robertson 5098* (EA, K, WAG).

Zimbabwe: Distr. Melsetter, Chisengu F. R. (fr. Dec.) *Armitage 176* (SRGH); Distr. Chipinga (fl. Dec.) *Goldsmith 52/65* (SRGH); Chirinda Outskirts (fl. Dec.) *Swynnerton 166* (BM, K, Z); Msasa Kop (fl. Sept.) *Taylor 1740* (E, SRGH); Chirinda (fr.) *Wild 2079* (BR, K); *Wild 2126* (BR, K, SRGH).

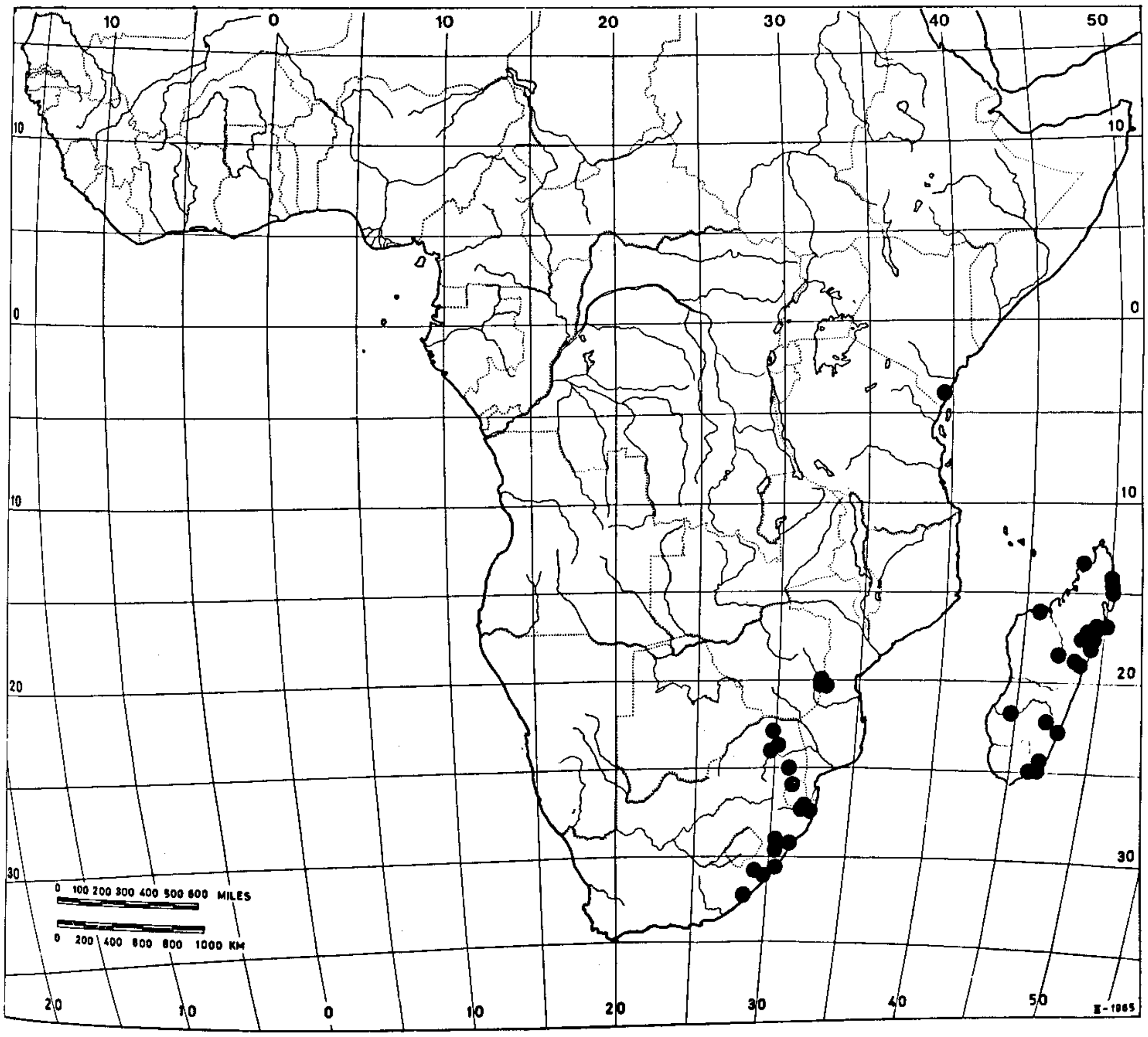


Fig. 103. Distribution of *Cnestis polyphylla*

Mozambique: Distr. Manica es Sofala, Mossurize, Espungabera (fl. Aug.) *Pimenta 13* (K, LISC, SRGH); Mt Marruma (fl. Sept.) *Swynnerton 1348* (BM, K).

S African Republic: Pondoland, Umfuta (fl.) *Bachmann 548* (E); Natal, Ubombo (fr. Nov.) *Botha & van Wijk 1128* (PRE); Transvaal, Bourkes Luck Potholes (fr. Dec.) *Burchmore LN 1149* (PRE); Swaziland, Piggs Peak (fl. Sept.) *Compton 31560* (K, M, PRE); Natal, Etonjaneni (fl. Nov.) *Edwards 2309* (K); Natal (fr.) *Gerrard 1098* (BM, K); Port Natal (fl.) *Gueinzius 54* (C, P); Transkei, N of Umtata (fr. Dec.) *Hilliard & Burtt 18781* (E); Bothas Hill (fl. Sept.) *Hutchinson 4651* (K); Transvaal, Pilgrims Rest (fr. Dec.) *Jalpin 14610* (PRE); Port Natal (fr.) *Krauss 60* (K, type of *C. natalensis*); Natal, Mbombe area (fr. Nov.) *Mthonti 1b* (PRE); Distr. Kentani (fl., fr. Sept.) *Pegler 803* (PRE, Z); Transvaal, Haenertsburg (fr. Nov.) *Pott 13389* (PRE); Natal, Maritzburg (fl.) *Rehmann 7534* (Z); Natal, Alexandra (fl. Sept.) *Rudatis 1119* (BM, K, L, P, WAG, Z); Transvaal, Distr. Letaba, Duivelskloof (fl. Sept.) *Scheepers 997* (BM, BR, K, M, PRE); Prov. Cape, Distr. Pondoland, Egossa F. (fl. Aug.) *Sim 2368* (PRE); Transkei, Mateku Waterfall (fr. Nov.) *Strey 10160* (K, WAG); Transkei, 9.6 km SW of Lusikisiki-Port St.Johns (fl. Aug.) *Venter & Vorster 157* (C, K, PRE).

Madagascar: Central Madagascar (fr.) *Baron 2403* (K); Cupania (fl. Aug.) *Baron 6759* (K); (fl.) *Baron 6761* (K); St.Marie I. (fr.) *Boivin 1888* (P); Nossi-Bé (fr.) *Boivin s.n.* (P, type of *C. lurida*); St.Marie I. (fl., fr.) *Boivin s.n.* (BM); St.Marie I. (fl.) *Boivin s.n.* (P, type of *C. boiviniana*); sin. loc. (fr.) *Boivin 1889* (P, type of *C. polyphylla* var. *bullata* and *C. bullata*); Foulpointe (fl., fr. Dec.) *Bosser 17013* (P); Nickelville (fr. Jan.) *Capuron 104* (P); Mandena, N of Fort Dauphin (fr.) *Capuron 370* (P); sin. loc. (fl., fr.) *Commerson s.n.* (P, type); Fenerive (fr. Nov.) *Debray 1875* (P); Belavenoke, Fort Dauphin (fl. Sept.) *Decary 10616* (P); 30 km N of Fort Dauphin (fr. Nov.) *den Outer & van Veenendaal 1182* (WAG); sin. loc. (fl.) *du Petit Thouars s.n.* (BM); sin. loc. (fl., y.fr.) *du Petit Thouars s.n.* (BM); SE of Alaotra L. (fl. Oct.) *Humbert 17574* (P); near Sambava (fr.) *Humbert & Capuron 24439* (K); Ambohoabé, Soanierana (fr. Dec.) *Lam & Meeuse 5669* (L); near Moramanga (fl. Aug.) *Perrier de la Bathie 18029* (K).

Reunion: Mare Longue, St.Philippe (fl.b. Oct.) *Bernardi 14500* (K, P, Z); sin. loc. (fl.b.) *Boivin 14101* (P); Dos d'Ane (fl. Dec.) *Bosser 20984* (P); Mare Longue, St.Philippe (fl. Oct.) *Cadet 4456* (P); sin. loc. (fl. Dec.) *Commerson s.n.* (P); St.Philippe (fl. Nov.) *Friedmann 2529* (K, P); sin. loc. (fl.) *Richard 37* (P); sin. loc. (fl., fr.) *Richard 58* (P).

Mauritius: sin. loc. (fr. Feb.) *Ayres s.n.* (K); sin. loc. (fl.) *Blackburn s.n.* (K); sin. loc. (fl., y.fr.) *Boivin 1562* (P); sin. loc. (fl. Aug.) *Boivin s.n.* (P); sin. loc. (fl.) *Bouton s.n.* (K, P); sin. loc. (fl., fr.) *Carmichael s.n.* (K); sin. loc. (fl., fr.) *Commerson 599* (L, P, type of *C. glabra*); sin. loc. (fl.b.) *Cunningham 364* (BM, K); near Mare aux Vacoas, Perrier Nature R. (fl. Oct.) *Lorence 1840* (K, P); sin. loc. (fl.) *Sieber Fl.M. 2 no.285* (BR, C, K, L, P).

Notes: 1. *C. polyphylla* is distributed in three well separated areas: Madagascar (including Mauritius and Reunion), SE Kenya and SE Africa. Especially in Madagascar, the species is strongly variable in number, size, shape and indumentum of the leaflets, length of the petiolules and position of the inflorescences.

Material with few, large, glabrous leaflets, long petiolules and inflorescences situated on the old branches was considered by many authors (e.g. Schellenberg, 1938; Keraudren, 1958) to represent *C. glabra*, material with numerous, small leaflets pilose beneath, and inflorescences situated on old and young branches to represent *C. polyphylla*. Analysis of the specimens now available shows that these species cannot be upheld as there are too many intermediate specimens.

According to Baillon (1867), *C. lurida* differs in the rounded apex of the comparatively small, almost membranous leaflets, which are greyish beneath. However, size and shape of the leaflets are close to *C. polyphylla*. The grey colour of the leaflets beneath is remarkable, but not related to other characters and does not warrant a separate specific status.

The specimen *Boivin s.n.*, type of *C. boiviniana*, fits also in *C. polyphylla*, although it is a fairly extreme form in having large obovate leaflets with a greyish indumentum beneath.

Material from SE Africa was described as *C. natalensis*. It differs from the material from Madagascar in the small, very oblique leaflets, relatively broad sepals often pilose inside, and an often somewhat larger follicle with a more or less distinct beak. Material from the isolated population in Kenya bridges the differences in characters of the leaflets, the sepals and the fruits between SE Africa and N Madagascar. This intermediate population makes it impossible to maintain the SE African taxon as distinct. See also chapter 2 on geographical distribution.

2. Lamarck described leaves, flowers and follicles. The specimen named *C. polyphylla* in the Lamarck herbarium consists of a single leaf. Commerson specimens named *C. polyphylla* by Lamarck in the De Jussieu herbarium and in the main collection in P are the only other elements still available. The Commerson specimen in the De Jussieu herbarium is chosen as lectotype.

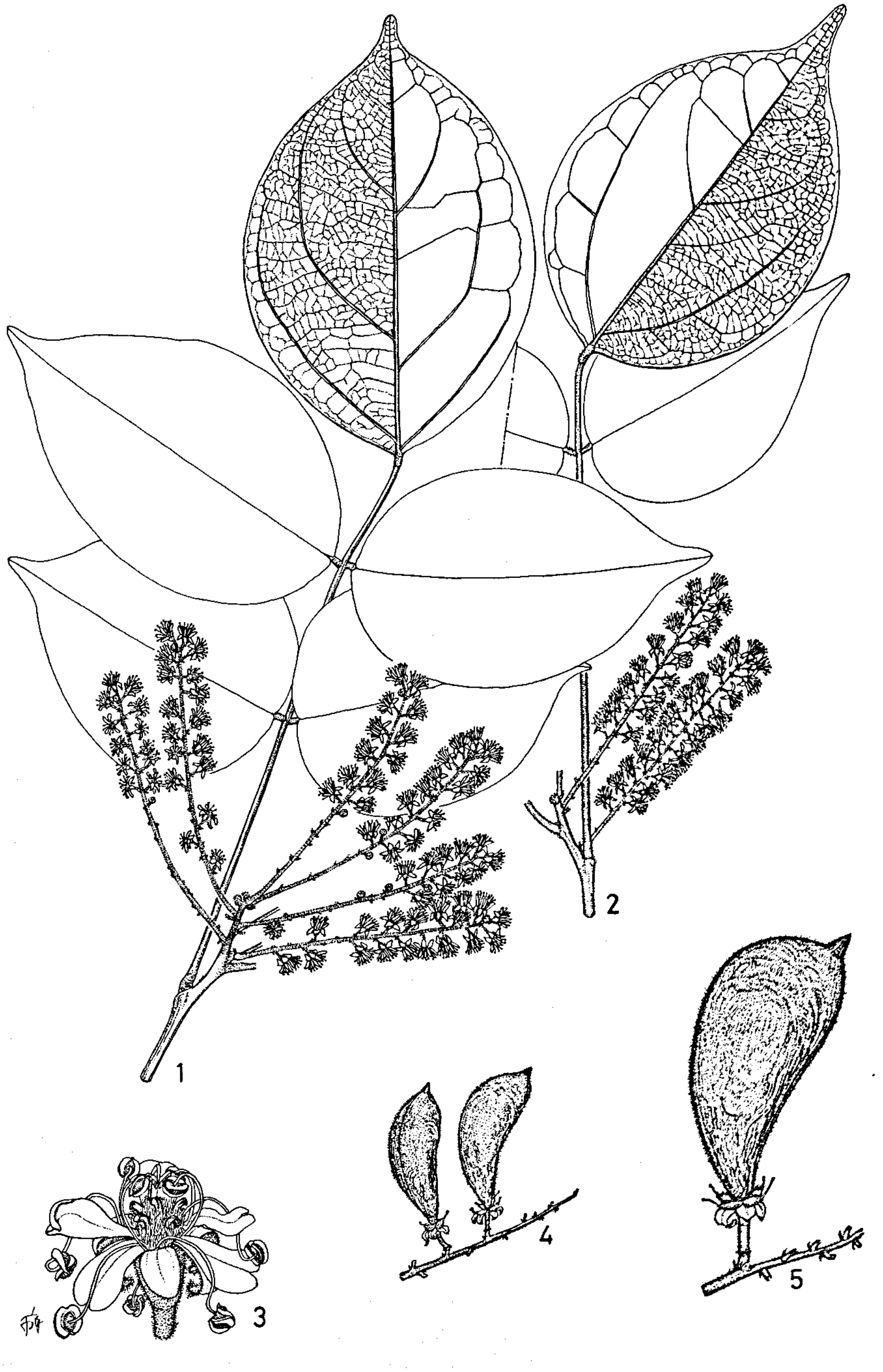


Fig. 104. *Cnestis racemosa*: 1-2. flowering branches, 2/3 ×; 3. flower, 6 ×; 4. follicles, 1 ×; 5. follicle, 2 × (1,3. *Voorhoeve 737*; 2. *Jansen 2475*; 4-5. *Morton 1616*).

3. Schellenberg (1938) cited *Hochstetter s.n.* as the type of *C. natalensis*. This is incorrect. The type is *Krauss 60*, on which the description in the protologue is based. Krauss (1844) published the name in Flora, in the list of plants collected by him in South Africa, but he is not responsible for the description and validation (see Gunn & Codd, 1981).

Uses: The vernacular names 'Liane des rats' and 'Mort des rats' refer to the poisonous effect of the fruits (and possibly also the roots) on rats. Drake del Castillo (1902) mentioned the use of the fruits to poison dogs on Madagascar. In animals the fruits produce paralysis of the limbs, convulsions, hypersecretion of the salivary and lachrymal glands and hyperglycaemia (excess of sugar in the blood) with glycosuria and albuminuria (abnormal amounts of sugar and albumen in urine). Death occurs after 60-70 hours. The not yet isolated poison is probably glycosidic (Kerharo & Bouquet, 1950). Plants are also used to make baskets according to the vernacular name 'liane a paniers'.

Cnestis racemosa Don **Fig. 104, 105**

C. racemosa Don, 1832: 91; Planchon, 1850: 440; Walpers, 1852: 306; Baker, 1868: 463; Schellenberg, 1910: 15; Chevalier, 1920: 167; Irvine, 1930: 114; Schellenberg, 1938: 41; Hepper, 1958: 743; Adam, 1971: 868.

Type: Sierra Leone, *Afzelius s.n.* (lecto design. by Schellenberg, 1938: BM).

C. liberica Schellenberg, 1915: 318; 1919: 436. Type: Liberia, Crozierville, *Dinklage 2449* (lecto: B).

Manotes racemosa (Don) Gilg, 1896: 215. Homotypic synonym of *Cnestis racemosa*.

Liana or straggling shrub. *Branches* cylindric, branchlets somewhat angular, more or less densely brown-pubescent, later glabrescent. *Leaves* 1-2(-3)-jugate; petiole (1.5-)3-9 cm, rachis 2-10 cm long, brown-pubescent. Leaflets papery, lateral ones usually opposite, circular, broadly elliptic or broadly ovate, 2-10 × 1.5-5 cm, truncate or sometimes rounded or subcordate and not or slightly unequal at base, terminal one broadly elliptic, 5-11.5 × 3.5-7.5 cm, rounded at base; all leaflets acuminate (with obtuse or rarely acute apex), glabrous above, sparsely pilose or almost glabrous beneath, midrib impressed above, prominent and pilose beneath, with 2-5 curved lateral nerves on each side; tertiary nerves reticulate, distinct on both sides; petiolules 3-5 mm long, sparsely pilose or glabrous. *Inflorescences* racemes or rarely panicles, 1-5 per leaf-axil on young branches, sometimes the supporting leaves reduced or very young resulting in a compound pseudoterminal inflorescence, 3-10 cm long, 15-30-flowered, yellowish brown-pubescent. Bracts subulate, very small, ca 1 mm long. *Pedicels* articulated 0.5-2 mm below the calyx, densely pubescent. *Flowers* heterostylous, possibly intermediate between heterodi- and heterotristylous. *Sepals* reflexed, narrowly imbricate in bud, (narrowly) ovate, 2.0-3.0 × 1.0-1.5 mm, acute, den-

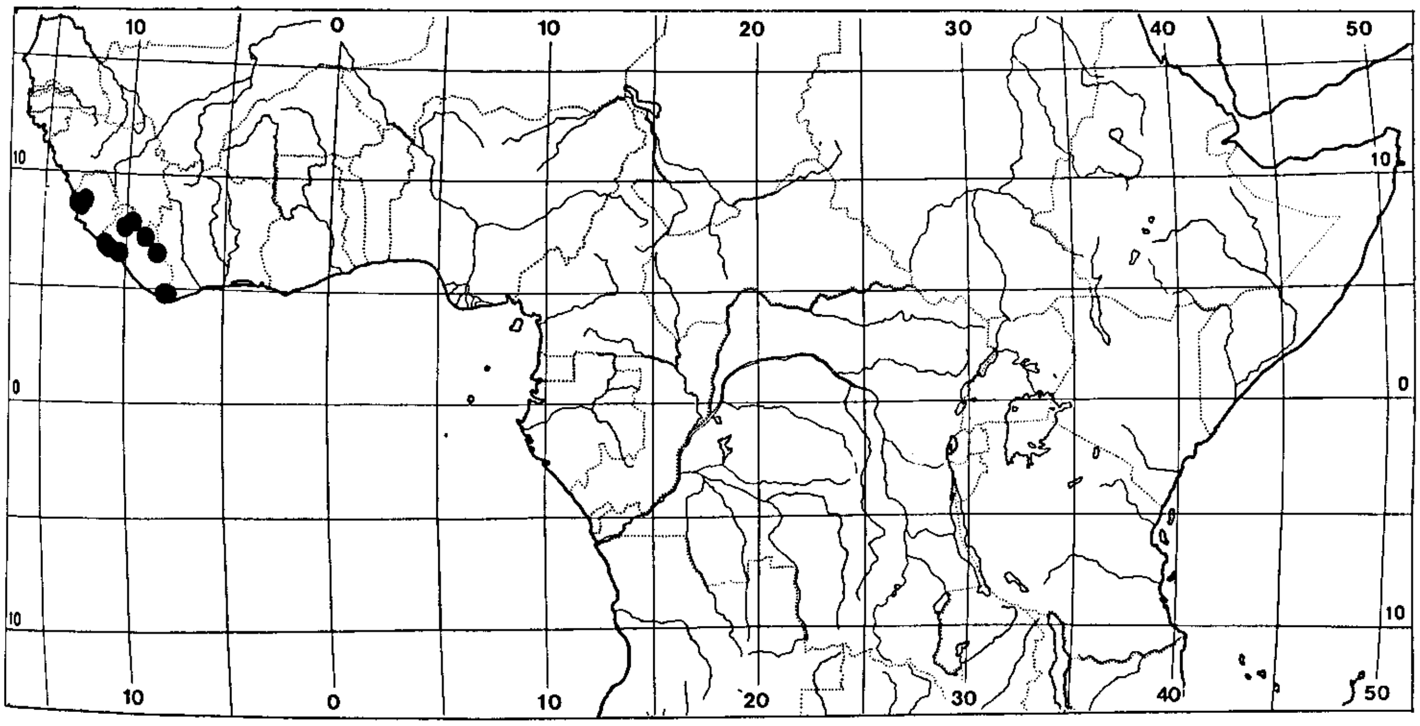


Fig. 105. Distribution of *Cnestis racemosa*

sely brown-pilose outside, glabrous inside. *Petals* valvate or very narrowly imbricate in bud, narrowly obovate, 2.0-3.0(-3.5) × 1.0 mm, cuneate at base, truncate or indistinctly retuse at top, glabrous, indistinctly veined. *Stamens* free, subequal or differing in length in the two whorls, 1.5-3.5 mm long, anthers ca 0.5 × 0.4 mm. *Pistils* 1.0-3.5 mm long; ovaries ca 0.5 mm long, yellowish pilose; styles straight or curved at top, pilose at base; stigmata prominent or not and oblique or not, often 2-lobed. *Follicles* 1, sometimes 2 in fruit, (narrowly) obovoid, oblique, 1.7-3.0 × 0.8-1.0 cm, cuneate with rather long stipe at base; apex obtuse, acute or mucronate; pericarp with rather short, soft hairs outside and with long, easily caducous, yellowish hairs inside. *Seeds* ovoid, 10-15 × 6-8 mm, testa often distinctly veined, sarcotesta 4-7 mm long.

Distribution: Sierra Leone, Liberia, western part of Ivory Coast.
Ecology: Secondary rain forest, bushes. Flowering mainly from October to January.

Specimens examined:

Sierra Leone: Mt Loma (Nov.) *Adam 23522* (K); Nimba-Gangra (fl.b. Oct.) *Adam 26217* (P); sin. loc. *Afzelius s.n.* (BM, type); Freetown, Heddles Farm (fr. Feb.) *Dalziel 974* (K); Njala (fr. Jan.) *Dalziel 8105* (K); near Hill Station (fl., fr. Jan.) *Dalziel 8119* (E, K, P); Zimmi (fl., y.fr. Nov.) *Deighton 382* (K); near Mattru (fl. Nov.) *Deighton 2335* (K); near Faiama (fr. Jan.) *Deighton 3875* (K); Kowama, Peri Chiefdom (fl. Nov.) *Deighton 5249* (K); Gaura Chiefdom (fl., y.fr. Dec.) *King 81b* (K); Havelock, Fourah Bay College (fl., fr. Jan.) *Morton 1616* (WAG); Kanu, near Mesina (fr. Jan.) *Morton & Jarr SL 1682* (WAG); Guma Valley, Penins. (fr, Mar.) *Morton & Jarr SL 1745* (WAG); near Freetown (fr. Mar.) *Nielsen 1662* (C); sin. loc. (fl.) *N. Thomas 6334* (B); Kumsabai (fl.b. Dec.) *N. Thomas 6739* (K); *N. Thomas 6790* (K); (fl. Dec.) *N. Thomas 6806* (K); *N. Thomas 6809* (B); *N. Thomas 6890* (B); (fr. Dec.) *N. Thomas 6963* (K); (fl.b.) *N. Thomas 6978* (B); Kenyema (fr. Jan.) *N. Thomas 7756* (B); sin. loc. (fr.) *N. Thomas 8688* (K).

Liberia: sin. loc. (fr. Feb.) *Adam 20817* (K); Beacon Rho, Liberian-Guinea border (fl. Nov.) *Adames 750* (B, K); Western Prov., Vonjama Distr., Wohmen (fl.b. Oct.) *Baldwin 10017* (K); Kolahun Distr., Genna Loffa (fl.b. Nov.) *Baldwin 10099* (K); Karmadhun (fl.b. Nov.) *Baldwin 10226* (K); Boporo Distr., Zuie (fl.b. Nov.) *Baldwin 10288* (K); Kle (y.fr. Dec.) *Baldwin 10635* (K); Gonatown (fr. Dec.) *Baldwin 10779* (K, WAG); Mecca (fr. Dec.) *Baldwin 10793* (K); Brewersville (fr. Dec.) *Baldwin 10969* (K); Harbel (fr. Dec.) *Bequaert 16* (K); Loffa county, N of Zorzor (fl., y.fr. Dec.) *Bos 2578* (WAG); Gongon (fl. Nov.) *Bunting 62* (BM); Monrovia, Crozierville (fr. Feb.) *Dinklage 2449* (B, type of *C. liberica*); sin. loc. (fr. Jan.) *Dinklage 3347* (BM, BR); 4 km S of Kakata (fl. Nov.) *Jansen 1017* (WAG); 10 miles S of Ganta (fr. Jan.) *Jansen 1429* (WAG); Bendu, 10 miles N of Robertsport (fr. Jan.) *Jansen 1767* (WAG); 20 miles N of Harper (fl. July) *Jansen 2475* (WAG); Gbanga (fl.b. Sept.) *Linder 650* (K); Medina, Bumtuma (fl.b. Oct.) *Linder 1318* (K); Peahtah (fl. Oct.) *Linder 1828A* (K); Harbel Div. 33 (fr. Jan.) *Stoop van de Kasteele 128* (WAG); (fl. Oct.) *Stoop van de Kasteele 238* (WAG); Loma National F. (fl.) *Voorhoeve 737* (WAG); sin. loc. (fr.) *Warner 92* (K); Kaka Town (fl. Apr.) *Whyte s.n.* (K).

Ivory Coast: Cavally R., Tépo land, Caté (fl.b. Aug.) *Chevalier 19800* (P); Dyolas Country, Sampleu-Ganhoué (fr. Apr.) *Chevalier 21144* (P).

Note: Although widely separated, the West-African *C. racemosa* seems to be related to *C. polyphylla* from E Africa and Madagascar. It differs in having few, conspicuously broad leaflets with few, curved, lateral nerves. Flowers and fruits are both very similar to those of *C. polyphylla*. *C. racemosa* can be easily distinguished from other West-African species by the small fruits that are not beaked, and by the number and shape of the leaflets.

Cnestis uncata Lemmens, **sp. nov.** **Fig. 106-109**

Frutex scandens vel liana ramulis juventute dense brunneo-pubescentibus demum glabrescentibus. Folia imparipinnata, 6-10-juga. Foliola crassi-chartacea, lateralia inferiora ovata, superiora anguste oblonga, (0.5)1.5-7 × 1-2.5 cm, basis cordata, foliolum terminale (ob)ovatum vel ellipticum, 4.5-7.5 × 2-3.5 cm, basi rotundatum vel subcordatum; foliola supra glabra (costa pilosa), subtus dense pilosa. Inflorescentia fasciculata. Pedicelli non articulati, 3-7 mm longi. Sepala reflexa, subulata, 3.0-4.5 × 0.5-0.8 mm, extra pilosa, intra glabra. Petala anguste oblonga, 5.0-7.0 × 0.8-1.0 mm, glabra. Stamina subaequalia. Folliculus 2.5-3 × 1 cm, uncatus rostro incurvato, extus intusque hispidus.

Type: Gabon, km 25 Libreville-Kango, *Breteler & Lemmens 8340* (holo: WAG; iso: LBV).

Liana or climbing shrub. *Branches* and branchlets cylindric, initially densely brown-pubescent, later glabrescent. *Leaves* 6-10-jugate; petiole 0.5-4 cm, rachis 7.5-23 cm long, brown-pubescent, later more or less glabrescent. Leaflets thickly papery, lateral ones alternate or sometimes opposite, ovate to narrowly oblong, (0.5-)1.5-7 × (0.5-)1-2.5 cm, cordate and unequal or subequal at base, terminal one ovate, obovate or elliptic, 4.5-7.5 × 2-3.5 cm, subcordate, rounded or somewhat cuneate at base; all leaflets obtuse or indistinctly acuminate, glabrous above (but midrib pilose), densely pilose with curled hairs beneath, midrib impressed above, prominent beneath, with 5-10 lateral nerves on each side; terti-

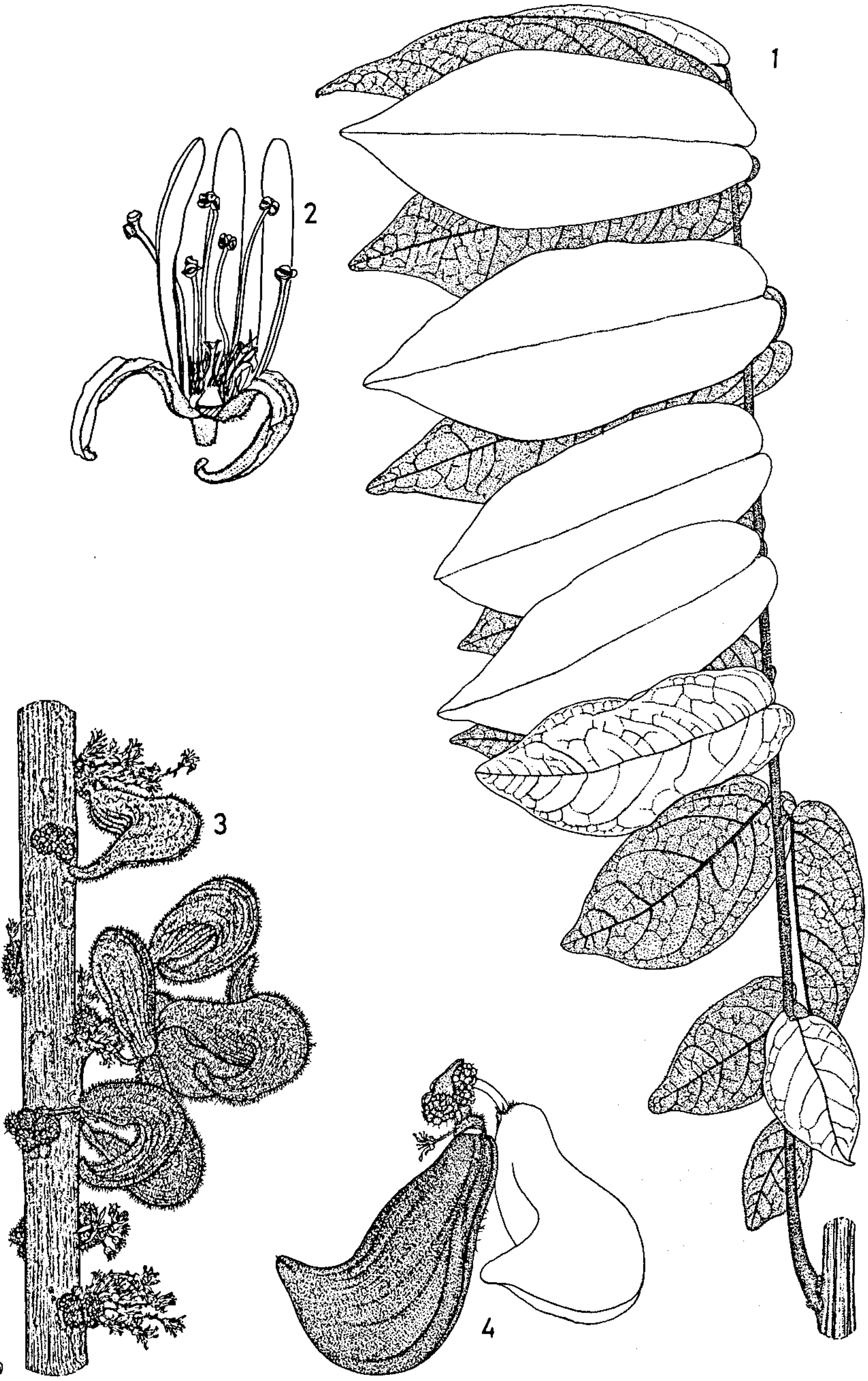


Fig. 106. *Cnestis uncata*: 1. branch with leaf, 2/3 ×; 2. flower partly, 6 ×; 3. branch with flowers and follicles, 2/3 ×; 4. follicles, 1 × (1,3-4. *Breteler & Lemmens 8340*; 2. *Breteler & Lemmens 8393*).

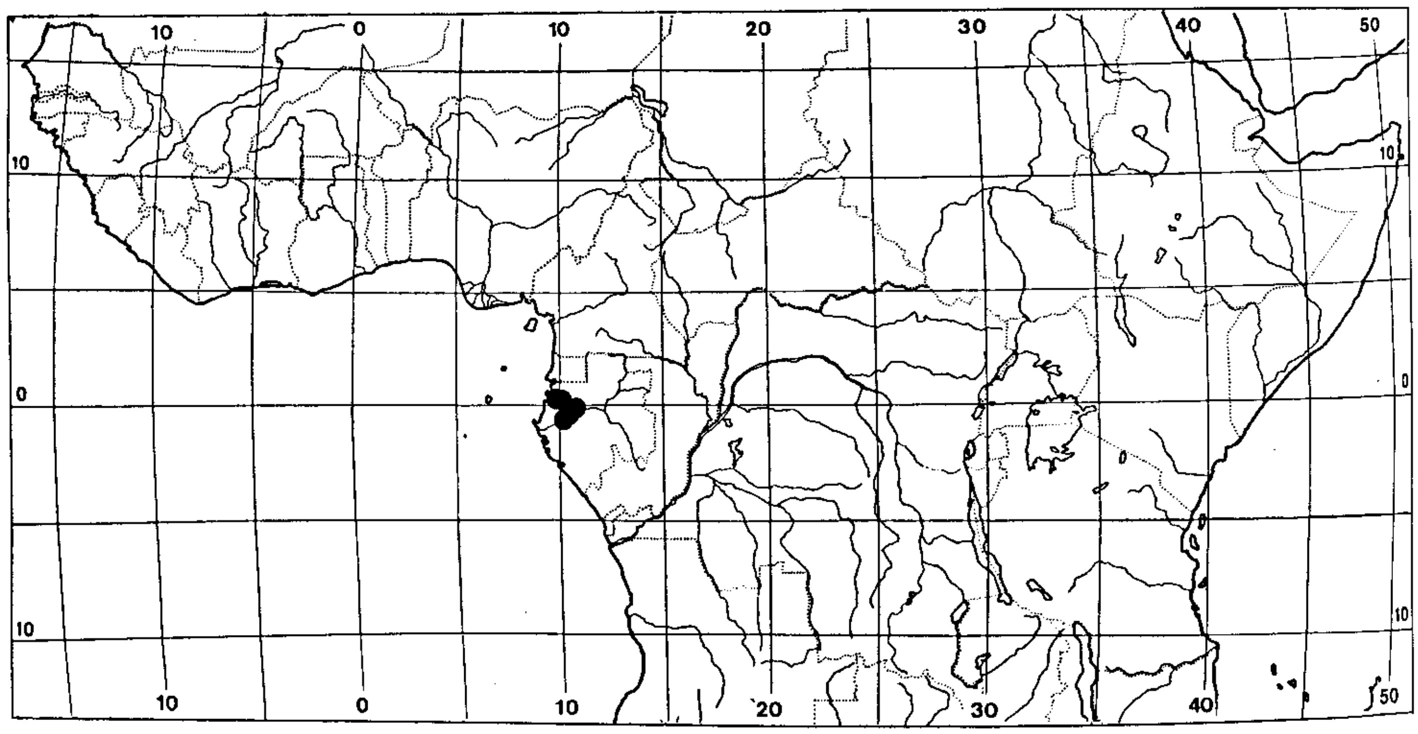


Fig. 107. Distribution of *Cnestis uncata*

ary nerves reticulate, prominent and distinct on both sides; petiolules 0-1 mm long, pilose. *Flowers* clustered in fascicles (rarely also some short racemes), 3-10 together on nodose thickenings on older branches, heterodistylous. Bracts ovate to subulate, 1-2 mm long, often partly grown together on the nodose thickenings. *Pedicels* not articulated, 3-7 mm long, densely pilose. *Sepals* reflexed, valvate in bud, subulate, narrowly oblong to sublinear, 3.0-4.5 × 0.5-0.8 mm, obtuse or acute, pilose outside, glabrous inside, distinctly 1-3-veined. *Petals* valvate or narrowly imbricate in bud, narrowly oblong to sublinear, 5.0-7.0 × 0.7-1.0 mm, rounded or cuneate at base, obtuse or subacute at top, glabrous, usually distinctly 3-veined. *Stamens* united at base, subequal or differing in length in the two whorls (long-staminate type of flowers), 1.0-1.6 or 3.1-4.3 mm long, anthers ca 0.2 × 0.2 mm. *Pistils* ca 1.1 or 2.8-4.4 mm long; ovaries ca 0.5 mm long, yellowish brown-pilose; styles more or less straight, pilose at base; stigmata more or less prominent and oblique, 2-lobed. *Follicles* 1(-2) in fruit, hook-shaped, 2-3 × 1 cm, cuneate with 5-10 mm long stipe at base; beak broad, strongly reflexed towards the ventral side of the follicle, 10-13 mm long; pericarp with very short, red, spinelike hairs and long, easily caducous, stinging hairs outside, with long, easily caducous, yellowish hairs inside. *Seeds* ovoid, ca 13 × 7 mm, sarcotesta ca 6 mm long.

Distribution: NW Gabon.
Ecology: Rain forest and secondary regrowths.

Specimens examined:

Gabon: Libreville-Kango, Nzogomitang (fr. Oct.) *Breteler & Lemmens 8304* (LBV, WAG); km 25 Libreville-Kango (fr. Oct.) *Breteler & Lemmens 8340* (LBV, WAG, type); km 10 (fl.b. Oct.) *Bre-*

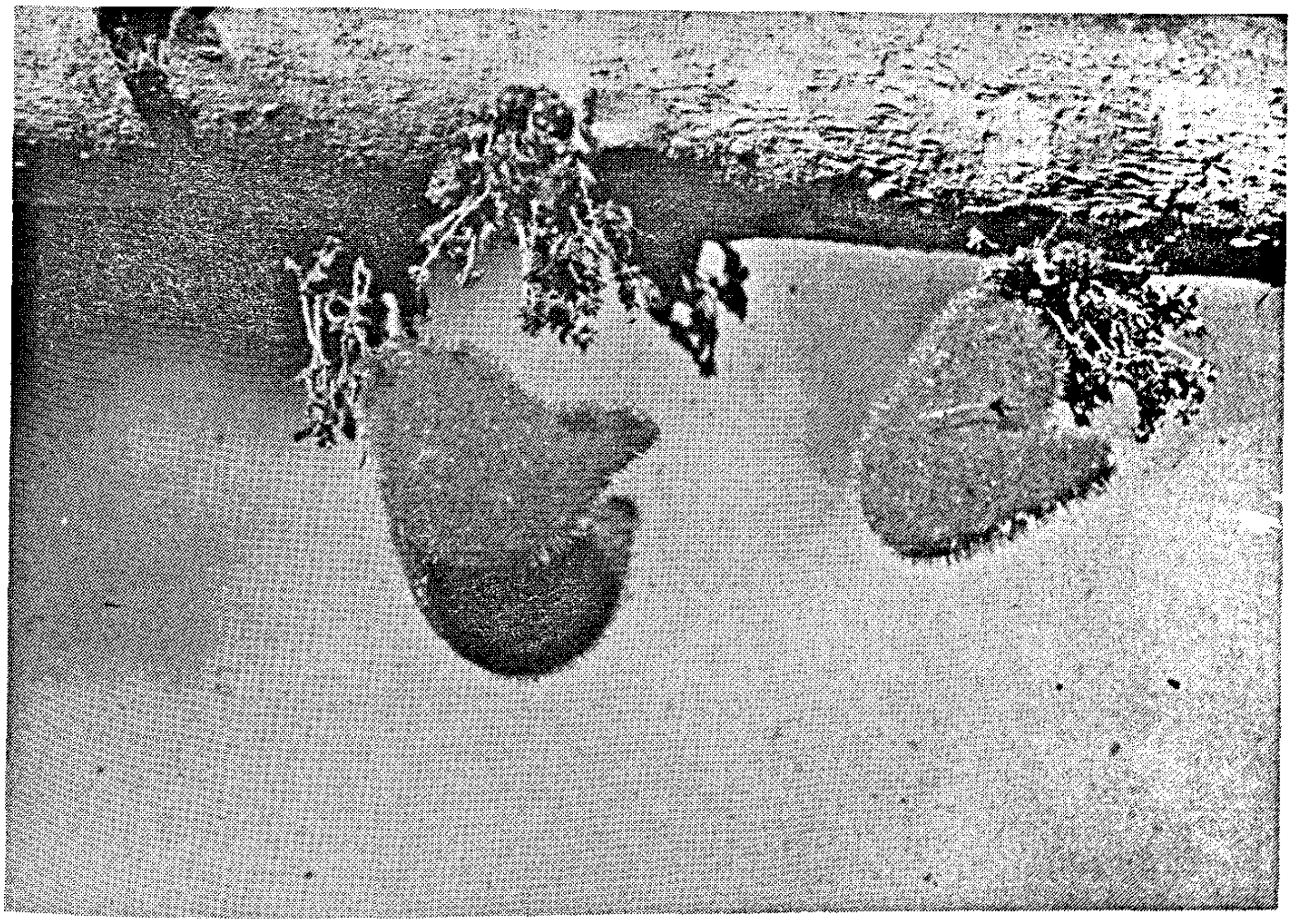


Fig. 108. *Cnestis uncata*: stem with inflorescences off flowering and follicles (*Breteler & Lemmens 8393*; phot. R.H.M.J. Lemmens).

teler & Lemmens 8374 (WAG); km 20 (fr. Oct.) *Breteler & Lemmens 8393* (LBV, WAG); Komo R., Kango (fr. Oct.) *Chevalier 26890* (P); Kango, near Komo R. (fr. Nov.) *J. de Wilde, Arends & de Bruijn 8925* (LBV, WAG); near Nkogo, banks of Ogooué R. (fr. Aug.) *Fleury 26383* (P); 10 km SW of Ndjolé (fr. Apr.) *Hallé 1804* (P); Donguila (fr.) *Leroy 9* (P); near Lambaréné (fr. Nov.) *van der Maesen 5318* (LBV, WAG).

Note: *C. uncata* has the flowers in fascicles, just as *C. urens*. It differs by having typical hook-shaped fruits (beak strongly reflexed) and fewer, larger leaflets, that are glabrous above. This difference in the leaves also permits the identification of flowering and sterile material.

Cnestis urens Gilg **Fig. 110, 111**

C. urens Gilg, 1891a: 67, fig.37; 1891b: 330; 1895b: 192; Durand & Schinz, 1896: 102; Schellenberg, 1910: 17, 94; 1915: 319; De Wildeman, 1916: 244; 1929: 540; 1931: 236; Schellenberg, 1938: 43; Troupin, 1952: 121, fig.1a.

Type: Gabon, Libreville, Sibange Farm, *Soyaux 255* (holo: B†, lecto: Z; iso: K, P).

C. laurentii De Wildeman, 1909: 96, fig.19; 1911b: 217; Gilg, 1911: 229. Type: Zaire, Eala, *Laurent 1639* (lecto: BR).

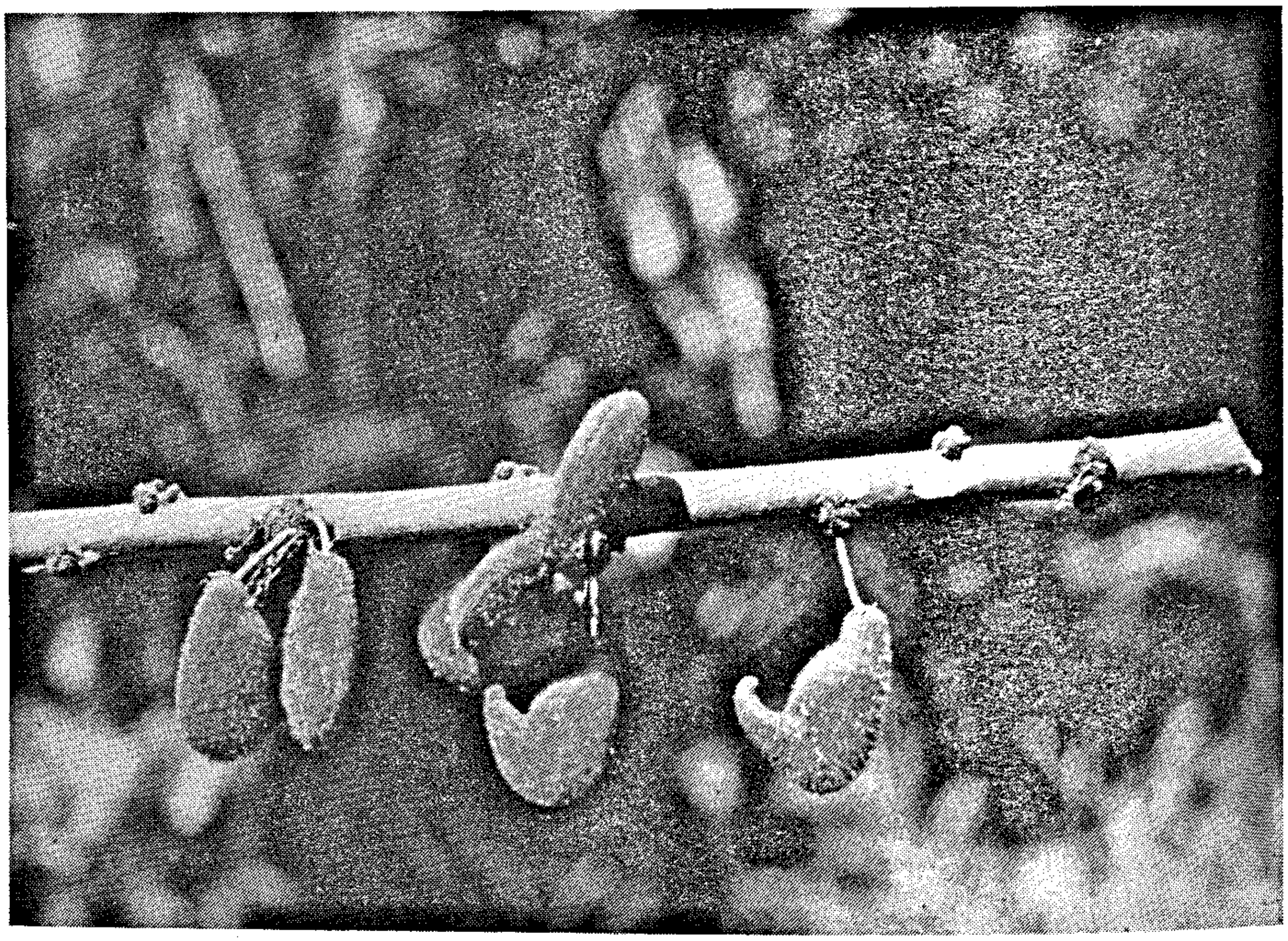


Fig. 109. *Cnestis uncata*: stem with follicles (*van der Maesen 5318*; phot. L.J.G. van der Maesen).

Liana or climbing shrub. *Branches* and branchlets cylindric, initially (yellowish) brown-pilose, later more or less glabrescent. *Leaves* 12-21-jugate; petiole 0.5-3 cm, rachis 11-22 cm long, yellowish brown-pilose, often with many long hairs at base of petiole. Leaflets thickly papery, lateral ones opposite or not, (narrowly) oblong, 0.5-3.5 × 0.5-1 cm, cordate and equal or unequal at base, terminal one narrowly (ob)ovate or narrowly elliptic, 2-3 × 0.7-1 cm, subcordate or rounded at base; all leaflets obtuse or rounded, scattered, sometimes sparsely, pilose above, densely pilose with erect hairs beneath, midrib impressed above, prominent beneath, pilose at both sides, with 5-7 lateral nerves on each side; tertiary nerves indistinct; petiolules 0-0.5 mm long, pilose. *Flowers* clustered in fascicles, 2-15 together on nodose thickenings in the leaf-axils of young and old branches, heterodistylous. Bracts subulate, 1-1.5 mm long, often partly grown together on the nodose thickenings. *Pedicels* not articulated, (2-)3-7 mm long, densely pilose. *Sepals* reflexed, valvate or narrowly imbricate in bud, narrowly ovate or narrowly oblong, 3.0-4.5(-5.0) × 0.7-1.0 mm, acute, pilose, rarely with glandular hairs outside, glabrous inside, distinctly or indistinctly up to 5-veined. *Petals* valvate or narrowly imbricate in bud, narrowly elliptic or oblong to almost linear, (4.0-)5.0-6.5 × 0.8-1.2 mm, rounded to cuneate at base, obtuse or rounded, rarely somewhat retuse and usually inflexed at top, glabrous, distinctly or indistinctly up to 5-veined. *Stamens* free, distinctly differing in length in the two whorls, 0.5-1.0 or 2.5-5.2 mm long, anthers ca 0.2 × 0.2 mm. *Pistils* 1.0-1.1 or 2.3-3.2 mm long; ovaries ca 0.5 mm long, yellowish brown-

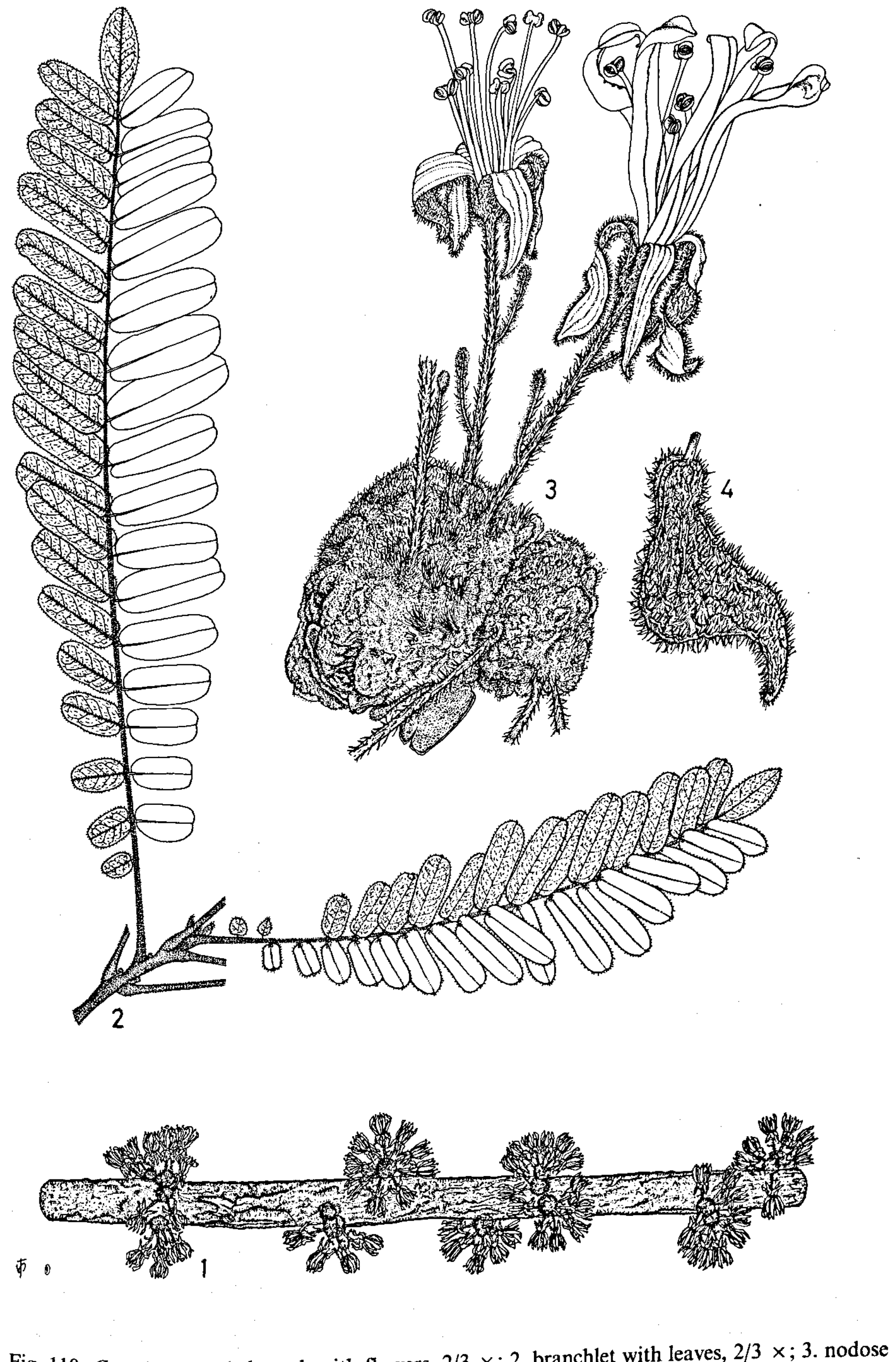


Fig. 110. *Cnestis urens*: 1. branch with flowers, 2/3 ×; 2. branchlet with leaves, 2/3 ×; 3. nodose thickening with flowers, 6 ×; 4. follicle, 1 × (1. *Couteaux 393*; 2. *Boone 84*; 3. *Laurent 762*; 4. *Laurent 1639*).

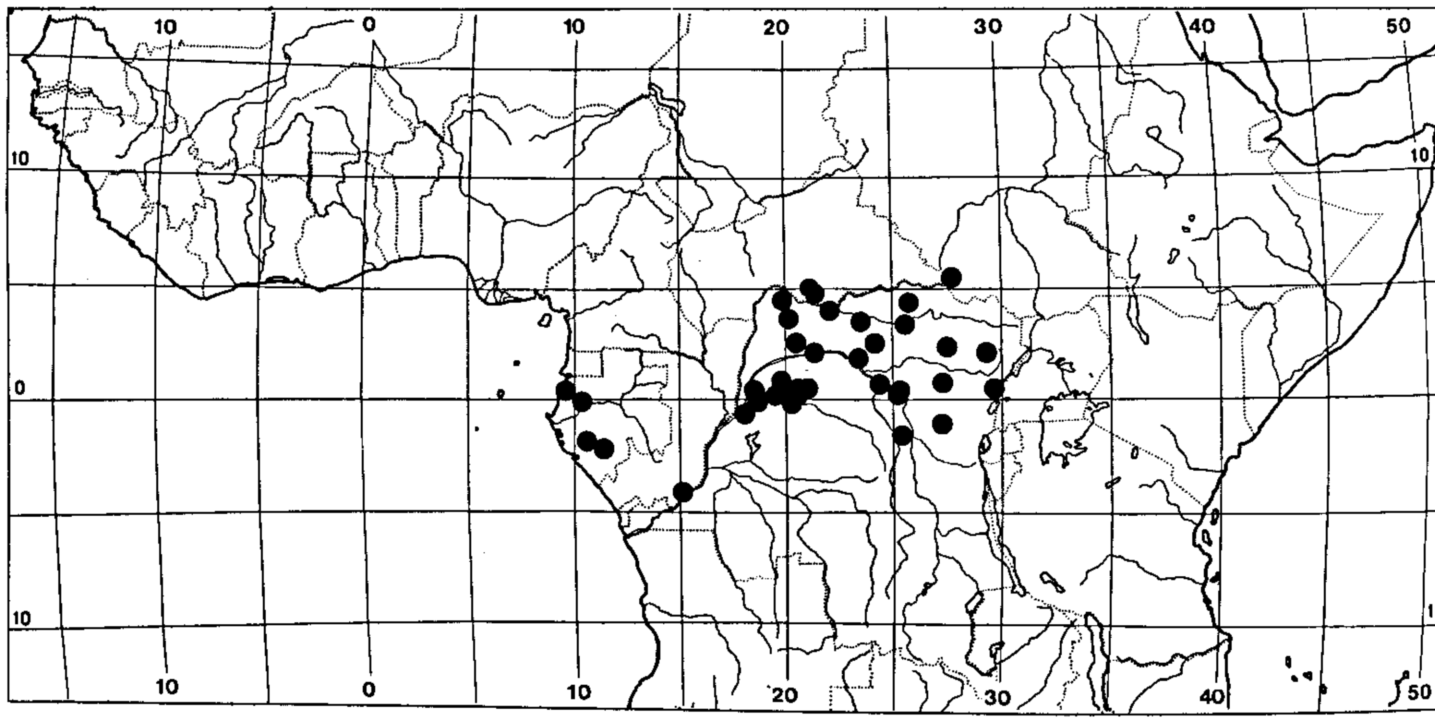


Fig. 111. Distribution of *Cnestis urens*

pilose; styles straight or curved, pilose at base; stigmata oblique, indistinctly 2-lobed. *Follicles* 1(-3) in fruit, ellipsoid, oblique, 2.5-4(-5) × 0.6-1.5 cm, more or less cuneate with 7-15 mm long, broad and indistinct stipe at base; beak slender, curved or involute at apex, (8-)12-30 mm long; pericarp with very short, red, spinelike hairs and numerous, long, easily caducous, stinging hairs outside and long, slender yellowish brown hairs inside. *Seeds* ovoid, 10-15 × 5-10 mm, sarcotesta 3-6 mm long.

Distribution: Southern part of Central African Republic, SW Sudan, Gabon, Congo, northern and central Zaire.

Ecology: Rain forest, semi-deciduous forest, regrowths. Flowering mainly from March to August, in central N Zaire usually in November to January.

Selection of the ca 100 specimens examined:

Central African Republic: Mako R., 20 km NW of Alindao (fl. June) *Tisserant 2536* (BM, BR); *Tisserant 2537* (P).

Sudan: Monbuttu land, Kussumbo (fr. Dec.) *Schweinfurth 3203* (K, Z); Niam-Niamland (fr.) *Schweinfurth s.n.* (K); Equatorial Prov., Zandeland, Sakure (y.fr. Jan.) *Wyld 672* (BM).

Gabon: Mouila-Yeno (Sept.) *Breteler, Lemmens & Nzabi 8095* (LBV, WAG); 10 km SW of Ndjolé (fl. Apr.) *Hallé 1940* (P); 40 km SW of Ndendé (fr. Dec.) *A. Louis, Breteler & de Bruijn 1100* (LBV, WAG); Libreville, Sibange Farm (fl. Mar.) *Soyaux 255* (K, P, Z, type).

Congo: Brazzaville (July) *Sita 4880* (BR).

Zaire: Avakubi (y.fr. Jan.) *Bequaert 2004* (BR, K); Ngene Ngene, 10 km NE of Kisangani (fl., y.fr. Aug.) *Bokdam 4222* (WAG); Nala (fl.) *Boone 84* (BR); Lisala (fl.) *Bruneel s.n.* (BR); Djilingi de Lilnote (fl.b., fr. May) *Collart 91* (BR); Eala (fl. June) *Corbisier Baland 1930* (BR, K); Prov. Orientale, Basoko, Mokaria (fl. Dec.) *Croegaert 62* (BR, K, WAG); Bosodula, N Furu (fr.) *de Bilderling 54* (BR); Likimi (fl. Dec.) *de Giorgi 1548* (BR); Equateur, Coquilhatville, Mabali, Tumba L. (fl. Jan.) *Deuse 222* (BR); Bas-Uele (fl. Dec.) *Dewulf 457* (BR); Basankusu, Terr. Lulonga-Iko-

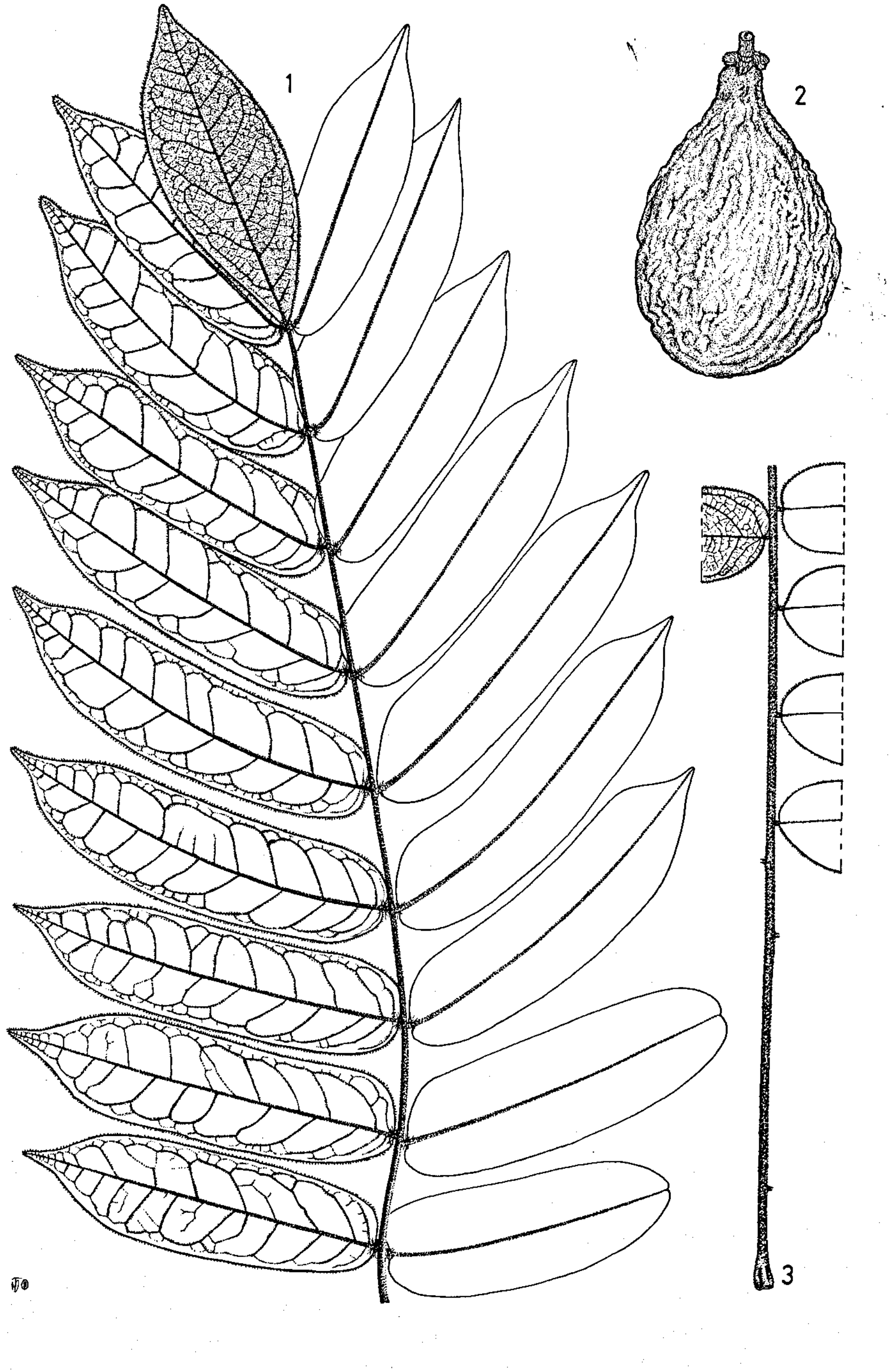


Fig. 112. *Cnestis yangambiensis*: 1. apical part of leaf beneath, 2/3 ×; 2. follicle, 2 ×; 3. basal part of leaf, 2/3 × (1-3. *J. Louis 13623*).

lomba (fl. July) *Dubois 499* (BR); Bambesa (y.fr. July) *Dubois 565* (BR); Kwada L. (fr. Mar.) *Evrard 540* (BR); Baringa, Maringa (fl., fr. Oct.) *Evrard 5085* (BR, K); Bambesa (fl., fr Jan.) *Gerard 4000* (BR); Bokote (fr.) *Hulstaert 962* (BR, partly); Eala (fl., y.fr. Aug.) *Laurent 1083* (BR); (fl., fr.) *Laurent 1639* (BR, type of *C. laurentii*); Wamba-Gombari, Uele-Nepeko (fl. July) *Lebrun 3302* (BR); Urega (fl., fr. July) *Lebrun 5775* (BR, K); 15 km E of Kisangani (fl.b. Nov.) *Lejoly 81/381* (BR); Elua I., Tumba L. (fr. Sept.) *J. Léonard 655* (BR); near Kisangani (fr. Nov.) *Lisowski 15167* (BR, K); Yangambi (fr. Dec.) *J. Louis 2899* (BR, K); Wabondo, Buta (fr. Nov.) *Mosango 424* (BR); Yangambi (fl.b. June) *Yafunga 198* (BR, WAG).

Note: The flowers and fruits and, to a lesser extent, the leaves of *C. urens* resemble certain forms of *C. corniculata*. However, the two species differ in their inflorescences: fasciculate in *C. urens* and racemose or paniculate in *C. corniculata*.

See note under *C. uncata* for differences with that species.

Uses: In Zaire the seed, softly boiled with sugar-cane serves as a medicine for the stomach (Troupin, 1952). The ashes of the fruits are used against toothache. Hunters wear a twig on the head as a talisman.

Cnestis yangambiensis Louis ex Troupin **Fig. 112, 113**

C. yangambiensis Troupin, 1951: 369; 1952: 122.
Type: Zaire, Haut-Zaire, Yangambi, Tutuku I., *J. Louis 13623* (holo: BR; iso: K).

Liana, sometimes small. *Branches* and branchlets cylindric, initially yellowish brown-pubescent, often also with long hairs, later more or less glabrescent. *Leaves* 13-20-jugate; petiole 0-6 cm, rachis 25-45 cm long, yellowish brown-pubescent, densely at base of petiole. Leaflets papery, lateral ones more or less alternate, (narrowly) oblong, more rarely ovate, 1.5-9 × 1-2.5 cm, truncate or subcordate and unequal at base, terminal one narrowly ovate or narrowly elliptic, 6-8 × 2.5-3 cm, cuneate or rounded at base; all leaflets acuminate, glabrous above, pilose, especially on the nerves beneath, midrib impressed above, prominent beneath, with 8-12 lateral nerves on each side; tertiary nerves indistinct; petiolules 0.5-1 mm long, pilose. *Inflorescences* racemes, 1-10 per leaf-axil on stem or older branches, 3-7.5 cm long, 10-20-flowered, densely yellowish brown-pilose with curled hairs. Bracts ovate to subulate, 1.5-2 mm long, curved. *Pedicels* articulated 0-0.5 mm below the calyx, densely pilose with curled hairs. *Flowers* heterodistylous. *Sepals* reflexed, valvate or very narrowly imbricate in bud, narrowly ovate or narrowly oblong, 2.5-3.5 × 0.7-0.8 mm, acute or obtuse, brown-pilose outside, glabrous inside, more or less distinctly 1-veined. *Petals* valvate or very narrowly imbricate in bud, narrowly oblong, rarely narrowly obovate, (2.7-)3.0-4.0 × 0.7-0.8 mm, rounded or cuneate at base, somewhat retuse and often inflexed at top, glabrous, indistinctly veined. *Stamens* free or very shortly united at base, subequal in length, 2.2-3.7 mm long, anthers

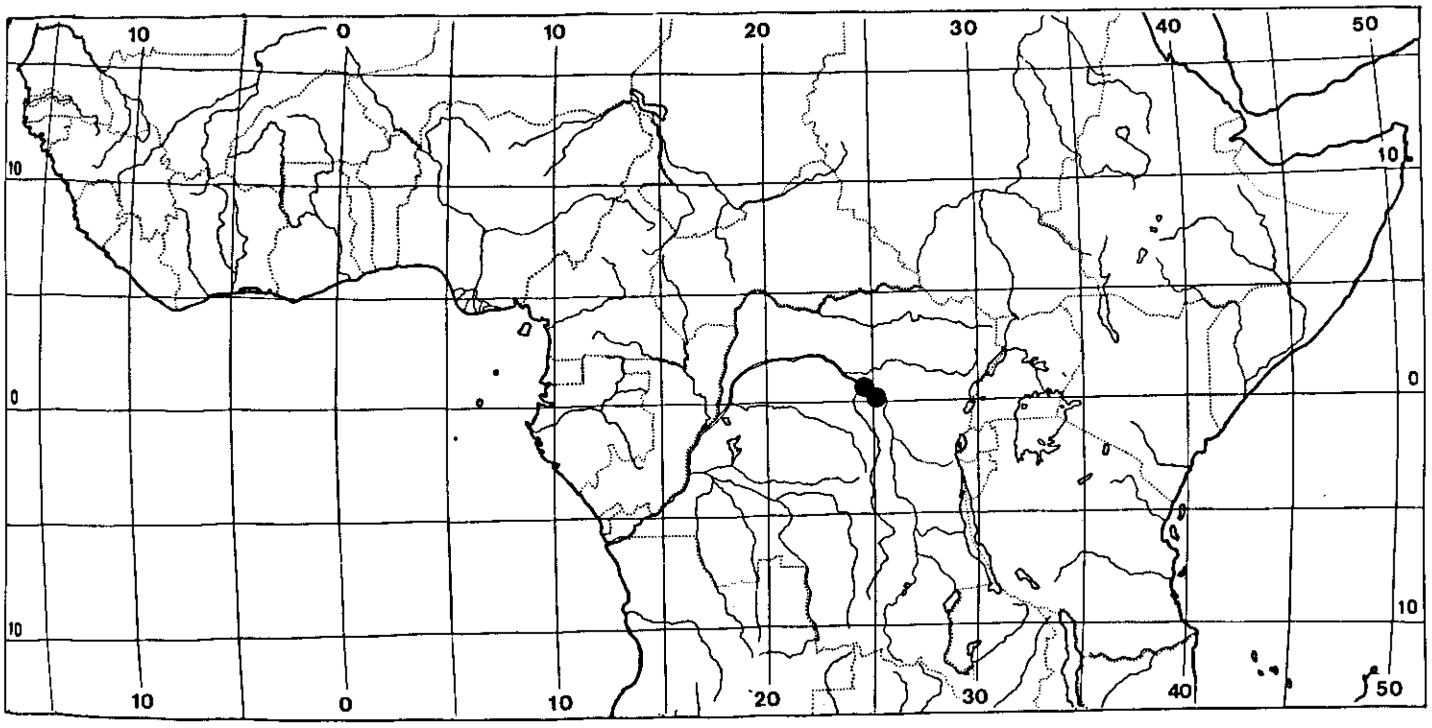


Fig. 113. Distribution of *Cnestis yangambiensis*

ca 0.2 × 0.1 mm. *Pistils* 1.2-1.5 or 2.7-3.2 mm long; ovaries ca 0.4 mm long, brown-pilose; styles curved at top, pilose at base; stigmata more or less prominent and oblique, 2-lobed. *Follicles* 1-3 in fruit, oblique-pyriform or oblique-obovate, 2-3(-3.2) × 1.2-1.6 cm, cuneate with indistinct, short stipe at base; apex obtuse or somewhat acute, lacking beak; pericarp with very short, red, spinelike hairs and long, easily caducous, stinging hairs outside (stinging hairs often almost completely fallen out in old fruits), with long, slender hairs inside. *Seeds* ovoid, 13-19 × 6-10 mm, sarcotesta 7-10 mm long, ruminate.

Distribution: N Zaire, near Yangambi.

Ecology: Primary, sometimes secondary rain forest, often near rivers. Fruiting specimens have been found from September to May.

Specimens examined:

Zaire: Haut-Zaire, Ngoli (Feb.) *Ankei 79/1103* (BR); *Ankei 79/1124* (BR); 7 km W of Kisangani (fr. Sept.) *Bokdam 3228* (WAG); Yangambi, Tutuku I. (fr. Oct.) *Germain 354* (BR); (fr.) *Germain 394* (BR); Kisangani, Kongolo I. (Mar.) *Lejoly 1137* (BR); *Lejoly 1396* (BR); *Lejoly 4557* (BR); Lubi, terr. Dibaya (May) *Liben 2993* (BR, WAG); Kisangani, Kongolo I. of Lindi (fr. May) *Lisowski 18471* (BR); 5 km upstream from Wanie-Rukula (fr. Nov.) *Lisowski 85578* (BR, WAG); Yangambi, Tutuku I. (fl., fr. Dec.) *J. Louis 12882* (BR, K); (fr. Feb.) *J. Louis 13623* (BR, K, type); Kisangani, Kongolo I. (fr. Mar.) *Mandango 1457* (BR); Kisangani (fr. Apr.) *Szafranski 1165* (BR, WAG).

Note: Flowering and sterile material of *C. yangambiensis* cannot be identified with complete certainty because of the overlap in variation with *C. corniculata*. In general, *C. yangambiensis* has longer leaves with a larger number of leaflets. Fruiting specimens are unmistakable.

Excluded species

Africa:

C. corniculata Bentham, 1849: 290, non Lam. = *Manotes expansa* Soland.

C. obliqua Palisot-de Beauvois, 1804: 97; Bojer, 1837: 84 = *Agelaea pentagyna* (Lam.) Baill.

C. pinnata Palisot-de Beauvois, 1804: 98 = *Rourea thomsonii* (Bak.) Jongkind

C. trifolia Lamarck, 1789: 24 = *Agelaea pentagyna* (Lam.) Baill.

Asia:

C. acuminata Wallich, no. 8533 (nomen nudum) = *Rourea minor* (Gaertn.) Alston

C. emarginata Jack, 1822: 42 = *Rourea emarginata* (Jack) Jongkind

C. erecta Blanco, 1837: 387 = *Rourea minor* (Gaertn.) Alston

C. florida Jack, 1822: 43 = *Rourea minor* (Gaertn.) Alston

C. glabra Blanco, 1837: 387, non Lam. = *Rourea minor* (Gaertn.) Alston

C. mimosoides (Vahl) Jack, 1822: 44 = *Rourea mimosoides* (Vahl) Planch.

C. monadelpha Roxb. ex De Candolle, 1825: 87 = *Rourea minor* (Gaertn.) Alston

C. pentaphylla Spanoghe, 1841: 189 = *Connarus monocarpus* L. ssp. *malayensis* Alston

C. stenopetala Griffith, 1854: 433 = *Rourea stenopetala* (Griff.) Hook.f.

C. trifolia Blanco, 1845: 270 = *Rourea minor* (Gaertn.) Alston

C. vestita Wallich, no. 8535 (nomen nudum) = *Agelaea borneensis* (Hook.f.) Merr.

C. volubilis Blanco, 1837: 383 = probably no *Connaraceae*.

America:

C. americana Martius, nomen in sched.; Schellenberg, 1938: 196 (in syn.) = *Rourea martiana* Baker

Connarus L.

by R.H.M.J. Lemmens

History and subdivision of the genus

In 1753 Linnaeus published *Connarus monocarpus*. Lamarck (1786) proposed three species in the genus, one of which does not belong to *Connarus* (*C. pentagynus* = *Agelaea pentagyna*), another is based on a Smeathman collection from Africa (*C. africanus*). In 1825 De Candolle described a number of African, Asiatic and American species in the genus *Omphalobium* Gaertner. Planchon (1850) reduced *Omphalobium* into the synonymy of *Connarus* and treated almost 40 species. In his monograph on *Connaraceae* Schellenberg (1938) recognized 121 species in *Connarus*. Leenhouts (1958b) made a revision of the genus for Asia. In comparison with Schellenberg he reduced the number of species considerably. The revision of *Connarus* for tropical America by Forero (1983) however, resulted in an extension of the number of recognized species.

Schellenberg (1938) divided *Connarus* into 3 subgenera: *Connarellus*, *Neoconnarus* and *Euconnarus*, based on the dehiscence of the follicle. His subgenera are divided into 10 sections. In agreement with Leenhouts (1958b) and Forero (1983) this division is considered to be dubious and not reflecting the natural relationships. Because only a limited part of the genus, i.e. the African species, have been studied in detail, no new subdivision is presented here.

Description of the genus

Connarus Linnaeus, 1753: 675; 1754: 305; Lamarck, 1786: 94; Cavanilles, 1790: 375; Willdenow, 1800: 691; Planchon, 1850: 424; Baker, 1868: 456; Schellenberg, 1938: 216; Troupin, 1952: 128; Hemsley, 1956: 22; Leenhouts, 1958b: 525; Liberato, 1980a: 15; 1980b: 12; Forero, 1983: 36.

Type species: *C. monocarpus* L. See note.

Tapomana Adanson, 1763: 343. Nom. illeg.

Omphalobium Gaertner, 1788: 217; De Candolle, 1825: 85; G. Don, 1832: 90. Type species: *O. indicum* Gaertner (= *Connarus monocarpus* L. ssp. *monocarpus*).

Erythrostigma Hasskarl, 1842: 45. Type species: *E. diversifolia* Hassk. (= probably *Connarus semidecandrus* Jack).

Anisostemon Turczaninow, 1847: 152. Type species: *A. trifoliatus* Turcz. (= *Connarus grandis* Jack).

Tricholobus Blume, 1850: 236. Type species: *T. fulvus* Bl. (lecto; = *Connarus villosus* Jack).

Lianas, shrubs or small trees. *Branches* cylindric. *Leaves* trifoliolate or imparipinnate, rarely upper leaves unifoliolate; leaflets opposite or not, often acuminate, often glandular punctate. *Inflorescence* an axillary panicle, often appearing terminal and more compound by a reduced development of the leaves. *Flowers* bisexual, pentamerous, heterostylous. *Pedicels* with a distinct joint. *Sepals* connate at the base, imbricate or valvate in bud, thick and fleshy or thin, usually glandular punctate. *Petals* longer than sepals, free or coherent, usually white, imbricate in bud, pilose or rarely almost glabrous outside, often with glandular hairs inside. *Stamens* 10, episepalous ones fertile, epipetalous ones shorter and fertile, sterile, or rudimentary; filaments united at base, longer ones usually with stipitate glands, shorter ones often lacking glands; anthers sometimes with glandular hairs on the apex. *Carpel* 1; style often pilose and with stipitate glands. *Follicle* red, opening lengthwise along the ventral suture, sometimes also along the dorsal suture, initially pubescent outside, but often glabrescent, glabrous or pilose and often with glands inside, often stipitate, usually with a short mucro apically. *Seed* solitary, attached to the ventral side of the follicle, ovoid or slightly kidney-shaped; testa shining black, yellow and fleshy (sarcotesta) below the hilum; endosperm absent; hilum lateral; radicle apical, dorsal or almost in the centre of the seed between the cotyledons; cotyledons thick, planoconvex.

A circumtropical genus. According to Schellenberg (1938) comprising about 120 species. In accordance with Leenhouts (1958b) I consider this number excessive. The combined number of species from Asia (Leenhouts), tropical America (Forero), and Africa is 77 species. They are generally confined to rain forest.

Note: Forero (1983) mentions *C. macrocarpus* L. as the type species. This is probably a printing error for *C. monocarpus*, as the combination *C. macrocarpus* has never been proposed so far.

Relations between the African, Asiatic and American species

When the African species are compared to the Asiatic ones, there is a remarkable resemblance between some species.

C. thonningii and *C. longistipitatus* are very closely related to the Asiatic, polymorphic *C. semidecandrus* Jack. The latter species only differs from *C. longistipitatus* in the always glabrous petals that are fimbriate at apex, and from *C. thonningii* in the usually less glandular-punctate sepals, petals and stamens, and often apparently fertile short stamens.

C. paniculatus Roxb. is very close to *C. griffonianus*, but unlike this species it has 10 fertile stamens.

The Asiatic *C. monocarpus* L. ssp. *monocarpus* is closely related to *C. africanus*. It differs in the often pinnate leaves, in the pericarp lacking glands inside and in the radicle, that is placed almost at the apex of the seed. *C. monocarpus* L. ssp. *malayensis* Leenhouts is related to *C. congolanus* and *C. gabonensis*, differing from the first in the usually pinnate leaves, the smaller follicle and in the exserted radicle, and from the latter in the smaller follicle.

Some South American species also show considerable resemblance to African species, e.g. *C. beyrichii* Planch. resembles *C. longistipitatus* and *C. punctatus* Planch. resembles *C. thonningii*. In Asiatic as well as in South American species usually all stamens are fertile. Only in a number of specimens of some American species sterile stamens are found, but in these plants all stamens are sterile, indicating functionally female plants. In some Asiatic species specimens can be found with sterile or rudimentary short stamens, but in most of these species 10 apparently fertile stamens is the more common situation. In Africa several species (nearly) always have sterile epipetalous stamens.

Only a worldwide revision of the genus can bring more lucidity in the relations of the species.

Keys to the species

Three keys are presented here. Specimens are best identified when complete material, i.e. with flowers and fruits, is available. Material with flowers only is sometimes difficult to identify.

A. Key to specimens with flowers and fruits

1a Follicle oblique-pyriform, up to 3.5 cm long, mucro lateral, rarely almost apical; radicle in seed apical 2
b Follicle ellipsoid, ovoid or (narrowly) obovoid, longer than 3.5 cm, not or only slightly oblique, mucro apical; radicle in seed dorsal or almost in the centre of the seed 4
2a All stamens (apparently) fertile, rarely short stamens rudimentary; follicle with a 5-10 mm long stipe, pericarp pilose inside . . . . **C. longistipitatus**
b Short stamens rudimentary, rarely (apparently) fertile; follicle with a 2-5 mm long stipe, pericarp glabrous or sparingly pubescent inside 3
3a Sepals valvate in bud, more or less fleshy; petals densely pubescent outside; follicle with small, stipitate glands inside. Nigeria to Zaire **C. griffonianus**
b Sepals imbricate in bud, thin; petals (almost) glabrous outside; follicle glabrous and lacking glands inside. Ivory Coast to Togo . . . . **C. thonningii**
4a Leaves (uni-)trifoliolate 5
b Leaves pinnate, with at least 5 leaflets 6
5a Sepals valvate or slightly imbricate in bud, fleshy; lateral margins of petals quite free; follicle not distinctly stipitate, pilose and without glands inside; radicle almost in the centre of the seed . . . . **C. congolanus**
b Sepals imbricate in bud, thin or somewhat fleshy at base only; margin of petals usually connate for a short distance; follicle with 2-5 mm long stipe, glabrous and glandular inside; radicle dorsal . . . . **C. africanus**
6a Leaflets papery, distinctly acuminate, with 3-5 lateral nerves on each side of the midrib; follicle glabrous inside . . . . **C. staudtii**
b Leaflets leathery, acute or hardly acuminate, with 5-7 lateral nerves on each side of the midrib; follicle pilose inside . . . . **C. gabonensis**

B. Key to flowering specimens

1a All stamens (apparently) fertile 2
b Short stamens distinctly rudimentary, anthers minute 4
2a Leaflets 5 or more, but often with few trifoliolate upper leaves . . . . **C. longistipitatus** (see note 2)
b All leaves trifoliolate, rarely uppermost leaves unifoliolate 3
3a Nodes often produced into a distinct process at the base of the petiole; leaflets leathery, acute or acuminate; sepals valvate or slightly imbricate in bud, fleshy; margin of petals quite free . . . . **C. congolanus**
b Nodes without a distinct process at the base of the petiole; leaflets papery or thinly leathery, long-acuminate; sepals imbricate in bud, thin or somewhat fleshy at base only; margin of petals usually connate for a short distance . . . . **C. africanus**
4a Base of the petiole provided with a black pulvinus; petiolules (3-)5-8 mm long, blackish; leaflets distinctly acuminate with long and slender apex, with 3-5 strongly curved lateral nerves on each side of the midrib . . . . **C. staudtii**
b Pulvinus at base of the petiole not blackish, usually indistinct; petiolules up to 6 mm long, not blackish; leaflets broadly acuminate to obtuse, with (4-)5-12 not strongly curved lateral nerves on each side of the midrib . 5
5a Sepals valvate in bud, more or less fleshy; petals densely pubescent outside; sepals and petals rather sparingly glandular punctate; long stamens with stipitate glands, short stamens lacking glands; reduced leaves at base of inflorescences up to 13 mm long; Nigeria to Zaire . . . . **C. griffonianus** (see note 2)
b Sepals imbricate in bud, thin, petals to quite glabrous outside; sepals and petals rather densely glandular punctate; long and short stamens with stipitate glands; reduced leaves at base of inflorescences minute, up to 1.5 mm long. Ivory Coast to Togo . . . . **C. thonningii**

Notes: 1. *C. gabonensis* is not included in this key because flowers are unknown.

2. *C. longistipitatus* very rarely has flowers with rudimentary short stamens, and *C. griffonianus* rarely with apparently fertile short stamens. *C. longistipitatus* has imbricate, thin sepals, longer than 3 mm and broader than 1.2 mm and coherent petals, pubescent outside. *C. griffonianus* has valvate, more or less fleshy sepals, up to 3 × 1.2 mm, and free petals, densely pilose outside.

C. Key to fruiting specimens

1a Follicle oblique-pyriform, up to 3.5 cm long, mucro lateral, rarely almost apical; radicle in seed apical 2
b Follicle ellipsoid, ovoid or (narrowly) obovoid, longer than 3.5 cm, not or only slightly oblique, mucro apical; radicle in seed dorsal or almost in the centre of the seed 4

2a Follicle with 5-10 mm long stipe, pilose inside . . . . . . **C. longistipitatus**
b Follicle with 2-5 mm long stipe, glabrous or sparingly pubescent inside 3
3a Follicle glabrous and without glands inside; leaves glabrous. Ivory Coast to Togo . . . . **C. thonningii**
b Follicle with small, stipitate glands and with some or without normal hairs inside; rachis and leaflets beneath pilose or glabrous. Nigeria to Zaire . . . . **C. griffonianus**
4a Leaves trifoliolate, rarely uppermost leaves unifoliolate 5
b Leaves pinnate, with at least 5 leaflets 6
5a Follicle with 2-5 mm long stipe; pericarp rather thin, glabrous but with small glands inside; radicle in seed dorsal; sepals thin, deciduous; leaflets papery or thinly leathery, long-acuminate; nodes without a distinct process at the base of the petiole . . . . **C. africanus**
b Follicle rounded or cuneate at base, not distinctly stipitate; pericarp thick, woody, pilose but lacking glands inside; radicle almost in the centre of the seed; sepals thick and stiff, persistent in fruit; leaflets leathery, acute or acuminate; nodes often produced into a distinct process at the base of the petiole . . . . **C. congolanus**
6a Follicle not distinctly veined, but somewhat striate outside, glabrous inside; leaflets papery, distinctly acuminate, with 3-5 strongly curved lateral nerves on each side of the midrib . . . . **C. staudtii**
b Follicle distinctly veined outside, pilose inside; leaflets leathery, acute or hardly acuminate, with 5-7 slightly curved lateral nerves on each side of the midrib . . . . **C. gabonensis**

Connarus africanus Lam. **Fig. 114, 115**

C. africanus Lamarck, 1786: 95; Cavanilles, 1789: 375, tab. 221; Vahl, 1794: 86; Willdenow, 1800: 691; Richard, 1831: 156; Hooker, 1849: 290; Planchon, 1850: 426; Walpers, 1852: 300; Baker, 1868: 457; Henriques, 1892: 111; Chevalier, 1920: 165; Schellenberg, 1923: 223; 1938: 283; Exell, 1944: 151; Hepper, 1958: 748; Irvine, 1961: 572; Exell, 1973: 368; Liberato, 1980a: 15; 1980b: 13.
Type: Sierra Leone, *Smeathman s.n.* (lecto: herb. De Jussieu in P; iso: BM, herb. Lamarck in P). See note.
C. venosus De Candolle, 1825: 85 (nomen; in syn.).
C. nigrensis Gilg, 1891b: 317; Chevalier, 1920: 165. Type: Nigeria, Lagos, *Barter 2143* (holo: B†; lecto: K; iso: P).
C. djalonensis Chevalier, 1920: 165. Type: Guinea, Fouta-Djalon, *Chevalier 18056* (lecto: P).
Omphalobium africanum (Lam.) De Candolle, 1825: 85; G. Don, 1832: 90, fig.20. Homotypic synonym of *C. africanus*.
Tricholobus africanus Heckel, 1891: 16. Homotypic synonym of *C. africanus*.

Liana or lianescent shrub. *Branches* cylindric, lenticellate, branchlets brown-

Fig. 114. *Connarus africanus*: 1. flowering branch, 2/3 ×; 2. flower partly, 6 ×; 3. follicle from dorsal side, 2/3 ×; 4. follicle, 1 ×; 5. seed in longitudinal section, 1 × (1. *Bos 2574*; 2. *Bos 4896*; 3-5. *van Harten 359*).

pubescent, soon glabrescent. *Leaves* trifoliolate, rarely uppermost leaves unifoliolate; petiole 2.5-14 cm, rachis 1.5-4 cm long, brown-pubescent when young. Leaflets papery; lateral ones opposite, ovate or elliptic, (4-)6.5-25 × 2-9.5 cm, rounded at base, up to 3 cm long acuminate; glabrous both sides (sometimes somewhat pubescent when very young), midrib impressed above, prominent beneath with (3-)4-7 lateral nerves on each side, tertiary nerves reticulate, usually distinct on both sides; petiolules 5-7 mm long, often wrinkled, glabrous. *Panicles* up to 35 cm long, up to ca 50-flowered, densely brown-pubescent. Bracts, as well as the reduced leaves at base of inflorescences, ovate, up to 1.5 mm long. *Pedicels* short, articulated 0-1.5 mm below the calyx, brown-pubescent. *Sepals* imbricate in bud, ovate, thin or somewhat fleshy at base, (2.1-)2.7-4.0 × (1.0-)1.2-2.0 mm, obtuse or rounded, rarely acute at top, more or less plane, brown-pilose outside, glabrous or pubescent inside, glandular punctate, often indistinctly up to 7-veined. *Petals* usually coherent (rarely completely free), imbricate in bud, narrowly elliptic to narrowly obovate, 5.3-7.5(-8.0) × 1.0-2.0 mm, cuneate at base, obtuse or rounded at top, glabrous or sparingly pubescent outside, glabrous or with glandular hairs inside, usually glandular punctate near the top, 3-7-veined, sometimes indistinctly so. *Stamens* 0.5-1.2 mm united at base; long ones 2.6-3.9 mm or 5.0-7.9 mm long, filaments with stipitate glands, anthers 0.3-0.5 × 0.2-0.3 mm; short ones 1.2-2.7 mm long, filaments lacking glands, anthers usually somewhat smaller, but apparently fertile. *Pistil* 2.5-3.9 mm or 5.0-7.0 mm long; ovary 1.0-1.5 mm long, brown-pilose; style pilose at base and with stipitate glands; stigma oblique, more or less 2-lobed, occasionally distinctly papillate. *Follicle* narrowly obovoid, slightly oblique, hardly compressed, 4.3-6.2 × (1.2-)1.5-2.4 cm, stipe (2-)3-5(-7) mm long; apex acute or with up to 2 mm long erect mucro; pericarp fairly thin, glabrous and lacking distinct veins, but slightly striate outside, glandular inside. *Seed* (ob)ovoid, 17-28 × 10-16 × 7-10 mm, sarcotesta 10-18 mm long, enveloping the basal part of the seed; radicle dorsal, 1/4-1/2 of length from top of seed. *Seedling* hypogeal.

Distribution: From southern Senegal to Cameroun, Equatorial Guinea and Sao Tomé.

Ecology: Rain forest, often near rivers; sometimes in thickets in savanna. Flowering in Senegal to Benin mainly from December to April, in Nigeria and Cameroun mainly from June to September and on Sao Tomé about December. Fruiting a few months later.

Selection of the ca 150 specimens examined:

Senegal: Casamance, Teudoux (May) *Adam 13571* (P); Oussouye, Okout (fr. Apr.) *Berhaut 5753* (M, P); (fl., y.fr. Apr.) *Berhaut 5789* (M, P); Bignona (fl. Mar.) *Berhaut 7185* (BR, M, P); Floup Fedyan (fr. Jan.) *Chevalier 2975* (P); sin. loc. (fl., fr.) *Heudelot 594* (B, P); (fl.) *Heudelot s.n.* (B, P); Casamance (fr. May) *Leprieur s.n.* (P); sin. loc. (fl.) *Perrottet 147* (BM, G); *Perrottet s.n.* (P); (fr.) *Perrottet s.n.* (P).

Guinea-Bissau: Bedanda-Cantanhez (fr. Sept.) *Alves Pereira 3139* (LISC); Pecixe (fr. Nov.) *Alves Pereira 3453* (LISC); Cantanhez (fl., y.fr. Apr.) *d'Orey 368* (LISJC); Fulacunda (fl., fr. July) *Esperito*

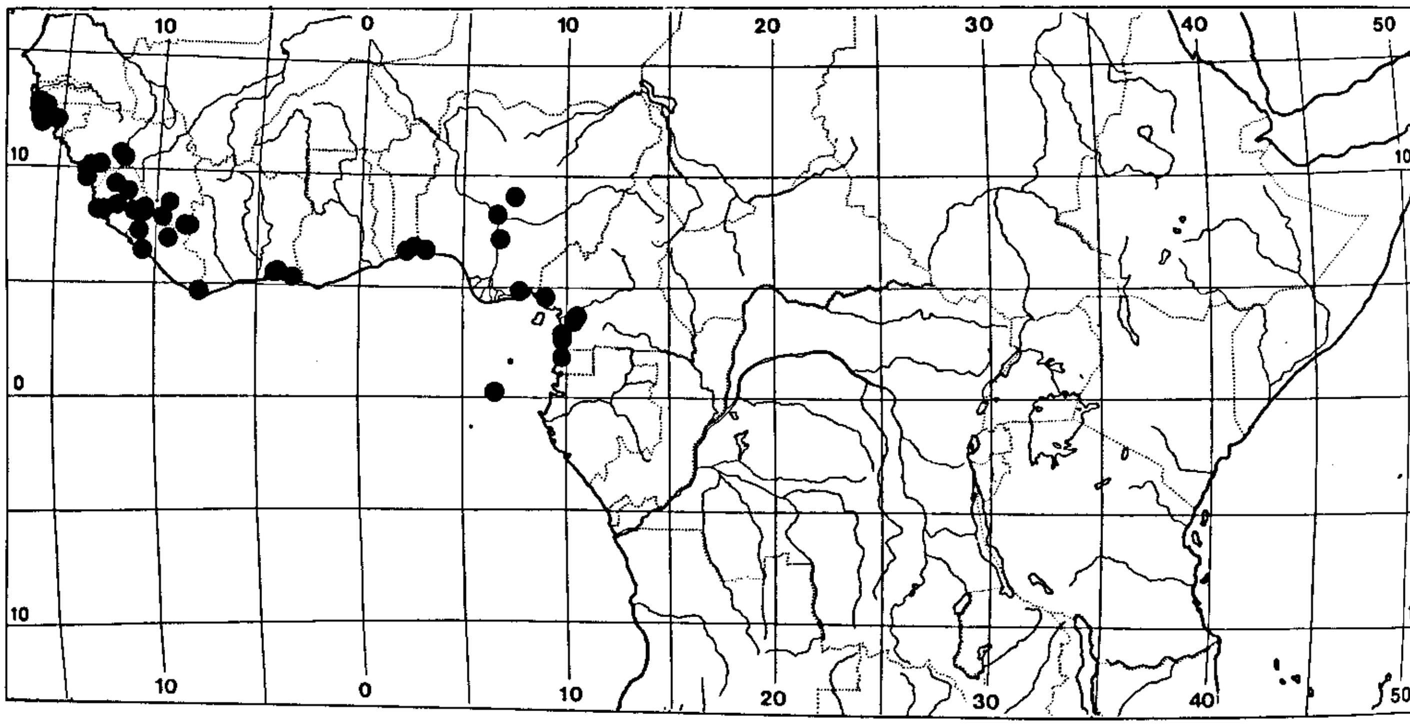


Fig. 115. Distribution of *Connarus africanus*

Santo 585 (COI, LISJC); Biombo (fl., y.fr. Feb.) *Esperito Santo 1792* (COI, K, LISC, P, WAG); Prabis (fl. Mar.) *Esperito Santo 1848* (COI, K, LISC, P, WAG); Cantanhez, Catio (fr. June) *Esperito Santo 2999* (COI, LISC, LISJC, P, WAG).

Guinea: Dalaba (fl. Apr.) *Adam 11839* (K); Kaba-Mamou (fr. Apr.) *Chevalier 12765* (P); Fouta Djalon, Bilima Kante (fl. Mar.) *Chevalier 18056* (P, type of *C. djalonensis*); Kouria-Irebéleya (fr. Sept.) *Chevalier 18263* (P); Fruiguiagbé, Bingaya (fl. Feb.) *Chillou 3625* (P); Konakry (fr. Oct.) *Dybowski 51* (P); near Mamou (fl. Feb.) *Jacques Félix 772* (P); Mamou R. (fl.) *Pobéguin 1441* (P); Fouta Djalon (fr. Jan.) *Pobéguin 1907* (P).

Sierra Leone: sin. loc. (fl.) *Afzelius s.n.* (BM); Njala (fl. Mar.) *Deighton 1092* (BM); Musaia (fr. Mar.) *Deighton 5453* (K); sin. loc. (fl., fr.) *Don s.n.* (K); Northern Prov., Makump (fl. Jan.) *Glanville 140* (K); Lake Sonfon (fl. Feb.) *Gledhill 262* (K, WAG); W Loma (fr. Sept.) *Jaeger 7352* (K); (fl. Dec.) *Jaeger 8998* (K); Bagroo R. (fl., fr.) *Mann 863* (K, P); Tiama (fl. Feb.) *Morton SL 873* (WAG); Songo Penins. (fl. Jan.) *Morton SL 1659* (K); sin. loc. (fl., fr.) *Scott Elliot 4698, 5603* (K); sin. loc. (fl. fr.) *Smeathman s.n.* (BM, P, type); (fl.) *Smeathman s.n.* (BM); Kennema (fl. Jan.) *N. Thomas 1494* (K).

Liberia: Central Prov., Gbarnga (fr. Sept.) *Baldwin 13228* (K); N of Zorzor (fl., fr. Dec.) *Bos 2574* (K, WAG); NE of Gbanga (fr. June) *Daniel 342* (BR, P); Fishtown, Gran Bassa (fr. Aug.) *Dinklage 1978* (B); 10 km from Monrovia, Elwa (fr. Mar.) *van Harten 359* (L, WAG); Bomi Hills-Maho R. (fl. Feb.) *van Meer 369* (WAG); Monrovia (fr. Sept.) *Voorhoeve 460* (WAG); Bomi Hills (fl.b. Feb.) *Voorhoeve 838* (WAG).

Ivory Coast: Banco (fr.) *Aubreville 467* (BR); Abidjan, Dabou (fr.) *Chevalier 15163* (BR, K, P); Guébo (fl. Feb.) *Chevalier 17127* (P); Assinie, Sanvi (fl. Apr.) *Chevalier 17864* (P); *Chevalier 17906* (P); Banco F.R. (fl., y.fr. Feb.) *de Koning 1161* (WAG); (fl., fr. Mar.) *de Koning 5541* (WAG); Port Bouet (fr. July) *Maire s.n.* (P); Abidjan-Gd.Bassam (fr. Dec.) *Oldeman 723* (BR, P, WAG); Vridi (fr. Dec.) *Roberty 15729* (G).

Benin: Pobé (Sept.) *Adjanohoun 70* (P); Ouja (fl., fr. Dec.) *Le Testu 196* (BM, BR, K, P).

Nigeria: Lagos (fl., y.fr.) *Barter 2143* (K, P, type of *C. nigrensis*); Lagos (fl. Sept.) *Dalziel 1022* (K); Kabba Prov., Kotonkarifi (fr. Feb.) *Daramola & Binuyo FHI 61265* (K); N Nigeria, Gurara R. (fl. June) *Elliott 179* (K); Kabba Prov., Igala, Ibaji Ojoku F.R. (fr. Feb.) *Latilo FHI 47107* (K); Eket Distr. (fl.) *Talbot 3242* (BM).

Cameroun: Lobé R. (fl., y.fr. Feb.) *Bos 4001* (K, P, WAG); Kribi (fl. June) *Bos 4896* (K, P, WAG); 8 km S of Kribi (fl. Sept.) *Bos 5347* (WAG); S of Badjob, SW of Eseka (fr. Jan.) *W. de Wilde 1740* (B, BR, K, MO, P, WAG, Z); Bulu-Last Banana, Ndian R. (fl. July) *Thomas 2361*

(WAG); Bipindi (fl., fr.) *Zenker 1538* (B, BR, E, G, GOET, K, L, M, MO, P, WAG, Z); (fr.) *Zenker 1675* (E, G, GOET, K, L, M, P, Z); (fl.) *Zenker 4642* (B, BR, G, GOET, K, L, M, MO, P, Z).
Equatorial Guinea: near Bata (fr. May) *Trilles 64* (P).
Sao Tomé & Principé: Sao Tomé, Juliana de Sousa (fr. July) *Esperito Santo 3972* (LISJC); Sao Tomé (fl. Dec.) *Quintas 135* (K).
Cult.: Ivory Coast, Adiopodoumé (seedlings) *de Koning 5180* (WAG).

Note: Schellenberg (1938) cited the specimen *Heudelot 594* as the type of *C. africanus*. This is incorrect. Lamarck (1786) only cites material collected by Smeathman in Sierra Leone. He cannot have seen material from Heudelot, who collected in Senegambia about 1837. Lamarck described both flowers and fruits. The specimen in the Lamarck herbarium shows flowers only. Consequently the Smeathman-specimen in the De Jussieu herbarium with flowers and fruits is chosen as lectotype.

Uses: According to de Lanessan (1886) a decoction of the bark is used as an astringent for wounds in Senegal. The seeds are used as a purge and vermifuge. They are especially effective against tapeworm, taken in the form of a decoction or with boiled rice; the effect is attributed to tannin (Dalziel, 1936). In Nigeria seeds are said to be used to bait hooks for fishing.

Connarus congolanus Schellenb. **Fig. 116, 117**

C. congolanus Schellenberg, 1938: 289 (as *C. sapinii* on p. 284; see note); Troupin, 1952: 135, fig.2 B,C.
Type: Zaire, Dilolo, *Sapin s.n.* (holo: BR).

Liana or lianescent shrub. *Branches* cylindric, lenticellate, branchlets occasionally somewhat angular, brown-pubescent, soon glabrescent. *Leaves* trifoliolate; petiole 2.5-17 cm long, usually with a distinct process on the branchlet beneath attachment, rachis 0.5-4.5 cm long, brown-pubescent when young. Leaflets leathery, lateral ones more or less opposite, ovate or elliptic, 5-25 × 3-10.5 cm, rounded (lateral leaflets) or cuneate (terminal one) at base, acute or up to 2.5 cm long acuminate; glabrous both sides, midrib strongly impressed above, prominent beneath with 4-9 lateral nerves on each side, tertiary nerves reticulate, more or less distinct on both sides; petiolules 5-6(-9) mm long, wrinkled, glabrous. *Panicles* up to 27 cm long, up to ca 50-flowered, densely brown-pubescent. Bracts, as well as the reduced leaves at base of inflorescences, ovate, 0.5-1 mm long (reduced leaves sometimes subulate and up to 10 mm long). *Pedicels* short, articulated 0-1.5 mm below the calyx, brown-pubescent. *Sepals* valvate or narrowly imbricate in bud, (narrowly) ovate or triangular, fleshy, persistent at follicles, 2.5-3.6 × 1.0-1.7 mm, acute or obtuse at top, plane or somewhat keeled, brown-pilose outside, glabrous inside, glandular punctate, indistinctly up to 5-veined. *Petals* free, valvate or narrowly imbricate in bud, narrowly elliptic, narrowly obovate to almost linear, (5.5-)6.5-8.1 × 1.0-1.7 mm, cuneate at

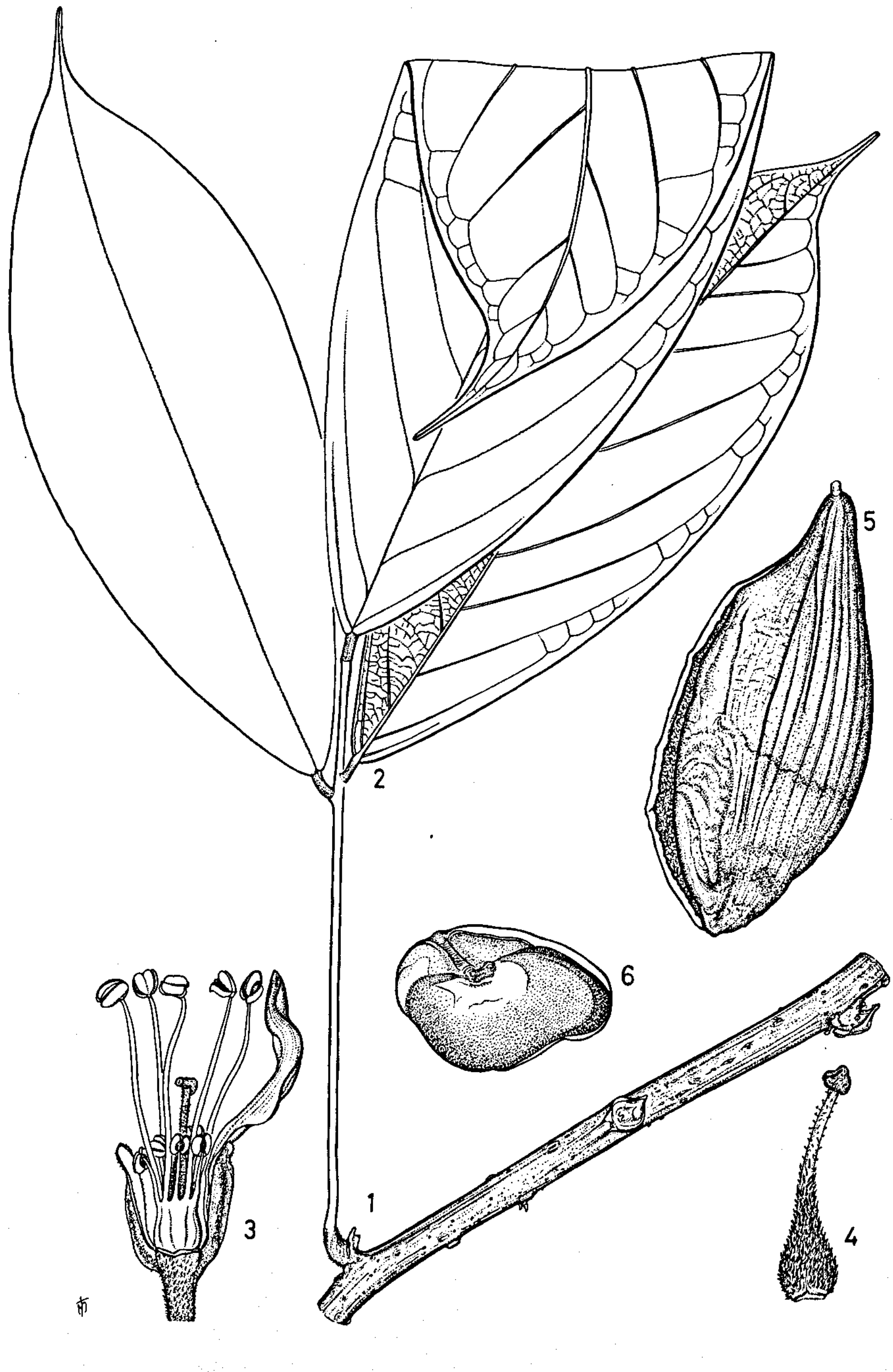


Fig. 116. *Connarus congolanus*: 1. branch with leaf, 2/3 ×; 2. leaflet beneath, 2/3 ×; 3. flower partly, 6 ×; 4. pistil, 8 ×; 5. follicle, 1 ×; 6. seed in longitudinal section, 1 × (1-4. *Leeuwenberg 5091*; 5-6. *Stoop v.d. Kasteele 335*).

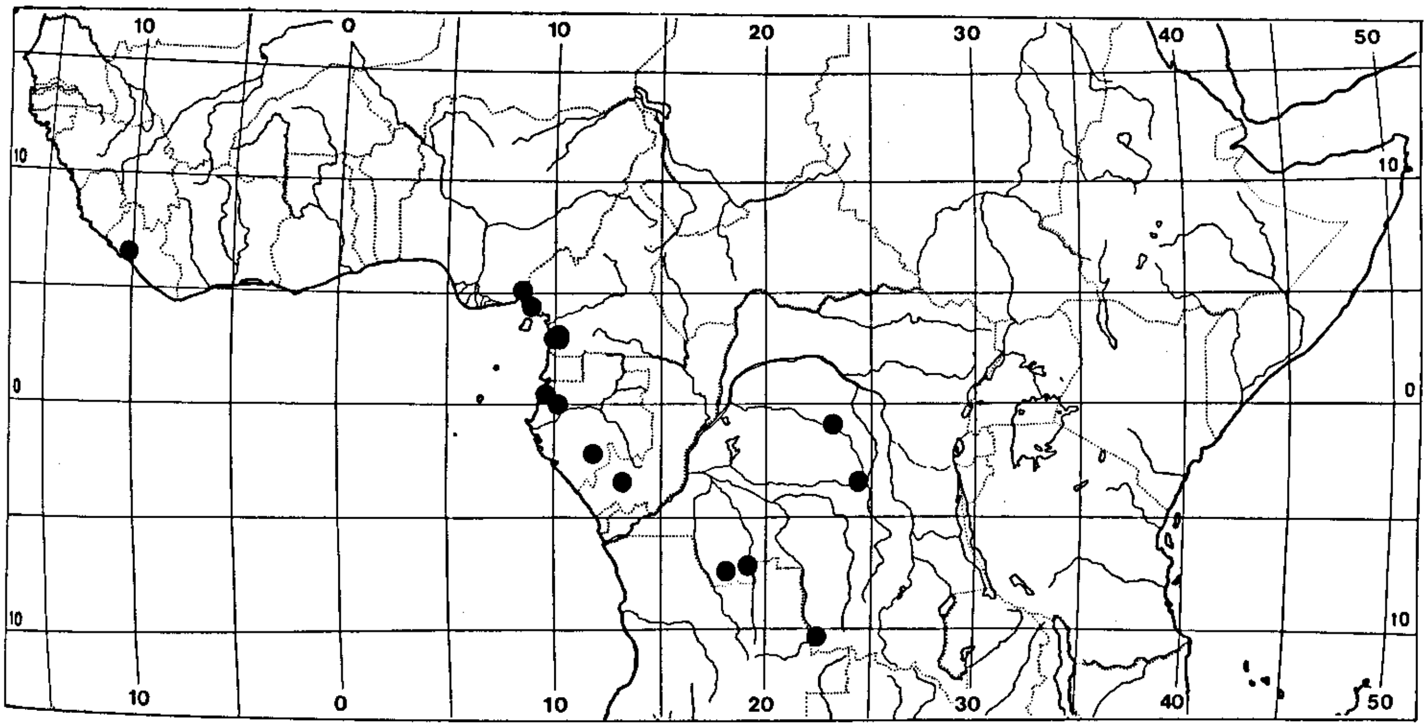


Fig. 117. Distribution of *Connarus congolanus*

base, obtuse at top, glabrous, rarely sparingly pubescent outside, glabrous or rarely with some glandular hairs inside, usually glandular punctate near the top, more or less distinctly up to 5(-7)-veined. *Stamens* 1.0-1.5 mm united at base; long ones 4.2-4.4 mm or 6.0-7.0 mm long, filaments with stipitate glands, anthers ca 0.3 × 0.2 mm; short ones 2.0-3.0 mm long, filaments lacking glands, anthers usually somewhat smaller, but apparently fertile. *Pistil* 3.4-4.1 mm or 7.9-9.7 mm long; ovary 1.0-1.5 mm long, brown-pilose; style pilose at base and with stipitate glands; stigma oblique, more or less 2-lobed, often distinctly papillate. *Follicle* ellipsoid, ovoid or obovoid, not or hardly oblique, 5.0-7.3 × 2.0-3.0 cm, rounded or cuneate but not stiped at base, obtuse or acute at apex; pericarp thick, woody, glabrous and distinctly veined outside, densely pilose inside. *Seed* obovoid, ca 34 × 25 × 20 mm, sarcotesta ca 10 mm long, enveloping the basal part of the seed at the ventral side only; radicle almost in the centre of the seed, between the cotyledons.

Distribution: Liberia, Nigeria to South and Central Zaire.

Ecology: Primary or secondairy rain forest, often near rivers. Flowering in Cameroun and Gabon mainly in March and April, in Zaire from January to September. Fruiting a few months later.

Specimens examined:

Liberia: Harbel (fr. July) *Stoop v.d. Kasteele 335* (WAG).

Nigeria: Calabar Prov., Uwet Distr., Buden Dunlop (fr. Aug.) *Binuyo FHI 41432* (BR, K); Calabar-Mamfe, Oban (fr. Mar.) *Onochie FHI 34828* (BR, K, P).

Cameroun: 6 km N of km 46 Kribi-Lolodorf (fl. Mar.) *Bos 6534* (K, P, WAG); 60 km SW of Eséka, S of Nyong R., 12 km W of Songbong (fl. Mar.) *Leeuwenberg 5049* (WAG); 53 km SW of Eséka, S of Nyong R., 3 km W of Songbong (fl. Mar.) *Leeuwenberg 5091* (B, C, G, K, L, LISC, MO, P, WAG); Bulu-Last Banana, Ndian R. (fr. July) *D. Thomas 2344* (MO, WAG, YA); Bipindi (fl.b.) *Zenker 4895* (BR, G, GOET, K, L, M, MO, P, Z).

Gabon: near Libreville (fl., fr. June) *Klaine 36* (B, K, P); (fr.) *Klaine 445* (P); (fl.) *Klaine 447* (P); Mbigou (fl. Apr.) *Le Testu 5412* (BM, P); Epambwa (fl. Mar.) *Le Testu s.n.* (BM); S of Ekouk (fl., fr. Nov.) *A. Louis, Breteler & de Bruijn 299* (LBV, WAG).

Congo: km 10 Mossendjo-Mayoko (fr. May) *Bouquet 1323* (P).

Zaire: Katako-Kombe (fl. Jan.) *Claessens 435* (BR); Kahemba, Kwango (fl. Mar.) *Devred 2997* (BR); Ikela (fl. Sept.) *Dubois 833* (BR); near Panzi (fr. Dec.) *Renier 12* (BR); Dilolo (fr. June) *Sapin s.n.* (BR, type).

Note: Schellenberg (1938) named the species, based on the specimen *Sapin s.n.* from Zaire, *C. sapinii*. Later he realized this name was already used by De Wildeman (1909) for another species, now a synonym of *C. griffonianus*. Consequently, in the appendix of his monograph on *Connaraceae* he changed the name into *C. congolanus*.

Connarus gabonensis Lemmens, **sp. nov.** — **Fig. 118, 119**

Liana. Folia imparipinnata, 3-4-juga. Foliola coriacea, lateralia anguste elliptica, 6-11 × 3-5 cm, basis rotundata, terminale anguste elliptica, 11-12 × 4.5 cm, basi rotundatum vel cuneatum; foliola acuta vel paulo acuminata, glabra. Inflorescentia grandis, laxa. Sepala circa 2 × 1 mm. Folliculus 5.5-7.5 × 2-2.5 cm, lignosus, extus nervatus, intus pilosus.

Type: Gabon, 15 km N of km 10 Lalara-Makokou, Okano R., *Breteler & J. de Wilde 494* (holo: WAG).

Liana. *Branches* cylindric or somewhat angular, lenticellate, branchlets soon glabrescent. *Leaves* 3-4-jugate; petiole 8-14 cm, rachis 7.5-12.5 cm long, soon glabrous. Leaflets leathery, lateral ones alternate, narrowly elliptic, 6-11 × 3-5 cm, rounded at base, terminal one narrowly elliptic, 11-12 × 4.5 cm, rounded or somewhat cuneate at base; leaflets acute or indistinctly acuminate, glabrous both sides, midrib impressed above, prominent beneath, with 5-7 lateral nerves on each side; tertiary nerves reticulate, distinct beneath, indistinct above; petiolules 5-7 mm long, wrinkled, glabrous. *Panicles* very large, up to 70 cm long, many-flowered, brown-pubescent. Bracts triangular or ovate, very small, up to 1 mm long. *Sepals* at base of follicle ovate to triangular, thick and stiff, ca 2.0 × 1.0 mm, acute at top, pilose outside, glabrous inside. *Follicle* ellipsoid, somewhat triangular in cross section, not oblique, 5.5-7.5 × 2-2.5 cm, cuneate but not stiped at base, obtuse at top; pericarp thick, woody, initially brown-pubescent but soon glabrescent and distinctly veined outside, densely pilose inside. *Seed* immature.

Distribution: Central Gabon; only known from the type.

Ecology: Found in riverbank vegetation in rain forest.

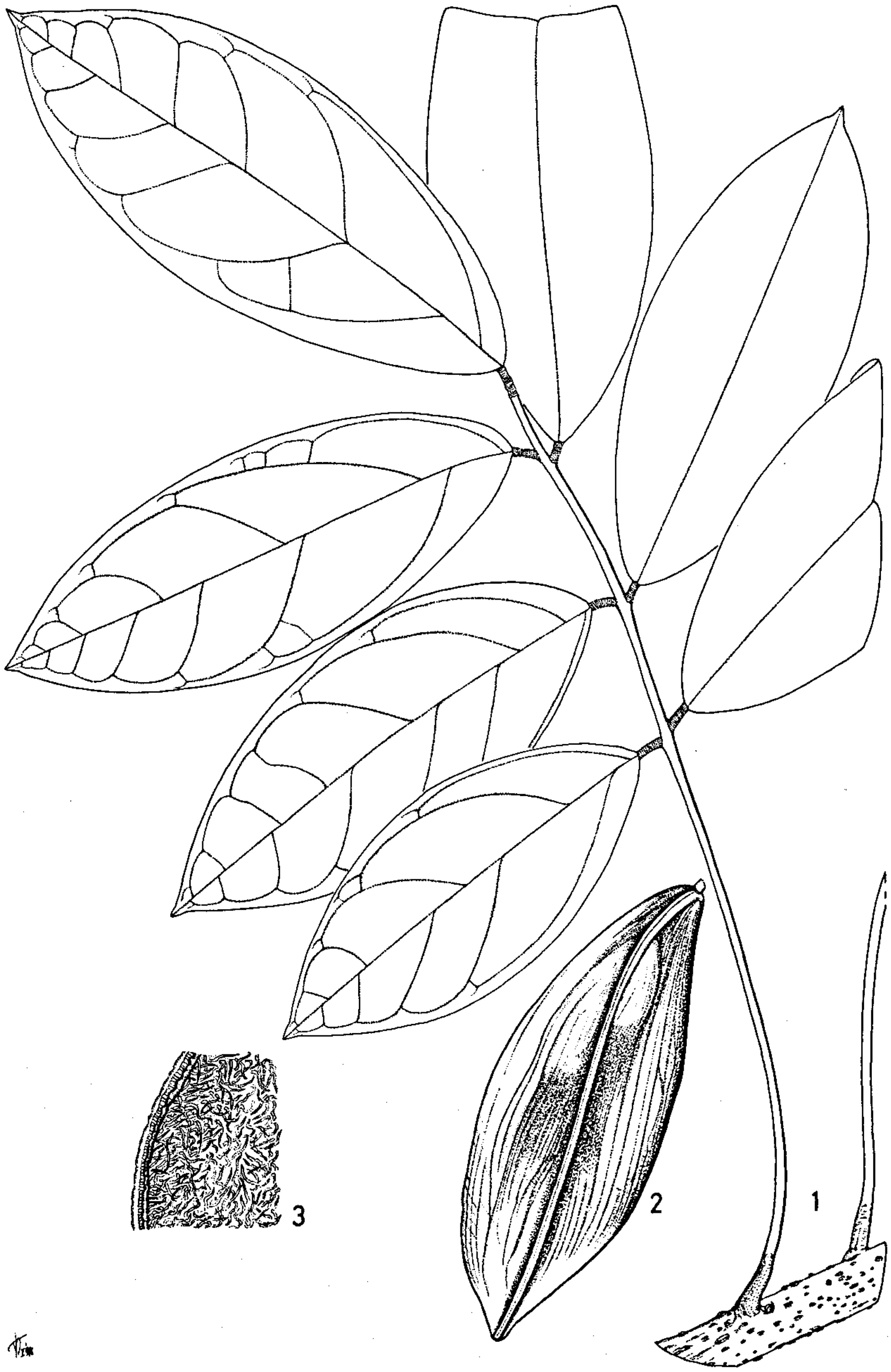


Fig. 118. *Connarus gabonensis*: 1. branch with leaf, 2/3 ×; 2. follicle from ventral side, 1 ×; 3. detail inner side of follicle, 24 × (1-3. *Breteler & J. de Wilde 494*).

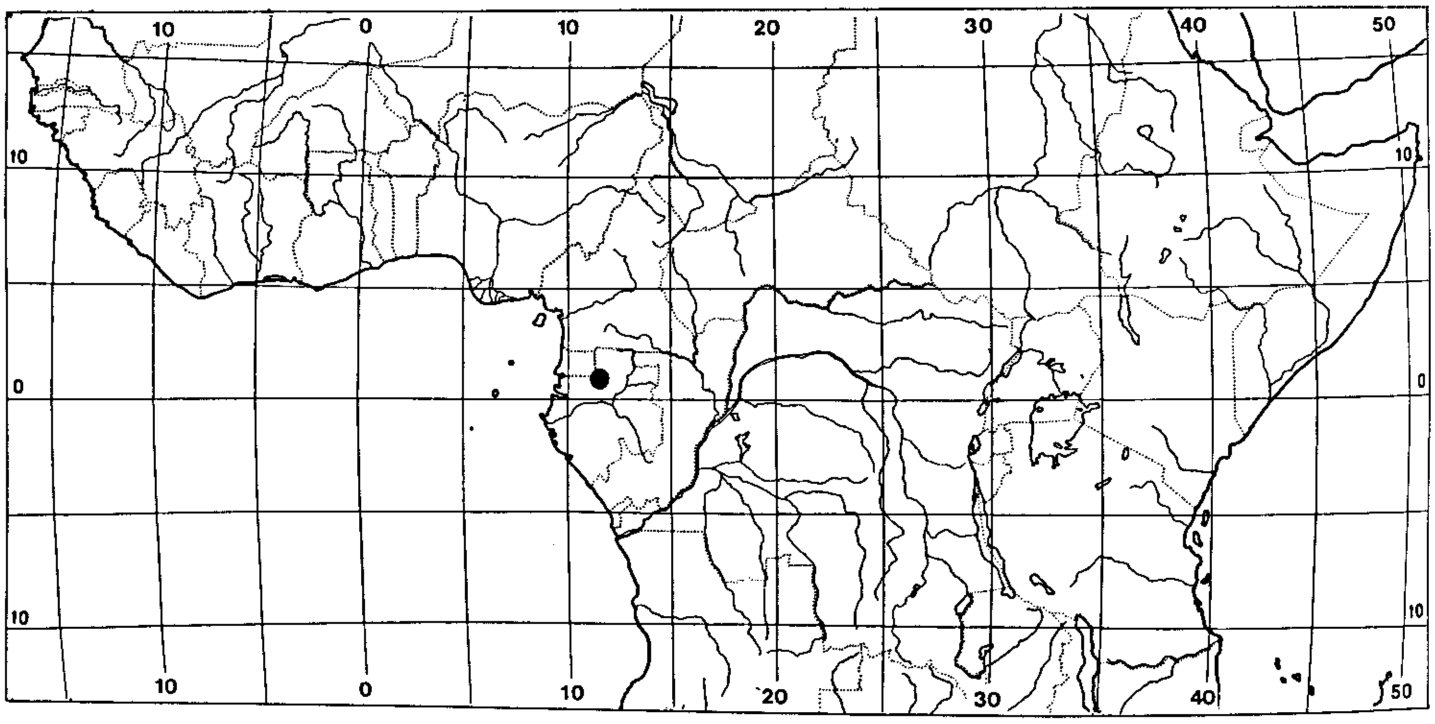


Fig. 119. Distribution of *Connarus gabonensis*

Specimen examined:

Gabon: 15 km N of km 10 Lalara-Makokou, Okano R. (fr. Oct.) *Breteler & J. de Wilde 494* (WAG, type).

Note: This species differs from the closely related trifoliolate *C. congolanus* by having pinnate leaves. Various flower parts are not or insufficiently known.

Connarus griffonianus Baill. **Fig. 120, 121**

C. griffonianus Baillon, 1867: 235; Schellenberg, 1923: 225; De Wildeman, 1929: 551; 1931: 239; Schellenberg, 1938: 269; Exell, 1944: 151; Troupin, 1952: 132; Hepper, 1958: 748; Exell, 1973: 368; Liberato, 1980b: 14.

Type: Gabon, *Griffon du Bellay 183* (lecto design. by Schellenberg, 1938: P).

C. griffonianus Baill. var. *subsericeus* (Schellenb.) Troupin, 1952: 134. Basionym: *C. subsericeus* Schellenberg, 1923: 227; Exell, 1928: 98; De Wildeman, 1929: 551; 1931: 239 (as *C. sericeus*); Schellenberg, 1938: 272; Gossweiler & Mendonça, 1939: 55, 145; Exell & Mendonça, 1954: 154. Type: Angola, Pungo Andongo, *Mechow 87* (lecto design. by Schellenberg, 1938: B†; lecto: BR; iso: Z).

C. englerianus Gilg, 1891b: 316; Durand & Schinz, 1896: 101; Durand & Durand, 1909: 119; Gilg, 1911: 232; Schellenberg, 1923: 225; 1938: 272; Troupin, 1952: 134. Type: Zaire, Kasai Distr., Mukenge, *Pogge 752* (holo: B†), neo: Zaire, Kakenge, Bakuba, *Gillardin 273* (BR).

C. luluensis Gilg, 1895b: 64; Durand & Durand, 1909: 119; Schellenberg, 1923: 225. Type: Zaire, Kasai, Lulua R., *Pogge 741* (holo: B†), neo: Zaire, Kazumba, Miao R., *Liben 3422* (BR).

C. florulentus Hiern, 1896: 189. Type: Angola, Pungo Adongo, near Quiembongo and Mata de Cabondo, *Welwitsch 614* (lecto: BM; iso: K).

C. villosiflorus Gilg, 1896: 209; Schellenberg, 1923: 225; 1938: 272. Type: Cameroun, Yaoundé, *Zenker 92* (holo: B†), neo: Cameroun, Bipindi (fl.) *Zenker 2878* (B, BR, E, G, GOET, K, L, M, MO, WAG, Z).

C. sapinii De Wildeman, 1909: 89 (as *C. sapini*); 1910a: 292. Type: Zaire, Madibi, *Sapin s.n.* (holo: BR).

C. macrothyrsus Gilg ex Schellenberg, 1910: 19. Homotypic synonym of *Manotes staudtii.*

C. incurvatus Schellenberg, 1923: 228; 1938: 273. Type: Central African Republic, Boro, *Chevalier 7688* (holo: B†; lecto: P).

C. obovatus Schellenberg, 1923: 229; 1938: 273. Type: Central African Republic, Bondjo Land, *Chevalier 6033 bis* (holo: B†; lecto: P).

C. orientalis Schellenberg, 1923: 228; 1938: 273; Troupin, 1952: 135. Type: Zaire, Mawambi-Kasanga, *Mildbraed 3085* (holo: B†), neo: Zaire, 7 km W of Kisangani, *Bokdam 3199* (WAG).

C. puberulus Schellenberg, 1923: 226; 1938: 271. Type: Cameroun, Tibati, *Ledermann 2324* (lecto design. by Schellenberg, 1938: B†), lecto: Cameroun, Yaoundé-Dendeng, *Mildbraed 8341* (K).

C. triangularis Schellenberg, 1923: 226; 1938: 271. Type: Cameroun, Lomie Distr., Assobam, Bunda R., *Mildbraed 5064* (holo: B†), neo: Cameroun, 14 km WSW of Kinsassa, 65 km NNE of Moloundou, *Letouzey & Villiers 10513* (BR, P). See note 1.

C. fernandesianus Exell & Mendonça, 1952: 234, fig.14; 1954: 154, fig.34. Type: Angola, Lunda, near Vila Henrique de Carvalho, *Exell & Mendonça 935* (holo: COI; iso: BM, BR).

Manotes staudtii Gilg, 1895b: 71. Type: Cameroun, Yaoundé, *Zenker & Staudt 122* (holo: B†; lecto: K; iso: BM).

Liana or lianescent shrub. *Branches* cylindric, often with shallow longitudinal grooves, lenticellate, branchlets densely brown-pubescent, later glabrescent. *Leaves* (2-)3-5-jugate; petiole (3-)5-12 cm, rachis 4-16 cm long, brown-pubescent when young. Leaflets papery to leathery, lateral ones opposite or not, (narrowly) elliptic or (narrowly) obovate, 5-22 × 2-7 cm, rounded or cuneate at base, terminal one narrowly elliptic or narrowly obovate, 9-21 × 3-8 cm, more or less cuneate at base; all leaflets acuminate, glabrous above, densely brown-pubescent to glabrous beneath, midrib impressed above, prominent beneath, with (5-)6-12 lateral nerves on each side; tertiary nerves reticulate, distinct beneath, usually indistinct above; petiolules 4-7 mm long, often wrinkled, pilose or glabrous. *Panicles* up to 35 cm long, up to ca 50-flowered, densely brown-pubescent. Reduced leaves at base of inflorescences linear, up to 13 mm long, more rarely ovate and small, bracts ovate, ca 1 mm long. *Pedicels* very short, articulated 0-1.5 mm below the calyx, brown-pubescent. *Sepals* often rather distinctly spirally arranged, valvate in bud, triangular to ovate, somewhat fleshy, (1.7-)2.0-2.5(-3.0) × 0.7-1.2 mm, acute or obtuse at top, more or less convex, brown-pilose outside, glabrous inside, glandular punctate with up to 15 glands,

Fig. 120. *Connarus griffonianus*: 1. branch with leaf, 2/3 ×; 2. branchlet with inflorescences, 2/3 ×; 3. detail leaflet beneath, 10 ×; 4. flower, 6 ×; 5. flower partly, showing stamens and pistil, 6 ×; 6. fertile and rudimentary stamen, 12 ×; 7. follicle, 1 ×; 8. detail inner side of follicle, 20 ×; 9. seed, 1 ×; 10. seed in longitudinal section, 1 × (1-6. *Breteler & J. de Wilde 625*; 7-10. *Devred 2531*).

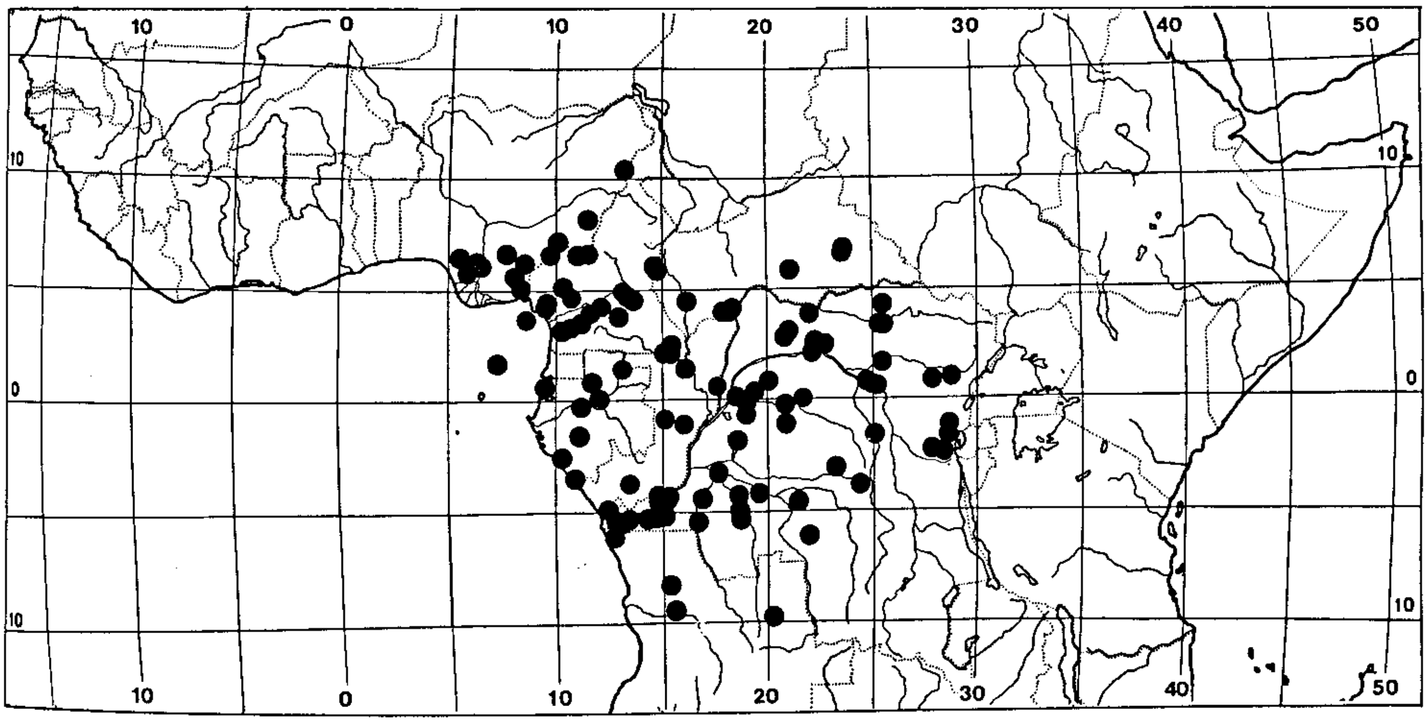


Fig. 121. Distribution of *Connarus griffonianus*

up to 3-veined. *Petals* free, imbricate in bud, narrowly elliptic to narrowly obovate, 4.5-6.5 × 1.0-1.5 mm, cuneate at base, obtuse or rounded at top, densely pilose outside, with some glandular hairs or sometimes glabrous inside, usually glandular punctate with some glands near the top, indistinctly up to 5-veined. *Stamens* 0.5-1 mm united at base; long ones 2.0-3.0 mm or 4.2-6.0 mm long, filaments mostly with stipitate glands, anthers ca 0.3 × 0.2 mm, usually lacking glands; short ones 1-1.7 mm long, rudimentary and sterile with slender filaments and very small anthers, exceptionally apparently fertile (see note 2), lacking glands. *Pistil* 2.1-2.8 mm or 4.2-6.0 mm long; ovary 1-1.5 mm long, brown-pilose; style pilose at base, with stipitate glands; stigma oblique, more or less 2-lobed. *Follicle* oblique-pyriform, compressed, 1.5-2.5 × 1.3-1.8 cm, stipe 2-4 mm long; apex with ca 1 mm long lateral mucro; pericarp thin, initially brown-pubescent but often glabrescent outside, with a few hairs and many glands inside. *Seed* (narrowly) ovoid, 10-15 × 4-7 × 4-6 mm, sarcotesta 5-7 mm long, enveloping the basal part of the seed; radicle apical.

Distribution: Central Africa, from Nigeria to E Zaire and south to N Angola.
Ecology: Rain forest, usually in lowland, under 1000 m altitude (see note 2 under *C. longistipitatus*). Flowering in Nigeria, Cameroun, Central African Republic and Gabon mainly from September to March, in Zaire it can be found flowering all the year round.

Selection of the ca 250 specimens examined:

Nigeria: Benin Div., Uyere-Oke, Owam F.R. (fl. Feb.) *Brenan & Onochie 8984* (BM, K); Benin Div., Okomu F.R. (fr. Feb.) *Brenan, Onochie, Jones & Richards 9071* (K); Mambilla Div., Gashaka-Gidan Kwano (fr. May) *Chapman 4487* (K); Vogel Peak (fl. Feb.) *Chapman 4742* (K); Sapoba (fl.)

Kennedy 2088 (BR, K, P); Udi Plateau (fl. Dec.) *MacGregor 372* (K); Ogoja Prov., Sonkwala (fl. Dec.) *Savory & Keay FHI 25160* (K); Oban (fr.) *Talbot 1765* (BM, K, Z).

Cameroun: Nola (fl., fr. Nov.) *Aubreville 256* (P); Bitye (fl.) *Bates 1609* (MO); Kumba Distr. (fl., fr. Feb.) *Binuyo & Daramola FHI 35529* (K); 5 km E of Bertoua (fr. Dec.) *Breteler 846* (BR, K, P, WAG); km 6 Bertoua-Batouri (fr. Mar.) *Breteler 1193* (BR, K, P, WAG); 6 km E of Bertoua (fl. Sept.) *Breteler 1850* (BR, K, P, WAG); N of Nyassosso (fl. Apr.) *Etuge & D. Thomas 15* (MO, WAG); Gounso (fl. Feb.) *Jacques Félix 3187* (P); Mai Idoanu, Mbaw R. (fl., y.fr. Feb.) *Latilo & Daramola FHI 34463* (B, K, MO, P); 14 km WSW of Kinsassa, 65 km NNE of Moloundou (fr. Mar.) *Letouzey & Villiers 10513* (BR, P, type of *C. triangularis*); *Letouzey & Villiers 10553* (BR, P); Molundu, Lokomo-Bumba (fl., y.fr. Jan.) *Mildbraed 4343* (HBG); Yaoundé-Dendeng (fr. Feb.) *Mildbraed 8341* (K, type of *C. puberulus*); Bipindi (fl.) *Zenker 105* (B, C, U); Yaoundé (fl.) *Zenker & Staudt 122* (BM, K, type of *Manotes staudtii* and *C. macrothyrsus*); Bipindi (fl.) *Zenker 2878* (B, BR, E, G, GOET, K, L, M, MO, WAG, Z, type of *C. villosiflorus*); (fr.) *Zenker 3578* (BR, E, G, GOET, K, L, M); (fr.) *Zenker 3617* (BR, E, G, GOET, K, L, M, MO, P, Z).

Central African Republic: km 17 Mbaiki-Boda, Bomangou F. (fr. Dec.) *Badré 333* (P, WAG); near Mbaiki (fr. Dec.) *Breyne 1304* (BR); Bembo (fl.b. Dec.) *Breyne 1378* (BR); Krébédjé (fl. Oct.) *Chevalier 6004* (G, L, P); sin. loc. (fl. Oct.) *Chevalier 6033 bis* (P, type of *C. obovatus*); Snoussi Land (fr. Mar.) *Chevalier 7688* (P, type of *C. incurvatus*); 2 km S of Carnot, Mambéré R. (fl., fr. Dec.) *Leeuwenberg 7252* (B, BR, K, MO, P, WAG); Yalinga Region (fr. May) *Le Testu 4710* (BR, P); Molo-Mondoko, Lissongo (fl. Sept.) *Tisserant 1586* (P, WAG).

Equatorial Guinea: Fernando Po (fl.) *Mann 7* (K); (fr.) *Mann 427* (K, P).

Sao Tomé & Principé: Principé, Ogue Pipi (fr. Dec.) *Exell 502* (BM); Pico Papagaio (fl.b. Dec.) *Exell 679* (BM).

Gabon: km 40 Lalara-Makokou (fl. Sept.) *Breteler & J. de Wilde 523* (WAG); Ivindo R. (fl. Sept.) *Breteler & J. de Wilde 625* (WAG); sin. loc. (fl., fr.) *Griffon du Bellay 183* (P, type); *Griffon du Bellay 274* (P); Bélinga (fr. July) *Hallé & Le Thomas 120* (P); (fr. June) *Hallé 3973* (P); near Libreville (fl.) *Klaine 3011 bis* (B, K, P); Lopé-Okanda (fr. Nov.) *Leeuwenberg 12451* (LBV, WAG); Ogooué (fl.) *Leroy s.n.* (P); Mayumba (fl. Mar.) *Le Testu 1002* (BR, K, P); Nyanga Region (fl.) *Le Testu 1772* (BM, BR, P); Gaboon R. (fl.) *Mann 980* (K, P); Sibange Farm near Libreville (fl. July) *Soyaux 298* (K, Z).

Congo: Mboté R. (fr. Sept.) *Bouquet 517* (P); near Brazzaville (fl. Aug.) *Chevalier 27734* (P); (fr. Aug.) *Chevalier 27744* (P); 15 km from Brazzaville (fl.b. Aug.) *de Néré 1705* (P); km 39 Edou-Boundji (fl. July) *Descoings 8077* (P); 25 km W of Sibiti, Mudongo (fr. Aug.) *Farron 4417* (P); Kimpanzou, Foulakari R. (fr. Nov.) *Lejoly 86/148* (BR); Ouesso (fl., fr. Mar.) *Pobéguin 131* (P); Alima R. (fr. Mar.) *Thollon 916* (BR, P).

Zaire: Leopoldville (fl. Sept.) *Achten 1231* (BR); Stanleyville (fl. Feb.) *Bequaert 6926* (BR); 7 km W of Kisangani (fl. Sept.) *Bokdam 3199* (WAG, type of *C. orientalis*); Yangambi (fl., fr. Oct.) *Bolema 98* (BR); Momfinu, Maluku (fl., fr. May) *Breyne 2200* (BR); Kimbuya-Kingedi, Lukula (fr. Aug.) *Compere 150* (BR, K); Eala (fl. Aug.) *Corbisier-Baland 1648* (BR, K); Leopoldville (fl. Aug.) *Couteaux 1098* (BR, G, K, L, WAG); Kiyaka, Kwango, Bunga F. (fr. Sept.) *Devred 2669* (BR, K); Luki (fr. Sept.) *Donis 2016* (BM, BR, P); Ndeke, Basankusu (fl., fr. Sept.) *Evrard 4892* (BR); Madabu (fl., fr. Mar.) *Gerard 2776* (BR); km 62 Boma-Matadi, Kimpelo (fr. June) *Germain 2319* (BR, K); Kakenge, Bakuba (fl. Nov.) *Gillardin 273* (BR, type of *C. englerianus*); Gombe, Congo R. (fl., fr. Apr.) *Jans 452* (BR); near Coquilhatville (fl., fr. July) *Lebrun 818* (BR, G, P); Yangambi (fl. July) *A. Léonard 864* (BR, K, M); Kazumba, Miao R. (fr. July) *Liben 3422* (BR, type of *C. luluensis*); Yangambi (fr. Nov.) *J. Louis 12773* (BM, BR, K, P); Kinkasi Benga, Popokabaka (fr. Oct.) *Pauwels 152* (BR); Bombimba (fl. Aug.) *Pynaert 320* (BR); Madibi (fr. June) *Sapin s.n.* (BR, type of *C. sapinii*); Ipamu (fr. Aug.) *Vanderyst 10304* (BR).

Angola: Lunda, Vila Henrique de Carvalho (fl. Apr.) *Exell & Mendonça 935* (BM, BR, COI, type of *C. fernandesianus*); Pango Manga, Maiombe (fl., y.fr.) *Gossweiler 6163* (BM, COI, LISU); Loco, Sumba, Peco (fl. June) *Gossweiler 9140* (K); Pungo-Andongo (fl.) *Mechow 87* (BR, Z, type of *C. subsericeus* and *C. griffonianus* var. *subsericeus*); Cuanza Norte, Camabatela (fl., fr. Feb.) *Teixeira et al. 12070* (LISC); Pungo Adongo (fl., fr.) *Welwitsch 614* (BM, K, type of *C. florulentus*).

Notes: 1. The holotype of *C. triangularis*, the only specimen cited by Schellenberg, was destroyed in B. According to Schellenberg, it is characterized by the triangular follicle and the leaflets, cordate at base. This description fits *C. griffonianus*. A specimen from Cameroun, *Letouzey & Villiers 10553*, is chosen as neotype. Its follicles are more or less triangular in outline, and the leaflets have a somewhat cordate base.

2. In *C. griffonianus* flowers with 10 apparently fertile stamens are found rarely, but then the anthers of the short stamens are distinctly smaller than those of the long stamens. This was found in only 3 specimens (*Le Testu 1002* from Gabon, *Jans 452* and *Gilbert 14202* from Zaire) out of the 68 flowering specimens studied. The plants from Zaire have fruits and there is no doubt that they belong to *C. griffonianus*. The specimen from Gabon has no fruits, but the narrow, thick sepals and the collecting locality agree with *C. griffonianus* rather than *C. longistipitatus*. For that reason it is identified as *C. griffonianus*.

Connarus longistipitatus Gilg **Fig. 122, 123**

C. longistipitatus Gilg, 1895b: 191; 1911: 232; Exell, 1928: 98; De Wildeman, 1931: 239 (as *C. longestipitatus*); Schellenberg, 1938: 268, fig.46 (as *C. longestipitatus*); Gossweiler & Mendonça, 1939: 90 (as *C. longistipulatus*); Troupin, 1952: 130 (as *C. longestipitatus*); Exell & Mendonça, 1954: 152 (as *C. longestipitatus*); Hemsley, 1956: 24, fig.9.

Type: Tanzania, Bukoba, *Stuhlmann 3831* (holo: B†), neo: Tanzania, Bukoba, Minziro F.R., *Watkins 532* (EA).

C. stuhlmannianus Gilg, 1895b: 192; Schellenberg, 1938: 268. Type: Tanzania, Bukoba, *Stuhlmann 1128* (lecto: B†), neo: Tanzania, Bukoba Distr., Kiziba, *Ford 54* (EA).

C. mildbraedii Schellenberg, 1923: 224; 1938: 267; Troupin, 1952: 129. Type: Cameroun, Lomie Distr., Mokumelos, *Mildbraed 5272* (holo: B†), neo design. by Troupin, 1952: Zaire, Lubutu-Kirundu, *Bequaert 6814* (BR).

C. vrydaghii Troupin, 1951: 372; 1952: 131, fig.2A. Type: Zaire, Bambesa, *Vrydagh 416* (holo: BR).

Liana or lianescent shrub. *Branches* cylindric, sometimes somewhat angular or with shallow longitudinal grooves, mostly lenticellate, branchlets initially brown-pubescent, soon glabrescent. *Leaves* (1-)2-4-jugate; petiole 3-11 cm, rachis (2-)4.5-17 cm long, brown-pubescent when young. Leaflets papery, rarely thinly leathery, lateral ones opposite or not, (narrowly) elliptic or (narrowly) ovate, 6-20 × 3-9 cm, rounded or cuneate at base, terminal one 7-20 × 4-11 cm, cuneate or sometimes rounded at base; all leaflets acuminate, glabrous both sides (very young sometimes sparsely pubescent), midrib impressed above, prominent beneath, with 4-7 lateral nerves on each side; tertiary nerves reticulate, distinct beneath, usually indistinct above; petiolules 4-6 mm long, wrinkled, soon glabrous. *Panicles* 3-20 cm long, up to ca 50-flowered, densely brown-

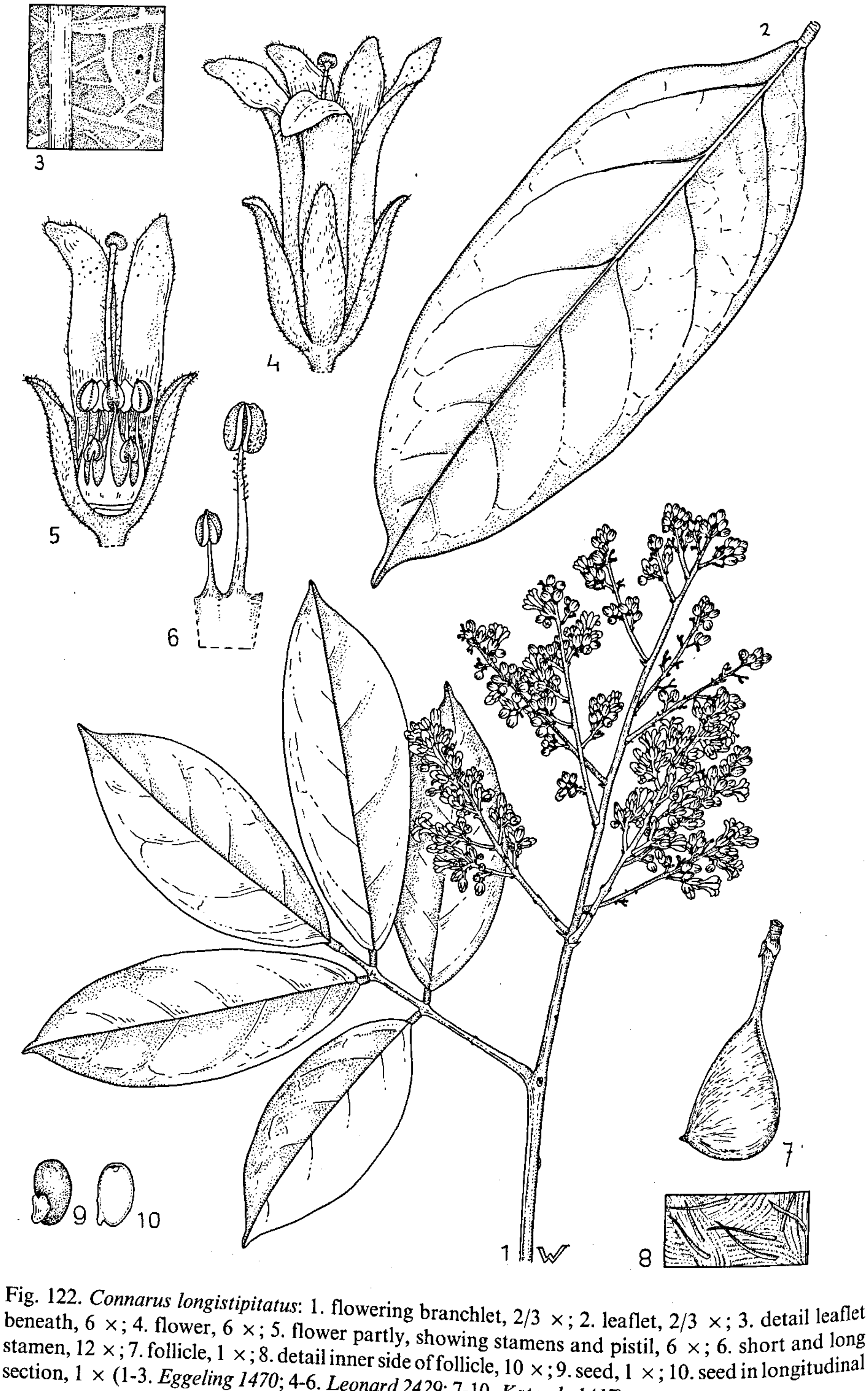


Fig. 122. *Connarus longistipitatus*: 1. flowering branchlet, 2/3 ×; 2. leaflet, 2/3 ×; 3. detail leaflet beneath, 6 ×; 4. flower, 6 ×; 5. flower partly, showing stamens and pistil, 6 ×; 6. short and long stamen, 12 ×; 7. follicle, 1 ×; 8. detail inner side of follicle, 10 ×; 9. seed, 1 ×; 10. seed in longitudinal section, 1 × (1-3. *Eggeling 1470*; 4-6. *Leonard 2429*; 7-10. *Katende 1417*).

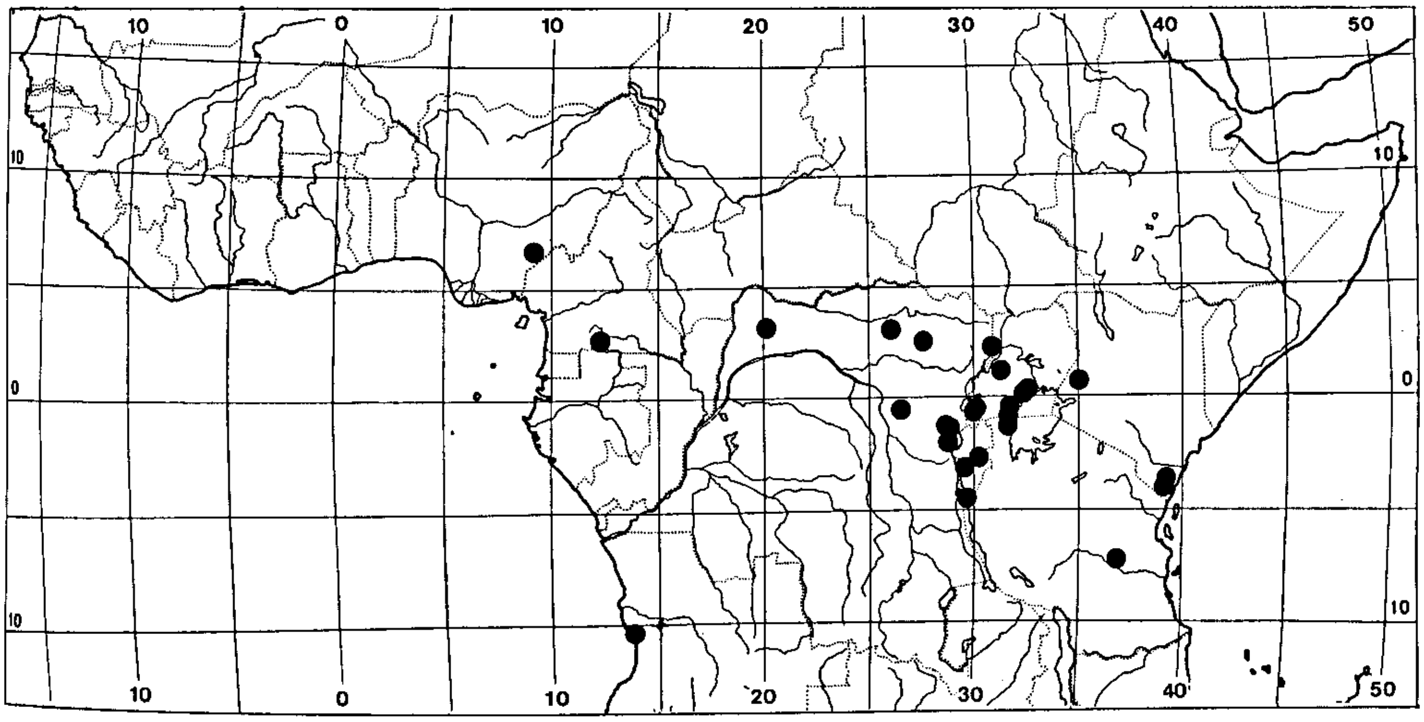


Fig. 123. Distribution of *Connarus longistipitatus*

pubescent. Reduced leaves at base of inflorescences as well as bracts triangular to (narrowly) ovate, 1-2 mm long (reduced leaves rarely longer). *Pedicels* very short, articulated 0-1 mm below the calyx, brown-pubescent. *Sepals* imbricate in bud, (broadly) ovate to obovate, rather thin (not fleshy), 3.0-4.5 × 1.3-2.0 mm, obtuse or rounded at top, more or less plane, brown-pilose outside, pubescent inside, glandular punctate with up to 25 glands, usually indistinctly up to 5-veined. *Petals* cohering at ca 1/3 from the base, imbricate in bud, narrowly elliptic to narrowly obovate, 5.5-8.0 × 1.5-2.0 mm, cuneate at base, obtuse at top, pubescent outside, with glandular hairs inside, glandular punctate near the top with some to rather numerous glands, usually indistinctly up to 5-veined. *Stamens* ca 1 mm united at base; long ones 3.3-4.2 mm or 6.0-7.5 mm long, filaments with stipitate glands, anthers ca 0.3 × 0.2 mm, usually lacking glands; short ones 2.0-2.6 mm long, apparently fertile, anthers mostly somewhat smaller than those of the long stamens, exceptionally rudimentary and sterile (see note 1), lacking glands. *Pistil* 3.3-4.0 mm or 5.1-6.5 mm long; ovary 1-1.5 mm long, brown-pilose; style pilose and with stipitate glands; stigma usually oblique, more or less 2-lobed. *Follicle* oblique-pyriform, somewhat compressed, 2.5-3.5 × 1.1-1.7 cm, stipe 5-10 mm long; apex with up to 2 mm long lateral mucro, rarely mucro almost apical; pericarp rather thin, brown-pubescent when young, but soon glabrous outside, pilose and lacking glands (very rarely with some glands) inside. *Seed* obovoid, 12-17 × 6-8 × 4-6 mm, sarcotesta 5-9 mm long, enveloping the basal part of the seed; radicle apical.

Distribution: E Zaire, Burundi, S Kenya, N Tanzania; once collected in Nigeria, twice in Cameroun, once in NW Zaire and once in N Angola.

Ecology: Usually in submontane or montane forests, above 1000 m (see note 2); sometimes in thickets in savanna. Flowering in E Zaire, Uganda and N Tanzania mainly from May to July or from November to January.

Specimens examined:

Nigeria: Obudu Cattle Ranch (fr.) *van Meer 1822* (WAG).
Cameroun: Meuban, 24 km S of Djoum (fl. Nov.) *Letouzey 8345* (P, WAG).
Zaire: Masisi-Walikale (fl. July) *Bequaert 6448* (BR); Lubutu-Kirundu (fr. Feb.) *Bequaert 6814* (BR, type of *C. mildbraedii*); Nala (fl.) *Boone s.n.* (BR); Mahagi, Kibali R. (fr. Apr.) *Deville 320* (BR); Mbongo (fr. Sept.) *Evrard 1750* (BR); Kishanga, Walikale (fr. June) *Gutzwiller 1073* (BR); Mutongo, Walikale (fr. May) *Gutzwiller 2760* (BR); *Gutzwiller 2827* (BR); Luamisole, (fl. May) *Hendrickx 378* (BR); Mushuva R. (fl. May) *Hendrickx 379* (WAG); Kinene, Masisi (fr. Dec.) *A. Léonard 1999* (BR); Kitshanga, Walikale (fl., fr. Jan.) *A. Léonard 2429* (BR); (fr. Feb.) *A. Léonard 2816* (BR); Bitale, km 48 Kavumu-Buniakiri (fl.b. Apr.) *Pierlot 135* (BR, K); km 123 Sake road, Walikale (fr. May) *Pierlot 2097* (BR); km 48.5 Kavumu-Walikale (fl., fr. June) *Pierlot 3149* (BR); Bushangania (fl. Jan.) *Rossignol 183* (BR); km 110 Kavumu-Walikale (fl.b. Apr.) *Troupin 3167* (BR, K); Bambesa (fr. Apr.) *Vrydagh 416* (BR, K, type of *C. vrydaghii*).
Angola: Cuanza sul, Amboim, Novo Redondo (fl., fr.) *Gossweiler 4482* (BM, COI, K).
Burundi: Kigamba, Cankuzo-Muhinga (fr. Oct.) *Auquier 4324* (BR); Urundi, Kitega (fr. Jan.) *van der Ben 1842* (BR, K); (fl.) *van der Ben 1849* (BR).
Uganda: N of Kagera (y.fr. Feb.) *Bagshawe 158* (BM); near Entebbe, Mengo Distr., Busiro (fl., fr. Nov.) *Dawkins 666* (EA, K); Makimo F. (fl. Dec.) *Dümmer 536* (BM); Mengo Distr., Kivuvu (fl., y.fr. Nov.) *Dümmer 1248* (BM, K); (fl. May) *Dümmer 2614* (BM, K); Budongo F. (fl. Dec.) *Eggeling 1470* (BM, BR, K); *Eggeling 1556* (K); Entebbe (fl. July) *Eggeling 4411* (K); near Kyanga, Kalinzu F. (fl.b., fr. Dec.) *Gibson 387* (BR, K); Entebbe, Nubi village (fl. Dec.) *Godman 40* (BM); Masaka Distr., Kyotera county (fr. Dec.) *Katende 1417* (EA); Budongo F. (Nov.) *Loveridge 127a* (K); Mabira F. (fl. Dec.) *Maitland 327* (K); Kanoni (fl., fr. July) *Maitland 641* (K); Kigezi Distr., Kayonza F.R. (fr. Aug.) *Paulo 642* (BR, EA, K); Budongo F. (fl.b. Mar.) *Sangster 111* (K); Mabira F. (fr.) *Ussher 94* (BM, K).
Kenya: Kwale (fl.b.) *Graham 1695* (EA, K); Shimba Hills, Longo Magandi (fr. Feb.) *Magogo & Glover 192* (EA); Trans-Nzoia Distr., Kapretwa near Kitale (fr.) *Thorold s.n.* (BM).
Tanzania: Kiziba, Kagera basin (fr. July) *Ford 54* (EA, type of *C. stuhlmannianus*); Bukoba, Kikongoro F.R. (fl.b. Dec.) *Kanywa 32* (EA); Bukoba (fl., y.fr.) *Proctor 835* (K); (fr.) *Proctor 1028* (K); (fl. Jan.) *Proctor 1109* (K); Msolwa F. (fl. Nov.) *Vollesen 4158* (C, EA); Bukoba, Minziro F.R. (fr. Sept.) *Watkins 532* (EA, type).

Notes: 1. In a single specimen, *Vollesen 4158* from Kenya, rudimentary short stamens are found, a character common in *C. griffonianus*. However, the broad, thin sepals are characteristic for *C. longistipitatus*. Moreover *C. griffonianus* has never been collected in Kenya.

2. *C. longistipitatus* is usually found above 1000 m altitude, but in E Africa it is also present in the lowland. The Central African specimens with known altitude are all collected in the mountains, above 1000 m. The closely related *C. griffonianus* is mainly restricted to lowland areas, and is rarely found in the mountains. According to the labels, only 5 specimens of the latter species were collected from above 1000 m. In the area, where both species occur, *C. longistipitatus* is usually restricted to the mountains, and *C. griffonianus* is found at lower altitudes.

Connarus staudtii Gilg **Fig. 124, 125**

C. staudtii Gilg, 1896: 208; Schellenberg, 1923: 224; Exell, 1928: 98; De Wildeman, 1929: 551; Schellenberg, 1938: 286, fig.48; Gossweiler & Mendonça, 1939:

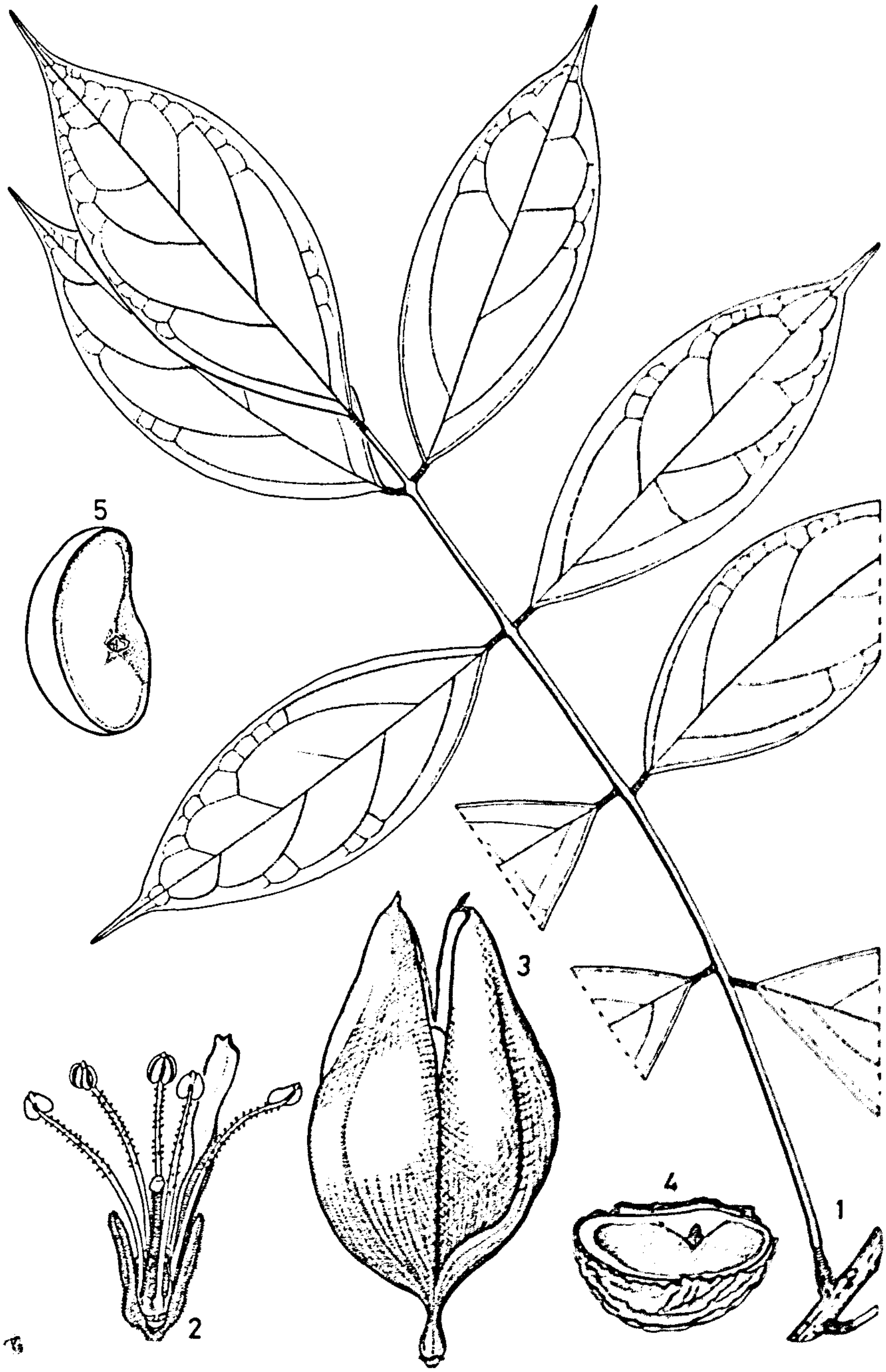


Fig. 124. *Connarus staudtii*: 1. branch with leaf, 2/3 ×; 2. flower partly, showing stamens and pistil, 6 ×; 3. follicle, 1 ×; 4. seed in longitudinal section, 1 ×; 5. seed in longitudinal section, testa removed, 1 × (1. *Pauwels 6205*; 2. *Claessens 91*; 3. *Talbot 1427*; 4-5. *Klaine 1961*).

55; Troupin, 1952: 136, fig.2B; Exell & Mendonça, 1954: 154; Hepper, 1958: 748.

Type: Cameroun, Lolodorf, *Staudt 271* (holo: B†; lecto: G; iso: K, P).

C. macrourus Gilg, nomen in herb. Zenker; Schellenberg, 1938: 286 (in syn.).

C. odoratissimus Gilg, nomen in herb. Zenker; Schellenberg, 1938: 286 (in syn.).

Liana or lianescent shrub. *Branches* cylindric, lenticellate, branchlets often somewhat angular, brown-pubescent, soon glabrescent. *Leaves* 2-5-jugate; petiole with distinct, blackish articulation at base, 1.5-12 cm long, rachis 3.5-31 cm long, brown-pubescent when young, soon becoming glabrous. Leaflets (stiffly) papery, lateral ones alternate or more or less opposite, (narrowly) ovate or (narrowly) elliptic, 3.5-14 × 2.5-5.5 cm, rounded or cuneate and not or hardly unequal at base, terminal one elliptic, 7-16 × 4-5.5 cm, cuneate at base; all leaflets 1.6-3.2 cm long acuminate, brown-pubescent when very young, soon becoming glabrous, midrib impressed above, prominent beneath, with 3-5 curved lateral nerves on each side; tertiary nerves indistinct on both sides; petiolules (3-)5-8 mm long, wrinkled, blackish, glabrous. *Panicles* 6-17 cm long, up to ca 50-flowered, brown-pubescent. Bracts, as well as the reduced leaves at base of inflorescences, triangular or ovate, ca 1 mm long. *Pedicels* very short, articulated 0-0.5 mm below the calyx, brown-pubescent. *Sepals* valvate in bud, (narrowly) triangular or ovate, thin or somewhat fleshy at base, 1.8-2.3 × 0.5-0.9 mm, acute or sometimes obtuse at top, plane or more or less convex, brown-pubescent outside, glabrous inside, glandular punctate with ca 12 glands, without distinct veins. *Petals* usually coherent, imbricate in bud, narrowly elliptic or narrowly oblong, (4.2-)5.0-6.9(-7.8) × (0.8-)1.0-1.3(-1.5) mm, cuneate at base, obtuse or rounded and often inflexed at top, yellowish brown-pubescent outside, with glandular hairs inside, glandular punctate near the top, indistinctly (0-)3-5-veined. *Stamens* 0.3-0.6(-0.8) mm united at base; long ones 2.4-3.3 mm or 4.5-6.5 mm long, filaments with stipitate glands, anthers ca 0.3 × 0.2 mm; short ones 1.1-1.6(-1.8) mm long, rudimentary, lacking anthers or anthers extremely small. *Pistil* 2.4-3.2 mm or 4.2-6.4 mm long; ovary 0.8-1.2 mm long, brown-pilose; style usually pilose and with stipitate glands; stigma usually oblique, more or less 2-lobed. *Follicle* ellipsoid or obovoid, not or hardly oblique, 3.6-6.8 × 2.1-3.2 × 1.6-2.6 cm, cuneate with often indistinct, up to 7 mm long stipe at base; apex with up to 1.5 mm long mucro; pericarp rather thick, opening along the ventral and dorsal suture, glabrous both sides, lacking distinct veins, but somewhat striate. *Seed* (ob)ovoid or somewhat kidney-shaped, 22-32 × 10-22 × 10-17 mm, sarcotesta ca 5 mm long, partly enveloping the basal part of the seed, ruminate; radicle almost in the centre of the seed, between the cotyledons.

Distribution: SE Nigeria, W Cameroun, Gabon, S Congo, W Zaire, N Angola (Cabinda).

Ecology: Rain forest, often along rivers. Flowering in Cameroun in April and May, in Gabon and Congo about September, in Zaire from June to September. Fruiting a few months later.

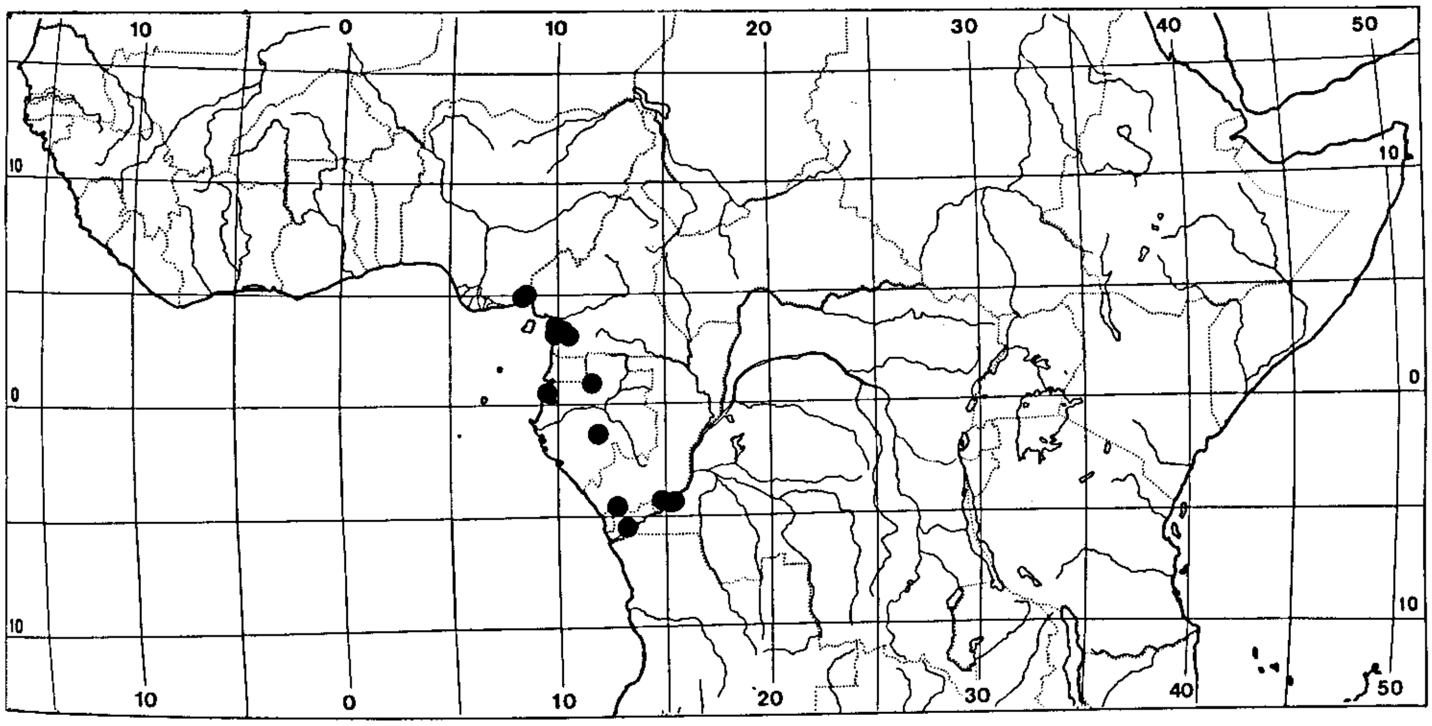


Fig. 125. Distribution of *Connarus staudtii*

Specimens examined:

Nigeria: Ngwugwo, Yalu road (fr. Dec.) *Ariwaodo 876, FHI 58005* (K, P); Oban (fl.b.) *Talbot 1297* (BM); (fr.) *Talbot 1427* (BM, K, Z); Eket Distr. (fl.) *Talbot s.n.* (BM).

Cameroun: 65 km SSW of Eséka (fr. June) *W. de Wilde 2759* (BR, K, MO, P, WAG); Ebea, 26 km N of Kribi (fl. Apr.) *Leeuwenberg 5622* (WAG); km 58 Edea-Kribi (fl. May) *Leeuwenberg 5674* (B, BR, C, K, MO, P, WAG); Fenda, 58 km E of Kribi (fl.) *Mildbraed 5949* (HBG); Lolodorf (fl.) *Staudt 271* (G, K, P, type); Bipindi (fl. Apr.) *Zenker 541* (B, BR, C, G, MO, P); (fl.) *Zenker 2066* (BM, E, G, GOET, K, P, Z); (fr.) *Zenker 2769* (BM, BR, E, G, GOET, K, L, M, MO, P, WAG, Z); (fl. y.fr.) *Zenker 2960* (BM, BR, E, G, GOET, K, L, M, P, Z); (fl.) *Zenker 3061* (B, BM, BR, E, G, GOET, K, L, M, MO, P, WAG, Z); (fr.) *Zenker 3858* (BM, E, G, GOET, K, MO); *Zenker 3964* (BM, E, G, K); (fl.b.) *Zenker 4985a* (BM, K, MO).

Gabon: 42 km N of km 10 Lalara-Makokou (fl., fr. Sept.) *Breteler & J. de Wilde 442* (WAG); km 35 Mouila-Yeno (fl., fr. Sept.) *Breteler, Lemmens & Nzabi 8232* (LBV, WAG); near Libreville (fr.) *Klaine 1961* (B, BR, K, P, WAG); (fr. June) *Klaine 2228* (P); (fr. Oct.) *Klaine 3092* (P).

Congo: Djoumouna (fl. Sept.) *Bitsindou s.n.* (P); Taba-Mandzakala (y.fr. Oct.) *Sita 2650* (P).

Zaire: Sabuka (fl.) *Claessens 91* (BR); Luki (fl. Sept.) *Donis 2005* (BR, K); Lukaya, Ngafula (fr. Nov.) *Pauwels 6029* (BR, WAG); (fl., fr. June) *Pauwels 6205* (BR).

Angola: Belize, Maiombe (fr.) *Gossweiler 6984* (BM, COI, LISU).

Fig. 126, 127

Connarus thonningii (DC.) Schellenb.

C. thonningii (DC.) Schellenberg, 1923: 224; 1938: 280; Hepper, 1958: 748; Irvine, 1961: 573; Ern, 1984: 165.

Basionym: *Omphalobium thonningii* De Candolle, 1825: 86; Don, 1832: 90.

Type: Ghana, Töffri, *Thonning s.n.* (holo: herb. De Candolle in G; iso: C). See note.

C. florulentus Thonning, nomen in sched.; De Candolle, 1825: 86 (in syn.).

C. floribundus Thonning ex Schumacher, 1827: 73; Walpers, 1842: 561; Plan-

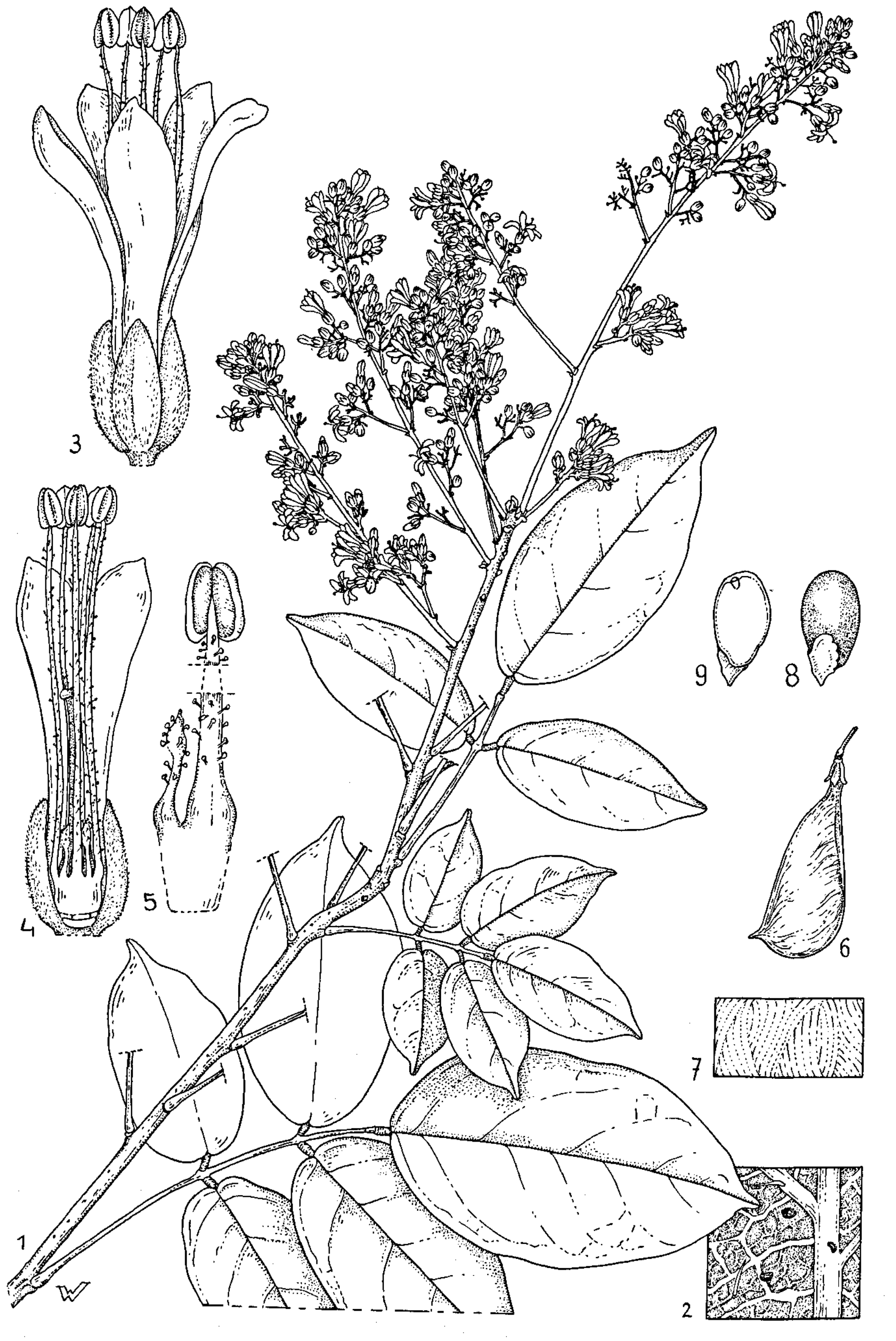


Fig. 126. *Connarus thonningii*: 1. flowering branch, 2/3 ×; 2. detail leaflet beneath, 10 ×; 3. flower, 6 ×; 4. flower partly, showing stamens and pistil, 6 ×; 5. fertile and rudimentary stamen, 12 ×; 6. follicle, 1 ×; 7. detail inner side of follicle, 10 ×; 8. seed, 1 ×; 9. seed in longitudinal section, 1 × (1-2. *Geerling & Bokdam 427*; 3-5. *Hall 2707*; 6-9. *Aké Assi 7191*).

chon, 1850: 426; Walpers, 1852: 300; Baker, 1868: 457. Type: Ghana, Töffri, *Thonning 339* (holo: C). See note.

C. nemorosus Vahl ex Schumacher, 1827: 73 (nomen).

Liana or lianescent shrub. *Branches* cylindric, often with shallow longitudinal grooves, mostly lenticellate, branchlets glabrous, sometimes initially pubescent but very soon glabrescent. *Leaves* 1-3(-4)-jugate; petiole 2-5 cm, rachis 0.5-8 cm long, brown-pubescent when young. Leaflets papery, lateral ones opposite or not, elliptic, 4.5-10 × 2.5-5 cm, rounded at base, terminal one elliptic or obovate, 6.5-9.5 × 3-4.5 cm, rounded or somewhat cuneate at base; all leaflets obtuse or shortly acuminate, glabrous both sides, sometimes puckered, midrib impressed above, prominent beneath, with 5-8 lateral nerves on each side; tertiary nerves reticulate, mostly distinct on both sides; petiolules 3-4 mm long, wrinkled, glabrous. *Panicles* 4-15 cm long, up to 50-flowered (sometimes more), densely brown-pubescent. Bracts, as well as the reduced leaves at base of inflorescences triangular or ovate, 1-1.5 mm long. *Pedicels* short, articulated 1-2 mm below the calyx, brown-pubescent. *Sepals* narrowly imbricate in bud, (narrowly) ovate, rather thin (at least near the top), 2.5-3.3 × 1-1.5 mm, obtuse at top, more or less convex, brown-pilose outside, glabrous inside, usually strongly glandular punctate, up to 5-veined. *Petals* free, imbricate in bud, very narrowly elliptic to almost linear, 5.5-7.7 × 0.8-1.7 mm, cuneate at base, obtuse at top, sparingly pilose to almost glabrous outside, with some glandular hairs inside, strongly glandular punctate, especially near the top, indistinctly up to 5-veined. *Stamens* ca 1 mm united at base; long ones 2.8-5.3 mm or 6.1-9.0 mm long, filaments with many stipitate glands, anthers ca 0.5 × 0.3 mm, mostly with glands at the top; short ones 1.5-2.3 mm long, rudimentary and sterile with rather slender filaments and very small anthers, filaments and mostly also anthers with glands. *Pistil* 3.8-4.5 mm or 5.3-8.3 mm long; ovary 1-1.5 mm long, yellowish brown-pilose; style pilose at base, with many stipitate glands; stigma usually oblique, more or less 2-lobed. *Follicle* oblique-pyriform, somewhat compressed, 2.2-2.5 × 1.0-1.3 cm, stipe 2-5 mm long; apex with an up to 2 mm long lateral mucro; pericarp thin, initially brown-pubescent but very soon glabrous and sometimes with glands outside, glabrous, glossy and lacking glands inside. *Seed* ovoid, ca 13 × 7 × 5 mm, sarcotesta ca 6 mm long, enveloping the basal part of the seed; radicle apical.

Distribution: W Africa: Ivory Coast, S Ghana, S Togo.

Ecology: Thickets in savanna, remnants of forests, usually near rivers. Flowering from June to October, fruiting a few months later.

Specimens examined:

Ivory Coast: Séguela-Mankono (fr. Dec.) *Aké Assi 7191* (K, P); Soubré, Sassandra (fl. June) *Chevalier 19111* (P); Gawi-Seyey, Iringou R. (fl. July) *Geerling & Bokdam 182* (B, BR, WAG); Bouna-Ferkessedougou, Comou R. (fl. Aug.) *Geerling & Bokdam 427* (B, BR, WAG); Bouaké-Dabakala (fr. Jan.) *Roberty 690* (G).

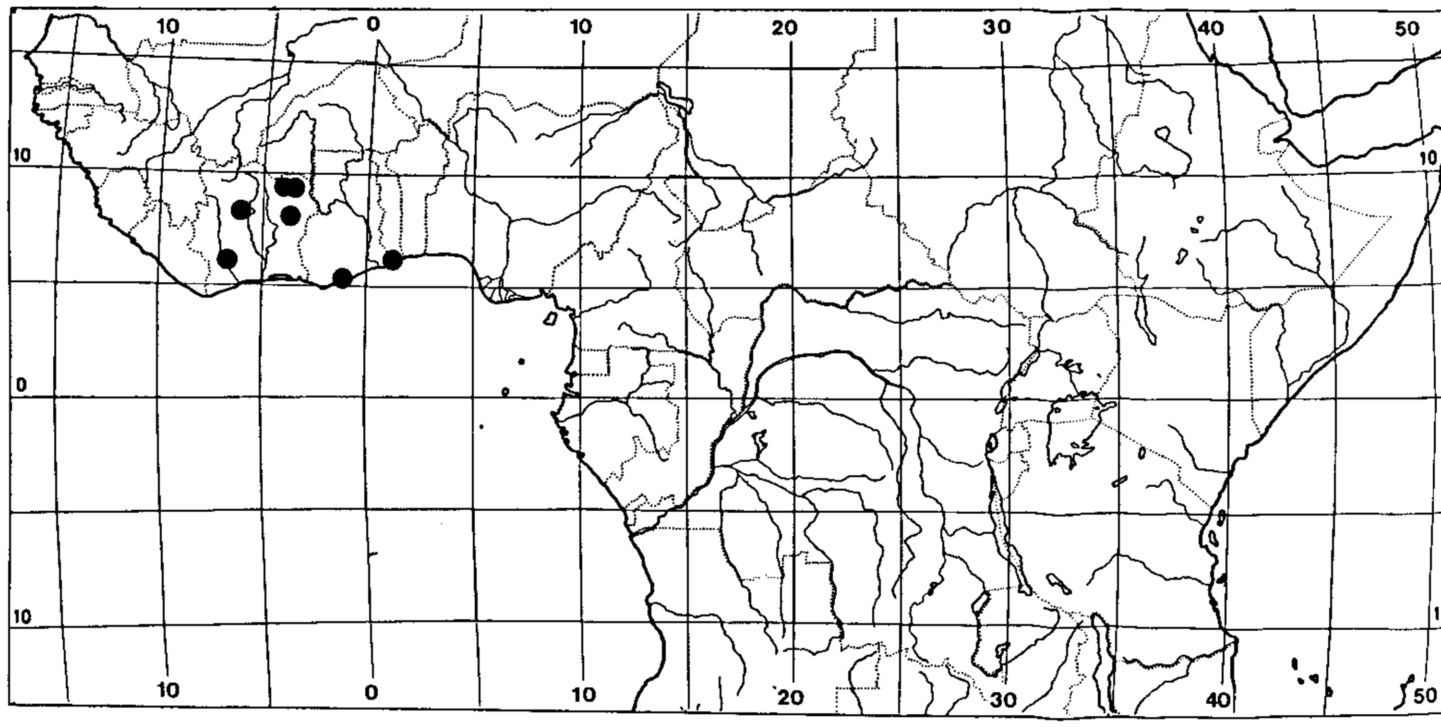


Fig. 127. Distribution of *Connarus thonningii*

Ghana: Cape Coast (y.fr.) *Brass s.n.* (BM); Ahkaful F.R., near Cape Coast (fr. Feb.) *Hall 1717* (P); Cape Coast (fl., fr. Oct.) *Hall 2707* (K); Töffri (fl.) *Thonning 339* (C, type of *C. floribundus*); *Thonning s.n.* (G, type).
Togo: near Lome (fl., fr.) *Warnecke 446* (BM, K, P).

Note: Four sheets with flowering branchlets of *C. thonningii*, collected by Thonning, are kept in C (Copenhagen). Likely these are four duplicates of *Thonning 339*, which number is noted on one of the sheets only. The Thonning-specimen in Herb. De Candolle (G) is then possibly another duplicate, while the material in C is an isotype of *C. thonningii*, as suggested by Hepper (1970, note on one of the sheets).

Doubtful species

Connarus smeathmannii (DC.) Planchon, 1850: 436; Baillon, 1867: 235; Baker, 1868: 458; De Wildeman, 1904: 124; 1906: 246; 1909: 90; 1910a: 293; 1916: 241; Schellenberg, 1923: 225; Hepper, 1958: 748.
Basionym: *Omphalobium smeathmannii* De Candolle, 1825: 86; G. Don, 1832: 91.

De Candolle cites a collection from Sierra Leone by Smeathman. In the description he designates 3-5 leaflets per leaf. Most likely he did not see any material, since he did not add '(v.s.)', like he did with the other *Omphalobium* species. Planchon (1850) cited *Connarus smeathmannii* under 'species dubia'. Baillon (1867, in note) did not exclude that *Connarus griffonianus* Baill. is identical with *C. smeathmannii* (DC.) Planch., but Schellenberg (1923) excluded this possibility. None of these authors were able to find any material that fits the description given by De Candolle and that was collected by Smeathman in Sierra Leone.

The only species found in Sierra Leone is the invariably trifoliolate *C. africanus*. It must be noted however, that some species, usually found in Central and East Africa, are occasionally collected in West Africa, i.e. *C. congolanus* and *C. longistipitatus*.

I agree with Schellenberg that *C. smeathmannii* (DC.) Planch. must be considered as a nomen dubium and should not be used.

Excluded species (Africa)

C. duparquetianus Baillon, 1867: 237 = *Jollydora duparquetiana* (Baill.) Pierre
C. libericus Stapf, 1906: 93 = *Rourea thomsonii* (Baker) Jongkind
C. mannii Baker, 1868: 459 = *Cnestis mannii* (Baker) Schellenb.
C. pentagynus Lamarck, 1786: 95 = *Agelaea pentagyna* (Lam.) Baill.
C. pseudoracemosus Gilg, 1891b: 317 = *Cnestis mannii* (Baker) Schellenb.
C. pubescens Baker, 1868: 458 = *Rourea thomsonii* (Baker) Jongkind
C. punctulatus Hiern, 1896: 189 = *Agelaea pentagyna* (Lam.) Baill. (flowers only; leaves not *Connaraceous*)
C. reynoldsii Stapf, 1906: 94 = *Rourea solanderi* Baker
C. thomsonii Baker, 1868: 458 = *Rourea thomsonii* (Baker) Jongkind

Ellipanthus Hook.f.

by R.H.M.J. Lemmens

History and subdivision of the genus

For a long time *Ellipanthus* has been considered as an exclusively Asiatic genus. Not until 1947 the first species from Africa was described, *E. hemandradenioides*. In 1958 Keraudren correctly placed *Hemandradenia madagascariensis* Schellenberg, proposed in 1938, in *Ellipanthus* as well.

Schellenberg (1922) has separated *Pseudellipanthus* from *Ellipanthus*, mainly based on the flowers, being 4-merous and unisexual in the former, and 5-merous and bisexual in the latter. These characters however, are not constant. In several Asiatic species a single specimen may show 4-merous as well as 5-merous flowers, while unisexual flowers are not restricted to *Ellipanthus beccarii* Pierre (syn. *Pseudellipanthus beccarii* (Pierre) Schellenb.). Consequently and in accordance with Leenhouts (1958b), *Pseudellipanthus* is returned into the synonymy of *Ellipanthus*.

Leenhouts also reduced *Hemandradenia* Stapf into the synonymy of *Ellipanthus*, but did not make the necessary new combinations. I agree with Eimunjeze (1976) that *Hemandradenia* is a distinct genus, differing from *Ellipanthus* especially in the follicles and seeds (see also under *Hemandradenia*).

Description of the genus

Ellipanthus Hooker f., 1862: 434; Schellenberg, 1938: 181; Hemsley, 1956: 22; Leenhouts, 1958b: 520; Keraudren, 1958: 20.

Type species: *E. unifoliolatus* (Thwaites) Thwaites.

Pseudellipanthus Schellenberg, 1922: 314; 1938: 189. Type species: *P. beccarii* (Pierre) Schellenb. (= *Ellipanthus beccarii* Pierre)

Large shrubs or small trees. *Branches* cylindric. *Leaves* unifoliolate; leaflets acuminate. *Inflorescences* axillary. *Flowers* in small panicles, bisexual or unisexual, pentamerous or tetramerous, heterodistylous. *Pedicels* with a distinct joint. *Sepals* connate at the base, valvate or very narrowly imbricate in bud. *Petals* longer than sepals, free, usually white, imbricate in bud, pilose outside and usually also inside. Episepalous *stamens* fertile, epipetalous ones rudimentary; filaments united at base, pilose. *Carpel* 1; style pilose. *Follicle* brown, yellow or red, pericarp woody, opening lengthwise along the ventral suture, densely tomentose outside, glabrous inside, more or less stipitate. *Seed* solitary, rarely two seeds per follicle, attached to the ventral side of the follicle, ovoid or ellipsoid, basal part with a yellow or orange sarcotesta, inserted below the hilum, testa shining black; endosperm thin; hilum lateral; radicle apical; cotyledons thick.

A genus of about seven species occurring in Asia and E Africa, mainly restricted to rain forest.

Relations between the African and Asiatic species

The differences between all species of *Ellipanthus* are extremely subtile, and often the species are not entirely separable, as the differential characters show some overlap.

The Malesian species *E. beccarii* Pierre and *E. tomentosus* Kurz usually have 4-merous unisexual flowers, and 5-merous bisexual flowers, respectively. But exceptions are found in both species. The type species, *E. unifoliolatus* (Thwaites) Thwaites from Ceylon, has been collected only twice. The type specimen apparently has unisexual flowers which seems to be the only differential character with the African species. The descriptions of *E. calophyllus* Kurz and *E. glabrifolius* Merr. by Schellenberg do not offer a clear delimitation towards neither the African nor the remaining Asiatic species.

The African species are very close to each other and differ only somewhat in the leaves. (See also note under *E. madagascariensis*). They both have (narrowly) ovate leaflets, while the Asiatic species have (narrowly) elliptic or obovate, only rarely ovate leaflets. Other distinguishing characters seem to be absent.

In my opinion it is quite possible that a more comprehensive study of all the *Ellipanthus*-species would lead to the conclusion, that there is only a single species in the genus. However, a complete revision of *Ellipanthus* is beyond the scope of this present work.

Key to the species

Leaflets papery or thinly leathery, ovate to narrowly ovate; lateral nerves not or hardly impressed above; tertiary nerves distinct on both sides; African continent . . . . **E. hemandradenioides**

Leaflets leathery, narrowly ovate; lateral nerves strongly impressed above; tertiary nerves not distinct above; Madagascar . . . . . . **E. madagascariensis**

Ellipanthus hemandradenioides Brenan **Fig. 128, 129**

E. hemandradenioides Brenan, 1947: tab.3452; Hemsley, 1956: 22.
Type: Kenya, Malindi Distr., Mida, *Dale 3876* (holo: K; iso: BR).

Shrub or small tree, up to 10 m high. *Branches* cylindric, usually lenticellate, branchlets often somewhat angular, pubescent, soon glabrescent. *Petiole* 3-7 mm long, initially pubescent but soon glabrous. *Leaflet* (stiffly) papery or sometimes thinly leathery, ovate or narrowly ovate, 3-11.5(-16.5) × 2-5(-8) cm,

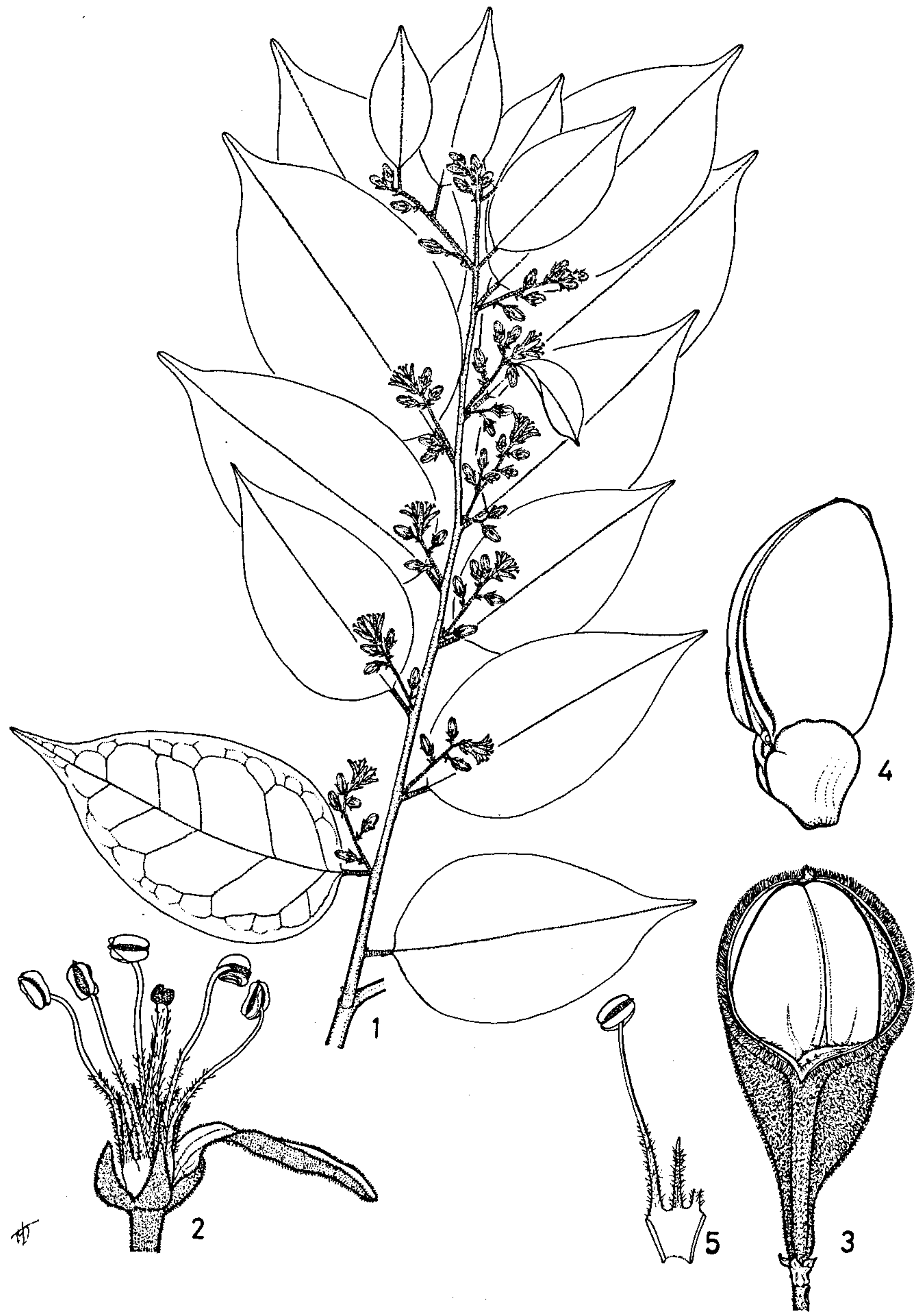


Fig. 128. *Ellipanthus hemandradenioides*: 1. flowering branch, 2/3 ×; 2. flower partly, showing stamens and pistil, 6 ×; 3. follicle, 2 ×; 4. seed, 2 ×; 5. fertile and rudimentary stamen, 6 ×; (1-2,5. *Faulkner 2158*; 3-4. *Reitsma & J. de Wilde 143*).

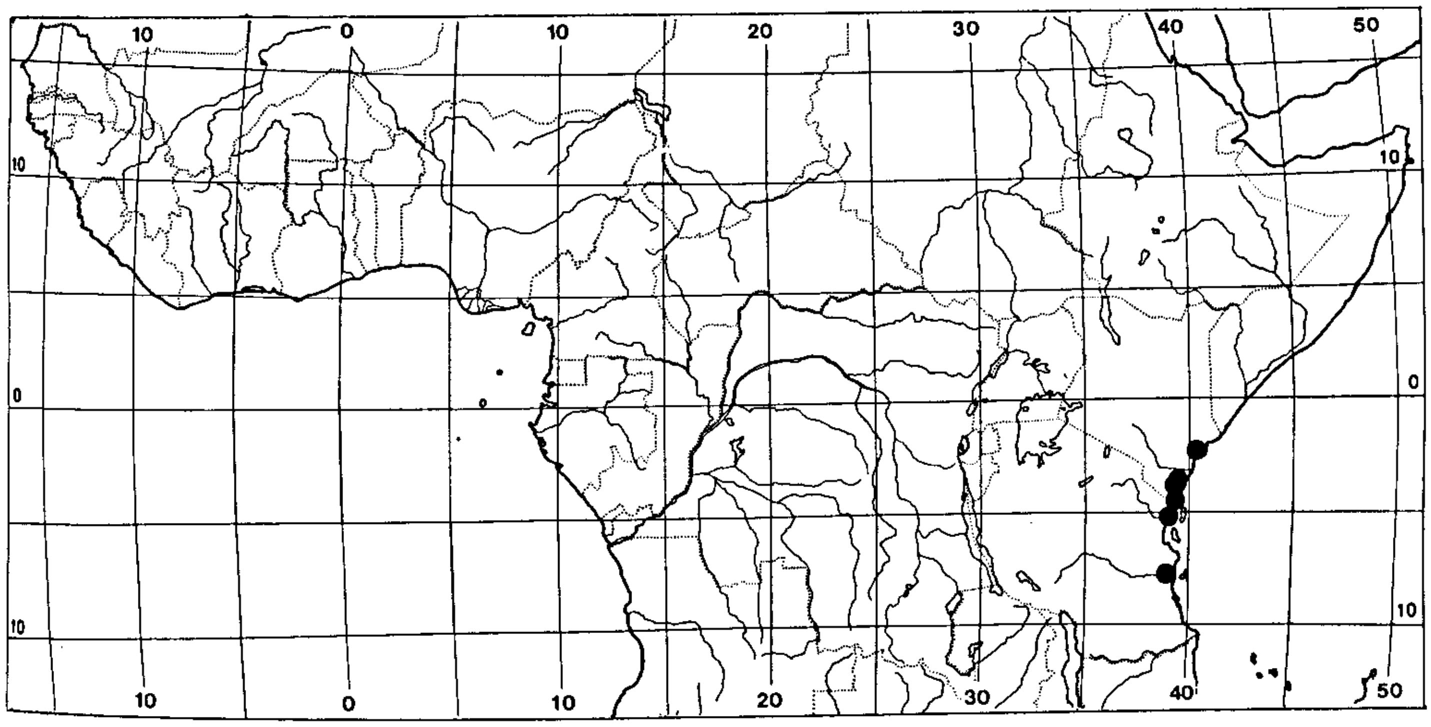


Fig. 129. Distribution of *Ellipanthus hemandradenioides*

cuneate to rounded at base, rarely peltate, more or less distinctly acuminate; glabrous both sides (sometimes some hairs on midrib), midrib impressed above, prominent beneath with 3-6(-7) lateral nerves on each side, tertiary nerves finely reticulate, distinct on both sides; petiolule 2-3.5 mm long, wrinkled, glabrous or somewhat pubescent. *Panicles* axillary, 1, rarely 2 per axil, 1-3(-5) cm long, up to ca 15-flowered, densely brown-pubescent. Bracts ovate to subulate, 0.5-1.5 mm long, curved. *Pedicels* articulated 0.5-1.5 mm below the calyx, densely yellowish brown-pubescent. *Sepals* valvate or narrowly imbricate in bud, ovate, 1.9-2.1 × 1.1-1.2 mm, acute or obtuse, more or less plane, brown-pilose outside, glabrous inside. *Petals* imbricate in bud, narrowly oblong, 5.6-8.2 × 1.2-2.0 mm, rounded at base and at top, pilose outside, pubescent inside, indistinctly 0-3-veined. *Stamens* 0.8-1.0 mm united at base, tube glabrous outside, pilose or glabrous inside; episepalous ones 4.5-7.2 mm long, filaments pilose in lower half, anthers 1.0-1.2 × 0.6-0.8 mm; epipetalous ones rudimentary, 2.1-2.8 mm long, filaments pilose, anthers lacking. *Pistil* 3.5-4.7 mm or 6.2-8.2 mm long; ovary ca 1.5 mm long, yellowish brown-pilose; style pilose; stigma prominent, lobed. *Follicle* oblique-ellipsoid, 2.2-2.8 × 0.8-1.1 × 0.8-1.0 cm, stipe distinct or indistinct, up to 8 mm long; apex acute or with up to 3 mm long mucro; pericarp somewhat woody, densely golden-yellow or orange-brown tomentose outside, glabrous inside. *Seed* ovoid or ellipsoid, 11-18 × (5-)8-10 × 5-8 mm, sarcotesta (3-)6-7 mm long, enveloping the basal part of the seed; radicle almost apical but somewhat dorsal; cotyledons thick; endosperm thin or rudimentary.

Distribution: E Kenya and E Tanzania, along the coast.
Ecology: Lowland rain forest, sometimes in bushes in savanna. Flowering from July to October and around March, fruiting a few months later.

Specimens examined:

Kenya: Kilifi Distr., Arabuko-Sokoke F.R. (fl. Sept.) *Beentje 2314* (WAG); Malindi Distr., Mida (fl. Oct.) *Dale 3573* (EA, K); (fr. Apr.) *Dale 3876* (BR, K, type); Kwale Distr., Buda Mafisini F., 8 miles WSW of Gazi (fr. Aug.) *Drummond & Hemsley 3954* (B, BR, K); Kwale Distr., Buda F. (fr. Mar.) *Faden 74/292* (EA, K, WAG); Lamu Distr., Witu F. (Feb.) *Faden 77/570* (BR); Kwale Distr., Muhaka F. (Mar.) *Faden 77/602* (BR, K); Kilifi Distr., Gede F. (fr. Oct.) *Gachathi 200/82* (EA); Lamu Distr., Witu F. (fr. Nov.) *Gathii 125* (EA); Malindi Distr. (Jan.) *Greenway EAH 12580* (EA); Lamu Distr., 5 km N of Klitu Ranger F. Post (Feb.) *Katende 1750* (EA); Kwale Distr., Shimba F. (fl.b. Jan.) *Katende & Lye 4797* (EA, K); Kilifi Distr., Arabuko N.F. (fl. Mar.) *Padwa B 910* (BR, EA); Kilifi Distr., S of Jilore F. Station (fr. Nov.) *Perdue & Kibuwa 10056* (BR, EA); 9 km E of Bamba, Ganze road (fr. Nov.) *Reitsma & J. de Wilde 143* (WAG); Kwale Distr., Muhaka F. (Feb.) *Robertson & Luke 4558* (WAG); Gedi (fr. Mar.) *Trump 103* (EA, K).

Tanzania: Tanga Distr., Nyamaku (y.fr. July) *Faulkner 2009* (EA, K); (fr. Dec.) *Faulkner 2109* (B, BR, K); (fr. Jan.) *Faulkner 2118* (B, BR, K); (fl. July) *Faulkner 2158* (B, BR, EA, K, LISC); Utete Distr., Ngubuluni F.R., Kibiti (fr. Dec.) *Shabani 291* (EA).

Note: Two accessions of this species show peltate leaflets (*Greenway EAH 12580*, *Robertson & Luke 4558*, both sterile). There is no reason to keep these specimens apart on any taxonomic ground, as two Asiatic species (*E. beccarii* and *E. tomentosus*) also show peltate leaflets in some specimens.

Ellipanthus madagascariensis (Schellenb.) Capuron ex Keraudren **Fig. 130**

E. madagascariensis (Schellenb.) Keraudren, 1958: 2.
Basionym: *Hemandradenia madagascariensis* Schellenberg, 1938: 65. Type: Madagascar, probably NW, *Baron 5626* (holo: K).

Shrub or small tree. *Branches* cylindric, lenticellate, branchlets somewhat angular, glabrous. *Petiole* 2-4 mm long, glabrous. *Leaflet* leathery, narrowly ovate, 8-13.5 × 3-5 cm, rounded to almost truncate at base, obscurely acuminate; glabrous both sides, midrib strongly impressed above, prominent beneath, with 5-7 lateral nerves, that are impressed above, on each side, tertiary nerves very finely reticulate, distinct beneath, not above; petiolule 1.5-2 mm long, wrinkled, glabrous. *Panicles* axillary, 1 or 2 per axil, 1.5-3 cm long, up to ca 25-flowered, brown-pubescent. Bracts ovate to subulate, 0.5-2 mm long, curved. *Pedicels* articulated 1-1.5 mm below the calyx, densely yellowish brown-pubescent. *Sepals* valvate or narrowly imbricate in bud, ovate, 1.8 × 1.1 mm, acute, somewhat convex or more or less plane, brown-pilose outside, glabrous inside. *Petals* imbricate in bud, oblong, 4.0-4.3 × 1.6-1.7 mm, rounded at base and at top, pilose outside and inside, but inside glabrous at base, not distinctly veined. *Stamens* ca 0.8 mm united at base, tube glabrous outside, pilose inside; episepalous ones 2.8 mm long, filaments pilose in lower half, anthers 1.0 × 0.5 mm; epipetalous ones rudimentary, 1.8 mm long, filaments pilose in lower half, anthers lacking. *Pistil* 3.4 mm long; ovary 1.5 mm long, yellowish brown-pilose; style pilose; stigma prominent, lobed. *Follicle* and *seed* unknown.

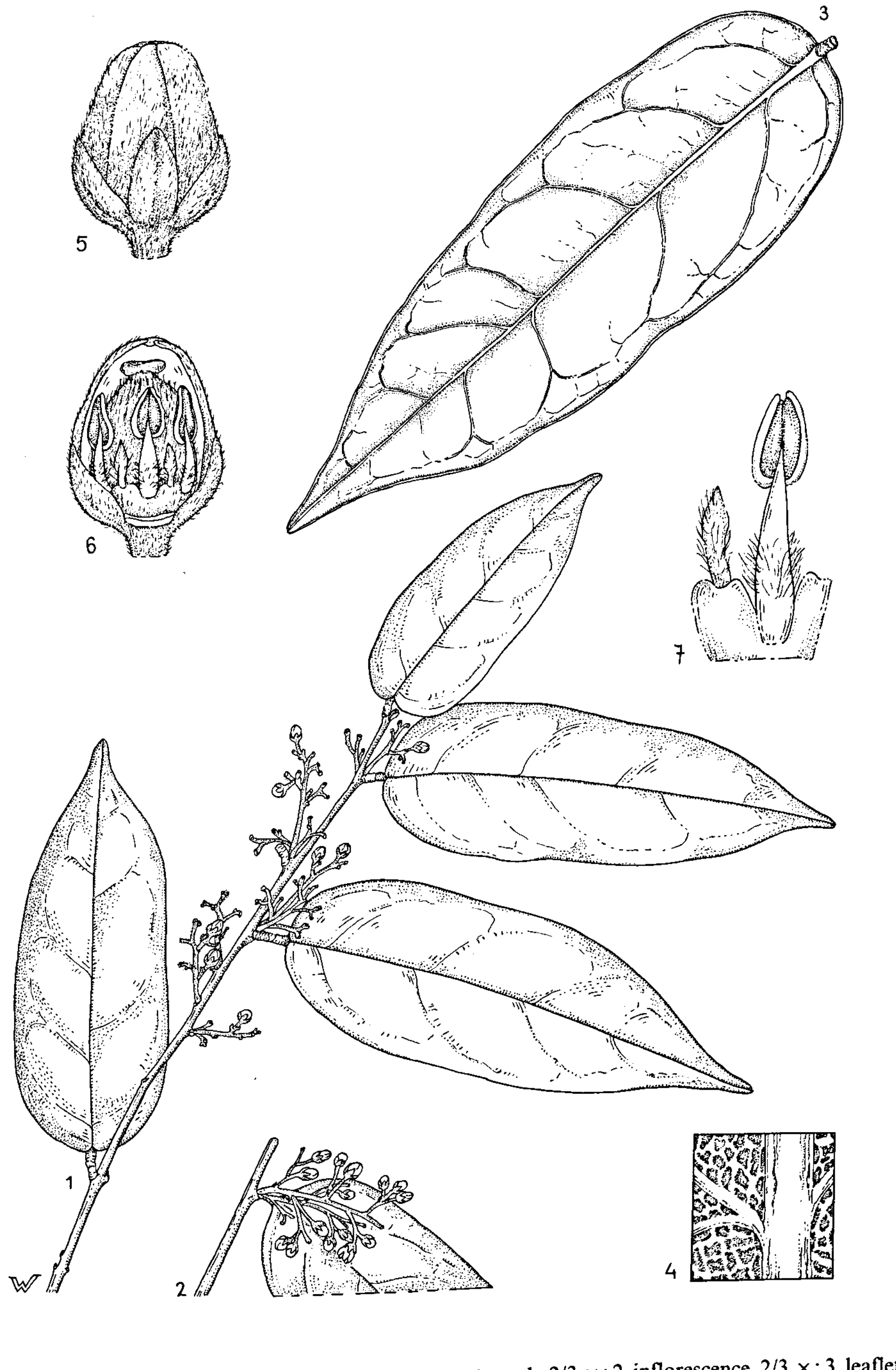


Fig. 130. *Ellipanthus madagascariensis*: 1. flowering branch, 2/3 ×; 2. inflorescence, 2/3 ×; 3. leaflet beneath, 2/3 ×; 4. detail leaflet beneath, 6 ×; 5. flower bud, 6 ×; 6. flower bud partly, showing stamens and pistil, 6 ×; 7. fertile and rudimentary stamen, 12 × (1-7. *Baron 5626*).

Distribution: NW Madagascar; only known from the type, collected a century ago.

Specimen examined:

Madagascar: probably NW (fl.b.) *Baron 5626* (K, type).

Note: *Ellipanthus madagascariensis* is very similar to *E. hemandradenioides*. It differs only by the more leathery, narrower leaflets, with more impressed secondary nerves and indistinct tertiary nerves above. The two species may be conspecific, but are maintained here due to scarcity of material, and and as follicles of *E. madagascariensis* are still unknown.

Hemandradenia Stapf

by V.E. Eimunjeze

Reprint from 1976 with additional information on new collections by F.J. Breteler

History and delimitation of the genus

Hemandradenia is characterized by unifoliolate leaves and non-stipitate, indehiscent fruits.

Stapf (1908) described it on the basis of two different specimens collected in Ivory Coast and Equatorial Guinea and expressed some doubt whether his new genus was sufficiently distinct from the formerly Asiatic genus *Ellipanthus* Hook.f. He, however, clearly indicated the main differences between the two genera as found in the fruits and seeds. He described two species based on the material at his disposal as *H. mannii* and *H.chevalieri.*

Schellenberg (1938) selected *H. mannii* as the type species and described a third one: *H. madagascariensis.* As the latter species had no fruits, he could not vouch for its true identity in *Hemandradenia.*

Leenhouts (1958-b) reduced *Hemandradenia* to a synonym of *Ellipanthus*, but did not make the necessary new combinations.

In the same year Aubréville and Pellegrin described a fourth species from Ivory Coast: *H. glomerata*. Capuron in Keraudren's revision of the family for Madagascar (1958) transferred Schellenberg's species to *Ellipanthus.*

The genera *Hemandradenia* and *Ellipanthus* are indeed closely related, in that both share unifoliolate leaves, flowers with mostly 5 stamens and 5 staminodes, and a single carpel. The carpel, however, is stipitate in *Ellipanthus* and sessile in *Hemandradenia*, which makes it possible to distinguish between the two genera with flowering material only. The fruits of the former are true follicles, but indehiscent in the latter. The sarcotesta present in both genera, is restricted to a part of the seed in *Ellipanthus*, whereas in *Hemandradenia* the entire outer layer of the seed coat is fleshy.

The main distinguishing characters of the two genera may be summarized thus:

Hemandradenia	*Ellipanthus*
Carpel not stipitate.	Carpel stipitate.
Fruit indehiscent.	Fruit dehiscent (true follicle).
Fruit wall thinly crustaceous.	Fruit wall woody.
Seed coat completely fleshy.	Seed coat partly fleshy.

In view of these differences *Hemandradenia* is maintained here as a distinct genus within the *Connaraceae*.

Description of the genus

Hemandradenia Stapf, 1908: 288; Schellenberg, 1910: 21, 103; 1938: 64; Thonner, 1915: 244; Leenhouts, 1958b: 520; Aubréville, 1959: 194; Hutchinson, 1964: 168; Dickison, 1973a: 121-138.

Type species: *H. mannii* Stapf.

Shrubs or small trees. *Leaves* alternate, entire, unifoliolate. Petiole terete and jointed to a petiolule, each with a pulvinus. *Inflorescences* axillary, glomerate or paniculate. Bracts minute, subtriangular. *Flowers* small, subsessile, predominantly 5-merous, bisexual. *Sepals* 5, basally connate, slightly imbricate to valvate. *Petals* 5, shortly coherent in the lower part to completely free, valvate to slightly imbricate. *Stamens* usually 5 fertile, opposite the sepals, alternating with 5 staminodes opposite the petals, both shortly connate at the base into a ring. *Pistil* 1; ovary sessile, ovoid to ellipsoid, with 2 collateral ovules; style short and fairly stout or long and filiform; stigma capitate to lobulate. *Fruits* ellipsoid, ovoid or obovoid, indehiscent, tomentose, yellow to brownish when ripe. Calyx persistent in fruit. Fruit wall thinly crustaceous. *Seed* 1, outer layer of seed coat fleshy (sarcotesta), inner layer thin; endosperm thin to copious; embryo with flat cotyledons. Germination epigeous.

Distribution: 2 species in West and Central Africa.

Note: The endosperm is very thick in *H. mannii* (Fig. 133:16) and the cotyledons are thin and narrow, whereas in *H. chevalieri* the figure shows that the endosperm is thin and cotyledons are very thick. This discrepancy may be attributed to differences in state of maturity of the seeds. *H. mannii* seeds as shown are probably less mature than *H. chevalieri* seeds, although the former had, at collecting time, already the colour of mature fruits.

Key to the species

Leaf margin not revolute; flowers in panicles, axillary and subterminal; sepals 1-2 mm long; petals free; fruits obovoid . . . . **H. chevalieri**

Leaf margin revolute near base; flowers in axillary glomerules; sepals 3-4.5 mm long; petals coherent in lower part; fruits ellipsoid or ovoid . . . **H. mannii**

The seedlings of the two species can easily be distinguished as follows (see Fig. 27):

Hypocotyl shorter than epicotyl; cotyledons completely glabrous; first leaves cordate at base . . . . **H. chevalieri**

Hypocotyl longer than epicotyl; cotyledons hairy at inner base; first leaves obtuse at base . . . . **H. mannii**

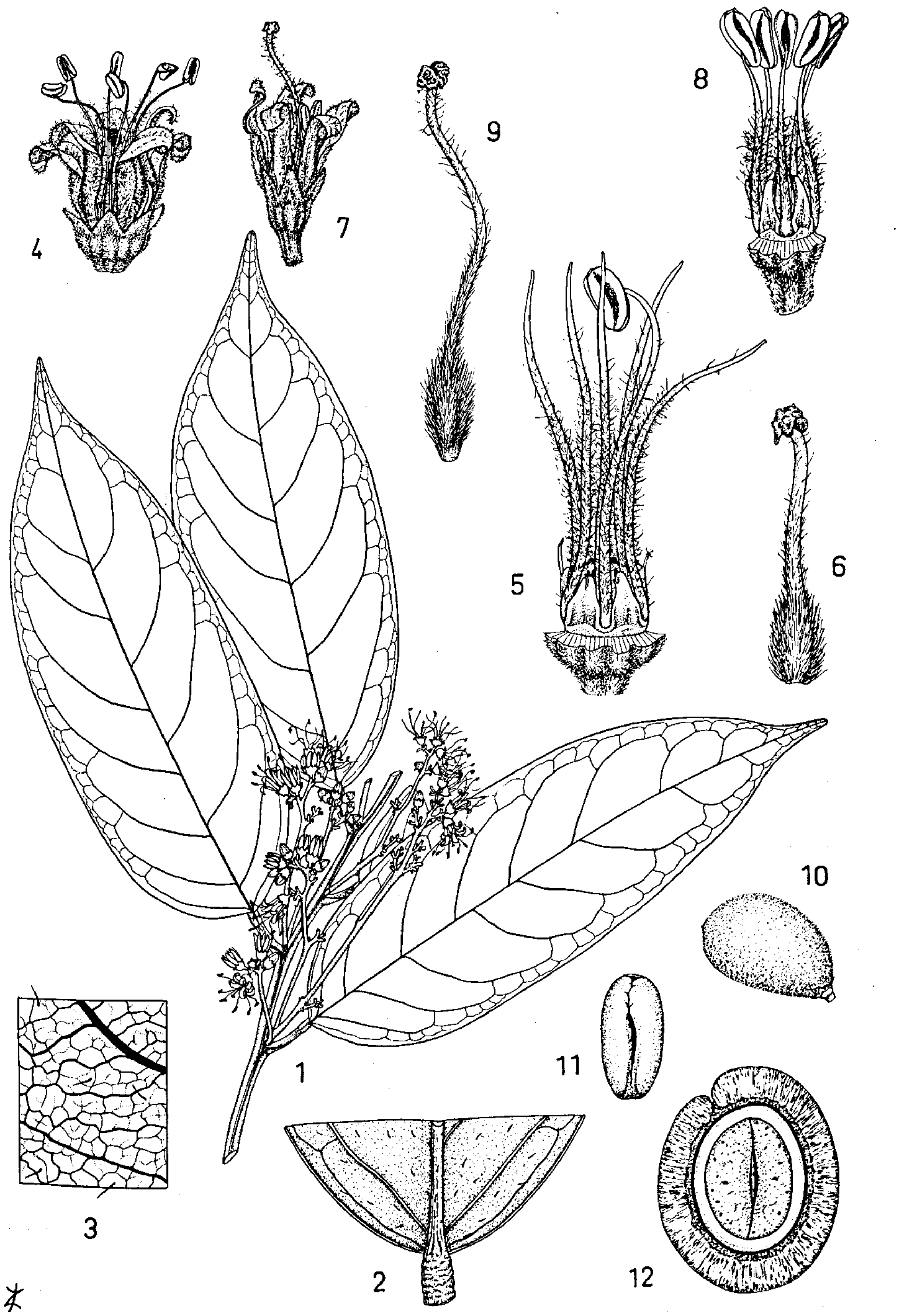


Fig. 131. *Hemandradenia chevalieri*: 1. flowering branch, 2/3 ×; 2. leaf base beneath, 2 ×; 3. detail of venation, 4 ×; 4. stamen-dominant flower, 4 ×; 5. long stamens with staminodes, 8 ×; 6. short pistil, 8 ×; 7. pistil-dominant flower, 4 ×; 8. short stamens with staminodes, 8 ×; 9. long pistil, 8 ×; 10. fruit, 2/3 ×; 11. seed, 2/3 ×; 12. cross section seed, 2 ×. (1, 3-6. *Chevalier 19968*; 2. *de Wit 9020*; 7-9. *Aubréville 1495*; 10-12. *de Koning 6169*).

Hemandradenia chevalieri Stapf **Fig. 17, 131, 132**

H. chevalieri Stapf, 1908: 289; Schellenberg, 1938: 65; Hepper, 1958: 749; Aubréville, 1959: 194.

Type: Ivory Coast, basin of Cavally R., shore between Tabou and Béréby, *Chevalier 19943* (holo: P).

Shrub or small tree. *Branches* dark-brown, with few scattered or many lenticels. Branchlets pale-brown tomentose, soon glabrescent. *Leaves*: petiole 5-7 mm long, terete pale-brown tomentose, glabrescent; petiolule terete, sometimes grooved above, 2.5-3 mm long, pale-brown tomentose, glabrescent; blade thinly coriaceous, oblong-elliptic, sometimes narrowly so, (7.5-)9-14(-18) cm long, (2-)3-6 cm broad; glabrous above, sparsely appressed-pubescent beneath; usually rounded, rarely broadly cuneate and subpeltate at base, apex acuminate; acumen c. 0.5-1.3(-2) cm long, with rounded or rarely truncate tip; leaf margin thickened, very slightly undulate; midrib prominent beneath with 5-9(-10) rather prominent lateral nerves; areolation large (see Fig. 131). *Inflorescences* paniculate, many-flowered, subterminal and/or in the axils of the upper leaves, c. 2-7(-10) cm long; peduncles up to 4 cm long, pale-brown tomentose. *Flowers* 5(-7)-merous, 5-8 mm long, subsessile; pedicel up to 1.5 mm long, pale-brown tomentose. *Sepals* slightly spreading or erect, triangular, c. 1.5 mm long, shortly connate at base, valvate, pale-brown tomentose outside, glabrous inside, apex acute. *Petals* free, imbricate, erect or slightly spreading and finally reflexed and once or twice coiled, narrowly elliptic, 5-5.5 mm long, c. 1 mm broad, finely tomentose both sides, apex acute. *Stamens* 3.5-7 mm long; filaments filiform, pubescent up to c. 1 mm below anther. *Anthers* cordate, c. 1 mm long. *Staminodes* 5, narrowly ovate to narrowly elliptic, c. 1.5 mm long, glabrous, entire or shortly dichotomously branched and slightly beaked. *Staminal ring* usually puberulous inside, sometimes glabrous, generally glabrous outside. *Pistil* 3.5-7 mm long; stigma capitate to lobulate, exserted or not; style appressed-pubescent, occasionally only lower half and then upper half puberulous to glabrous; ovary ellipsoid, densely hirsute. *Fruit* obovoid, 2.6-2.9 cm long, 1.5-1.8 cm in diameter, densely tomentose, yellowish to brownish when ripe. *Seed* obovoid, 1.8-2.4 cm long, 0.9-1.2 cm in diameter; inner seed coat thin and brittle; endosperm cartilaginous; radicle short and stout, 3 mm long, 2 mm in diameter, protruding at the micropylar end, slightly beyond the endosperm; cotyledons obovoid, cream coloured, turning reddish-brown on exposure, up to 2.3 cm long, 1.0 cm broad, c. 6 mm thick, rather mealy.

Seedling: Viable seeds germinate in 2-3 weeks. *Primary root* well developed. *Hypocotyl* (2-)3-5.6 cm long, pale-brown appressed-pubescent. *Cotyledons* obovate, c. 2.4 × 1.1 cm, equal, opposite, horizontally spread, very shortly petiolate, swollen at inner base, glabrous, red outside, greenish-yellow inside, soon completely reddish. *Epicotyl* 7-9.7(-11) cm long, terete, pale-brown appressed-pubescent. *First leaves* opposite, unifoliolate; petiole and petiolule together 1-1.6 cm long, pale-brown appressed-pubescent. Blade ovate, 4.5-7 × 3.9-5.1 cm, top

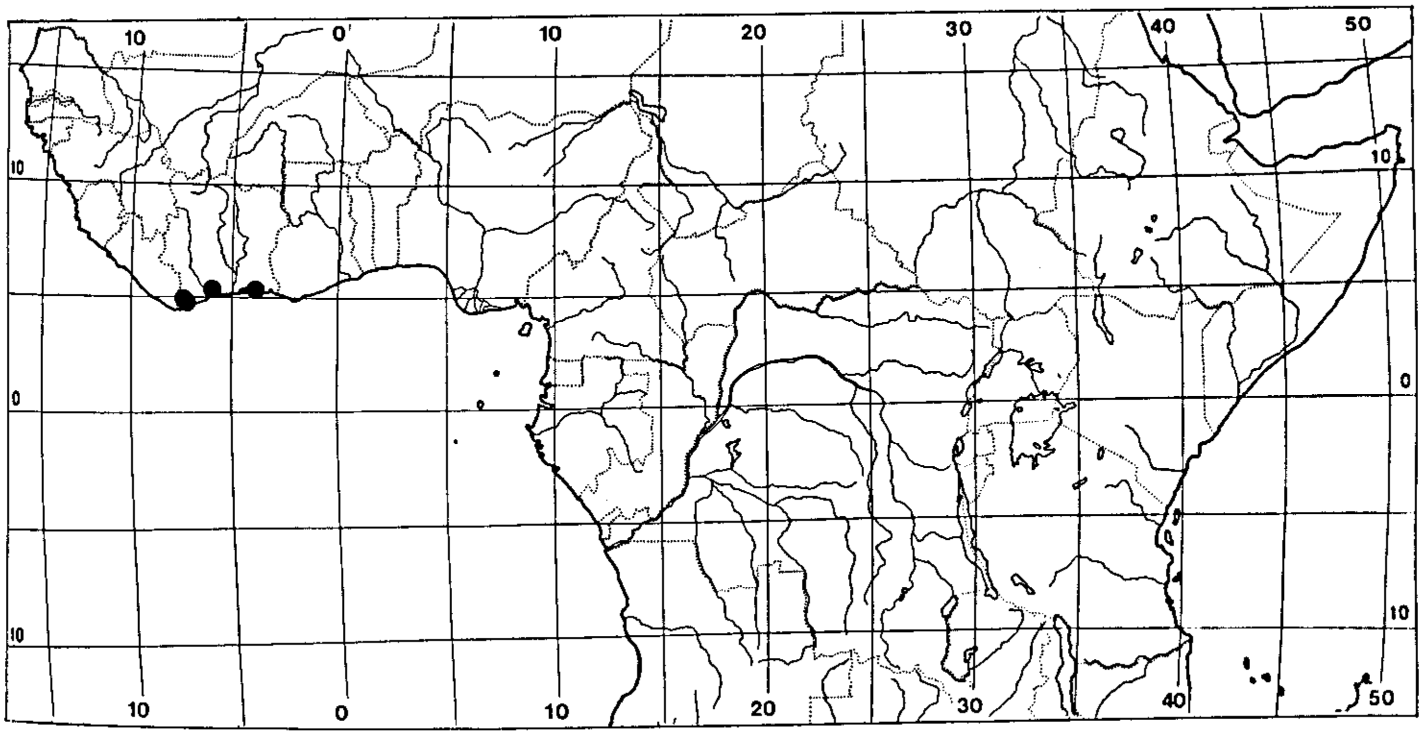


Fig. 132. Distribution of *Hemandradenia chevalieri*

acuminate to subcaudate, cordate at base, glabrous above, sparsely appressed-pubescent beneath, more densely so on the midrib and main lateral nerves. *Subsequent leaves* alternate, both petiole and petiolule 2-2.8 cm long; blade ovate to elliptic, 5.8-6.5 × 4-4.3 cm, obtuse at base; otherwise similar to the first leaves.

Distribution: Ivory Coast.
Ecology: Rain forest and semi-deciduous forest.

Specimens examined:

Ivory Coast: Port-Bouët, *Aubréville 1495* (BR, P); (fr. April) *1636* (P); Embouchure du Sassandra (fr. April) *Aubréville* 2803 (BR, P); between Tabou and Béréby (fl. Aug.) *Chevalier 19943* (P, type); (fl. Aug.) *19968* (BR, P); Banco Forest, *Cremers 395* (BR); *445* (P); (fr. Nov.) *De Koning 6169* (WAG); (fr. Jan.) *De Wit 9020* (WAG); *Toilliez 334* (BR); *347* (BR).
Cult. Wageningen: *Eimunjeze s.n.* (motherplant *De Koning 6169*) (WAG, seedling); *De Wit et De Bruijn We 28* (WAG, seedling).

Note: Herbarium records show that this species has been collected in Banco forest reserve. This is not shown on the distribution map, because according to Mr. J. de Koning, *H. chevalieri* does not occur naturally in the Banco forest reserve, but it is present only in cultivation in the Banco forest Arboretum.

Fig. 133, 134

Hemandradenia mannii Stapf

H. mannii Stapf, 1908: 288; Schellenberg, 1910: 21, 103; 1938: 64; Hepper, 1958: 749; Dickison, 1973a: 121-138.
Type: Equatorial Guinea, Muni river, *Mann 1763* (holo: K).
H. glomerata Aubréville et Pellegrin, 1958: 35; Aubréville, 1959: 194. Type: Ivory Coast, Haute-Niouniourou, *Aubréville 4123* (holo: P; iso: WAG).

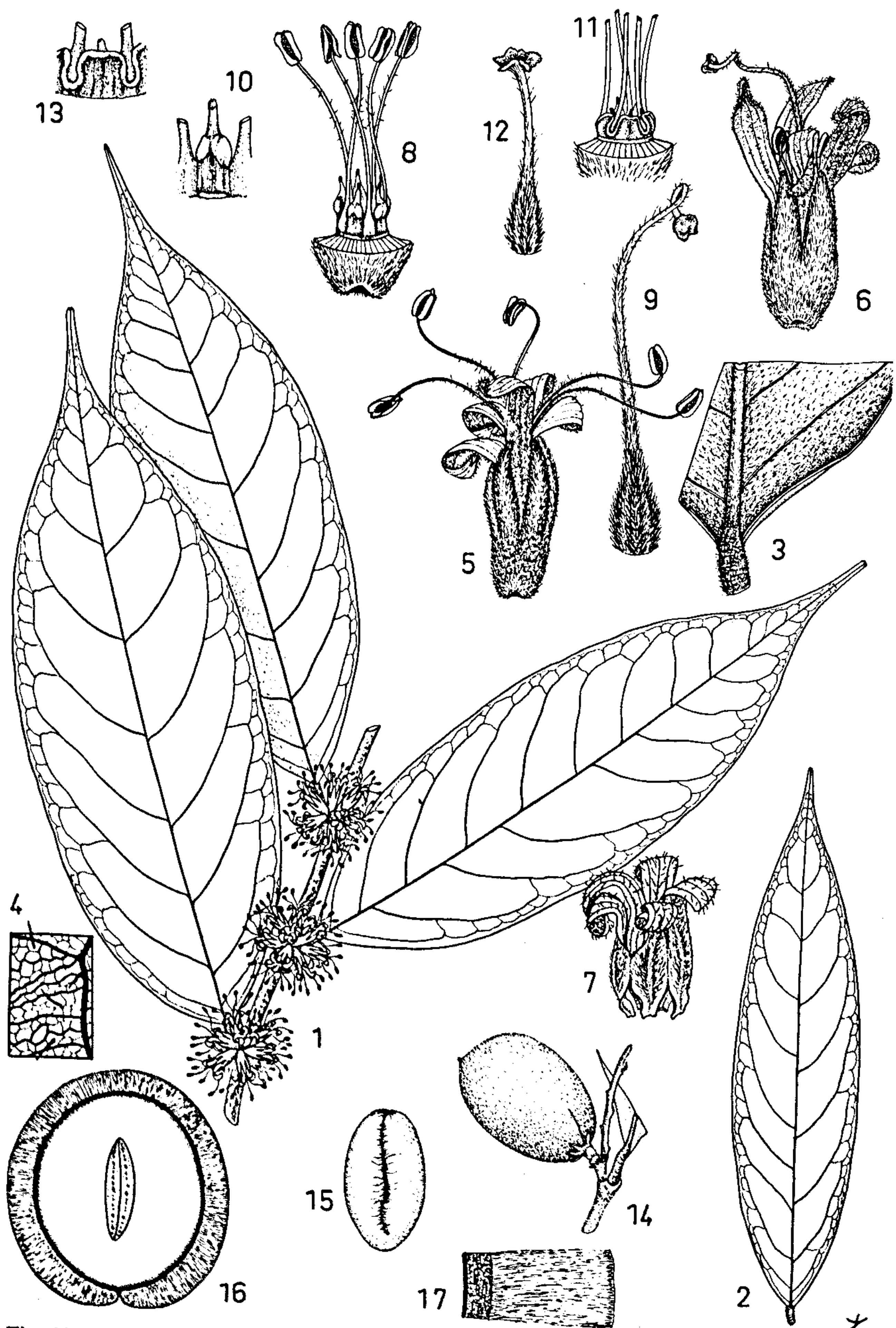


Fig. 133. *Hemandradenia mannii*: 1. flowering branch, 2/3 ×; 2. leaf beneath, 2/3 ×; 3. revolute leaf base, beneath, 2 ×; 4. detail of venation, 4 ×; 5. stamen-dominant flower, 4 ×; 6. pistil-dominant flower, 4 ×; 7. corolla, 4 ×; 8. stamens and staminodes, 6 ×; 9. long pistil, 6 ×; 10. detail staminode pistil-dominant flower, 12 ×; 11. staminodes stamen-dominant flower, 6 ×; 12. short pistil, 6 ×; 13. detail staminode stamen-dominant flower, 12 ×; 14. fruiting branchlet, 2/3 ×; 15. seed, 2/3 ×; 16. cross section of seed, 2 ×; 17. detail of seed-coat, 10 ×. (1, 3-5, 11-13. *Equipe Tisserant 316*; 2. *J. Léonard 583*; 6, 8-10. *Germain 7450*; 7. *Latilo FHI 30960*; 14-17. *Breteler 6116*).

Shrub or small tree 3-15 m tall and up to 8 cm in diameter. *Branchlets* terete, pale-brown appressed-pubescent, glabrescent. *Leaves*: petiole (3-)4-7 mm long, petiolule 2-3.5 mm long, both usually terete, sometimes grooved above, mostly pale-brown appressed-pubescent in young leaves and puberulous or glabrescent in older ones; blade thinly coriaceous, narrowly elliptic or elliptic, 7-18.5 cm long, 1.5-6.5 cm broad, glabrous above, pale-brown appressed-pubescent and finally glabrescent beneath; obtuse to cuneate at base, slightly caudate to acuminate at apex; margin thickened, slightly undulate, revolute in the basal part; acumen c. (0.2)0.4-1.8 cm long, usually rounded, very rarely faintly emarginate at the tip; main lateral nerves 6-10(-11) pairs, areolation small and distinct (see Fig. 133). *Inflorescences* glomerate, few to many-flowered, pale-brown appressed-pubescent. *Flowers* (4-)5-merous, subsessile, pedicel up to 1 mm long, appressed-pubescent. *Sepals* erect or slightly spreading, slightly imbricate or valvate, narrowly triangular, 3-4.5 mm long, c. 1 mm broad, pale-brown appressed-pubescent outside, glabrous inside, apex acute. *Petals* slightly spreading, narrowly ovate to narrowly obovate or narrowly elliptic, (5-)6-8 mm long, coherent in the lower part for 2-3 mm length, apical part erect or reflexed and once or twice coiled, pale-brown appressed-pubescent outside, inside glabrous or tomentulose to puberulous or partly so. Corolla often detaching as a unit at the end of anthesis. *Stamens* usually 5 fertile, 5-9(-10.5) mm long, filaments filiform, variously partly pubescent, rarely completely pubescent or glabrous. *Staminodes* 5, 1-1.5(-3.5) mm long, usually triangular, rarely oblong and beaked, or occasionally with broad base and upper half filiform and beaked, in the latter case thickened glands between the stamens and staminodes may be observed. *Anthers* yellow c. 1 mm long, usually ovate, rarely elliptic, occasionally the base and/or connective pilose. *Pistil* 3.5-6.5(-11) mm long, stigma capitate to lobulate, exserted in long-styled flowers; style short and fairly stout in short-styled flowers, long and filiform in long-styled flowers, pale-brown appressed-pubescent, often sparsely so in the upper half; ovary ovoid to obovoid, densely hirsute, rarely appressed-pubescent. *Fruits* ellipsoid or ovoid, 3.3 cm long, 2 cm in diameter, densely tomentose, yellowish-brown when ripe. Fruit wall crustaceous, 1.5mm thick, glabrous inside. *Seed* ellipsoid or ovoid, c. 2.3 cm long, c. 1.3 cm in diameter; sarcotesta greyish-violet or cream; endosperm very hard. Radicle short and stout, 3.5 mm long, 2.5 mm in diameter, cotyledons thin, flat and narrow, 17 mm long, 7 mm broad.

Seedlings: *Primary* root well developed. *Hypocotyl* 7.5-8 cm long, terete, densely pale-brown appressed-pubescent. *Cotyledons* elliptic, c. 1.3 × 0.8 cm, horizontally spread, equal, opposite, fleshy, very shortly petiolate, hirsute at inner base. *Epicotyl* c. 4.5 cm long, terete, densely pale-brown appressed-pubescent. *First leaves* opposite, unifoliolate, petiole and petiolule together 0.7-1 cm long, densely pale-brown appressed-pubescent. Blade elliptic, c. 7.5 × 5 cm, obtuse at base, caudate at apex, glabrous above, appressed-pubescent beneath, more densely so on the midrib and main lateral nerves.

Distribution: Ivory Coast, Nigeria, Cameroun, Central African Republic, Equatorial Guinea, Gabon and Zaïre.

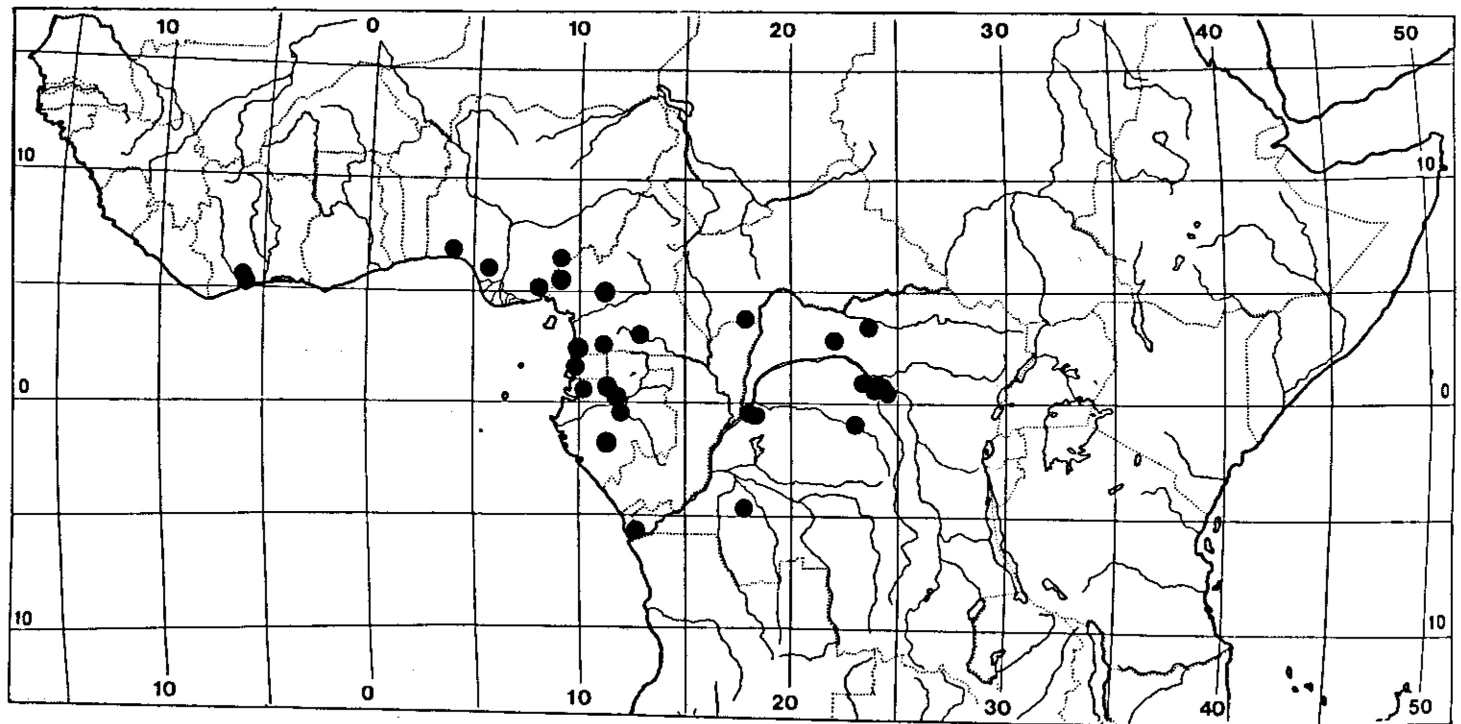


Fig. 134. Distribution of *Hemandradenia mannii*

Ecology: Rain forests and semi-deciduous forests at low and medium altitudes.

Specimens examined:

Ivory Coast: Haute-Niouniourou (fl. Feb.) *Aubréville 4123* (P, WAG, type of *H. glomerata*); 38 km N.E. of Sassandra (fr. Nov.) *Breteler 6116* (WAG).

Nigeria: Benin, Okomu F.R. (fr. Dec.) *Brenan 8561* (BM, BR, FHI, K); *9160* (FHI); (fr. Feb.) *Brenan and Onochie 9026* (FHI, K); Obudu, Okwangwo F.R. (fl. May) *Latilo FHI 30960* (K); Eluji, Shasha F.R. (fl. April) *Ross 193* (BM, BR); Calabar, Ikoromo (fr. July) *Ujor FHI 31629* (FHI).

Cameroun: Bitye nr. R. Dja (fl. Sept.) *Bates 1881* (BR, K); Akonekye, 15 km N.W. d'Ambam (fr. March) *Letouzey 10206* (P).

Central African Republic: Mbaiki and Boukoko Region (fl. Oct.) *Tisserant (Equipe) 316* (P); (fl. Oct.) *1157* (P); (fl. Sept.) *1891* (P); (fr. Jan.) *2337* (P).

Equatorial Guinea: River Muni, *Mann 1763* (K, type).

Gabon: Monts de Cristal, River Sanga (fr. Feb.) *Hallé and Villiers 5287* (P); Lastoursville (fl. June) *Le Testu 8867* (BM, P).

Zaïre: Binga, *Croegaert 46* (BR); Ikela (fr. May) *Dubois 823* (BR); Tumba Lake, Elema Isl. (fl. March) *Evrard 3779* (BR, K); *3786* (BR); Kimbili Mts, *Flamigni 10446* (BR); between Yafela and Yandjali (fl. and fr. Dec.) *Germain 4559* (BR); Yabibi, towards Basoko (fr. Oct.) *Germain 4637* (BR); Yandjali, between Isangi and Ligasa, *Germain 4924* (BR); Ikela, (fl. June) *Germain 7413* (BR); R. Lukenzu, Ikela (fl. June) *Germain 7450* (BR); Yangambi, *Gilbert 7869* (BR); *8255* (BR); Mpotia, Tumba Lake (fl., fr. Sept.) *Léonard 583* (BR, L, WAG); Basukutu, nr. Lubilu (fl. Nov.) *Léonard 1547* (BR); Dundusana, *Mortehan 504* (BR); (fl. Dec.) *877* (BR); Gimbi, Fuka Valley (fl. Feb.) *Toussaint 842* (BR); Inéac, Gimbi (fl. Jan.) *Wagemans 466* (BR); (fr. Jan.) *467* (BR, WAG).

Cult. Wageningen: *De Bruijn 2038* (WAG, seedling of *Breteler 6116*).

Additional material examined:

Cameroun: km 26 Ipono-Dipikar I., bank of Northern Ntem R. (fl., fr. June) *J.J. de Wilde 8321* (WAG); near Akonetye, S of Ebolowa (fr. Aug.) *Koufani 153* (WAG, YA); 26 km NW NGuti (fr. June) *Letouzey 13815* (WAG); N of Banda (fr. Apr.) *J. & A. Raynal 10751* (YA).

Gabon: near Koumameyong (fl., fr.juv. Apr.) *Breteler et al. 8980* (WAG); Lara R. near Mitzic-

édouneu Rd (fr. Nov.) *Louis et al. 475* (LBV, WAG); 40 km N of Lébamba (fr. Nov.) *Louis et al. 1042* (LBV, WAG).
Zaïre: La Kulu (fl.b.) *Van den Brande 239* (BR); ibid. (fl. Sept.), *Van den Brande 696* (BR); Gimbi (fr. July) *Wagemans 1543* (BR).

Note: Comparative studies of the holotype and isotype of *H.glomerata* (*Aubréville 4123*) with material of *H. mannii* showed that the former only represents a short-styled (stamen-dominant) specimen of *H. mannii*, and in conjunction with other characters, perfectly fits into the variability of *H. mannii*.

Additional Note: The material from Cameroun and Gabon is slightly aberrant in having distinctly apiculate to beaked fruits. *J.J. de Wilde 8321* from the former country is also differing by its large oblong leaves (up to 25 × 8 cm) which are densely brown-floccose beneath when young.

Excluded species

Hemandradenia madagascariensis Schellenberg (1938) = *Ellipanthus madagascariensis* (Schellenb.)Capuron (1958).

Note: Examination of the type material (*Baron 5626*) preserved in the Kew Herbarium leaves no doubt that this material belongs in *Ellipanthus*.

Jollydora Pierre

by F.J. Breteler & H.W. van Ziel

History of the genus

The type species of this genus was first described by Baillon (1867: 236) as *Connarus duparquetianus*, named after the type collector, the R. P. Duparquet. When Pierre studied this species in 1895, on the basis of flowering material collected in Old Calabar by Mann (no 2307) and fruiting material from Gabon collected by Jolly (no 111), he concluded that *C. duparquetianus* was to be placed in a new genus. This was named *Jollydora*: gift of Jolly. An interesting detail is the fact that Pierre published his new genus by means of a very detailed drawing, made by Delpy and based on the two specimens cited above. This drawing was multiplied and distributed as 'indelible autograph' e.g. to the botanical museum in Berlin (see Gilg 1896: 217). This constitutes valid publication of a monotypic new genus.

In 1896 (l.c.) Gilg published a second species which he named *J. pierrei*. Pierre had labelled some material from the same area as *J. ellimabouro*. Schellenberg (1910: 70) compared this material with the type of *J. pierrei* and concluded that it belonged to this species. A third species was described by Schellenberg in 1919 from the Victoria area in Cameroun and named *J. glandulosa*. In 1930 Mildbraed published *J. pedunculosa* from the same area, based on two collections made by himself. Hepper's (1958: 749) presumption that Mildbraed's species (cited by him as *J. peduncula*) is synonymous with *J. glandulosa* is confirmed. Schellenberg overlooked Mildbraed's name completely.

Since Pierre published it in 1895 the genus *Jollydora* has never been disputed. It is very well delimitated within the *Connaraceae* by its habit, its pinnate leaves, and its unicarpellate flowers producing indehiscent, 1-2-seeded fruits. Its rather isolated position was illustrated by Gilg and followed by Schellenberg in placing it in a separate subfamily the *Jollydoroideae*.

That it differs considerably from 'common' *Connaraceae* is illustrated by names given to *Jollydora* specimens which were published in really different families, e.g. *Anthagathis* by Harms (1897: 195) who placed it in the *Leguminosae* and *Ebandoua* by Pellegrin (1955: 331) who considered it to be Anacardiaceous. When material is not carefully studied it is easily mistaken for a species of the *Sapindaceae*.

Gilg (1896: 217) stated that Pierre had been asked to set the genus apart from the other *Connaraceae* and to classify it in the *Simaroubaceae*.

Description of the genus

Jollydora Pierre, 1895 (unprinted drawing); 1896: 1233; Gilg, 1896: 217;

1897b: 189; Schellenberg, 1910: 69; 1919: 455; 1938: 24; Hutchinson, 1964: 167.
Type species: *Jollydora duparquetiana* (Baill.) Pierre.
Anthagathis Harms, 1897: 195. Type species: *Anthagathis monadelphia* Harms (= *J. duparquetiana* (Baill.) Pierre).
Ebandoua Pellegrin, 1955: 331. Type species: *Ebandoua cauliflora* Pellegrin (= *J. duparquetiana* (Baill.) Pierre).

Small, evergreen, usually unbranched treelets, up to ca 8 m high, showing the architectural model of Corner. Young parts covered with a reddish to light-brown woolly, silky or tomentose indumentum. *Leaves* pinnate, usually crowded at the top. *Petiole* somewhat thickened at base, usually shorter than rachis. *Leaflets* opposite to alternate, even or odd in number, the rachis as a rule terminated by a leaflet; petiolule short, somewhat thickened. *Inflorescence* a raceme, clustered on the stem or in the leaf-axils. *Pedicel* jointed. *Flowers* 5-merous, heterotristylous. *Sepals* imbricate, free, unequal, the two outer smaller. *Petals* imbricate, free or somewhat coherent. *Stamens* 10, united at base into a more or less conspicuous cup partly enclosing the ovary. *Pistil* 1; ovary ellipsoid, ovules nearly basally attached; stigma simple or somewhat lobed. Fruit 1-2-seeded, indehiscent. *Seed* with almost completely fleshy seedcoat. Endosperm absent. Cotyledons thick and almost horny, radical apical.

Distribution: 3 species in tropical Africa, from E Nigeria to Angola (Cabinda).
Ecology: Rainforest, up to ca 1000 m altitude.

Key to the species

1a Vegetative parts and sepals with aglandular hairs only; fruits obovoid-ellipsoid to almost globose, always shortly but distinctly stipitate (whole area) . . . . **J. duparquetiana**
b Leaflets with scattered glandular hairs along midrib both sides; sepals with glandular hairs, at least partly so; fruits either not stipitate or stipitate but then narrowly (sub)ellipsoid **2**
2a Sepals with a mixture of glandular and aglandular hairs; fruits narrowly (sub)ellipsoid, tapering both ends (Gabon) . . . . **J. pierrei**
b Sepals predominantly with glandular hairs; fruits ellipsoid, not stipitate (S E Nigeria, W Cameroun) . . . . **J. glandulosa**

Jollydora duparquetiana (Baill.)Pierre **Fig. 18, 135-137**

J. duparquetiana (Baillon)Pierre, 1895 (unprinted drawing); 1896: 1233; Gilg, 1896: 218; Schellenberg, 1910: 71; 1919: 456; 1938: 26; Hepper, 1958: 749.
Basionym: *Connarus duparquetianus* Baillon, 1867: 236.
Type: Gabon, sin.loc., *Duparquet 54* (holo: P, see note).

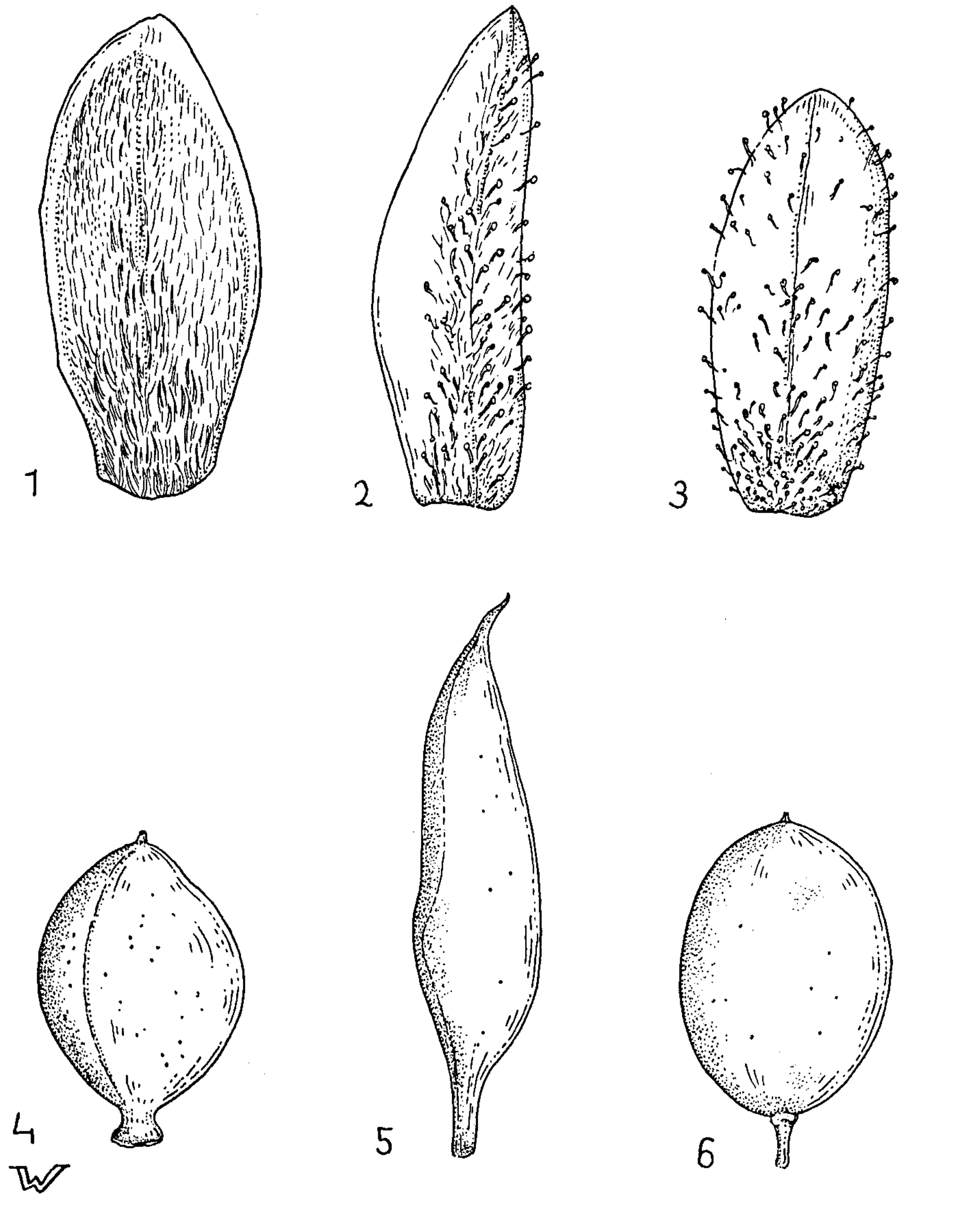


Fig. 135. *Jollydora* species: sepals with indumentum outside (15 ×) and fruitshape (1 ×), 1,4. *J. duparquetiana*; 2,5. *J. pierrei*; 3,6. *J. glandulosa*. (1. *Breteler 9001*; 2. *Klaine 2335*; 3. *Letouzey 13416*; 4. *J.J. de Wilde 309*; 5. *Jolly 77*; 6. *Latilo FHI 30923*).

J. rufobarbata Gilg ex Schellenberg, 1910: 71. Type: Cameroun, Bipindi, Zenker 1685 (lecto: K; iso: BM, Z).

J. acuta Schellenberg, nomen in herb. Zenker

J. cinnabarina Gilg, nomen in herb. Zenker

J. gigantophylla Gilg, nomen in herb. Zenker

J. gilgiana Schellenberg, nomen in herb. Zenker
J. villosissima Gilg, nomen in herb. Zenker
Anthagathis monadelphia Harms, 1897: 196. Type: Gabon, Mondah forest, *Breteler & J.J. de Wilde 387* (neo: WAG, see note).
Ebandoua cauliflora Pellegrin, 1955: 331. Type: Gabon, Haute Ngounié, Ebandou Dicobi, *Le Testu 6307* (holo: P).

Small, usually unbranched treelet to ca 8 m tall and ca 5 cm diameter. Bark of stem brown-red to grey-yellow, rather smooth. Wood reddish to pale-brown. *Petiole* 4.5-22 cm long, yellow to red-brown, often becoming greyish, pulvinus up to 2 cm long and 12 mm thick. Rachis 7-45 cm long, 2-5 mm thick. *Leaflets* 5-11, papery to coriaceous, elliptic to obovate or oblong, 10-47 × 3-13(17) cm, cuneate at base, up to 2.5 cm long acuminate, petiolule 3-10 mm long; midrib slightly prominent above, lateral nerves 7-18 pairs. *Inflorescence* cauliflorous, usually consisting of one to several, up to 7-flowered, clustered racemes, very rarely axillary, reddish tomentose; rachis up to ca 2 cm long. *Pedicel* articulate, with a small bract (up to 1 mm long) and two opposite bracteoles of ca 0.5 mm long, the upper part less than 1mm long. *Sepals* ovate-elliptic to oblong, 2-5 × 1-3 mm, obtuse to acute at apex, appressed-short-hairy outside, glabrous inside. *Petals* coherent in the middle, otherwise free, oblong, 5-9 × 0.8-2 mm, apex rounded, glabrous both sides. *Stamens* 10, rarely one missing, the long ones 2-5.5 or 4.5-6.3 mm long, the short ones 1-2.5 or 2.5-5.5 mm long; filaments glabrous; anthers 0.6 mm long. *Pistil* 1-7 mm long; ovary 0.7-1.3 mm long, pubescent; style 0-0.5, 1.5-2.5, or 2.5-5.5 mm long, glabrous or with a few hairs; stigma somewhat lobed or not. *Fruit* obovoid-ellipsoid to subglobose 2-4 cm long, 1-2.2 cm diameter, mucronate or not, shortly but distinctly stipitate, yellow to orange or scarlet at maturity; pericarp shining outside, 0.5-1 mm thick, glabrous or glabrescent. *Seeds* 1-2 per fruit; testa almost completely fleshy, except in a narrow zone on the preraphal side, 0.5-1.5 mm thick, whitish when fleshy, brown when not; cotyledons thick and almost horny, radicle minute.

Distribution: From eastern Nigeria to Angola (Cabinda).
Ecology: Primary or old secondary forest, often recorded from rather wet habitats.

Specimens examined:

Nigeria: Calabar R. (fl. March) *Latilo FHI 41338* (K); Old Calabar R. (fl.fr. Febr.) *Mann 2307* (K); (fl. Febr.) *Mann 2309* (P) (most likely a duplicate of *Mann 2307*, see note); 20 km ENE of Calabar (fr. April) *Van Meer 1144* (WAG); Oban (fl.) *Talbot 1708* (BM).
Cameroun: Near Grand Batanga (fr. Jan.) *Bos 3758* (WAG); 8 km S. of Kribi (fr. Febr.) *Bos 3985* (WAG); ca 18 km Kribi-Lolodorf (fl. March) *Bos 4061* (WAG); (fl. March) *Bos 4122* (WAG); 28 km Kribi-Lolodorf (fl. April) *Bos 4325* (WAG); 12 km Kribi-Ebolowa (fr. April) *Bos 4438* (WAG); 20 km Kribi-Lolodorf (fr. Dec.) *Bos 5817* (WAG); 8 km W of Bipindi (fl. Febr.) *Bos 6360* (WAG); km 28 Kribi-Lolodorf (fl. March) *Bos 6614* (WAG); 15 km SE of Kribi (fl. March) *Bos 6644* (WAG); ca 40 km Kribi-Edea (fl. April) *Bos 6730* (WAG); 40 km S of Kribi (fl. Aug.) *Bos & Breteler 7276* (WAG); S Bakundu F.R. (fl. March) *Brenan 9407* (BM, BR, K, P); (fl. March)

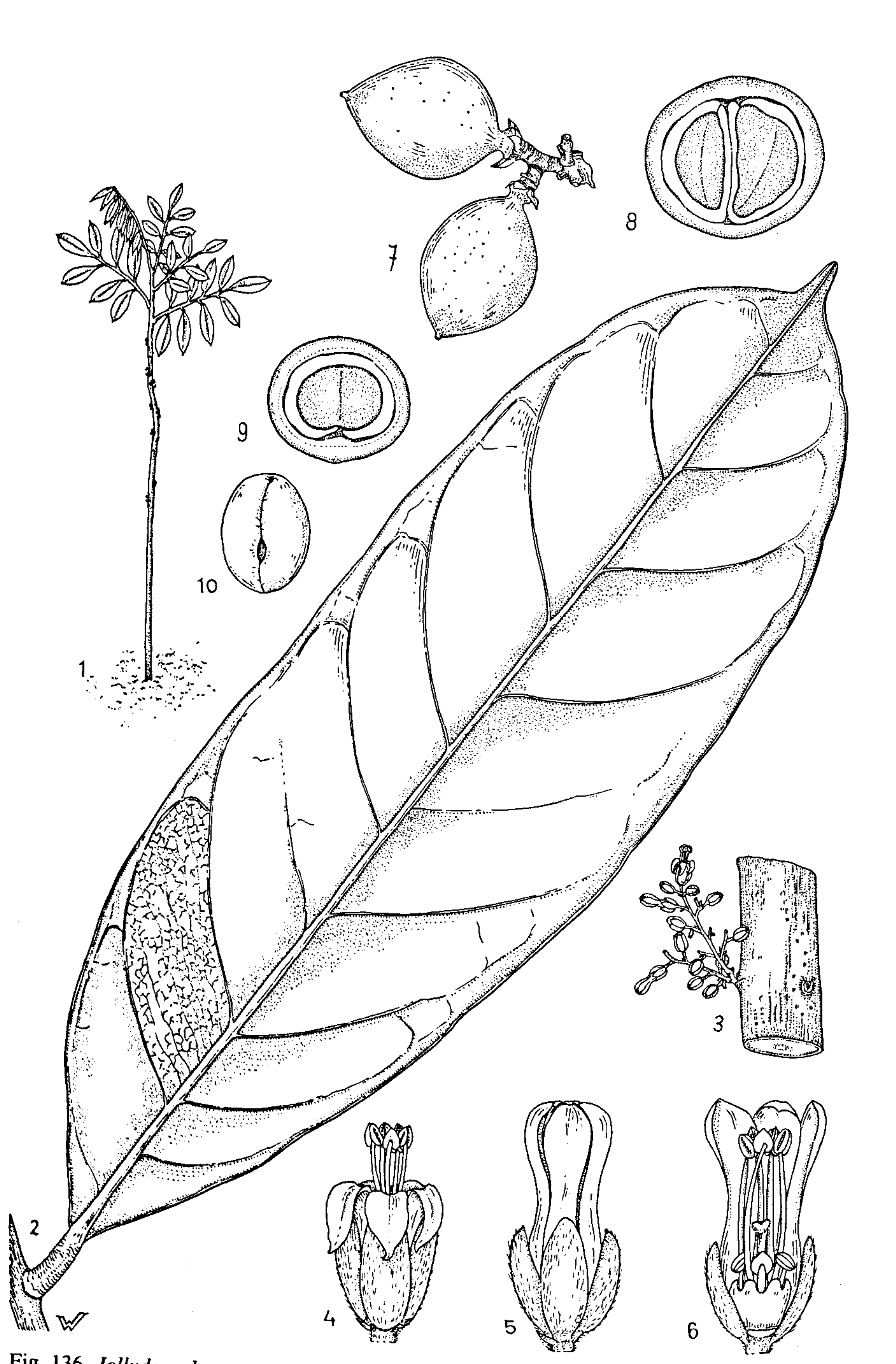


Fig. 136. *Jollydora duparquetiana*: 1. habit, ca 1/40; 2. leaflet beneath, 2/3 ×; 3. inflorescence, 2/3 ×; 4-5. flowers, 4 ×; 6. flower, one sepal and petals removed, 4 ×; 7. fruits, 2/3 ×; 8. two-seeded fruit in transverse section, 1 ×; 9. one-seeded fruit in transverse section, 1 ×; 10. seed with sarcotesta, ventral side with hilum, 1 ×. (2. *Louis et al. 1256*; 3. *J.J. de Wilde et al. 7850*; 4-6. *Breteler et al. 9001*; 7,8. *J.J. de Wilde et al. 309*; 9,10. *J.J. de Wilde 8301*).

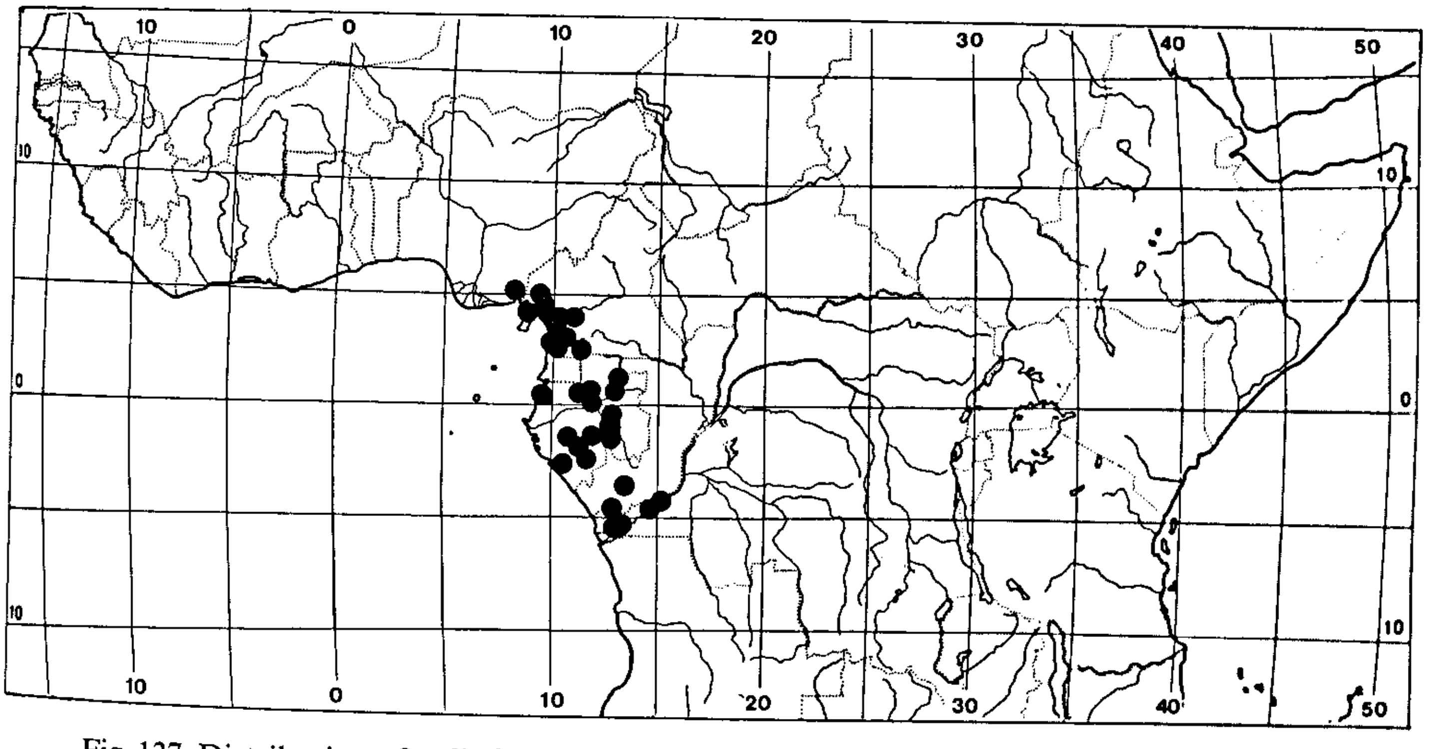


Fig. 137. Distribution of *Jollydora duparquetiana*

Brenan 9411 (BM, BR, K, P); 39 km E. of Douala (fl. Febr.) *Breteler c.s. 2601* (C, P, WAG); 25 km Ebolowa-Kribi (fl. Dec.) *J.J. de Wilde 7850* (WAG); Nkoemvone (fl. Dec.) *J.J. de Wilde 8005* (WAG); 16 km Kribi-Ebolowa (fr. June) *J.J. de Wilde 8301* (WAG); 50 km NW of Eséka (fl. Nov.) *W. de Wilde 1254* (BR, K, P, WAG); 40 km NW of Eséka (fl. Dec.) *W. de Wilde 1436* (WAG); 60 km NW of Eséka (fr. Febr.) *W. de Wilde 1767* (WAG); 60 km SW of Eséka (fl. March) *W. de Wilde 2139* (BR, K, MO, WAG); (fr. March) *W. de Wilde 2139B* (WAG); W of Limbe (Victoria) (fr. Nov.) *Gentry & Thomas 52850* (WAG); Elephant Mt near Kribi (March) *Huber 1052* (YA); Kumba (fl. Jan.) *Keay FHI 37369* (K, P, WAG); 60 km SW of Eséka (fl. March) *Leeuwenberg 5039* (BR, K, P, WAG); km 11 Loum-Yabassi (fl. March) *Leeuwenberg 9481* (WAG); near Bella (fr. Jan.) *Letouzey 4168* (P); 50 km SE of Kribi (fr. March) *Letouzey 9009* (BR, P); 40 km SE Kribi (fl. March) *Letouzey 9091* (HBG, P); km 81 Kribi-Ebolowa (fl. April) *Letouzey 9449* (BR, P, WAG); 20 km SW of Ambam (fl. March) *Letouzey 10163* (P); 20 km N of Eséka (fr. Dec.) *Letouzey 12321* (P); 35 km SW of Edea (fl. Jan.) *Letouzey 12659* (P); 25 km NNE of Bipindi (fl. Jan) *Letouzey 12826* (P); Baduma Forest (fr. June) *Nemba & Thomas 117* (WAG); Kumba (fr. May) *Olorunfemi FHI 30576* (K); Dipikar I. (fr. Dec.) *Satabié 498* (P, YA); Limbe (Victoria) (fl. May) *Winkler* 40b (Z); Bipindi (fl.) *Zenker 1685* (BM, E, G, K, P, Z, type of *J. rufobarbata*); (fr.) *Zenker 1980* (BM, G, K); (fl.) *Zenker 1995* (BM, E, G, GOET, K, L, P, Z); (fr.) *Zenker 2510* (BM, BR, E, G, K, P); (fl.) *Zenker 2744* (BM, E, G, K); (fl.) *Zenker 3438* (BM, BR, E, G, GOET, K, L, M, MO, P); (fl.) *Zenker 3754* (BM, BR, E, G, K, MO); (fl.) *Zenker 3756* (BM, BR, E, G, GOET, K, MO).

Gabon: Libreville (fr.) *Autran (Heckel) 15* (P); 25 km NW Libreville (fr. Aug.) *Breteler & de Wilde 387* (WAG, type of *Anthagathis monadelphia*); near La Lara (fl. Sept.) *Breteler & de Wilde 443* (WAG); (fr. Sept.) *Breteler & de Wilde 447* (WAG); 34 km Mouila-Yeno (fr. Sept.) *Breteler c.s. 8121* (LBV, WAG); 5-10 km W of Kouménayong (fl. April) *Breteler c.s. 9001* (LBV, WAG); *9003* (LBV, WAG); 15 km N of Doussala (fr. March) *de Wilde & Jongkind 9462* (WAG); Cap Estérias (fr. Jan.) *J.J. de Wilde c.s. 309* (LBV, WAG); sin.loc. (fl.) *Duparquet 54* (P, type, see note); Bélinga (fr. March) *Florence 688* (P); Makokou (fr. March) *N. Hallé 1503* (P); *1504* (P); (fl.) *N. Hallé 2647* (P); Bélinga (fr. June) *N. Hallé 3934* (P); *4054* (P); *N. Hallé & Le Thomas 173* (P); 7 km SW Makokou (fr. April) *Hladik 2067* (P); Mondah Forest (fr. Feb.) *INEF s.n.* (P); Libreville (fr. April) *Jolly 111* (P); (fr. May) *Klaine 186-2* (P); (fl. Sept.) *Klaine 359* (P); (fr. Jan.) *Klaine 395* (P); (fr. June) *Klaine 470* (P); (fl. Aug.) *Klaine 532* (P); (fr. Feb.) *Klaine 716 bis* (P); SE Sindara (fl. Sept.) *Leeuwenberg & Persoon 13633* (LBV, WAG); Ebandou Dicobi (fl. Sept.) *Le Testu 6307* (BM, BR, P, type of *Ebandoua cauliflora*); Matoro (fl. Oct.) *Le Testu 7495* (BM, P); Lastoursville (fl. Oct.) *Le Testu 7519 bis* (BM, BR, P); Coumamala (fl.fr. Sept.) *Le Testu 8342* (BM, P); *8343*

(BM, P); Oveng (fr. Nov.) *Louis c.s. 395* (LBV, WAG); 20 km N of Lastoursville (fr. Nov.) *Louis c.s. 805* (WAG); 32 km SE Sindara (fr. Dec.) *Louis c.s. 1256* (LBV, WAG); *1332* (LBV, WAG); Oveng (fr. May) *Reitsma c.s. 901* (LBV, WAG); (fl. May) *Reitsma c.s. 903* (LBV, WAG); 30 km SW of Doussala (fl. Aug.) *Reitsma 1430* (WAG); 40 km NW of Oveng (fl. Sept.) *Reitsma 1514* (WAG); 30 km SW of Doussala (fr. Febr.) *Reitsma 1961* (WAG); 25 km WSW of Mitzic (fr. Nov.) *Reitsma 2577* (WAG); Sibang (fl. June) *Soyaux 10* (K, Z); Sibang (fr. July) *Thomas & Wilks 6344* (WAG); 32 km SE of Sindara (fr. Feb.) *Wilks 1224* (WAG).

Congo: Moufouma (fr. Aug.) *Farron 4293* (P); Djoumouna (fl.Oct.) *Farron 4662* (P); (fl. Nov.) *F. Hallé 1480* (P); Mantaba (fr. Sept.) *Koechlin 3121* (P); Banza N'Dounga (Sept.) *Koechlin 5274* (P); sin.loc. (fl.) *Sita 2629* (P).

Zaire: Lusanga Sundi (fr. Sept.) *Donis 1452* (BR); Luki (fr. March) *Donis 1754* (BR); (fr. May) *Wagemans 1521* (BR); (fr. Aug.) *Wagemans 1621* (BR); Gimbi (fr. Feb.) *Wagemans 2203* (BR).

Angola: Belize (fr.) *Gossweiler 8011* (BM, LISU).

Notes: Baillon (1867: 236) cites *Duparquet 55* as the type. This is an error. By personal communication of N. Hallé and J.C. Jolinon from the Paris herbarium attention was drawn to a note attached to *Mann 2309* (P,see below). This note from the hand of Pierre proves that no 55 is a misprint and should read no 54. Schellenberg (1938: 26) cites both numbers 54 and 55! *Duparquet 54* is also cited (l.c.: 58) by him under *Manotes griffoniana*.

The Paris specimen of the Mann collection referred to as *Mann 2309* should most likely read *Mann 2307*. The figure 7 on the original label of this Mann duplicate can be mistaken for a 9 as did Delpy when he made the detailed drawing, based on *Mann 2307* and *Jolly 111*, on which this genus was founded.

Harms (1897: 196) did not cite a specimen when publishing *Anthagathis monadelphia*, but cited Gabon as its origin. Not any material could be traced which might possibly be accepted as type of this monotypic genus. Therefore a neotype has been designated.

Jollydora glandulosa Schellenb. **Fig. 135, 138**

J. glandulosa Schellenberg, 1919: 455; 1938: 25; Hepper, 1958: 749.
Type: Cameroun, between Joh. Albrechtshöhe and Ediki, *Winkler 1042* (holo: B†; lecto: Z).

J. pedunculosa Mildbraed, 1930: 971. Type: Cameroun, 15-35 km NE of Limbe (Victoria), Likomba Pflanzung, *Mildbraed 10607* (lecto: K).

J. peduncula Mildbraed, nomen on *Mildbraed 10607*.

Treelet up to ca 5 m tall, usually unbrached. *Petiole* 15-18 cm long, up to 10 mm thick at base, rachis 10-45 cm long. *Leaflets* up to 13, opposite to subopposite, papyraceous, oblong to obovate-elliptic, 8-43 × 2.5-10.5 cm, up to 1.5 cm long acuminate, cuneate at base; petiolule 4-10 cm long; midrib prominent both sides, lateral nerves 6-13 on each side. *Inflorescence* of clustered racemes, axillary or just below the leaves; each raceme up to 9 mm long, 1-3 flowered, with mixture of appressed and red glandular hairs. *Pedicel* jointed, 0.5-7 mm long. Bracts and bracteoles up to 0.7 mm long. *Sepals* ovate-triangular or

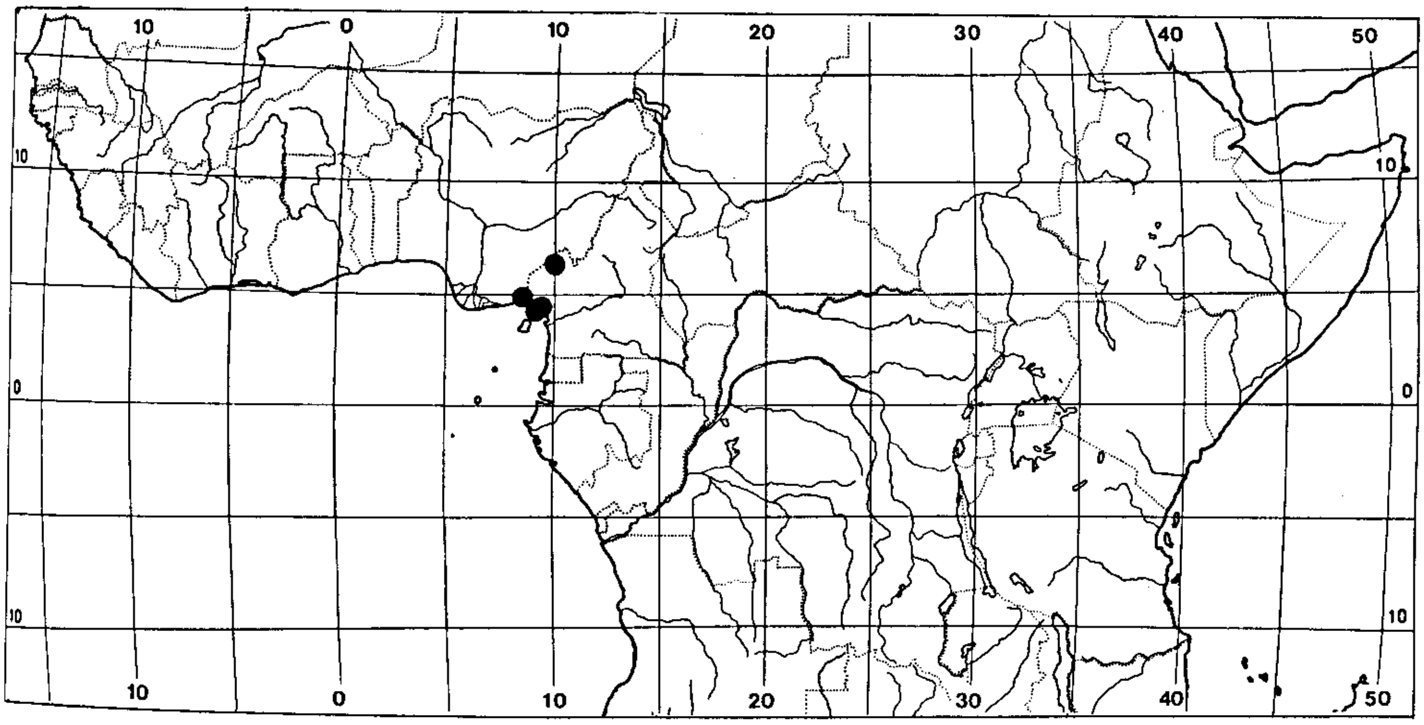


Fig. 138. Distribution of *Jollydora glandulosa*

oblong, 2-6 × 1.5-3 mm, rounded to acute at apex, outside with appressed aglandular and red glandular hairs, glabrous inside. *Petals* coherent in the middle, otherwise free, oblong, 9-11 × 1.2-1.5 mm, top rounded, glabrous both sides. *Stamens* 10, the long ones 5-6.5 or up to 10 mm long, the short ones 1.5-3 or 5-6.5 mm long; filaments glabrous, anthers ca 0.6 mm long. *Pistil* 1, 4.5 or 10 mm long; ovary ca 1.5 mm long, pubescent, hairs ca 2.5 mm long; style glabrous; stigma distinct, subentire. *Fruit* 1(-2?)seeded, ovoid-ellipsoid, up to 4 × 2.5 cm, yellow, glabrous or glabrescent. *Seeds* ovoid-ellipsoid, 15-18 × 10-13 mm.

Distribution: SE Nigeria, W Cameroun.
Ecology: Rain forest.

Specimens examined:

Nigeria: Obudu, Boshi-Okwangwo F.R. (fr. May) *Latilo FHI 30923* (K).
Cameroun: Near Obang, 18 km S of Wum (fl. Dec.) *Letouzey 13416* (P); 15-35 km NE of Limbe (Victoria)(fl.Nov.) *Mildbraed 10607* (K, type of *J. pedunculosa*); between Joh. Albrechtshöhe and Ediki (fl. Dec.) *Winkler 1042* (Z, type).

Notes: The characters of the type specimen of this species were already discussed by Schellenberg in 1910 (p. 70). At that moment he classified it with some doubt as *J. pierrei*, because of insufficient knowledge of the flowers of *J. pierrei*. In 1919 (l.c.) this doubt had disappeared as result of a misuse of the conformity in leaf indumentum between *J. duparquetiana* (*Zenker 2744 & 3756*) and *J. pierrei* (*Jolly 77, Soyaux 186*). The leaf indumentum being the same in the two *J. pierrei* specimens and in *Zenker 2744*, the latter is no longer considered to represent *J. duparquetiana* but *J. pierrei*. This Zenker material has an aglandular calyx, so *J. pierrei* has a calyx without glands. As a result *J. glandulosa* can be distinguished from *J. pierrei* by its glandular calyx.

A character which might be useful to distinguish sterile material of this species from *J. duparquetiana* and *J. pierrei* is found in the angle between the midrib and its main laterals. This angle is 45° in *J. glandulosa* and usually 50°-70° in the other two species.

Jollydora pierrei Gilg **Fig. 135, 139**

Jollydora pierrei Gilg, 1896: 218; Schellenberg, 1910: 69; 1919: 456; 1938: 26, p.p. (except material from Cameroun, see note under *J. glandulosa*).

Type: Gabon, Sibang, *Soyaux 186* (holo: B †); neotype: Gabon, near Libreville, *Klaine 1596* (P).

J. ellimabouro Pierre, nomen in herb. *Klaine 390*; Gilg, 1896: 218 (as *J. elimaboura*); Schellenberg, 1910: 70.

Treelet up to 5 m tall, usually unbranched. *Petiole* 7-13 cm long, rachis 4-9 cm long. *Leaflets* 3-7, opposite or alternate, papyraceous, narrowly (obovate-) elliptic, 11-22 × 3.5-8 cm, cuneate at base, rather abruptly acuminate apically, acumen 5-15(20) mm long, slender; midrib and the 10-16 main laterals on each side prominent both sides as well as the tertiary, reticulate venation; petiolule 3-8 mm long. *Inflorescence* of clustered racemes, cauliflorous; raceme ca 7-flowered, up to 1.5 cm long. *Pedicel* jointed; bracts and bracteoles 0.5-1 mm long, tomentose. *Sepals* elliptic to ovate-triangular, 2-4.5 × 1-1.5 mm, rounded to acute at top, outside with appressed and erect glandular hairs, glabrous inside. *Petals* usually partly coherent, free at base and apically, oblong, 7-9 × 0.8 mm, top rounded, glabrous both sides. *Stamens* 10, the long ones 5-6.5 or 5-8 mm long, the short ones ca 1.5 mm or 3-5 mm long; filaments glabrous; anthers

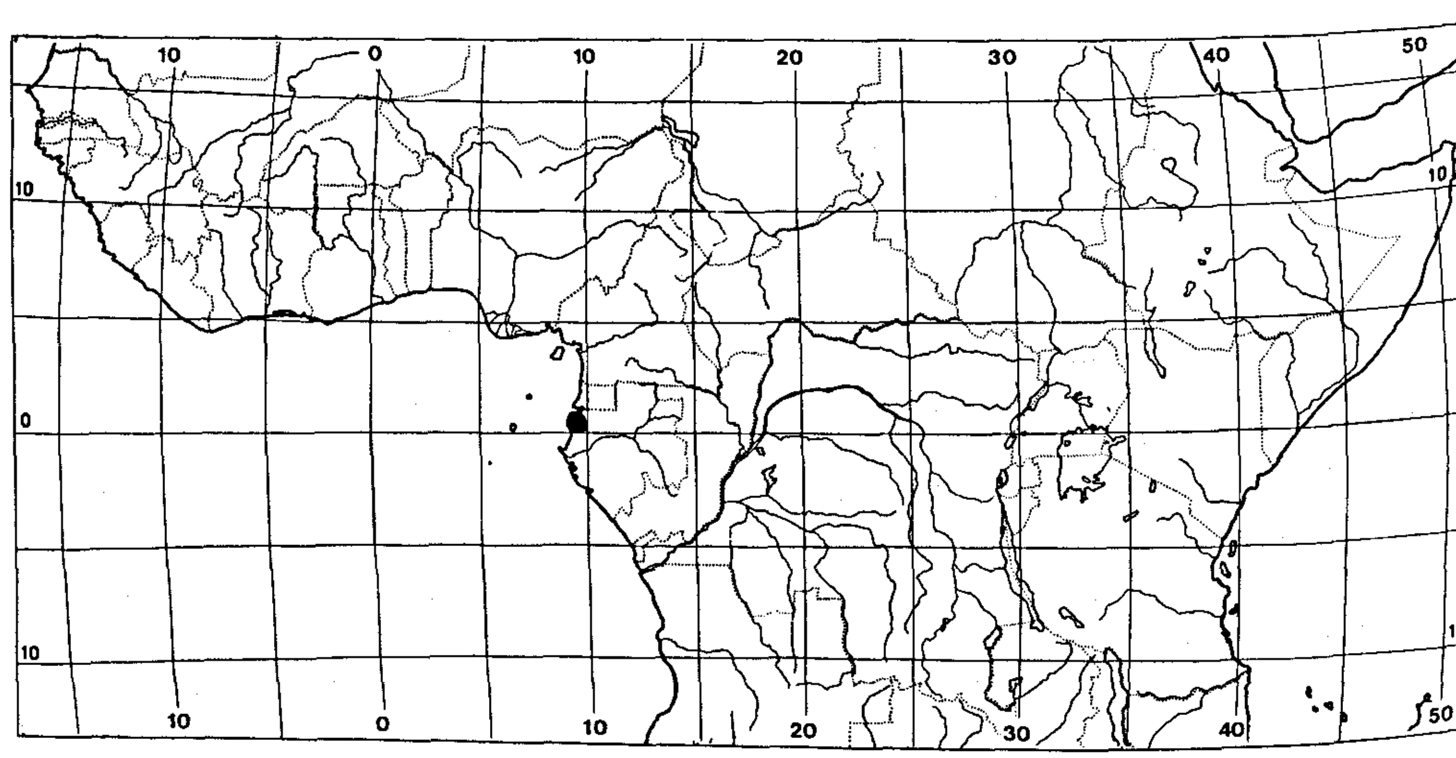


Fig. 139. Distribution of *Jollydora pierrei*

0.6 mm long. *Pistil* 1.2-8 mm long; ovary ca 1 mm long, woolly; style 1 or 7 mm long, with a few hairs; stigma lobed. *Fruit* narrowly ellipsoid, tapering both ends, 4.5-6 cm long (up to 9 cm long in Schellenberg 1938: 28), 0.9-1.7 cm diam., 1(-2) seeded. Pericarp smooth, glossy, glabrous or glabrescent. *Seed* narrowly ellipsoid, 2-3 cm long, 6-10 mm diam.

Distribution: Gabon, only collected near Libreville.
Ecology: Rain forest.

Specimens examined:

Gabon: Libreville (fr. Febr.) *Jolly 77* (P); near Libreville (fl. Oct.) *Klaine 390* (P); (fl.fr. July) *Klaine 1596* (P,type); (fl. July) *Klaine 1903* (P); (fl. July) *Klaine 2335* (P); (fr. Dec.) *Klaine 2564* (P); (fr. May) *Klaine 2884* (P).

Note: Schellenberg (1938: 26) described the fruits as being up to 9 cm long and Gilg (1896: 218), the author of this species, as up to 8 cm long. This is much longer than measured in the material examined for this revision. The specimen seen by both these authors and not examined now is *Jolly 186*, the type, which was lost in Berlin.

Manotes Sol. ex Planchon

by C. C. H. Jongkind

History of the genus

Manotes was described by Planchon in 1850 with a single species: *M. expansa*. In 1867 Baillon proposed a second species, *M. griffoniana*. Many new species, mostly based on minor differences in indumentum and/or leafshape, were added in the following decennia. In 1897 Gilg described the genus *Dinklagea* with the only species *D. macrantha*. In 1910 Schellenberg published his thesis 'Beitrage zur vergleichenden Anatomie und zur Systematik der Connaraceen' in which *Connaraceae* were critically reviewed but not formally revised. In this work Schellenberg reduced *Dinklagea* to a section of *Manotes* and so *Dinklagea macrantha* became *Manotes macrantha*. The formal revision was completed much later and published in 1938. In his revision Schellenberg did not apply most of his critical remarks made in 1910. His species concept is very narrow and resulted in as many as ten *Manotes* species. The present revision maintains only three of them. Together with *M. lomamiensis* described by Troupin in 1951, the total number of species recognized here in the genus *Manotes* becomes four. *M. soyauxii* which Schellenberg in 1938 considered to be a synonym of *M. pruinosa* (= *M. expansa*) was described by him in 1919 from W Congo. In this revision it is considered to be a hybrid between *M. expansa* and *M. griffoniana*. The present revision is based on many recent collections and on ca 75% of the herbarium material seen by Schellenberg, the remainder being destroyed in Berlin.

Delimitation of the genus

Manotes is distinctly delimitated within *Connaraceae* not only by generative characters but also by a vegetative one.

Among the genera with 5-carpellate flowers *Manotes* is the only genus with a short but distinct androgynophore. *Manotes* is also the only genus of this group where inner and outer pericarp split apart at maturity.

When sterile, *Manotes* can be distinguished from other material with pinnate leaves by its typical pattern of the ultimate veinlets (see fig. 147.4).

Some other characters can be added when delimitation against some particular taxon is concerned but the above mentioned characters are always sufficient in distinguishing *Manotes* from other genera of *Connaraceae*.

Indumentum

In *Manotes* there are three kinds of hairs on the vegetative and generative

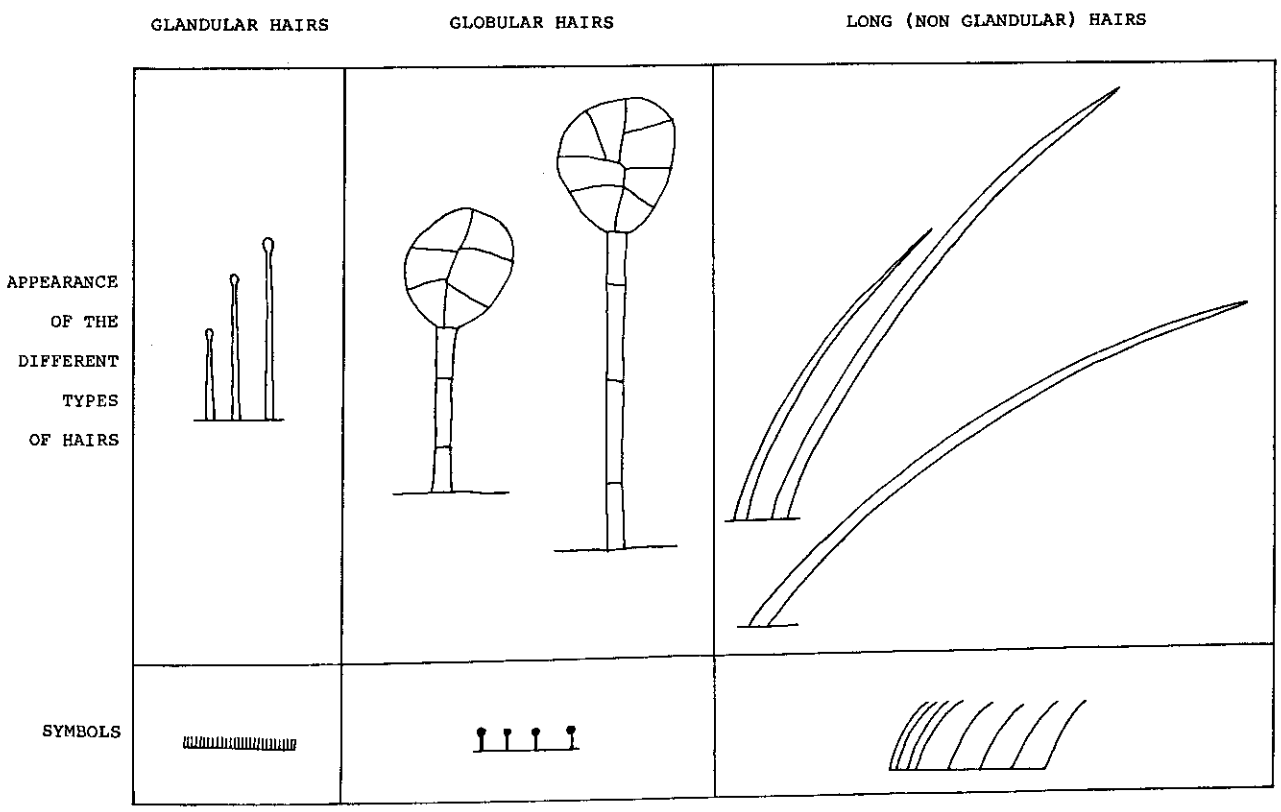


Fig. 140. The three hair types of *Manotes*.

parts. These three types are termed here glandular hairs, globular hairs and long hairs (fig. 140) and they are described as follows.

The glandular hairs are one-celled and have a small globular top on which, when dry, often tiny cristals can be observed. These hairs are usually erect and up to 0.15 mm long.

The globular hairs are many-celled in the shape of a stalked globe. The globe is in every direction more than one-celled in diameter and it is usually strikingly coloured. Its stalk is a few cells long and one cell wide. They can be up to 1 mm long, but usually they are shorter.

The long hairs are not glandular, they are one-celled and have a sharp end. They are usually appressed or subappressed and up to 1.5 mm long.

The presence or absence of these different hair types on the pistil and on the fruit is the most decisive character to distinguish most species of *Manotes*. The indumentum of the other generative parts and the vegetative parts may vary between collecting localities especially in *M. expansa* that has a large geographical distribution. *M. lomamiensis* on the other hand, with a restricted area of distribution, is much more constant in its indumentum.

Description of the genus

Manotes Solander ex Planchon, 1850: 438; Bentham & Hooker, 1862: 433; Baker, 1868: 451,459; Gilg, 1890: 67; Schellenberg, 1910: 18,97; 1938: 54; Thonner, 1915: 244; Aubréville, 1959: 193; Troupin, 1952: 70; Exell, 1954: 140; Hutchinson, 1964: 169.

Type species: *M. expansa* Solander ex Planchon.

Dinklagea Gilg, 1897a: 242; 1897b:190. Type species: *D. macrantha* Gilg (= *M. macrantha* (Gilg) Schellenberg).

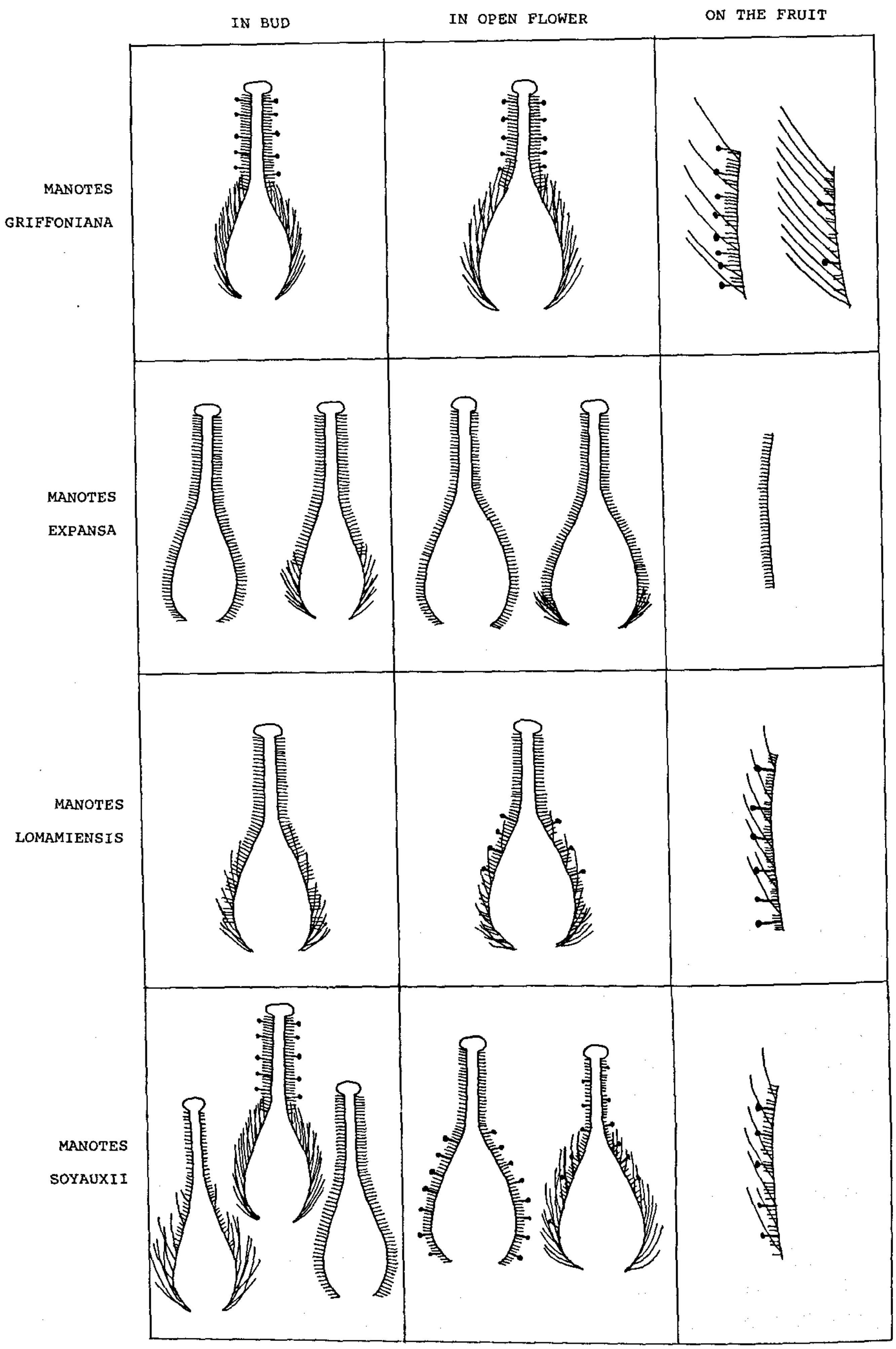


Fig. 141. The indumentum of the pistil and the fruit of *Manotes* section *Manotes* (see fig. 140 for the symbols of the different indumentum types).

Lianas or scandent shrubs. *Branches* cylindric or very slightly lobed; wood presumably always without interxylary phloem. *Leaves* imparipinnate. Leaflets opposite or subopposite, entire, symmetric or nearly so; the nervation ending in a dense pattern of very fine parallel veinlets. *Flowers* in axillary, paniculate or racemose inflorescences, pentamerous, hetero-tristylous or hetero-distylous, reddish to yellow. *Sepals* connate at the base, valvate in bud. *Petals* longer than sepals, free, imbricate in bud. Androgynophore short but distinct. *Stamens* in two whorls, free, the five stamens opposite the sepals longer than the five stamens opposite the petals. *Pistils* five, free. *Fruit* a follicle, one to five per flower, constricted at base, beaked or not, glabrous inside, dehiscing by a ventral suture exposing the pendulous seed; inner pericarp separating from exocarp at maturity. Calyx persistent and usually accrescent in fruit. *Seed* solitary, subovoid, attached to the ventral suture; testa shiny and completely fleshy (sarcotesta) or with a thin part on the dorsal side, sarcotesta with a threadlike appendix attaching the seed to the base of the follicle; hilum ventral; radicle apical; embryo with thin flat distinctly nerved cotyledons completely enclosed by abundant endosperm. *Seedling* as far as known epigeal with a strongly elongated hypocotyl.

A genus of four species and one putative hybrid of humid tropical Africa, extending from Guinea to E Zaire and from the Central African Republic to the North of Angola. In drier regions confined to gallery forest.

Note: In his monograph of the *Connaraceae* Schellenberg (1938) distinguished the two sections of *Manotes* on the character of axillary inflorescences in section *Dinklagea* (*M. macrantha*) versus terminal inflorescences in section *Manotes*, all other species). This character is not tenable to distinguish the two sections, as explained in the paragraph on inflorescences. The characters used to distinguish the two sections in this revision are the ones mentioned in the key.

Key to the sections and species

1a Petals with two lateral lobes (fig. 147.6). Stamens of a single flower all about the same length, pistils unequal to them (hetero-distyly). Leaflets coriaceous. Dimensions of the flower bud when the calyx lobes are about to open 3-3.5 × 2-2.5 mm. . section **Dinklagea**, only species: **M. macrantha**

b Petals without such lateral lobes. Stamens in two whorls of clearly different length, pistils unequal to either whorl (hetero-tristyly). Leaflets papery. Dimensions of the flower bud when the calyx lobes are about to open 1-2.7 × 1-1.8 mm. . . . . section **Manotes** –2

2a Pistil in bud as well as in open flower with globular hairs all over the style and with a dense cover of long hairs on the ovary. Fruit always with long (>0.3 mm) hairs, more or less distinctly mixed with glandular and globular hairs (fig. 141). Flower bud with full-grown, closed calyx (nearly) globose. . . . . **M. griffoniana** b Pistil with a different indumentum, style in bud without globular hairs. Fruit often without long hairs. Flower bud with full-grown, closed calyx ovoid, ca 1.5 times as long as wide. . . . . –3

3a Fruit with short glandular hairs only, lacking both globular and long hairs. West and Central Africa. . . . . **M. expansa**

b Developing (> 2.5 mm) and mature fruit with globular hairs as well as long hairs, short glandular hairs not in evidence. S Zaire. . . **M. lomamiensis**

Note: Within the area where *M. expansa* and *M. griffoniana* occur together, some hybrid specimens may be found that do not fit in this key (see **M. soyauxii**).

Manotes expansa Sol.ex Planch. **Fig. 141-143**

M. expansa Solander ex Planchon, 1850: 439; Baker, 1868: 459; Schellenberg, 1910: 20; 1938: 59; Hepper, 1958: 747; Burkill, 1985: 524.
Type: Sierra Leone, sin. loc., *Afzelius s.n.* (holo: BM).

M. longiflora Baker, 1868: 460; Hutchinson, 1928: 517; Schellenberg, 1938: 56; Mangenot, 1957: 1; Hepper, 1958: 747: Aubréville, 1959: 193; Irvine, 1961: 573; de Koning, 1983: 277,288; Burkill, 1985: 524. Type: Nigeria, Eppah, *Barter 3283* (holo: K).

M. pruinosa Gilg, 1891b: 332; De Wildeman, 1912: 407; Schellenberg, 1938: 59 p.p. except *Le Testu 1049* and *1061* (see note under *M. soyauxii*), *Tilman 79* and *Verschueren 28* (see under *M. griffoniana*); Troupin, 1952: 72; Exell & Mendonça, 1954: 140. Type: Zaire, Lulua, *Pogge 724* (holo: B†; lecto: K).

M. sanguineo-arillata Gilg, 1891b: 333; De Wildeman, 1905: 91; 1912: 407. Type: Zaire, Mukenge, *Pogge 749* (holo: B†; lecto: K).

M. aschersoniana Gilg, 1891b: 334. Type: Zaire, Mukenge, *Pogge 751* (holo: B†; lecto: K).

M. brevistyla Gilg, 1891b: 334; Schellenberg, 1910: 18,19. Type: Zaire, Musumba, *Pogge 532* (syn: B†), Lulua, *Pogge 739b* (syn: B†). Neotype: Zaire, Kaskama, Kananga (= Luluabourg), *Gillardin 263* (holo: BR).

M. cabrae De Wildeman & Durant, 1900c: 62; Schellenberg, 1910: 20. Type: Zaire, Mayombe, *Cabra 30* (holo: BR).

M. moandensis De Wildeman, 1909: 106. Type: Zaire, near Moanda, *Gillet 3989* (holo: BR).

M. leptothyrsa Gilg, nomen in herbarium *Dinklage 1735* (B, P), *1842* (B, BR, BM, P, Z), and *2011* (B); Schellenberg, 1910: 20, nomen.

M. griffoniana auct. non Baillon, Schellenberg, 1938: 58 p.p.: *Dewèvre 434*, *Gossweiler 7792*, *7805*, and *8109*, and *Thollon 974* (see note under *M. griffoniana*).

Cnestis corniculata auct. non Lamarck, Bentham, 1849: 290.

Branchlets with a dense indumentum of long hairs; older branches glabrous or with a few hairs and lenticellate. *Petiole* 2-4.5(-7.5) cm long; rachis 4-15.5

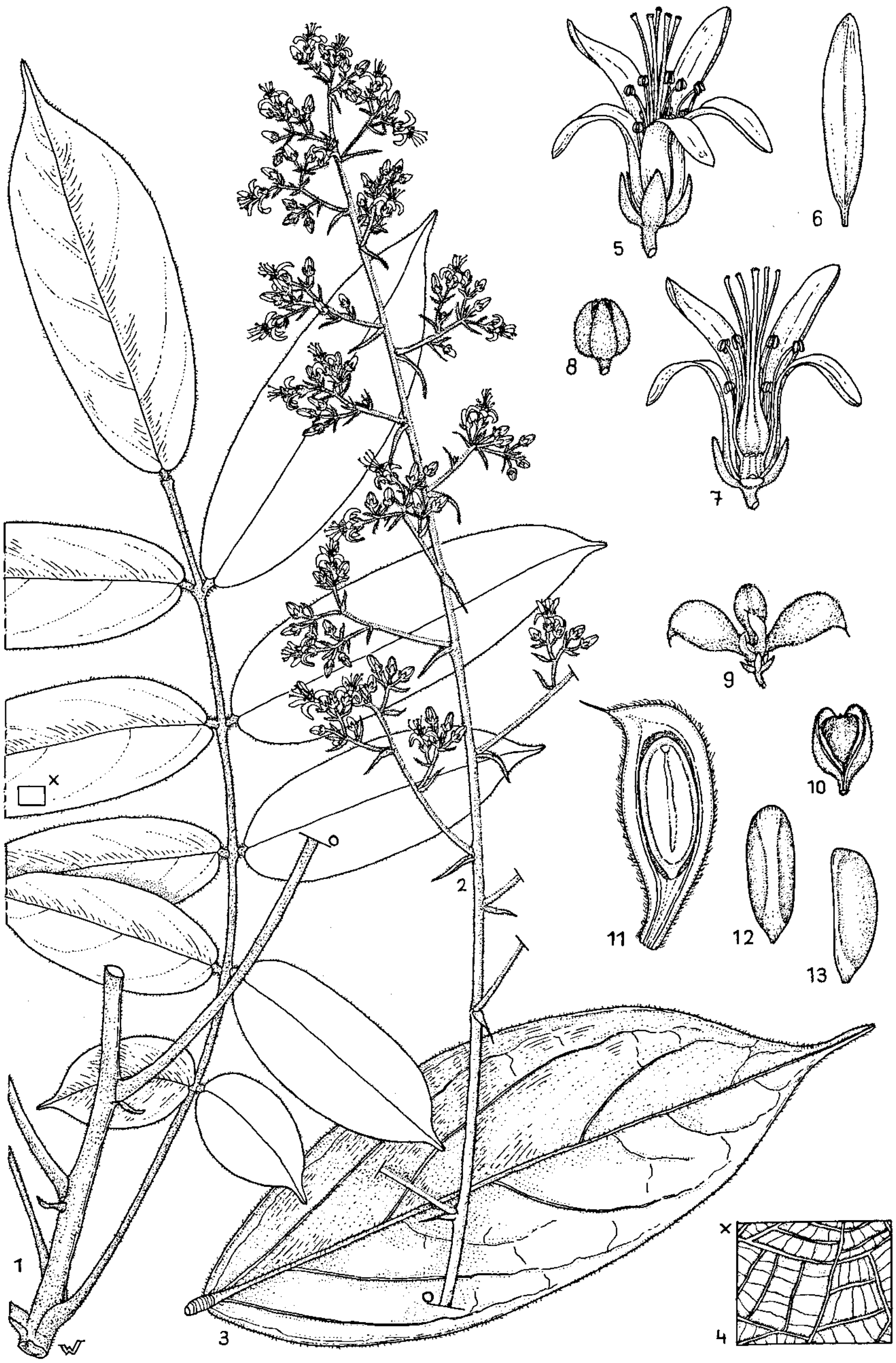


Fig. 142. *Manotes griffoniana*: 1-2. flowering branchlet (with interruption), 2/3 ×; 4. detail of leaflet (see × in 1.), 4 ×; 5. flower, 4 ×; 6. petal, 4 ×; 7. flower partly, showing androgynophore, 4 ×; 8. flower bud, 4 ×; 9. follicles, 2/3 ×; 11. length section of follicle, showing seed and flat cotyledons, 2 ×; 12-13. seed, showing partly fleshy testa (dark part), 2 ×.

Manotes expansa: 3. leaflet 1.5 ×; 10. follicle dehiscing by a ventral suture, 2/3 ×. (1-2. *Troupin 4500*; 3. *A. Louis et al. 731*; 4. *Troupin 4500*; 5-7. *A.Louis et al. 1389*; 8. *Bos 3243*; 9. *A.Louis et al. 184*; 10. *Carlier 29*; 11-13. *A.Louis et al. 184*).

cm long, pubescent to glabrous; petiolules 1-4 mm long; *leaflets* 7-13, ovate to elliptic, pubescent or glabrous, base cordate to acute; apex acuminate; young leaflets pink; terminal leaflet 3.8-15.5 × 1.4-6.8 cm; lateral leaflets 2.3-15 × 1.1-6.5 cm. *Inflorescence* up to 40 cm long, pubescent to glabrous. *Pedicel* above the joint 1-3 mm long. Flower bud when the calyx lobes are about to open (1.5-)1.8-2.2(-2.7) × (1-)1.2-1.5(-1.8) mm. *Sepals* lanceolate (1.7-)2.5-3.5(-4) × 0.8-1.5 mm, greenish-white to dark red but usually pink. *Petals* narrowly elliptic 5.5-7.5(-11) × 0.8-1.2(-2) mm, reflexed, first white often with pink, later yellow. Sepals and petals frequently with all three kinds of hairs. Long *stamens* 3-6 mm; short stamens 1.5-4 mm long; filaments white, with glandular hairs and sometimes with globular hairs as well; anthers yellow. *Pistil* 2-5.5 mm long, unequal to the stamens, white to pink with glandular hairs and sometimes with long hairs at the base of the ovary. *Follicles* 1-5, up to 20 × 10 mm, orange to red, minutely velutinous (glandular hairs), beaked. *Seed* ca 10 × 5 mm; testa partly fleshy and red, dorsal partly thin and black. *Seedling* epigeal; hypocotyl strongly elongated and densely pubescent; first leaves opposite.

Distribution: From Guinea to Zaire and from the Central African Republic to N Angola.

Ecology: Rain forest and gallery forest, observed and collected particularly in the forest edges. From sea level up to 600 m alt.

Selection of more than 500 specimens examined:

Guinea: N'Zérékoré (fl. Dec.) *Adam 7824* (P); Diéké (fl. Oct.) *Baldwin 9661* (K, P); Friguiagbé (fr.) *Chillon 2423* (C); Macenta (fl. July) *Jacques-Félix 1012* (P).

Sierra Leone: Freetown (fl., fr. Dec.) *Dalziel 955* (K, P); Njala (fl. Nov.) *Deighton 1787* (BM, K); Kokoru (fl. Oct.) *Deighton 5197* (K, P); Korombai (fl. Dec.) *N.W.Thomas 6922* (K).

Liberia: Mt Bele Rd (fl. Nov.) *Adam 754* (K, P); Nyaake (fr. June) *Baldwin jr. 6218* (K, P); Brewersville (fl. Sept.) *Barker 1076* (K, P); N of Zorzor (fl. July) *Bos 2222* (BR, K, WAG); Chien (fl., fr. Jan.) *Bos 2847* (BR, K, P, WAG); Grand Bassa, Fishtown (fl., fr. Oct.) *Dinklage 1842* (B, BM, BR, G, P, Z); NE of Suacoca (fl. Oct.) *Traub 293* (BM, BR, C, G, K).

Ivory Coast: Toulepleu (fl. Sept.) *Adam 6329* (P); between Grabo and Taté (fl. Aug.) *Chevalier 19760* (P); between Taté and Tabou (fl. Aug.) *Chevalier 19816* (P); Banco F.R. (fl. June) *de Koning 6984* (WAG); 17 km W of Abidjan (fl., fr. June) *W.de Wilde 299* (BR, P, WAG, Z); Adiopodoumé (fl., fr. July) *Geerling & Bokdam 323* (B, BR, WAG); Sassandra (fl., fr. Dec.) *Leeuwenberg 2244* (K, L, P, WAG); 18 km W of Abidjan (fl., fr. Sept.) *Oldeman 442* (B, BR, P, WAG); Adiopodoumé (fl., fr. Sept.) *Roberty 12161* (G, K, Z); San Pedro (fl., fr. Aug.) *Thoiré 323* (BR, K, P).

Ghana: Bibiana (fl., fr. May) *Darko 872* (K, P); Ananji (fl., fr. Oct.) *Howes 973* (K, P); near mouth of Ankobra R. (fl. April) *J.K.Morton 6590* (K, WAG).

Nigeria: Eppah (fl.) *Barter 3283* (K, type of *M. longiflora*); Jesse (fl. Sept.) *Butler Cole 21* (BR, K, P); Lagos (fl.) *Dalziel 1023* (C, K, M); Enuga (fr.) *Hepper 2230* (K, P); Old Calabar (fl.) *Mann 2256* (K, P); Ijebu-Ode (fl., fr. Jan.) *Onochie FHI 19687* (K, P, WAG); Eket (fl.) *Talbot 3112* (BM, K, Z).

Cameroun: 15 km N of Kribi (fl. Feb.) *Bos 3830* (BR, K, P, WAG); 20 km NE of Ngambe (fl. Jan.) *Letouzey 11060* (P).

Central African Republic: 10 km from M'Poko bridge (fl. March) *Descoings 10088* (P); Yalinga region (fl. Aug.) *Le Testu 3072* (BM, P); Waka region (fl. Nov.) *Tisserant 1688* (P); Boukoko (fl., fr. Nov.) *Equipe Tisserant 1254* (BM, P).

Equatorial Guinea: Sanje, Benito R. (fl. Sept.) *Bates 571* (L, P).

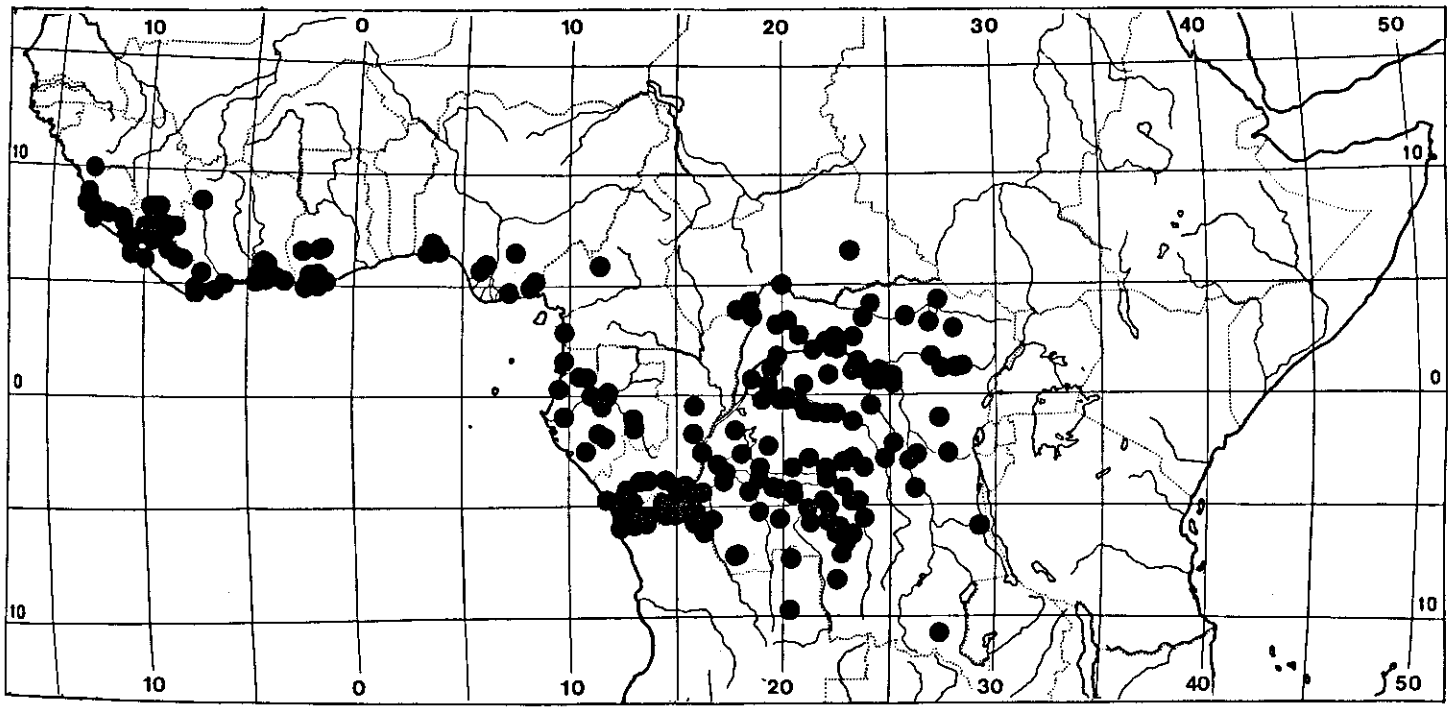


Fig. 143. Distribution of *Manotes expansa*

Gabon: Moanda-Franceville Rd (fl., fr. Sept.) *Breteler 6241* (LBV, WAG); 25 km NE of Assok (fl. Aug.) *Breteler & de Wilde 107* (LBV, WAG); Mouila (fl., y.fr.) *Le Testu 5051* (BM, P); Moubana (fl. Aug.) *Le Testu 5482* (BM, BR, P); 35 km SW of Doussala (fl., fr. May) *Reitsma et al.* 1021 (LBV, WAG).

Congo: Moutampa (fl. June) *Bouquet 165* (P); Brazzaville (fl.) *Chevalier 4008* (P); Batéké plateau (fr. Nov.) *Descoings 9837* (P); between Maya and Loukakou (fr. Nov.) *Descoings 11385* (P); Niari region (fl., fr.) *Thollon 974* (P).

Zaire: Kinshasa (fl. May) *Bequaert 7552* (BR, K); Kimuenza-Lukaya (fl. Dec.) *Breyne 14* (BR, K); Mayombe (fl.) *Cabra 30* (BR, type *M. cabrae*); Kiama (fr. April) *Callens 1701* (BR, K); Nyangwe (fl. Jan.) *Claessens 111* (BR, K); Bokote (fl. Dec.) *Dubois 315* (BM, BR, K); Lulonga (fl. July) *Dubois 511* (BR, K); Yalikungu (fl. Jan.) *Evrard 5472* (BR, K); Kwango-Wamba (fr. Aug.) *Germain 2569* (BR, K); 10 km Bengamisa Rd (fl. March) *Gilbert 2143* (BM, BR, K); Kakenge (fl. Dec.) *Gillardin 323* (BR, K); Sangaie (fl. Feb.) *Gillardin 501* (BR, K); Bosako (fl.) *Hulstaert 1031* (BR, K, WAG); Libenge (fl. Oct.) *Lebrun 1551* (BR, P); Gemena-Karaiva (fl. Dec.) *Lebrun 1882* (BR, K, P); Buta-Titule (fl. April) *Lebrun 2660* (BR, P); Niangara-Wamba (fl. June) *Lebrun 3217* (BR, P); Urenga (fl., fr. July) *Lebrun 5750* (BR, K); Kindu-Katakokbe (fl. Aug.) *Lebrun 6083* (BM, BR, K); Yangambi (fl., fr. Jan.) *Louis 945*, (fl., fr. Sept.) *Louis 2570*, (fl., fr. June) *Louis 4242* (fl., fr. Nov.) *Louis 6779* (fl. June) *Louis 10109* (fl. Nov.) *Louis 12816* (BM, BR, K, P); Mukenge (fr. Jan.) *Pogge 718*; fl. June) *Pogge 724*, (fr. Sept.) *Pogge 751* (K); Moand (fl. Aug.) *Schouteden 97* (BM, BR); Hemptinne St.Benoit (fr.) *Vanderyst 23637* (BR); (y.fr.) *Vanderyst 23682* (BR).

Angola: Saurimo (= Vila Henrique de Carvalho) (fl. April) *Exell & Mendonça 937* (BM, COI); Cabinda, Caio, Hombe, Lufu R. (fl., fr. Feb.) *Gossweiler 7792* (BM, COI, K, LISU); (fl. March) *Gossweiler 7805* (BM, BR, K); Cabinda, Chiluango R. (fl., fr. June) *Gossweiler 8109* (BM, COI, K); Congo, Zombo, Beie (fl. Feb.) *Gossweiler 13394* (LISC); Lunda, Dundo (fr. Oct.) *Gossweiler 13691 (13699?) (B, BM, K, P); (fl., fr. May) Gossweiler 14013* (K, LISC, P); Cabinda, Buca Zau-Chiaca (fl., fr. Aug.) *Monteira et al. 209* (BM, COI, LISC); (fl. Aug.) *Raimundo et al. 227* (LISC); Uige, Quimbele e Icoca (fr. Aug.) *Raimundo et al. 827* (BR, LISC).

Cult.: Seedlings, *de Koning 5453* (WAG).

Note: *M. expansa* has the largest distribution and also the greatest variation of all species of *Manotes*. The variation in the indumentum of most parts of the plant throughout the area is remarkable. The farther from the equator the plant grows, the more hairy it usually is. The synonym *M. longiflora* for example represents the hairy types at the north side of the distribution area of *M. expansa* from Ivory Coast to the Central African Republic. At the south side this tendency is less clear, but there *M. expansa* meets its hairy relative *M. lomamiensis*. Striking differences are observed in different areas, in W Africa there is less variation between plants from Sierra Leone and Nigeria than there may be between two plants from nearby localities within Zaire or Gabon.

Manotes griffoniana Baill. **Fig. 15, 141, 142, 144, 145**

M. griffoniana Baillon, 1867: 244; Baker, 1868: 460; Schellenberg, 1910: 19; 1938: 58 p.p. except *Dewèvre 434*, *Gossweiler 7792,7805*, and *8109*, and *Thollon 974* (see under *M. expansa*) and *Thollon 895* and *1278* (see note under *M. soyauxii*); Troupin, 1952: 74 p.p. except *De Giorgi 219* and *Gillardin 213* (see note under *M. lomamiensis*); Exell, 1954: 140.

Type: Gabon, Pyrat, *Griffon 292* (holo: P).

M. tomentosa Gilg, 1891b: 331; Schellenberg, 1910: 19. Type: Gabon, Sibange, near Libreville, *Soyaux 432* (holo: B†; lecto: K; iso: Z).

M. laurentii De Wildeman, 1905: 90; Schellenberg, 1938: 57 p.p. (except *De Giorgi 219* see *M. lomamiensis*). Type: Zaire, border of Pioka R., *Laurent s.n.* (holo: BR).

M. tessmannii Schellenberg, 1919: 443; 1938: 56. Type: Cameroun, Akonangi in Campo area, *Tessmann s.n.* (holo: B†); Cameroun, near Zingui, 20 km WSW of Ebolowa, *Letouzey 10290* (neo: P).

M. zenkeri Gilg ex Schellenberg, 1910: 19; 1919: 444; Hutchinson, 1928: 517; Schellenberg, 1938: 57; Hepper, 1958: 747; Burkill, 1985: 524. Type: Cameroun, Bipindi, *Zenker 896* (lecto: GOET; iso: E, P).

M. rosea Schellenberg, 1919: 445; 1938: 58. Type: Cameroun, Bebai in Campo area, *Tessmann 652* (holo: B†; lecto: K).

M. rubiginosa Schellenberg, 1919: 445; 1938: 57. Type: Angola, Cazengo, *Gossweiler 659* (holo: B†; lecto: K; iso: BM, P).

M. altiscandens Gilg, nomen in herbarium *Zenker* (*896*, GOET).

M. pruinosa auct.non Gilg, Schellenberg, 1938: 59 p.p.: *Tilman 79* and *Verschueren 28*.

Branchlets with a usually dense indumentum of long hairs, lenticellate. *Petiole* 2.5-8.5 cm long; rachis 4-14 cm long, pubescent; petiolules 1-4 mm long; *leaflets* 7-13, ovate to elliptic, pubescent, base cordate to acute; apex acuminate; young leaflets pink; terminal leaflet 4.3-12 × 1.5-5 cm; lateral leaflets 1.9-12 × 0.9-4 cm. *Inflorescence* up to 40 cm long, pubescent. Flower buds with closed calyx at most 1-1.2(-1.7) × 1-1.2(-1.5) mm. *Pedicel* above the joint 0.5-2 mm long. Sepals (1.3-)1.7-2(-2.5) × (0.7-)1-1.2 mm, lanceolate, from greenish-white to dark red but usually pink. *Petals* 5.5-7.5 × 0.8-1.3 mm, reflexed, first white sometimes with with pink, later yellow. *Sepals* and petals with all three kinds

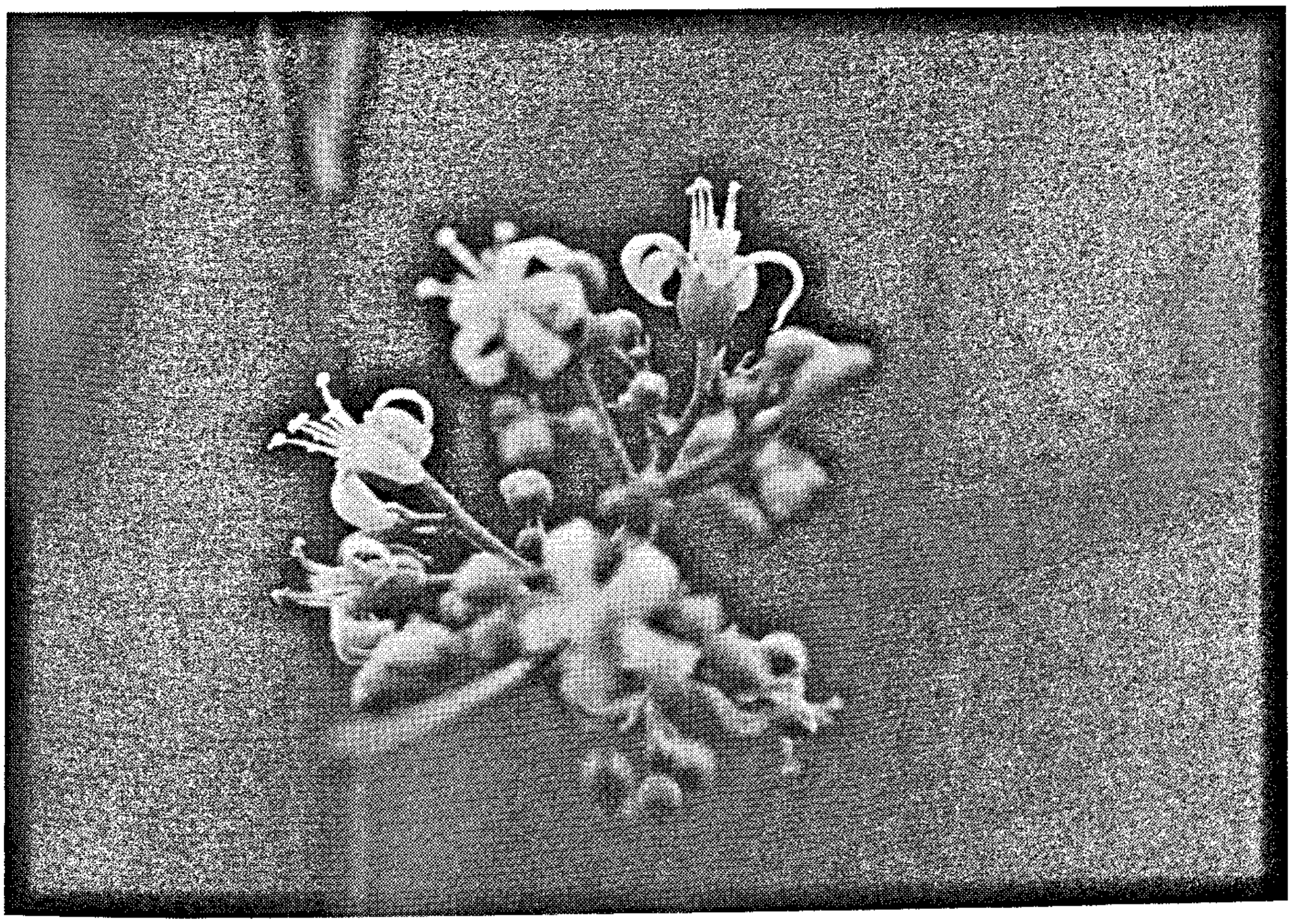


Fig. 144. *Manotes griffoniana*: flowers (*de Wilde & Jongkind 9589*; phot. C.C.H. Jongkind).

of hairs. Long *stamens* 3-6.5 mm, short stamens 1.5-4 mm long; filaments with glandular hairs and usually with globular hairs as well. *Pistil* 2-5.5 mm long, unequal to the stamens, ovary entirely covered with long hairs, style with glandular and globular hairs (already present in bud!). *Follicles* 1-5, up to 20 × 10 mm, orange-brown to red-brown, with long hairs, globular hairs and sometimes with glandular hairs as well. *Seed* ca 10 × 5 mm; testa for the greater part fleshy and red, dorsal partly thin and black; endosperm dirty-white. *Seedling* epigeal; hypocotyl strongly elongated and densely pubescent; first pair of leaves opposite and often unifoliolate, membranaceous.

Distribution: From Nigeria eastward to Zaire and southward to Angola.

Ecology: Rain forest and gallery forest, observed and collected particularly at forest edges. From sea level up to 900 m alt.

Selection of the nearly 200 examined specimens:

Nigeria: Calabar (fl., fr. July) *Daramola 55183* (BR, K); Oban-Osomba (fl. March) *Latilo & Oguntayo 70551* (K, WAG); Bonny R. (fl., fr. Oct.) *Mann 508* (K, P); Calabar near Uquo (fl., fr. May) *Onochie 33155* (K, WAG); Eket distr. (fl.) *Talbot & Talbot 3125* (BM, K); Port Harcourt (fl., fr. July) *Timmerman 13* (L, WAG).

Cameroun: Bitye (fl.) *Bates 1077* (BM, MO, Z); Kribi (fl. Nov.) *Bos 3243* (BR, K, P, WAG); Longii (fl. March) *Bos 4104* (BR, K, P, WAG); Bertoua (fl. March) *Breteler 1190* (BR, K, M, P, WAG, Z), (fl., fr. July) *Breteler 1677* (BR, K, M, P, WAG); Bimba (fl. April) *Breteler 2814* (BR,

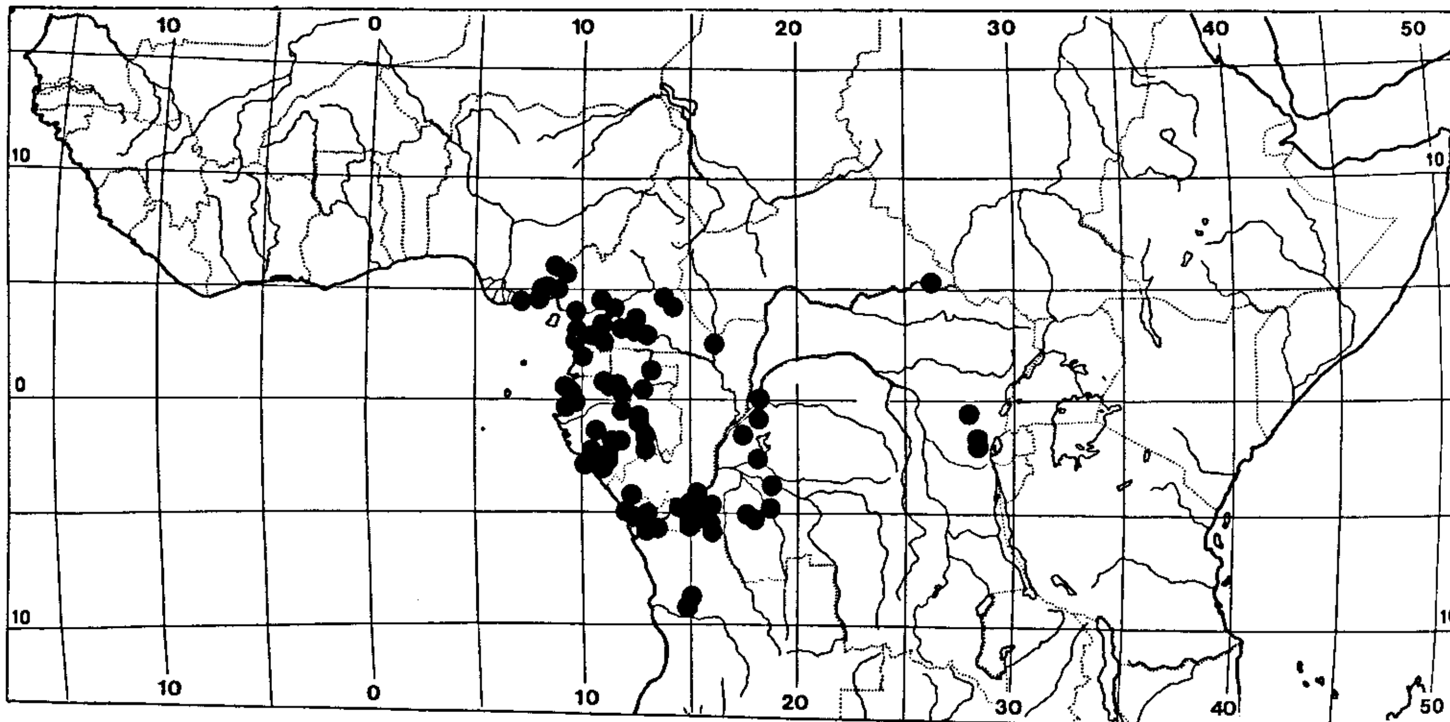


Fig. 145. Distribution of *Manotes griffoniana*

K, P, WAG); 65 km SSW of Eséka, Nyong R. (fl., fr. June) *W.de Wilde 2747* (BR, P, WAG); (fr. July) *W.de Wilde 2850* (B, BR, K, MO, WAG); Bipindi (fl., fr.) *Zenker 1169* (BM, G, GOET, K, L, M, P, WAG, Z); (fl.) *Zenker 2996* (BM, BR, GOET, K, L, M, P, WAG, Z); (fl.) *Zenker 3106* (B, BM, BR, GOET, K, L, M, WAG, Z); (fr.) *Zenker 3198* (BM, BR, GOET, K, L, M, P, WAG, Z).

Central African Republic: Obo region, Zemio Rd (fl. Dec.) *Descoings 12251* (P); Sangha R. (fl. July) *Thomas & Fay 7271* (MO, WAG).

Equatorial Guinea: Bebai, Campo (fl. Nov.) *Tessmann 652* (K, type *M. rosea*).

Gabon: Gamba (fl. Sept.) *Breteler 5616* (WAG); near Libreville, 25 km on road to Kango (fr. Nov.) *Breteler 8537* (LBV, WAG); Ndendé (fl., fr. Dec.) *Descoings 6400* (P); Kerellé, Denis, Pyrat (fl.) *Griffon du Bellay 292* (P, type); near Libreville (fl., fr.) *Klaine 28b* (BM, K, P); 32 km SE of Sindara (fl., fr. Dec.) *Louis et al. 1299* (LBV, WAG); (fl. Dec.) *Louis et al. 1389* (LBV, WAG); Sibange, near Libreville (fl., fr. April) *Soyaux 432* (B, BR, K, P); Cap Esterias (fr. Sept.) *Villiers 323* (P).

Congo: Boko region (fr. Aug.) *de Neré 507* (P); Brazzaville-la Foulakari (fr. Feb.) *Descoings 9608* (P); Kitabi (fl.) *Lecomte s.n.* (P); Ogooué (fl.) *Leroy s.n.* (P).

Zaire: Lukengo (fr. Jan.) *Compère 1232* (BR, K); M'Vuazi (fl. Sept.) *Devred 321* (BR, K, P); Bikoro-Inongo (fl. Oct.) *Evrard 2671* (BR, K); Eala (fl., fr. Oct.) *J.Léonard 877* (BR, M, K); Eala (fl., fr. May) *Louis 1986* (BR, K, P); Mabali (fl. Oct.) *Thonnet 22* (BR, K); Kavumu-Walikale (fl. Sept.) *Troupin 4407* (BR, K, WAG); (fl., fr. Oct.) *Troupin 4500* (BR, K, WAG); (fl. Sept.) *Troupin 4540* (BR, K); (fl., fr. Nov.) *Troupin 4702* (BR, K, WAG); Kangu (fl. Oct.) *Vanderyst 26081* (BR).

Angola: Cuanza Norte, Quiage (fr. Feb.) *F.J.Cardoso 82* (COI); Cuanza Norte, Cazengo (fr.) *Gossweiler 659* (BM, K, P, type *M. rubiginosa*); Cabinda, Bélize (fl., fr. Nov.) *Gossweiler 7569* (BM, BR, COI, K, LISU); Golungo Alto, Mata de Quisucula (fl. Aug.) *Welwitsch 4639* (BM, COI, G).

Cult.: Seedlings, *Jongkind 688* (WAG), from seeds collected in Gabon, *Breteler 8537*.

Manotes lomamiensis Troupin **Fig. 141, 146**

M. lomamiensis Troupin, 1951: 366; 1952: 76.

Type: Zaire, district du Bas-Katanga, Kaniama, *Mullenders 2182* (holo: BR).

M. laurentii auct.non De Wildeman & Durand, Schellenberg, 1938: 57 p.p.: *De Giorgi 219*.

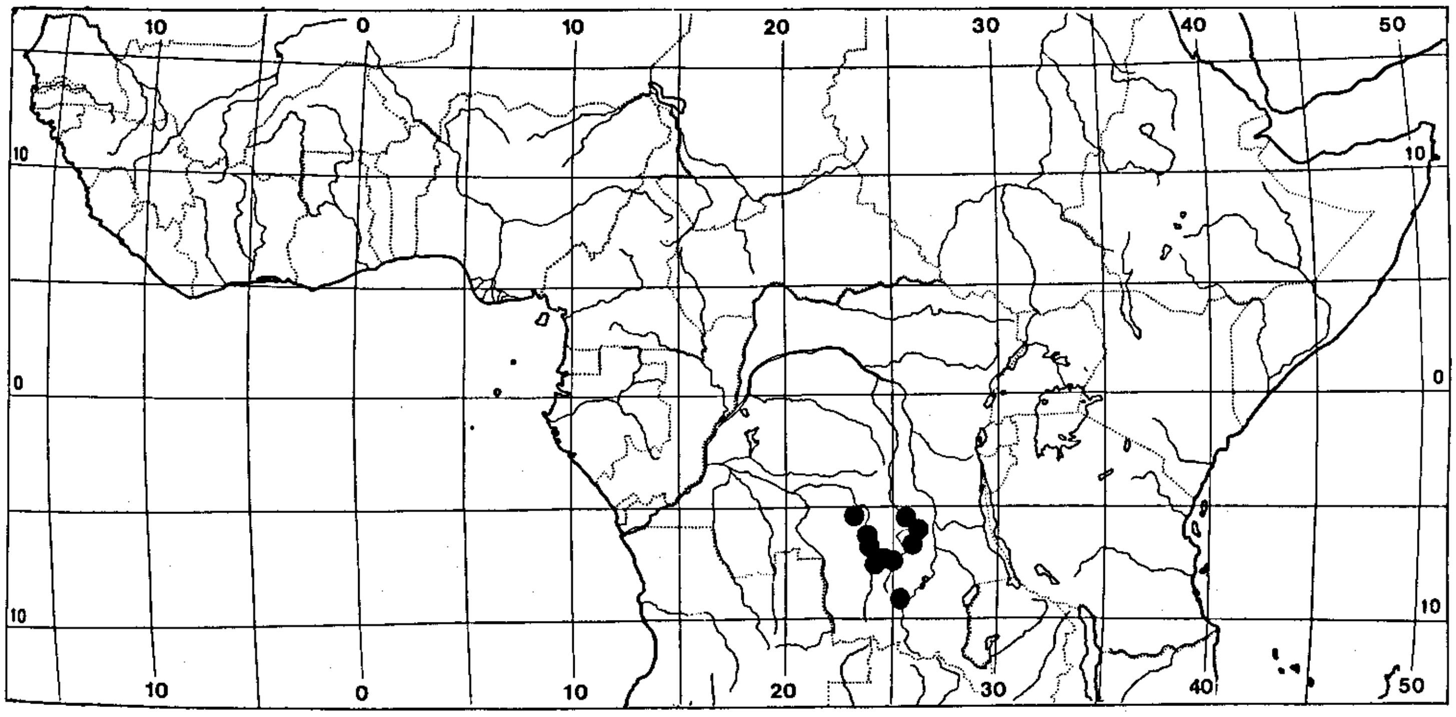


Fig. 146. Distribution of *Manotes lomamiensis*

M. griffoniana auct.non Baillon, Troupin, 1952: 74 p.p.: *De Giorgi 219* and *Gillardin 213*.

Branchlets with a dense indumentum of long hairs. *Petiole* 1.5-5.5 cm long; rachis 7-11 cm long, hairy; petiolules 1-4 mm long; *leaflets* 9-13, ovate to elliptic, pubescent, base cordate to acute, apex acuminate; terminal leaflet 6-9.5 × 1.8-4 cm; lateral leaflets 2.9-8.5 × 1.8-4 cm. *Inflorescence* up to 35 cm long, pubescent. Flower buds with closed calyx up to 1.7-2.3 × 1.5 mm. *Pedicel* above the joint 1-3 mm long. *Sepals* lanceolate, (1.5-)2-3 × 0.8-1.2 mm. *Petals* narrowly elliptic, 7.5-8.5 × 0.8-1.2 mm. Sepals and petals frequently with all three kinds of hairs. Long *stamens* 3-6 mm, short stamens 1.5-4 mm long; filaments with glandular hairs and usually with globular hairs. *Pistil* 2-5.5 mm long, unequal to the stamens, with glandular hairs and, on the ovary, also with long hairs; ovary soon after fertilization covered with many globular hairs. *Follicles* 1-5, up to 20 × 10 mm, beaked, covered with a mixture of all three kinds of hairs. *Seed* ca 10 × 5 mm.

Distribution: S Zaire.
Ecology: Gallery forest.

Specimens examined

Zaire: Lukelenge (fl. Oct.) *De Giorgi 219* (BR); Yambo forest, E of Kaniama (fr. July) *Delvaux 341* (BR); 75 km of Kaniama, Kaniama-Bukama Rd (fr. July) *Delvaux 370* (BR); Kabalo Terr., Tendy (fr. July) *Delvaux 429* (BR); Kasai, Gandajika (fl. March) *Devred 3984* (BR); Bilala (fl., fr. Feb.) *Gillardin 213* (BR); Yamba (fl. May) *Herman 2323* (BR); Kaniama, Haut Lomami (fr. Sept.) *Mullenders 1072* (BR, M, P); (fr. Aug.) *Mullenders 2182* (BR, type); Sentery Terr., Sangwa (fl. June) *Risopoulos 1095* (BR); Nakariba, Kabongo-Kongolo (fl. April) *Schmitz 1642* (BR).

Manotes macrantha (Gilg) Schellenb. **Fig. 147, 148**

M. macrantha (Gilg) Schellenberg, 1910: 18; Hutchinson, 1928: 517; Schellenberg, 1938: 62; Hepper, 1958: 747.

Basionym: *Dinklagea macrantha* Gilg, 1897: 242.

Type: Liberia, Grand Bassa, Fishtown, *Dinklage 1633* (holo: B; iso: BM, BR, E, G, Z).

Liana, mainly climbing by leaves modified to strong woody hooks. *Branchlets* velutinous, soon glabrescent. *Petiole* 5.5-10.5 cm long; rachis 4.5-11 cm long, almost glabrous; petiolules 2-5 mm long; *leaflets* 5-9, ovate to elliptic, cordate to subcordate at base, coriaceus, slightly hairy beneath, glabrous above; apex acuminate; terminal leaflet 10-18 × 3.5-6 cm; lateral leaflet 5.5-16.5 × 2.5-6 cm. *Inflorescence* up to 10 cm long, pubescent or glabrous, frequently in the axil of a hook-like modified leaf. Flower bud when the calyx lobes are about to open 3-3.5 × 2-2.5 mm. *Pedicel* above the joint 1-4 mm long. *Sepals* lanceolate, 4-5 × 1.5-2 mm, red, frequently with all three kinds of hairs. *Petals* with two lateral (glandular?) lobes, 5.5-8 × 1.5-1.7 mm, yellow, covered on both sides with glandular hairs. *Stamens* 3-6 mm long; filaments covered with glandular hairs. Short *pistils* ca 2 mm, long pistils ca 6 mm long, with short glandular hairs only. *Follicles* 1-5, up to 20 × 10 mm, thinly woody, minutely velutinous with short glandular hairs only, beaked. Sepals in fruit 8-10 × 2-4 mm, dark red. *Seed* ca 10 × 7 mm; testa totally fleshy and red.

Distribution: Liberia, W Ivory Coast and Gabon.

Ecology: Rain forest and gallery forest, observed and collected particularly in forest edges.

Specimens examined

Liberia: Ganta (fr. Nov.) *Adam 30188* (K); Sinoe Co: Duo (fl. March) *Baldwin jr.* 11360 (K, WAG); Duport (fr. April) *Bos 1888* (BR, K, P, WAG); Monrovia (fr. April) *Cooper 73* (K); Devilsbush, 15 km E of Monrovia (fl. March) *de Wilde & Voorhoeve 3624* (B, BR, K, P, WAG); Grand Bassa, Fishtown (fl., fr. April) *Dinklage 1633* (B, BM, BR, E, G, Z, type); (fr. Aug.) *Dinklage 1747* (B); Grand Bassa, *Dinklage 1804* (B); (fl., fr. July) *Dinklage 1965* (G, K, P); Monrovia (fl., fr. April) *Dinklage 2812* (B, HBG, P, WAG); 20 km NW of Harper (fl., fr. Aug.) *Hall 45560* (K); Sinoe to Port (fl. Jan.) *Jansen 1128* (WAG); 20 mls N of Buchanan (fl. Feb.) *Jansen 1902* (WAG); 7 mls N of Harper (fr. July) *Jansen 2400* (WAG); Devilsbush, near Payesville (fr. Aug.) *Leeuwenberg & Voorhoeve 4909* (B, BR, HBG, P, WAG); Porobush, Duport area (fl. March) *van Harten 360* (HBG, WAG); Devilsbush, Payesville (fr. July) *Voorhoeve 342* (WAG).

Ivory Coast: 50 km E of Sassandra (fr. April) *Leeuwenberg 4054* (B, BR, HBG, WAG).

Gabon: near Djidji, W of Koumameyoung, *Breteler et al. 8715* (LBV, WAG); Lopé Reserve (fr. Nov.) *Breteler 9012* (WAG, alc.!); Doudou Mts, W of Doussala (old fr. March) *de Wilde & Jongkind 9330* (LBV, WAG); Ogouoé-Ivindo Fauna Res. (fr. Nov.) *Louis 64* (LBV, WAG); near entrance Lopé Reserve, *Jongkind 702* (LBV, WAG); 45 km SW of Doussala (fr. Oct.) *Reitsma 1728* (WAG); Lopé Reserve (fr. Nov.) *Reitsma 2642* (WAG); NW of Mouila on road to Fougamou (y.fr. July) *Thomas 6507* (MO, WAG); St. Martin (fr. March) *A. Walker s.n.* (P, WAG).

Fig. 147. *Manotes macrantha*: 1. flowering branchlet, 2/3 ×; 2. leaflet, 2/3 ×; 3. detail of leaflet (see × in 2.), 4 ×; 4. flower, 4 ×; 5. flower partly, showing androgynophore, stamens, and pistils of a short-styled flower, 4 ×; 6. petal, showing two lateral lobes, 4 ×; 7. branchlet with fruits, 2/3 ×; 8. fruit, 2 ×. (1,4-6. *de Wilde 3624;* 2,3. *Leeuwenberg 4909;* 7,8. *Bos 1888*).

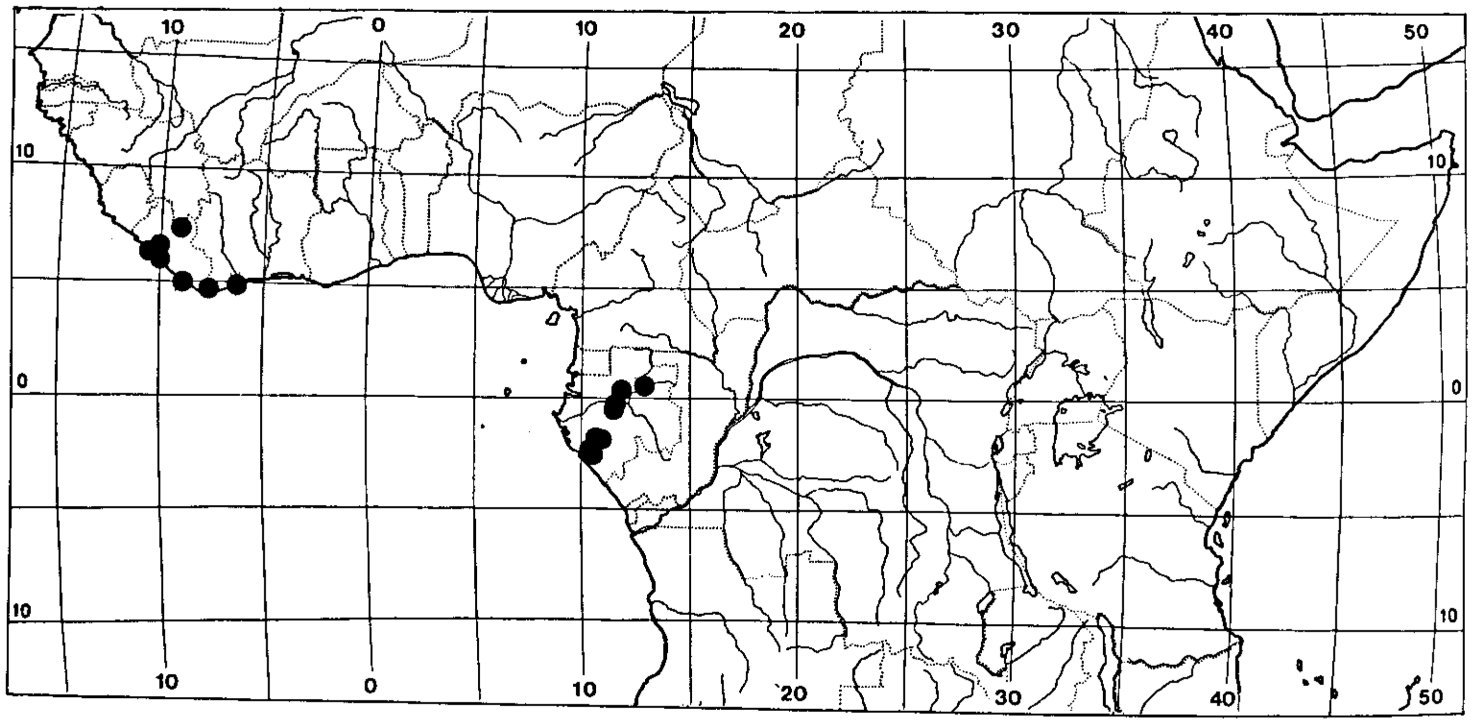


Fig. 148. Distribution of *Manotes macrantha*

Manotes soyauxii Schellenb. **Fig. 141, 149**

M. soyauxii Schellenberg, 1919: 446.
Type: Congo, Loango near Nanga, *Soyaux 120* (holo: B†; lecto: K)
M. griffoniana auct. non Baillon, Schellenberg, 1938: 58 p.p.: *Thollon 895* and *1278*.
M. pruinosa auct. non Gilg, Schellenberg, 1938: 59 p.p.: *Le Testu 1049* and *1061*, and *Soyaux 120*.

Branchlets with a long indumentum of long hairs. *Petiole* ca 4 cm long; rachis 7-12 cm, glabrous; petiolules 1-4 mm long; *leaflets* 9-13, ovate to elliptic, slightly pubescent or glabrous, base cordate to acute, apex acuminate; terminal leaflet 5-8.5 × 2-3.2 cm; lateral leaflet 1.1-7.5 × 0.8-2.5 cm. *Inflorescence* up to 27 cm long, pubescent to glabrous. Flower bud with closed calyx up to 2-2.5 × 1.5-1.7 mm. *Pedicel* above the joint 1.5-6 mm long. *Sepals* lanceolate 2.5-3 × 1 mm. *Petals* narrowly elliptic 7.5-9 × 1.2-1.4 mm. Sepals and petals frequently with all three types of hairs. Long *stamens* 3-6 mm; short stamens 1.5-4 mm long; filaments with glandular hairs and globular hairs as well. *Pistil* 2-5.5 mm long, unequal to the stamens, ovary with (short) glandular hairs and long hairs only or with globular hairs as well, style sith glandular hairs only. *Follices* with all three types of hairs.

Distribution: Cameroun, Gabon, Congo, and Zaire.

Specimens examined:

Cameroun: 13 km SW of Eséka (fl. March) *Leeuwenberg 5163* (B, BR, C, EA, K, LISC, MO, P, SRGH, WAG, YA).

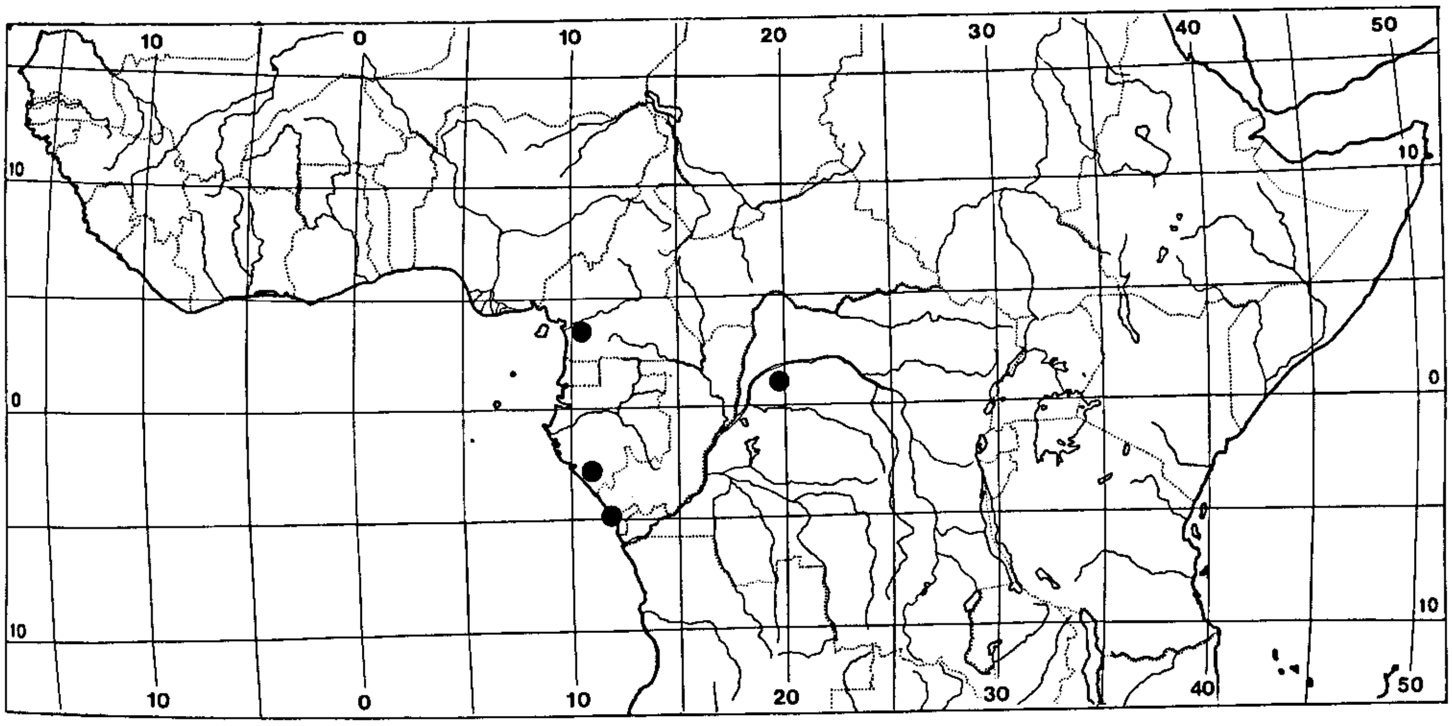


Fig. 149. Distribution of *Manotes soyauxii*

Gabon: Tchibanga (fl. July) *Le Testu 1049* (BM, P); (fl., y.fr. July) *Le Testu 1061* (BM, P); (fl., y.fr.) *Le Testu 2332* (BM).
Congo: Loango near Nanga (fl. Sept.) *Soyaux 120* (K, type); Alima R. (fl.) *Thollon 895* (P); Loango (fl., fr. Oct.) *Thollon 1278* (P).
Zaire: Basankusu-Bokakote Rd (fl., fr. Sept.) *Evrard 4812* (BR, K)

Note: The 8 specimens of *M. soyauxii* cited here all originate from an area where *M. expansa* and *M. griffoniana* occur together, and are all in one way or another intermediate between these species. It is felt that *M. soyauxii* is a hybrid between *M. expansa* and *M. griffoniana*. The fact that the specimens differ to such an extent from each other could be explained when they represent different hybridisation levels, e.g. F1, F2 and stages still farther away from the original species. The specimens of putative hybrid origin are outnumbered in the same area by the size of *M. expansa* and *M. griffoniana* populations.

Excluded species

Manotes asiatica Gagnepain, 1951: 207 = *Eurycoma longifolia* Jack (*Simaroubaceae*).
Manotes macrophylla Hiern, 1896: 190 = *Ostryoderris lucida* (Welw. ex Baker) Bak. f. (*Papilionoideae*).
Manotes palisotii Planchon, 1850: 439 (ill. name) = *Rourea thomsonii* (Baker) Jongkind.
Manotes racemosa (Don) Gilg, 1896: 215 = *Cnestis racemosa* Don.
Manotes staudtii Gilg, 1895b: 71 = *Connarus griffonianus* Baill.

Rourea Aublet

by C. C. H. Jongkind

History of the genus

Rourea was published in 1775 by Aublet with *R. frutescens* as the only species. Another three *Rourea* species were described prior to the publication of a short revision of the *Connaraceae* by Planchon in 1850. In this work Planchon added 24 new species or combinations from America, Asia, and Africa.

In 1867-1870 Baillon combined Planchon's genera *Roureopsis* and *Bernardinia*, and the genus *Byrsocarpus* of Schumacher with *Rourea*. This concept of *Rourea* is almost the same as that of the present revision. In treating *Rourea* in this large sense Baillon was followed by most taxonomists e.g. Baker, Hiern, De Wildeman, and initially also Gilg.

Later on Gilg, followed by Schellenberg, employed a much more narrow generic concept resulting in many new genera notably *Jaundea*, *Paxia*, *Santaloides*, *Santaloidella*, and *Spiropetalum*, all within the circumscription of *Rourea* sensu Baillon. In consequence of this, and because of the reinstalment of *Byrsocarpus* and *Roureopsis*, the name *Rourea* vanished from Africa and Asia. All these genera with narrow and unreliable generic delimitations caused confusion to such an extent that Schellenberg (1938) referred flowering material of *Rourea parviflora* to *Byrsocarpus parviflorus* (Gilg) Schellenberg and fruiting material of the same species to *Santaloidella gilletii* Schellenberg. This unsatisfactory situation culminated in the publication of the *Connaraceae* in Das Pflanzenreich in 1938 by Schellenberg.

In 1958 when Leenhouts treated the *Connaraceae* for Flora Malesiana he rejected many of the new genera and he accommodated the pertinent Asiatic species once more to the genus *Rourea*. Keraudren (1958) acted along the same lines for Madagascar in treating the former *Byrsocarpus orientalis* and *Santaloides gudjuana* as species of *Rourea*.

The main difference in the delimitation of *Rourea* between the present treatment, in accordance with Baillon, and that of Leenhouts, is that the latter work recognizes *Roureopsis* as a distinct genus.

Delimitation of the genus

Among *Connaraceae* with five-carpellate flowers *Rourea* is delimitated by the combination of the following characters: pinnate leaves (but occasional branches with exclusively unifoliolate- or trifoliolate- leaves may occur), no androgynophore, follicles rounded at base, not stipitate, glabrous inside, and seeds without endosperm.

Description of the genus

Rourea Aublet, 1775: 467 (nom. conserv.); Planchon, 1850: 413; Bentham & Hooker, 1862: 432; Baillon, 1867: 228; Baker, 1868: 455; Baillon, 1870: 18; Gilg, 1891a: 66; Schellenberg, 1910: 34, 37, 55; 1938: 194; Keraudren, 1958: 3; Leenhouts, 1958a: 143; 1958b: 510; Hutchinson, 1964: 166; Forero, 1976: 1; 1983: 138.

Type species: *R. frutescens* Aublet.

Byrsocarpus Thonning ex Schumacher, 1827: 246; Bentham & Hooker, 1862: 431; Baillon, 1867: 228; Baker, 1868: 451; Gilg, 1890: 66; Schellenberg, 1910: 34, 39, 117; 1938: 146; Troupin, 1952: 88; Hemsley, 1956: 15; Keraudren, 1957: 525; Hutchinson, 1964: 166; Mendes, 1966: 622; Mendes, 1969: 5; Liberato, 1980a: 12. Type species: *B. coccineus* Thonn. ex Schum. (= *Rourea coccinea* (Thonn. ex Schum.) Benth.).

Bernardinia Planchon, 1850: 412; Bentham & Hooker, 1862: 431; Gilg, 1891a: 65; Schellenberg, 1910: 57, 126; 1938: 100; Hutchinson, 1964: 165; Forero, 1983: 25. Type species: *B. fluminensis* (Gardn.) Planch. (= *Rourea fluminensis* (Gardn.) Jongkind).

Roureopsis Planchon, 1850: 432; Gilg, 1891a: 66; Schellenberg, 1910: 24-27, 105; 1938: 107; Troupin, 1952: 77; Hutchinson, 1964: 165; Leenhouts, 1958b: 505. Type species: *R. pubinervis* Planch. (= *Rourea emarginata* (Jack) Jongkind).

Taeniochlaena Hooker f., 1862: 433; Gilg, 1891a: 68; Schellenberg, 1938: 167. Type species: *T. griffithii* Hook.f. (= *Rourea acutipetala* Miquel).

Paxia Gilg, 1891a: 70; 1891b: 320; Schellenberg, 1910: 30, 111; 1938: 114; Troupin, 1952: 79; Hutchinson, 1964: 165. Type species: *P. scandens* Gilg (= *Rourea myriantha* Baill.).

Spiropetalum Gilg, 1891a: 70; 1891b: 335; Schellenberg, 1910: 31, 114; 1938: 103; Troupin, 1952: 127; Hutchinson, 1964: 169; Liberato, 1980a: 9. Type species: *S. odoratum* Gilg (= *Rourea solanderi* Baker).

Santalodes O.Kuntze, 1891: 154 nom.rej., see Hemsley & Bullock, 1956: 57.

Jaundea Gilg, 1894: 388; 1895b: 66; Schellenberg, 1910: 43; 1919: 457; 1938: 161; Troupin, 1952: 83; Hemsley, 1956: 19; Hutchinson, 1964: 166; Mendes, 1966: 627; Liberato, 1980a: 13. Type species: *J. zenkeri* Gilg (= *Rourea thomsonii* (Baker) Jongkind).

Santaloides Schellenberg, 1910: 35-37, 46-54, 119 (nom. conserv.); 1912: 246; 1938: 119; Hemsley, 1956: 13; Hemsley & Bullock, 1956: 57; Hutchinson, 1964: 166; Mendes, 1966: 622; Mendes, 1969: 8; Liberato, 1980a: 10. Type species: *S. minus* (Gaertn.) Schellenberg (= *Rourea minor* (Gaertn.) Alston).

Santaloidella Schellenberg, 1938: 118; Troupin, 1952: 80; Hutchinson 1964: 167. Type species: *S. gilletii* Schellenberg (= *Rourea parviflora* Gilg).

Lianas, shrubs or small trees. *Branches* cylindric or clearly lobed, often ending in a tendrilloid tip; wood of some species frequently with interxylary phloem. *Leaves* imparipinnate, occasionally with one leaflet only; leaflets opposite or subopposite, entire, symmetric or asymmetric, often mucronate. *Inflorescences* axillary, paniculate or racemose sometimes nearly globose, frequently more than one per axil of the sometimes rudimentary leaf, sometimes one or more together at the end of a leafy branch and resembling a terminal inflorescence. *Flowers* pentamerous, heterodistylous, sweet-scented; pedicel always with a distinct joint. *Sepals* free or almost completely connate, imbricate in bud, persistent and usually accrescent, sometimes strongly so, accrescent soon after pollination when the fruit is still very small. *Petals* as long as to much longer than the sepals, free or connivent near base, often lorate and inrolled or folded, white often with a trace of yellow or red, glabrous or with a few hairs apical. *Stamens* in two whorls, slightly united at base, the five stamens opposite the sepals longer than the five opposite the petals; filaments glabrous. *Carpels* five, free, glabrous to pilose. *Follicles* one to five per flower, ovate to elliptic with a rounded to acute apex or beaked, glabrous inside, glabrous or velutinous, and/or with glandular hairs outside, orange to red or (rarely) white, dehiscing by a ventral suture or more or less circumscissile at base. *Seed* solitary, rarely two per follicel, subovoid to ellipsoid; testa partly to almost totally fleshy, this part yellow to red; other part of the testa dark brown to black (sometimes red?) and shiny; hilum basal; endosperm absent in mature seed; cotyledons planoconvex, glabrous; radicle apical to ventral. *Seedlings* epigeal or hypogeal.

A circumtropical genus with forty to seventy species of forests and savannas. Most species are restricted to the tropical rain forest.

Note: The genera *Rourea* and *Roureopsis* sensu Leenhouts are here united. The main differences used to distinguish *Roureopsis* from the former were inrolled petals and sepals not imbricate in fruit. However, these characters are not exclusive. Inrolled petals are also found in *Rourea thomsonii* (the former *Jaundea* species) and the sepals of the fruiting calyx are not imbricate in many American species and often also not in *Rourea cassioides* (formely *Byrsocarpus cassioides*).

Leenhouts united the Asiatic *Taeniochlaena* with *Roureopsis*. His diagnosis for the combined genera needed only minor adjustments in order to accommodate the African *Spiropetalum* and *Paxia* as well. Hence these genera are also united with *Rourea* in the present paper.

Generic adjustments would have been necessary anyway, due to the discovery of the fruits of *Paxia calophylla* and *Paxia calophylloides* (*Rourea calophylla* and *Rourea calophylloides*). These fruits turned out to have a velutinous and a powdery indumentum respectively, while the other species of *Paxia* have glabrous fruits. The possession of glabrous fruits was one of the two characters separating *Paxia* and *Spiropetalum*.

Sectional arrangment

The subgenera and sections that were made for previous taxonomic treatments are not upheld in this revision because the genus concept changed much and also because they were often based on artificial characters (e.g. see note on *R. minor* pag. 341).

In this revision the genus is divided into five sections. They are described below and their species are enumerated. They are synonymous with one or more of the genera in Schellenberg's revision of 1938.

These sections are not very sharply delimitated one against the other but it is felt that they are rather natural entities which structure the variation in the important characters within the genus.

For the clustering of the American species see page 368.

Section **Bernardinia** (Planchon) Jongkind **comb. & stat. nov.**

Basionym: *Bernardinia* Planchon as genus.

Type species: *B. fluminensis* (Gardn.) Planch. (= *Rourea fluminensis* (Gardn.) Jongkind).

Small stomatal vestibule. Petals never inrolled. Fruit glabrous, usually more than one developed follicle per flower. Sepals in fruit only slightly accrescent and often reflexed. Testa fleshy for about 1/4. Radicle apical.

Species: *R. fluminensis.*

Distribution: America.

Section **Byrsocarpus** (Thonn. ex Schum.) Jongkind **comb. & stat. nov.**

Basionym: *Byrsocarpus* Thonning ex Schumacher as genus.

Type species: *B. coccineus* Thonn. ex Schum. (= *Rourea coccinea* (Thonn. ex Schum.) Benth.).

Synonym: *Jaundea* Gilg.

Small stomatal vestibule. Petals sometimes inrolled. Fruit glabrous, usually only one but sometimes two developed follicles per flower rarely more. Sepals clasping the base of the fruit, slightly accrescent. Testa in one species, R. coccinea, variable, for 1/4 to nearly entirely fleshy. In the other species always nearly entirely fleshy. Radicle apical or ventral.

Species: *R. cassioides, R. coccinea, R. orientalis, R. thomsonii.*

Distribution: Africa.

Section **Rourea**

Synonym: *Santaloidella* Schellenberg.

Small stomatal vestibule. Petals never inrolled. Fruit glabrous or sparsely hairy, usually only one developed follicle per flower. Sepals clasping the base of the fruit, slightly to strongly accrescent. Testa fleshy for about 1/4. Radicle apical.

Species: *R. accrescens, R. acropetala R. camptoneura* cluster, *R. frutescens* cluster, *R. gardneriana* cluster, *R. induta* cluster, *R. krukovii, R. martiana* cluster, *R. parviflora, R. pinnata, R. prancei, R. pubescens, R. revoluta* cluster, *R. suerrensis* cluster.

Distribution: Africa, America, Asia.

Section **Roureopsis** (Planchon) Jongkind **comb. & stat. nov.**

Basionym: *Roureopsis* Planchon as genus.

Type species: *Roureopsis pubinervis* Planch. (= *Rourea emarginata* (Jack) Jongkind).

Synonym: *Taeniochleana* Hook. f.; *Paxia* Gilg; *Spiropetalum* Gilg.

Large stomatal vestibule. Petals inrolled. Fruit glabrous, velutinous, or with an indumentum of glandular hairs only. One or one to five follicles per flower. Sepals not clasping the fruit, often strongly accrescent. Testa for about 1/4 fleshy. Radicle apical or ventral.

Species: *R. acutipetala, R. asplenifolia, R. calophylla, R. calophylloides, R. confundens, R. dictyophylla, R. emarginata, R. erythrocalyx, R. myriantha, R. obliquifoliolata, R. solanderi, R. stenopetala.*

Distribution: Africa, Asia.

Section **Santaloides** (Schellenb.) Jongkind **comb. & stat. nov.**

Basionym: *Santaloides* Schellenberg.

Type species: *Santaloides minus* (Gaertn.) Schellenb. (=*Rourea minor* (Gaertn.) Alston).

Synonym: *Rourea* subg. *Palliatus* Leenh.

Small stomatal vestibule. Petals never inrolled. Fruit glabrous, usually one developed follicle per flower. Sepals clasping the base of the fruit, slightly accrescent. Seed entirely enveloped by the sarcotesta which is for the greater part free from the seed. Radicle more or less apical.

Species: *R. balansea, R. fulgens, R. harmandiana, R. minor, R. mimosoides, R. prainiana, R. radlkoferiana, R. rugosa.*

Distribution: Africa, Asia.

General key for the African species mainly based on fruiting material.

1a Fruit velutinous. . . . . –2
 b Fruit glabrous or nearly so or with a powdery indumentum of glandular hairs only. . . . . –3
2a Calyx lobes 1-1.5 times as long as wide, unequal in shape. . **R. solanderi**
 b Calyx lobes 2-4 times as long as wide, equal in shape. . . **R. calophylloides**
3a Fruit covered with a powdery indumentum of glandular hairs. . . . . **R. calophylla**
 b Fruit glabrous or nearly so. . . . . –4
4a Radicle more or less apical. . . . . –5
 b Radicle distinctly ventral. . . . . –8
5a Testa for ca one third fleshy, yellow to scarlet, other two third thin, maroon to almost black and shiny. . . . . **R. parviflora**

b Testa almost completely fleshy, yellow to scarlet, if not then the thin dark-coloured part almost completely covered by the free part of the sarcotesta. . . . . –6
6a Sarcotesta for an important part free from the seed. . . . . . . **R. minor**
b Sarcotesta completely united with the seed. . . . . –7
7a Branches without lenticells or distinct cork layer. Leaflets asymmetrical at base. Inflorescences on a leafy branch. . . . . **R. cassioides**
b Branches with lenticells and/or distinct cork layer. Leaflets symmetrical at base. Inflorescences usually in the axil of deciduous leaves. **R. orientalis**
8a Petiole 0-0,5 cm. Leaves pinnate. . . . . **R. obliquifoliolata**
b Petiole distinctly longer, or leaves unifoliolate. . . . . –9
9a Sepals 6-12 mm long, not appressed in fruit. . . . . –10
b Sepals 2-4 mm long, clasping base of fruit (not always appressed when dry). . . . . –11
10a Inflorescence up to 5 cm long. Apex of the leaflets long-acuminate; acumen emarginate (e.g. fig. 161.1). . . . . **R. erythrocalyx**
b Inflorescence usually longer than 5 cm. Apex of the leaflets acuminate; acumen retuse to mucronate (fig. 165.2-165.4). . . . . **R. myriantha**
11a Apex of lateral leaflets acute to emarginate. . . . . **R. coccinea** subsp. **coccinea** var. **coccinea**
b Apex of lateral leaflets acuminate, or leaves unifoliolate. . . . . –12
12a Petals distinctly folded inward in bud, not imbricate. Leaflets in West and Central Africa with a prominent parallel tertiary nervation. In East Africa only in mountain forest (1200-3500 m alt.). . . . . **R. thomsonii**
b Petals imbricate in bud, at most slightly folded. Leaflets never with a pronounced parallel tertiary nervation. In East Africa only at low altitudes. . . . . –13
13a Deciduous, sometimes scandent, shrub. East Africa. . . . . **R. coccinea** subsp. **boiviniana**
b Usually evergreen liana or scandent shrub. Central and Eastern W Africa. . . . . **R. coccinea** subsp. **coccinea** var. **viridis**

Key to the African species based on flowering material

1a Petals lorate and inrolled particularly so in bud, not imbricate (fig. 167.3). . . . . –2
b Petals only slightly folding inward in bud, imbricate. . . . . –9
2a Petiole 0-0,5 cm long. Leaves pinnate. . . . . **R. obliquifoliolata**
b Petiole distinctly longer, or leaves unifoliolate. . . . . –3
3a Inflorescence and sepals outside covered by (sometimes small) multicellular glandular hairs. . . . . –4
b Inflorescence and sepals with an indumentum of ordinary hairs rarely mixed with a few glandular hairs. . . . . –5
4a Flower buds globose. Inflorescence densely covered by glandular hairs, obscuring its epidermis from view. . . . . **R. calophylla**

b Flower buds ellipsoid or ovoid. The glandular hairs on the inflorescence too small to cover its epidermis from view. . . . . **R. calophylloides**

5a Sepals distinctly hairy inside, at anthesis some of them for more than 2/3 of their length connate. . . . . **R. solanderi**

b Sepals (almost) glabrous inside, free to connate for less than 1/3. . . . . –6

6a At least some leaves with more than twelve leaflets. Branches without lenticells. . . . . **R. cassioides**

b All leaves with less than twelve leaflets. Branches usually lenticellate. . –7

7a Leaflets with a long acuminate apex; acumen emarginate. (fig. 161.1). Inflorescence up to 5cm. Pedicel very short, with a joint close to calyx. . . . . **R. erythrocalyx**

b Leaflets often shortly acuminate; acumen retuse to mucronate. Inflorescence often longer than 5 cm. Pedicel with a joint removed from the calyx. . . . . –8

8a Sepals elliptic-ovate, apex rounded-acute. Petals spiral in flower and bud. Filaments curved inwards (fig. 165.6). . . . . **R. myriantha**

b Sepals triangular-ovate, apex acute to acuminate. Petals usually only once folded inwards. Filaments straight or curved outwards (fig. 177.7). . . . . **R. thomsonii**

9a Carpels only hairy on their adaxial side. Leaflets (long) acuminate. . . . . **R. minor**

b Carpels hairy all around. Apex of leaflets acuminate or not. . . . . . –10

10a At least some leaves with more than twelve leaflets. . . . . –11

b All leaves with less than twelve leaflets. . . . . –14

11a Leaflets with an acuminate apex; acumen usually emarginate. Inflorescence up to 2 cm long. Old branches deeply furrowed. In rain forest. **R. parviflora**

b Apex of the leaflets emarginate to acuminate. Inflorescence often longer than 2 cm. Old branches never deeply furrowed. In forest and savanna. . . . –12

12a Branches without lenticells or cork layer. Inflorescences on immature leafy branches. . . . . **R. cassioides**

b Branches with lenticells and/or a distinct cork layer. Inflorescences on older branches. . . . . –13

13a Plant from Southern Africa, East Africa south of the equator, or Madagascar. Petals connivent near their base. Leaflets nearly symmetrical at base. . . . . **R. orientalis**

b Plant from all parts of tropical Africa except Madagascar. If from the same area as *R. orientalis* than petals not connivent and leaflets usually asymmetrical at base. . . . . **R. coccinea** subsp. **coccinea** var. **coccinea**

14a Lateral leaflets with an acute to emarginate apex. . . . . **R. coccinea** subsp. **coccinea** var. **coccinea**

b Lateral leaflets acuminate. . . . . –15

15a Decidous shrub (sometimes scandent). E Africa. . . . . **R. coccinea** subsp. **boiviniana**

b Liana or scandent shrub, usually evergreen. Central and Eastern W Africa. . . . . –16

16a Leaves with 5-19 leaflets; acumen usually emarginate. Inflorescence up to 2 cm long. Old branches deeply furrowed. . . . . **R. parviflora**
b Leaves with 1-7 leaflets; acumen never emarginate. Inflorescence sometimes longer. Old branches never deeply furrowed. . . . . **R. coccinea** subsp. **coccinea** var. **viridis**

Rourea calophylla (Gilg ex Schellenberg) Jongkind **comb.nov.** **Fig. 150, 151**

Basionym: *Paxia calophylla* Gilg ex Schellenberg, 1910: 31; 1919: 447; 1938: 115.
Type: Cameroun, Bipindi, *Zenker 1963* (holo: B; iso: BM, BR, G, E, GOET, K, L, M, MO, P, WAG, Z).

Large liana or shrub. *Petiole* up to 11 cm long; rachis up to 12 cm long; petiolules 2-6 mm long; *leaflets* 3-7, ovate to elliptic, usually with three to five long arching lateral nerves, glabrous, thinly coriaceous, acuminate at apex; terminal leaflet 8-22 × 3-10.5 cm; lateral leaflets nearly symmetrical, 5-19 × 3-10 cm. *Inflorescence* up to 20 cm long, with many striking reddish, glandular hairs. Flower buds globose. *Pedicel* above the joint 1-3 mm. *Sepals* 3-4 × 1-2 mm, outside covered with glandular hairs, inside with ordinary hairs. *Petals* 7-10 × 2-2.5 mm, lorate, inrolled in bud, free. Long *stamens* 1.8-5.5 mm long, short stamens 1-3.5 mm long; filaments curving inwards. *Pistil* 1.2-4.5 mm long; style glabrous or with some hairs; ovary pilose. *Follicles* one or two per flower, rarely more, ca 30 × 15 mm, beaked, covered with many reddish glandular hairs, dehiscing by a ventral suture. Sepals 5-7 × 3-4.5 mm in fruit, coriaceous. Seedcoat for ca one third fleshy; thin part of the testa probably very dark red and shining. Radicle ventral.

Distribution: E Nigeria, Cameroun, Gabon, Angola (Cabinda).
Ecology: Lowland rain forest.

Specimens examined:

Nigeria: S Bakundu N.A.F.R. (fl. Jan.) *Binuyo & Daramola FHI 35065* (K, P).
Cameroun: 60 km SW Eseka (y.fr. March) *Leeuwenberg 5101* (K, MO, P, WAG); Tisongo Lake (fl.b. Feb.) *Struhsaker 24* (K); Bipindi (fl.) *Zenker 1963* (B, BM, BR,G, GOET, K, L, M, MO, P, WAG, Z, type); (fl.) *Zenker 2177* (WAG); Bipindi (fl.) *Zenker 150* (C, L, U).
Gabon: Lalara-Makokou Road (fl. Sept.) *Breteler & de Wilde 490* (LBV, WAG); ca 24 km N of Koumameyoung, *Breteler et al. 8634* (LBV, WAG); near Djidji, W of Koumameyoung (fr. April) *Breteler et al. 8975* (LBV, WAG); Libreville, *Klaine 3319* (P); S of Medouneu, (fl. Sept.) *Leeuwenberg & Persoon 13576* (LBV, WAG); 40 km E S.E.F., Crystal Mts (fl., y.fr. Sept.) *Leeuwenberg & Persoon 13583* (LBV, WAG); Gwagnya (fl. March) *Le Testu 6415* (BM, BR, P, WAG); Kemboma (fl. Sept.) *Le Testu 8919* (BM, BR, P); near Oveng (fr. June) *Reitsma 1245* (WAG); (fr. Sept.) *Reitsma 1472* (WAG).
Congo: between N'Gongo and crossing Maamar (y.fr. May) *Sita 3764* (P).
Angola: Cabinda, Buca Zau, Chiaca (fl.b. June) *Monteiro & Murta 27* (LISC).

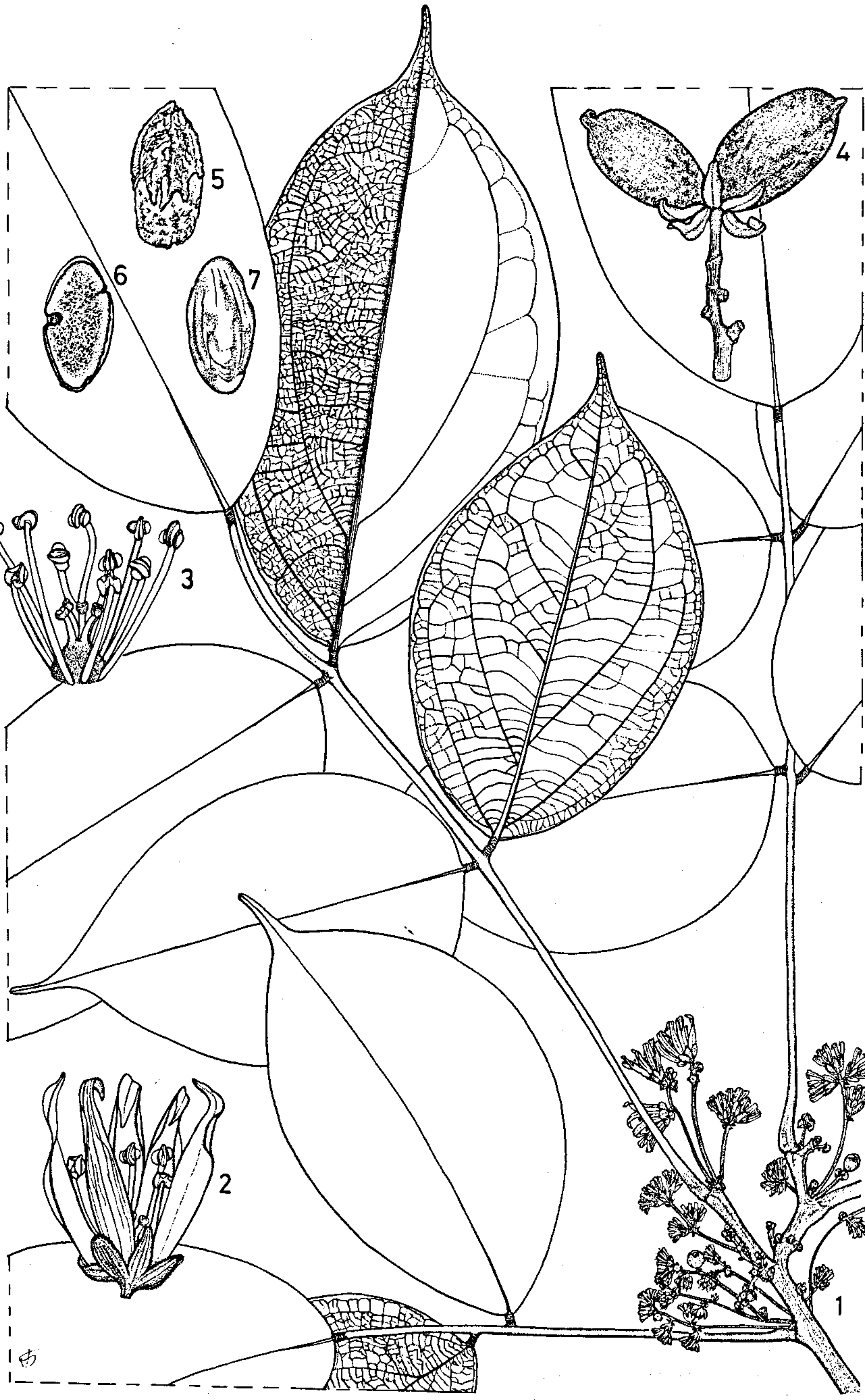


Fig. 150. *Rourea calophylla*: 1. flowering branchlet, 2/3 ×; 2. flower, 4 ×; 3. stamens and pistils of a short-styled flower, 6 ×; 4. fruit, 1 ×; 5. seed, 1 ×; 6. cotyledon inside with ventral radicle, 1 ×; 7. cotyledon outside, 1 ×. (1. *Zenker 1963*; 2-3. *Binuyo & Daramola FHI 35095*; 4-7. *Reitsma et al. 1472*)

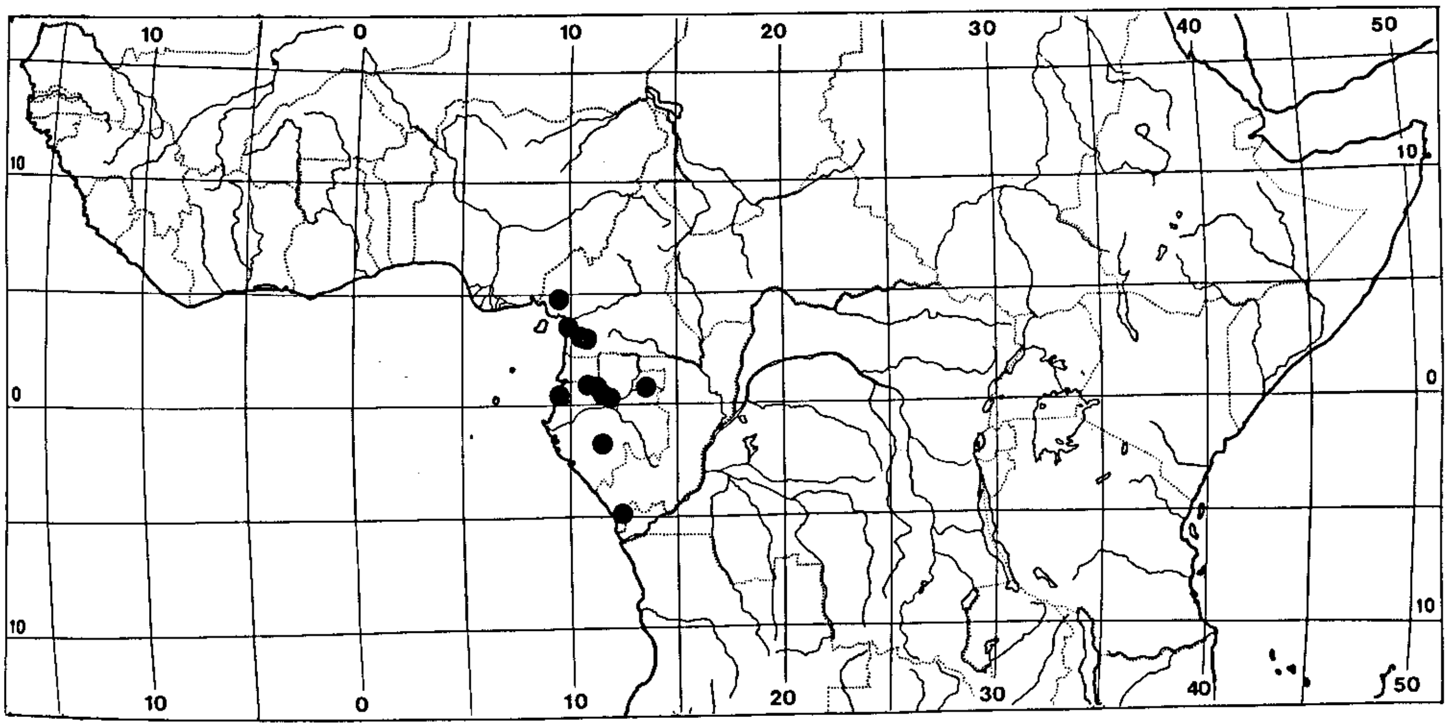


Fig. 151. Distribution of *Rourea calophylla*

Rourea calophylloides (Schellenberg) Jongkind **comb.nov.** **Fig. 152, 153**

Basionym: *Paxia calophylloides* Schellenberg, 1938: 115.
Type: Gabon, Tchibanga, *Le Testu 1735* (holo: BM; iso: P).

Large liana. *Petiole* up to 12 cm long; rachis up to 30 cm long; petiolules 2-6 mm long; *leaflets* 3-7, elliptic to obovate, glabrous, thinly coriaceous; apex acuminate; terminal leaflet 18-19 × 10-12 cm; lateral ones 10-12 × 6-10 cm. *Inflorescence* up to 10 cm long, with many small glandular hairs, often cauliflorous or subcauliflorous. Flower bud oblong. *Pedicel* above the joint 3-5 mm long. *Sepals* 5-9 × 2-3 mm, both sides with ordinary hairs, only outside with many small glandular hairs. *Petals* 12-13 × 1.5-2 mm, lorate, coherent near base, inrolled in bud, glabrous. Long *stamens* 3.5-6 mm long; short ones 2-4 mm long. *Pistil* 2-7 mm long; style with many hairs; ovary pilose. *Follicles* velutinous, beaked, dehiscing by a ventral suture, often more than one per flower. Sepals in fruit 6-9 × 2.5-4 mm, outside rather densely covered with glandular hairs. Testa for ca one fourth fleshy. Radicle ventral.

Distribution: S Gabon.
Ecology: Lowland rain forest.

Specimens examined.

Gabon: between Mouila and Yeno (fr. Sept.) *Breteler & Lemmens 8007* (LBV, WAG); 3 km along road from Moabi to Doussala (fr. Nov.) *de Wilde et al. 8943* (WAG); Tchibanga (fl. May)

Fig. 152. *Rourea calophylloides*: 1. flowering branchlet, 2/3 ×; 2. flower bud partly, showing the inrolled petals, 4 ×; 3. flower partly, showing the stamens and the pistils of a short-styled flower, 4 ×; 4. branchlet with young fruits, 2/3 ×; 5. young follicle, ventral side, 2/3 ×; 6. follicles, one showing seed, 2/3 ×; 7. empty follicles, 2/3 ×; 8. seed with sarcotesta (lower part), 2 ×; 9. cotyledon inside with the ventral radicle, 2 ×. (1-3. *Le Testu 6497*; 4-5. *Breteler et al. 8007*; 6-9. *J.de Wilde 8943*).

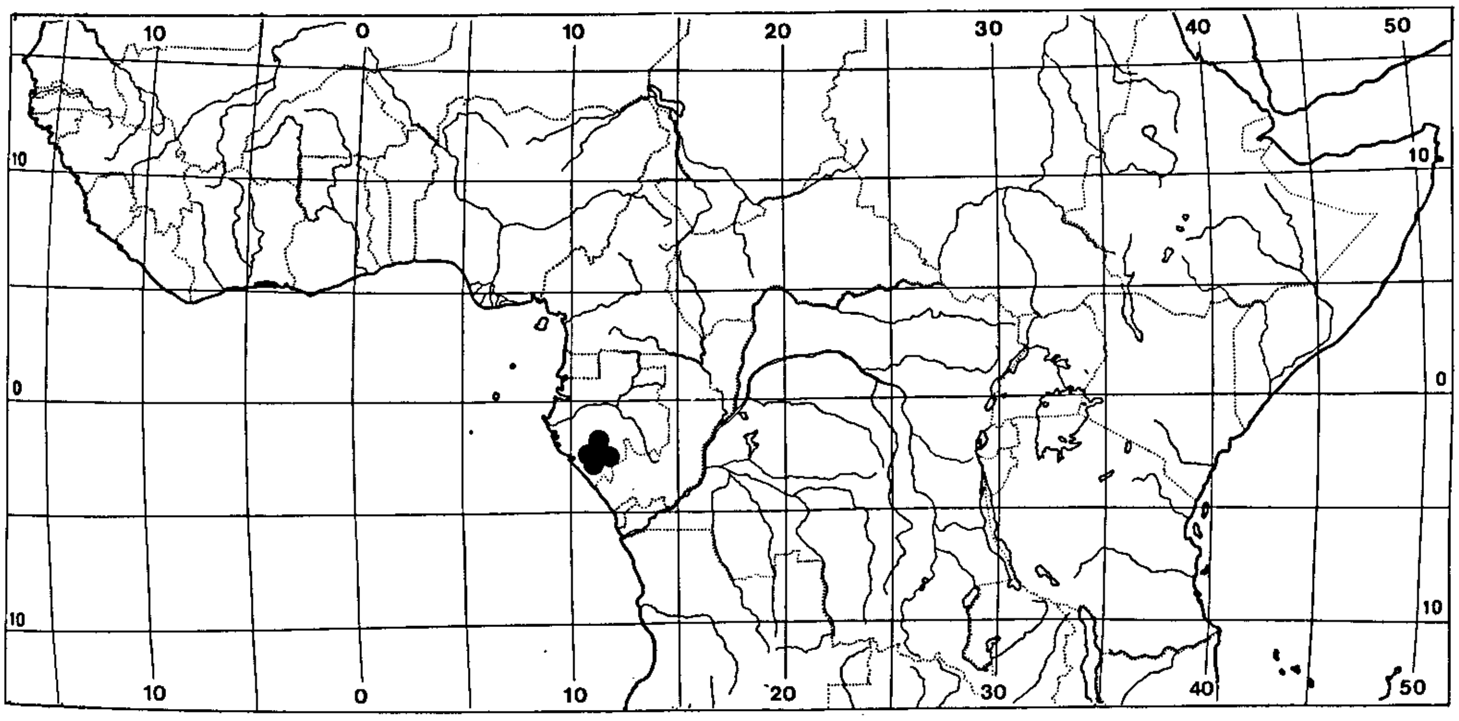


Fig. 153. Distribution of *Rourea calophylloides*

Le Testu 1735 (BM, P, type); Mourombo (fl. May) *Le Testu 5444* (BM, BR, LISC, P); Nzouna (fl. April) *Le Testu 6497* (BM, BR, P).

Note: This is the only species of *Rourea* in Africa with a narrow distribution.

Rourea cassioides Hiern **Fig. 154, 155**

R. cassioides Hiern, 1896: 187.
Type: Angola, Cuanza Norte, Mt Queta, *Welwitsch 4627* (holo: BM; iso: C, COI, G, K).
Byrsocarpus cassioides (Hiern) Schellenberg, 1910: 41; 1912: 243; 1938: 148; Troupin, 1952: 91; Exell & Mendonça, 1954: 150.

Liana. *Branches* glabrous, never lenticellate; branchlets puberulous. *Petiole* 2.5-4 cm long; rachis 7-35 cm long; petiolules 1-2 mm long; *leaflets* 13-31, glabrous to puberulous, chartaceous, papillate beneath; apex rounded; terminal leaflet oblong-ovate to elliptic, 3-7 × 1-3 cm; lateral ones strongly asymmetrical, elliptic to oblong, 1.4-7 × 0.8-2.5 cm. *Inflorescence* up to 6 cm long, puberulous, in the axil of immature or reduced leaf on developing shoots. *Pedicel* above the joint 1-3.5 mm long. *Sepals* 3-4 × 1.5-2.5 mm, puberulous outside, nearly glabrous inside. *Petals* 5-8 × 1.5-2 mm, free, top in bud sometimes distinctly folded. Long *stamens* 3.5-5.5 mm long, short ones 2.8-4.5 mm long. *Pistil* 1.5-4 mm long; style with some long hairs; ovary pilose. *Follicles* one per flower rarely more, 13-16 × 7-8 mm, symmetrical, with rounded top, glabrous, dehiscing by a ventral suture. Sepals in fruit 4-5 × 3-4 mm, with some scattered hairs

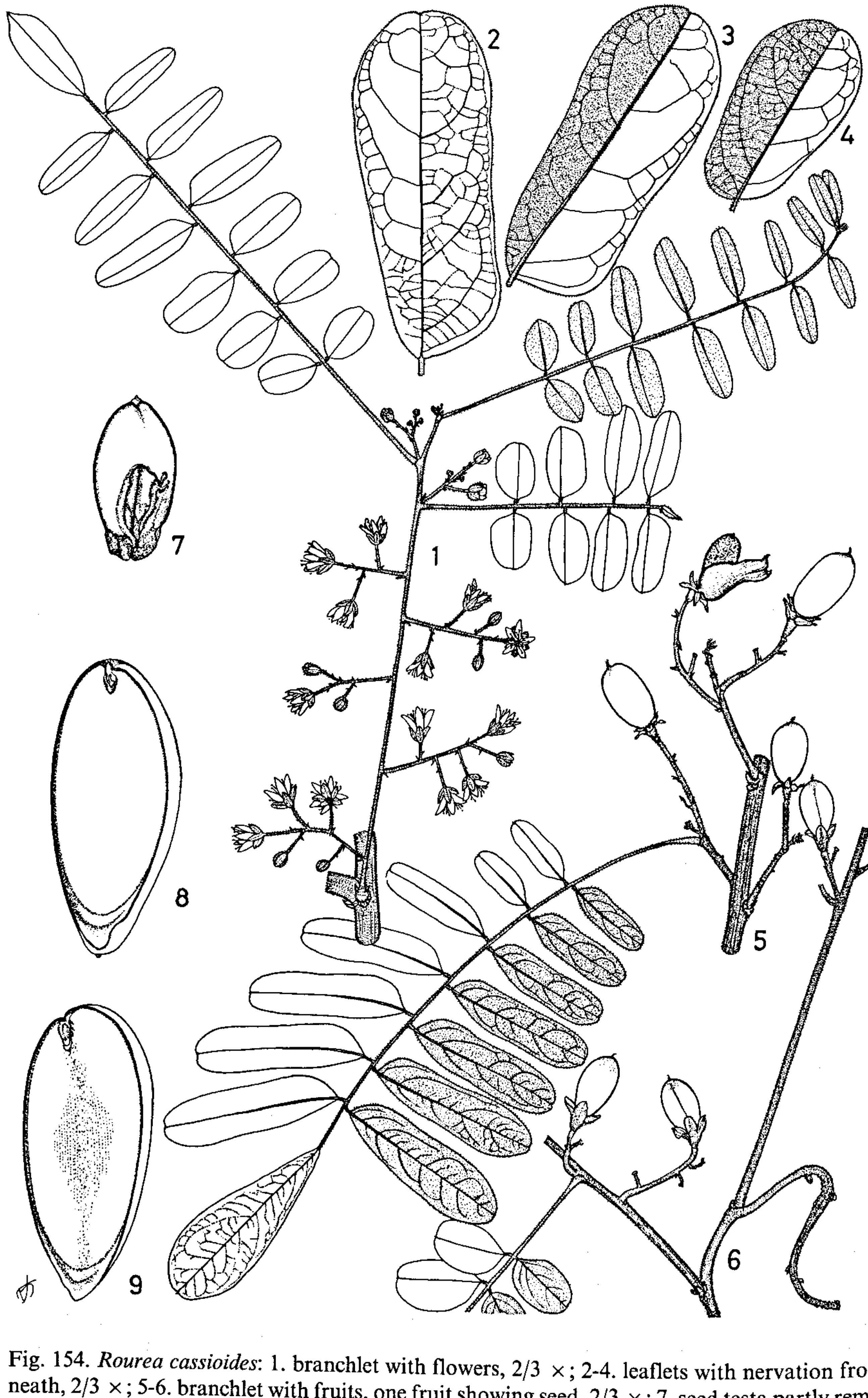


Fig. 154. *Rourea cassioides*: 1. branchlet with flowers, 2/3 ×; 2-4. leaflets with nervation from beneath, 2/3 ×; 5-6. branchlet with fruits, one fruit showing seed, 2/3 ×; 7. seed testa partly removed, cotyledons visible, 2 ×; 8-9. cotyledons with apical radicle, 4 ×. (1. *Breteler 1284*; 2-4. *Le Testu 4645*; 5. *Compere 1160*; 6-9. *W.de Wilde 2637*).

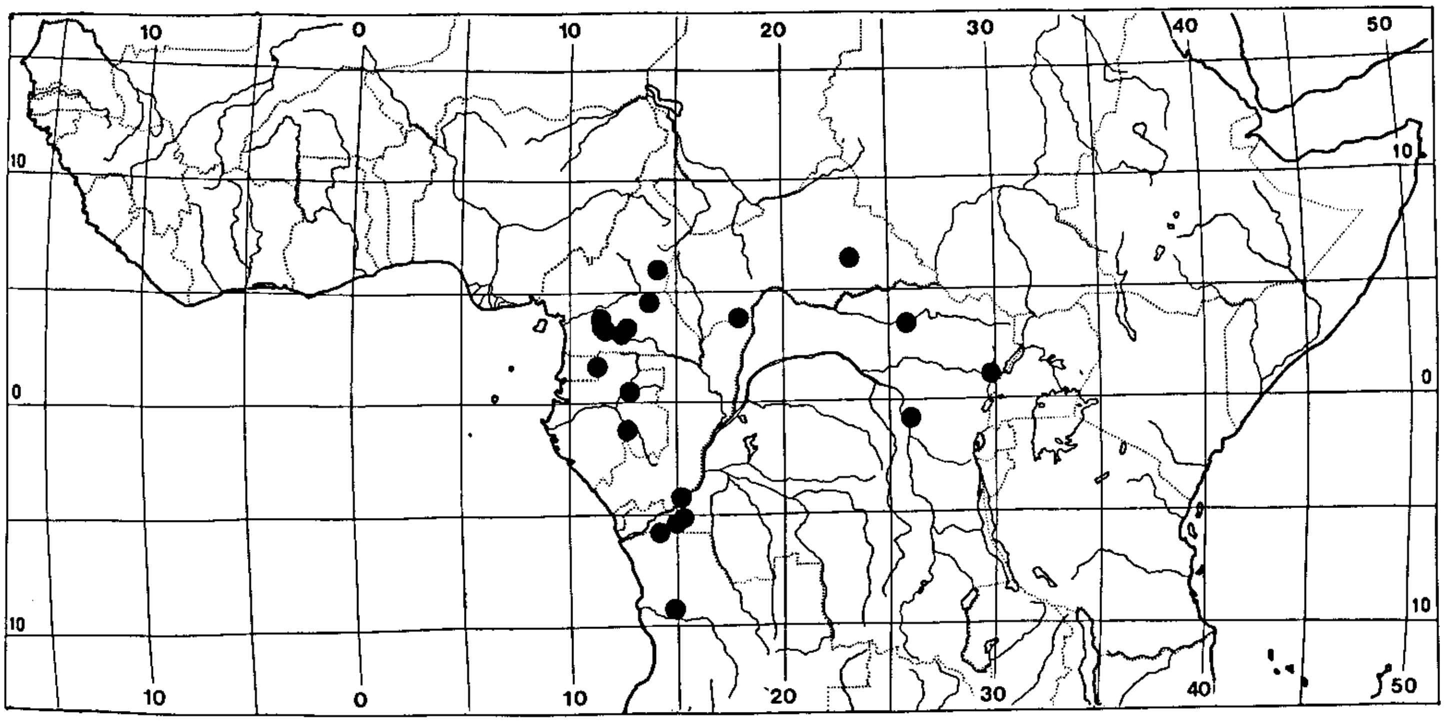


Fig. 155. Distribution of *Rourea cassioides*

outside. *Seed* with the radicle emerging at the apical end; testa entirely fleshy.

Distribution: Central Africa.
Ecology: Lowland rain forest.

Specimens examined:

Cameroun: 42 km SE Mbalmayo (fr. May) *Asonganyi 46* (P, YA); 69 km SE Akonolinga (fr. June) *Asonganyi 304* (P, YA); Bitye (fl.) *Bates 1652* (BM, MO); Bertoua (fl. April) *Breteler 1284* (BR, WAG); N'Kolbisson (fr. June) *W.de Wilde et al. 2637* (BR, MO, WAG); Ngoekele (Etang); (fr. Oct.) *Endengle 69* (P, YA); (fr. Nov.) *Endengle 82* (P, YA); Mbanga (fr. July) *Letouzey 2358* (P); 40 km E Mbalmayo (fr. March) *Letouzey 11344* (BR, P, WAG); N Lom R. (fl. April) *Mildbraed 8929* (K); Kongola-Mbussa (fl. April) *Mildbraed 9060* (K).
Central African Republic: Yalinga (fl. April) *Le Testu 4645* (BM, BR, P, WAG); Boukoko (fl. March) *Equipe Tisserant 1407* (BR, P, WAG); (fr. July) *Equipe Tisserant* 1529 (P).
Equatorial Guinea: sin. loc. (fl. April) *Tessmann 337* (K).
Gabon: 10 km S of Makokou, *Florence 2018* (P); Lopé Reserve, *Jongkind 707* (WAG); Moucwagnya (fl. April) *Le Testu 8732* (P, WAG); Abam (fl.) *Le Testu 9132* (BR, LISC, P).
Congo: Brazzaville, *M.J.de Brazza 240* (P).
Zaire: Lubutu-Kirundu (fr. Feb.) *Bequaert 6794* (BR); Songa (fl. Feb.) *Compère 892* (BR); Dembo (fr. Jan.) *Compère 1160* (BR); M'Vuazi (fl., fr. Sept.) *Devred 768* (BR); Bas-Uele (fl. March) *Dewulf 721* (BR); Bambesa (fr. June) *Gérard 5225* (BR); Mt Hoyo (fr. Aug.) *Lisowski 40462* (BR).
Angola: Cuanza Norte, Granja S.Luiz (fr.) *Gossweiler 5250* (BM, COI); Cuanza Norte, Queta Mts (fr. Dec.) *Welwitsch 4627* (BM, C, COI, G, K, type).

Rourea coccinea (Thonn. ex Schum.) Bentham **Fig. 156-160**

For literature, synonyms, and typification see under the subspecies and varieties.

Fig. 156. *Rourea coccinea* subsp. *coccinea* var. *coccinea*: 1. flowering branchlet, 2/3 ×; 4-5. branchlets with fruits, 2/3 ×; 6. seed, showing almost entirely fleshy testa, 4 ×.

Rourea coccinea subsp. *boiviniana*: 2. flowering branchlet, 2/3 ×; 3. leaflet, 2/3 ×. (1. *Latilo FHI 47131*; 2. *Jaasund 2625*; 3. *Torre & Correira 17053*; 4. *Hiepko et al. 286*; 5. *W.de Wilde 336*; 6. *Hiepko et al. 286*).

Liana or shrub. *Branches* lenticellate, cylindrical, sometimes with a distinct cork layer. *Petiole* 0.9-7.5 cm long; rachis 0-12 cm long; petiolules 0.5-5 mm long; *leaflets* 1-21, ovate to oblong or obovate, glabrous to pubescent, chartaceous to thinly coriaceous; apex emarginate to acuminate; terminal leaflet 1.6-15 × 1-8 cm; lateral ones symmetrical to strikingly asymmetrical, 0.7-10 × 0.6-5.5 cm. *Inflorescence* up to 11 cm long, few flowered, glabrous to pubescent. Pedicel above the joint 1-10 (-30) mm long. *Sepals* 1.5-4 × 1.5-3 mm, usually wider than long. *Petals* 6-11.5 × 1.5-3.5 mm, often coherent near base, imbricate and not folded in bud, apex emarginate to acute, sometimes with a few apical hairs. Long *stamens* 1.8-7 mm long, short ones 1.3-6 mm long. *Pistil* 1.7-9 mm long; style with a few to many hairs; ovary pilose. *Follicles* one or two per flower, rarely more, ellipsoid with a rounded or acute apex, 15-20 × 7-10 mm, glabrous, dehiscing by a ventral suture. *Seed* with the radicle ventral; testa for one quarter to entirely fleshy and orange to red, remaining part of testa if available black and shining; cotyledons green. *Seedling* hypogeal; hypocotyl not elongated, first two leaves opposite.

Distribution: West, Central, and East Africa, with a disjunction in East Africa. This disjunction separates subsp. *coccinea* in the West from subsp. *boiviniana* in the East (see fig. 160).

Key to the subspecies and varieties

1a Decidous (sometimes scandent) shrub, inflorescences and young foliage simultaneously on the bare shrub. Lateral leaflets 4-10, symmetrical or nearly so; apex acute to acuminate. East Africa. . **R. coccinea** subsp. **boiviniana**
b Decidous or evergreen shrub or liana. Lateral leaflets 0-20, symmetric to strongly asymmetrical; apex emarginate to acuminate. West, Central, and East Africa. . . . . **R. coccinea** ssp. **coccinea** –2
2a Lateral leaflets 0-6; apex acuminate. . . . . **R. coccinea** subsp. **coccinea** var. **viridis**
b Lateral leaflets 4-20; apex emarginate to acute. . . . . **R. coccinea** subsp. **coccinea** var. **coccinea**

Rourea coccinea (Thonn. ex Schum.) Benth. subsp. **coccinea** var. **coccinea** **Fig. 156, 157**

R. coccinea (Thonn. ex Schum.) Bentham, 1849: 290; Hiern, 1896: 186.
Basionym: *Byrsocarpus coccineus* Thonning ex Schumacher, 1827: 227; Planchon, 1850: 412; Baker, 1868: 452; Schellenberg, 1938: 148; Troupin, 1952: 91; Exell & Mendonça, 1954: 148; Hemsley, 1956: 17; Hepper, 1958: 741; Aubréville, 1959: 13; Irvine, 1961: 568; Mendes, 1966: 624; Adam, 1971: 866,867; Berhaut, 1975: 20; Liberato, 1980a: 12; Hall & Swaine, 1981: 139; de Koning, 1983: 279; Ern, 1984: 164; Burkill, 1985: 518.
Type: Ghana (Danish Guinea), sin. loc., *Thonning 19* (holo: C).

Byrsocarpus coccineus var. *parvifolius* Planchon ex Schellenberg, 1910: 41; Baker, 1868: 452. Type: Liberia, Cestos R., *Dinklage 1948* (holo: B).

R. inodora De Wildeman & Durand, 1899c: 71, fig. 36; 1899a: 17. Type: Zaire, Kembo, *Dewèvre 442* (holo: BR).

Byrsocarpus puniceus Thonning ex Schumacher, 1827: 227; Planchon, 1850: 412. Type: Ghana (Danish Guinea), sin. loc., *Thonning 14* (holo: C).

Byrsocarpus parvifolius Planchon, 1850: 412, nomen.

Byrsocarpus ledermannii Schellenberg, 1919: 451; 1938: 154. Type: Cameroun, Banjo, *Ledermann 2232* (lecto: B†). Neotype: Cameroun, Mayo Banyo, *Letouzey 8546* (holo: WAG; iso: P).

Byrsocarpus puberulus Schellenberg, 1938: 150. Type: Zaire, Kisantu, Kinanga, *Oddon* in *Gillet 1876* (holo: BR).

Byrsocarpus tisserantii Aubréville & Pellegrin, 1950: 59. Type: Central African Republic, Oubangui, Waka area, *Tisserant 257* (holo: P; iso: BM).

Byrsocarpus tomentosus Schellenberg, 1938: 151 (pro parte: only Angolan material!); Exell & Mendonça, 1954: 149.

Byrsocarpus astragalifolius A.Chevalier, nomen.

Shrub, rhizomatous shrublet or liana, often deciduous. *Branchlets* with lenticells in a contrasting colour, branches sometimes with a distinct cork layer. *Leaflets* 5-21, ovate to elliptic or angular-oblong; terminal leaflet 1.5-4 × 1-3 cm, with an emarginate to slightly acuminate apex; lateral leaflets symmetrical to strikingly asymmetrical, 0.5-4 × 0.5-3 cm, with an emarginate to acute (never acuminate) apex. *Inflorescences* up to 6 cm, in the axil of full-grown or deciduous leaves. Seed-coat partly to entirely fleshy.

Distribution: Most parts of Tropical Africa, but in E Africa only in W Tanzania.

Ecology: Savanna, savanna woodland, and secondary forest, from sea level up to 1250 m alt.

Selection of the more than 400 specimens examined:

Senegal: Niassia (fl. April) *Berhaut 5738* (P); Boudié Forest (fl.b. July) *Berhaut 6096* (P); Soutou (fr.) *Berhaut 7355* (P); Djibelor (fr. Sept.) *v.d. Berghen 6652* (BR).

Mali: near Kayes (fl., fr. May) *Legagneux s.n.* (L).

Guinea Bissau: Cacine (fr. Aug.) *Espirito Santo 621* (COI, LISJC); Cacine R. (fl. June) *Espirito Santo 2948* (LISC, LISJC, P, WAG); Bedanda Catanhez (fr. Sept.) *Alves Pereira 3159* (LISC).

Guinea: Macenta (fl. Feb.) *Adam 3742* (P); N'Zerekoré (fr.) *Adam 5222* (P); Dyeke (fr. Oct.) *Baldwin 9659* (K); Kaba valley (y.fr. May) *Chevalier 13131* (P); Friguiagbé (y.fr. May) *Chillon 392* (P); Benty (fl. June) *Jacques-Félix 1726* (P); Boké (fl. April) *Paroisse 53* (P); Konakry (fr. June) *Pobéguin 35* (P); Los isles (fr.) Pobéguin 1181 (P); Ziama Mts (fr. May) *Schnell 2654* (P).

Sierra Leone: Taiama (fr. Aug.) *Dawe 496* (K); Kowama (fr. Nov.) *Deighton 5250* (K); Kortright, Freetown (fl. April) *Gledhill 405* (B, K, WAG); Foria N.P. (fl. Feb.) *Gledhill 415* (K); Juba Peninsula (fl. May) *Morton SL1329* (K, WAG); Fourah Bay College, Freetown (fr. June) *Morton & Jarr SL2046* (K, WAG); Makéni (fl. April) *Roberty 171276* (G).

Liberia: Mt Nimba (fr. July) *Adam 28587* (WAG); Tubman bridge (fr. Sept.) *Barker 1409* (K); Cestos R. (fr. May) *Dinklage 1948* (B, type of *Byrsocarpus coccineus* var. *parvifolius*); Monrovia (fr. July) *Dinklage 3075* (Z); E of Harper (fr. July) *Jansen 2434* (WAG); Sinkor, Monrovia

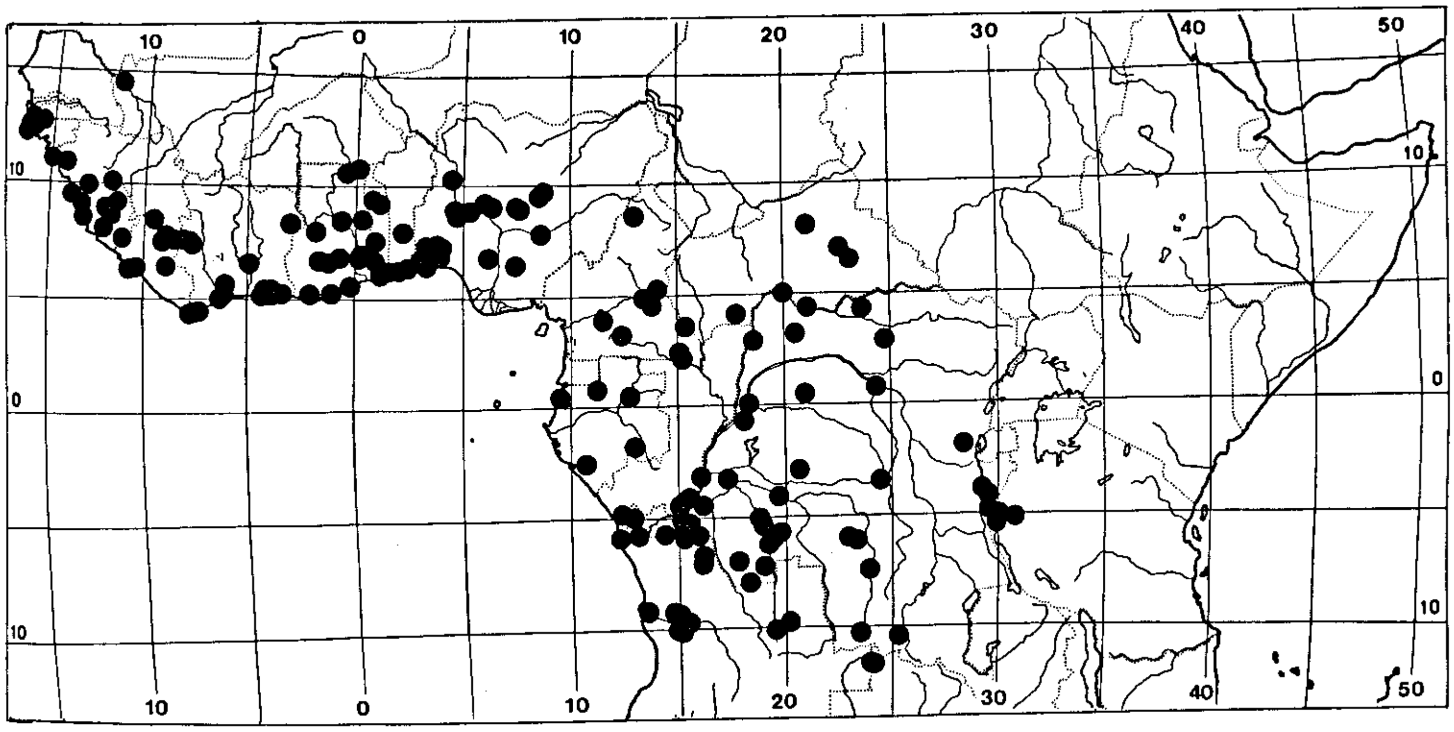


Fig. 157. Distribution of *Rourea coccinea* subsp. *coccinea* var. *coccinea*

(fl. March) *van Harten* 363 (WAG); 2 km W of Tappeta (fl., fr. Feb.) *van Meer 469* (WAG).

Ivory Coast: near Tabou (fr. April) *Breteler 7404* (WAG); km 116 on the Bouna-Bondoukou Rd (fl. March) *de Wilde & Leeuwenberg 3507* (B, BR, P, WAG); 17 km W of Abidjan (fl. Nov.) *Leeuwenberg 1923* (BR, WAG, Z); E of Béyo (fl. March) *Leeuwenberg 2930* (B, BR, L, P, WAG, Z); Mt Tonkoui (fl. March) *Leeuwenberg 2952* (BR, P, U, WAG, Z).

Ghana: Achimoto (fr. May) *Ankrah GC20173* (K); Kintampo N.P. (fr. July) *Chipp 525* (K); Kumasi Town F.R. (fr. March) *Cudjou 510* (H, WAG, Z); Tantara Hill near Dome Accra (y.fr. Feb.) *Enti FE2115* (MO, WAG); Gambaga (fl. March) *Hepper & Morton A3136* (K); Salaga (fl. Oct.) *Krause s.n.* (K); 1 km N of Salt Pond (fl. March) *Leeuwenberg 11162* (WAG); Konongo, Ashanti (fr. July) *Obeng-Darko 8031* (WAG); Achimota (fr. Nov.) *Roberty 12862* (G); Kpandu (fr.) *Rodenburg 31* (L).

Togo: Avétonou (fr. Sept.) *Breteler 7136* (B, WAG); Cacaveli (fl. Sept.) *Ern et al. 133* (B); Fosse aux Lions savanna (fr. Oct.) *Ern et al. 1702* (B); 3 km SW de Faille d'Aledjo (fr. Oct.) *Ern et al. 1980* (B); Adétikopé (fr. Nov.) *Ern 2361a* (B); Alédjo-Kadara (fl. Dec.) *Ern 2786* (B); 26 km NE of Aného (fr. April) *Hakki et al. 112* (B); Basser (fr. April) *Hakki et al. 370* (B); 8 km NE of Atakpamé (fr. Sept.) *Hiepko et al. 286* (B); 7 km E of Lomé (fr. May) *Jansen 2612* (WAG); NW Palimé (fr. Sept.) *Mathey et al. 129* (B).

Benin: Cotonou (fr. March) *Chevalier 4446* (P); Tohoué village (fl., fr. Jan.) *Chevalier 22798b* (P); Agouagou (fl. May) *Chevalier 23532* (P).

Nigeria: 50 mls S of Yelwa (fr. July) *Cook 313* (K); Wawagi F.R. (fl. May) *Eimunjeze & Adebusuyi FHI 69996* (K, WAG); Ibadan (fl. Feb.) *Emwiogbon FHI 47152* (WAG); Milliken Hill (fl., fr. July) *Latilo FHI 27610* (WAG); Nimbia F.R. (fl., y.fr. April) *Latilo FHI 47131* (K, WAG); Lagos, Isolo (fl., fr. March) *Leeuwenberg 11211* (WAG).

Cameroun: 10 km SW Ndemba (fr. May) *Breteler 2931* (P, WAG); Hoséré Gode (fr. July) *Fotius 2092* (K, P, YA); 7 km W of Yaounde (fr. Aug.) *Leeuwenberg 6041* (P, WAG); 65 km NNE of Moloundou (fl. March) *Letouzey & Villiers 10536* (BR, HBG, P, WAG); Bundi (fl. March) *Mildbraed 4682* (HBG, P).

Central African Republic: 35 km SE Boda (fr. June) *Badré 95* (P, WAG); Ndouka and Kouti Tèlé terr. (fl. May) *Chevalier 8247* (BR, G, L, P, WAG, Z); Ouadda area (fl. April) *Descoings 11059* (P); Parc Manovo, Gounda (fr. July) *Fay 7309* (BR, MO, P); Yalinga (fl.) *Le Testu 3844* (BR, P); (fl. Feb.) *Le Testu 4565* (BR, P); Waka area (fl., fr. Dec.) *Tisserant 257* (BM, P, type *Byrsocarpus tisserantii*).

Gabon: km 30 Moanda-Bakoumba, *Breteler 6749* (LBV, WAG); Corisco Bay (fl.) *Mann 1848*

(K, P); Oveng-Mitsic (fl. March) *Reitsma 735* (WAG); 20 km NE of Oveng (fr. June) *Reitsma 1226* (WAG); 30 km S of Doussala (fl. Oct.) *Reitsma 1740* (WAG).

Congo: Djoumouna Forest (fr. Oct.) *Bitsindou 6* (P); Brazzaville (fr. Dec.) *de Wit 6010* (WAG).

Zaire: Kimbuba (fr. Dec.) *Callens 3841* (BR, K); Nsafu Road (fr. Feb.) *Devred 1532* (BR); Befale-Tongote (fr. May) *Evrard 4147* (BR, K); Bolombo Eala (fl. Aug.) *Lebrun 1184* (BR, K); Banzyville (fl. Jan.) *Lebrun 2095* (BR, K); Eala (fl.) *Leemans 318* (B, BR); Tshibombo (fr. Nov.) *Liben 1933* (BR, K); N Bondo near Baye (fr. July) *Lisowski 50078* (BR, K); Yangambi (fl. April) *Louis 14554* (BR, C, K); 40 km NNW Kolwezi (y.fr. Feb.) *Malaisse & Robbrecht 2295b* (BR).

Angola: Cuanza Norte, Pungo (fl. Aug.) *da Silva 2129* (BR); Cazengo, Granja de S. Luis (fr.) *Gossweiler 5248* (BM, COI, LISU); Cabinda, Panga Mungo (fl.) *Gossweiler 6202* (BM, COI, LISU); Luanda, Musseque de Luanda (fl. Nov.) *Gossweiler 10512* (BM, COI, K, M); Lunda, Dundo (fl. Oct.) *Gossweiler 13699* (B, K); Cuanza Sul, Rosa Vianense-Calulo (fr. Jan.) *Raimundo et al. 645* (BR, LISC); Cuanza Norte, Golungo Alto (fl. Dec.) *Welwitsch 4624* (BM, COI, G); Lunda, Dundundo R. (fl.) *Young 478* (BM, BR, COI, LISC); Lunda, Saurimo (fl. Aug.) *Young 620* (BM, COI, LISC); Lunda, Alto Cuilo (fl. Sept.) *Young 694* (BM, COI, LISC).

Burundi: Kigwena mission (fl. Sept.) *Auquier 4132* (BR); Rumonge (fl. Jan.) *Reekmans 8550* (BR, K, WAG); Gitwe (fr. Jan.) *Reekmans 9572* (BR, K, WAG); Nyaunza (fl. Feb.) *Shantz 697* (K).

Tanzania: Gombe stream N.P. (fl. Oct.) *Morris Goodall 87* (EA); (fl. Oct.) *Morris Goodall 101* (EA); (fl. Nov.) *Morris Goodall 106* (EA); Uvinza, Malagarassi (fl.b. Feb.) *Peter 36169* (B); Uvinza, W Lugufu (y.fr. Feb.) *Peter 36572* (B); Kasakata (fr. March) *Suzuki 208* (EA); Kasakela Res. (fr. Nov.) *Verdcourt 3343* (BR, EA).

Zambia: S of Matonchi farm (fl. Nov.) *Milne-Redhead 3145* (BR, K); N of Dambo, NE of Dobeka bridge (fr. Dec.) *Milne-Redhead 3885* (BR, K).

Cult.: Seedlings, *de Koning 3821, 5953* (WAG).

Rourea coccinea (Thonn.ex Schum.) Benth. subsp. **coccinea** var. **viridis** (Gilg) Jongkind **comb.nov.** **Fig. 158, 159**

Basionym: *R. viridis* Gilg, 1891b: 327; De Wildeman, 1912: 406.

Type: Zaire, Mukenge, *Pogge 750* (holo: B†).

Neotype: Cameroun, Bipindi, *Zenker 248* (holo: WAG; iso: B, C, G, MO).

R. mannii Gilg, 1891b: 323. Type: Equatorial Guinea, Muni R., *Mann 1828* (holo: B†; lecto: K).

R. poggeana Gilg, 1891b: 326. Type: Zaire, Mukenge, *Pogge 748* (holo: B†; lecto: K).

R. unifoliolata Gilg, 1891b: 325. Type: Zaire, Mukenge, *Pogge 1626* (holo: B†). Neotype: Cameroun, near Bamekok, *Breteler 2831* (= *Letouzey 4775*) (holo: WAG; iso: B, HBG, K, P).

R. dinklagei Gilg, 1895b: 67. Type: Cameroun, Grand Batanga, *Dinklage 908* (holo: B†). Neotype: Cameroun, 40 km NW of Bertoua, *Breteler 2935* (holo: WAG, Z).

R. pallens Hiern, 1896: 188. Type: Angola, Cazengo, Cabondo, *Welwitsch 4629* (holo: BM).

R. foenum-graecum De Wildeman & Durand, 1899a: 18; 1899c: 75, fig. 38. Type: Zaire, Boma, *Dewèvre 424* (holo: BR).

R. ealensis De Wildeman, 1909: 91. Type: Zaire, Eala, *Pynaert 560* (holo: BR).

R. laurentii De Wildeman, 1909: 90, fig. 24. Type: Zaire, Bomange, *M.Laurent 1634* (holo: BR).

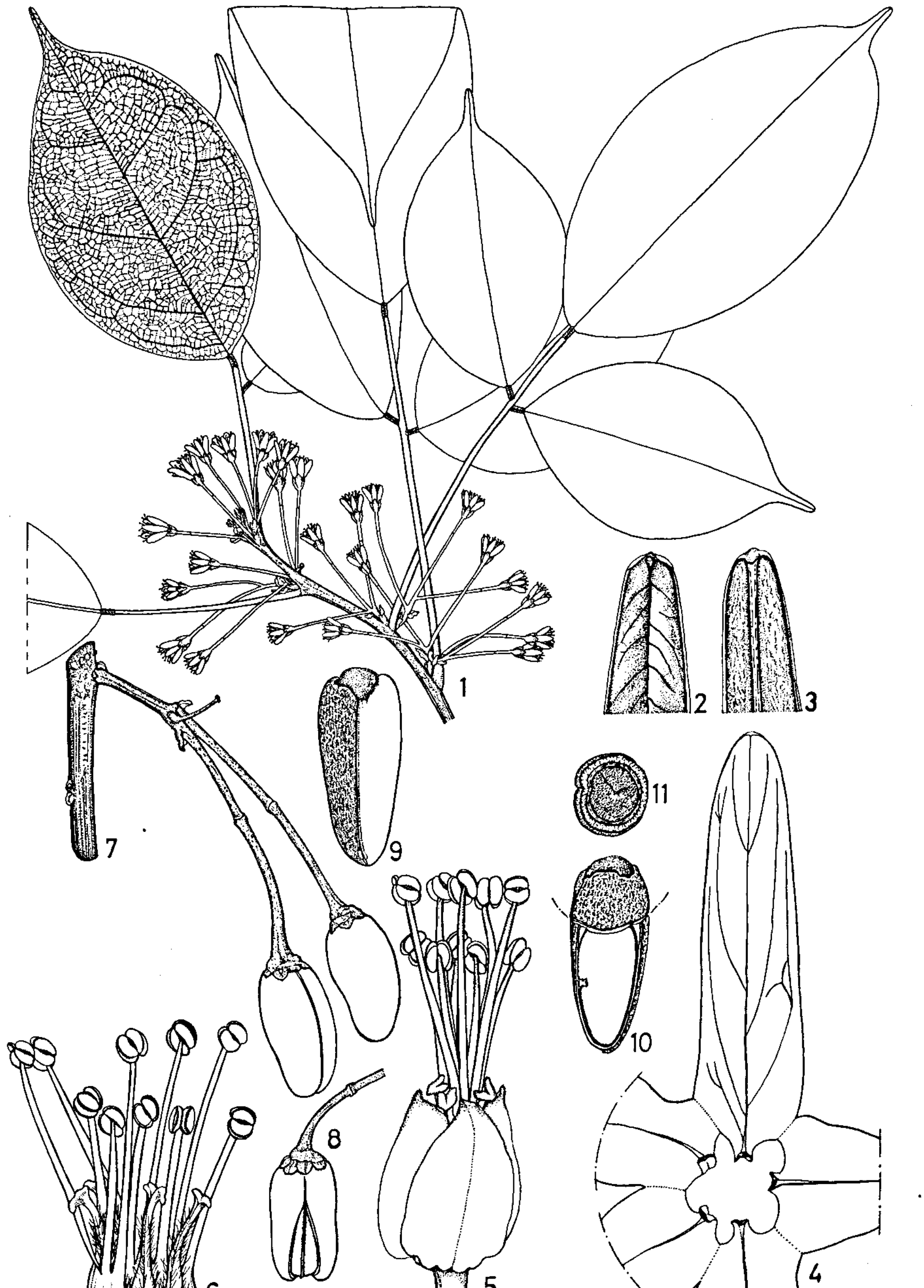


Fig. 158. *Rourea coccinea* subsp. *coccinea* var. *viridis*: 1. flowering branchlet, 2/3 ×; 2. acumen of leaflet from above, 8 ×; 3. acumen of leaflet from beneath, 8 ×; 4. petals (connivent near base), 12 ×; 5. flower petals removed, 8 ×; 6. stamens and pistils, 8 ×; 7. infructescence, 2/3 ×; 8. follicle opening by a ventral suture, 2/3 ×; 9. seed with an entirely fleshy testa, partly damaged (basal part accidently removed), 1 ×; 10. seed partly, one cotyledon partly removed, with dorsal radicle, 1 ×; 11. cross section of seed, showing fleshy testa, 1 ×. (1-6. *Breteler & de Wilde 691*; 7. *Bos 3291*; 8. *Breteler 2935*; 9-11. *A.Louis 1218*).

R. coriacea De Wildeman, 1911a: 258; 1912: 404. Type: Zaire, Lulonga-Coquilhatville, *Pynaert 746* (holo: BR).

R. zenkeri Gilg, nomen in herbarium *Zenker*.

Byrsocarpus viridis (Gilg) Schellenberg, 1910: 46; 1912: 245; 1938: 158; Troupin, 1952: 96; Exell & Mendonça, 1954: 150; Hepper, 1958: 741; Burkill, 1985: 519. Basionym: *R. viridis* (see above).

Byrsocarpus poggeanus (Gilg) Schellenberg, 1910: 45; 1912: 245; 1919: 453; 1938: 154; Troupin, 1952: 93, fig. 7; Hepper, 1958: 741; Burkill, 1985: 519. Basionym: *R. poggeana* Gilg (see above).

Byrsocarpus dinklagei (Gilg) Schellenberg, 1929: 544; 1938: 157; Troupin, 1952: 94. Basionym: *R. dinklagei* Gilg (see above).

Byrsocarpus foenum-graecum (De Wild.) Schellenberg, 1910: 41; 1912: 244. Basionym: *R. foenum-graecum* De Wildeman (see above).

Byrsocarpus coriaceus (De Wild.) Schellenberg, 1912: 401. Basionym: *R. coriacea* De Wildeman (see above).

Byrsocarpus laurentii (De Wild.) Schellenberg, 1912: 401; 1938: 157. Basionym: *R. laurentii* De Wildeman (see above).

Byrsocarpus papillosus Schellenberg, 1919: 453; 1938: 154. Type: Cameroun, between Sangmelima and Dja R., *Mildbraed 5507* (holo: B†; lecto: HBG).

Large liana or shrub. *Branches* rarely with a (thin) cork layer, branchlets glabrous and often green. *Leaflets* 1-5(-7), ovate to obovate, (nearly) glabrous; apex acuminate; terminal leaflet 4-15 × 2-8 cm; lateral ones 2-10 × 1.5-5.5 cm, nearly symmetrical. *Inflorescence* ca 2 cm long, but sometimes up to 11 cm long, usually in the axil of a full-grown leaf; branches often green. *Seedcoat* nearly always entirely fleshy.

Distribution: From Nigeria eastward to Central African Republic, southward to Angola.

Ecology: Rain forest and gallery forest from sea level up to 870 m alt.

Selection of the ca 150 specimens examined:

Nigeria: Onogholo F.R. (fr. June) *Eimunjeze & Oguntayo FHI 72763* (K, WAG); Ikom farmland (fl. Oct.) *Emwiogbon et al. FHI 87264* (WAG); Eket distr. (fl.) *Talbot & Talbot 3172* (G); 2 mls from Calabar (fl. May) *van Meer 1514* (WAG).

Cameroun: 2 km S of Gr. Batanga (fr. Sept.) *Bos 5355* (P, WAG); 30 km SW of Batouri (fr. April) *Breteler 2831* (= *Letouzey 4775*) (B, HBG, K, P, WAG, type *R. unifoliolata*); 27 km SW of Bertoua (fr. May) *Breteler 2961* (WAG); N'Kolbisson (fr. May) *W.de Wilde 2611* (B, MO, WAG, Z); Barombi Kang (fl. Feb.) *D.W.Thomas 4365* (MO, WAG); Nyong R. 2 km downstream of Akonolinga (fr. April) *D.W.Thomas 6268* (MO, WAG); Bipindi (fr. March) *Zenker 248* (B, C, G, MO, WAG, type *R. viridis*).

Central African Republic: 10 km N of Bambari (fl. March) *Tisserant 1477* (P); Boukoko (fl. Dec.) *Equipe Tisserant 1290* (P); (fl. March) *Equipe Tisserant 1666* (BR).

Equatorial Guinea: Muni R. (fl.) *Mann 1828* (K, type of *R. mannii*).

Gabon: km 5 Belinga-Makokou (fl. Sept.) *Breteler & de Wilde 691* (LBV, WAG); 15 km SSE of Pano (fr. Oct.) *Breteler 6978* (LBV, WAG); km 15 Libreville-Kango Road (fr.) *Breteler 8542* (WAG, alc.!); 9 km SSW of Makokou (fr. Nov.) *Leeuwenberg 11426* (LBV, WAG); Pingo (fl. Sept.)

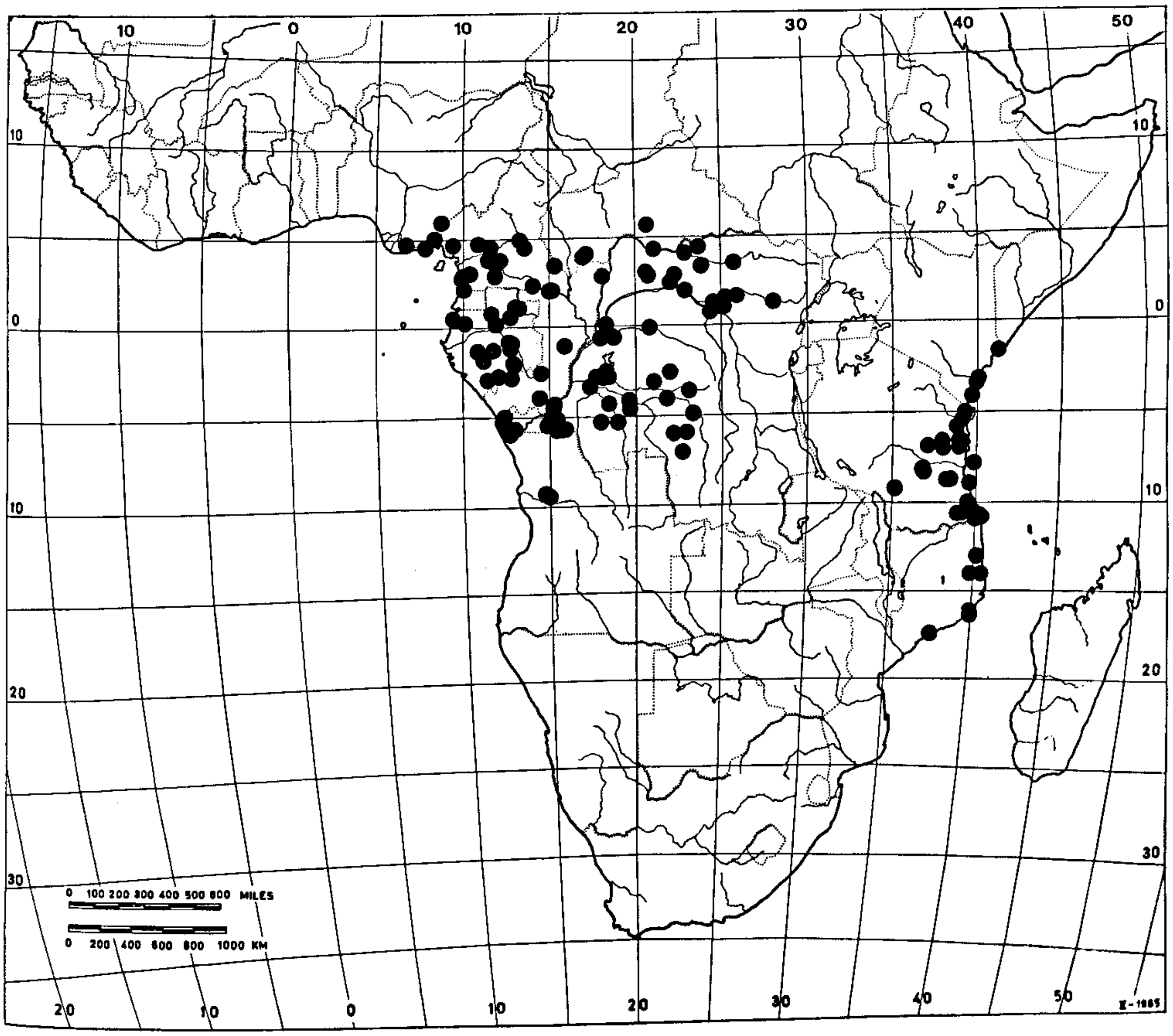


Fig. 159. Distribution of *Rourea coccinea* subsp. *coccinea* var. *viridis* (West and Central Africa) and *Rourea coccinea* subsp. *boiviniana* (East Africa).

Le Testu 6082 (BM, BR, P); 32 km SE of Sindara (fr. Dec.) *Louis et al. 1325* (LBV, WAG).

Congo: M'Bamou, Bouenza (fr. Nov.) *Bouquet 768* (P); Edou (fl. July) *Descoings 7797* (P); between Meya and Loukakou (fr. Nov.) *Descoings 11388* (P); M'Binda (fr. March) *Sita 3543* (BR, P, WAG).

Zaire: Penge (fl. Jan.) *Bequaert 2176* (BR); INEAC Bongabo (fr. June) *Breyne 1676* (BR); Kinkosi (fr. Dec.) *Callens 3874* (BR); Kiyaka-Kwango (fl. Sept.) *Devred 2657* (BR); Luki (fr. Dec.) *Donis 2265* (B, BR); Likati (fr. March) *Gérard 2226* (BR); Tupkwo (fr. May) *Gérard 4524* (BR); Bokoro (fr. Oct.) *Jans 600* (BR); Bolongula (fr. 20 Nov. 1903) *Laurent s.n.* (BR); Tshondo (fr. Jan.) *Liben 2200* (BR, WAG); (fr. June) *Louis 9882* (B, BR); Bikoro (fl. March) *Nsola 533* (BR).

Angola: Cuanza Norte, Queta, *Gossweiler 5578* (BM, COI); Cabinda, Buca Zau (fl.) *Gossweiler 6762* (BM, COI, LISU); Cabinda, Bélize (y.fr.) *Gossweiler 7130* (BM, COI); Cuanza Norte, Cazengo (fr. June) *Welwitsch 4629* (BM, type *R. pallens*).

Cult: Photograph in collection WAG of seedlings in greenhouse. Seedlings of *Breteler 8542* from Gabon.

Note: In selecting neotypes for *R. viridis* and *R. unifoliolata* specimens that are well represented in many herbaria were preferred over those collected at the original localities, as specimens with characters exactly matching the protologues of both species have been collected all over Central Africa.

Rourea coccinea (Thonn.ex Schum.) Benth. subsp. **boiviniana** (Baill.) Jongkind **comb.nov.** **Fig. 156, 159**

Basionym: *R. boiviniana* Baillon, 1867: 231.
Type: Kenya, Mombasa, *Boivin s.n.* (holo: P).
R. maxima (Baker) Gilg, 1895a: 192. Basionym: *Byrsocarpus maximus* Baker, 1868: 453; Schellenberg, 1919: 454; 1938: 155. Type: Tanzania, Rovuma R., *Kirk s.n.* (holo: K).
R. ovatifolia (Baker) Gilg, 1895a: 192. Basionym: *Byrsocarpus ovatifolius* Baker, 1868: 452. Type: Tanzania, Rovuma R., *Meller s.n.* (holo: K).
R. usaramensis Gilg, 1895a: 192. Type: Tanzania, Dunda, *Stuhlmann 6420*; Dilangilo, *Stuhlmann 6641*; Kikuli, *Stuhlmann 6780*; Magule, *Stuhlmann 7091* (syn: B†). Neotype: Tanzania: Pangani, Khuki-plateau, *Goetze 99* (holo: K; iso: E).
R. goetzei Gilg, 1900: 394. Type: Tanzania, Khutu-Uhehe, *Goetze 415* (holo: B†; lecto: K; iso: E).
Byrsocarpus boivinianus (Baill.) Schellenberg, 1938: 155; Hemsley, 1956: 16; Mendes, 1966: 625,626; Mendes, 1969: 7. Basionym: *R. boiviniana* Baillon (see above).
Byrsocarpus goetzei (Gilg) Greenway, 1940: 41. Basionym: *R. goetzei* Gilg (see above).
Byrsocarpus usaramensis (Gilg) Schellenberg, 1910: 43; 1912: 244. Basionym: *R. usaramensis* Gilg (see above).

Shrub, sometimes scandent. *Branches* often with a distinct corklayer, branchlets puberulous to glabrous. *Leaflets* 5-9(-11), terminal ones and lateral ones nearly identical in shape, ovate to elliptic, 1-10 × 1-5 cm, glabrous or sparsely hairy; apex acute to acuminate. *Inflorescence* up to 10 cm long; leaf- and flower buds are opening simultaneously on the bare shrub, during the flowering time there are no mature leaves present.

Distribution: Kenya, Tanzania, and Mozambique.
Ecology: Coastal bush and thicket edges in savanna, from sea level up to 700 m alt.

Specimens examined:

Kenya: Mombasa (fr.) *Boivin s.n.* (P, type); Arabuko-Sokoke Forest (fr. June) *Dale 3775* (EA, P); Arabuko (fr. April) *Donald 9* (EA, G, K); Mararani, *Kucher 13484* (EA); Sokoke Forest, *Moggridge 155* (EA); N of Sokoke For. Station (fr. June) *Musyoki & Hansen 1022* (C, EA, K).
Tanzania: Entebbe (fl. Oct.) *Brown 341* (K); Kilosa (fr. Jan.) *Burtt 74* (EA); sin.loc. (fl.) *Busse 636* (EA, G); Makonde plateaux (fr.) *Busse 1088* (B, EA, G); 30 km S Handeni (fl. March) *Drummond*

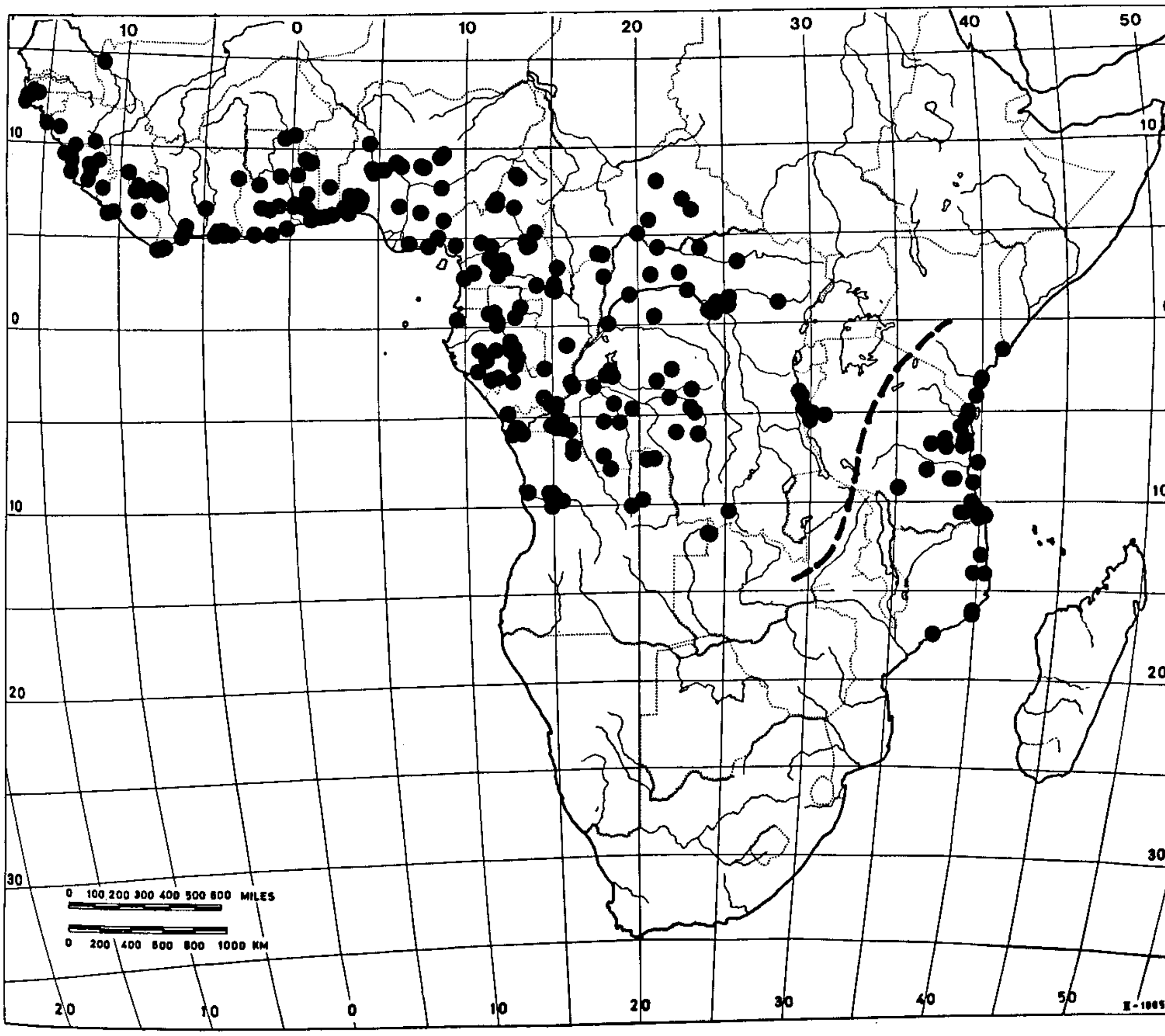


Fig. 160. Distribution of *Rourea coccinea*: subsp. *coccinea* (West) and subsp. *boiviniana* (East).

& Hemsley 1467 (B, BR, K); Morogoro-Dar es Salaam, *Furuya 10* (EA); Seedi (fl. Dec.) *Gillman 1141* (EA); Mnima (fr. March) *Gillman 1292* (EA); Pangani (fl.) *Goetze 99* (E, K, type of *R. usaramensis*); Tondwa-Dawe Simba (fl. Oct.) *Greenway 5383* (K); Funga (fr.) *Heardi 177/OB* (BR); Pande F.R. (fl. Nov.) *Harris 3604* (EA); Kilwa Masoko (fl. Sept.) *Jaasund 2625* (EA); Chidya (fl. Oct.) *Jahl 167* (EA); Rovuma R. (fr.) *Kirk s.n.* (K, type of *R. maxima*); Ruva For. station (fr.) *Magogo 751* (K); banks of the Rovuma R. (fr.) *Meller s.n.* (K, type of *R. ovatifolia*); Bana F.R. (fr. Jan.) *Mfinange 12* (BR, EA, K); Bana F.R. (fr. Oct.) *Mgaza 690* (BR, EA, K); (fl. Oct.) *Mgaza 762* (fl. Oct.) *Mgaza 763* (EA); Amboni-Gombero (fr. June) *Peter 23956a* (B); Chiwata, *Price 46* (EA); Banda F.R. (fr. Dec.) *Proctor 2810* (K); Balenge (fl. Nov.) *Rodgers 522* (EA); Selous Reserve (fr. Feb.) *Rodgers 894* (EA); N Ruhudje R. (fl.) *Schlieben 1353* (B, K); Lutamba Lake (fl. Oct.) *Schlieben 5454* (B, G, HBG, P, Z); Mchinjiri (fr. Feb.) *Semsei 659* (K); Kilosa (fr. 12 Jan. & 13 Jan. 1922) *Swynnerton s.n.* (BM); Nakitala thicket (fl. Dec.) *Vollesen 3076* (C, EA).

Mozambique: Mussoril (fl. 1884/85) *Carvalho s.n.* (COI); Nangororo Road (fr. March) *Gomes e Sousa 4638* (COI, IIAM, PRE, WAG); 10 km W Palma (fr. March) *Gomes e Sousa 4680* (COI, IIAM, PRE, WAG); Mocimboa-Mueda, *Jansen 8107* (II,AM); Palma-Nangade (fl. Oct.) *Mendonça 998* (COI, IIAM, LISC, SRGH); Eráti (fr. Dec.) *Torre & Paiva 9583* (COI, IIAM, LISC); 36 km de Vila da Maganja (y.fr. Jan.) *Torre & Correira 17053* (LISC); Praia-Logoa (fr. Jan.) *Torre & Correira 17356* (LISC); António Enes, Boila (fr. Jan.) *Torre & Correira 17372* (LISC).

Note: In Schellenberg's revision this species is segregated into ten different species of the genus *Byrsocarpus*. Schellenberg separated them on differences in leaf shape and indumentum, characters that are very variable and not suitable for the delimitation of species. The only constant character that separates *Rourea coccinea* from the other former *Byrsocarpus* species (*R. cassioides*, *R. orientalis*, and *R. parviflorus*) is the place of the radicle in seed. This differential character was not recognized as such by Schellenberg.

The leaf shape in *R. coccinea* ranges from leaves with 21 small leaflets with an emarginate apex, to leaves with one or three leaflets with an acuminate apex. Every possible number and shape between these extremes is found, but not in every possible combination. In the present revision these variants are considered to belong to one species with two subspecies and two varieties, in an attempt to bring order in at least part of this extensive variation. The number of intermediates is far too large to justify maintenance of taxa involved on species level. The subspecies coccinea and boiviniana are segregated by a disjunction in the species distribution in E Africa, as is made visible at the map of fig. 160.

Rourea erythrocalyx (Gilg ex Schellenb.) Jongkind **comb.nov.** **Fig. 161, 162**

Basionym: *Roureopsis erythrocalyx* Gilg ex Schellenberg, 1910: 27, 28 descr. in clavi.

Type: *Gillet 2006* (holo: B†; lecto: BR)

R. thonneri De Wildeman, 1911b: 215,tab.14. Type: Zaire, Ubangi, Gugo near Yakoma, *Thonner 228* (holo: BR).

Paxia erythrocalyx Gilg, nomen on Gillet 2006 (BR).

Roureopsis thonneri (De Wild.) Schellenberg, 1919: 447; 1938: 111; Troupin, 1952: 78; Exell & Mendonça, 1954: 145. Basionym: *R. thonneri* De Wildeman (see above).

Large liana up to 20 m long. *Branchlets* puberulous. Petiole 1-8 cm long; rachis 2.5-12 cm long; petiolules 1-3 mm long; *leaflets* 3-11, ovate to elliptic, glabrous or puberulous beneath, many mucous cells in the upper surface, these show as small pits in herbarium specimens; apex acuminate; acumen emarginate; terminal leaflet 3.5-10 × 1.5-6 cm; lateral ones 2.5-9 × 1.5-4.5 cm, somewhat asymmetrical. *Inflorescence* up to 6 cm long, puberulous, bracteoles near the calyx. *Pedicel* jointed at the apex. *Sepals* 3-5 × 1.5 mm, nearly glabrous inside. *Petals* 11-14 × 1-1.5 mm, free, inrolled at least in bud. Long *stamens* 1.5-4.5 mm long, short ones 1-3 mm long. *Pistil* 1.2-5 mm long, style sparsely hairy; ovary pilose. *Follicles* one to five per flower, 14-22 × 6-8 mm, glabrous, dehiscent by a ventral suture. Sepals in fruit 13-15 × 4-7 mm, reddish, thinly coriaceous, sparsely hairy or glabrous outside. Seed coat for ca one fourth fleshy, other part of testa shining black. Radicle ventral.

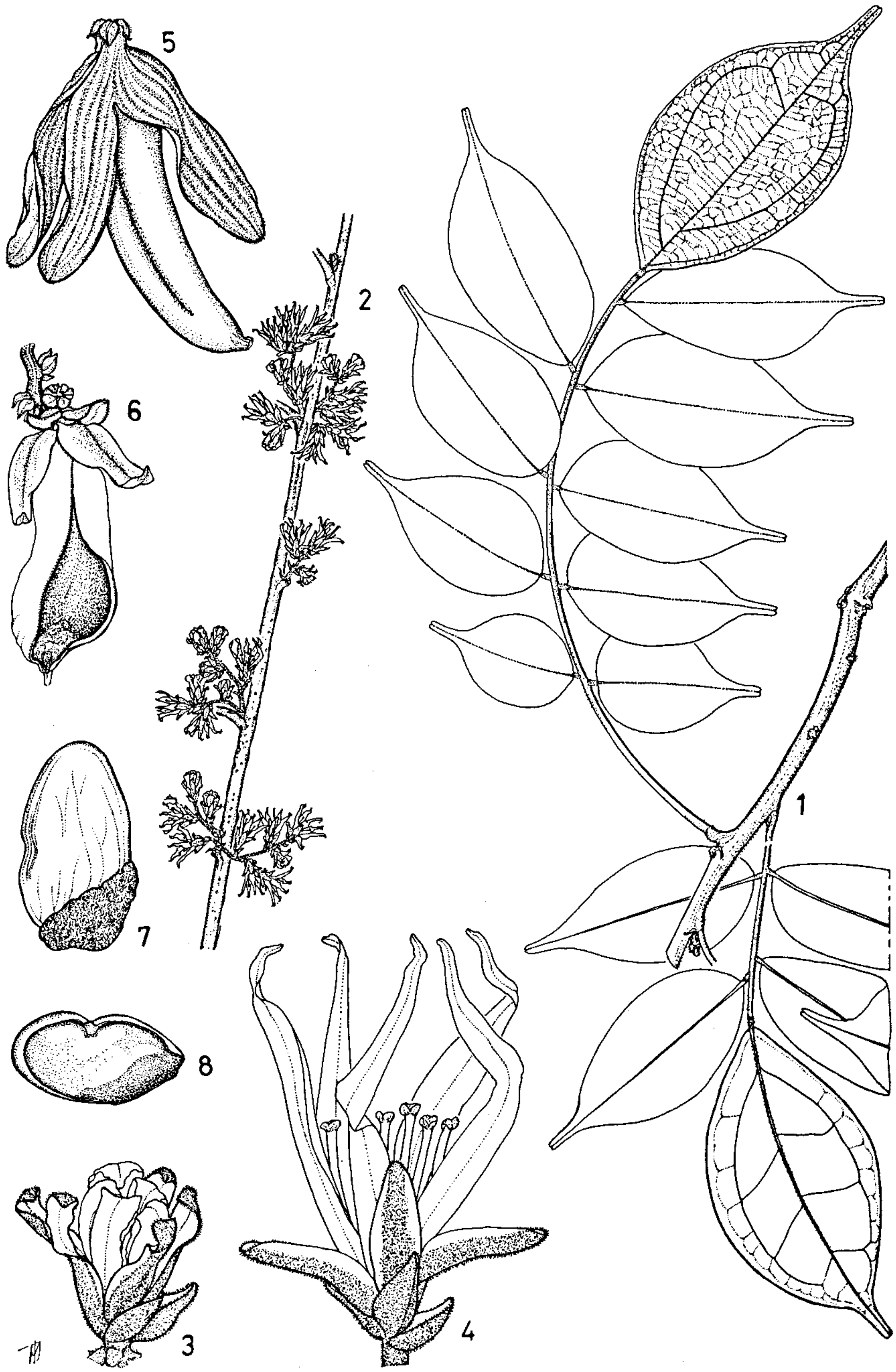


Fig. 161. *Rourea erythrocalyx*: 1. leaves, 2/3 ×; 2. branchlet with flowers, 2/3 ×; 3. opening bud, 6 ×; 4. flower, 6 ×; 5. young fruit, 2 ×; 6. empty follicle, 2 ×; 7. seed, 2 ×; 8. cotyledon inside with dorsal radicle, 2 ×. (1. *J.Louis 9536*; 2-4. *Le Testu 7651*; 5. *J.Gillet 2006*; 6-8. *Reitsma et al., 1488*)

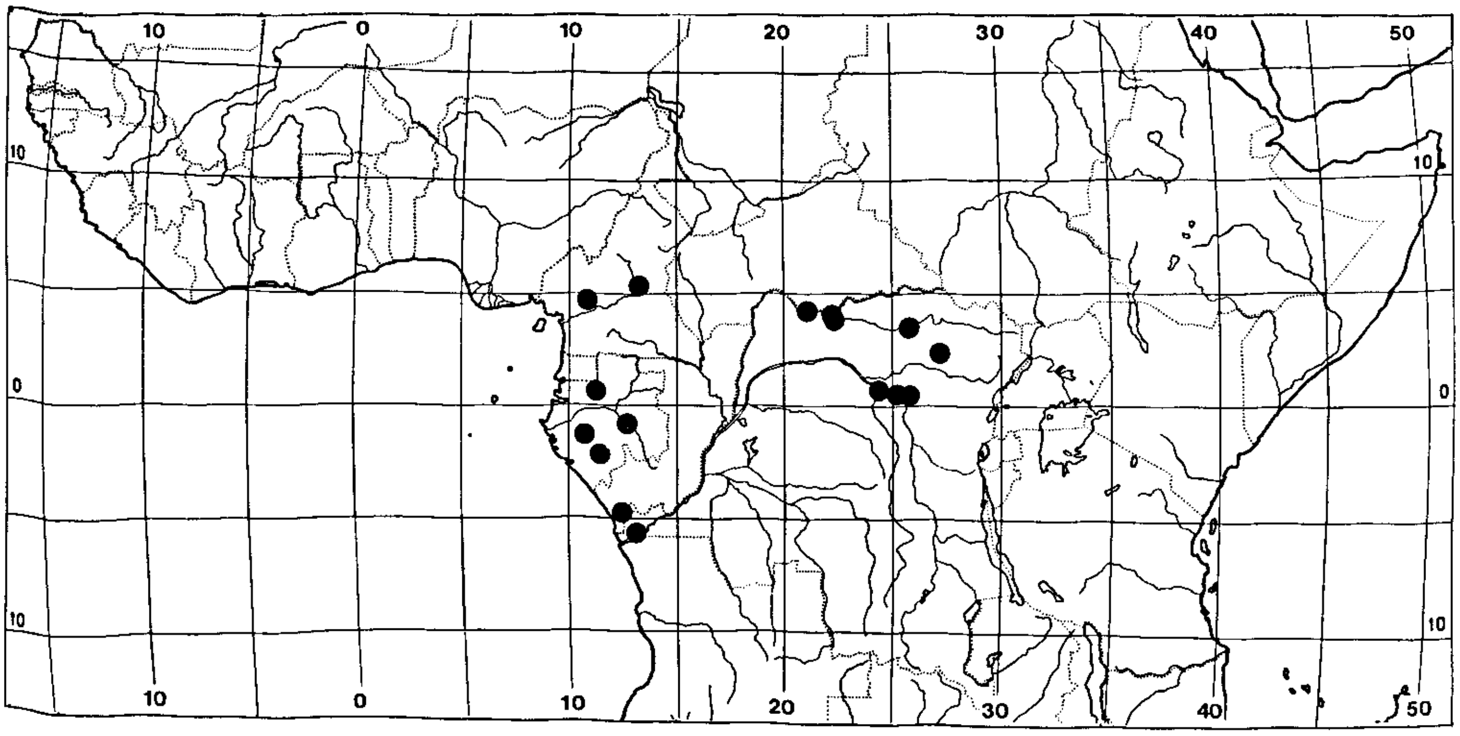


Fig. 162. Distribution of *Rourea erythrocalyx*

Distribution: Cameroun, Gabon, Angola (Cabinda), Zaire.
Ecology: Rain forest from sea level up to 500 m alt.

Specimens examined:

Cameroun: Samat-Messimni (fl. Feb.) *Letouzey 3400* (P); 5 km NW Ndikinimeki (fl. Dec.) *Letouzey 10905* (P, WAG).

Gabon: Ndendé-Lébamba (fl. Aug.) *Breteler 7696* (WAG); Ogooué (fr. July) *Hallé 271* (P); IRET Makokou (fl.b. Sept.) *Hladik 1385* (P); *Hladik 1549* (P)); Ganda (fl.) *Le Testu 6081* (BM, BR, P); Lastoursville (fl., fr.) *Le Testu 7651* (BM, BR, P, WAG); 20 km NE Oveng (fl. Sept.) *Reitsma 1488* (WAG.

Congo: Moutsene Batéké village, Bouba Road, *Bouquet 1032* (P).

Zaire: 10 km E Kisangani (fl. Oct.) *Bokdam & de Wit 3340* (WAG); Amboko (y.fr. April) *Claessens 449* (BR); Bas-Uele (fl. March) *Dewulf 643* (BR); Singa valley (fr. Jan.) *Donis 2311* (BR); INEAC Luki, *Dubois 372* (BR, WAG); Bambesa (fr. May) *Gérard 2922* (BR, WAG); (fl. Feb.) *Gérard 3265* (BR, WAG); (fl. Jan.) *Gérard 4348* (BR); (fr. April) *Gérard 5113* (BR); (fr. May) *Gérard 5470* (BR, WAG); sin.loc. (fr.) *Gillet 2006* (BR, type); Banzyville-Yakoma (fl. Feb.) *Lebrun 2206* (BR, P); Babobgié (fl. June) *Lejoly 3832* (BR); Yangambi (fr. May) *Louis 9536* (BR); (fl. July) *Louis 10492* (BR, P, WAG); *Louis 11789* (BR); *Louis 15771* (BR); Luki (fr. Jan.) *Madoux 277* (BR, WAG); Luki (fr. Jan.) *Nsimundele 130* (BR); Gugo near Yakoma (fl. Feb.) *Thonner 228* (BR, type *R. thonneri*); N'Kula valley (fr. Feb.) *Toussaint 242* (BR).

Angola: Maiombe, Mungo (y.fr. Jan.) *Gossweiler 6140* (COI); Maiombe, Buco-Zau (y.fr. Oct.) *Gossweiler 6799* (COI, LISU).

Note: The specific epithet *erythrocalyx* that is cited simply as nomen by Schellenberg (1938: 111) and by Troupin (1952: 78), was validly published by Schellenberg in 1910 with its description in the key on page 27, and citation of specimens on page 28.

Rourea minor (Gaertn.) Alston **Fig. 163, 164**

R. minor (Gaertn.) Alston, 1931: 67; Leenhouts, 1958: 514; Vidal, 1962: 34; Ramamoorthy, 1976: 363.

Basionym: *Aegicerus minus* Gaertner, 1788: 216,tab.46.

Type: Sri Lanka, *König s.n.* (holo: L).

R. santaloides (Vahl) Wight & Arnott, 1834: 144; Baker, 1868: 455. Basionym: *Connarus santaloides* Vahl, 1794: 87. Type: Sri Lanka, Colombo, *Wight cat.nr. 539* (lecto: K).

R. afzelii R.Brown ex Planchon, 1850: 418. Type: Sierra Leone, *Afzelius s.n.* (holo: BM).

R. platysepala Baker, 1886: 336; Keraudren, 1958: 8, fig. 4. Type: Madagascar, *Baron 2528* (holo: K; iso: P).

R. gudjuana Gilg, 1891b: 323. Type: Sudan, Dar Fertit, *Schweinfurth 229* (holo: B†; lecto: K).

R. splendida Gilg, 1891b: 321. Type: Zaire, Mukenge, *Pogge 744* (holo: B†). Neotype: Angola, Luachimo R., *Carisso & Mendonça 130* (holo: COI; iso: BM).

R. chiliantha Gilg, 1896: 212. Type: Zaire, Mukenge, *Pogge 727*; 732; 739a; 745; 746; 747; 757 (syn: B†). Neotype: Zaire, Bamanga, *Dewèvre 1146a* (holo: BR).

R. bamangensis De Wildeman & Durand, 1899b: 82. Type: Zaire, Bamanga, *Dewèvre 1146* (holo: BR).

R. striata De Wildeman, 1909: 94,tab.24. Type: Zaire, km 18 Grand Lacs railway. *M.Laurent 1032* (holo: BR).

R. bipindensis Gilg, nomen; Schellenberg, 1910: 45.

Santaloides minus (Gaertn.) Schellenberg, 1924: 28; 1938: 126. Basionym: *Aegicerus minus* Gaertn. (see above).

Santaloides afzelii (R.Br. ex Planch.) Schellenberg, 1910: 53; 1912: 248; 1938: 138, fig. 24; Hepper, 1958: 746; Irvine, 1961: 573; Mendes, 1966: 622; Mendes, 1969: 9; Berhaut, 1975: 40; Liberato, 1980a: 11; Ern, 1984: 165; Burkill, 1985: 525; Caballé, 1986: 200, 226, 229. Basionym: *R. afzelii* R.Br. ex Planch. (see above).

Santaloides platysepalum (Baker) Schellenberg, 1938: 138. Basionym: *R. platysepalum* Baker (see above).

Santaloides gudjuanum (Gilg) Schellenberg, 1919: 454; 1938: 138; Andrews, 1952: 355; Aubréville, 1952: 13. Basionym: *R. gudjuana* Gilg (see above).

Santaloides splendidum (Gilg) Schellenberg, 1919: 455; 1938: 140; Troupin, 1952: 82, fig. 5; Exell & Mendonça, 1954: 148; Hemsley, 1956: 13, fig. 5. Basionym: *R. splendida* Gilg (see above).

Santaloides bamangensis (De Wild. & Dur.) Schellenberg, 1919: 455; 1938: 138. Basionym: *R. bamangensis* De Wildeman (see above).

Santaloides urophyllum Schellenberg, 1919: 454; 1938: 140; Exell & Mendonça, 1954: 145. Type: Cameroun, Bipindi, *Zenker 3421* (holo: B; iso: E, G, L, M, MO, Z).

Santaloides gossweileri Exell & Mendonça, 1952: 233, tab.13a; 1954: 148, tab.33. Type: Angola, Moxico, Teixeira de Sousa, *Gossweiler 12345* (holo: BM; iso: LISC).

Fig. 163. *Rourea minor*: 1. flowering branchlet, 2/3 ×; 2. leaf with narrow leaflets, 2/3 ×; 3. long acuminate leaflet, 2/3 ×; 4. leaflet with short apex, 2/3 ×; 5. young infructescence with accrescent calyx, 2/3 ×: 6. fruits dehiscing by a ventral suture, 2/3 ×; 7. fruits dehiscing circumscissile at base and by a ventral suture, 2/3 ×; 8. fruits dehiscing circumscissile at base, 2/3 ×. (1. *Hart 330*; 2. *Rakotosou 16029*; 3. *Zenker 535*; 4. *Torre & Pereira 12464*; 5. *Bos 4940*; 6. *Bosser 7528*; 7. *Espirito Santo 2647*; 8. *Jans 760*)

Small tree, shrub or large liana up to 26 m long and 15 cm diameter, evergreen. *Branches* glabrous, cylindrical to deeply furrowed, often with interxylary phloem; branchlets puberulous or glabrous. *Petiole* 2-9 cm long; rachis 0-17 cm long; petiolules 1-4 mm long; *leaflets* 1-11(-19), ovate to oblong-elliptic, chartaceous or thinly coriaceous, glabrous, often wax coated beneath; apex acuminate; acumen up to 2.5 cm, never mucronate, midrib usually fading away distally; terminal leaflet 1.5-12.5 × 0.7-6 cm; lateral ones 1.5-12 × 0.5-6 cm, nearly symmetrical to asymmetrical. *Inflorescence* up to 9 cm long, glabrous. Pedicel above the joint 3-7 mm long. *Sepals* 1.5-4 × 1-3.5 mm (wider than long), margin ciliate, glabrous elsewhere. *Petals* 5-8 × 1.5-4 mm, usually connivent near the base, imbricate in bud, apex rounded. Long *stamens* 3.5-6 mm long, short ones 2.5-4.5 mm long; anthers obcordate. *Pistil* 2-5 mm long; style sparsely hairy or glabrous; ovary sparsely hairy but only adaxially. *Follicles* one per flower, rarely more, 10-22 × 5-12 mm, ovate, finely longitudinally striate, dehiscing more or less circumscissile at base and/or rarely by a ventral suture, glabrous; apex acute or acuminate. Sepals in fruit ca 4 × 3 mm (wider than long). *Seed* ovoid with an acute apex; sarcotesta for the larger part free from the other parts of the seed, covering the thin part of the testa almost entirely; radicle more or less apical. *Seedling* hypogeal; first two leaves opposite (de Vogel, 1980: 221).

Distribution: West, Central, and East Africa, Madagascar, and Asia.
Ecology: From rain forest to savanna, from sea level up to 1500 m alt.

Selection of the more than 150 African specimens examined:

Senegal: Dinndefelou, *Adam 19990* (P); Mt Assirik (fl. Nov.) *Tutin 172* (K).
Mali: Sikasso (fl. Oct.) *Demange 2666* (P); Doniéna (y.fr. Jan.) *Demange 3381* (P); Fantarasso (y.fr. Dec.) *Floret 1402* (BR, P).
Guinea Bissau: Bafata (fr. April) *Alves Pereira 1799* (LISC); Bafata, Geba (fr. Feb.) *Espirito Santo 2674* (BR, COI, LISC, LISJC, P, WAG); Bafata, Madina do Boé (fl. Jan.) *Espirito Santo 2860* (COI, LISC, LISJC, P); Bissora-Massaba (y.fr. Jan.) *d'Orey 65* (LISC).
Guinea: Sérédou (y.fr. Dec.) *Camara et al. 16* (BR); Timbo (fl. Dec.) *Chevalier 14637* (P); Kouroussa (fr. May) *Chevalier 25842* (P); Dintinn (fl. Dec.) *Jacques-Félix 608* (P); near Dabadou (fl. Jan.) *Lisowski 10318* (BR, WAG); Labe-Tougue Road (fr. Feb.) *Lisowski 51507* (BR); between Pita and Dalaba (fl. Dec.) *Roberty 6527* (G); Petel (fl. Jan.) *Roberty 16422* (G).
Sierra Leone: Gberia Fotombu (fl. Sept.) *Small 283* (P).
Liberia: Karmadhun (fr. Nov.) *Baldwin 10154* (K, WAG); Ganta (fr. Jan.) *Harley 1471* (K).
Ivory Coast: Sonderegue (fr. March) *Hudru 6472* (P); Tieman (fl. Oct.) *de Kruif 455* (WAG); Sassandra (fl. Aug.) *J.J.de Wilde* 343 (WAG); Bonna N.P. (fl. Jan.) *Oldeman 923* (B, WAG); N de Boundiala (fr. Jan.) *Roberty 7017* (G, Z); 15 km NE of Korhogo (y.fr. July) *Versteegh & den Outer* 468 (U, WAG).
Burkina Faso: Bobo-Dioulasso (y.fr. Oct.) *Geerling & Bokdam 1433* (WAG); (fl. Oct.) *Geerling & Bokdam 1458* (BR, WAG).
Ghana: Banda ravine, Wenhi (fl. Dec.) *Morton 25130* (K); Atuna (fl.b. Dec.) *Vigne 3530* (P).
Togo: Aledjo Kodoio (fl. Dec.) *Brunel & Heitz 1515* (B); Sokodé (fl. Dec.) *Brunel 7121* (B); Aledjo (fl. Dec.) *Ern 2616* (B, P); (fl., y.fr. Feb.) *Ern 3023* (B); Sokodé-Bafilo (fr. April) *Hakki et al. 259* (B).
Nigeria: Gangoro F.R. (y.fr. Feb.) *Chapman 4157* (K); Kpashimi F.R. (fr. May) *Eimunjeze et al. FHI 66325* (K, WAG); Vogel Peak area, *Hepper 2772* (K); 11 mls SE of Kaduna (fl. Dec.) *Jackson*

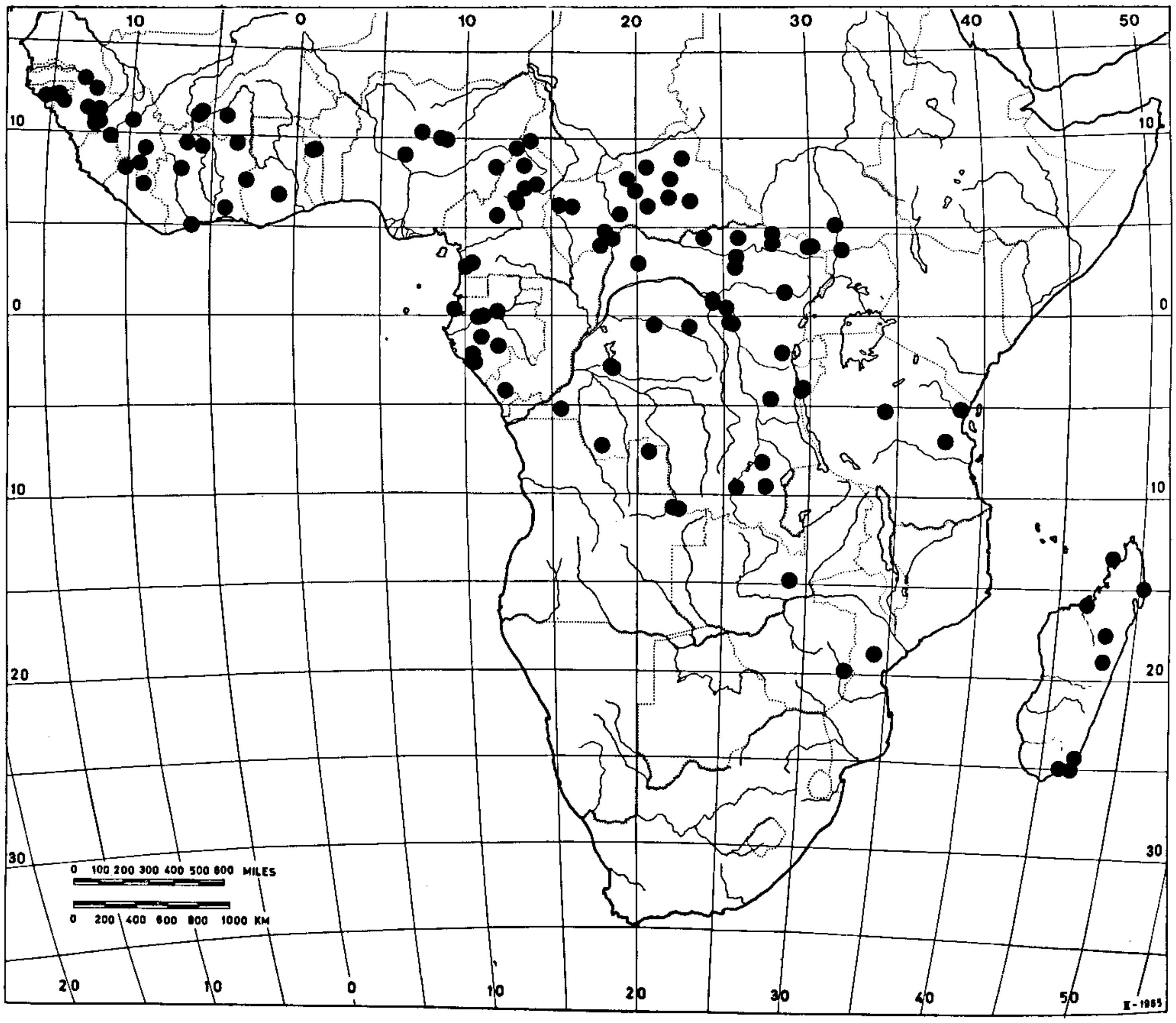


Fig. 164. Distribution of *Rourea minor* in Africa

192 (K); Anara F.R. (fl.b. Oct.) *Keay FHI 21124* (K); Jaguidi (fl. Nov.) *Keay FHI 22270* (K); Nimbia F.R. (fr. April) *Latilo FHI 47136* (K); Kan Gimi (fl. Nov.) *Ogbeni & Obiora FHI 21692* (K); Sang R. F.R. (fl. Dec.) *Olorunfemi FHI 55667* (K, P); Jos (fl., fr. March) *Tuley 2232* (K).

Cameroun: 15 km SE of Kribi (y.fr. June) *Bos 4940* (P, WAG); 4 km S of Ngaoundéré (fl. Oct.) *Breteler 585* (WAG); 7 km S of Poli (fr. July) *Fotius 2166* (P, YA); Lac Mbella Assom (fl.b. Dec.) *Letouzey 2478* (K, P); Guider (fl. Sept.) *Meurillou 1451* (BR, P, YA); 70 km E Tibati (fl. Dec.) *Satabié 560* (P, YA); Lake Tison (fl. Nov.) *Satabié 778* (P, YA); 100 km N of Meiganga (fl.b. Nov.) *W.de Wilde & J.J.de Wilde 4145* (P, WAG); Bipindi (fr.) *Zenker 2979* (G, GOET, L, M, MO, WAG, Z).

Central African Republic: 15 km from Mbaika (fl. Dec.) *Badré 329* (P, WAG); Krebedje (fl.) *Chevalier 5690* (K, P); Kaga Pongourou (fl.b.) *Chevalier 6559* (G, L); Kaga Dje, Kaga M'Bre (fl.b. Dec.) *Chevalier 6623* (Z); Ndéllé (fr. April) *Chevalier 8158* (P); Bouali (fr. March) *Descoings 10190* (P); route de Bria (fr. April) *Descoings 11002* (P); Ouadda-Djalle (fl. Oct.) *Mazade 1643* (P); Yalinga (fl. Oct.) *Le Testu 3311* (BM, P, WAG).

Sudan: Sakor R., *Andrews 1543* (K); Abingo R. (fr. May) *Andrews 1587* (K); Lado, Yei R. (fr. Nov.) *Sillitoe 227* (K).

Gabon: 10 km SW of Ndjolé (fl.b. April) *Hallé 1716* (P, WAG); Libreville (y.fr.) *Klaine 2167* (BR); Coundou (fl. March) *Le Testu 5876* (BM, BR, LISC, P); Moulounda (fl.) *Le Testu 8038* (BM, BR, WAG); 50 km SW of Forestry Camp Doussala (fl. Feb.) *Reitsma 1916* (WAG); ca 50 km SW of Doussala (y.fr. April) *Reitsma 3339* (WAG).

Congo: forest near Makaba (fr. Dec.) *Sita 4751* (BR, P, WAG).

Zaire: Yangambi (fr. July) *Bolema 1227* (BR); Nakpudu (fl., fr. Oct.) *De Graer 20/157* (BR); Panzi-Kwango (fl. June) *Devred 2025* (BR, WAG); Lebo (y.fr. Oct.) *Gérard 3482* (BR, WAG); Kurukwata (fl. Dec.) *Gérard 3692* (B, WAG); Mpese mission (fl. April) *Germain 2095* (P); Epulu (fl. Sept.) *Hart 330* (BR); Ntolo (fl. May) *Jans 689* (BR); Kabambare (y.fr. July) *Luxen 186* (B, BR); Mingazi (fr. Sept.) *Pierlot 840* (BR); Kaluke R. (fr. July) *Quarré 5820* (BR); Dumba (fr. Aug.) *Risopoulos 801* (BR, WAG).

Angola: Luachimo R. (fr. July) *Carrisso & Mendonça 130* (BM, COI, type of *R. splendida*); Moxico, Teixeira de Sousa (fr. July) *Gossweiler 12342* (BM, LISC); (fl., fr. July) *Gossweiler 12345* (BM, LISC, type of *Santaloides gossweileri*).

Burundi: Bururi Road (fl. June) *Lewalle 902* (M, WAG); Bururi (fr. Dec.) *Lewalle 5015* (G); Mutambara (fr. Oct.) *Reekmans 1076* (BR); Gitwe (fr. May) *Reekmans 6986* (WAG).

Uganda: Kobboko (fr. March) *Eggeling 1835* (K); Amua Valley, fl. Dec.) *Eggeling 5548* (EA); Otze (fl. Jan.) *Oakley 25* (EA).

Tanzania: Nderema-Monga Road (fr.) *Drummond & Hemsley 3427* (B, BR, K); Amani, *Peter 302* (B); (fr. May) *Peter 10249* (B); NE of Kinole, *Pocs & Lungwecha 6881* (EA).

Zambia: Kawambwa (y.fr. Aug.) *Fanshawe 3591* (BR, K).

Zimbabwe: Makurupini Forest, *Mavi 1440* (SRGH); Makurupini Forest, *Müller 2379* (SRGH).

Mozambique: Gorongasa (fl., y.fr. Oct.) *Torre & Pereira 12464* (COI, LISC).

Madagascar: Nossi-Bé, *Boivin s.n.* (P); Morarano (fr. Dec.) *Bosser 7528* (P); S of Moramange, *Decary 18397* (P); Manampanihy valley near d'Ampasimena (fl.) *Humbert 20582* (K); Antalaha (fr. Nov.) *Perrier de la Bathie 2026* (P); Fort Dauphin (fr. Sept.) *Rakotosou 16029* (P).

Note 1: The neotype for *R. chiliantha* was selected by Troupin in 1951 in the herbarium of Brussel. It is published here for the first time.

Note 2: This species is widely distributed and it shows a rather wide range of variation in its leaves.

In Schellenberg's revision of 1938 it is represented by six different specific names in his genus *Santaloides*, based on the almost free sarcotesta that can easily be removed. Leenhouts (1958) treated *Santaloides* as a synonym of *Rourea*. In my opinion the six species of Schellenberg have to be united as they represent a single variable species (see also Mendes, 1966:622), for which *R. afzelii* is the oldest name for Africa.

In Asia occurs a *Rourea* species from the former genus *Santaloides* that also has a very variable appearance and a wide distribution, from Sri Lanka to the Pacific Islands. Careful comparison of these two widely distributed species from Africa and from Asia respectively, undeniably shows that both represent a single species for which *R. minor* is the oldest name.

Previously the Asiatic and the African material was classified in different sections of *Santaloides* by Schellenberg, and Leenhouts placed them in different sections of *Rourea*. These two sections were distinguished on the dehiscence of the fruit: by a ventral suture for the Asiatic material and by a circumcission at the base in the African specimens. After carefull scrutiny of many specimens this difference in dehiscence proved not to be restricted to material of either continent. Some specimens from Africa, particularly from Madagascar, are clearly dehiscing by a ventral suture (e.g. *Baron 6413* and *Bosser 7528*) and among the Asiatic material specimens occur that show, besides their ventral suture, at least partly a basal suture as well. As such no character remained to treat the African and Asiatic material as different entities, neither as sections, nor as species.

Rourea myriantha Baill. **Fig. 165, 166**

R. myriantha Baillon, 1867: 198; Baker, 1868: 455.
Type: Gabon, *Griffon du Bellay s.n.* (holo: P).
R. soyauxii Gilg, 1891b: 324. Type: Gabon, Sibange Farm, near Libreville, *Soyaux 70* (holo: B†; lecto: P; iso: K, Z).
Santalodes myriantha (Baill.) O.Kuntze, 1891: 155. Basionym: *R. myriantha Baill.* (see above).
Paxia myriantha (Baill.) Pierre 1896: 1233; Schellenberg, 1919: 448; 1938: 115; Exell & Mendonça, 1954: 145. Basionym: *R. myriantha* Baill. (see above).
Paxia scandens (Gilg, 1891b: 321. Type: Gabon, Sibange Farm, near Libreville, *Soyaux 262* (lecto: K; B†; iso: P, Z); *Soyaux 380* (para: B†; iso: P).
Paxia soyauxii (Gilg) Pierre ex Schellenberg, 1910: 31; 1938: 116; Troupin, 1952: 80. Basionym: *R. soyauxii* Gilg (see above).
Paxia liberosepala (Baker f.) Schellenberg, 1938: 115; Hepper, 1958: 740. Basionym: *Spiropetalum liberosepalum* Baker f., 1913: 24. Type: Nigeria, Oban, *Talbot 1404* (holo: K; iso: BM, G).
Paxia cinnabarina Schellenberg, 1919: 449; 1938: 118; Hepper, 1958: 741. Type: Cameroun, Bipindi, *Zenker 2791* (holo: B†; lecto: K; iso: E, G, L, M, Z).
Paxia lancea Schellenberg, 1919: 450; 1938: 118. Type: Cameroun, Mimfia, *Zenker 4553* (holo: B†). Neotype: Gabon, Lastoursville region, *Le Testu 7962* (holo: WAG; iso: E, BM, BR, P).
Paxia zenkeri Schellenberg, 1919: 448; 1938: 116. Type: Cameroun, Bipindi, Nkaumbe, *Zenker 3337* (holo: B; iso: E, G, K, L, MO, P, Z).

Large liana up to 40 m long. *Branches* glabrous and often silvery grey; branchlets puberulous. *Petiole* 5-10 cm long; rachis 0-15 cm long; petiolules 1-5 mm long; *leaflets* 1-11, very variable in shape, ovate, elliptic or oblong to oblong-obovate, coriaceous or rarely chartaceous, nearly glabrous; apex acute to acuminate, mucronate; terminal leaflet 4-18 × 2-8.5 cm; lateral ones 3-14 × 1.5-6.5 cm, almost symmetrical. *Inflorescence* up to 15 cm long, puberulous or glabrous; bracts and bracteoles similar to small sepals. *Pedicel* above the joint 0-2 mm long. Flower bud globose. *Sepals* 3-4 × 1.5-2.5 mm, puberulous outside, almost glabrous inside, the sun exposed sides red, the shaded parts white (often the two colours present in one flower); *petals* 10-15 × 1-3 mm, frequently coherent near the base, folded in bud. Long *stamens* 2-6 mm long, short ones 1.5-3 mm long, filaments curved inwards. *Pistil* 1.5-5 mm long; style with some hairs; ovary pilose. *Follicles* one per flower sometimes more, 25-45 × 15-20 mm, beaked, glabrous, frequently (pseudo?) lenticellate. Sepals in fruit 6-12 × 4-6 mm, coriaceous, nearly glabrous. Seed coat for one third fleshy, other part of testa thin, shining and very dark red to black. Radicle ventral.

Distribution: From Nigeria eastward to Zaire and southward to Angola.
Ecology: Rain forest from sea level up to 500 m alt.

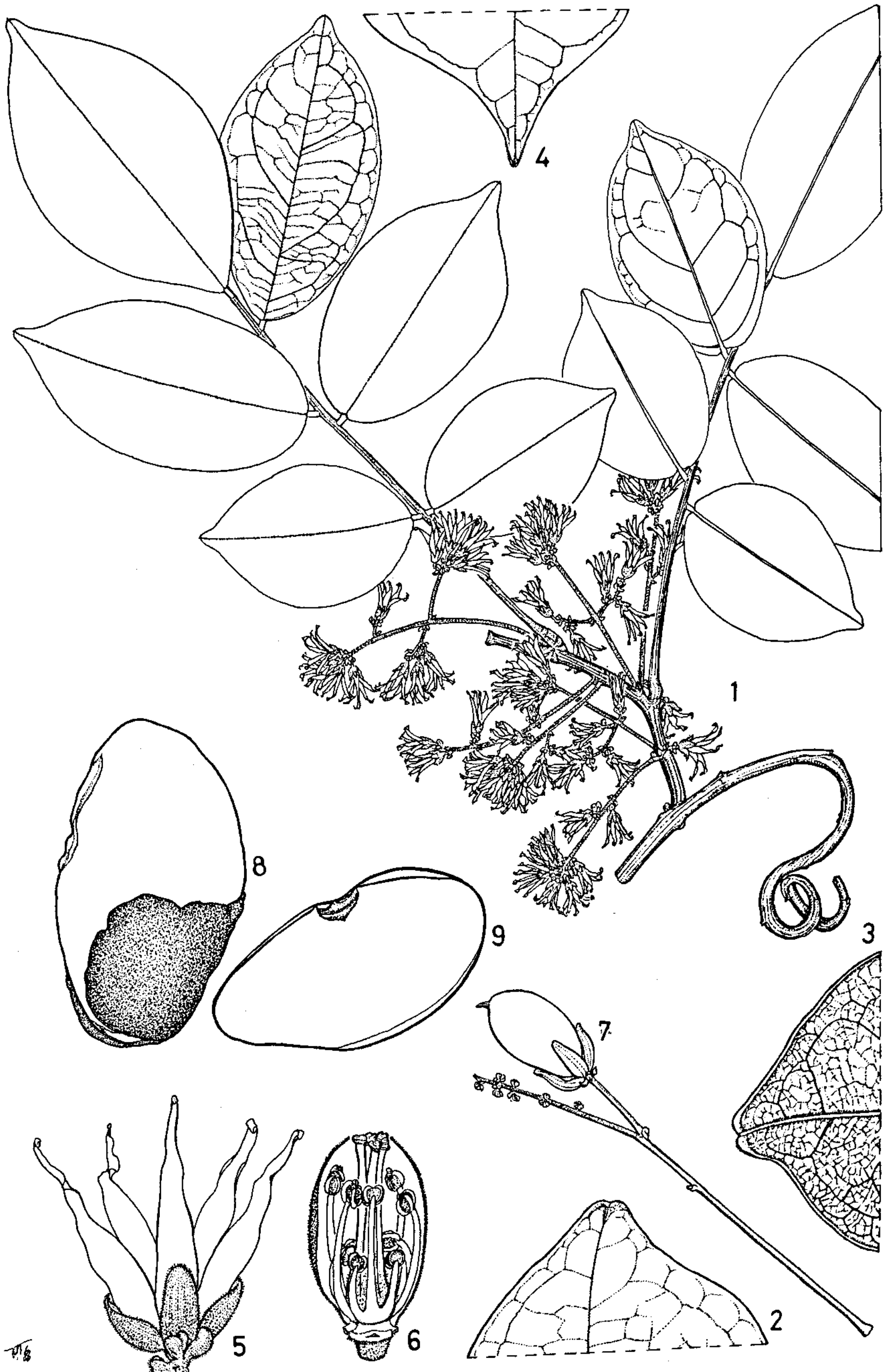


Fig. 165. *Rourea myriantha*: 1. flowering branchlet, 2/3 ×; 2-4. leaflet apices, 2 ×, 2. & 4. from above, 3. from below; 5. flower, 4 ×; 6. flower partly, showing stamens and pistils of a long-styled flower, 6 ×; 7. fruit, 2/3 ×; 8. seed, showing sarcotesta (dark part), 2 ×; 9. cotyledon inside with ventral radicle, 2 ×. (1. *J.de Wilde 8071*; 2-3. *Letouzey 12045*; 4. *Zenker 2933*; 5-6. *J.de Wilde et al. 511*; 7. *Farron 4607*; 8-9. *Zenker 2933*).

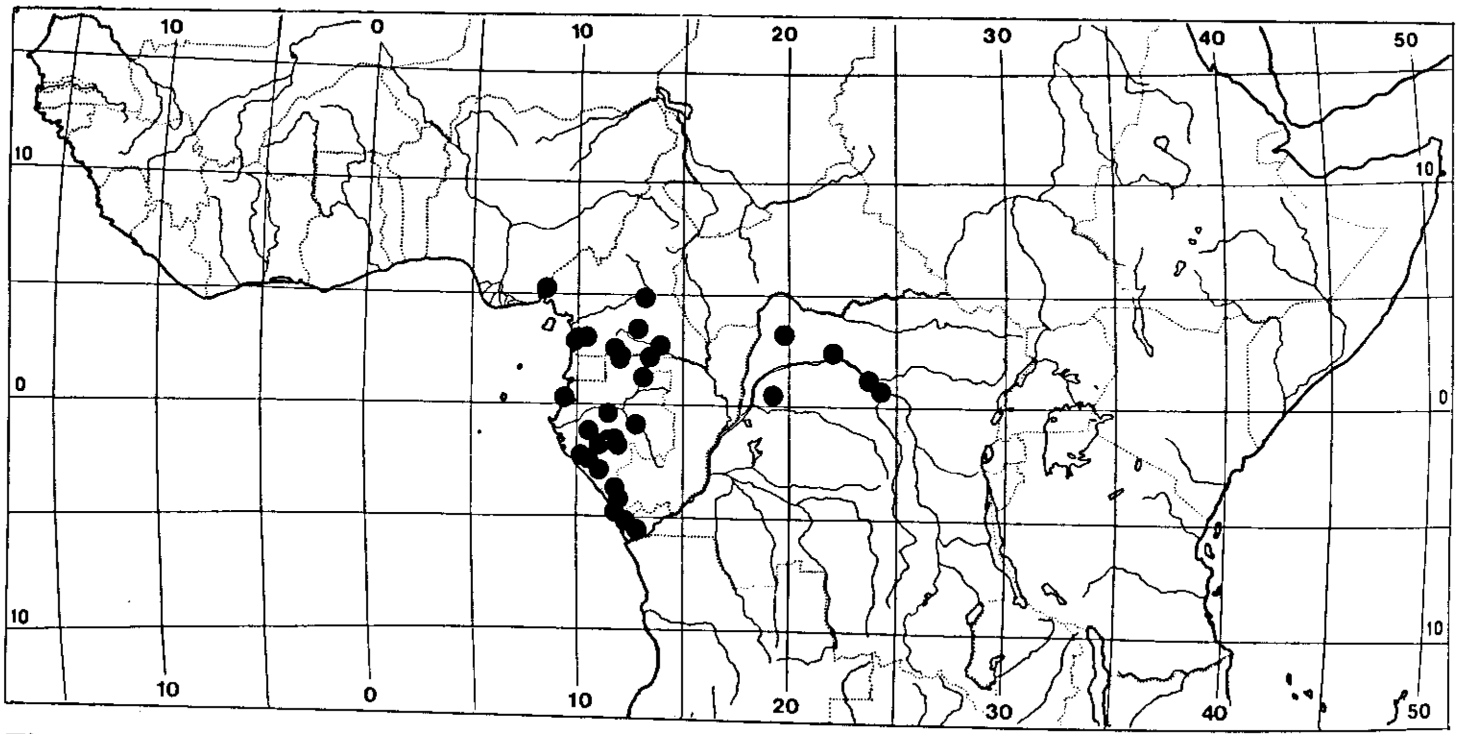


Fig. 166. Distribution of *Rourea myriantha*

Selection of the 76 specimens examined:

Nigeria: Oban (fl.) *Talbot 1404* (BM, G, K, type of *Paxia liberosepala*).

Cameroun: Kribi (fl. March) *Bos 4121* (P, WAG); (fl. May) *Bos 4496* (P, WAG); between Poute and Ebaka (fr.) *Letouzey 2913* (P;WAG); 12 km E of Somalomo (fr. Feb.) *Letouzey 4334* (P, WAG); near Mvangan (fl. March) *Letouzey 10122* (BR, P, WAG); Mbalam (fl. Feb.) *Letouzey 12045* (K, P, WAG); Bipindi (fr. April) *Zenker 584* (B, C, G, MO, P, U, WAG).

Gabon: sin. loc. (fl.) *Griffon du Bellay s.n.* (P, type) Bélinga (fr. July) *Hallé & Le Thomas 75* (P); Libreville (fl. March) *Klaine 3* (HBG, P); (fl. March) *Klaine 2822* (G); Tchibanga (fr. Sept.) *Le Testu 1631* (BM, P); Pounga (fl. Feb.) *Le Testu 5242* (BM, BR, LISC, P, WAG); Haute Ngounié (fl. Feb.) *Le Testu 6394* (BM, BR, P); Lastoursville (fl. March) *Le Testu 7951* (BM, BR, LISC, P, WAG, type of *Paxia lancea*); Sibange Farm, near Libreville (fl. March) *Soyaux 70* (K, P, Z, type of *R. soyauxii*); (y.fr. March) *Soyaux 262* (K, P, Z, type of *Paxia scandens*).

Congo: between Kakamoeka and the Loundji (fl. March) *Attims 84* (P); near Edou (fl.b. July) *Descoings 7995* (P); 4 km W Grand-Bois (fr. Aug.) *Farron 607* (P, WAG); Boungola (fl. Jan.) *Farron 4876* (P, WAG).

Zaire: Yambata (fl. Oct.) *De Giorgi 1377* (BR); (fl. Oct.) *De Giorgi 1425* (BR); Gemena (fl. July) *Evrard 1349* (BR); E of Basoko (fr. Feb.) *Germain 4743* (BR); Mondjo (fr. Sept.) *J.Léonard 524* (BR); Yangole (fr. Oct.) *Louis 12097* (BR).

Angola: Cabinda, Panga Mungo (fl.) *Gossweiler 6294* (COI, LISU) (fr. Aug.) *Gossweiler 6590* (COI, LISU); Cabinda, Buco Zau (fr. Sept.) *Gossweiler 6712* (COI).

Note 1: This species is in Schellenberg's revision segregated into six species of the former genus *Paxia*. They were delimited by him exclusively by the shape of the leaflets. It is often not hard to recognize two or more of those six species on separate sheets of a single herbarium accession, as *R. myriantha* is very variable in the shape of the leaflets. No relation between leaflet shape and geographical area was found.

Note 2: Because it was hard to find a collection that properly matches the first description of *Paxia lancea* properly, the neotype does not originate from the same area as the lost holotype.

Rourea obliquifoliolata Gilg **Fig. 19, 167, 168**

R. obliquifoliolata Gilg 1891: 328.
Type: Zaire, Mukenge, *Pogge 733* (holo: B†).
Neotype: Cameroun, Bipindi, *Zenker 2992* (holo: WAG; iso: B, BR, E, G, GOET, L, M, MO, Z).
R. fasciculata Gilg, 1891b: 329. Type: Zaire, Mukenge, *Pogge 731* (holo: B†). Neotype: Cameroun, Kribi, *Bos 5363* (holo: WAG; iso: BR, K, P).
R. fasciculata Gilg var. *flagelliflora* Welwitsch ex Hiern, 1896: 187. Type: Angola, Cuanza Norte, Cazengo, *Welwitsch 4628* (holo: BM; iso: COI, G, P).
R. adiantoides Gilg, 1896: 213. Type: Cameroun, Yaoundé, *Zenker & Staudt 402* (holo: B†; lecto: K).
R. ptaeroxyloides Gilg, nomen; Schellenberg, 1910: 28.
Roureopsis obliquifoliolata (Gilg) Schellenberg, 1910: 28; 1938: 108; Troupin, 1952: 77; Exell & Mendonça, 1954: 145; Hepper, 1958: 740; Burkill, 1985: 524. Basionym: *R. obliquifoliolata* Gilg (see above).
Roureopsis fasciculata (Gilg) Schellenberg, 1910: 28. Basionym: *R. fasciculata* Gilg (see above).

Large liana up to 25 m long or shrub. *Branchlets* puberulous. *Petiole* 0-0.5 cm long; rachis 3.5-28 cm long, puberulous; petiolules 0.5-3 mm long; *leaflets* 13-41, ovate to elliptic or rhombic to kidney-shaped, puberulous beneath on the midrib or glabrous, chartaceous; apex rounded to subacuminate, mucronate; terminal leaflet 1.7-9 × 1-5 cm; lateral ones 0.7-8.5 × 0.4-3.5 cm, strikingly asymmetrical. *Inflorescence* up to 1.2 cm long, subglobose, often many together at the end of a leafy branch resembling a terminal inflorescence. *Pedicel* above the joint 0-1 mm long. *Sepals* 3-6 × 1.5-2.5 mm, nearly glabrous inside. *Petals* 11-14 × 1.5-2 mm, lorate, free, inrolled in bud. Long *stamens* 2.5-7 mm long, short ones 1.5-5 mm long. *Pistil* 1.5-6 mm long; style with a few hairs; ovary with hairs only on surfaces facing adjacent carpels. *Follicles* one to five per flower, 15-24 × 7-10 mm, glabrous, dehiscing by a ventral suture. Sepals in fruit 6-8.5 × 2.5-3 mm, reddish, chartaceous to coriaceous, almost glabrous. Seedcoat for ca one fourth fleshy, other part of testa thin, shining and black; radicle ventral.

Distribution: From Nigeria eastward to Zaire and southward to Angola.
Ecology: Rain forest and gallery forest from sea level up to 1000 m alt.

Selection of the more than 150 specimens examined:

Nigeria: Calabar, Akor-Orem (fl. Jan.) *Onochie FHI 36103* (K); Oban (fl.) *Talbot 504* (Z).
Cameroun: Bukundu F.R., *Binuyo & Daramola FHI 35075* (P); Kribi (fl. Nov.) *Bos 3344* (WAG); (fl., fr. Nov.) *Bos 3356* (WAG); (fr. May) *Bos 4556* (WAG); (fl. June) *Bos 4823* (BR, MO, P, WAG); (fl., fr. Sept.) *Bos 5363* (BR, P, WAG, type of *R. fasciculata*); Bertoua (fl., y.fr. Sept.) *Breteler 239* (WAG); (fr. Dec.) *Breteler 707* (BR, WAG); Yokodouma (fl. June) *Breteler 1546* (BR, WAG); Mboro R. (fl. Jan.) *J.J.de Wilde 7904* (WAG); S of Nkoulaze (fr. March) *Letouzey 4546* (BR, P);

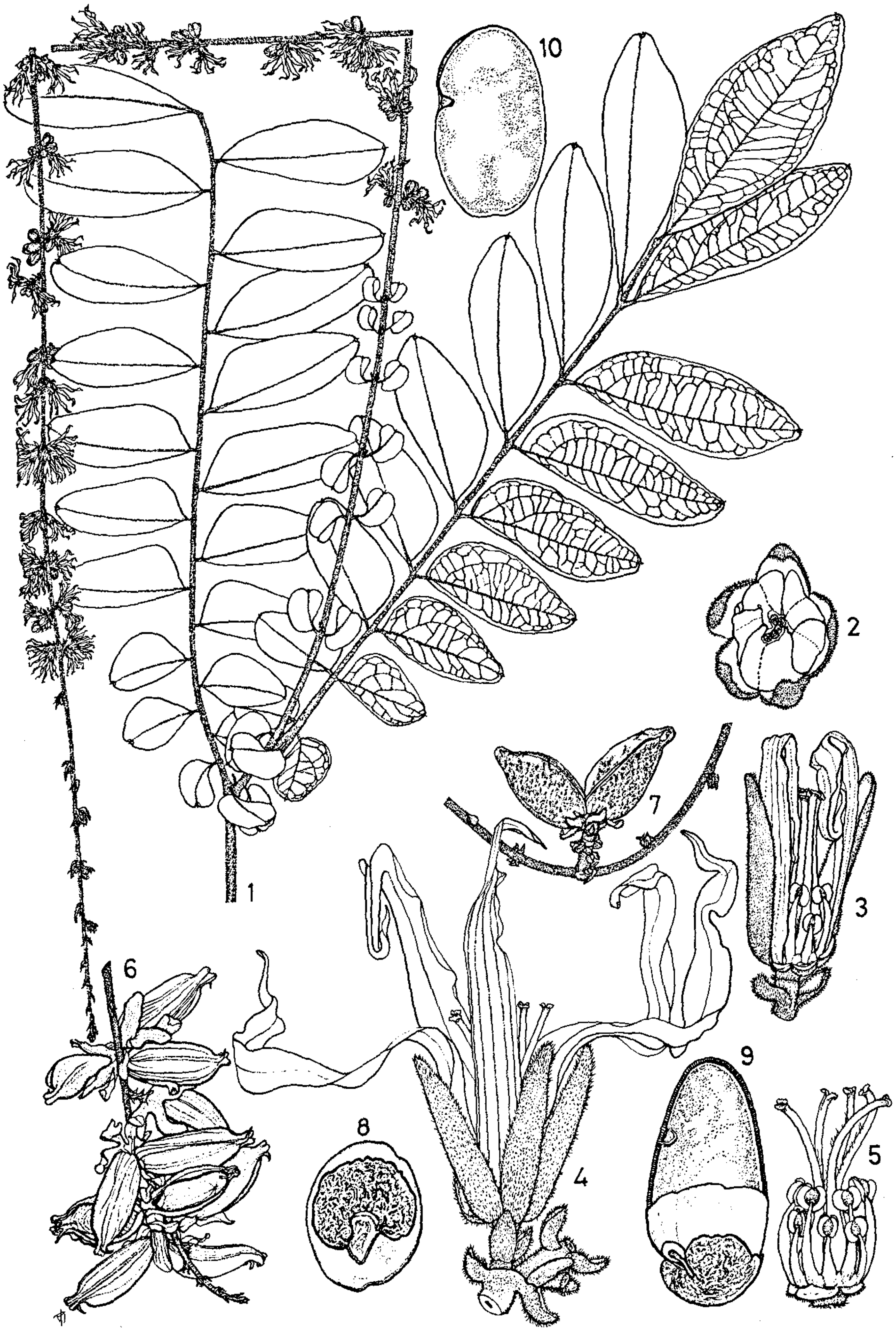


Fig. 167. *Rourea obliquifoliolata*: 1. flowering branchlet, 2/3 ×; 2. young flower from above, 4 ×; 3. young flower partly, showing inrolled petals, 4 ×; 4. flower, 4 ×; 5. stamens and pistils of a long-styled flower, 4 ×; 6. branchlet with fruits, 2/3 ×; 7. fruit, 2/3 ×; 8. seed from beneath, showing sarcotesta (dark part) and hilum, 2 ×; 9. seed partly (one cotyledon partly removed) showing cotyledon inside with ventral radicle, 2 ×; 10. cotyledon with ventral radicle, 2 ×. (1. *Breteler 6240*; 2-5. *A.Louis et al. 938*; 6. *Reitsma et al. 1280*; 7-9. *A.Louis et al. 515*; 10. *Reitsma et al. 1280*).

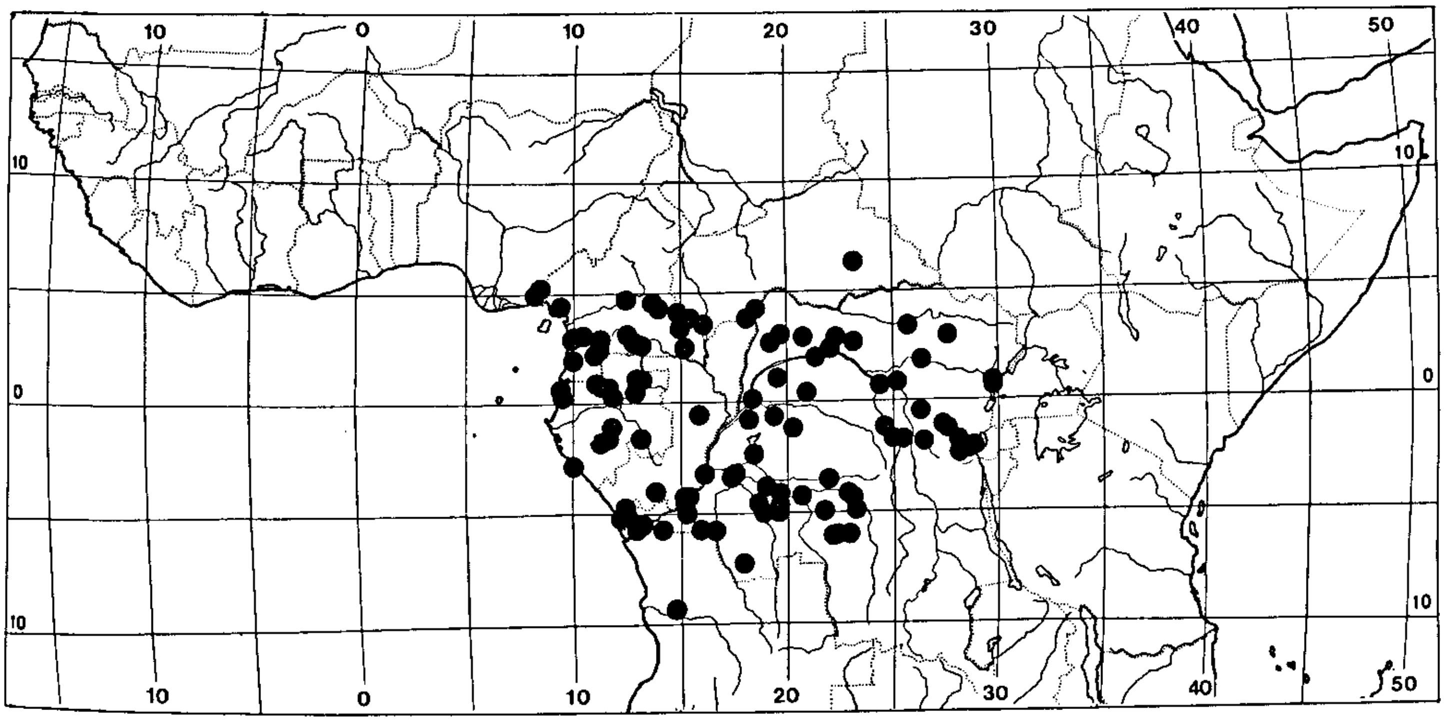


Fig. 168. Distribution of *Rourea obliquifoliolata*

Banga (fl. April) *Letouzey 4902* (BR, P); Bipindi (fl.) *Zenker 2992* (B, BR, E, G, GOET, L, M, MO, WAG, Z, type).

Central African Republic: Bimbo (fl. Dec.) *Breyne 1379* (BR); 35 km SW Bangui (fr. Dec.) *Hepper 4114* (K); Sosa, W of Yandiba (fl. July) *Leeuwenberg 6247* (BR, P, WAG); near Mbanza (fr. Nov.) *Leeuwenberg 7137* (WAG); Yalinga (fl. July) *Le Testu 4006* (BM, BR, P, WAG); (fr. Nov.) *Le Testu 4289* (BR); Mbaiki (fl. June) *Equipe Tisserant 3775* (BR).

Equatorial Guinea: Bebai, *Tessmann 536* (K); sin. loc. (fl.) *Tessmann 1008a* (HBG, K).

Gabon: Mayibout 2 (fl., fr. Sept.) *Breteler & de Wilde 666* (LBV, WAG); Gamba (fr. Sept.) *Breteler & van Raalte 5644* (WAG); between Mouila and Yéno (fr. Sept.) *Breteler & Lemmens 8111* (LBV, WAG); Nkogo (fr. Aug.) *Chevalier 26355* (P); Mbigou (fl. June) *Le Testu 5968* (BM, BR, P); Oveng (fr. Nov.) *Louis et al. 515* (LBV, WAG).

Congo: km 16 route Mouyondzi-Mayama, *Bouquet 633* (P); Otende village (fl. June) *Bouquet 1486* (P); Stanleypool (fl. Aug.) *Fr.Hens 38* (Z); Ngandju Sedec (fl. June) *Vermoesen 2450* (BR).

Zaire: Beonde (fr. April) *Bamps 586* (BR); Panga (fl., fr. Dec.) *Bequaert 1532* (BR); Panzi (fl. Feb.) *Callens 3121* (BR); Kizulu (fr. Dec.) *Compère 983* (BR); Mobwasa (fl. May) *De Giorgi 836* (BR); Bokakata (fr. Feb.) *Dewèvre 772* (BR); Mbolohu Road (fl. Sept.) *J.de Wilde 383* (BR, WAG); Bankaie (fr. July) *Gilbert 14355* (BR); Kapinga (fr. Nov.) *M.Laurent s.n.* (BR); Bunyakiri (fl., fr. Feb.) *A.Léonard 2910* (BR, WAG); Bulungu (fr. April) *Pauwels 5582* (BR).

Angola: Cabinda, Panga-Mungo (fl.) *Gossweiler 6288* (COI); Cabinda, Buco Zau (fr.) *Gossweiler 7322* (COI, LISU); Cabinda, Buco Zau (fl. Oct.) *Monteiro et al. 382* (LISC); Cuanza Norte, Cazengo (fl., fr. June) *Welwitsch 4628* (BM, COI, G, P, type *R.fasciculata* var *flagelliflora*).

Cult: Photograph in collection WAG of seedlings in greenhouse. Seedlings of *Breteler s.n.* 1961 from Cameroun.

Note 1: Although this species has been proposed as new on several occasions it is very uniform in comparison to other species of *Rourea*. Even Schellenberg found no reasons to segregate it into several taxa and in 1938 he treated it in the same manner as in the present revision.

Note 2: Because this species is uniform throughout its area, the neotypes have been selected by their availability in the herbaria, rather than by their origin in the vicinity of the original collecting localities.

Rourea orientalis Baill. **Fig. 169-171**

R. orientalis Baillon, 1867: 230; Keraudren, 1958: 7, fig. 1.
Type: Kenya, Mombasa, *Boivin s.n.* (holo: P).

R. orientalis var. *hirtella* Keraudren, 1957: 527; 1958: 7. Type: Madagascar, Morondava-Bemaraha, *Humbert 11367* (lecto: P); *11360b* (para: P).

R. orientalis var. *pubescens* Keraudren, 1957: 527; 1958: 7. Type: Madagascar, Ankarafantsika, *Reserves Naturelles 2005* (lecto: P); *2543* (para: P).

R. pervilleana Baillon, 1867: 232; 1887: tab.16; Drake de Castillo, 1902: 32. Type: Madagascar, Nossibé, *Pervillé 755* (holo: P).

R. ovalifoliolata Gilg, 1891b: 327. Type: Kenya, Mombasa, *Hildebrandt 1943* (holo: B†; lecto: K).

R. macrantha Gilg, 1900: 393. Type: Tanzania, Uhehe, Ruahe, *Goetze 417* (holo: B†; lecto: K).

R. bussei Gilg, nomen on *Busse 804*.

Byrsocarpus orientalis (Baill.) Baker, 1868: 452; Schellenberg, 1919: 453; 1938: 151; Hemsley, 1956: 17, fig. 6; Mendes, 1966: 624; Mendes, 1969: 6. Basionym: *R. orientalis* Baill. (see above).

Byrsocarpus orientalis var. *hirtella* Keraudren, 1957: 527 (see *R. orientalis* var. *hirtella* Keraudren).

Byrsocarpus orientalis var. *pubescens* Keraudren, 1957: 527 (see *R. orientalis* var. *pubescens* Keraudren).

Byrsocarpus pervilleanus (Baill.) Schellenberg, 1938: 153. Basionym: *R. pervilleana* Baill. (see above).

Byrsocarpus baronii Baker, 1887: 462; Schellenberg, 1938: 151. Type: Madagascar, *Baron 4922* (holo: K).

Byrsocarpus ovalifoliolatus (Gilg) Schellenberg, 1910: 42. Basionym: *R.* ovalifoliolata *Gilg* (see above).

Byrsocarpus tomentosus Schellenberg, 1919: 452; 1938: 151 (pro parte: Angolan material is excluded, it represents *R. coccinea* ssp. *coccinea* var. *coccinea*); Troupin, 1952: 92. Type: Tanzania, Ssongea, *Busse 804* (holo: B; iso: EA, G, WAG).

Byrsocarpus usambaricus Schellenberg, 1938: 154. Type: Tanzania, E Usambara, Longusa-Sigital, *Peter 40014* (holo: B).

Byrsocarpus baillonianus Gilg, nomen; Schellenberg, 1910: 40.

Shrub, rhizomatous shrublet, small tree or lianescent shrub, usually deciduous, often evergreen in SE Zaire. *Branches* strongly lenticellate, terete and often with a distinct cork layer; branchlets puberulous to tomentose. *Petiole* 1.5-7 cm long; rachis 6-30 cm long; petiolules 0.5-2 mm long; *leaflets* 13-33, oblong to oblong-ovate, chartaceous to thinly coriaceous, glabrous to tomentose; apex rounded to acute; terminal leaflet 1-5.5 × 0.5-3 cm, sometimes obovate; lateral ones 0.8-5 × 0.3-2.5 cm, nearly symmetrical. *Inflorescence* up to 7 cm long, glabrous to tomentose. Pedicel above the joint 1-5 mm long. *Sepals* 1.5-3 × 1.5-3 mm. *Petals* 7-12 × 3-4 mm, coherent near base, sometimes folded

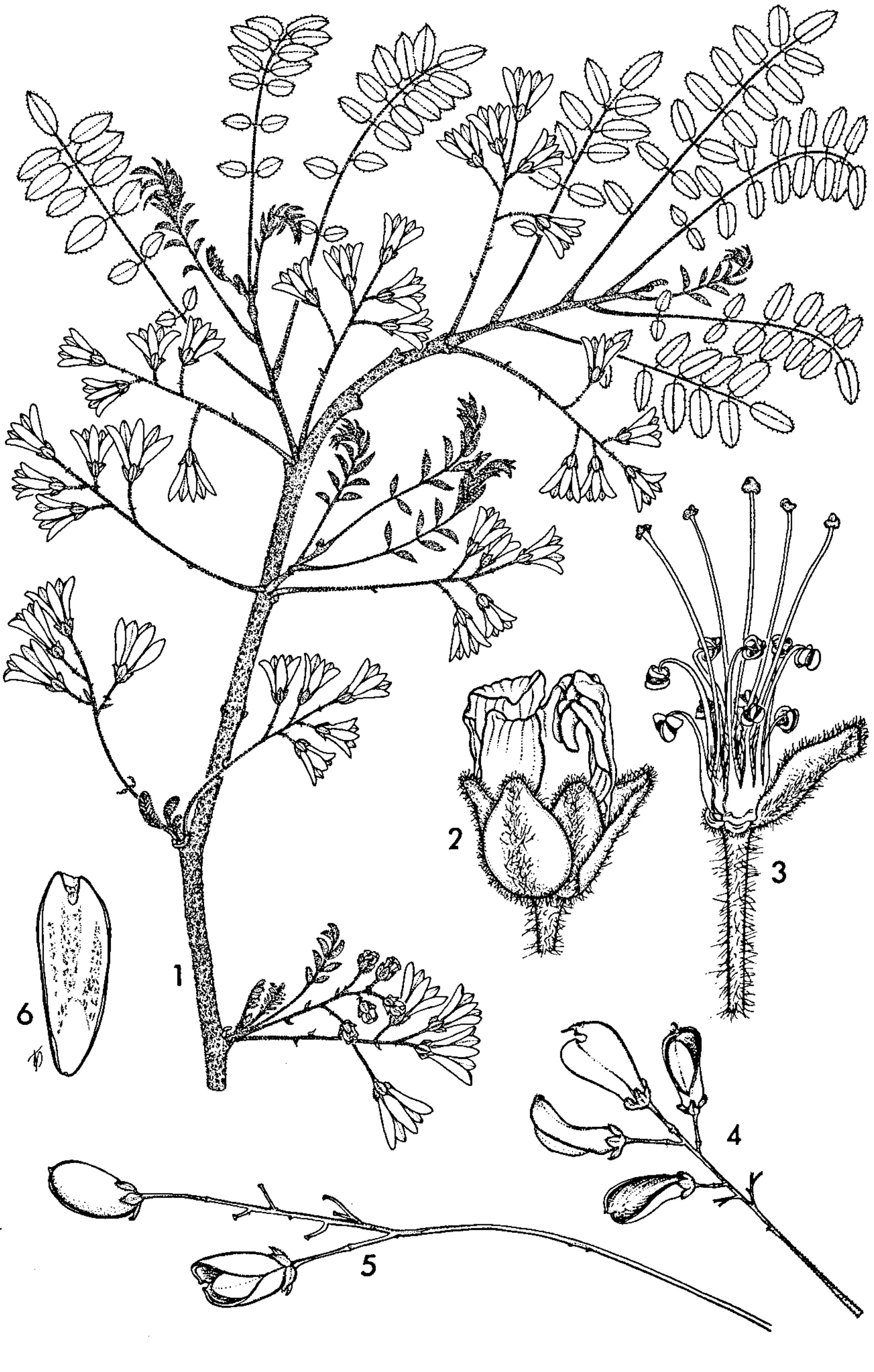


Fig. 169. *Rourea orientalis*: 1. flowering branchlet, 2/3 ×; 2. opening flowerbud, 9 ×; 3. stamens and pistils, long-styled flower, 4 ×; 4-5. fruits, some showing seed, 2/3 ×; 6. cotyledon with apical radicle, 2 ×. (1-3. *Mendonca 870*; 4. *Torre & Paiva 9758*; 5. *Torre & Paiva 9493*; 6. *Torre & Paiva 9758*).

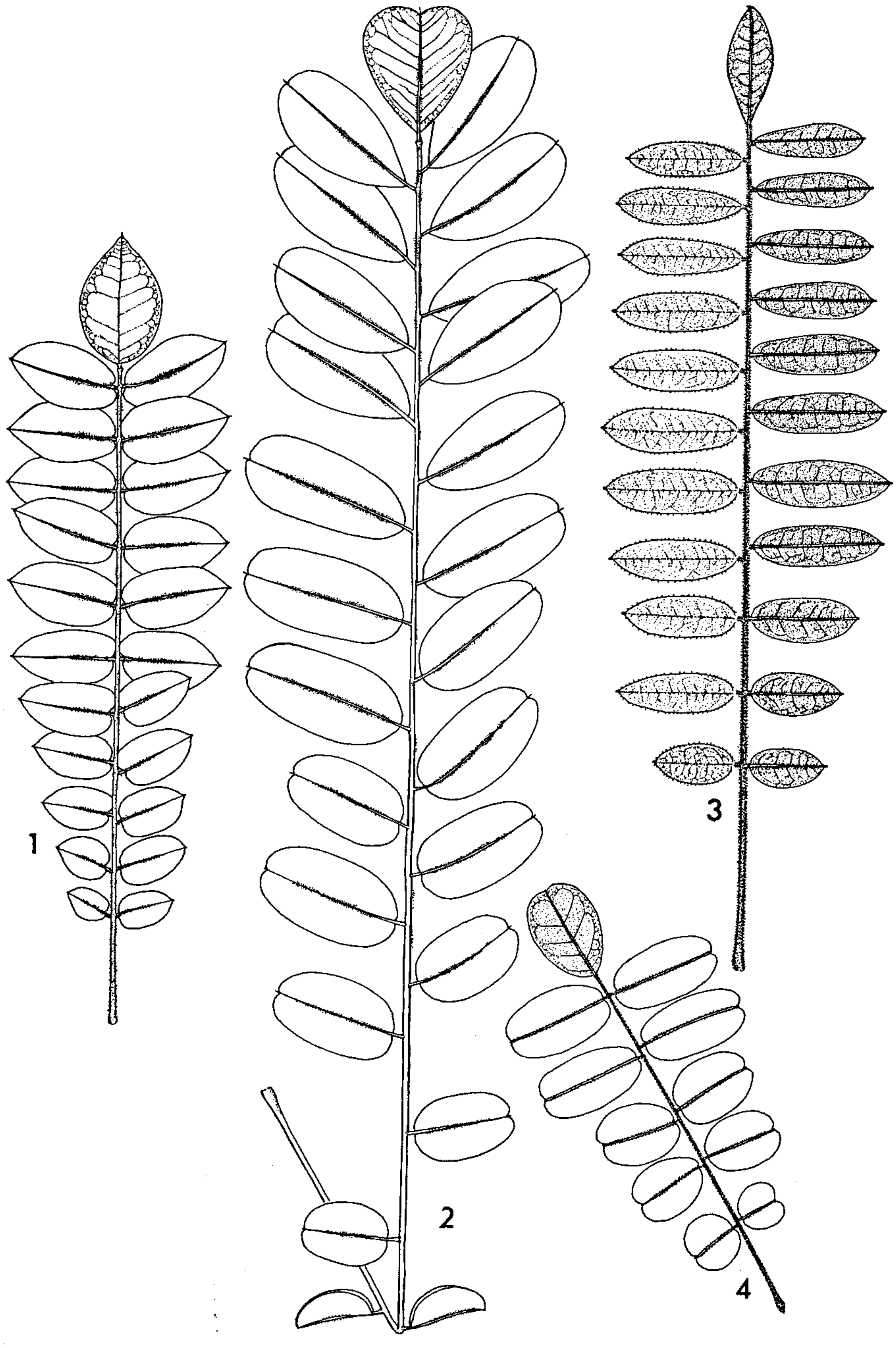


Fig. 170. *Rourea orientalis*: 1-4. leaves, 2/3 ×. (1. *Torre & Paiva 9758*; 2. *Torre & Paiva 9493*; 3. *Milne-Redhead 3660*; 4. *Lewis 174*).

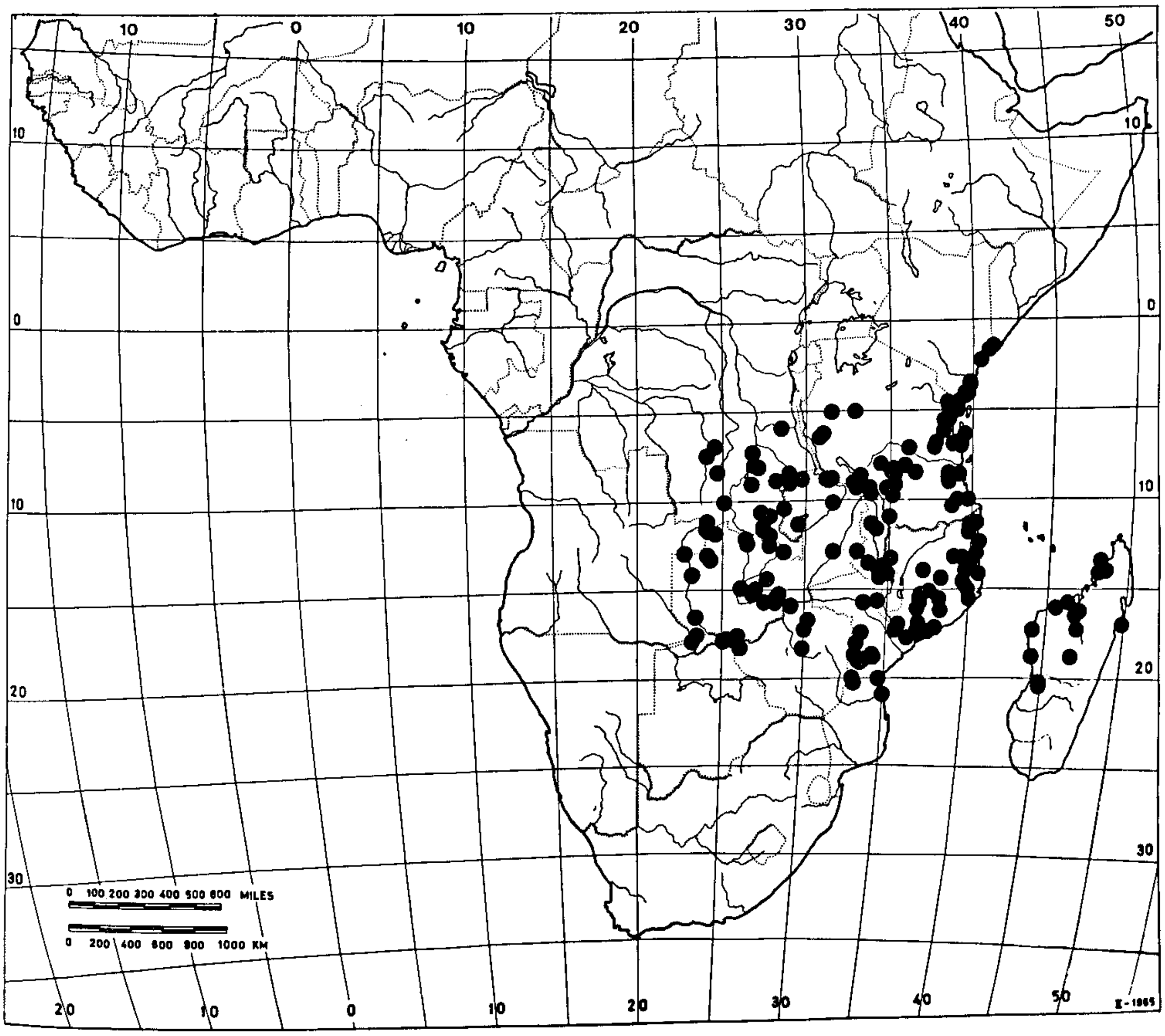


Fig. 171. Distribution of *Rourea orientalis*

at the top especially in bud. Long *stamens* 1.5-7 mm long, short ones 1-4.5 mm long. *Pistil* 1.5-4 mm long; style sparsely hairy; ovary pilose. *Follicles* one per flower rarely more, 15-23 × 5-12 mm, symmetrical, top rounded, dehiscing by a ventral suture, glabrous. Sepals in fruit 3.5-5 × 3-4 mm, imbricate. Seed coat entirely fleshy and scarlet, the radicle is emerging from the sarcotesta at the apical end.

Distribution: E Africa, Southern-Central Africa, Southern Africa excluding the Republic of South Africa, and Madagascar.

Ecology: Thicket edges in savanna and semi-deciduous forest up to 2500 m alt., frequently on termite mounds.

Selection of the more than 300 specimens examined:

Zaire: Kina (fl. Oct.) *Desenfans 4582* (BR); Niemba (fl. Oct.) *De Saeger P3* (BR); 63 km NW of Kolwezi, *Empain et al. 2316* (BR); Pweto (fr. Dec.) *Lisowski 54242* (BR); Musoshi (fr. Dec.)

Lisowski 54244 (BR); Kaniama (fr. Dec.) *Mullenders 1748* (BR); Kisamamba (fr. Dec.) *Symoens 6763* (BR).

Kenya: Pengo Hill (fl. Jan.) *Bamps 6333* (BR, EA); Mombasa (fr.) *Boivin s.n.* (P, type); Mikongaga (fr. Dec.) *Haerdi 177/0* (EA); Mombasa (fl. March) *Hildebrandt 1934* (BM, K); Sokoke (fl.) *Jeffrey K166* (EA, G, K); 25 km NW of Kiunga shops, *Muchiri 536* (EA); Shimba Forest (fl. April) *Lucas et al. 245* (K).

Tanzania: 8 km N Mpanda (fr. Feb.) *Boaler 483* (EA); Lupa F.R. (fr. Dec.) *Boaler 785* (K); Zanzibar, Kizimkazi (fr. March) *Faulkner 2521* (B, BR, K); 19 km from Lukumburu to Songea (fl. Nov.) *Gillet 17885* (EA); Univ.College Dar es Salaam (fr. Nov.) *Harris 2604* (EA, WAG); Dabaga (fl.b. Feb.) *Lynes D67* (K); Kidatu (fr. Jan.) *Mhoro 211* (EA, K); Nahoro (fr. Dec.) *Milne-Redhead & Taylor 7612* (B, BR, EA, K); Amboni-Kiongwe (fr. June) *Peter 23701* (B); Kombe (fr. Jan.) *Peter 35443* (B).

Zambia: Mwinilunga (fl. Sept.) *Angus 570* (BM, K); Mfuwe (fr. Nov.) *Astle 4110* (K, SRGH); 15 km S of Broken Hill (fl. Sept.) *Brenan & Greenway 7859* (K, P); 25 mls S of Solwezi (fl. Sept.) *Brenan & Greenway 7987* (K, WAG); Chingola (fl. Oct.) *Fanshawe 2536* (K); S of Matonchi Farm, fl. Oct.) *Milne-Redhead 2726* (BM, BR, K); SW of Dobeka bridge (fr. Dec.) *Milne-Redhead 3660* (BR, K); Kalambo Falls (fl. Nov.) *Richards 18418* (BR, K); Mapanza W (fl. Sept.) *Robinson 899* (K); near Chavuma (fr. Oct.) *White 3499* (K).

Zimbabwe: Victoria Falls (fl. Nov.) *Armitage 163/59* (SRGH); 4 km N of the confluence of the Muzirizwi R. and the Bwazi R. (fr. Jan.) *Biegel et al. 4817* (K, PRE, SRGH); 12 km S of Kadoma, *Burrows 1959* (SRGH); near top of Katombora Rapids (fr. Dec.) *Gonde 400* (SRGH); Chipingabadfa Farm (fl. July) *Jacobsen 1405* (PRE); Haroni R. (fr. Jan.) *Mavi 804* (SRGH); S of Matonchi Farm (fl. Oct.) *Milne-Redhead 2726* (BM, BR, K); km 8 Margula-Lions Den (fl. Oct.) *Pope 798* (BM, K, PRE, SRGH).

Malawi: Mua Livulezi Forest (y.fr. Jan.) *Adlard 535* (P, SRGH); 5 mls S of Monkey Bay (fl. Dec.) *Eccles 208* (SRGH); 77 km N of Lilongwe (fl. Oct.) *Gillet 17514* (L, SRGH, WAG); Kasungu N.P. (fl. Dec.) *Hall-Martin 1037* (SRGH); Songwe N.P. (y.fr. Nov.) *Hall-Martin 1134* (SRGH); Nkhata Bay (fr. Jan.) *Pawek 5057* (SRGH); Salima (fr. Feb.) *Robson 1614* (SRGH).

Mozambique: Namacurra (fr. May) *Andrada 1530* (COI, LISC); Quissanga (fr. Oct.) *Barbosa 2422* (IIAM, LISC, SRGH); Buzi Reserve (fl., fr. Oct.) *Carvalho 672* (IIAM, PRE); Moatize (fr. Jan.) *Correia 348* (COI, IIAM, LISC, SRGH); Gogoi Road (fr. Nov.) *Laech & Chase 10499* (COI, LISC, PRE, SRGH); Marrupa, Mahua (fl. Oct.) *Mendonça 870* (COI, K, LISC, PRE); Erati, between Namapa and Nacaroa (fl. Oct.) *Mendonça 1147* (COI, LISC, PRE); de Namina a Ribaue (fr. Dec.) *Torre 1111* (COI); Lichinga (fl.b. March) *Torre & Paiva 11017* (LISC); km 34 from Catandice, Tete Road (fr. Dec.) *Torre & Correia 13551* (IIAM, LISC, M, WAG).

Namibia: E Caprivi strip, Chobe R. (fr. Jan.) *Killick 3389* (M, PRE, SRGH); W Caprivi strip, Kwando Flood Plain margin (fl. Oct.) *Tinley 1530* (L, M, PRE).

Botswana: Chobe distr. (fl. Oct.) *Miller B/1099* (PRE); Kasane Rapids, *Robertson & Elffers 53* (K,PRE).

Madagascar: Nossi-Bé (y.fr. Dec.) *Bernardi 11839* (L, P, Z); Sainte-Marie, *Boivin 1887* (P); Marovato-Anketraka (fr. Jan.) *Gilbert 5457* (P); Forest relicts SE of Morondava (fl. Oct.) *Humbert 11367* (P, type of *R. orientalis* var *hirtella*); Tsiempihy Forest (fr. Dec.) *Léandri et al. 2284* (P); Ambato Boeni (fl.) *Saboureau 1113* (P).

Note 1: Flowers and foliage are usually produced simultaneously on the bare shrub.

Note 2: This species is in Schellenberg's revision represented by four different species in the former genus *Byrsocarpus,* all of them exclusively based on differences in leaf shape or leaf indumentum. These characters are too feeble to justify recognition of these taxa. Most of these forms are found throughout the entire area of the species.

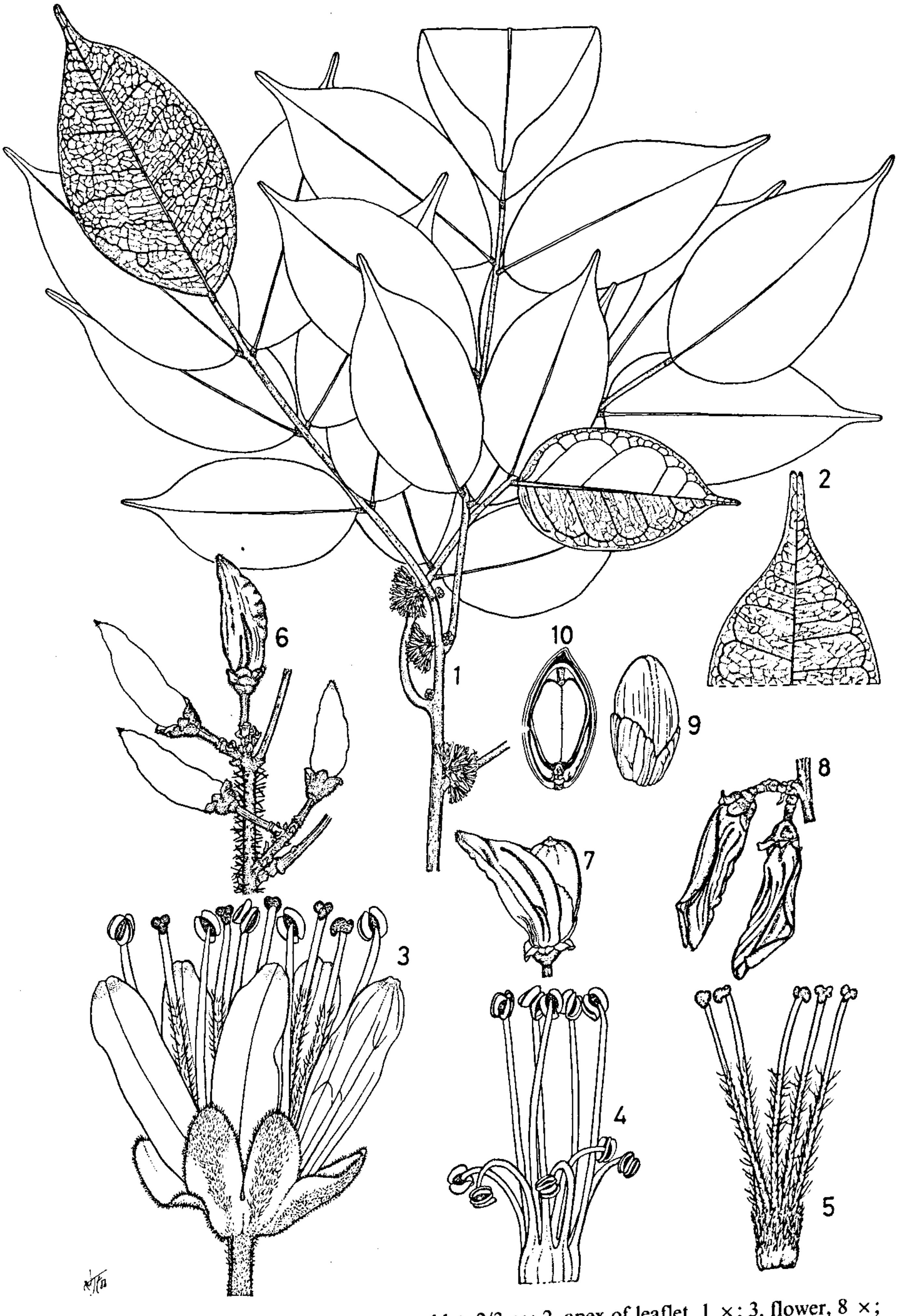


Fig. 172. *Rourea parviflora*: 1. flowering branchlet, 2/3 ×; 2. apex of leaflet, 1 ×; 3. flower, 8 ×; 4. stamens, 8 ×; 5. pistils of a long styled flower, 8 ×; 6. branchlet with fruits, 2/3 ×; 7. follicle showing seed, 2/3 ×; 8. empty follicles, 2/3 ×; 9. seed showing sarcotesta, 1 ×; 10. seed longitudinal section, showing the cotyledons and the apical radicle, 1 ×. (1. *Zenker 2876*; 2. *Breteler 1649*; 3-5. *Zenker 2876*; 6. *J.Louis 15336*; 7. *J.Louis 2722*; 8. *A.Leonard 2879*; 9-10. *Breteler 1649*).

Rourea parviflora Gilg **Fig. 172, 173**

R. parviflora Gilg, 1891b: 322.
Type: Cameroun, Mt John, *E.Mann 1795* (holo: B†; lecto: K; iso: P).
R. strigulosa Gilg, 1896: 211. Type: Cameroun, Yaoundé, *Zenker & Staudt 747* (holo: B†; lecto: K; iso: BM, GOET, M, Z).
Byrsocarpus parviflorus (Gilg) Schellenberg, 1910: 45; 1912: 245; 1938: 157; Troupin, 1952: 97; Exell & Mendonça, 1954: 150. Basionym: *R. parviflora* (see above).
Santaloidella gilletii Schellenberg, 1938: 119; Troupin, 1952: 81; Caballé, 1986: 198, 214. Type: Zaire, sin. loc., *Gillet anno 1909* (holo: BR).

Large liana up to 35 m long and 15 cm diameter. *Branches* deeply furrowed, usually with interxylary phloem; branchlets puberulous to glabrous. *Petiole* 2.5-7 cm long; rachis 6-22 cm long; petiolules 1-2 mm long; *leaflets* 5-19, ovate to oblong or oblong-obovate, nearly glabrous; apex usually acuminate; acumen often emarginate; terminal leaflet 5-15 × 2-6 cm; lateral ones 2-14 × 1-5 cm, asymmetrical to nearly symmetrical. *Inflorescence* up to 2 cm long, puberulous. Pedicel above the joint 1.5-4 mm long. *Sepals* 2 × 1.5 mm. *Petals* 5-6 × 1.5-2.5 mm, connivent near base, imbricate and only slightly folded in bud. Long *stamens* 2.5-5 mm long, short ones 2-4 mm long. *Pistil* 2-5 mm long; style with some hairs; ovary pilose. *Follicles* one per flower rarely more, 25-32 × 10-15 mm, ovoid, acute at top, glabrous except for a few hairs at the top, dehiscing by a ventral suture. Sepals in fruit 4-6 × 4-6 mm. *Seed* up to 22 × 12 mm, testa for ca one thirth fleshy and yellow, other part of testa thin, very dark (red?) and shining, radicle apical, hypocotyl in seed already ca 1 mm long. *Seedling* epigeal; hypocotyl strongly elongated. Primary root absent. Cotyledons spreading, succulent. First leaves pinnate, (sub-) verticillate.

Distribution: Central Africa, and eastern W Africa.
Ecology: Rain forest from sea level up to 1000 m alt.

Specimens examined:

Nigeria: 11 mls from Ikot (fl. Jan.) *Okafor & Latilo FHI 56020* (K, P, WAG).
Cameroun: Bitye (fl.) *Bates 1639* (BM, MO, Z); Bertoua, *Breteler 1304* (P, WAG); (fr. July) *Breteler 1649* (M, P, WAG); 45 km E de Foumban (y.fr.) *Letouzey 7702* (P); Tissongo (fr. Aug.) *Mc Key 6* (P, YA) & seedlings (YA); Mt John (fl.) *Mann 1795* (K, P, type); Mendoum (fr. Feb.) *J. & A.Raynal 10073* (P, YA); Yaoundé (fl.b.) *Zenker & Staudt 747* (BM, GOET, K, M, Z, type *R. strigulosa*); Bipindi (fl.) *Zenker 2867* (E,G, GOET, L, M, MO, P, WAG); (fl.) *Zenker 540* (C, G, MO, P, U, WAG).
Central African Republic: Boukoko (fr. Aug.) *Equipe Tisserant 1555* (BM, BR, P).
Gabon: Mouila-Yéno, *Breteler & Lemmens 8141* (LBV, WAG); 15 km N of Doussala (fr. March) *de Wilde & Jongkind 9470* (LBV, WAG); Poupa (fl. Oct.) *Le Testu 8411* (BM, BR, P, WAG); Mouyanama-Mbigou (fr. April) *Louis et al. 1497* (LBV, WAG).
Congo: Komono (fr. Jan.) *Bouquet 2363* (P); Louvoulou (fr. Feb.) *Farron 4969* (P).
Zaire: Bunyakiri (fr. Feb.) *A.Léonard 2879* (BR, WAG); Yangambi (fr. Oct.) *Louis 2722* (BR,

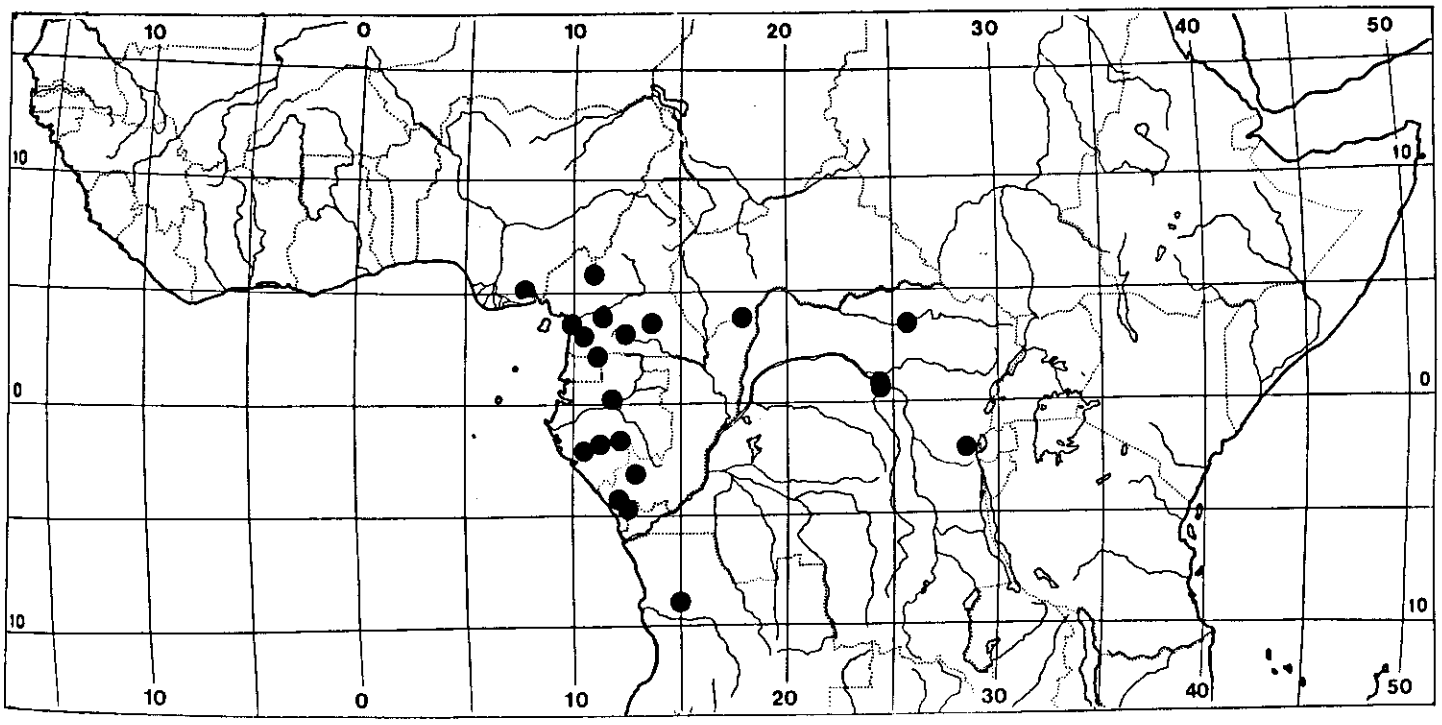


Fig. 173. Distribution of *Rourea parviflora*

G); *Louis 4286b* (BR); (fr. July) *Louis 5684* (BR, C); Yangole, *Louis 11925* (BR); 20 km NE Yamboa (fr. June) *Louis 15336* (BR); Bambesa, *Pittery 274* (BR); Yangambi (y.fr. Feb.) *Toussaint 871* (BR, P); (y.fr. Feb.) *Toussaint 872* and *873* (P); (y.fr. Feb.) *Toussaint 874* (BR, P).

Angola: 5 km de Bula Atumba (fr. April) *Cardoso 117* (COI); Maiombe, Buco Zau (fr. Jan.) *Gossweiler 6929* (COI, LISC); sin.loc. (y.fr.) *Gossweiler 7602* (COI, LISC).

Note 1: As already observed under History of the genus, this species was formely (Schellenberg 1938) known under two names i.e. *Byrsocarpus parviflorus* for flowering specimens and *Santaloidella gilletii* for fruiting specimens. For the former the fruits were supposed to be still wanting while for the latter the flowers needed yet to be collected. This case is very illustrative to show what results may be expected from excessive splitting.

Note 2: Many specimens are partly covered with long, flat, and tough hairs, which are often red- or black-coloured and can be found on the branches, leaf petiole, and rachis. These hairs are very peculiar and quite different from usual plant hairs, but they cannot be considered as artefacts as they are already present in the seedling stage (see pag. 21 and fig. 26.2).

Note 3: According to the amount of material collected this species seems to be rather rare. However, in view of the small and inconspicuous inflorescences and fruiting branches, and the frequency of the occurrence of seedlings observed in Gabon, it may be just undercollected.

Fig. 174-176

Rourea solanderi Baker

R. solanderi Baker, 1868: 456.
Type: Sierra Leone, sin. loc., *Afzelius s.n.* (holo: BM).

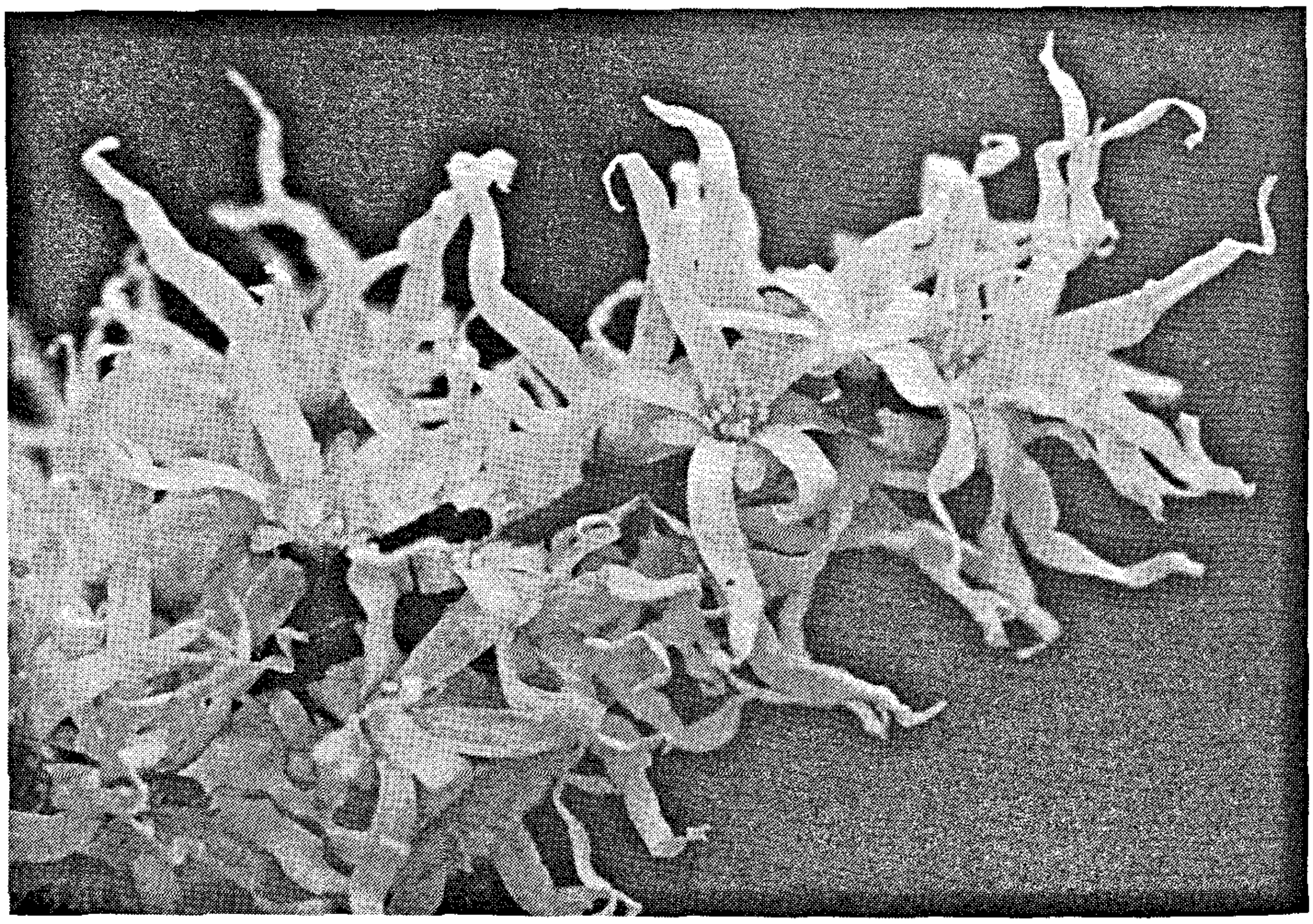


Fig. 174. *Rourea solanderi*: flowers (phot. H.C.D. de Wit, Liberia)

R. heterophylla Baker, 1868: 456. Type: Sierra leone, sin. loc., *Afzelius s.n.* (holo: BM; iso: G).

Santalodes solanderi (Baker) O.Kuntze 1891: 155. Basionym: *R. solanderi* Baker (see above).

Santalodes bakeri O.Kuntze 1891: 155. Type: The same as for *R. heterophylla* Baker (see above).

Spiropetalum solanderi (Baker) Gilg, 1896: 214; Schellenberg, 1938: 104; Irvine, 1961: 574; Hall & Swaine, 1981: 291; Burkill, 1985: 526. Basionym: *R. solanderi* Baker (see above).

Spiropetalum heterophyllum (Baker) Gilg, 1896: 214; Schellenberg, 1938: 106; Irvine, 1961: 573; Hall & Swaine, 1981: 291; Burkill, 1985: 525. Basionym: *R. heterophylla* Baker (see above).

Spiropetalum odoratum Gilg, 1891b: 336; 1896: 214; Schellenberg, 1938: 105; Troupin, 1952: 127; Exell & Mendonça, 1954: 144. Type: Gabon, Sibange Farm, near Libreville, *Soyaux 249* (holo: B†; lecto: P).

Spiropetalum polyanthum Gilg, 1895b: 69; 1896: 214; Schellenberg, 1919: 450. Type: Cameroun, Abo, *Buchholz s.n.* March 1874 (holo: B†; lecto: P).

Spiropetalum triplinerve Stapf, 1906: 93; Schellenberg, 1938: 104. Type: Liberia, near Monrovia, *Whyte s.n.* (holo: K).

Spiropetalum reynoldsii (Stapf) Schellenberg, 1919: 450; de Koning, 1983: 291; Burkill, 1985: 525. Basionym: *Connarus reynoldsii* Stapf 1906: 94. Type: Liberia, near St. Paul's R., *Reynolds s.n.* (holo: K).

Fig. 175. *Rourea solanderi*: 1. flowering branchlet, left in bud, right in flower, 2/3 ×; 2. leaflet partly, 2/3 ×; 3. flower buds, 2 ×; 4. flower, 4 ×; 5. stamens, 6 ×; 6. pistils of a long-styled flower, 6 ×; 7. follicles, 2/3 ×; 8. open follicle, 2/3 ×; 9. lenght section follicle, showing the cotyledons, 2/3 ×; 10. seed, 2/3 ×; 11. cotyledon inside with ventral radicle, 2/3 ×. (1-2. *Leeuwenberg 4024*; 3-6. *Oldeman 174*; 7. *de koning 4579*; 8. *Bos 3089*; 9. *de koning 4579*; 10-11. *Bos 3089*).

Spiropetalum calophyllum Gilg, nomen in herbarium *Zenker*.
Spiropetalum erythrocarpum Gilg, nomen in herbarium *Zenker*.
Spiropetalum erythrosepalum Gilg, nomen in herbarium *Zenker*.
Spiropetalum klainianum Pierre, nomen in herbarium *Klaine*.
Spiropetalum phaeseosepalum Gilg, nomen in herbarium *Zenker*.

Shrub to large liana. *Branches* glabrous, terete or furrowed; branchlets tomentose to glabrous. *Petiole* 1-13 cm long; rachis 0-15 cm long, glabrous to tomentose, sometimes with a few glandular hairs; petiolules 2-5 mm long; *leaflets* 1-9, ovate to elliptic, chartaceous to coriaceous, glabrous to tomentose, frequently with many mucous cells at the upper side, these show as small pits in herbarium specimens; apex acute to acuminate, mucronate; in developing leaves the mucronate tip is already full-grown when other parts of the leaflet are still small; terminal leaflet 2-18 × 1-9 cm; lateral ones 1.5-18 × 1-8 cm, nearly symmetric. *Inflorescence* up to 7 cm long, puberulous to tomentose. *Pedicel* above the joint 0.5-6 mm long. *Sepals* partly united, some of them for 3/4 connate, ca 5 × 2.5 mm, wider than long, velutinous on both sides. *Petals* 10-24 × 1.5-3 mm, lorate, sometimes connivent near base, folded inward in bud. Long *stamens* 2-7.5 mm long, short ones 1.5-4.5 mm long. *Pistil* 1.3-4.5 mm long; style with a few or many hairs; ovary pilose. *Follicles* one to three per flower rarely more, 20-35 × 10-25 mm, often beaked, velutinous and sometimes also with a few glandular hairs. Free parts of the sepals in fruit unequal, 5-10 × 10-15 mm, coriaceous, sometimes with small glandular hairs. Seedcoat for one fourth fleshy, other parts of testa thin, shining, and black. Radicle ventral. *Seedling* hypogeal; first leaves often scalelike or abortive.

Distribution: West and Central Africa.
Ecology: From rain forest to savanna and to the sea shore. Alt. 0-650 m.

Selection of the ca 150 specimens examined:

Sierra Leone: sin. loc. (fr.) *Afzelius s.n.* (BM, type); Njala (fl. May) *Deighton 3000* (P); Makump (fr. July) *N.W.Thomas 961* (P); Rowala (fr. July) *N.W.Thomas 1158* (P).

Liberia: Sangwin (y.fr. March) *Baldwin 11310* (K, WAG); between Zorzor and Voinjama (fl. Dec.) *Bos 2615* (WAG); Louisiana (fl. Jan.) *Bos 2620* (BR, K, P, WAG); 3 mls W of Tapita (fl. July) *Jansen 859* (WAG); Bomi Hills (fl. Aug.) *Voorhoeve 1216* (WAG).

Ivory Coast: Yapo Bot. Reserve (fr. Feb.) *de Koning 232* (WAG); Banco F.R. (fr. June) *de Koning 1789* (WAG); (fl. Feb.) *de Koning 5380* (WAG); km 119 Tabou-Tai Road (fl. March) *J.J.de Wilde et al. 3597* (WAG); Abouadou Forest (fr. July) *Leeuwenberg 2703* (WAG); 34 km N Sassandra (fl. April) *Leeuwenberg 4024* (WAG); 17 km W Abidjan (fl. July) *Oldeman 174* (B, G, WAG, Z); NNE Béréby (fr. Nov.) *Oldeman 616* (WAG).

Ghana: Takoradi-Tarkwa Road (fl. July) *Enti R774* (BR, WAG); Andabra mouth (fr. Feb.) *Hall 2911* (K); Bronikrom (y.fr. May) *Hall & Nabooh GC46619* (K); Aiyinasi (fr. Nov.) *Hepper et al. 7472* (K); Bonsa R. (y.fr. Aug.) *Vigne 139* (K).

Nigeria: Awi-Akamkpa Road (fl. Feb.) *Daramola FHI 55531* (K); Grace Camp (fr. March) *Jones & Onochie FHI 17035* (K); Oyo (fl. Aug.) *Keay FHI 25360* (K); Benin near aerodrome (fl. Jan.) *Keay FHI 37348* (K); Ibaji Ojoko N.A.F.R. (fl., fr. June) *Latilo FHI 47690* (K, P); Sapoba (fr.

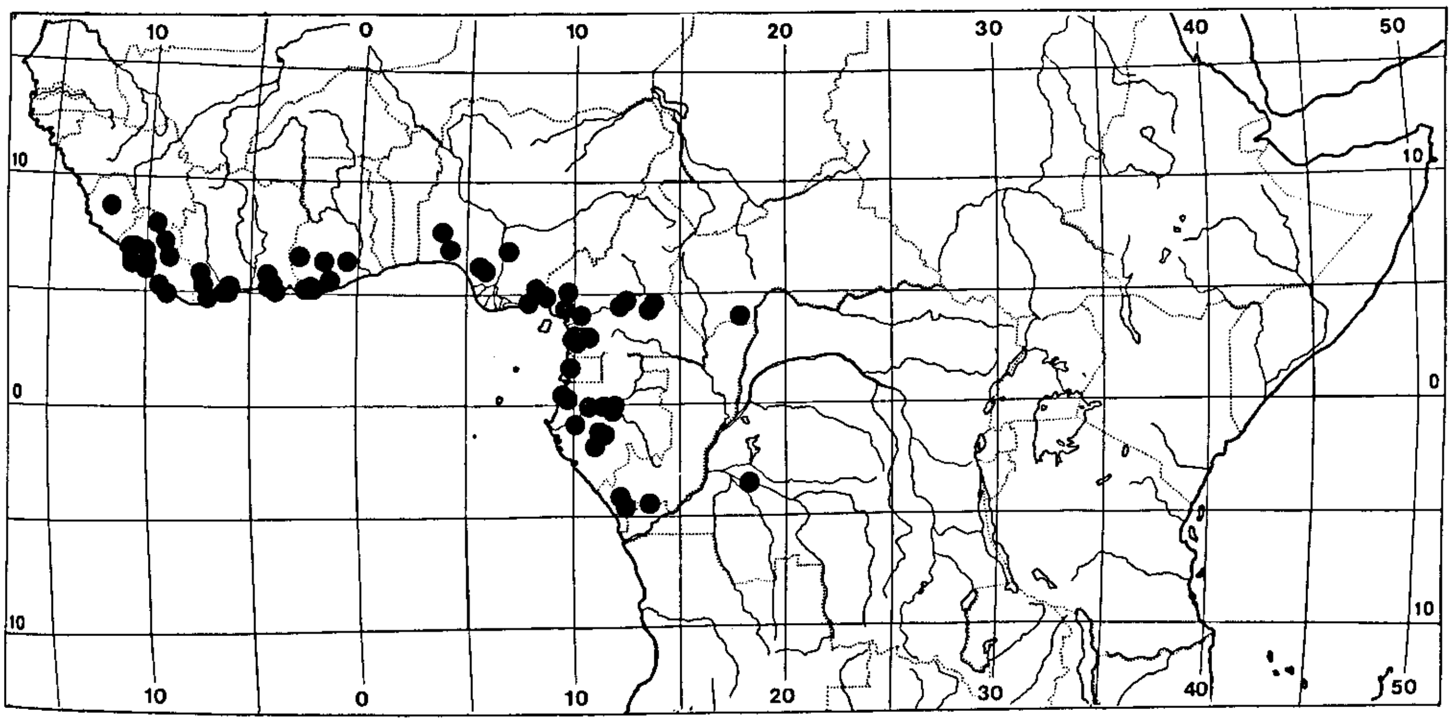


Fig. 176. Distribution of *Rourea solanderi*

Nov.) *Meikle 609* (K); Eket distr. (fl.) *P.A. Talbot 3349* (Z); 32 mls ENE Ijebu Ode (fr. April) *van Meer 730* (WAG).

Cameroun: 2 km S of Kribi (fl. June) *Bos 4836* (MO, P, WAG); 2 km N of Longii (fr. June) *Bos 4913* (P, WAG); Bertoua (fl. March) *Breteler 1217* (WAG); 65 km SSW of Eséka (fl. June) *W.de Wilde et al. 2753* (B, MO, WAG, Z); near Konye (fr. April) *Nemba & Thomas 13* (MO, WAG); Ndian R. (fl., fr. July) *D.W.Thomas 2362* (MO, P, YA).

Central African Republic: Boukoko (fl. Feb.) *Equipe Tisserant 1661* (BM); (fr. June) *Equipe Tisserant 1770* (BM).

Equatorial Guinea: Sanje, Benito R. (fl. Sept.) *Bates 574* (G, L, P).

Gabon: road Libreville-Kango (fr. Oct.) *Breteler & Lemmens 8391* (WAG); Mboro (fr. Oct.) *Fleury 27101* (P); road from Booué along Ivindo R. (fl. Oct.) *Floret et al. 1879* (P); SW Ndjolé (fl. April) *Hallé 1620* (P, WAG); SW Lambaréné (fr. May) *Hallé 2099* (P); Mouila (fl. Jan.) *Le Testu 5199* (BR, LISC, P); Ghediba (fl. June) *Le Testu 5957* (BM, BR, P); Lastoursville (fl.) *Le Testu 7405b* (BM, P); Lopé Reserve (fl. Nov.) *Louis et al. 65* (LBV, WAG); Lopé Reserve (fr. May) *Reitsma 2300* (WAG).

Congo: 41 km from Boko Songko (fr. July) *de Neré 1497* (P); S.B.B. Makaba (fl.b. June) *Sita 3124* (P).

Zaire: Makaw (fr. Dec.) *Jans 986b* (BR).

Angola: Cabinda, Bélize (fl.) *Gossweiler 7080* (COI, LISU).

Cult.: Seedlings from Ivory Coast, *de Koning 3191, 3364, 4621* (WAG).

Note: In Schellenberg's revision this species forms the genus *Spiropetalum*, with four species, only based on differences in leaf shape and indumentum. The shape of the leaflets is very variable. Some leaf forms are restricted to a part of the area of the species, like the form represented by the former *Spiropetalum triplinerve* that is confined to Liberia and Ivory Coast.

Rourea thomsonii (Baker) Jongkind **comb.nov.** **Fig. 177-179**

Basionym: *Connarus thomsonii* Baker, 1868: 458.

Type: Nigeria, Old Calabar, *Thomson 26* (holo: K; iso: E).

R. pseudobaccata Gilg, 1891b: 325. Type: Zaire, Lande der Niamniam, *Schweinfurth 2969* (para: B†; iso: Z); *3855* (B†; lecto: K; iso: P).

R. monticola Gilg, 1895b: 68. Type: Tanzania, Uluguru Mts, *Stuhlmann 8857 & 9071* (syn: B†). Neotype: Tanzania, Uluguru Mts, Morogoro, *Schlieben 2794* (holo: BR; iso: B, G, Z).

R. buchholzii Gilg, 1895b: 67. Type: Cameroun, Abo, *Buchholz s.n.* anno 1874 (holo: B†). Neotype: Cameroun, Bipindi, *Zenker 2503* (holo: WAG; iso: E, G, L, M, MO, Z).

R. baumannii Gilg, 1896: 211. Type: Togo, Miso Heights, *Baumann 31* (holo: B, alc! n.v.).

R. nivea Gilg, 1896: 210. Type: Cameroun, Lolodorf, *Staudt 6* (holo: B†; lecto: P; iso: G).

R. venulosa Hiern, 1896: 187. Type: Angola, Pungo Alto, *Welwitsch 4630* (holo: BM; iso: COI, G, K).

R. albido-flavescens Gilg, 1901: 316. Type: Tanzania, Ukinga, Mt Manganyema, *Goetze 1212* (holo: B†; lecto: BR; iso: E, G, L, P).

R. lescrauwaetii De Wildeman, 1909: 92; 1912: 405. Type: Zaire, Lac Foa, *Lescrauwaet 198* (lecto: BR); Eala, *Seret 868* & Eala, *M.Laurent 839* & Eala, *Pynaert 1403* (para: BR).

R. lescrauwaetii var. *sereti* De Wildeman, 1909: 92. Type: Zaire, Nala, *Seret 826* (holo: BR).

R. lescrauwaetii var. *tenuifolia* De Wildeman, 1909: 93. Type: Zaire, Mongo, *Huyghe & Ledoux 32* (lecto: BR); Mogandjo, *M.Laurent 1630* (para: BR).

R. oddoni De Wildeman, 1909: 93. Type: Zaire, Sanda, *Gillet 3755* (holo: BR).

R. verrucolosa De Wildeman, 1909: 95. Type: Zaire, Lubefu, *Lescrauwaet 368* (holo: BR).

R. claessensii De Wildeman, 1911a: 258; 1912: 403. Type: Zaire, Dobo, *Claessens 725* (holo: BR).

R. hypovellerea Gilg, nomen in herbarium *Zenker*.

Cnestis pinnata Palisot de Beauvois 1804: 98 & fig. 60; Don, 1832: 91. Type: Nigeria, sin. loc., *P.de Beauv. s.n.* (holo: G) (see Note 1).

Manotes palisotii Planchon, 1850: 439, nom. illeg. Type: the same as for *Cnestis pinnata* (see above).

Connarus pubescens Baker, 1868: 458. Type: Nigeria, Old Calabar, *Mann 2254* (holo: K).

Connarus libericus Stapf, 1906: 94. Type: Liberia, 6 mls of Monrovia, *Whyte s.n.* (holo: K).

Jaundea pinnata (P.de Beauv.) Schellenberg, 1938: 164; Andrews, 1952: 354; Troupin, 1952: 87, fig. 6; Exell & Mendonça, 1954: 151; Hemsley, 1956: 21, fig. 7; Hepper, 1958: 741; Irvine, 1961: 573; Mendes, 1966: 627; Adam, 1971: 871,874; Berhaut, 1975: 34; Troupin, 1978: 160; Liberato, 1980a: 14; Hall & Swaine, 1981: 217; Troupin, 1982: 224; de Koning, 1983: 286; Ern, 1984: 165; Burkill, 1985: 523; Caballé, 1986: 194. Basionym: *Cnestis pinnata* P.de Beauv. (see above).

Jaundea pubescens (Baker) Schellenberg, 1919: 462; 1938: 162; Troupin, 1952: 84; Exell & Mendonça, 1954: 151; Hepper, 1958: 741; Burkill, 1985: 523; Caballé 1986: 194. Basionym: *Connarus pubescens* (see above).

Jaundea pubescens var. *oddonii* (De Wild.) Troupin, 1952: 86. Basionym: *R. oddonii* De Wild. (see above).

Jaundea pseudobaccata (Gilg) Schellenberg, 1919: 462. Basionym: *R. pseudobaccata* Gilg (see above).

Jaundea zenkeri Gilg, 1894: 388; 1895b: 66. Type: Cameroun, Yaounde, *Zenker 613* (holo: B†; lecto: K).

Jaundea monticola (Gilg) Schellenberg, 1919: 461; 1938: 166; Andrews, 1952: 354; Troupin, 1952: 88. Basionym: *R. monticola* Gilg (see above).

Jaundea baumannii (Gilg) Schellenberg, 1919: 460; 1938: 164; Hepper, 1958: 741; Ern, 1984: 165. Basionym: *R. baumannii* Gilg (see above).

Jaundea lescrauwaetii (De Wild.) Schellenberg, 1919: 461; 1938: 163. Basionym: *R. lescrauwaetii* De Wild. (see above).

Jaundea oddonii (De Wild.) Schellenberg, 1919: 461; 1938: 162; Exell & Mendonça, 1954: 152. Basionym: *R. oddonii* De Wild. (see above).

Jaundea congolana Schellenberg, 1919: 460. Type: Zaire, Kimuenza, *Gillet 2176* (syn: B†; lecto: BR).

Santalodes monticola (Gilg) O.Kuntze 1903: 155. Basionym: *R. monticola* Gilg (see above).

Paxia dewevrei De Wildeman & Durand, 1899b: 83. Type: Zaire, *Dewevre 237* (holo: BR).

Byrsocarpus pseudobaccatus (Gilg) Schellenberg, 1910: 45; 1912: 245. Basionym: *R. pseudobaccata* Gilg (see above).

Byrsocarpus monticolus (Gilg) Schellenberg, 1910: 44; 1912: 244. Basionym: *R. monticola* Gilg (see above).

Byrsocarpus buchholzii (Gilg) Schellenberg, 1912a: 245. Basionym: *R. buchholzii* Gilg (see above).

Byrsocarpus baumannii (Gilg) Schellenberg, 1910: 44; 1912: 244. Basionym: *R. baumannii* Gilg (see above).

Byrsocarpus niveus (Gilg) Schellenberg, 1910: 44. Basionym: *R. nivea* Gilg (see above).

Byrsocarpus alb(id)o-flavescens (Gilg) Greenway ex Burtt Davy 1940: 41. Basionym: *R. albido-flavescens* Gilg (see above).

Byrsocarpus oddoni (De Wild.) Schellenberg 1912: 401. Basionym: *R. oddoni* De Wild. (see above).

Spiropetalum heterophyllum auct. non (Baker) Gilg, Liberato, 1980a: 10.

Evergreen large liana, shrub, or small tree. *Branches* often brown lenticellate, terete; branchlets puberulous or glabrous. Wood without interxylary phloem. *Petiole* 2.5-11 cm long; rachis 2-26 cm long; petiolules 3-6 mm long; *leaflets* 5-13, ovate or oblong to oblong-obovate, chartaceous to thinly coriaceous, pubescent to glabrous, 4-11 pairs of main lateral nerves, all nerves usually prominent beneath, the tertiary nervation frequently forming a pattern of almost par-

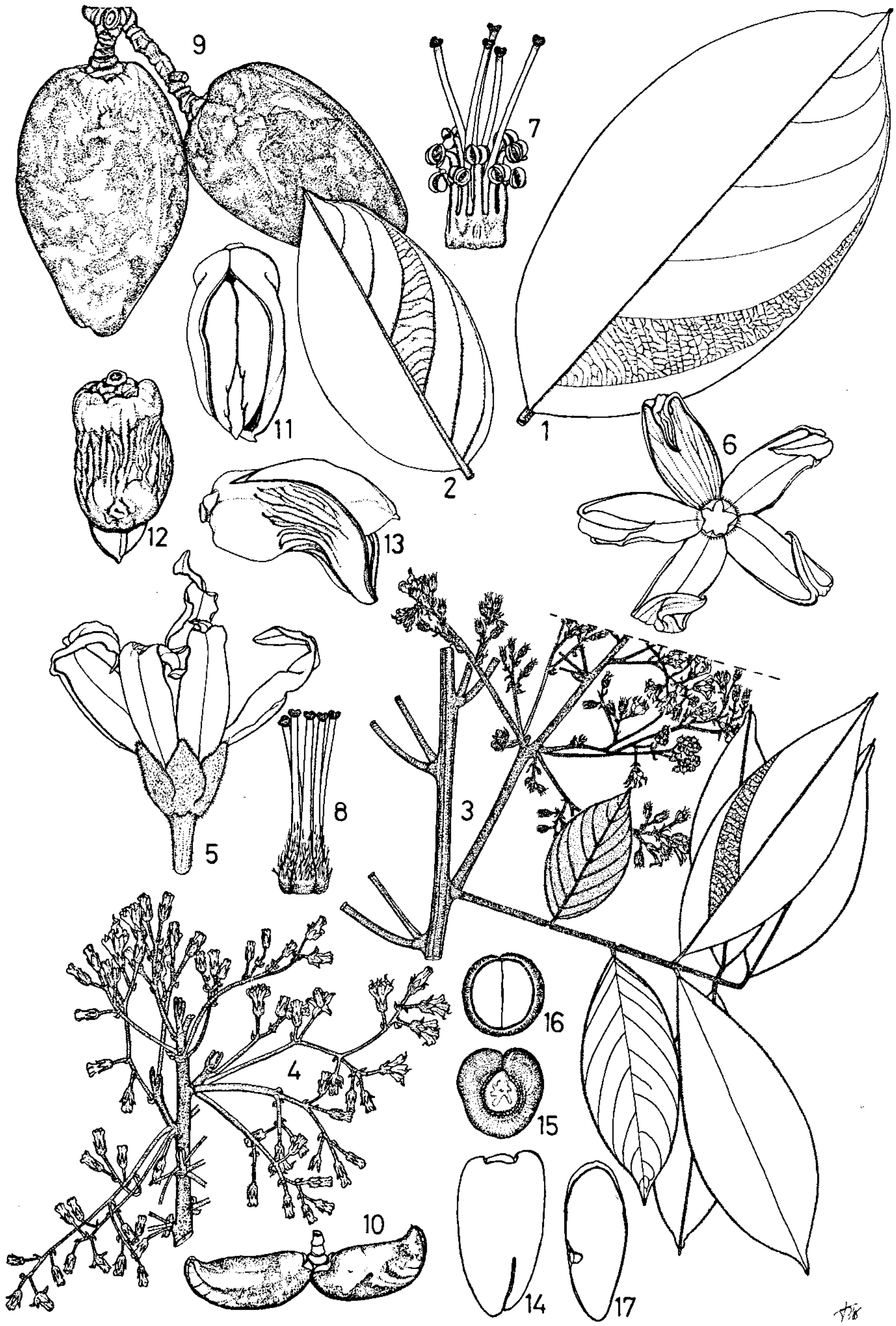


Fig. 177. *Rourea thomsonii*: 1-2. leaflets, 2/3 ×; 3-4. flowering branchlets, 2/3 ×; 5. flower, 4 ×; 6. connivent petals, 4 ×; 7. stamens and pistils of a long-styled flower, 10 ×; 8. pistils, 10 ×; 9-10. fruits, 2/3 ×; 11-13. open follicle, 2/3 ×, 11. ventral view, 12. dorsal view, 13. lateral view; 14. seed, 2/3 ×; 15. seed from below, showing the hilum surrounded by the sarcotesta, 2/3 ×; 16. cross section of seed, 2/3 ×; 17. cotyledon inside with ventral radicle, 2/3 ×. (1-2. *Leeuwenberg 11312*; 3. *Hart 214*; 4-8. *de Koning 6497*; 9. *J.de Wilde 8382*; 10. *Leeuwenberg 9471*; 11-17. *Breteler & de Wilde 803*).

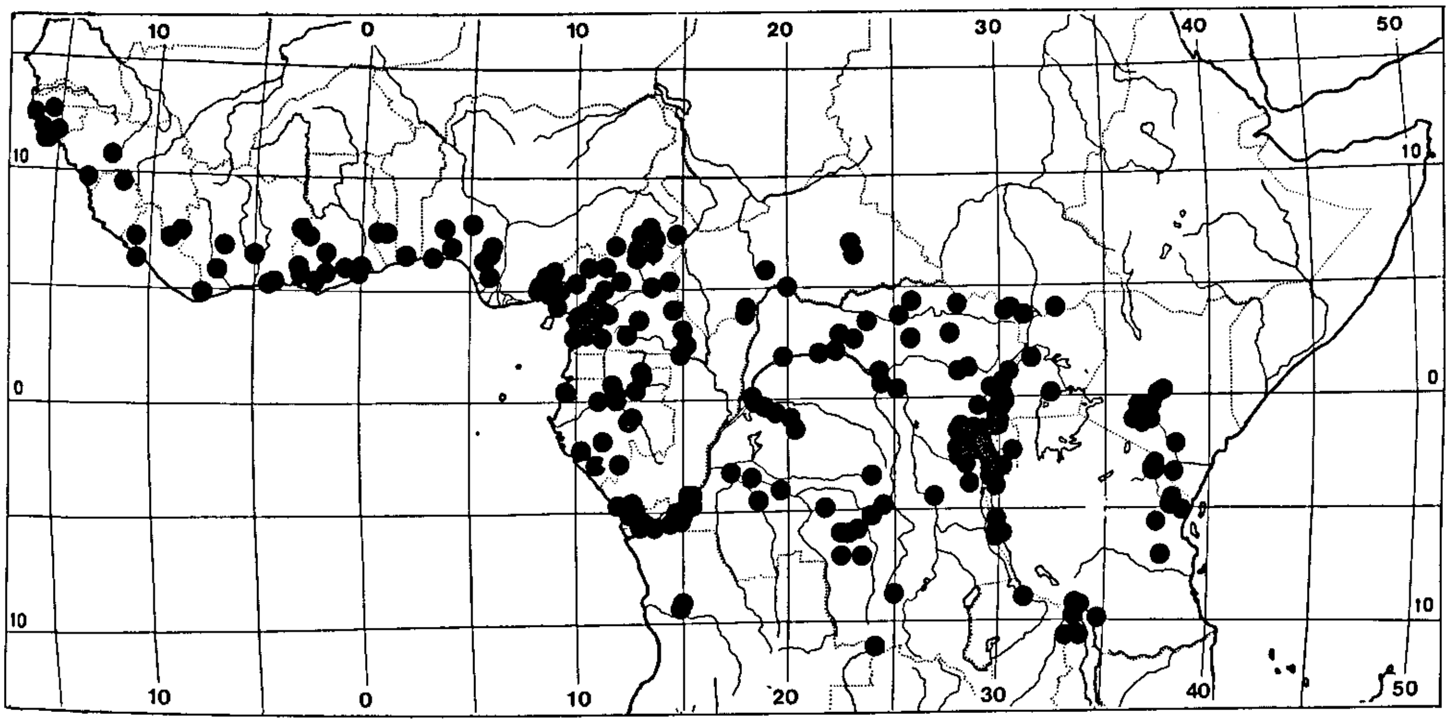


Fig. 178. Distribution of *Rourea thomsonii*

allel lines; apex acuminate, mucronate; terminal leaflet 7.7-21 × 2-11 cm; lateral leaflets 5-20 × 1.5-9 cm, nearly symmetric. *Inflorescence* up to 18 cm long, often one or more together at the end of a leafy branch and resembling a terminal inflorescence, glabrous or pubescent. *Pedicel* above the joint 1-8 mm long. *Sepals* 1.5-3.5 × 1-2 mm, almost glabrous inside. *Petals* 6-11 × 1-2.5 mm, coherent near base, inrolled in bud, with acute apex. Long *stamens* 1.5-6 mm long, short ones 1-5 mm long. *Pistil* 1-5 mm long; style with some hairs; ovary pilose. *Follicles* one per flower sometimes more, 20-45 × 10-25 mm, symmetrical with rounded apex or oblique with acute apex, glabrous, dehiscing by a ventral suture. Sepals in fruit 2-3 × 2-4 mm, often wider than long. Testa almost entirely fleshy, the thin, black part situated in a ventral groove. Radicle ventral. *Seedling* hypogeal; first two leaves opposite but often scale like or abortive; first fully developed leaves unifoliolate.

Distribution: From Guinea Bissau to Kenya and Mozambique in the East and to Angola in the South.

Ecology: Wet tropical forest including periodically inundated riverine forest and semi-deciduous forest, from sea level up to 3500 m alt.; in East Africa only and abundant in evergreen mountain forest (1200-3500 m alt.).

Selection of the more than 450 examined specimens:

Senegal: Basse-Casamance (fl. Dec.) *v.d. Berghen 1565* (BR).

Guinea Bissau: Ilha dos Galinhas (fr. June) *Espirito Santo 717* (COI, LISJC); Fulacunda (fr. May) *Espirito Santo 2039* (COI, LISC).

Guinea: near Kouria (fl. Nov.) *Caille 14810* in herb. *Chevalier* (BR, P, WAG); Dalaba (fl. Nov.) *Chevalier 34579* (P); Konkore (fr. Sept.) *Pobéguin K31* (P).

Sierra Leone: ml 96 from Makeni on Falaba to Kabala Road (fl. Nov.) *Morton SL2864* (K, WAG); Kangumu (fl.) *Smythe 118* (K, P).

Liberia: Nimba-Gangra (fl.b. Oct.) *Adam 26217* (P); Genna, Tanyehun, *Baldwin jr. 10752* (K); Duport (fr. Oct.) *Barker 1437* (K); Ganta (fr. April) *Harley 372* (K).

Ivory Coast: Toumodi (fr. March) *Aké Assi 8521* (G); Tate village, *Chevalier 19800b* (P); Daloa (fl. Sept.-Oct.) *Chevalier 34156* (P); Banco F.R. (fr. Nov.) *de Koning 2857* (WAG); (fr. Dec.) *de Koning 4972* (WAG).

Ghana: Akropong, Akwapim, *Adams 4730* (K); ml 33 Takoradi-Tarkwa Road (fl. July) *Enti R774* (K); Kumasi (fl. Jan.) *Irvine 39* (K); Secondi (fr. March) *Irvine 2402* (E); Adamsu (fl. Dec.) *Vigne 3497* (BR, K).

Togo: E Badou (fr. April) *Hakki et al. 583* (B); Atakpamé (fl. Nov.) *Mildbraed 7423* (K).

Benin: between Abomey and Boguila (fr. Feb.) *Chevalier 23178* (BR, K).

Nigeria: Calabar (fl. Feb.) *Daramolo FHI 55523* (K, P); Warrake (fr. June) *Dundas FHI 21483* (K); Omo F.R. (fr. June) *Gentry & Pilz 32797* (MO, WAG); Lagos, near Vand (fl. Dec.) *Hagerup 75* (P); Benin (fl. Jan.) *Keay FHI 37349* (K, P); near Osomba village (fl., fr. March) *Latilo & Oguntayo FHI 70531* (K, WAG); 11 mls S of Ipetu, *Onochie FHI 5225* (K); Old Calabar (fl., fr.) *Thomson 26* (K, E, type).

Cameroun: 15 km W of Matsari (fr. May) *Biholong 515* (P); 17 km from Kribi (fr. Aug.) *Bos 5037* (MO, P, WAG); 10 km S of Meiganga (fl. Nov.) *W.de Wilde et al. 3998* (P, WAG); Eschou (fl. April) *Letouzey 3883* (P); Slopes NE of l'hosere Banyo (fr. June) *Letouzey 8572* (P); 65 km NNE of Moloundou (fr. March) *Letouzey & Villiers 10513* (BR, P); Dengdeng (fl. April) *Mildbraed 8853* (K); Ngwenfon (fl. Dec.) *Satabié 210* (K, P, YA); Ndian R. (fr. July) *D.W.Thomas 2359* (MO, YA).

Central African Republic: Krebedje (fl.) *Chevalier 10643* (P); Waka area (fl. Oct.) *Le Testu 1249* (BM, BR, P); Yalinga (fr.) *Le Testu 3833* (P); la Haut-Kotto (fl. Nov.) *Le Testu 4392* (BM, BR, P, WAG); Boukoko (fl.) *Equipe Tisserant 437* (BR, P, WAG).

Sudan: 10 mls S of Yei (fl. Dec.) *Myers 7994* (K); near Issore (fr. Aug.) *Myers 11783* (K).

Equatorial Guinea: sin. loc. (fl. March) *Tessmann 953* (K).

Gabon: Bélinga (fl. Sept.) *Breteler & de Wilde 712* (LBV, WAG); between Mouila and Yéno (y.fr. Sept.) *Breteler & Lemmens 8096* (LBV, WAG); on Dyem Lake (fr. Aug.) *Fleury 26438* (P); old road of the Nke (fr. Oct.) *Floret et al. 1830* (P); Tchibanga (fl. May) *Le Testu 1730* (BR, K, P); Lastoursville (fl. June) *Le Testu 7375* (P).

Congo: Boungolo (fl.b. June) *Sita 1292* (P); Chaillu, 30 km from Irogo (y.fr. Feb.) *Sita 4014* (P).

Zaire: Mulubule (fl. July) *Bequaert 36* (BR); Mobeka (fl.) *De Giorgi 1454* (BR); Madabu (fl.b. Dec.) *Gérard 2571* (BR); Epulu (fl. Feb.) *Hart 428* (BR); Kamina (fl. June) *Herman 2162* (BR, K); road to Nsemendwa 15 km from Makaw (fl.b. Jan.) *Jans 997* (BR, WAG); Manenga (y.fr. March) *Nkunga P6310* (BR, WAG); Mbandaka (=Coquilhatville) (fr.) *Pynaert 804* (BR); Lupaya (fr. Aug.) *A.Léonard 5718* (BR, WAG); Kisangani (fr. Feb.) *Szafranski 1105* (BR, WAG); km 110 Kavumu-Walikale Road (fl. Feb.) *Troupin 6353* (BR, WAG).

Angola: Cuanza Norte, Monto Bello (fl.) *Gossweiler 689* (BM, K, P); Cabinda, Pango Mungo (fl.) *Gossweiler 6114* (BM, COI); Cabinda, Bélize (fl.) *Gossweiler 7090* (BM, LISU); Uige, Colonato (fr. Oct.) *Raimundo et al. 515* (LISC, WAG); Pungo Alto (fl., fr. Nov.) *Welwitsch 4630* (BM, COI, G, K, type *R. venulosa*).

Rwanda: Bushekeli (y.fr. Sept.) *Runyinya 594* (BR); Lac Kivu, Wahu I., *Van der Ben 245* (BR).

Burundi: Bugarama (fl. June) *Lewalle 969* (BR, G); Muyange (fr. Sept.) *Reekmans 1030* (BR); near Karuzi (fr. Jan.) *Van der Ben 1841* (BR).

Uganda: Kajansi Forest (fl.b. Oct.) *Chandler 2476* (B, BR, EA); Bwamba Pass (fl. Aug.) *Eggeling 3362* (K); Bujenji county (y.fr. Feb.) *Katende 1518* (EA); Khaya Dawei (fr. Sept.) *Myers 9460* (K); Kanungu, Kigezi (fl. June) *Purseglove 802* (BR, K).

Kenya: Ngangao, *Drummond & Hemsley 4337* (K); Mbololo Hill (fl. Oct.) *Joana 8998* (EA); Kirima Mt (y.fr. Oct.) *Polhill & Verdcourt 293* (EA, K); Upland Limuru (fr. Oct.) *Verdcourt 359* (EA, K).

Tanzania: Milo (fl. Oct.) *Archibold 2476* (K); Kasoje (fl. June) *Kakeya 37* (EA); Shagaya F.R. (fr. Oct.) *Mgaza 627* (EA); Kirua Vunjo-Kilema Road (fr. March) *Semkiwa 80* (EA); Kyimbila (fl.) *Stolz 2204* (C, G, M, WAG, Z); Murgwanza (fl. Jan.) *Tanner 5805* (B, K, WAG).

Zambia: 16 km SW of Kalene Hill Mission (fl. June) *Drummond 8284* (K, SRGH); Abercorn (fl. May) *Richards 15140* (K, SRGH); Nyika Plateau (fl., fr. Oct.) *Robson 485* (K, SRGH); (fl. Nov.) *Robson 615b* (K, SRGH).

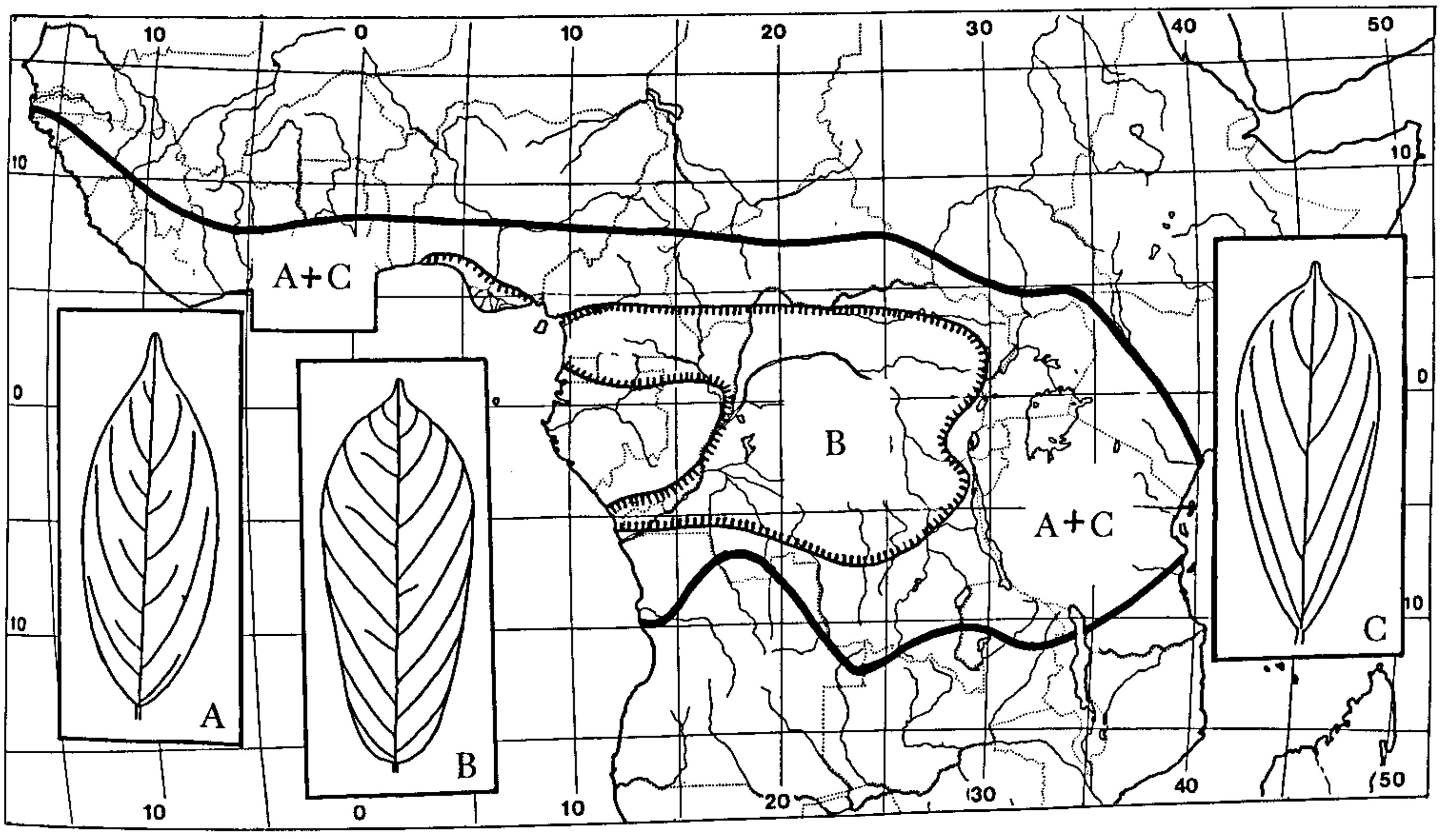


Fig. 179. *Rourea thomsonii*: map showing area of the distribution of dominant leaflet shape.

Malawi: Luselo Reserve (fr. Dec.) *Banda 743* (K, SRGH); Misuku Hills (fr. Dec.) *Pawek 4227* (K).
Cult.: Seedlings, *de Koning 3540* (WAG), *3778* (WAG).

Note 1: The oldest known name for this taxon is *Cnestis pinnata* P.de Beauv. but the combination *Rourea pinnata* exists already for another species: *R. pinnata* (Merr.) Veldkamp, 1968: 543.

Note 2: In Schellenberg's revision this species forms the genus *Jaundea*, with six species, only based on differences in leaf shape and leaf indumentum. As such the delimitation of *R. thomsonii* in the present revision is the same as that of the former genus *Jaundea*.

The shape of the leaflets and especially their nervation is very variable, and provides numerous intermediary combinations that deny recognition of the former *Jaundea* species in any rank. Some leaf forms are restricted to a part of the area of the species. The distribution of the most extreme leaf forms is given in fig. 179. The margin of this concentrical distribution pattern is dominated by a leaf shape represented by the former species *Jaundea pinnata* (leaflet A) in the north and south, and in the east by *Jaundea monticola* (leaflet C). The median band is dominated by a form represented by the former *Jaundea pubescens* sensu Troupin (leaflet B). The centre of the pattern is without a clearly dominating leaf form.

Note 3: Fruits are frequently attacked by insects and then become globose and pitted.

Notes on extra African species.

Asia

Rourea acropetala Pierre, 1898: pl. 379d; Vidal, 1962:32 p.p. (type only).
Type: Laos, Attopeu region, *Harmand* in Herbarium *Pierre 3292* (holo: P; iso: L)
R. oligophlebia Merrill, 1937: 178; Leenhouts, 1958: 513; Vidal, 1962: 31. Type: Sumatra, Bila, *Rahmat 2342* (holo: A or NY n.v.; iso: L)

Distribution: Vietnam, Laos, Indonesia (Sumatra).

Specimens examined:

Laos: Attopeu region (fl.) *Harmand* in Herbarium *Pierre 3292* (L, P, type).
Vietnam: Prov. Tuyên Quang (fl. April) *Chevalier 37426* (P); near Tourane (fr. June) *Clemens 3365* (P); Hung Son (fl.) *Eberhardt 3930* (P); Huê (fl., y.fr. March) *Squires 225* (P); (fl. March) *Squires 244* (P).
Sumatra: between Sunggapa and Pargambiran (fr. May) *Bartlett 8161* (G, L); Gunong Susah (fl. May) *Rahmat 2342* (L, type of *R. oligophlebia*); Padang Lawas (fr. July) *Rahmat 4912* (L).

Note: Leenhouts (1958: 515) knew *R. acropetala* only from the flowering type specimen. He reduced it into the synonymy of *R. minor*. In 1962 Vidal treated it as a distinct species once more and made the first description of what, in his opinion, were the fruits of this species. The characters Vidal used to delimitate *R. acropetala* are leaf characters of the type specimen in combination with fruit characters from the other specimen, *Vidal 720*. In my opinion these two collections represent different species, the flowering type specimen is conspecific with the collections that were subsequently designated as *R. oligophlebia*, while the fruiting collection, *Vidal 720*, belongs without any doubt to *R. minor*.

In this revision *Roureopsis* is united with *Rourea* which makes the following new combinations necessary:

Rourea asplenifolia (Schellenb.) Jongkind **comb.nov.**
Basionym: *Roureopsis asplenifolia* Schellenberg, 1938: 111; Leenhouts, 1958: 506.

Rourea confundens (Leenh.) Jongkind **comb.nov.**
Basionym: *Roureopsis confundens* Leenhouts, 1978: 507.

Rourea dictyophylla Jongkind **nom.nov.**
Agelaea pinnata King, 1897: 18.
Roureopsis pinnata (King) Leenhouts, 1958: 510.
Note: The combination *Rourea pinnata* exists already for another species: *R. pinnata* (Merr.) Veldkamp, 1968: 543.

Rourea emarginata (Jack) Jongkind **comb.nov.**
Basionym: *Cnestis emarginata* Jack, 1822: 42.
Roureopsis emarginata (Jack) Merrill, 1952: 220; Leenhouts, 1958: 508; Vidal, 1962: 24.

Because not all Asiatic species are treated in Flora Malesiana or have been recombined here, some additional literature on the remaining Asiatic species of *Rourea* is given.

Rourea acutipetala Miquel
Roureopsis acutipetala (Miq.) Leenhouts, 1958: 509; Vidal, 1962: 26.

Rourea balansea Baillon, 1875: 309.

Rourea fulgens Planchon; Leenhouts, 1958: 519.

Rourea harmandiana Pierre, 1898: pl. 379e; Vidal, 1962: 44.

Rourea mimosoides (Vahl) Planchon; Leenhouts, 1958: 517; Vidal, 1962: 41.

Rourea pinnata (Merr.) Veldkamp, 1967: 543; Leenhouts, 1972: 934.

Rourea prainiana Talbot; Leenhouts, 1958: 520.

Rourea radlkoferiana Schumann; Leenhouts, 1958: 519.

Rourea rugosa Planchon; Leenhouts, 1958: 514.

Rourea stenopetala (Griff.) Hook. f.
Roureopsis stenopetala (Griff.) Schellenb.; Vidal, 1962: 23; Leenhouts, 1972: 933.

America

The monotypic American genus *Bernardinia* has also been referred into the synonymy of *Rourea*. It used to be kept apart because of the absence of an accrescent calyx. In *Rourea* the accrescence of the calyx varies from very pronounced (*R. accrescens*, *R. erythrocalyx*, and *R. myriantha*) to negligible (*R. gardneriana* and *R. coccinea*). Moreover, careful observation of material with young fruit shows that the fruiting calyx in *Bernardinia fluminensis* is accrescent, but this is overlooked as in mature fruits the calyx is often reflexed.

Rourea fluminensis (Gardn.) Jongkind **comb.nov.**
Basionym: *Connarus fluminensis* Gardner, 1842: 529.
Bernardinia fluminensis (Gardn.) Planchon, 1850: 413; Baillon, 1870: 18; Forero, 1983: 26.

On different occasions in this revision of the *Connaraceae* observations have been made on the different species concept used for the revisions of the Malesian and the African species at one hand, and the American species on the other. In order to facilitate comparison of the African, American, and Asiatic species of *Rourea*, I have arranged the American species into entities of what is felt to have comparable taxonomic level as the Asiatic and African species, resulting in the clusters given below. The taxa in those clusters are given in order of ancientry. These clusters are treated as species, with the first name in the cluster as their collective name. In arranging these clusters the stomata patterns, together with the characters of flowers and fruits, were of decisive importance. I did not see *R. laurifolia* and *R. pseudospadicea*, which are only known from their type specimens, and *R. omissa*, which is only known from two specimens. These three species are left out of this classification.

Rourea accrescens Forero

Rourea blanchetiana (Progel) Kuhlm.

Rourea camptoneura Radlk., *R. schippii* Standley

Rourea frutescens Aublet, *R. glabra* H.B.K. (excluding material from S Brasil), *R. surinamensis* Miq., *R. adenophora* Blake, 1923, *R. pittieri* Blake, *R. sprucei* Schellenb. (excl. var. *rondoniensis* Forero), *R. antioquensis* Cuatrec., *R. araguaensis* Forero.

Rourea gardneriana Planchon, *R. cuspidata* Benth. ex Baker, *R. doniana* Baker, *R. ligulata* Baker, *R. puberula* Baker, *R. amazonica* (Baker) Radlk., *R. duckei* Huber, *R. gracilis* Schellenb., *R. neglecta* Schellenb., *R. kappleri* Lanj., *R. paraensis* Forero, *R. sprucei* Schellenberg var. *rondoniensis* Forero, *R. glabra* auct. non H.B.K. sensu Forero: material from S Brasil.

Rourea induta Planchon, *R. psammophila* Forero

Rourea krukovii Steyerm.

Rourea martiana Baker, *R. discolor* Baker, *R. chrysomalla* Glaz. ex Schellenb., *R. cnestidifolia* Schellenb., *R. glazioui* Schellenb., *R. tenuis* Schellenb., *R. bahiensis* Forero

Rourea prancei Forero

Rourea pubescens (DC.) Radlk.

Rourea revoluta Planchon, *R. grosourdyana* Baill.

Rourea suerrensis Smith, *R. latifoliolata* Standley & Williams

Vismianthus Mildbr.

by F.J. Breteler & J. Brouwer

History of the genus

Vismianthus was first described by Mildbraed in 1935 and based on *V. punctatus* Mildbraed. The generic name and the epithet refer to the conspicuous glandular dots and streaks in the flowers and the leaves of this species respectively. *Vismianthus* is, like *Burttia*, a shrub-treelet with unifoliolate leaves and monocarpellate flowers. Mildbraed (l.c.) remarked upon the similarity between these two genera, but found the presence of the glands and streaks in the flowers sufficient reason to create a new genus. *Vismianthus*, like *Burttia*, has always been treated as a monotypic genus, but in this paper the Asiatic genus *Schellenbergia* is put into its synonymy and the only species of this Asiatic genus is henceforth combined in *Vismianthus*.

Description of the genus

Vismianthus Mildbraed, 1935: 706; Schellenberg, 1938: 98; Brenan & Greenway, 1949: 169; Hemsley, 1956: 7.

Type species: *V. punctatus* Mildbr.

Schellenbergia Parkinson, 1936: 295; Schellenberg, 1938: 179. Type species: *S. sterculiaefolia* (Prain) Parkins., (= *Vismianthus sterculiifolius* (Prain) Breteler & Brouwer).

Shrub or small tree. *Leaves* unifoliolate, long-petioled, with glandular dots and streaks. Hairs generally two-armed. *Inflorescence* racemose, few to many flowered. *Pedicel* jointed. *Flowers* heterodistylous, with dark glandular dots and streaks. *Sepals* 5, (sub)equal, imbricate in bud, very shortly connate, persisting in fruit. *Petals* 5, free. *Stamens* 10, all fertile, shortly connate at base. *Carpel* solitary; ovary sessile, ovules hemitropous, attached near or above middle of ventral suture; stigma (sub)capitate, papillose. *Fruit* a (sub)glabrous, 1-seeded follicle, glandular dotted, dehiscing along ventral suture, inner and outer pericarp separating. *Seed* with chalazal sarcotesta, partly free; endosperm rudimentary or absent; cotyledons plano-convex.

Distribution: 2 species, one in south-eastern Tanzania, one in south-western Burma.

Note: According to R.G. van den Berg (pers.comm.) the pollen grains of the two species of *Vismianthus* (and the one of *Burttia*) are very much alike in shape, dimensions, type of apertures, etc. Slight differences in ornamentation, especially the coarseness of the reticulum, wall thickness and shape of apertures do occur however. These do not seem to be of use for taxonomic subdivisions. Furthermore, pollen grains sampled from short or long anthers and from flowers with short or long styles do not differ.

Key to the species

Leaves with 4-6 pairs of main lateral nerves and retuse, sometimes almost cordate at base; petals heavily dark glandularly streaked and dotted; follicle very shortly stalked; sarcotesta fringed. Southern Tanzania . . . **V. punctatus**

Leaves with 6-8 pairs of main lateral nerves and rounded, seldom retuse, at base; petals without or with a few dark glandular dots and streaks; follicle clearly stalked; sarcotesta with one long appendage only. Western Burma . . . . **V. sterculiifolius**

Vismianthus punctatus Mildbr. **Fig. 180-181**

V. punctatus Mildbraed, 1935: 706; Schellenberg, 1938: 98; Brenan and Greenway, 1949: 169; Hemsley, 1956: 7.

Type: Tanzania, Lindi District, Mlinguru, about 20 km south of Lindi, *Schlieben 5757* (holo: B; iso: BM, BR, HBG, K, M, P, Z).

Shrub, up to 4.5 m, branching subradially. *Branches* grey or brownish with grey patches. Branchlets cylindrical, slightly grooved, tomentose when young with (un)equally two-armed hairs, glabrescent. *Leaves* usually crowded at end of shoots. Petiole 2-3.5 cm long, slender, terete to slightly grooved, densely villose when young, glabrescent, with many dark elongated glands, articulate at base of leaflet. Leaf blade herbaceous to papyraceous, ovate to almost cordate, 1.7 × 1.2 to 9 × 5 cm; apex acuminate to cuspidate, acumen 0.3-1.5 cm, base retuse to almost cordate; densely tomentose when young, becoming glabrous, persisting longest along main and secondary veins beneath; dotted and streaked with many small (0.3 mm) dark resinous glands; main lateral nerves 4-6 pairs. *Inflorescence* simple or compound (2)3-6 flowered; bracts and bracteoles elliptic to lanceolate or linear, keeled, 1.5-2 × 0.4-1 mm, densely ferruginously pubescent, caducous; peduncle 1-4.5 cm, densely pilose, glabrescent, with many dark glands. *Flowers* 5 mm long; pedicel 1-2.5 mm long, articulate, sparsely ferruginously hairy, sparsely dotted with dark resinous glands. *Sepals* elliptic-oblong, 2-3 × 1-1.8 mm, (somewhat) concave, apex obtuse, sparsely sericeous outside, each with approximately 8-20 dark-red resinous glands, concentrated along the axis and towards the base. *Petals* subequal, elliptic to oblong-obovate, 3-3.5 × 1.2-1.8 mm, apex obtuse, base truncate, glabrous, whitish yellow or white with many dark elongated glands, orientated lengthwise. *Stamens* 10, five episepalous ones 1.6-3 mm long in long-styled flowers and 4.5 mm in short-styled ones, the five epipetalous stamens 1-1.7 mm and 2.5-2.8 mm long respectively;

Fig. 180. *Vismianthus punctatus*: 1. flowering branch, 2/3 ×; 2. detail of inflorescence, 2 ×; 3. flower, sepals and petals partly removed, 4 ×; 4. petals, 4 ×; 5. fruit, 2 ×; 6. open fruit, 2 ×; 7. seed (immature) with sarcotesta, 2 ×; 8. basal part of seed with hilum and sarcotesta, 4 ×. (1-4. *Eggeling 6402*; 5-8. *Semsei 647*).

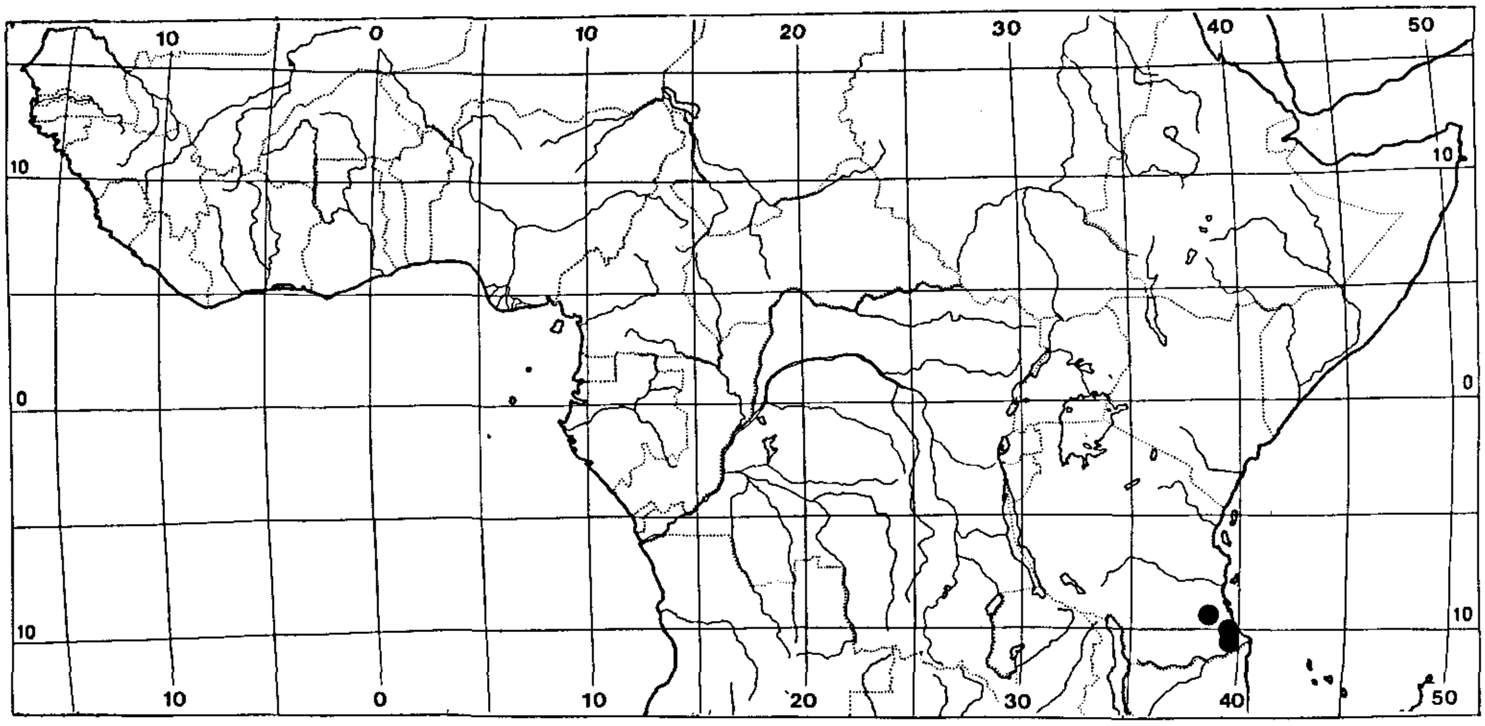


Fig. 181. Distribution of *Vismianthus punctatus*

filaments filiform, glabrous, very shortly connate at base; anthers ovoid, 0.4-0.6 mm long in long-styled and 1 mm long in short-styled flowers. *Pistil* 3-3.8 mm long in long-styled flowers, 2 mm in short-styled ones; style filiform, sparsely sericeous-villose, with a few dark glands or not; stigma (sub)capitate, more or less bilobed, papillose; ovary 0.5-1 mm long, ovoid-lenticular, densely ferruginously sericeous or villose with unequally two-armed hairs, and a few dark glands or not; ovules attached at or above middle of ventral suture, hemitropous. *Fruit* purplish brown 15-20 mm long, 6 mm wide, very shortly stalked, with rostrum of up to 3 mm, virtually glabrous when full-grown, prominently veined with many small glands. *Seed* (immature) ovoid, dark brownish, with fimbriate sarcotesta covering one end; endosperm very thin; cotyledons thin, wide, folded.

Distribution: S E Tanzania.

Ecology: Undershrub in forest or savanna shrub, between 250 and 800 m altitude.

Specimens examined:

Tanzania: Kilwa District (?)(fl. Nov.) *Crosse-Upcott 181* (K); Mchinjori (fl. Nov.) *Eggeling* 6402 (BR, EA, K); Kitangari (fr. March) *Gillman 1315* (EA); Namula (fr. Aug.) *Ludanga 1334* (BR, C, EA, K); Mlinguru (fl. Dec.) *Schlieben 5757* (B, BM, BR, G, HBG, K, M, P, Z, type); Mchinjiri (fr. Feb.) *Semsei 647* (B, BR, K).

Notes: As observed by Hemsley (1956: 9), mature fruits are needed to see whether the suspensor mechanism of *V. sterculiifolius* is also present in this species.

The ovules in *V. punctatus* are not basal and anatropous, as stated by Mildbraed (1935: 707) and Schellenberg (1938: 98), but ventrally attached and hemitropous.

Vismianthus sterculiifolius (Prain) Breteler & Brouwer **comb.nov.**

Basionym: *Ellipanthus sterculiaefolius* Prain, 1890: 209, plate VIII.
Type: Burma, Diamond Island, *Prain s.n.* (holo: K; iso: BM).
Schellenbergia sterculiaefolia (Prain) Parkinson, 1936: 295, plate 23; Schellenberg, 1938: 179, as *S. sterculiifolia.*

Shrub or tree, up to 4-6 m high, branching subradially. *Branches* slightly grooved, cylindrical, with many lenticels. Branchlets angular, slightly grooved, becoming terete, densely ferruginously tomentose with unequally two-armed hairs when young, glabrescent. *Leaves* often crowded at end of shoots. Petiole 2-5.5 cm long, slender, channeled and shallowly grooved, ferruginously sericeous-villose when young, becoming glabrous, with occasional red glandular dot, articulate at base of leaflet. Leaf blade herbaceous-papyraceous, ovate-elliptic-oblong, 3.5 × 2 to 12 × 7.5 cm; apex acuminate, acumen 0.5-2 cm; base rounded, sometimes retuse; densely ferruginously tomentose when young, becoming glabrous, persisting longest beneath; dotted with many small dark resinous glands (in young leaves only noticeable near the leaf margin); main lateral nerves, 6-8 pairs, quite apparent. *Inflorescence* simple or compound raceme, 6-20 flowered; bracts oblong-elliptic, keeled, 3 × 1.5 mm, to lanceolate and up to 3 × 0.5 mm, densely ferruginously pilose or sericeous, caducous; peduncle 1.0-4.5 cm, densely ferruginously tomentose, glabrescent; bracteoles lanceolate, up to 0.8 mm long, densely to sparsely tomentose, caducous. *Flowers* 4.5-6.5 mm long, fragrant; pedicel up to 3 mm long, articulate, ferruginously sericeous-pubescent, with a few dark glands. *Sepals* elliptic to elliptic-oblong, 2-3 × 1.0-1.3 mm, apex obtuse, sericeous-pubescent outside, with ca 8-40 dark resinous glands per sepal, mostly in lower half. *Petals* white, with up to six dark glands, lanceolate, 3.5-4.5 × 1.0-1.5 mm, apex obtuse, base truncate, glabrous. *Stamens* 10(11), five episepalous ones 1.5-2mm long in long-styled flowers and 5-5.2 mm in short-styled ones, the five epipetalous stamens 1.3-1.6 mm and 4-4.2 mm long respectively; filaments filiform, glabrous, very shortly connate at base; anthers ovoid, 0.4-0.8 mm long. *Pistil* 3.5-5 mm long in long-styled flowers, 3.7 mm in short-styled ones; style filiform, sericeous; stigma (sub)capitate, more or less bilobed, papillose; ovary 0.8 mm long, obliquely ovoid-lenticular, densely ferruginously sericeous with unequally two-armed hairs; ovules attached near middle of ventral suture, at first hemitropous. *Fruit* dark-brown, 35-40 mm long, 10 mm wide, clearly stalked (up to 7 mm), narrowing to slender rostrum of up to 6 mm long, virtually glabrous when ripe, prominently veined, with many small glands, with leathery outer pericarp, inner pericarp detached except along dorsal suture. *Seed* ovoid, 15 × 9 mm, with black pseudobaccate seed coat, basal end covered by yellow or reddish undulate sarcotesta with a 10 mm long appendage attached to the base of inner pericarp bringing it in a dangling position after dehiscence; hilum wedge shaped; endosperm rudimentary; cotyledons thick, plano-convex, containing albumen and oil.

Distribution: Burma.
Ecology: sublittoral forest.

Specimens examined:

Burma: Diamond Island (fr. Nov.) *Prain s.n.* (BM, K, type); Pyinmadon, Thabaung, Bassein District (fl. March) *Range Officer* (*Comm. C.E. Parkinson*) *2140* (DD, K).

Notes: Schellenberg (1938) separated this species (as *Schellenbergia sterculiifolia*) from *Vismianthus* (and *Burttia*) at an early phylogenetic stage, apparently because *Schellenbergia* has an Asiatic as opposed to African distribution. As a result the Asiatic taxon was placed in the tribe *Castanoleae* near *Ellipanthus* and the African *Vismianthus*, together with *Burttia*, in the *Byrsocarpeae*. This may be the reason why the strong congeneric characters of *Vismianthus* and *Schellenbergia* escaped Schellenberg's attention, probably also because of the supposed absence of resinous glands in *Schellenbergia*. They are present in this taxon, however, and can be observed in the leaves, flowers, and fruits. This character, together with the others as unifoliolate leaves, unicarpellate flowers with ten stamens, and similar fruit and seed characters makes the unification of the genera *Vismianthus* and *Schellenbergia* inevitable.

Parkinson's collection 8729, cited by him when publishing the new genus *Schellenbergia* has not been received on loan from DD where C.E. Parkinson's collection is kept. A request for a loan from two Rangoon herbaria (RAF and RANG) was not successful.

Unidentified material, possibly new species

by F.J. Breteler

In Gabon, N of Ayem Lake, 10 km SW of Ndjolé, N. Hallé collected under no 1727 a specimen which hitherto could not be identified. It has been collected from a shrub. It bears unifoliolate leaves and young fruits with remnants of sepals, petals, and stamens. Undoubtedly it is Connaraceous. The leaves fit well within the genus *Hemandradenia* and so do the remnants of calyx and corolla. Also its origin fits the geographical distribution of it. However, there are two characters which refrain me from putting it in this genus. These two are the apparently ten fertile stamens (at least ten long filaments are present) and the shape of the young, glabrescent fruit. This fruit shape, strongly cuneate at both ends, fits better in other genera like *Vismianthus* and *Ellipanthus*. Mature fruits and/or complete flowers are needed at least to decide where to place this specimen, that almost surely represents a new species.

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Index of scientific names

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