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## Liberian high forest trees

A systematic botanical study  
of the 75 most important or frequent high forest trees,  
with reference to numerous related species



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The author was awarded the degree of Doctor of Agricultural Sciences, State Agricultural University, Wageningen, the Netherlands, on a thesis with the same title

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## PREFACE

During my stay in Liberia from March 1960 to March 1963, I was employed as FAO Associate Expert with the FAO Mission in Liberia, giving instruction in dendrology and related subjects at the College of Forestry of the University of Liberia. During the first eighteen months I also cooperated with the German Forestry Mission to Liberia (Forest Inventory). The idea of writing this book came to me when I realized that in order to become acquainted with the trees of the Liberian forests one had to rely almost entirely on the works of French authors, viz. A. Aubréville 'La Flore Forestière de la Côte d'Ivoire', and Robert Schnell 'La Forêt Dense'. Both works provide a rich source of information which can be of value for Liberia, but unfortunately they are practically inaccessible to many Liberian foresters. Moreover Liberia has a number of important timber trees that have not yet been included in forestry literature.

On the advice of Professor Dr. H. C. D. de Wit of the University of Agriculture, Wageningen, The Netherlands, I changed the originally simple plan into a systematical and botanical study of the 75 most important or common Liberian high forest trees, giving references to numerous related species and including a key for identification, based on field and foliar characters.

I hope this book will serve its dual purpose of providing the botanist with all possible botanical information concerning the tree species involved, and to help the Liberian (and possibly the Sierra Leonean) forester to know and understand his forest for the benefit of forestry in general.

Wageningen, April 1965.



## ACKNOWLEDGEMENTS

I should like to express my sincere gratitude towards Professor Dr. H. C. D. de Wit, whose guidance and criticism, professional and personal interest have stimulated me throughout my work.

The line drawings are an essential supplement to the text and were nearly all prepared by Miss L. van der Riet; through her devotion and craftsmanship she made a major contribution to this book; I am greatly indebted to her. Figures 2, 16, 29, 41 and 43 were drawn by Miss I. Zewald.

My thanks are due to the Board of the University of Agriculture at Wageningen, The Netherlands, who allowed me to work full-time on the preparation of this book. I also wish to thank the FAO authorities and the authorities of the University of Liberia, who enabled me to devote a considerable part of my time in Liberia on data collecting; my special thanks are due to Dr. Rocheforte L. Weeks, President of the University, Mr. J. H. Burgh, Dean of the College of Forestry, and Ir. F. J. van Dillewijn, FAO Expert. Field work would have been considerably less effective without the devoted and skilful help of my field assistant and tree-finder David (Dho) Kwewon from Zuole, who accompanied me on most of my field trips (photograph 6).

My book may be seen as a result of the official cooperation in botanical research between the Universities of Monrovia and Wageningen.

I should like to mention in particular those Liberians who by their helpful interest and hospitality made work in Liberia possible, thereby contributing to the present result.

I wish to express my thanks towards the Directors and Keepers of the Herbaria at the British Museum (BM), Brussels (BR), Geneva (G), Hamburg (HBG), Kew (K), Leiden (L), Oxford (FHO), Paris (P), and Washington (US) for their kind help in various ways and loans of specimens. Special thanks are due to the Director and staff of the Herbarium at Wageningen (WAG) for their full cooperation.

I should like to thank in particular Mr. J. E. Wilson of the Pudoc for his revision of the English.

Colleagues and friends, both in Liberia and Europe, often assisted me, for which I remain indebted to them.

The Holland-West Africa Line (HWAL) provided free transport from Monrovia to Amsterdam for all my botanical collections.

## INTRODUCTION

**LINE DRAWINGS.** The original drawings are twice the size of the reproductions; they are kept in the Wageningen Herbarium (WAG). The specimens used for the figures are listed after Chapter V.

**PHOTOGRAPHS.** The photographs were all taken in Liberia, with a Kodak-Retinette camera; photographing in the often dark forest proved to be satisfactory with the Ilford Hp 3 film, which is both very fast and fine-grained when developed with a special developer. Photograph 18 presents the author to the reader.

The person most frequently photographed standing at the base of a tree is David Kwewon, tree finder.

**MAPS.** The boundaries shown in maps 1 and 2 are taken from the atlases of Sierra Leone, Guinea, and the Ivory Coast, and do not claim to represent the exact official boundaries. The lines of equal rainfall, isohyets, as shown in map 1, were deducted from rainfall data over the years 1953–1962 of 30 weather stations, communicated to me by the Division of Meteorology of the Department of Public Works and Utilities, Monrovia, as well as from the Atlas of Sierra Leone (1953), and a rainfall map of Ivory Coast from the Centre Technique Forestier Tropical, France.

Map 2 is taken from the planimetric map of Liberia, scale 1:1,000,000 (1953), but certain new highways are shown approximately. With the exception of Ganta (Gahn-pa) and Gbarnga (Gbanka) this map has been followed in the spelling of the names of localities.

Map 3, representing a cross-section of the western province of Liberia, is based on observations made during a tour through this province, the route of which is indicated in map 2.

In 1963 Liberia was subdivided into nine counties, to which no further reference is made in this book. The area west of the St. Paul river has been indicated as the western province, the area between the St. Paul and the Cestos river as the central province, and the area east of the Cestos river as the eastern province.

**AREAS INVESTIGATED.** Tours were organized in the framework of study trips for the students of the College of Forestry of the University of Liberia, or with the German Forestry Mission to Liberia, or as individual collecting trips. Although most study and collecting areas are near the main road, a sufficient all-round impression of the forest situation could be obtained because smaller or larger forested areas are often within

# Chapter I

## BOTANICAL EXPLORATION AND LITERATURE

**BOTANICAL EXPLORATION.** The Portuguese, who explored the area in 1460/61, were the first to map the Liberian coast, and many names such as Cape Mount, Montserrado county, Mesurado swamp, Cestos river, Cavalla river still bear witness of this. But nearly 400 years passed before systematic botanical collections of Liberia were made, although some specimens from the pre-Linnaean era are to be found in the Sloane Herbarium (BM), collected by passing naval surgeons between 1697 and 1703 on Cape Mesurado and Montserrado.

Although botanical exploration of other parts of West Africa was in full swing around 1800 (names such as Adanson in *Adansonia*, Afzelius in *Afzelia*, Berlin in *Berlinia* are indissolubly connected with West African botany), Liberia was not visited by a botanist until 1841. In this year the second Niger expedition, sent out from Britain to explore the Niger river, passed Liberia. The botanist of this expedition, Dr. Theodor Vogel (*Anthocleista vogelii* PLANCH.) made collections on Cape Mesurado (5–6 July), in Grand Bassa (9–14 July), and Cape Palmas (16–18 July), collecting nearly 150 specimens. Collecting was seriously hampered by the heavy rainfall. Vogel died in December 1841 on Fernando Po from fever; his specimens are now at Kew (K).

In 1855 a German botanist, Philipp Schoenlein (*Ouratea schoenleiniana* (KLOTZSCH) GILG) visited Cape Palmas, but he soon died from sunstroke. His collections were lost but for 14 specimens.

Dr. Naumann of the 'Gazelle Expedition' collected some 20 monocotyledons near Monrovia in 1874 (*Scleria naumanniana* BOECK., saw-grass). His collection was lost at Berlin in 1943.

Dr. O. F. Cook, an American botanist, collected 427 specimens during 1895/96.

The earliest major collections from Liberia were made by Max Dinklage (*Dialium dinklagei* HARMS; *Dinklageodoxa scandens* HEINE & SANDWICH). As a botanist to the Woermann company, Dinklage was employed to study the possibilities of utilizing the vegetation of Cameroon. In Cameroon, however, Dinklage proved to be an able businessman, and in 1894 he was appointed director of the Woermann company in Liberia. He gained an important position in Monrovia and even became German Consul before the first world war. With short intervals he lived in Liberia until 1930, where he returned in 1934 as botanist to a botanical expedition supported by the Harvard University (U.S.A.). Although 70 years old, Dinklage planned to make a trip up country to the Nimba region, but he fell ill with dysentery and died in the Ganta Mission in January 1935.

Dinklage made eleven field trips, mostly along the coast, and collected some 1

specimens (his total collections numbered 3388 specimens, but the balance was collected outside Liberia), including 32 new species and at least one new genus (*Polystemonanthus* HARMS); some of these species have not yet been found again (*Anthonotha ernae* (DINKL.) J. LÉONARD). Many of the duplicates of Dinklage's collections are at Kew (K); the original set was partly destroyed at Berlin during the second world war. An almost complete set is now at Hamburg (HBG).

Small collections were made by D. Sim in the Sinoe area (1901), A. Whyte (*Acioa whytei* STAPF) near Kakata and in the Sinoe area (1903), H. Reynolds (*Spiropetalum reynoldsii* (STAPF) SCHELLENB.) near Monrovia (1905) and Sir Harry Johnston (1907) (*Rinorea johnstonii* (STAPF) M. BRANDT).

In 1910 Bunting (*Cola buntingii* BAK. f.) made a small but important collection in the Gola forest. His specimens are at the British Museum (BM).

In 1926/27 Dr. H. D. Linder, botanist of the Harvard African Expedition made a long field trip in the central province of Liberia, collecting some 1600 specimens, which are now at the Arnold Arboretum (A), but the first duplicate set is at Kew (K).

Hitherto the collections mainly included herbs, shrubs and climbers, and little was known about the tree species of Liberia, but in 1928 G. Proctor Cooper of the Yale University, School of Forestry (U.S.A.) came to Liberia to make a study of the forest cover of the Firestone concession in the Du river area. He collected about 500 specimens, mostly woody plants, including some new species (*Cassipourea firestoneana* COOPER & RECORD) and numerous species of which the occurrence in Liberia was as yet unknown (*Amphimas*, *Anopyxis*, *Klainedoxa*, *Pachypodanthium* etc.). Many of his specimens are at Kew (K).

Since 1933 Dr. and Mrs. G. W. Harley have collected numerous plants, and in 1960 their collection included over 2200 specimens, most of which are represented at Kew (K). A duplicate set of some 1200 specimens, however, was bought by the College of Forestry of the University of Liberia when in 1960 Dr. and Mrs. Harley left Liberia after working for 35 years at the Methodist Mission in Ganta. An important part of this collection is formed by ferns, the special interest of Mrs. Harley. This duplicate set is the foundation of the Herbarium of the University of Liberia, called the 'Harley Herbarium' in honour of its collectors; its code symbol is LIB.

In 1943/44 J. C. Bequaert made some limited collections for the Arnold Arboretum (A). In 1947 and 1949 Dr. J. T. Baldwin went to Liberia to study *Strophanthus* as a possible source of cortisone precursors. He collected several thousand specimens, preserved in the Gray Herbarium (GH) (U.S.A.), and represented at Kew (K) by the first duplicate set.

On instructions of the U.S. Economic Mission to Liberia Karl Mayer made a survey of the forest resources of Liberia during the years 1947-'49. He made a collection of 235 species, but not all specimens were preserved; his plants ought to be at the Smithsonian Institution, Washington DC (US).

Recently new collections have contributed to the knowledge of the Liberian flora;

Voorhoeve collection (1960–1963, c. 1300 numbers, mainly tree species), de Wit (1961–1962, 124 numbers), de Wilde (1962, c. 260 numbers, trees and herbs), Leeuwenberg (1962, c. 400 numbers, many climbers), Kunkel (1961–1963, c. 170 fern species), van Dillewijn (1962, c. 70 specimens), Goll (1962, c. 30 specimens), van Harten (1963–1964, c. 300 numbers). Duplicates of most of these collections are represented at the Harley Herbarium (LIB) and the Wageningen Herbarium (WAG). That more collections are desirable is demonstrated by the fact that several new species have been discovered in these collections (*Strychnos*, *Asplenium*, *Nauclea* (?)).

SURVEY OF LITERATURE. Publications, dealing directly with Liberia are:

1. Hooker, Sir William Jackson; 'Niger Flora' (1849). This Niger Flora includes a sketch of the life of Dr. Theodor Vogel, the journal of Dr. Vogel, and the descriptions of the species of the Vogel collection. The journal in particular is full of interesting historical data.
2. Klotzsch, Johannes in *Abhandlungen der Akademie der Wissenschaften zu Berlin*, 1856, p. 221–252; an account of the plants collected by Philipp Schoenlein.
3. Engler, Adolph; *Uebersicht ueber die botanischen Ergebnisse der Forschungsreise der 'Gazelle' (1889)*; an account of the plants collected by Dr. Naumann.
4. Johnston, Sir Harry; *Liberia* (London, 1906); Appendix IV: The known plants of Liberia by Dr. Otto Stapf. An account of the Liberian specimens, present in the Kew Herbarium (the collections of Vogel, Sim, Whyte, Reynolds and Johnston), including also the publications of Klotzsch and Engler (2 & 3); of each species a short description is given.
5. Strong, Prof. Richard P.; *The African Republic of Liberia and the Belgian Congo* (Cambridge, Mass., U.S.A., 1940); an account of the observations made and material collected during the Harvard Expedition 1926/27; Volume I, chapter 23, p. 512–568, is a narrative report of Linders collections in Liberia.
6. Cooper, G. Proctor & S. J. Record; *The evergreen forests of Liberia*, Yale University, School of Forestry, Bull. 31 (New Haven, Conn., U.S.A., 1931). This is an account of Coopers collections in the Firestone concession, during 1928/29. The descriptions of the species are short but sometimes useful; the data on the uses of the various species are often interesting; the wood anatomical descriptions and the results of the tests on physical and mechanical properties of 104 of the 286 described species are the only data of this kind, which exist from many of these species. The nomenclature of the species has to be controlled with the recent *Flora of West Tropical Africa*, because some of the identifications are wrong: *Chlorophora excelsa* is actually *C. regia*, *Terminalia superba* is actually *T. ivorensis* etc. The vernacular names, though indicated as Bassa names, are often Gio names.
7. Dinklage, Max; *Verzeichnis der Flora von Liberia*, Fedde Repertorium XLI (1936/37), p. 235–271 (revised by J. Mildbraed). An account of Dinklage's Liberian collections, but including also all previous accounts of the flora of Liberia (4, 5, 6)

and giving a summary of the botanical history of Liberia. For information concerning Dinklage reference is made to the necrology by Mildbraed in *Notizbl. Bot. Garten, Berlin-Dahlem*, XII, p. 413 (1935). No descriptive data are given, but only the species names with the collector and his collection number.

8. Harley, George Way; *Native African Medicine, with special reference to its practice in the Mano tribe of Liberia*; Cambridge, Mass., U.S.A. (1941). In this narrative account of medical practices in a wide sense, frequent reference is made to species, collected by Dr. or Mrs. Harley, but no collection numbers are indicated, and Latin names are without author; in an appendix a botanical list is giving the Mano names of the species concerned.
9. Mayer, Karl R.; *Forest resources of Liberia, Agriculture Information Bulletin No. 67, U.S. Dept. Agric. (1951)*. A survey of the forest resources of Liberia, and a first trial of classification of the forest cover in various types, and of the tree species in utility classes. The identifications are in some cases questionable, and the nomenclature of many species is out of date. This booklet is a valuable source of general information, but the data on the acreage of high forest and volumes of merchantable timber are doubtful and now out of date.
10. Harley, Mrs. Winifred J.; *The ferns of Liberia, Contr. Gray Herb., 177, p. 58-101 (1955)*. This study attempts to bring together all known collections of ferns from Liberia; an annotated list is arranged in families.
11. Harley, Mrs. Winifred J.; *Handbook of Liberian Ferns, Ganta, Liberia (1959?)*. This booklet includes 105 drawings of ferns and short descriptions and is very useful for the identification of Liberian ferns, although at present it is known that at least 163 fern species occur in Liberia.
12. Unwin, A. H.; *West African Forests and Forestry (London, 1920)*. A review of the West African forest situation, dealing with Liberia on page 66-80. The account of the supposed richness of the Gola Forest is unreliable, and so are the identifications of the tree species, to which reference is made.
13. Hutchinson, J. and J. M. Dalziel; *Flora of West Tropical Africa (F.W.T.A.)*. First edition: vol. I, part 1: 1927; I, 2: 1928; II, 1: 1931; II, 2: 1936. Second edition: volume I revised by R. W. J. Keay, part 1 edited in 1954, part 2 in 1958; volume II revised by F. N. Hepper, edited in 1963; volume III, dealing with the Monocotyledons, is still in revision.  
This Flora is most valuable for the identification of flowering plants and includes much information concerning synonyms and botanical literature; few data concerning ecology, uses etc. are included. A key for the identification of families is included in volume II, 2nd ed.
14. Dalziel, J. M.; *The useful plants of west tropical Africa (U.P.W.T.A.), an appendix to F.W.T.A. (13)*. A compilation of all known data concerning the local uses of West African plants.
15. Schnell, R.; *La Forêt Dense (Paris, 1950)*; a botanical study of the forest region of

West Africa, more specifically the former French colonies, including an useful but incomplete key on vegetative characters.

16. Reed, William E.; Reconnaissance soil survey of Liberia, Agriculture Information Bulletin No. 66, U.S. Dept. Agric. (1951). The first and until now the only attempt to come to an identification and evaluation of the soils of the whole of Liberia.
17. Kryn, J. M. and E. W. Fobes; The Woods of Liberia, Forest Products Laboratory, Madison, Wis. (U.S.A.), Report 2159 (1959). A compilation of all data available in the literature on wood anatomy and mechanical properties of about 140 species, recorded from Liberia. Tree descriptions are very limited. Nomenclature is partly out of date.
18. Kunkel, G.; Trees of Liberia (1965). A list of about 100 tree species, annotated with their field characters and illustrated with figures of the leaves and fruits.

Some periodicals of interest for Liberian botany and forestry.

19. Botanische Jahrbücher. Place of publication of numerous original descriptions and taxonomical revisions of African taxa by German authors.
20. Kew Bulletin (formerly Bulletin of Miscellaneous Information). Place of publication of numerous original descriptions and taxonomical revisions of African taxa by British authors.
21. Bulletin de la Société botanique de France. Place of publication of many original diagnoses and taxonomical revisions by French authors.
22. Bulletin du Jardin botanique de l'Etat à Bruxelles. Place of publication of many original descriptions of African, and particularly Congolese, plants by Belgian authors.
23. Taxon. Official news bulletin of the International Association for Plant Taxonomy.
24. A.E.T.F.A.T.-Index. Index of the papers on systematic phanerogamy and of the new taxa concerning Africa south of the Sahara and Madagascar, published by the Association pour l'Etude Taxonomique de la Flore d'Afrique tropicale (A.E.T. F.A.T.) at Brussels.
25. Adansonia. Publication of the Muséum national d'histoire naturelle in Paris. This new series is a continuation of the former Notulae systematicae.
26. Journal of the West African Science Association, Ibadan, Nigeria.
27. Bois et Forêts Tropiques, published by the Centre Technique Forestier Tropical, Nogent-sur-Marne, France.
28. Commonwealth Forestry Review, published by the Commonwealth Forestry Association, London.
29. German Forestry Mission to Liberia, Report No. 1 (in print).

## Chapter II

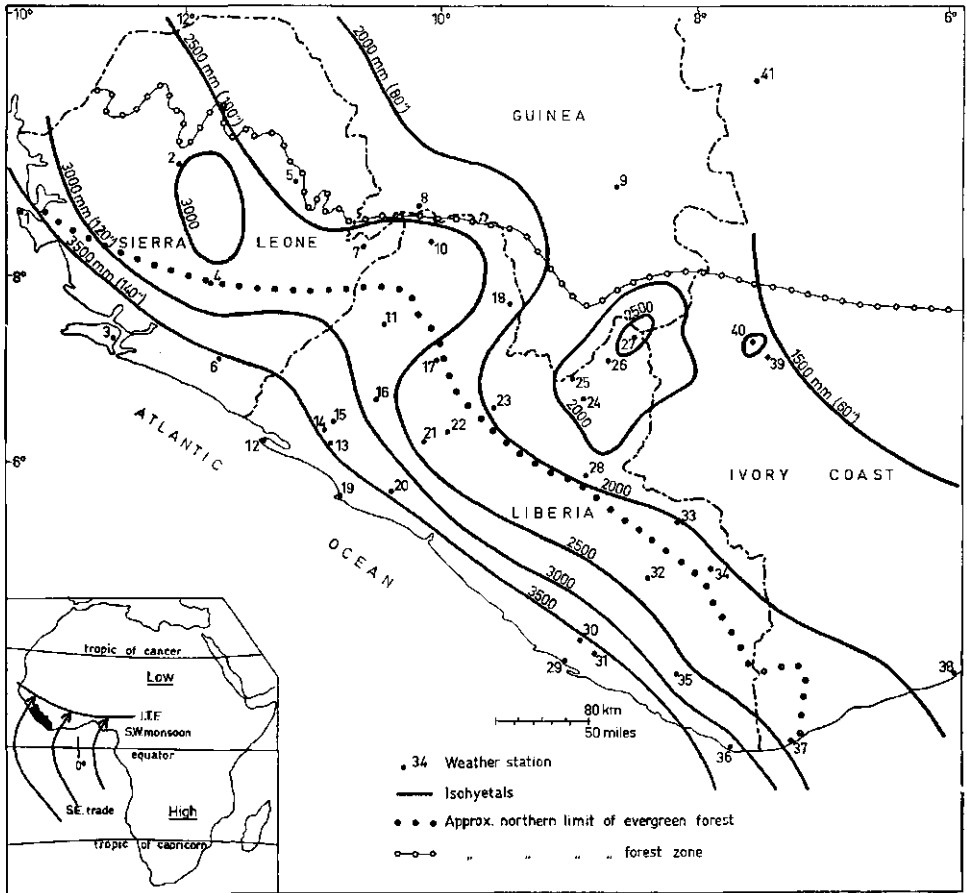
### GEOGRAPHY AND CLIMATE

**PHYSIOGRAPHY, GEOLOGY, AND SOILS.** Liberia is situated in the corner of West Africa where the general north-south tendency of the coast abruptly changes into a west-east orientation (see map 1). The coast line of Liberia is roughly 560 km ( $\approx$  350 M.) long and has approximately a N.W.-S.E. direction. The total area of this country, which is enclosed by the meridians of  $7^{\circ}30'$  West and  $11^{\circ}30'$  West and the parallels of  $4^{\circ}18'$  North and  $8^{\circ}30'$  North, is about 111,500 km<sup>2</sup> ( $\approx$  43,000 sq. miles). In the western and central provinces the country is about 270 km ( $\approx$  170 M.) deep, in the eastern province only about 175 km ( $\approx$  110 M.). Two major regions can be distinguished, differing in their physical features and height above sea level: (1) the belt of the rolling hills, and (2) the belt of the dissected table-lands (plateaux) (see map 3).

1. The belt of the rolling hills extends from the coast inland to a varying depth of 80–130 km ( $\approx$  50–80 M.), rising gradually from sea level to a height of about a hundred metres ( $\approx$  330'). Rock outcrops and some hilly ranges break the uniform pattern of this belt: Cape Mount, Cape Mesurado, Cape Palmas, the Bie Mountains, Gibi Range, Bassa Hills, Mount Finley etc. The strip along the coast is formed by coastal plains, a relatively flat area with a varying depth of 10–16 km ( $\approx$  6–10 M.). Here the rolling country profile dips below the surface; the lower parts are filled up with sandy soils, and the hill tops found scattered in this area are the extreme outcrops of the original rolling profile.
2. The belt of the dissected table-lands is separated from the first belt by a steep and hilly escarpment area, a narrow strip in which the land rises from about 100 m ( $\approx$  330') to about 200 m ( $\approx$  650'). This rather sudden rise can be experienced by every traveller proceeding by road from Monrovia to Totota. Just beyond Reputa the road climbs the Totota Hills on the summit of which the President Tubman farm is situated, but after passing this there is no marked descent as the table-lands have been reached. These plateaux cover the larger part of the Liberian hinterland, rising gradually to a height of about 300 m ( $\approx$  1,000') in Ganta, or 600 m ( $\approx$  2,000') in Voinjama.

A marked feature of this belt, and in a lesser degree of the belt of the rolling hills, is the presence of a number of steep mountainous ranges with a general S.W.–N.E. direction. These ranges form the remnants of the pre-Cambrium mountains which existed here over 500 million years ago and have been worn down by long ages of erosion. Most marked are the high Kpo- and Wologisi ranges in the western province, the latter culminating in Mount Wutivi, which is 1,340 m ( $\approx$  4,400') high. Other ranges in the central and eastern province are less outspoken: Bong Range, ranges west and





Map 1. Average annual rainfall distribution in Liberia and neighbouring countries. The numbered weather stations are listed below, with the average annual rainfall in millimetres.

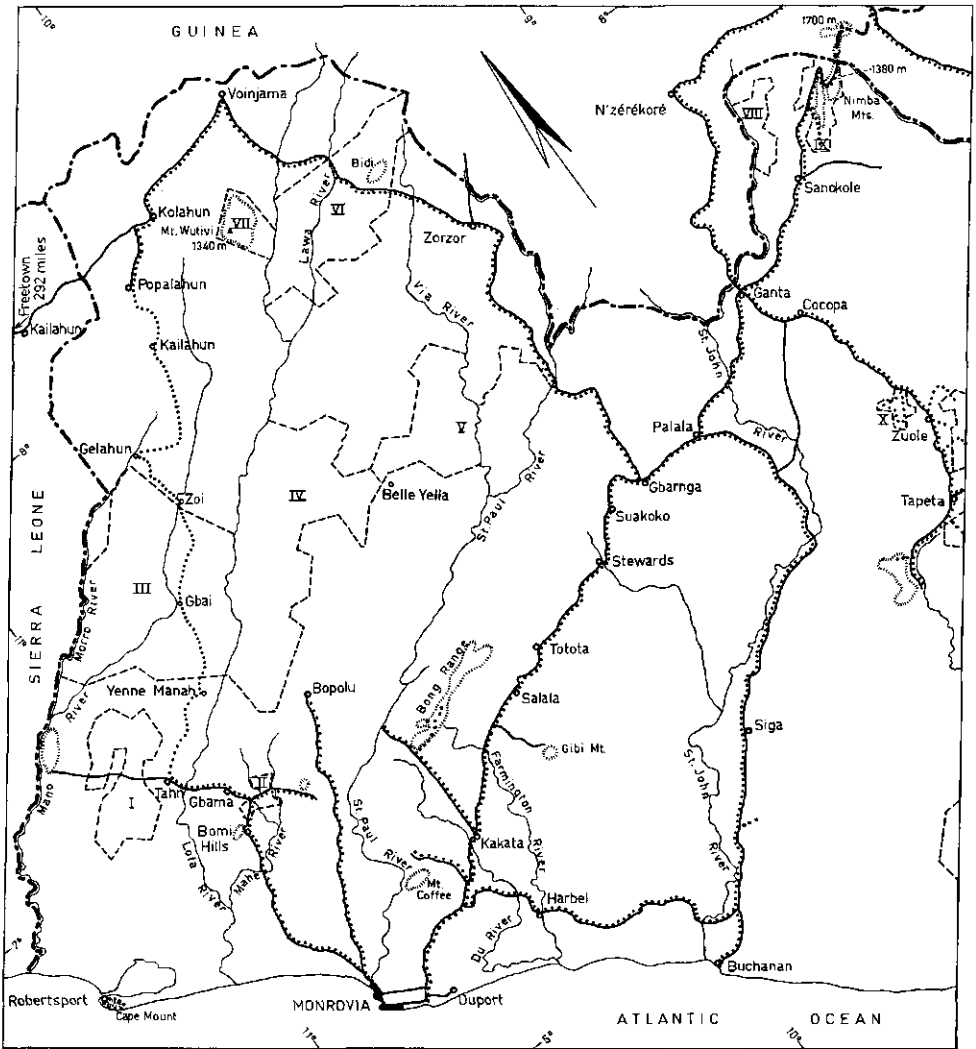
Inset: the continent of Africa; Liberia and Sierra Leone indicated black; distribution of high pressure and low pressure belt and a position of the Inter Tropical Front (I.T.F.) during the rainy season.

<b>SIERRA LEONE:</b>		12. Robertsport	- 4290	28. Tapeta	- 1750
1. Freetown	- 3500	13. Clay	- 3400	29. Greenville	- 4350
2. Makeni	- 3000	14. Goodrich	- 3350	30. Najor town	- 3550
3. Bonthe	- 4000	15. Bomi Hills	- 3300	31. Flahn town	- 3700
4. Bo	- 2775	16. Bopolu	- 2600	32. Pine town	- 2350
5. Yengema	- 2250	17. Belle Yella	- 2130	33. Zwedru	- 2000
6. Pujehun	- 3500	18. Zorzor	- 2050	34. Ziatown	- 2050
7. Kailahun	- 2650	19. Monrovia	- 4750	35. Buah	- 2600
		20. Harbel	- 3450	36. Harper	- 3050
		21. Salala	- 2400		
<b>GUINEA:</b>		22. Totota	- 2200	<b>IVORY COAST:</b>	
8. Guékoudo	- 2390	23. Suakoko	- 1900	37. Tabou	- 2350
9. Beyla	- 1700	24. Ganta	- 2150	38. Sassandra	- 1700
<b>LIBERIA:</b>		25. Cocopa	- 2050	39. Man	- 1500
10. Kolahun	- 2680	26. Sanokole	- 2250	40. Mtn. Tonqui	- 2500
11. Zoi	- 2800	27. Mtn. Nimba	- 3000	41. Odiene	- 1500

east of Tapeta, Putu and Tiehnpo ranges. The Nimba range in the outer north-west of the central province forms part of the more extensive Nimba complex in Guinea. Mount Nimba in Guinea reaches a height of 1,700 m ( $\approx$  5,600'); in Liberia the highest point of this range, also the highest point of Liberia, is the 'Guest House Hill' of 1,380 m ( $\approx$  4,520'). When this hill has been levelled for iron mining (it is composed of iron ore of nearly 70%), Mount Wutivi will be the highest peak in Liberia.

The Nimba complex is at the origin of the three major rivers which drain the table-lands in the eastern and central province: Cavalla, Cestos and St. John rivers. In addition the interior of the eastern province is drained by the Duobe river, a major tributary of the Cavalla river, flowing S.E., contrary to the general S.W. direction of the rivers in Liberia. The belt of rolling hills in these provinces is drained by numerous smaller rivers, such as the Du, Farmington, Timbo, Sehnkwehn, Sino, Dugbe, and Dubo rivers. They find their origin in the steep escarpment, separating the rolling hills from the table-lands. The more accentuated chains of hills in the western province cause the drainage pattern to be slightly different. The catchment areas of the three major rivers, St. Paul, Lofa and Mano river, are narrow and drawn out. They drain both the table-lands and the rolling hills; the only minor rivers are the Maffa and the Po. The lower course of the Farmington and Cavalla rivers excepted, all these rivers are only navigable for canoes, and only for shorter stretches between rapids. The rivers of Liberia hardly form any well-developed valleys and flood-plains. They flow almost entirely over bedrock and rapids.

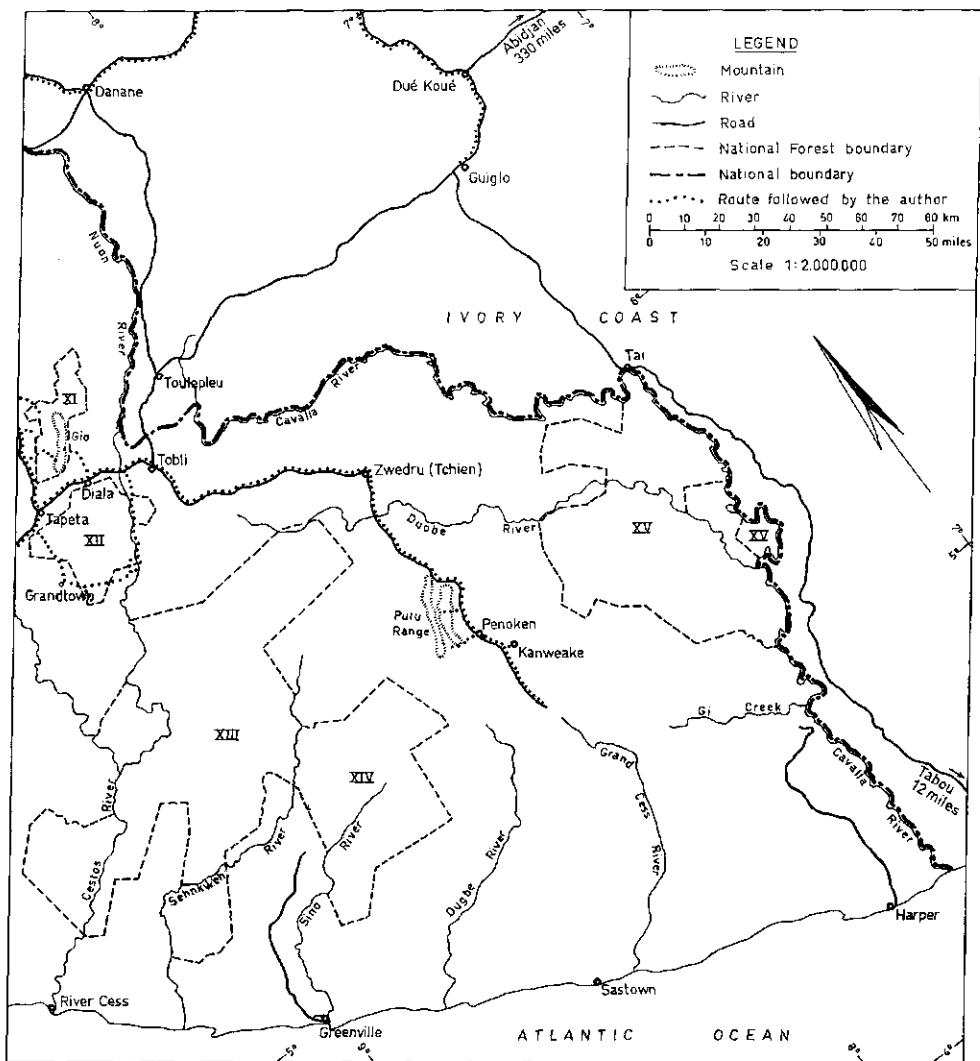
The bedrock of Liberia is of pre-Cambrium age, made up of igneous and metamorphic rocks such as granitic gneisses, sandstones and schists. This bedrock comes to the surface in river beds and on steep hills, but is covered generally by a layer of soil varying in depth from a few to hundreds of feet. Little exact and detailed information is available on the soil types and their distribution in Liberia. The work of Reed (Chapter I, 16) is the earliest and hitherto the only review of the soils of Liberia, but it is also limited. Most recent publications on Liberia dealing with this subject are based on Reed. Generally the following may be said. The soil which covers the major part of Liberia is an oxisol (Soil Classification, A comprehensive system, 7th approximation, U.S. Dept. Agric., 1960), formerly called latosol (Reed, l.c.) or lateritic soil. It is the general type of soil, developing on undulating to hilly country in tropical and subtropical areas with a high rainfall. Formerly it was indicated as part of the zonal soils in which the effect of climate and vegetation is reflected in a number of distinct horizons in the soil profile. It is characterized by the occurrence of an oxic horizon, viz. a horizon in which weathering has at some time removed or altered most of the silica combined with iron and aluminum; the percentage of free sesquioxides is quite high. In general it is a well-drained soil; the fertility depends on the type of parent material and on the quantity of unweathered minerals. Approximately the first 20 cm ( $\approx$  8") form a topsoil which is brownish in colour owing to a high humus content. This topsoil is often sharply divided from the subsoil, which is red, brown or yellow in colour, and in which



Map 2. North-western half of Liberia. Legend: see facing map.

National Forests (approximate acreage in brackets):

- I : Vai (119,300)
- II : Yoma District of the Gola National Forest (36,500)
- III : Gola (511,500)
- IV : Kpelle (432,000)
- V : Belle (271,800)
- VI : Loma (231,000)
- VII: Mount Wutivi National park (not yet surveyed)



Map 2. South-eastern half of Liberia. National Forests (VIII, IX, and X on facing map):

- VIII: Nimba-West (34,700)
- IX : Nimba-East (76,600)
- X : North Gio (11,800)
- XI : Gio (81,370)
- XII : Gbi (150,600)
- XIII: Krahn-Bassa (1,270,000)
- XIV: Sapo (360,000)
- XV : Grebo (643,200)

a layer of gravelly concretions (iron-aluminum oxides) of varying thickness is often present.

In sharp contrast to these oxisols are the azonal soils, classified (Reed, l.c.) as 'lithosol'. A striking character of these soils is that the erosion keeps pace with the profile development. Therefore these are usually shallow soils, a few inches to a few feet deep, often with outcroppings of the parent material; they develop on hilly and rugged land.

On the valley floors alluvial and colluvial soils have been developed, and depending on drainage, various soil types can be distinguished (Reed, l.c.) which are reflected in the vegetation.

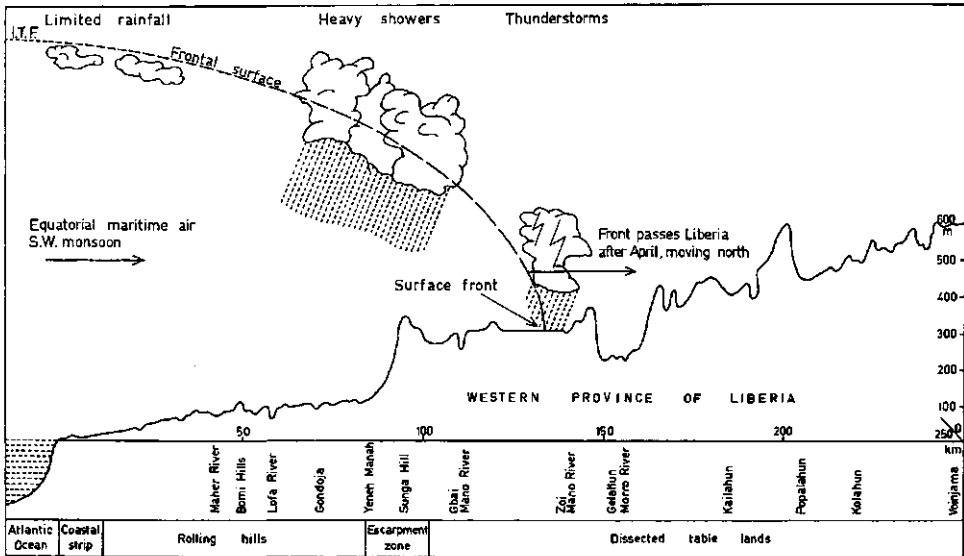
**CLIMATE.** The climate of Liberia, and more generally West Africa, is determined by the movements of the Inter Tropical Front (I.T.F.). Above the Sahara there is a hot and dry mass of air, the Tropical Continental Air Mass. In the equator zone above the atlantic ocean there is a relatively cool, moist air mass, the Equatorial Maritime Air Mass. Where these two air masses meet, the I.T.F. is formed; the maritime air which is cooler and therefore heavier, moves as a wedge under the warmer, lighter continental air, and the separating plane between the two air masses is called the frontal surface. The frontal surface is shaped like a curved plane, slanting in a southern direction (see map 3). The point at which the frontal surface reaches the earth is called the surface front, or front. Near the front differences in temperature and moisture content on either side are marked. On higher altitudes the two air masses mix and the differences are equalized. Owing to the slanting character of the frontal surface this zone of equalization is found far south of the front.

From September 23 to March 21 the sun is overhead south of the equator, and a low pressure belt builds up above the continent of South Africa. At the same time a high pressure belt is formed above North Africa. The wind blowing from the high pressure belt to the low pressure belt, in this case a north-south direction, becomes a north-eastern wind, owing to the deflection to the right on the northern hemisphere (Law of Buys Ballot). It is known as the Harmattan, a dry, hot, often dust laden wind. This is the period of the dry season, when the major part of West Africa comes under influence of the tropical continental air mass.

From March 21 to September 23 the sun is overhead north of the equator. A low pressure belt now builds up above the Sahara, and a high pressure belt above South Africa. The winds blowing from the high to the low pressure belt, on the southern hemisphere deflected to the left, are the south-east trade winds, blowing over the atlantic ocean. When crossing the equator they are deflected to the right and become the south-west monsoon winds. This is the period of the rainy season, when large parts of West Africa come under influence of the equatorial maritime air mass (see map 1, inset).

Owing to this change in the position of low and high pressure belts the Inter Tropical Front is always on the move, either in southern direction (as a warm front), when there is a high pressure belt above the Sahara, or in northern direction (as a cold front),

when there is a high pressure belt above South Africa. The passage of the I.T.F. is called the frontal passage, and the passage of the various zones in the frontal surface is accompanied by characteristic types of weather. Near the surface front there is cloud formation, and thunderstorms, which are often dry, are of frequent occurrence. After the passage of the surface front there is heavy cloud formation and rainfall in torrential showers. Towards the end of the frontal passage there is a more regular but limited rainfall (see map 3).



Map 3. Cross-section of Liberia through the western province.  
Schematic presentation of the Inter Tropical Front moving northward.  
Horizontal scale  $\approx 1:2,000,000$ ; distances in kilometres.  
Vertical scale  $\approx 1:20,000$ ; altitudes in metres.

With these data the climate in Liberia is easily made clear. About at the beginning of May the I.T.F. reaches Liberia on its way north, and the beginning of the rainy season is indicated by thunderstorms and strong winds characteristic for the zone of the surface front. In June, when the surface front has passed, there is a heavy rainfall, and in July and/or August rainfall decreases, because the end of the I.T.F. with a limited rainfall is now overhead. This is the period of the mid dry season. This mid dry season is very distinct in the south-east of the country, but becomes less marked towards the north-west and is even absent in the northern part of the western province. This is caused by the fact that the zone of limited rainfall never reaches so far north, i.e. the frontal passage in these regions is never complete. Instead there is a period of sustained rainfall from June to September. In August and September there is again an increased precipitation, when the zone of heavy rainfall passes again over Liberia, now

when the I.T.F. is on its way south. September often shows the heaviest rainfall of the whole year. The end of the rainy season, in October or November, is again accompanied by thunderstorms in the neighbourhood of the surface front.

The dry season lasts from about mid-November to the beginning of May. In the northern regions the country is under influence of the Harmattan, and the air is filled with a fine, reddish dust; there may be a dry period of two to three months with little or no rainfall. The coastal area, however, is rarely reached by the Harmattan for a period longer than two weeks and in some years it may fail to break through altogether. This is caused by the fact that a local low pressure – high pressure system develops in the coastal region. During day time the land is heated more than the sea; above the land a low pressure area develops, and a high pressure area above the sea. This results in a sea wind, which brings the coastal region under influence of moist maritime air. This sea wind weakens or turns into a land wind at night, and when there is a breakthrough of the Harmattan in the coastal area, it will usually occur at night or in the early morning.

**RAINFALL.** The moisture-laden monsoon winds hit squarely the coast of Liberia, and even the slight rise of the country results in heavy rains; extreme precipitation is measured on the mountainous outcrops along the coast (Cape Mount, Monrovia etc.). On an average the coastal belt receives over 4,000 mm ( $\approx 160''$ ) rainfall. The moisture content of the air rapidly decreases and over the short distance of 32 km ( $\approx 20$  M.) annual rainfall may decrease with 800 mm ( $\approx 36''$ ). However, this steep decrease in rainfall is slowed down and the isohyets (lines of equal rainfall) become more widely spaced towards the interior. In map 1 the approximate position of the isohyets in Liberia and neighbouring countries is shown. This map is slightly different from previously published approximations, but agrees well with the concept of the rainfall distribution in Sierra Leone and the Ivory Coast. The isohyets in the eastern and central provinces are roughly parallel to the coast, but in the western province they penetrate much deeper into the interior. This is perhaps caused by the structural feature of the western province: the high mountainous ranges in southwest–northeast direction, which open the way for the monsoon to penetrate deep into the interior; possibly the fact that the mid dry season does not occur in this area is also of some influence. The high rainfall zone around the Nimba complex is clearly orographically influenced.

Whereas Sierra Leone has more or less the same pattern of rainfall as Liberia, the situation in the Ivory Coast is quite different. Here the coast from Tabou to Abidjan has a slight north-east direction, and the western part of the Ivory Coast lies more or less in the wind shadow of Liberia. This is reflected in the annual rainfall, which averages less than 2,000 mm ( $\approx 80''$ ). Only beyond Abidjan, where the coast again assumes a slight south-east direction, the rainfall rises above 2,000 mm, and the south-east part of the Ivory Coast and the south-west part of Ghana have a forest cover, to a certain extent comparable with the Liberian evergreen forest.

TEMPERATURE AND HUMIDITY. During the rainy season cloud formation reduces the direct radiation which reaches the earth surface; this is the cause that temperatures in the relatively cool maritime air remain relatively low, and that differences between day and night are small. During the dry season the hot Harmattan and the higher direct radiation will cause the day temperatures to rise, but the clear skies will result in lower night temperatures. In the coastal area the neighbourhood of the sea has a tempering effect. The result is an average temperature for the country between  $24^{\circ}$  and  $30^{\circ}\text{C}$  ( $= 75^{\circ}$ — $86^{\circ}\text{F}$ ); in the coastal area the average is lower than in the interior, and daily and seasonal differences are small; in the interior the average temperature is higher, but daily and seasonal differences are greater. In the coastal area relative humidity rarely comes below 80%, and on average is above 90%. In the interior there is a much wider variation in humidity, which during the Harmattan may fall below 50%.



# Chapter III

## VEGETATION

**HISTORY.** The combined factors of climate and geography (high temperature, high rainfall, and low altitude) would result in a high forest-vegetation covering the major part of Liberia; other vegetation types would occur on such limited areas as beaches, some natural savannas and ill-drained swamps. This vegetation would have a balanced character, and generally remain constant when seen over larger areas.

The term climax vegetation is often used, i.e. a mature vegetation developed in the local natural environment (topography and climate). The term 'primary' or 'virgin' is applied to this forest when it has never been touched or disturbed by man (felling), but it is not always possible to distinguish a primary climax-vegetation from a secondary one.

Primary forest probably existed in the distant past, when the forest zone of West Africa was still uninhabited or when only hunting pigmy tribes roamed the forests (stories about pigmies, 'little men', are still told in Liberia). Permanent human settlement probably took place in fairly recent times, and the practice of shifting cultivation made the primary forest cover gradually vanish during the bygone ages, to be replaced by a secondary vegetation.

It is believed that as recently as 300 years ago Liberia was much more densely populated than at present. The area supporting high forest would have been much smaller than nowadays. If this view is correct, this could be compared with the present situation in Sierra Leone, where high forest stands are limited, and the major part of the country is covered by low bush and young secondary forest, included in the sequence of shifting cultivation.

However, diseases, tribal warfare, and slave trading are believed to have reduced the population of Liberia to its present level of about one million, and the low bush in the abandoned country might then have developed into the present high forest, which would be of a secondary character.

Evidence of this development is found in the forest: the occurrence of extensive single dominant forests (discussed later), the occurrence of forests where the secondary character becomes evident from the species composition, and the presence of relics of human occupation such as graves, ancient roads etc.

**PRESENT SITUATION.** The present high forest (tentatively defined as forest with a closed canopy at or above a height of 30 m ( $\approx 100'$ ) and a more or less distinct development of strata) can be arranged into three groups, (1) primary high forest, (2) old secondary forest which has reached the climax, and (3) old secondary forest which has not yet

reached the climax. The first group appears to be extremely rare in Liberia; it is restricted to remote and limited localities of which only the gorges in the Nimba mountains are known to me. Steep slopes prevented all agriculture there and the belief in numerous spirits made the people afraid to penetrate into this area. The second and third group form the bulk of the Liberian high forests, estimated to cover 35% of the country. There is no sharp division between these two groups and they can only be distinguished by species composition, average diameter of the trees of the upper canopy and the development of strata.

When the forest is still relatively young, light demanding species play a dominant role: *Albizia* spp., *Fagara* spp., *Terminalia* spp., *Pycnanthus angolensis* etc. In further progressed forests e.g. *Erythrophleum ivorense*, *Uapaca guineensis* and *U. corbisieri*, *Antiaris toxicaria* var. *welwitschii*, *Parinari excelsa* etc. are characteristic. The dominance of (at least when young) shade-tolerant species increases with age: *Lophira alata*, *Strombosia glaucescens*, *Klainedoxa gabonensis*, many caesalpinioidaceous and sapotaceous species. Those trees often produce a hard and heavy wood.

An ultimate climax may be regarded as (1) a climatic climax, and (2) edaphic climaxes. The climatic climax is found on the most common combination of soil and topography, i.e. dry land forest on rolling country with lateritic soils (oxisols). The edaphic climaxes are found where soil or topography result in a vegetation different from the climatic climax, e.g. swamps, river borders etc. It is realized that essentially all climax vegetations are subject to the climatic conditions, and the distinction is only made for practical purposes.

The general term 'high forest' is used in the following text without further indication whether climax or non-climax forest is meant.

The balance of about 65% of the country, not supporting high forest, is composed of forested and non-forested areas. Non-forested areas are farmlands, rivers, roads, town sites and savannas. Two types of savanna may be distinguished: (1) the coastal savanna, and (2) the savanna woodland of the outer north-west of the country. Both savanna types are for the larger part anthropogenous, and must be considered as degraded forests. The coastal strip, now covered by savanna, once supported a type of high forest with a composition more or less similar to that of the inland high forests, as may be concluded from existing forest relics. However, some flat plains with a pure white-sand soil probably never supported a forest cover.

The savanna woodland of the north-west lies within the climatic limits of the deciduous, perhaps even the moist semi-deciduous forest, but the ancient practice of burning with additional erosion degraded the original forest cover to savanna woodland with fire-resistant trees and scattered rock outcrops of barren granite boulders.

Experiments in Ivory Coast clearly demonstrate that these areas would be covered by a forest vegetation when completely protected from fire (not the barren rocks, presumably). The threat of an increasing savanna-area in Liberia is real, as is e.g. demonstrat-

ed by the occurrence of elephant grass (*Pennisetum purpureum* SCHUMACH.) along the road between Totota and Gbarnga.

Forested areas with a non high forest cover are: (1) artificial forests (which will gradually increase in acreage): rubber plantations, cacao, coffee, and citrus cultures, eventually also timber-tree plantations, and (2) low bush and secondary forest.

The term low bush tentatively refers to young secondary forest which is included in the sequence of shifting cultivation. The vegetation is felled and burnt once every seven to fifteen years and the cleared area is farmed for two years (the first year with rice, the second year with cassava). After two years the farm is left and a dense tangle of herbs, climbers and low shrubs is immediately established. *Musanga cecropioides*, the corkwood or umbrella tree, is usually the first tree species to invade the area. This tree may form pure stands during the first few years of succession, but soon other species are introduced, of which *Harungana madagascariensis* and *Macaranga* spp. are the most gregarious. Cut-grass or saw-grass (*Scleria* spp.) renders the young low bush impenetrable during a certain period of its development, but eventually dies through lack of light. It has to be noted that certain low bush areas occur within the high forest, which apparently are not the direct result of previous farming activities. Their origin may be edaphic (poor soils, drift soils, high ground water level), but in some cases their existence is caused or maintained by elephants which appear to appreciate some open places in their territory.

When not disturbed, the low bush develops into a secondary forest, in which light demanding species play a dominant role. This secondary forest eventually reaches the high forest stage. It is estimated that the succession towards mature high forest (climax) lasts 300 to 400 years.

At present the main high forest areas are in the eastern and western provinces, and about half of the total high forest acreage is included in National Forests (see map 2). These high forests may form extensive closed forest complexes, but more often the canopy is broken by patches of low bush and various stages of secondary forest. Limited relics of high forest are to be found all over the country, often on rocky hills and sometimes as 'devil bush' or 'porro bush'.

**CLASSIFICATION.** Owing to the steep decrease of rainfall from the coast towards the interior, there is a gradual change in the forest composition and different forest types can be recognised. Cooper and Record (Chapter I, 6) made the following stratification: 1. Coastal mangrove swamps; 2. Tropical evergreen forests; 3. Fringing forests; 4. Deciduous forest; 5. Parkland forests, and 6. Savanna grassland. Karl Mayer (Chapter I, 9) slightly modified this scheme in naming the fringing forest 'Transitional forest' and in taking Cooper and Records classes 5 and 6 together.

However, true deciduous forest is hardly existing in Liberia. The 'deciduous forest' of Karl Mayer is actually a transitional forest type between the evergreen forest and the semi-deciduous forest type as found in the Ivory Coast. To distinguish the transition

between the evergreen forest and the drier forest types of Liberia as a separate forest type is a too detailed stratification. Karl Mayers statement that leguminous species become more prevalent in this supposed transitional forest is questionable. Mangrove swamps, savannas and savanna woodland formations are within the climatic limits of the high forest zone, and are either of edaphic origin (mangrove swamps) or (in most cases) degraded forests.

I therefore prefer to distinguish only two major vegetation zones in Liberia: (1) the Evergreen Forest Zone and (2) the Moist Semi-Deciduous Forest Zone. Where high forest is found in these zones, normal sites support tropical evergreen (hereafter only referred to as 'evergreen') respectively moist semi-deciduous forest; both terms thus refer to dryland forest. Under abnormal conditions of site or soil edaphic forest types are found: mangrove forest, swamp forest, river border forest, (in some cases possibly certain types of single dominant forest).

**Mangrove forest.** This forest is characteristic of the silty lagoons along the coast. Three *Rhizophora* species (see *Rhizophoraceae*), characterized by high, slender stilt-roots, and *Avicennia africana*, a tree with pneumatophores, form the main constituents of this forest. Probably owing to the poor soil conditions these trees rarely grow taller than 6 m ( $\approx 20'$ ) in Liberia.

**Swamp forest.** It is not possible here to give a full account of the various types of fresh-water swamps. Most common, however, are the *Mitragyna ciliata* forests, found in swampy valleys which are not flooded during the whole year, but where the roots have always access to the ground water. *Mitragyna ciliata* is often a dominant species in this forest, accompanied by *Heritiera utilis* and *Gilbertiodendron splendidum*. In general there seems to be little difference in the composition of this forest in the evergreen and in the moist semi-deciduous zone; it may be that *Nauclea* aff. *vanderguchtii* which is frequently found with *Mitragyna ciliata* is more or less restricted to the evergreen zone. Towards the deciduous forest (hardly found in Liberia) *Mitragyna ciliata* is replaced by *M. stipulosa*. *Mitragyna* fails to grow where a swamp is inundated throughout the year; here the forest cover is poor and low, large trees are rare or absent. Typical trees are *Raphia* palms and *Voacanga* spp. (*Apocynaceae*). In the eastern province swamp forests are often characterized by the abundance of *Loesenera kalantha*.

**River borders.** River borders are often characterized by a specific flora. Typical riparian species are *Cathormion altissimum*, *Monopetalanthus pteridophyllus* (in the moist semi-deciduous zone replaced by *M. compactus*), *Plagiosiphon emarginatus* (a small tree with blunt spines on the bole), *Gluema ivorensis* and, locally gregarious, *Pandanus* sp.

**The evergreen forest.** Not all trees of the evergreen forest are necessarily evergreen. Many species do change their foliage at one time and stand bare for a shorter or longer period, but not all trees change simultaneously and, unlike in the deciduous forest, the change is spread over the whole year. Frequently new flushes of leaves are brilliantly red coloured (*Lophira*, *Cynometra*, *Aubrevillea*).

Two factors determine the presence of the evergreen forest: (1) a sufficiently high annual rainfall and (2) the absence of an accentuated dry season of more than one month. Both conditions are met in a belt parallel to the coast, in the eastern and central province more or less between the coast and the isohyetal of 2000 mm, in the western province penetrating deeper inland but not to the same extent as the isohyets. The more marked dry season in the north-west of the country results in a slightly more deciduous forest type, even where a rainfall higher than 2000 mm is recorded (see map 1).

The boundary with the moist semi-deciduous forest is by no means always a sharp or a continuous one. Locally fairly distinct or sharp differences may be observed on either side of a watershed, elsewhere the change is very gradual. Patches of evergreen forest may occur in the moist semi-deciduous zone and reverse. The Nimba area which has an increased rainfall partly supports a typical evergreen forest (occurrence of *Monopetalanthus compactus*!), on the higher slopes blending into montane evergreen forest dominated by *Parinari excelsa*.

The evergreen forest shows two distinct types: (1) the mixed forest and (2) the single dominant forest. In the mixed forest there is a wide spectrum of species of which locally one may be more abundant than the others, but none is really dominant. Characteristic are such species as *Lophira alata* in the story of emergent trees, *Heritiera utilis*, *Sacoglottis gabonensis*, *Calpocalyx aubrevillei* and *Dialium* spp. in the closed canopy and lower stories. Valuable timber trees are relatively scarce: *Heritiera utilis* quite abundant but nearly always with small diameters, some *Lovoa trichilioides* and *Guarea cedrata* but hardly any *Entandrophragma* or *Khaya* species. The occurrence of *Khaya ivorensis* in the evergreen forest has been recorded by Karl Mayer, but this has not yet been confirmed.

The single dominant forests are characterized by the dominance of one single species: *Cynometra ananta* or *C. leonensis*, *Gilbertiodendron preussii*, *Monopetalanthus compactus*, *Parinari excelsa*, *Tetraberlinia tubmaniana*.

This dominance may be most evident in the upper canopy (*Parinari* forest, *Gilbertiodendron* forest), in the middle story (*Chidlowia sanguinea* forest, *Stachyothyrsus stapfiana* forest) or in all stories (*Tetraberlinia* forest). In case the species is dominant in one story only, a certain even-aged character can be suspected, and the forest is probably of secondary origin: an incidental abundant and successful regeneration during the low bush or young secondary forest stage resulted in a mature single dominant forest. Of the species *Parinari excelsa* and *Monopetalanthus compactus* nearly pure stands were observed in various stages of development: sapling- and pole-stage forests, older secondary forests and apparently mature forests. It is still an open question whether these mature single dominant forests can be considered as a climax vegetation. In other cases, however, the species is dominant or at least extremely frequent in all stories of the forest (*Tetraberlinia tubmaniana*) and the single dominant character may be owing to edaphic factors (*Tetraberlinia tubmaniana* e.g. seems to prefer rather sandy,

non-lateritic soils). It is a striking fact that most single-dominant species belong to the sub-family *Caesalpinioideae*. The single dominant forests occupy a considerable part of the evergreen forest, but an estimate about their actual extent is at present impossible.

The moist semi-deciduous forest is a transition between the evergreen forest and the semi-deciduous forest. Elements of both occur in this forest which occupies the northern half of Liberia. More species stand bare and for a longer period than in the evergreen forest, and change of foliage tends to occur during the dry season. Meliaceous species are more common, and typical trees of the semi-deciduous forest such as *Nesogordonia papaverifera* and *Aningeria robusta* may be found. Single dominant leguminous species are less common or absent.

True deciduous forest with such indicant species as *Celtis* spp., *Mansonia altissima*, *Morus mesozygia*, *Pericopsis elata* (formerly *Afrormosia elata*) is extremely rare in Liberia (I only found it on the eastern slopes of the ridge in the Gio National Forest, but without *Pericopsis*).

**A COMPARISON OF VEGETATIONS.** The inventories of Karl Mayer and timber cruisers working recently in Liberia all led to the conclusion that the Liberian high forest is not comparable with the rich high forests of Ivory Coast or Ghana. The dominance of hard and heavy, often leguminous species, and the relative scarcity of meliaceous species make the prospects for a similar rich forest industry somewhat doubtful. Karl Mayer blamed the secondary character of the forest for this unsatisfactory species composition (from the economic point of view), but this view cannot be upheld. The differences are to be explained by the climatological factors, i.e. the high rainfall in Liberia, the lower rainfall in Ivory Coast and Ghana. In fact the vegetation of Liberia is more closely related to that of south Cameroon and Gabon, as is demonstrated by the relatively high number of vicarious species: *Copaifera salikounda* and *C. religiosa*, *Didelotia idae* and *D. unifoliolata*, *Monopetalanthus compactus* and *M. pectinatus*, *Stachyothyrsus stapfiana* and *S. staudtii*, *Tetraberlinia tubmaniana* and *T. polyphylla* (notably all *Caesalpinioideae*).

However, a discussion of the consequences of this very specific character of the Liberian high forests for Liberian forestry is outside the scope of this book.

## Chapter IV

### KEYS ON FOLIAR CHARACTERS

The following keys may assist in identifying forest trees without the use of floral characters. Mostly trees attaining a diameter over 40 cm ( $\approx 16''$ ) at breast height are included. Only in a few, very characteristic cases exceptions are made.

The material, used for identification, is assumed to be a leaf-bearing branch of a mature tree; occasionally a few fruit characters are added. Although an attempt has been made to restrict the main key characters to leaves, in some large and difficult groups it proved necessary to employ some field characters. This stresses the importance of careful field notes by collectors. For the observation of details (glands, pubescence) the use of a hand lens of 10  $\times$  magnification is needed.

The key, although as complete as possible at the present time, will need occasional additions because many species occurring in Ivory Coast, but not yet recorded for Liberia, will be discovered when the large forest areas of the eastern province are more closely investigated. It must be stressed that the key does not claim to result in absolutely certain identifications; it only serves as a general guide. Identifications should be checked by means of the descriptions and pictures in this book, or in other publications, especially if a species, although included in the key, is not treated here in detail.

With a few exceptions the keys are based on a strictly dichotomous principle; each number gives two alternatives, a and b, and each alternative either leads to a new number or to an identification, in which case the page, where reference is made to the species concerned, is indicated in italics. Names marked \* have not yet been recorded from Liberia.

#### KEYS

- |   |       |
|---|-------|
| I. Leaves simple, alternate                                     | p. 25 |
| II. Leaves simple, opposite or in whorls                        | p. 35 |
| III. Leaves digitately compound or trifoliolate                 | p. 38 |
| IV. Leaves pinnately compound                                   | p. 40 |
| V. Leaves bipinnately compound                                  | p. 47 |
| VI. Trees with stilt-roots                                      | p. 50 |
| VII. Trees with prickles or spines on bole, branches, or leaves | p. 52 |

## KEY I: LEAVES SIMPLE, ALTERNATE

- |  |               |
|--|---------------|
| 1. a. Slash exuding a white or creamy latex  | Group A p. 25 |
| b. Slash different   | 2             |
| 2. a. Slash with a strong turpentine or cedar scent  | Group B p. 27 |
| b. Slash different   | 3             |
| 3. a. Leaf margin dentate, denticulate, serrate or crenulate                                   | Group C p. 28 |
| b. Leaf margin entire  | 4             |
| 4. a. Leaf with glands or glandular points on petiole and/or blade                             | Group D p. 29 |
| b. Leaf without glands or glandular points   | 5             |
| 5. a. Blade markedly palmately nerved or with two or more main nerves, spreading from the base | Group E p. 30 |
| b. Blade regularly pinnately nerved  | Group F p. 31 |

## KEY I, GROUP A: slash exuding a white or creamy latex

- |  |                                  |
|--|----------------------------------|
| 1. a. Blade with three pronounced, basal nerves and a dentate margin   | <i>Morus mesozygia</i> 281       |
| b. Blade different   | 2                                |
| 2. a. Blade like sand-paper beneath  | 3                                |
| b. Blade different   | 4                                |
| 3. a. Branchlets with an annular scar at the nodes   | <i>Ficus exasperata</i> 281      |
| b. Branchlets not with an annular scar at the nodes  | <i>Antiaris africana</i> 284     |
| 4. a. Blade deltoid, midrib dichotomous  | <i>Ficus lepreuri</i>            |
| b. Blade different   | 5                                |
| 5. a. Blade large, fiddle-shaped   | <i>Ficus lyrata</i>              |
| b. Blade different   | 6                                |
| 6. a. Blade delicately auriculate at base; lowest pair of nerves basal; latex turning red  | <i>Bosqueia angolensis</i> 281   |
| b. Blade different   | 7                                |
| 7. a. Blade with a pair of marginal glands on the lower surface near the base; margin towards the apex often denticulate                       | <i>Sapium aubrevillei</i> 94     |
| b. Blade different   | 8                                |
| 8. a. Savanna tree; leaves markedly distichous along zig-zag branchlets  | <i>Anthostema senegalense</i> 94 |
| b. Tree and leaves different   | 9                                |
| 9. a. Stipules when shed leaving annular scars at the nodes  | 10                               |
| b. Stipules absent or present, but then not leaving annular scars at the nodes when shed   | 12                               |
| 10. a. Petiole c. 5 mm long; blade (narrowly) elliptic, rounded – cordate at base, acute at the top, glabrous; tree with a heavily fluted bole | <i>Treculia africana</i> 281     |



- b. Petiole more than 1 cm long 11
- 11. a. Blade suborbicular, markedly cordate at base, scabrous on both sides, with  
c. five pairs of nerves; bole of the tree often reddish; latex turning brown  
*Ficus mucosa* 281
- b. Leaves and tree different; trees often epiphytic *Ficus* spp.
- 12. a. Blade distinctly oblique at base, suborbicular – broadly elliptic; petiole  
2–12 mm long 13
- b. Blade different 14
- 13. a. Blade scabrous beneath *Antiaris africana* 284
- b. Blade glabrous beneath *Antiaris toxicaria* var. *welwitschii* 282
- 14. a. Blade truncate – cordate at base, as a rule suborbicular – broadly elliptic 15
- b. Blade cuneate – obtuse at base, as a rule (narrowly) elliptic to (narrowly)  
obovate *Sapotaceae* 19
- 15. a. Blade scabrous or villous beneath 16
- b. Blade nearly glabrous or minutely puberulous beneath 17
- 16. a. Blade scabrous beneath, suborbicular – broadly elliptic; 6–12 pairs of  
nerves *Antiaris africana* 284
- b. Blade golden brown villous beneath, narrowly oblong; 12–18 pairs of  
nerves *Brevia leptosperma*\*
- 17. a. Nerves in 14–18 pairs; blade minutely puberulous beneath between the  
strongly reticulate veins (lens!) *Chlorophora excelsa* 286
- b. Nerves in 6–12 pairs; blade nearly glabrous beneath 18
- 18. a. Petiole 2–12 mm long *Antiaris toxicaria* var. *welwitschii* 282
- b. Petiole 2–6 cm long *Chlorophora regia* 285
- 19. a. Blade (densely) pubescent or puberulous beneath; nerves prominent  
(when nerves indistinct, check *Manilkara*) 20
- b. Blade glabrous beneath or with a few scattered hairs 23
- 20. a. Blade with a silvery grey indumentum beneath, more or less glabrescent  
*Chrysophyllum albidum* 344
- b. Indumentum not silvery 21
- 21. a. Petiole 0.8–1 cm long; nerves in 15–20 pairs, with yellowish hairs  
*Aningeria robusta* 339
- b. Petiole more than 1.5 cm long; indumentum dark brown or golden brown 22
- 22. a. Hairs appressed; nerves in 20–30 pairs *Chrysophyllum delevoiyi* 344
- b. Hairs not appressed; nerves in 15–20 pairs *Chrysophyllum perpulchrum* 341
- 23. a. Petiole shorter than 1 cm, or leaf sessile 24
- b. Petiole longer than 1 cm 28
- 24. a. Blade with very numerous and fine, parallel, inconspicuous nerves; blade  
bright green, up to 10 cm long, 5 cm wide, abruptly acuminate at the top  
*Chrysophyllum pruniforme* 342
- b. Blade different 25

25. a. Leaf subsessile, rather large; fruit big, up to 15 cm across and 8 cm thick, depressed globose, born on the stem 26  
 b. Leaf petiolate, as a rule rather small; fruits small 27
26. a. Leaf up to 40 cm long, obovate, with over 20 pairs of nerves  
*Omphalocarpum ahia* 340  
 b. Leaf up to 25 cm long, obovate, with 15–20 pairs of nerves  
*Omphalocarpum elatum* 340
27. a. Blade narrowly elliptic to narrowly obovate, up to 10 cm long, obtusely acuminate at the top; nerves slightly raised beneath, in 8–12 pairs  
*Afrosersalisia afzelii* 339  
 b. Blade obovate, obtuse to rounded at the top; nerves hardly raised beneath, numerous; leaf grey-greenish  
*Manilkara obovata* 345
28. a. Nerves prominent beneath 29  
 b. Nerves faint or inconspicuous beneath 31
29. a. Leaves not in terminal tufts; nerves in seven to nine pairs; petiole 2–3 cm long; blade elliptic – oblong or obovate, 13–25 cm long, 5–10 cm wide, membranous  
*Aubregria taiensis\**  
 b. Leaves more or less in terminal clusters; nerves as a rule more than nine pairs; blade coriaceous 30
30. a. Blade obtuse – rounded at the top, 15–25 cm long, 6–7 cm wide; slash white and orange mottled  
*Kantou guereensis* 340  
 b. Blade long-acuminate at the top, 12–32 cm long, 3–8 cm wide; tree of river borders; slash pink-red  
*Gluema ivorensis* 340
31. a. Leaves clustered in pseudo-whorls, with acute stipules of c. 5 mm long (at least at the end of the branchlets); blade 7–15 cm long, 2–5 cm wide; nerves in c. 10 pairs, very faint; reticulation of veins hardly distinct; bark of tree defoliating with large, thin scales, leaving pale brown patches on the dark stem  
*Neolemonniera clitandrifolia* 340  
 b. Leaves, though concentrated towards the end of the branchlets, not in pseudo-whorls; stipules as a rule absent 32
32. a. Blade papery, glossy green above, 7–15 cm long, 3–6 cm wide; reticulation of veins slightly raised beneath; slash pink-red; fruit large, up to 10 cm across  
*Tieghemella heckelii* 349  
 b. Blade coriaceous, dull glaucous grey or greyish green above, 6–16 cm long, 4–8 cm wide; nerves hardly raised beneath; reticulation of veins nearly absent; slash pale-pink; fruit up to 3 cm long, 1.5 cm across  
*Manilkara obovata* 345

KEY I, GROUP B: slash with a strong turpentine or cedar scent

1. a. Tree with stilt-roots  
 (when the leaves are pinnately compound: *Xylopia staudtii* 54  
*Santiria trimera*)  
 b. Tree not with stilt-roots 2

2. a. Slash bright yellow, fibrous; a small, rarely medium-sized tree  
*Enantia polycarpa* 54  
b. Slash not bright yellow 3
3. a. Petiole more than 1 cm long, grooved; midrib arched, blade folded, fragrant when crushed; slash pink-red  
*Beilschmiedia mannii* 120  
b. Petiole up to 1 cm long; blade different 4
4. a. Leaf subsessile; margin markedly undulate  
*Pachypodanthium staudtii* 54  
b. Leaf distinctly petiolate; margin not undulate 5
5. a. Leaf narrowly oblong; tree of secondary forest  
*Cleistopholis patens* 57  
b. Leaf obovate, grey or glaucescent beneath  
*Monodora myristica*

KEY I, GROUP C: blade with a crenate, dentate or serrate margin

1. a. Blade (often densely) stellate pubescent on the lower surface 2  
b. Blade not stellate pubescent on the lower surface 3
2. a. Denticulation formed by the tips of the nerves, extending beyond the edge; blade cordate at base, palmately nerved  
*Mansonia altissima* 374  
b. Margin serrate; blade rounded or faintly cordate at base  
*Duboscia viridiflora*
3. a. Blade distinctly three-nerved at base 4  
b. Blade different 7
4. a. Blade dentate along the whole margin 5  
b. Blade dentate towards the top only 6
5. a. Tree with white latex; forest tree  
*Morus mesozygia* 281  
b. White latex absent; mostly a shrub, rarely a tree  
*Trema guineensis*
6. a. Blade at base with a pair of hairy glands above; petiole 2.5–6 cm long  
*Discoglyprema caloneura*  
b. Blade at base not with a pair of glands; petiole shorter; slash with alternating layers of brown and white  
*Celtis mildbraedii*
7. a. Blade cordate at base 8  
b. Blade cuneate at base 9
8. a. Leaves glabrous beneath, large, 11–30 cm long, up to 14 cm wide, markedly distichous;  
*Homalium letestui*  
b. Leaves tomentose beneath, up to 20 cm long and 9 cm wide  
*Homalium molle*
9. a. Margin itself entire, but carrying a row of horny, spinescent teeth towards the top of the blade; small tree  
*Ochtocosmus africanus*  
b. Margin in itself dentate – undulate 10
10. a. Blade distinctly dentate – crenate or undulate along the whole margin 11  
b. Blade finely or indistinctly denticulate – crenulate, usually only towards the top 12
11. a. Blade with four – five pairs of strong nerves, connected by a conspicuous

- reticulation of parallel veins; slash granular, purplish violet *Panda oleosa*
- b. Blade with more than five pairs of nerves; slash not purple or violet: check various species of *Homalium* or *Scotellia*
12. a. Blade near the base with a pair of glands on the margin, on the lower surface; petiole 1–2.5 cm long *Sapium aubrevillei* 94
- b. Blade not with marginal glands at the base 13
13. a. Petiole puberulous, c. 3 mm long; midrib puberulous; blade caudate; slash burning on taste: 'pepper stick' *Drypetes aubrevillei* 94
- b. Petiole glabrous 14
14. a. Blade with c. ten pairs of nerves, hardly distinct from the veins; petiole 6–10 mm long, twisted at base; margin decurrent; slash brown, making a hissing sound *Sacoglottis gabonensis* 116
- b. Blade with three to nine pairs of conspicuous nerves; margin not decurrent 15
15. a. Blade obovate, with three to four pairs of nerves, glabrous; apex obtuse to shortly acuminate *Scotellia coriacea*
- b. Blade elliptic – oblong, acute at the top, with five to nine pairs of nerves; some hairs in the axil of the nerves on the lower surface *Homalium aubrevillei*

KEY I, GROUP D: leaves with glands on petiole or blade

1. a. Lower surface of the blade with glandular pits in the axil of the nerves; blade obovate; fruit four-winged, papery *Combretodendron macrocarpum* 124
- b. Leaves different 2
2. a. A pair of glands on the petiole, below the blade 3
- b. Glands on the blade 4
3. a. Petiole 0.5–1.5 cm long, tomentose  
*Parinari excelsa* (or *P. congensis* when the blade is cordate) 314
- b. Petiole 3–5 cm long, pubescent when young, glabrescent; glands laterally on the petiole, c. 1 cm beneath the blade, not always conspicuous  
*Terminalia superba* 89
4. a. Petiole more than 1 cm long 5
- b. Petiole 0.5–1 cm long 8
5. a. Glands stipitate, at the base of the scaly lower surface of the blade; tree of secondary forest *Croton aubrevillei*
- b. Glands not stipitate 6
6. a. Base of the blade shortly auriculate, with a gland in each lobe; tree often with stilt-roots, in secondary forest *Macaranga barteri* 105
- b. Base of blade cuneate or rounded, not auriculate 7
7. a. Glands pubescent, at the very base, visible above; petiole more than 2.5 cm long  
*Discoglyprena caloneura*
- b. Glands not pubescent, on the margin near the base, visible on the lower surface; petiole 1–2.5 cm long *Sapium aubrevillei* 94

8. a. Blade narrowly obovate – narrowly oblong, 10–35 cm long, 3–8 cm wide; reticulation of the veins fine, more or less perpendicular to the midrib; slash exuding a soft, clear gum *Strephonema pseudocola* 85  
 b. Leaf different; slash granular, with some water in the slash wound; branchlets lenticellate: *Rosaceae* 9
9. a. Blade with a rusty-brown indumentum on the lower surface; glands basal, on the upper surface *Parinari chrysophylla* 318  
 b. Blade different 10
10. a. Glands on the lower surface of the blade, basal *Acioa barteri*  
 b. Glands on the upper surface of the blade, basal and sometimes apical 11
11. a. Blade slightly cordate at base; margin of the leaf-tip usually glandular *Parinari aubrevillei* 317  
 b. Blade cuneate at base; margin of the leaf tip not glandular *Parinari glabra* 318

KEY I, GROUP E: leaves distinctly palmately nerved or with two or more main nerves spreading from the base

1. a. Petiole shorter than 1.5 cm 2  
 b. Petiole more than 1.5 cm long; blade with stellate hairs, at least when young: *Sterculiaceae, Tiliaceae* 10
2. a. Margin dentate – serrate 3  
 b. Margin entire 5
3. a. Leaf with three parallel nerves, continuing beyond the middle of the blade; slash with white latex *Morus mesozygia* 281  
 b. Leaf with three to five nerves, spreading from the base, reaching up to the middle of the blade; slash without latex 4
4. a. Margin dentate along the upper part of the blade only; base three-nerved, rounded – cuneate; slash with alternating layers of creamy white and brown layers *Celtis mildbraedii*  
 b. Margin finely serrate along the whole margin; base three- to five-nerved, slightly cordate; blade with stellate hairs beneath; slash with fine ripple marks *Duboscia viridiflora*
5. a. Base of the blade slightly auriculate; tree with a white latex, turning red *Bosqueia angolensis* 281  
 b. Leaf and tree different 6
6. a. Base of the blade markedly unequal-sided, one side cuneate, the other side rounded; one pair of basal nerves; slash with alternating layers of creamy white and dark purplish brown *Celtis adolfi-frederici*  
 b. Leaf and slash different 7
7. a. Base of blade with about three pairs of not very pronounced nerves, spreading fan-wise from the base, the strongest pair reaching up to the middle of the blade; petiole with a pair of caducous stipels; tree smooth and grey,

- slash thick and fibrous, red, sticky *Didelotia idae* 184  
 b. Tree and leaves different 8
8. a. Blade rounded at base, ovate *Guibourtia dinklagei* 203  
 b. Blade cuneate at base, elliptic 9
9. a. Nerves parallel to the midrib; petiole c. 5 mm long *Anisophyllea meniaudi* 306  
 b. Nerves not parallel to the midrib; petiole c. 1 cm long  
*Ophiobotrys zenkeri*
10. a. Blade palmatilobed *Triplochiton scleroxylon* 373  
 b. Blade not palmatilobed 11
11. a. Blade markedly cordate 12  
 b. Blade truncate or cuneate at base 15
12. a. Apex of blade rounded; margin denticulate *Mansonia altissima* 374  
 b. Apex acute – acuminate; margin entire 13
13. a. Blade softly tomentose on the upper surface, more densely tomentose on the lower surface; tree of river borders *Christiana africana*  
 b. Blade glabrous above 14
14. a. Blade five-nerved at base; understory tree without marked buttresses; fruits big, globular, containing water and edible seeds: ‘monkey apple’  
*Cola lateritia*  
 b. Blade seven-nerved at base; large forest tree with very well developed buttresses; fruits with winged seeds *Pterygota macrocarpa\**
15. a. Blade rounded at the top, densely pubescent beneath with large stellate hairs  
*Sterculia tragacantha*  
 b. Blade acute – acuminate at the top; lower surface sparsely pubescent with minute stellate hairs, but with tufts of hairs in the axils of the nerves  
*Nesogordonia papaverifera* 369

KEY I, GROUP F: trees with regularly pinnately nerved leaves

1. a. Trees with stilt-roots, See KEY VI, page 50  
 b. Trees not with stilt-roots 2
2. a. Slash exuding a copious red or reddish sap 3  
 b. Slash not exuding a copious red or reddish sap 4
3. a. Blade narrowly oblong, cordate at base, with 20–35 pairs of nerves  
*Pycnanthus angolensis* 289  
 b. Blade (narrowly) elliptic – obovate, cuneate at base, with 6–13 pairs of nerves  
*Coelocaryon oxycarpum* 291
4. a. Branchlets and/or leaves with stellate or scaly hairs, especially in the early stages 5  
 b. Branchlets and/or leaves with simple hairs or glabrous 12
5. a. Lower leaf surface covered with a dense indumentum of scaly hairs 6  
 b. Lower leaf surface with an indumentum of stellate hairs 7

6. a. Lower leaf surface with a pair of stipitate glands at base; base cordate  
*Croton aubrevillei*
- b. Lower leaf surface not with a pair of glands at base; blade cuneate at base  
*Heritiera utilis* 363
7. a. Leaf with 20–35 (–40) pairs of nerves; blade very often damaged by insects  
*Pycnanthus angolensis* 289
- b. Leaf with less than 20 pairs of nerves 8
8. a. Leaf subsessile; blade narrowly elliptic, cuneate at base; margin undulate  
*Pachypodanthium staudtii* 54
- b. Leaf different 9
9. a. Reticulation of veins markedly parallel, transverse to the nerves, close, finely raised; nerves reaching to the edge  
*Coula edulis* 297
- b. Reticulation of veins different 10
10. a. Nerves in 10–15 pairs, yellowish  
*Sterculia oblonga*
- b. Nerves in less than 10 pairs; 11
11. a. Blade obovate, up to 11 cm long, with tufts of hairs in the axils of the nerves on the lower surface; slash pink, with fine ripple marks  
*Nesogordonia papaverifera* 369
- b. Blade narrowly oblong, up to 30 cm long; slash pale yellow  
*Octoknema borealis*
12. a. Petiole with a distinct joint at the top, and a pair of thornlets (stipels) below this joint; blade (broadly) elliptic, with six to eight pairs of nerves; buttressed tree of marshy sites and river borders; slash yellow and bitter, with fine ripple marks  
*Haplormosia monophylla* 244
- b. Leaf and tree different 13
13. a. Blade narrowly obovate, emarginate to obtuse at the top, with very numerous, fine, parallel nerves, 1–2 mm apart  
*Lophira alata* 292
- b. Leaf different 14
14. a. Branchlets distinctly laterally flattened 15
- b. Branchlets terete 16
15. a. Leaf with intrapetiolar, persistent stipules; blade obovate – narrowly elliptic, up to 6 cm long, rounded at the top, with two faint pseudo-nerves parallel to the midrib  
*Erythroxylum mannii* 127
- b. Branchlets with vertical lines at the base of the petiole; blade elliptic, with hardly distinct veins  
*Ongokea gore* 300
16. a. Leaves in pseudo-whorls, within the whorl very unequal in size, the lower leaf largest, up to 20 cm long with a petiole up to 8 cm long, the upper leaf smallest, c. 4 cm long, subsessile; tree of marshy places  
*Spondianthus preussii*
- b. Leaves different 17
17. a. Leaves with long stipules, covering the terminal bud, caducous, leaving

- annular scars around the nodes when shed 18
- b. Stipules absent or present, but then not leaving annular scars at the nodes when shed 19
18. a. Stipules up to 10 cm long; blade with c. 15 pairs of nerves, hardly raised on either side; petiole hardly canaliculate; fruit depressed globose, three- to five-lobed, c. 7 cm across *Klainedoxa gabonensis* 354
- b. Stipules up to 1.5 cm long; blade with c. 10 pairs of nerves, slightly raised above and beneath; petiole distinctly canaliculate; fruit laterally compressed, ellipsoid, c. 6 cm across, with a smooth skin and a very fibrous mesocarp *Irvingia gabonensis* 357
19. a. Blade with about three pairs of weak nerves spreading fan-wise from the base; petiole often with a pair of minute stipels below the blade *Didelotia idae* 184
- b. Leaf different 20
20. a. Blade pilose or tomentose on the lower surface 21
- b. Blade glabrous or glabrescent on the lower surface 22
21. a. Nerves joining a marginal nerve *Bridelia grandis* 94
- b. Nerves not joining a marginal nerve; petiole with a pair of indistinct glands above *Parinari excelsa* 314
22. a. Petiole distinctly jointed at the base and the top; blade 15–35 cm long, with 10–17 pairs of nerves; buttressed tree of marshy sites *Protomegabaria stapfiana*
- b. Petiole not jointed both at the base and the top 23
23. a. Leaves small, 3–6 cm long, more or less oblique, cuneate at base, pubescent on the c. 3 mm long petiole and on the midrib, distinctly distichous *Drypetes klainei*
- b. Leaves otherwise, as a rule larger 24
24. a. Leaves sessile 25
- b. Leaves distinctly petiolate 26
25. a. Blade up to 9 cm long, caudate at the top; nerves obscure; understory tree with soft, fibrous, pale brown slash and often a pitted bark *Scytopetalum tieghemii*
- b. Blade as a rule more than 10 cm long, narrowly oblong, acute at the top, with undulate margin *Pachypodanthium staudtii* 54
26. a. Blade ovate, slightly cordate at base, acute at the top, with 3–4 pairs of nerves *Okoubaka aubrevillei*
- b. Blade not cordate at base 27
27. a. Blade distinctly obovate, cuneate at base 28
- b. Blade ovate elliptic, when slightly obovate also rounded at base 30
28. a. Trees with stilt-roots: *Uapaca*, see KEY VI, p. 50
- b. Trees not with stilt-roots 29
29. a. Petiole up to 1.5 cm long *Terminalia ivorensis* 85
- b. Petiole 2–7 cm long *Terminalia superba* 89



30. a. Blade broadly elliptic to broadly obovate, rounded at base, abruptly and shortly cuspidate at the top; tree of swampy sites *Scotellia leonensis*
- b. Blade different 31
31. a. Reticulation of veins fine, markedly parallel and close, more or less transverse to the nerves; nerves in c. 10 pairs, prominent beneath, reaching close to the margin *Coula edulis* 297
- b. Leaf different 32
32. a. Petiole up to 10 mm long 33
- b. Petiole more than 10 mm long 34
33. a. Blade more or less pustulate; reticulation of veins indistinct *Strombosia glaucescens* 303
- b. Blade not pustulate; reticulation of veins distinct *Pteleopsis hylodendron* 85
34. a. Blade arched and slightly folded; reticulation of veins distinct *Beilschmiedia mannii* 120
- b. Blade not markedly arched and folded; reticulation of veins hardly visible; tree of marshy sites or near water *Coelocaryon oxycarpum* 291

## KEY II: LEAVES SIMPLE, OPPOSITE OR IN WHORLS

1. a. Leaves in whorls of three or more 2  
    b. Leaves opposite 5
2. a. Leaves in whorls of three, c. 10 cm long, with interpetiolar, caducous stipules *Anopyxis klaineana* 306  
    b. Whorls composed of more than three leaves 3
3. a. Leaves four to seven in a true whorl, all implanted at the same height on the branchlets; blade (narrowly) obovate, up to 20 cm long, with 20–40 pairs of nerves; fluted tree with white latex *Alstonia boonei* 59  
    b. Leaves in pseudo-whorls, in a very dense cluster 4
4. a. Leaves in one whorl very unequal-sized, the lowest leaf largest and long petiolate, the upper leaf smallest and (sub) sessile; tree without latex *Spondianthus preussii*  
    b. Leaves of one whorl more or less equal-sized, obovate, acuminate, with hardly distinct venation; tree with white latex *Neolemonniera clitandrifolia* 340
5. a. Slash exuding a white latex: *Apocynaceae* 6  
    b. Slash not exuding a white latex 7
6. a. Nerves on the lower surface with tufts of hairs in the axil; latex not sticky when rubbed between the fingers; fruit propeller-shaped, thin, up to 20 cm long *Funtumia africana* 63  
    b. Nerves on the lower surface not with tufts of hairs but often with glandular pits in the axil; latex sticky when rubbed between the fingers; fruit propeller-shaped, thick and short, 10–15 cm long *Funtumia elastica* 63  
    c. Leaves and fruits different: check other *Apocynaceae*
7. a. Slash slowly exuding a yellow or orange latex or a sticky gum 8  
    b. Slash not exuding a latex or gum 12
8. a. Blade with less than 20 pairs of nerves; small, rarely medium sized or large trees: *Harungana madagascariensis* and *Vismia guineensis* with orange latex; *Garcinia kola* (a large tree) with a sticky gum; *Garcinia* spp. with yellow latex  
    b. Blade with more than 20 pairs of fine, parallel nerves 9
9. a. Blade with resin ducts between or crossing the nerves 10  
    b. Blade not with resin ducts 11
10. a. Resin ducts as a rule between the nerves; nerves c. 3 mm, rarely 5 mm apart; fruit more or less globose, often with remnants of the calyx and stamens at base; seeds 3–16 in each fruit, angular *Pentadesma butyracea* 111  
    b. Resin ducts as a rule crossing the nerves near the midrib; nerves rarely less than 5 mm apart; fruit 25–50 cm long, 8–14 cm thick, with up to 80 seeds *Allanblackia floribunda* 107

11. a. Blade with numerous, sometimes translucent, glandular points; fruits glo-  
bular, pale yellow with small brown warts, or scurphy: 'Mammee apple'  
*Mammea africana* 108
- b. Blade not with glandular points; tree with stilt-roots, often in swamps  
*Symphonia globulifera* 107
12. a. Tree of the tidal swamps near the coast 13
- b. Tree different 14
13. a. Tree with stilt-roots *Rhizophora* spp. 306
- b. Tree not with stilt-roots, but often with pneumatophores  
*Avicennia africana* 21
14. a. Blade with numerous translucent points, stipules absent: *Myrtaceae* (when  
a large tree, check *Syzygium guineense*)
- b. Blade not with translucent points 15
15. a. Leaves with three to five nerves, parallel to the midrib 16
- b. Leaves regularly pinnately nerved 17
16. a. Blade reddish hirsute on the lower surface *Sakersia africana*
- b. Blade different *Memecylon* spp.
17. a. Leaves in tufts at the end of the branches; blade (narrowly) obovate, as a  
rule large, up to 1.50 m long; branchlets often with prickles above the nodes;  
trees in swamps and in secondary forest, sometimes with stilt-roots  
*Anthocleista* spp.
- b. Leaves different 18
18. a. Nerves and veins hardly raised on the lower surface, inconspicuous; blade  
up to 10 cm long, obovate; petiole c. 5 mm long; interpetiolar stipules 1–2 mm  
long, caducous; terminal bud sticky; slash yellow, granular  
*Cassipourea nialatou* 310
- b. Nerves and veins distinctly raised on the lower surface 19
19. a. Leaves without interpetiolar stipules; blade often somewhat recurved (ar-  
cuate) and folded; slash fragrant *Beilschmiedia mannii* 120
- b. Leaves with interpetiolar stipules, or an interpetiolar scar on the nodes  
when the stipules are shed 20
20. a. Nerves on the lower surface with small pits in the axils; stipules oblong, c.  
1 cm long, 4 mm wide, covering the terminal bud, caducous  
*Pausinystalia lane-poolei* 321
- b. Leaves and stipules different 21
21. a. Leaves and stipules small; petiole as a rule shorter than 1 cm: species of  
*Cassipourea* or *Canthium*
- b. Leaves as a rule large, with stipules of 0.5–10 cm long 22
22. a. Interpetiolar stipules broadest at base, triangular, subacute, c. 6 mm long  
*Nauclea pobeguini* 328
- b. Interpetiolar stipules 1.5–10 cm long, obovate 23

23. a. Nerves on the lower surface with tufts of hairs in the axil; tree always in swamps *Mitragyna ciliata* 321  
 b. Nerves not with tufts of hairs in the axil 24
24. a. Blade distinctly but sparsely pilose on the lower surface *Nauclea xantoxylon\** 328  
 b. Blade glabrous, or minutely puberulous on the midrib beneath 25
25. a. Tree of dry land; slash yellow; fruit c. 3 cm across, pitted with c. 3 mm wide pits; midrib glabrous *Nauclea diderrichii* 326  
 b. Trees of swamps; slash pink; fruit 6–8 cm across, pitted with 7–10 mm wide pits; midrib sometimes minutely puberulous beneath *Nauclea* aff. *vanderguchtii* 328

## KEY III: LEAVES DIGITATELY COMPOUND OR TRIFOLIOLATE

1. a. Leaves opposite 2
- b. Leaves alternate 3
2. a. Nerves hardly raised on the lower surface, in the central leaflet in more than ten pairs; leaflets glossy, glabrous, with entire margin, four to eight on each leaf *Oldfieldia africana* 98
- b. Nerves conspicuous beneath, in less than 10 pairs on the central leaflet; leaflets four to five, with dentate margin (when margin entire, *Vitex* spp.)  
*Vitex micrantha* 101
3. a. Leaves trifoliolate 4
- b. Leaves with more than three leaflets 8
4. a. Leaves together at the top of the petiole (a digitate leaf with three leaflets) 5
- b. Leaflets in one pair at the top of the petiole, and a terminal leaflet at the top of the rachis (a pinnate leaf with one pinna and an odd leaflet): *Erythrina* 7
5. a. Slash exuding a white latex; cultivated tree *Hevea brasiliensis* 94
- b. Slash not exuding a white latex 6
6. a. Leaflets with numerous translucent points; margin as a rule entire; branchlets sometimes spinescent: various *Rutaceae*
- b. Leaflets not with translucent points; margin denticulate-crenulate; unarmed tree *Allophylus africanus*
7. a. A gland at the top of the rachis present; petiole and rachis as a rule with one or more recurved prickles; thorns on the bole conical, with a sharp, black point; flowers red *Erythrina vogelii* 338
- b. Rachis not with a gland at the top; petiole and rachis not with prickles; thorns forming heavy, thorny ridges on the bole; flowers lilac  
*Erythrina mildbraedii* 338
8. a. Leaflets more than nine, spreading umbrella-wise; tree often with low stilt-roots *Musanga cecropioides* 281
- b. Leaflets nine or less 9
9. a. Leaflets with numerous glandular, often translucent points; leaflets four to nine, as a rule seven; nerves numerous, slightly raised, hardly distinct from the veins *Araliopsis tabouensis* 332
- b. Leaves different 10
10. a. Leaflets with glandular points on the margin *Ricinodendron heudelotii* 101
- b. Leaves different 11
11. a. Margin of leaflets dentate along the whole length *Myrianthus arboreus*
- b. Margin of leaflets entire or slightly denticulate towards the top only 12
12. a. Petiole very long, with two acute appendices (stipules) adnate to the base  
*Cussonia bancoensis* 335

- b. Petiole without acute appendices at base 13
13. a. Leaflets brown-scaly on the lower surface; apex long acuminate to caudate; tree often with planklike stilt-roots *Heritiera utilis* 363
- b. Leaflets not with brown scales on the lower surface 14
14. a. Leaflets obovate, shortly cuspidate, up to 10 cm long; slash red-white striped; tree unarmed; kapok red-brown *Rhodognaphalon brevicuspe* 70
- b. Leaflets narrowly elliptic, acute – acuminate, up to 20 cm long; trees armed on bole or branches; kapok greyish 15
15. a. Leaflets stalked; large trees with prickles on the bole; flowers creamy white *Ceiba pentandra* 65
- b. Leaflets (sub)sessile; large trees with prickles on the branches; flowers brilliantly red *Bombax buonopozense* 70
- (The introduced species *Adansonia digitata* and *Bombacopsis glabra* are not included in the key).

## KEY IV: LEAVES PINNATELY COMPOUND

1. a. Leaves opposite 2  
b. Leaves alternate 3
2. a. Leaflets on the upper surface with a single or a pair of glands at base; flowers brilliantly red *Spathodea campanulata*  
b. Leaflets without basal glands; flowers pink  
*Stereospermum acuminatissimum*
3. a. Leaves bi- or trifoliolate 4  
b. Leaves with more than 3 leaflets 10
4. a. Leaf with only 2 leaflets 5  
b. Leaf with 3 leaflets, see KEY III, 7, p. 38
5. a. Petiole longer than 1 cm 6  
b. Petiole as a rule 0.5 cm, rarely up to 1 cm long 7
6. a. Leaflets slightly falcate, the midrib excentric towards the inner margin  
*Guibourtia leonensis* 203  
b. Leaflets suborbicular; sterile shoots with simple or forked spines  
*Balanites wilsoniana\**
7. a. Petiole with a pair of small prickles (stipellae) at the top; leaflets slightly asymmetrical but not falcate, 6–20 cm long, terminated by a horny mucro  
*Pellegriniodendron diphyllum* 199  
b. Leaf different 8
8. a. Leaflets with 1 (2) strong, (sub)basal nerve(s), markedly curved and reaching over the middle of the blade; midrib strongly excentric towards the inner margin; leaves drying black *Guibourtia ehie* 200  
b. Leaflets different 9
9. a. Leaflets c. 2 cm long, c. 1 cm wide, ciliate, with a pubescent petiole  
*Cryptosepalum minutifolium\** 166  
b. Leaflets falcate, 6–10 cm long, 2–4 cm wide, glabrous; margin not with glandular cells *Cynometra ananta* 167  
c. Leaflets as a rule larger, with a few glandular cells on the edge; leaf often with stipules: check *Gilbertiodendron* spp.
10. a. Leaf with more than 15 pairs of small, narrowly oblong, 1–3 cm long, 0.2–1 cm wide leaflets 11  
b. Leaf with less pairs, as a rule larger leaflets 13
11. a. Leaflets emarginate at the top; rachis pubescent  
*Didelotia brevipaniculata* 186  
b. Leaflets acute at the top; midrib forming the distal edge 12
12. a. Leaflets 1.5–3 cm long, 0.5–1 cm wide, mucronate at the top, with large, intrapetiolar, persistent stipules *Monopetalanthus pteridophyllus* 207

- b. Leaflets up to 1.5 cm long, 2–4 mm wide, not mucronate at the top; stipules caducous *Monopetalanthus compactus* 204
13. a. Leaf with 7–12 pairs of 1–2 cm long, c. 5 mm wide, oblong, emarginate leaflets; small tree with blunt spines, often at river borders *Plagiosiphon emarginatus* 208
- b. Leaf and tree different 14
14. a. Tree with stilt-roots and a fragrant slash; leaf imparipinnate *Santiria trimera* 75
- b. Tree not with stilt-roots, or when stilt-roots are present, then the slash not fragrant, and leaf paripinnate. 15
15. a. Nerves on the lower surface of the leaflets with tufts of hairs in the axil; leaves clustered at the end of the branchlets *Entandrophragma utile* 260
- b. Leaflets different 16
16. a. Leaf with prickles on petiole, rachis, and sometimes on the midrib of the leaflets; leaves clustered, more than 50 cm long; branches spiny 17
- b. Tree and leaves unarmed 18
17. a. The two edges of the blade joining the petiolule at about the same height; petiolule c. 5 mm long; blade cordate to obtuse at base *Fagara macrophylla* 338
- b. Base of the leaflets strongly asymmetrical, the distal side broad, joining the petiolule well below the narrow, cuneate proximal side *Fagara tessmannii* 335
18. a. The upper surface of the leaflets, especially towards the apex, with small glandular pits near the edge, as a rule where the nerves fork; leaflets in 6–12 pairs, sessile; blade coriaceous, with revolute edge, 8–13 cm long, 2–4.5 cm wide; leaves clustered at the end of the branches *Gymnostemon zaizou* 362
- b. Leaves different 19
19. a. Leaflets with a characteristic intra-marginal nerve; tree with a deeply grooved bark; fruits edible, 'golden plum' (tree often planted) *Spondias mombin*
- b. Leaf and tree different 20
20. a. Stipellae present on the rachis 21
- b. Stipellae absent 22
21. a. Leaflets over 4.5 cm long, in 6–10 pairs and an odd leaflet; slash with some red sap *Amphimas pterocarpoides* 134
- b. Leaflets less than 2 cm long, or in 2–4 pairs only; various papilionaceous trees: *Millettia*, *Lonchocarpus*
22. a. Nerves on the glabrous lower surface slightly impressed in the blade; blade thick coriaceous, the midrib impressed above, prominent beneath; reticulation of veins indistinct; blade obtuse – emarginate at the top; margin slightly revolute *Quassia undulata* 358
- b. Leaf different 23
23. a. Leaflets densely tomentose on the lower surface 24



- b. Leaflets glabrous or more or less pubescent beneath or tomentose on rachis and midrib only 25
24. a. Leaf paripinnate with 2–4 (–5) pairs of leaflets, each leaflets with 6–10 pairs of nerves *Anthonotha fragrans* 138  
 b. Leaf imparipinnate with 5–7 pairs of leaflets, each leaflet with 15–25 pairs of nerves; slash exuding some creamy latex *Trichilia lanata* 248
25. a. Branchlets distinctly ridged; leaf with 2–3 pairs of leaflets, each leaflet with more than 10 pairs of nerves; petiole slightly winged *Blighia welwitschii*  
 b. Branchlets not distinctly ridged, terete 26
26. a. Leaflets with more than 15 pairs of very prominent nerves on the lower surface; leaves clustered at the end of the branches 27  
 b. Leaves different 28
27. a. Leaflets pilose on midrib and nerves beneath; base of blade rounded – cordate; slash with a strong turpentine scent *Canarium schweinfurthii* 75  
 b. Leaflets glabrous beneath; blade with an undulate margin; slash not scented *Entandrophragma candollei* 255
28. a. Slash of the tree highly scented somewhat like turpentine or cedar 29  
 b. Slash not scented or slash unknown 36
29. a. Leaflets with a strong marginal nerve; apex obtuse to emarginate; petioles twisted *Copaifera salikounda* 156  
 b. Leaflets different 30
30. a. Slash dark red 31  
 b. Slash yellowish or pale pinkish or pale brown 32
31. a. Petiole markedly swollen at base, terete; leaves clustered, as a rule long; small tree *Carapa procera*  
 b. Petiole not markedly swollen at base, flattened, often slightly winged; margin of leaflets revolute; leaves not clustered; buttressed tree  
*Lovoa trichilioides* 272
32. a. Leaves with scaly or stellate hairs on petiole, rachis and lower leaf surface (lens!); slash thin with a turpentine scent *Dacryodes klaineana* 80  
 b. Leaves not with scaly hairs 33
33. a. Leaflets pilose on midrib and nerves beneath; base of blade rounded to cordate; slash with a turpentine scent *Canarium schweinfurthii* 75  
 b. Leaf and tree different 34
34. a. Tip of the leaflets folded; leaflets numerous, alternate; leaves very long, with a markedly swollen petiole base; slash yellowish *Turraeanthus africanus* 276  
 b. Leaf different 35
35. a. Petiole winged, the wings involute; margin of leaflets very undulate  
*Guarea cedrata* 264  
 b. Petiole flattened above or subwinged at base; slash as a rule with ripple marks  
*Entandrophragma cylindricum* 257

36. a. Leaves with a winged petiole; the edges sometimes curling inwards, giving the petiole a deeply grooved aspect 37  
 b. Petiole not winged, but sometimes with lateral ridges; 39
37. a. Petiole winged along the whole length 38  
 b. Petiole winged along the lower half only; leaflets pilose beneath on midrib and nerves *Canarium schweinfurthii* 75
38. a. Edges of the petiole curling inwards; margin of the leaflets undulate  
*Guarea cedrata* 264  
 b. Petiole flattened above; margin of the leaflets revolute *Lovoa trichilioides* 272
39. a. Leaf with a winged rachis 40  
 b. Rachis not winged 41
40. a. Leaflets in 2 pairs, the upper pair much larger than the lower pair  
*Hymenostegia afzelii* 166  
 b. Leaflets in 4–6 pairs, more or less equal-sized *Cynometra leonensis* 171
41. a. Leaf with only 2 pairs of leaflets, the lower pair slightly alternate, about half the size of the upper, 2–5 cm long, falcate pair  
*Cryptosepalum tetraphyllum* 163  
 b. Leaf different 42
42. a. Leaflets with distinctly twisted petiolules 43  
 b. Petiolules not distinctly twisted or leaflets sessile 50
43. a. Leaflets alternate 44  
 b. Leaflets (sub)opposite 47
44. a. Leaflets 8–12; stipules not intrapetiolar, c. 2 cm long, c. 1 cm wide, persistent  
*Crudia senegalensis* 162  
 b. Leaflets 5–8; stipules different 45
45. a. Leaflets with numerous translucent points; pods warty  
*Tessmannia baikiaeoides* 129  
 b. Leaflets not with translucent points 46
46. a. Stipules very early caducous, linear; forest tree with flat pods  
*Crudia gabonensis* 159  
 b. Stipules intrapetiolar, deeply bilobed; smaller tree *Crudia klainei*\* 162
47. a. Leaflets with a strong marginal nerve 48  
 b. Leaflets not with a strong marginal nerve 49
48. a. Leaf with a persistent, intrapetiolar, c. 1 cm long stipule; leaflets acute  
*Paramacrolobium coeruleum* 143  
 b. Leaf not with intrapetiolar stipules; leaflets rounded to emarginate at the top  
*Copaifera salikounda* 156
49. a. Petiole less than 1 cm long; blade often with a pair of glands on the lower surface near the base  
*Loesenera kalantha* 216  
 b. Petiole more than 1 cm long; leaflets not with glands *Afzelia bracteata* 129
50. a. Petiole short, slightly swollen and rugose, forming a joint, with the first

- pair of opposite leaflets directly above this joint (see fig. 73 G) 51
- b. First pair of leaflets not directly above the (swollen) base of the petiole, or leaflets alternate 59
51. a. Leaves with persistent intrapetiolar stipules, with or without reniform appendices; margin of leaflets with a few glandular cells *Gilbertiodendron* 52
- b. Leaves different 55
52. a. Leaflets in 2–4 pairs; stipules with reniform appendices 53
- b. Leaflets in 4–7 pairs; reniform appendices present or not 54
53. a. Stipules up to 1 cm long; fruit with one ridge, 15–20 cm long; upper leaflets up to 25 cm *Gilbertiodendron limba* 129
- b. Stipules 2–4 cm long; fruit with three lateral ridges, red-brown villous, up to 50 cm long; upper leaflets up to 50 cm long *Gilbertiodendron splendidum*
54. a. Stipules with reniform appendices; fruit with 2–3 lateral ridges, up to 30 cm long *Gilbertiodendron bilineatum*
- b. Stipules not with appendices; fruit with two lateral ridges, up to 12 cm long *Gilbertiodendron ivorense* 129
55. a. Leaflets sessile 56
- b. Leaflets on short petiolules 57
56. a. Tips of the leaflets retuse – emarginate *Didelotia afzelii* 186
- b. Tips of the leaflets acute – acuminate, not retuse *Tetraberlinia tubmaniana* 212
57. a. Leaflets in 2 pairs only, up to 18 cm long *Gilbertiodendron aylmeri* 129
- b. Leaflets in 3 or more pairs 58
58. a. Branchlets with 2–4 black, pointed excrescences above the leaf axil; tree sometimes with stilt-roots *Stachyothyrsus stapfiana* 209
- b. Branchlets not with black excrescences; leaf tip often mucronate; fruit with one strong lateral ridge; bark yellow, flaky *Gilbertiodendron preussii* 196
59. a. Petiole heavily swollen at base, the swollen part 2–3 times as thick as the rest of the petiole 60
- b. Petiole slightly swollen or not at base 62
60. a. Leaflets 8–30, narrowly oblong, with a folded leaf tip; slash fragrant *Turraeanthus africanus* 276
- b. Leaflets elliptic – narrowly obovate, not folded at the top 61
61. a. Leaflets in 3–4 pairs, the lower pair smaller than the upper pair *Stachyothyrsus stapfiana* 209
- b. Leaflets in more than 5 pairs, more or less equal-sized; slash cedar-scented *Carapa procera*
62. a. Leaflets with translucent points 63
- b. Leaflets not with translucent points 65
63. a. Leaflets opposite, acute at the top *Daniellia* spp. 174
- b. Leaflets alternate 64
64. a. Leaflets with a strong marginal nerve, obtuse – emarginate at the top;

- fruit spherical, laterally compressed, c. 5 cm across *Detarium senegalense* 159  
(not yet recorded from Liberia is *Stemonocoleus micranthus*, with leaves very similar to those of *Detarium*, but with papery fruits).
- b. Leaflets not with a strong marginal nerve; blade acute – acuminate, slightly retuse at the tip; fruit warty *Tessmannia baikiaeoides* 129
65. a. Leaf paripinnate, leaflets opposite or subopposite 66  
b. Leaf imparipinnate, or leaflets alternate 77
66. a. Leaflets sessile, asymmetrical at base 67  
b. Leaflets stalked or subsessile 68
67. a. Leaflets in 4–6 pairs, rachis slightly winged, sparsely tomentose above *Cynometra leonensis* 171  
b. Leaflets in 8–12 pairs, rachis pilose *Brachystegia leonensis* 148
68. a. Leaflets obtuse to rounded, the extreme tip abruptly acuminate or cuspidate (tip sometimes reduced); nerves not prominent 69  
b. Leaflets acute – acuminate at the top, nerves prominent 71
69. a. Leaflets in 2–4 (–5) pairs, petiolule 5–15 mm long; cuspidate tip 2–5 mm long *Khaya anthotheca* 268  
b. Leaflets in more than 4 pairs 70
70. a. Leaflets in 5–6 pairs; petiolule c. 6 mm long; cuspidate tip 5–10 mm long *Khaya ivorensis* 270  
b. Leaflets in 7–11 pairs; petiolules 2–3 mm long; cuspidate tip c. 2 mm long, with folded edges, or reduced; midrib often puberulous beneath *Entandrophragma angolense* 252
71. a. Terminal pair of leaflets with 3–5 pairs of nerves 72  
b. Terminal pair of leaflets with more than 5 pairs of nerves 73
72. a. Leaflets in 2–4 pairs; blade rounded – obtusely cuneate at base *Anthonotha explicans* 143  
b. Leaflets in 5–7 pairs; blade narrowly cuneate at base *Chidlowia sanguinea*
73. a. Petiole, rachis, and lower surface of leaflet with an indumentum of stellate or scaly hairs; leaflets 2–4 pairs, caudate; slash turpentine-scented *Dacryodes klaineana* 80  
b. No scaly or stellate hairs present on lower blade surface 74
74. a. Branchlets with 2–4 black, pointed excrescences above the leaf axil *Stachyothyrsus stapfiana* 209  
b. Branchlets different 75
75. a. Petiole distinctly flattened at base, sometimes slightly winged; leaflets 5–9 pairs; leaves clustered; slash cedar-scented, often with ripple marks *Entandrophragma cylindricum* 257  
b. Leaf and tree different 76
76. a. Leaflets in 2–5 pairs, slightly falcate *Berlinia* spp. 144  
b. Leaflets in 4–9 pairs, narrowly oblong or obovate *Trichilia heudelotii* 248

77. a. Leaflets opposite with 15 or more pairs of very fine, parallel nerves, hardly raised on either surface; leaves clustered; slash exuding some creamy gum  
*Antrocaryon micraster*
- b. Leaves and trees different 78
78. a. Reticulation by veins obscure; petiole 7–14 cm long, with faint lateral ridges; leaflets 7–17; slash with some white latex *Guarea thompsonii* 266
- b. Leaves and tree different 79
79. a. Petiole, rachis, and lower surface of the leaflets with stellate or scaly hairs; leaflets 4–8, caudate; slash with turpentine smell *Dacryodes klaineana* 80
- b. No stellate or scaly hairs 80
80. a. Leaflets subsessile, 8–20; rachis finely puberulous; branchlets slightly angled  
*Majidea fosteri*
- b. Leaflets distinctly stalked 81
81. a. Petiole 1–4 cm long 82
- b. Petiole more than 5 cm long 86
82. a. Leaflets 11–17, up to 5 cm long and 2 cm wide, rounded at base; slash with red sap and ripple marks  
*Dialium dinklagei* 182
- b. Leaflets 5–11, as a rule larger 83
83. a. Leaflets glabrous, 5; buttressed tree with some red sap in the slash and fine ripple marks  
*Dialium aubrevillei* 179
- b. Leaflets more or less pubescent 84
84. a. Leaflets 5–7, with a close and prominent reticulation on the lower surface; slash exuding some red sap; ripple marks present *Dialium guineense* 182
- b. Leaflets as a rule 7–11; reticulation otherwise 85
85. a. Leaf with (as a rule persistent) sickle-shaped stipules; leaflets suborbicular to elliptic, abruptly acuminate at the top; tree of river borders and swampy sites  
*Pterocarpus santalinoides* 243
- b. Stipules absent; leaflets (narrowly) elliptic – (–) oblong, acute at the top; tree with red, smooth bark on the upper part of the bole and the branches  
*Distemonanthus benthamianus* 188
86. a. Petiole and rachis pubescent – puberulous 87
- b. Petiole and rachis glabrous 88
87. a. Leaves clustered at the end of the branches; slash scented, often with ripple marks  
*Entandrophragma cylindricum* 257
- b. Leaves not clustered, slash not scented or with ripple marks  
*Trichilia heudelotii* 248
88. a. Leaflets 5–7, caudate – acuminate at the top; petiole terete  
*Lannea welwitschii*
- b. Leaflets 4–12, the lower pair suborbicular, the upper pair with an obtusely acute top; petiole flattened above  
*Pseudospondias microcarpa*
- c. Leaves long, in a terminal cluster  
*Trichoscypha* spp.

## KEY V: LEAVES BIPINNATELY COMPOUND

1. a. Each pinna with only two leaflets; pinnae in one or two pairs; glands on the rachises *Newtonia duparquetiana* 230
- b. Each pinna with more than two leaflets 2
2. a. Each leaf with only one pair of pinnae; a gland on the petiole 3
- b. Each leaf with two or more pairs of pinnae 7
3. a. Leaflets in more than nine pairs, opposite (rarely alternate) *Xylia evansii* 228
- b. Leaflets in less than nine pairs, or, when alternate, less than 18 4
4. a. Leaflets opposite 5
- b. Leaflets alternate (but see also 10a) *Cylicodiscus gabunensis\** 230
5. a. Leaflets in 3–5 pairs, oblique – rhombic, up to 4.5 cm long; small trees in swamps *Newtonia elliotii* 230
- b. Leaflets in 4–7 pairs, elliptic, as a rule longer than 5 cm 6
6. a. Petiole short and stout, 1–2 cm long, jointed at base, with a 3–5 mm wide gland at the top; rachis with distinct glands between the upper pairs of leaflets *Calpocalyx aubrevillei* 225
- b. Petiole (1.5–) 3–6 cm long, slender, with a small gland at the top; glands on the rachis inconspicuous *Calpocalyx brevibracteatus* 226
7. a. Leaflets alternate 8
- b. Leaflets opposite 12
8. a. Leaflets 1–2 cm long, 0.5–1 cm wide, rounded at both ends; each leaf with 5–9 pairs of pinnae, each pinna with 12–24 leaflets *Tetrapleura tetraptera* 221
- b. Leaflets larger, acute – acuminate at the top; each leaf with 2–6 pairs of pinnae 9
9. a. Each leaf with 4–6 pairs of pinnae, each pinna with 12–24 long-acuminate or caudate leaflets; rachis rusty brown puberulous *Bussea occidentalis* 152
- b. Each leaf with 2–4 pairs of pinnae, each pinna with 4–12 leaflets; rachises not rusty puberulous 10
10. a. Each leaf with only 2 pairs of pinnae (rarely 1, see 4b), each pinna with 4–8 leaflets; fruit cross-shaped on cross-section; no glands on petiole *Tetrapleura chevalieri* 232
- b. Each leaf with 2–4 pairs of pinnae, each pinna with 8–12 leaflets; fruits flat 11
11. a. Midrib and petiolule of the leaflets glabrous or with a few scattered hairs; tree of evergreen forest *Erythrophleum ivorense* 191
- b. Midrib and petiolule of the leaflets puberulous; tree of the drier forest types *Erythrophleum suaveolens* 194
12. a. Leaflets narrowly oblong or linear, 2–20 mm long, 0.5–4 mm wide; ratio length : width = 4 : 1 – 8 : 1 13

- b. Leaflets not linear, as a rule larger, with a length : width ratio smaller than 4 : 1 17
13. a. Leaf with less than 10 pairs of pinnae 14  
 b. Leaf with 10 or more pairs of pinnae 15
14. a. Rachis with a gland between the upper 2–3 pairs of pinnae; basal leaflet on the distal side of each pinna reduced; leaflets 1–1.5 cm long, 3–4 mm wide; tree of river borders *Cathormion altissimum* 235  
 b. Rachis without glands; distal basal leaflet of each pinna not reduced; leaflets 1.4–2 cm long, c. 4 mm wide; fruit flat and papery  
*Aubrevillea kerstingii* 224  
 or immature specimen of *Aubrevillea platycarpa* 222
15. a. Petiole 5–10 cm long, with a flat gland at the base; rachis rusty puberulous; rachises of the pinnae 4–13 cm long, each pinna with 30–50 leaflets; each leaflet 8–10 mm long, 1–2 mm wide *Parkia bicolor* 232  
 b. Petiole 0.7–1.5 (–3) cm long 16
16. a. Each leaf with 10–20 pairs of pinnae, each pinna up to 6 cm long; leaflets 3–8 mm long, c. 1 mm wide; petiole without gland  
*Piptadeniastrum africanum* 239  
 b. Each leaf with 20–50 pairs of pinnae, each pinna 2–4 cm long; leaflets 2–4 mm long, 0.5 mm wide; a swollen gland present on the petiole and on the rachis between the upper pairs of leaflets *Samanea dinklagei* 242
17. a. Leaves without glands on petiole and/or rachis 18  
 b. Leaves with glands on petiole and/or rachis 19
18. a. Leaflets rhombic, the midrib diagonal; rachis with a marked central ridge, covered by rusty, stellate hairs *Pentaclethra macrophylla* 236  
 b. Leaflets obovate, with an arched midrib and a characteristic reticulation of ascending nerves; apex as a rule emarginate; rachis shallowly and broadly grooved above *Aubrevillea platycarpa* 222
19. a. Petiole with a distinct gland on or below the middle 20  
 b. Petiole not with glands, but a gland on the rachis between the first pair of pinnae 23
20. a. Pinnae with 2–5 pairs of leaflets; leaves with (1–) 2–4 pairs of pinnae 21  
 b. Pinnae with 6–20 pairs of leaflets; leaves with (3–) 4–8 pairs of pinnae 22
21. a. Leaflets (sub)sessile, midrib broadened at base; rachises delicately puberulous *Albizia zygia* 220  
 b. Leaflets with 1–2 mm long, thin petiolules; rachises nearly glabrous  
*Albizia glaberrima* 220
22. a. Leaflets markedly rhombic, the midrib diagonal; one basal nerve parallel to the proximal edge *Albizia adianthifolia* 220  
 b. Leaflets (obliquely) elliptic, midrib median, no basal nerve parallel to the edge  
*Albizia ferruginea* 217

23. a. Pinnae in 2 pairs, with glands between the leaflets

*Cathormion rhombifolium\**

b. Pinnae in 3–4 pairs, not with glands between the leaflets

*Newtonia aubrevillei* 229



## KEY VI: TREES WITH STILT-ROOTS

- |   |                                 |     |
|---|---------------------------------|-----|
| 1. a. Leaves simple   |                                 | 6   |
| b. Leaves pinnately compound  |                                 | 2   |
| c. Leaves digitately compound   |                                 | 3   |
| 2. a. Leaf imparipinnate; slash strongly fragrant   | <i>Santiria trimera</i>         | 75  |
| b. Leaf paripinnate; slash not fragrant   | <i>Stachyothyrsus stapfiana</i> | 209 |
| 3. a. Leaflets with a serrate margin  | <i>Myrianthus arboreus</i>      |     |
| b. Leaflets entire  |                                 | 4   |
| 4. a. Leaflets with black glandular points on the margin  | <i>Ricinodendron heudelotii</i> | 101 |
| b. Leaflets not with glandular points on the margin   |                                 | 5   |
| 5. a. Leaflets 5–7, with an indumentum of brownish scales beneath   | <i>Heritiera utilis</i>         | 363 |
| b. Leaflets more than 9, spreading umbrella-wise  | <i>Musanga cecropioides</i>     | 281 |
| 6. a. Leaves parallel-nerved  |                                 | 7   |
| b. Leaves pinnately nerved  |                                 | 8   |
| 7. a. Leaf with spines along the margin and midrib  | <i>Pandanus</i> sp.             |     |
| b. Leaves not spiny   | <i>Dracaena</i> sp.             |     |
| 8. a. Leaves opposite   |                                 | 9   |
| b. Leaves alternate   |                                 | 11  |
| 9. a. Leaves very large, up to 1.50 m long, obovate   | <i>Anthocleista</i> spp.        |     |
| b. Leaves not longer than 15 cm   |                                 | 10  |
| 10. a. Tree of brackish coastal swamps and lagoons, without yellow latex  | <i>Rhizophora</i> spp.          | 306 |
| b. Tree of fresh water swamps, with yellow latex  | <i>Symphonia globulifera</i>    | 107 |
| 11. a. Slash strongly fragrant; leaves obovate, up to 10 cm long; nerves hardly more pronounced than the veins on the lower surface; fruits in bunches, finger-shaped | <i>Xylocopa staudtii</i>        | 105 |
| b. Slash not fragrant; nerves markedly distinct from the veins; fruits not in bunches   |                                 | 12  |
| 12. a. Petiole less than 1 cm long; stilt-roots low   |                                 | 13  |
| b. Petiole more than 1 cm long; leaves often clustered; stilt-roots as a rule high  |                                 | 14  |
| 13. a. Leaf densely brown-pubescent beneath   | <i>Bridelia grandis</i>         | 94  |
| b. Leaf sparsely pubescent beneath  | <i>Bridelia</i> spp.            | 96  |
| 14. a. Leaf on the lower surface with a dense indumentum of brownish scaly hairs; apex long acuminate   | <i>Heritiera utilis</i>         | 363 |
| b. Leaf different   |                                 | 15  |
| 15. a. Leaf densely brown pubescent beneath with simple hairs   | <i>Uapaca paludosa</i>          | 105 |

- b. Leaf glabrous beneath 16
- 16. a. Base of the blade slightly auriculate, with a pair of glands in the lobes  
*Macaranga barteri* 105
- b. Base of the blade cuneate, without glands 17
- 17. a. Leaf with a tuft of red hairs in the axil of the petiole; fruit smooth, crowned  
by the remnants of 3 styles *Uapaca heudelotii* 105
- b. Leaf different 18
- 18. a. Blade thin-coriaceous or papery, margin undulate; veins raised beneath;  
fruit warty, without remnants of styles; bark rough-scaly, brown  
*Uapaca guineensis* 101
- b. Blade thick-coriaceous, the veins impressed; fruit smooth, with remnants  
of 5 styles; bark fairly smooth, grey-black *Uapaca corbisieri* 104

## KEY VII: TREES WITH PRICKLES OR SPINES ON BOLE, BRANCHES OR LEAVES

- |  |                                 |     |
|--|---------------------------------|-----|
| 1. a. Leaves simple  |                                 | 2   |
| b. Leaves trifoliolate or digitately compound  |                                 | 6   |
| c. Leaves pinnately compound   |                                 | 7   |
| d. Leaves bipinnately compound   | <i>Dichrostachys glomerata</i>  | 243 |
| 2. a. Leaves opposite, very large  | <i>Anthocleista</i> spp.        |     |
| b. Leaves alternate  |                                 | 3   |
| 3. a. Blade slightly auriculate at base, with an inconspicuous gland in each lobe  | <i>Macaranga barteri</i>        | 105 |
| b. Leaf different  |                                 | 4   |
| 4. a. Blade glabrous beneath, with numerous parallel nerves; stipules leaving annular scars on the nodes; spines only in juvenile stage  | <i>Klainedoxa gabonensis</i>    | 354 |
| b. Blade more or less pubescent on the lower surface   |                                 | 5   |
| 5. a. Blade densely brown pubescent beneath with erect hairs; reticulation conspicuous   | <i>Bridelia grandis</i>         | 94  |
| b. Blade pubescent beneath with appressed hairs; reticulation faint  | <i>Bridelia stenocarpa</i>      | 96  |
| 6. a. Leaf trifoliolate, see KEY III, 6 a, 7, p. 38  |                                 |     |
| b. Leaf digitately compound with more than 3 leaflets, see KEY III, 14, p. 39  |                                 |     |
| 7. a. Leaf with 7–12 pairs of leaflets, each leaflet up to 2 cm long, with an emarginate top; spines on the bole                         | <i>Plagiosiphon emarginatus</i> | 208 |
| b. Leaflets more than 2 cm long, not emarginate; thorns and prickles on bole, branches and leaves  | <i>Fagara</i>                   | 8   |
| 8. a. The two edges of the blade joining the petiolule at about the same height; petiolule c. 5 mm long; blade cordate to obtuse at base | <i>Fagara macrophylla</i>       | 338 |
| b. Base of leaflets strongly asymmetrical, the distal side broad, joining the petiolule well below the narrow, cuneate proximal side     | <i>Fagara tessmannii</i>        | 335 |

## *Chapter V*

### ARRANGEMENT OF THE TEXT

Seventy-five species, belonging to twenty-three families are discussed and described. Families and species are alphabetically arranged; in the *Leguminosae* the species are alphabetical within the sub-families.

Each family is introduced by a short general description. The discussion of each species is headed by its binomial and a numbered reference in square brackets, for example [8, 13/50, 76]. This indicates that this species is depicted on photograph 8 and figure 13, and that further reference to this species is made on pages 50 and 76.

Literature references are of two kinds, viz.:

1. Strictly botanical literature with reference to basionym, synonyms, and types, recent monographic revisions etc. (K!) denotes that the type has been studied in the Kew Herbarium; (lit!) denotes that important literature references are given in the article quoted.
2. More general (forestry) literature.

The descriptive text is subdivided into: BOTANY (description of leaves, flowers, fruits, seedlings); TAXONOMICAL NOTES (including reference to related species); FIELD NOTES (field description, ecology, similar species, etc.); SILVICULTURE (a short outline, for a limited number of species only); USES.

With the exception of pages on which a new family begins, each text page is headed by the name of the family and the genus concerned.

Botanical and technical terms are included in the glossary of terms.

## ANNONACEAE

A large family of trees, shrubs and woody climbers, common in most tropical lowland forests. Leaves simple, alternate, estipulate, pinnately nerved. Flowers as a rule hermaphrodite with 3 sepals and 6 petals, numerous free stamens which are often crowded and free carpels. *The free carpels can only be seen with a lens.* Some tropical African *Annonaceae* have completely fused carpels when in fruit, others retain the separate carpels. Seeds, when cut transversely, show the ruminant endosperm.

The *Annonaceae* have pendent, or at any rate never erect flowers; only one or two flower simultaneously in one inflorescence. The colours, yellow purplish or green, of the usually fleshy or waxy flowers are always dull, never bright. Many *Annonaceae* have a peculiarly dull, greyish lower leaf surface. The slash is usually fibrous and strongly scented.

The only large tree of this family, occurring in the high forest of Liberia, is *Pachypodanthium staudtii* (ENGL. & DIELS) ENGL. & DIELS. Very common smaller trees are *Xylopia staudtii* ENGL. & DIELS and *Enantia polycarpa* (DC.) ENGL. & DIELS. The former is readily recognised by its stilted roots, fragrant slash and bunches of finger-shaped fruits originating from a single flower (the carpels remaining free). *Enantia* is characterised by a conspicuously bright yellow, fragrant slash.

*Pachypodanthium staudtii* (ENGL. & DIELS) ENGL. & DIELS [1/28, 123]

'*Pachypodanthium*': Gr. pachys: thick; Gr. pous: foot; Gr. anthos: flower; apparently the name refers to the swollen base of the floral axis carrying the stamens.

'*staudtii*': named after Staudt, the collector of the type specimen.

Engl. & Diels, Not. Bot. Gart. Berl., III, p. 55 (1900); *ibid.*, Monogr. Afr. Pfl.fam. & -gatt., IV, p. 32 (1901); Diels, Bot. Jahrb., 53, p. 437 (1915); Pellegrin, Bull. Soc. Bot. France, 95, p. 136 (1948); R. Fries, Nat. Pfl.fam., 2nd ed., 17a, II, p. 60 (1953).

*Uvaria staudtii* ENGL. & DIELS (basionym); Not. Bot. Gart. Berl., II, p. 292 (1899); type: Staudt 133, Cameroon (K!).

1927: F.W.T.A. 1st ed., I, p. 51

1931: Cooper & Record, Evergr. For. Liberia, p. 16

1936: Aubréville, F.F.C.I., 1st ed., I, p. 100

1937: Dalziel, U.P.W.T.A., p. 6

1950: Normand, A.B.C.I., I, p. 81; Pl. XV

1954: F.W.T.A., 2nd ed., I, p. 39

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 130

1959: Kryn & Fobes, Woods of Liberia, p. 80

1960: Keay, Nigerian Trees, I, p. 57

1960: Taylor, Syn. Silv. Ghana, p. 87

1961: Irvine, Woody Plants of Ghana, p. 15

1963: de Saint Aubin, La Forêt du Gabon, p. 150

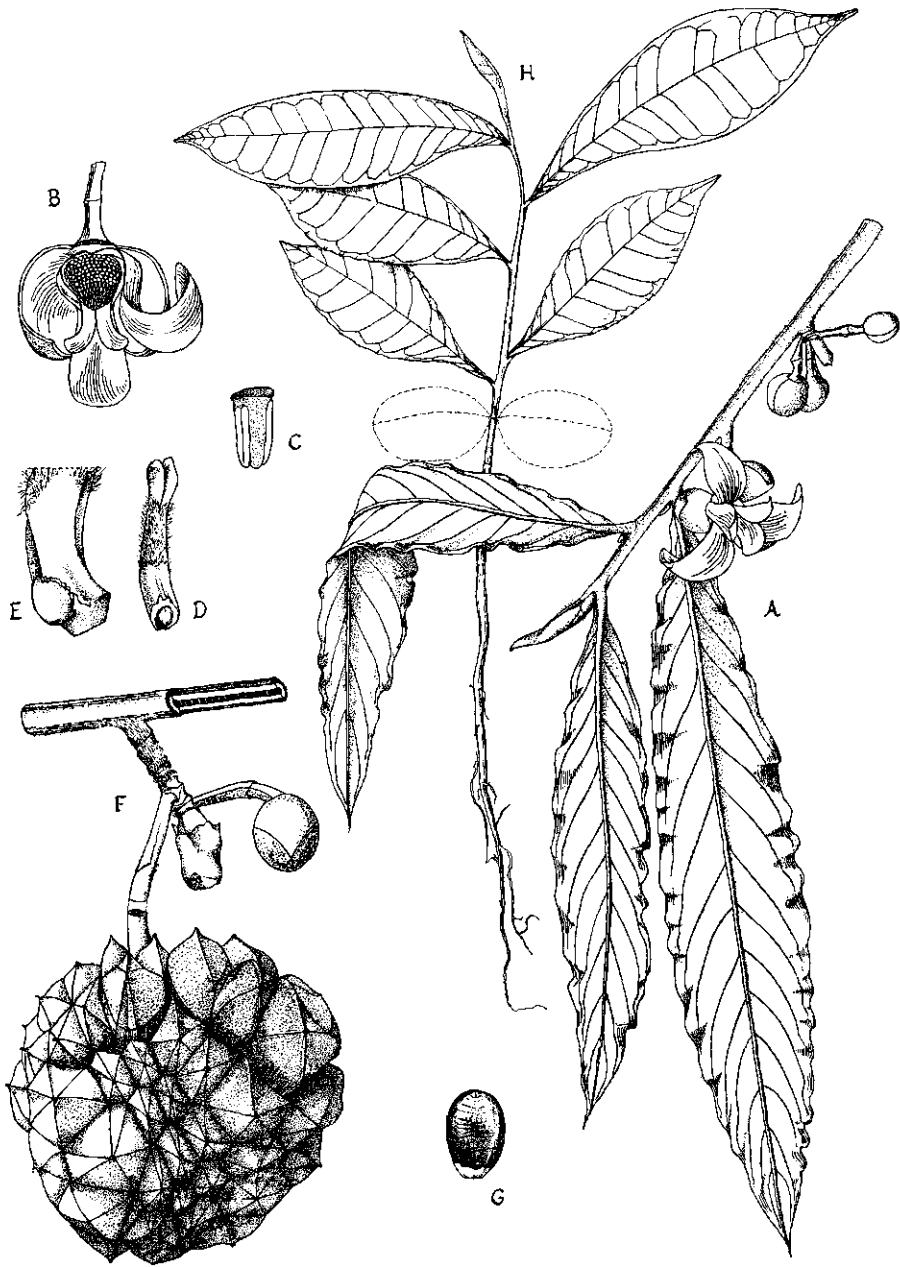


Fig. 1. *Pachypodanthium staudtii* (Engl. & Diels) Engl. & Diels A: branch with leaves and flowers ( $\times \frac{1}{2}$ ); B: open flower ( $\times 1$ ); C: stamen ( $\times 10$ ); D: pistil ( $\times 10$ ); E: ovary, lower part opened and ovule visible ( $\times 20$ ); F: branch with inflorescence and fruit ( $\times 1$ ); G: seed with short, white aril at base ( $\times 1$ ); H: seedling, cotyledons (dotted), and first 2 leaves already shed ( $\times \frac{1}{2}$ ).

LOCAL NAME: gpala-duo (Gio); zree-chu (Bassa, cf. Cooper)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: from Sierra Leone to Congo

**BOTANY.** A medium-sized or tall forest tree. Leaves simple, alternate, distichous. Petiole 2–5 mm long, stout, flattened above, like the branchlets grey-greenish tomentellous with minute stellate hairs. Pith of the branchlets septate. Blade narrowly elliptic, 10–24 cm long, 2–5 cm wide (saplings may have broader leaves), coriaceous, glabrous and glossy dark green above, lighter green and dull beneath, densely tomentellous when young, with sparse stellate hairs when older. Base rounded to cuneate, slightly asymmetric; apex acute to acuminate; margin entire, strongly undulate. Midrib prominent beneath, flat above; nerves 10–15 (–18) on each side of the midrib, slightly prominent beneath, flat above, steeply ascending.

Inflorescence laterally on the twigs, but not on the latest shoot, short and thick with numerous scars of shed bracts, suggesting a lateral dwarf shoot, consisting of a bud, usually accompanied by a single, open flower and/or a fruit. Bracts scaly, alternating, each enclosing a flower and a lateral flower bud; flower enclosed by a secondary bract at the base of its pedicel; bracts early caducous, secondary bract dropping later and often splitting in two halves. Peduncle 4–6 mm long, pedicel 5–7 mm long, both 2–3 mm thick, tomentellous, accrescent when the fruit grows. Sepals 3, coriaceous, closed in bud, triangular, c. 10 mm wide at base, 12–15 mm long, concave, stellate-tomentellous outside, glabrous inside. Petals 6, imbricate, in 2 series of 3, pale yellow – creamy, with purple dots; claw thick, limb elliptic, apex acute; outer petals c. 2.5 cm long with a few stellate hairs outside at the base, recurved between the sepals; inner petals slightly smaller, enclosing with the claws the stamens and the carpels; limb erect or slightly recurved. Perianth inserted below a swollen, about 4 mm wide ring, which carries the stamens and surrounds an elongated centre carrying the carpels. Anthers numerous, sessile, 1–1.5 mm long, arranged in crowded spirals under the carpels. Connective broadening into a purple, truncate shield above the linear thecae. Carpels numerous, free, with one basal ovule, arranged in crowded spirals, c. 2 mm long; upper part pale green, glabrous, obovate, apex bilobed; lower part tomentellous, glabrescent towards the base.

Fruit globular, apocarpous but with the mericarps pressed tightly together, 3–7 cm in diameter, grey-greenish tomentellous, the surface embossed with irregular 4–6 sided pyramidal, ribbed, woody points, muricate. Mericarps angular, obconical, c. 2 cm long, their base slightly impressed in the receptacle. When ripe, the laterally carmine-red, fleshy carpels separate and drop individually, or the fruit may drop as a whole. Seed glossy brown, 1–1.5 cm long, 6–8 mm wide, laterally flattened, with a dark seam on the edge and a short 1–3 mm high, white, fleshy aril at the base.

Seedling: germination epigeal. Hypocotyl 6–7 cm long, woody, glabrous. Cotyledons

sessile, almost orbicular, nearly 2 cm in diameter. Epicotyl very short, 1–2 mm long, finely stellate-pubescent. First two leaves sub-opposite, sessile, ovate, c. 4.5 cm long, 2.5 cm wide, rounded at base, acute at the apex, finely undulate. Following leaves alternate, progressively larger, cuneate at base.

**TAXONOMICAL NOTES.** The species was first described as *Uvaria staudtii* ENGL. & DIELS (1899, l.c.), but in 1900 Engler and Diels elevated it to a new genus called *Pachypodanthium*. *Pachypodanthium* ENGL. & DIELS was based on this species only (1900, l.c.). Supplementary information, especially concerning the flower, was given by Diels (1915, l.c.). At present four species are referred to this genus, which occurs in West and Central Africa, but hitherto only *P. staudtii* has been found in Liberia. Pellegrin (1948, l.c.) distinguishes a variety 'le Testui', with shorter and broader leaves, which seems to be localized in Gabon. It should be noted that the outer series of petals is spreading and that the stigma is lobed. It may be also remarked that only one ovule is present in each carpel, not 'numerous ovules' cf. F.W.T.A., 1954, l.c. p. 39.

The present description and figures are based on material collected in Liberia: Gbi Nat. For. 550; Bong Range 754, 1176; Nimba Mountains 891; Nursery Paynesville, v. Harten s.n.

**FIELD NOTES.** *Pachypodanthium staudtii* may reach a height of up to 36 m ( $\approx$  120') (150 ft, Taylor) and a diameter of 90 cm ( $\approx$  3'), rarely more. The base of the tree is straight or slightly swollen. The bole is straight and slender, cylindrical. The crown is small, fairly open with nearly horizontal branches; branchlets and leaves drooping, giving the crown a characteristic drooping habit. The bark is yellowish or grey-greenish, sometimes grey-black, shallowly longitudinally fissured, thick and soft, not scaly. The slash is strongly fragrant, bright ochre-brown, turning darker when exposed, fibrous under the bark ridges, slightly granular and lighter in colour under the bark grooves (dilatation tissue). The high wood rays are easily recognised in the slash.

*Pachypodanthium staudtii* occurs scattered in the high forest on well-drained, moist soils; it is sometimes very common in older secondary forests. The tree is evergreen and a light demander, although young trees are reported to tolerate shade reasonably well. The flowering season seems to be undefined, flowering trees were observed during February, April, and August. The flowers are sweetly fragrant. The main fruiting season seems to be from July to October, but fruits have also been found during the rest of the year. The seeds are spread by birds and small mammals (monkeys). Seedlings are not common in the high forest.

*Pachypodanthium staudtii* could be confused with another annonaceous tree, common in young secondary forest: *Cleistopholis patens* (BENTH.) ENGL. & DIELS, which may grow up to 25 m ( $\approx$  80') high and has a similar drooping crown habit. However, the slash is pale and watery, the margin of the leaf blade is straight and the fruit consists of separate, shortly and stoutly stalked mericarps.



USES. A decoction of the bark is used as a 'worm medicine' (Gio). The wood is locally used for construction and carpentry. It is yellowish or greenish brown, moderately hard and heavy, with little difference between sapwood and heartwood. It is reported to be fairly durable.

## APOCYNACEAE

A large family of trees, shrubs, climbers, and – more rarely – herbs, cosmopolite but mostly tropical. White latex present in the bark. Leaves simple, opposite or in whorls, stipulate, pinnately nerved. Flowers actinomorphic, hermaphrodite, pentamerous. Calyx 5-lobed, imbricate, often glandular. Corolla gamopetalous, contorted in bud. Stamens epipetalous; anthers introrse, 2-celled, sagittate. Pistil 1, superior or subinferior, composed basically of two distinct, unicarpellate, unilocular ovaries. Style usually one, stigma variable. Fruit a (double) follicle, berry, capsule, or drupe.

Formerly the latex of *Funtumia elastica* (PREUSS) STAPF and various apocynaceous climbers has been collected for rubber, but this practice was abandoned after the introduction of the rubber tree (*Hevea brasiliensis* (A. JUSS.) MÜLL. ARG.), which has a much higher yield. Leaves, bark, and latex of many *Apocynaceae* have a wide range of various medical uses. Of this family only one large tree occurs in the high forest of Liberia: *Alstonia boonei* DE WILD.. Medium-sized (e.g. *Funtumia* spp.) and small trees as well as lianas of this family are common. Often used as an ornamental tree in the neighbourhood of villages, *Rauvolfia vomitoria* AFZEL. occurs. It is characterized by its whorled leaves and small, green or red berries. The bark is used medicinally, especially for stomach-ache.

### *Alstonia boonei* DE WILD.

[2/35]

'*Alstonia*': named in honour of Charles Alston, a Scottish botanist (1683–1760).

'*boonei*': named after Boone, the collector of the type specimen.

De Wildeman, Fedde Rep., XIII, p. 382 (1914); type: Boone s.n., Congo (BR!); J. Monachino, Pacific Science, III, No. 2, 1949 (a revision of the genus *Alstonia* L.; litt!). Until recently it was misnamed as: *Alstonia congensis* ENGL., in most literature concerning West Africa.

- |   |  |
|---|--|
| 1931: F.W.T.A., 1st ed., II, p. 42 ( <i>A. congensis</i> , not var. <i>glabrata</i> ) | 1954: Bois & For. Trop., No. 38, p. 22–26                                |
| 1936: Aubréville, F.F.C.I., 1st ed., III, p. 162 ( <i>A. congensis</i> )              | 1959: Aubréville, F.F.C.I., 2nd ed., III, p. 194 ( <i>A. congensis</i> ) |
| 1937: Dalziel, U.P.W.T.A., p. 366 ( <i>A. congensis</i> )                             | 1959: Kryn & Fobes, Woods of Liberia, p. 9 ( <i>A. congensis</i> )       |
| 1939: Eggeling & Harris, Fifteen Uganda Trees, p. 9 ( <i>A. congensis</i> )           | 1960: Normand, A.B.C.I., III, p. 88, Pl. CXLIX ( <i>A. congensis</i> )   |
| 1951: Eggeling & Dale, Indigenous Trees Uganda, p. 24                                 | 1960: Taylor, Syn. Silv. Ghana, p. 87                                    |
|   | 1960: Esdorn & Zohm, Flora 150, 2/3, p. 318–331 (litt.)                  |

1961: Irvine, *Woody Plants of Ghana*, p. 613–615  
 1963: de Saint Aubin, *La Forêt du Gabon*, p. 152  
 1963: F.W.T.A., 2nd ed., II, p. 68

LOCAL NAMES: yung (Gio)

TRADE NAME: Emien

GEOGRAPHICAL DISTRIBUTION: From Senegal to Congo, Uganda, and Sudan

**BOTANY.** A large tree, up to 45 m ( $\approx$  150') high and 1.20 m ( $\approx$  4') in diameter above the heavily fluted base. Leaves with 4–7 in whorls, which are 1.5–6.5 cm interspaced, simple, coriaceous, glabrous, dark green, glossy above, slightly glaucescent beneath, sessile or subsessile. Blade (narrowly) obovate, (2.5–) 8–18 (–26) cm long, (0.6–) 3–5.5 cm wide. Base narrowly cuneate; apex acuminate (specially leaves of saplings and water shoots), bluntly acute, rounded or sometimes emarginate; margin entire. Midrib depressed above, prominent beneath, broad; nerves flat above, slightly raised beneath, nearly rectangular to the midrib, (25–) 30–40 on each side, straight, parallel, joining a submarginal nerve about 1 mm from the edge.

Inflorescence terminal, compound, with 2–3 tiers of pseudo-umbels. Axis of the inflorescence glabrescent; primary peduncles branched, short greyish-pubescent, 0.5–4 (–7) cm long. Bracts ovate – triangular, 1–1.5 mm long, pubescent, ciliate; bracteoles linear, about 1 mm long, or absent. Pedicel c. 6 mm long, greyish-pubescent. Calyx 5-lobed, calyx tube about 1 mm long, pubescent outside; lobes c. 1.5 mm long, imbricate in bud, ciliate, pubescent on both sides, ovate, pale green, spreading when flowering. Calyx persistent in fruit. Petals 5, connate, pale green; corolla tube 7–14 mm long, outside increasingly short pubescent towards the throat, inside velvety beneath the stamens, upper part inflated; throat thickened, densely crowded with stiff white hairs. Corolla lobes contorted in bud, horizontally spreading when flowering, slightly obliquely ovate, 3–5 mm long, 2–4 mm wide, pubescent outside. Stamens 5, inserted in the inflated part of the corolla tube. Filaments 0.5 mm long, glabrous. Anthers introrse, c. 1.5 mm long, 0.8 mm wide, acute at the apex, cordate at base; the thecae opening lengthwise. Carpels 2, multiovulate, united only at the base, pressed together, c. 2 mm long, villous outside except at the base. Styles 2, united above the carpels, glabrous. Stigma 0.5 mm long, bi-lobed, reaching to just below the anthers; indusium membranous.

Fruits formed by two pendent, 20–40 cm long, green follicles on one common stalk, puberulous, finely longitudinally striate; when ripe splitting lengthwise on the tree. Seeds numerous, flat, attached in the middle, c. 4 mm long, 2 mm wide, with 1 cm long hairs on both ends.

Seedling: germination is epigeal, and takes 18–25 days (Taylor). Hypocotyl 2.5–3.5 cm long, light green, herbaceous. Cotyledons short-petiolate. Blade ovate, about 14 mm long, 7 mm wide, thin herbaceous. Apex rounded; margin entire; decurrent; base

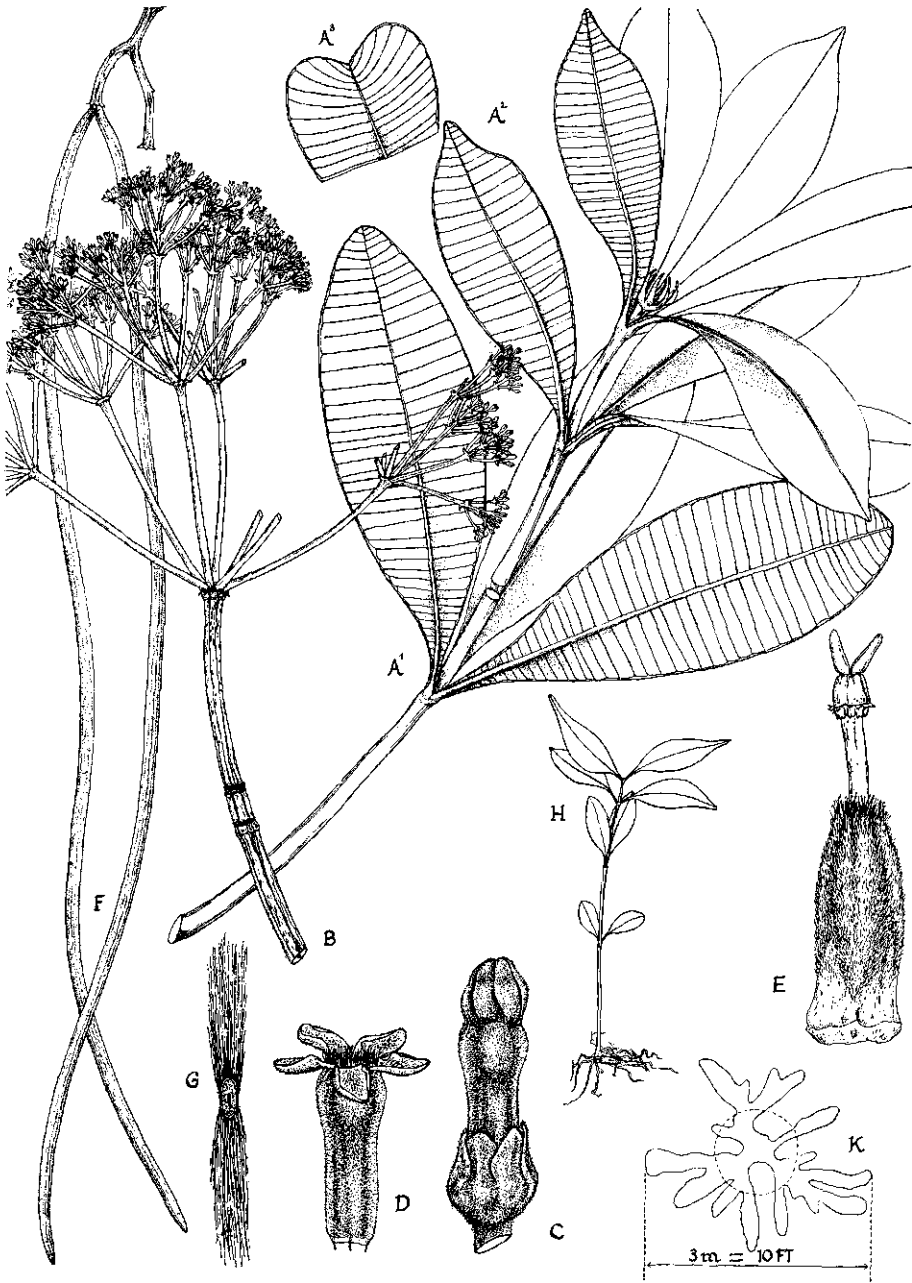


Fig. 2. *Alstonia boonei* DE WILD. A<sup>1</sup>, A<sup>2</sup>: branchlets with leaves ( $\times \frac{1}{2}$ ); A<sup>3</sup>: top of an emarginate leaf ( $\times \frac{1}{2}$ ); B: inflorescence ( $\times \frac{1}{2}$ ); C: flower bud ( $\times 4$ ); D: open corolla ( $\times 4$ ); E: pistil; style with membranous indusium ( $\times 15$ ); F: fruit ( $\times \frac{1}{2}$ ); G: seed ( $\times 1$ ); H: seedling ( $\times \frac{1}{2}$ ); K: cross-section of a tree at 1 metre above the ground (full line), and 7 metres above the ground (dotted circle) ( $\times 1/100$ ).

cuneate. Epicotyl 1–2 cm long. At the first few nodes only opposite leaves. Petiole c. 2 mm long. Blade (narrowly) ovate, 1–3 cm long, 5–8 mm wide, herbaceous. Apex tapering from the middle, bluntly acute; margin entire, decurrent; base cuneate. Midrib and nerves fine. Seedlings wholly glabrous.

TAXONOMICAL NOTES. The genus *Alstonia* L. is most widely distributed in S.E. Asia and on the islands of the Pacific. For Africa the first species of *Alstonia* was described by Engler (Bot. Jahrb., VIII, p. 64, 1887) as *A. congensis*, based on sterile material of a young specimen collected by Naumann in 1874 (Congo). The type description therefore lacks a description of the flower. In 1907 de Wildeman proposed a second species of *Alstonia*, *A. gillettii* (Mission E. Laurent I, p. 507) and in 1914 a third species, *A. boonei* (Fedde Rep., l.c.). According to de Wildeman the difference between the two latter species was that *A. gillettii* had a glabrous inflorescence and ovary, whereas *A. boonei* had a pubescent inflorescence and ovary. Since the material of Engler (*A. congensis*) was sterile, it was impossible to decide whether *A. congensis* had a pubescent inflorescence and ovary or a glabrous one. Monachino (1949, l.c.) published a careful study of the material concerned. Owing to the similarities between the leaves of *A. congensis* ENGL. and *A. gillettii* DE WILD. he concluded that the species were identical. Consequently *A. congensis* ENGL. must be attributed with a glabrous inflorescence and ovary. Since the bulk of the material known from West Africa has a pubescent inflorescence and ovary it belongs to *A. boonei* DE WILD., but it is generally referred to as *A. congensis* ENGL.

In the key to the species, Monachino (1949, l.c. p. 139) uses as last distinctive character between the two species the fact that *A. boonei* has petiolate leaves, with petiole 1–2 cm long, and *A. congensis* sessile or subsessile leaves, with a petiole of less than 5 mm long. Besides the difference in pubescence, *A. boonei* has a corolla tube of c. 6–12 mm long, *A. congensis* one of c. 4–6 mm long. The material from Liberia (cited below) has all the characteristics of *Alstonia boonei* except for the leaves, which are markedly sessile or subsessile. This indicates that intermediate forms exist, as far as the leaves are concerned, and it may be questioned whether the differences between the two taxa are of specific rank. Since these differences are not only expressed in the pubescence of the floral parts and fruits, but also in the size of the corolla, and according to Esdorn & Zohm (1960, l.c.) in the wood anatomy, *A. boonei* is accepted as a distinct species. It should be realised that the leaves are not a reliable criterion for identification. In the F.W.T.A., 2nd ed., l.c., the first key item used to differentiate the two species is the supposed difference between the leaves, which, as demonstrated above, is not valid. The specimen cited from Sierra Leone under *A. congensis* (Gola Forest, Small 712, K!) is sterile and cannot therefore be identified with certainty. However, it must obviously be an *A. boonei*, since *A. congensis* seems to be confined to an area extending from Southern Nigeria to Congo.

The present description and figures of *A. boonei* are based on material, collected in

Liberia: Tapeta area 234, 530, 590; Chien area 638; Bomí Hills 819, 1040; Bong Range 33A, and in the Ivory Coast: Leeuwenberg 2472.

FIELD NOTES. The base of the tree is heavily fluted with narrow, straight, thin, branched butt flares up to 7 m ( $\approx$  24'). The bole has its largest diameter just above the butt flares; below that point one can hardly speak of a bole at all. Figure 2 K shows the cross-section of a large *Alstonia* (col. No. 819) at one metre above the ground; the dotted circle gives the cross-section at a height of seven metres. When young the tree is nearly straight with only one or two narrow, low butt flares. The bole is usually straight and cylindrical up to 27 m ( $\approx$  90') to the first branches. The crown is fairly open, heavily branched, with the branches in whorls, rounded. The bark is yellowish green or grey, dark when wet, rough, 1–2 cm thick, fairly soft, with numerous corky, yellowish brown, scattered lenticels. The slash is rough-granular, ochre yellow, abundantly exuding a white latex. The latex seems to be dangerous to the eyes (Aubréville).

When mature the trees are often damaged by windbreak and decay. They coppice easily from the base when cut or damaged. The leading shoot is not terminal but either formed by one of the lateral branches or by a dormant bud under the uppermost whorl (Eggeling & Harris). The tree is deciduous at the end of the rainy season, before the flowers appear. The flowers are sweetly fragrant. The new leaves appear in November–December. Seen from the ground the leaves may appear digitate. At certain periods of the year they may be 'weeping', i.e. exuding moisture from the leaves (Taylor). The fruits are ripe in January or February. The seeds are dispersed by wind. Collection of the seeds may be difficult because the fruits open on the tree. Taylor states that about 1,000 seeds make one ounce. Seedlings were found in the neighbourhood of the tree about four months after the fruiting season.

*Alstonia boonei* is found all over Liberia, both in the evergreen forest and in the drier forest types. The tree may occur on gentle or even on steep, rocky hill sites, but is most commonly found scattered or in small groups in wet or marshy places, which occasionally may be inundated. This light-demanding, but when young shade-bearing, fast-growing species can often be found in secondary formations.

In the high forest only two trees with opposite leaves, *Funtumia africana* (BENTH.) STAPF and *Funtumia elastica* (PREUSS) STAPF, have a similar abundant white latex flow like *Alstonia*. They are medium-sized trees of the middle story of the forest, and most common in secondary forests. The base of the trunk of *Funtumia* is not fluted, its flowers are in axial inflorescences and its fruits resemble aeroplane propellers. *Funtumia africana* is found all over Liberia, *F. elastica* grows only in the drier regions. The fruits of *F. africana* are c. 20 cm long and thin; the fruits of *F. elastica* are shorter and broader. The latex of *F. elastica* was formerly tapped for rubber; unlike the latex of *F. africana* it feels sticky when rubbed between the fingers.

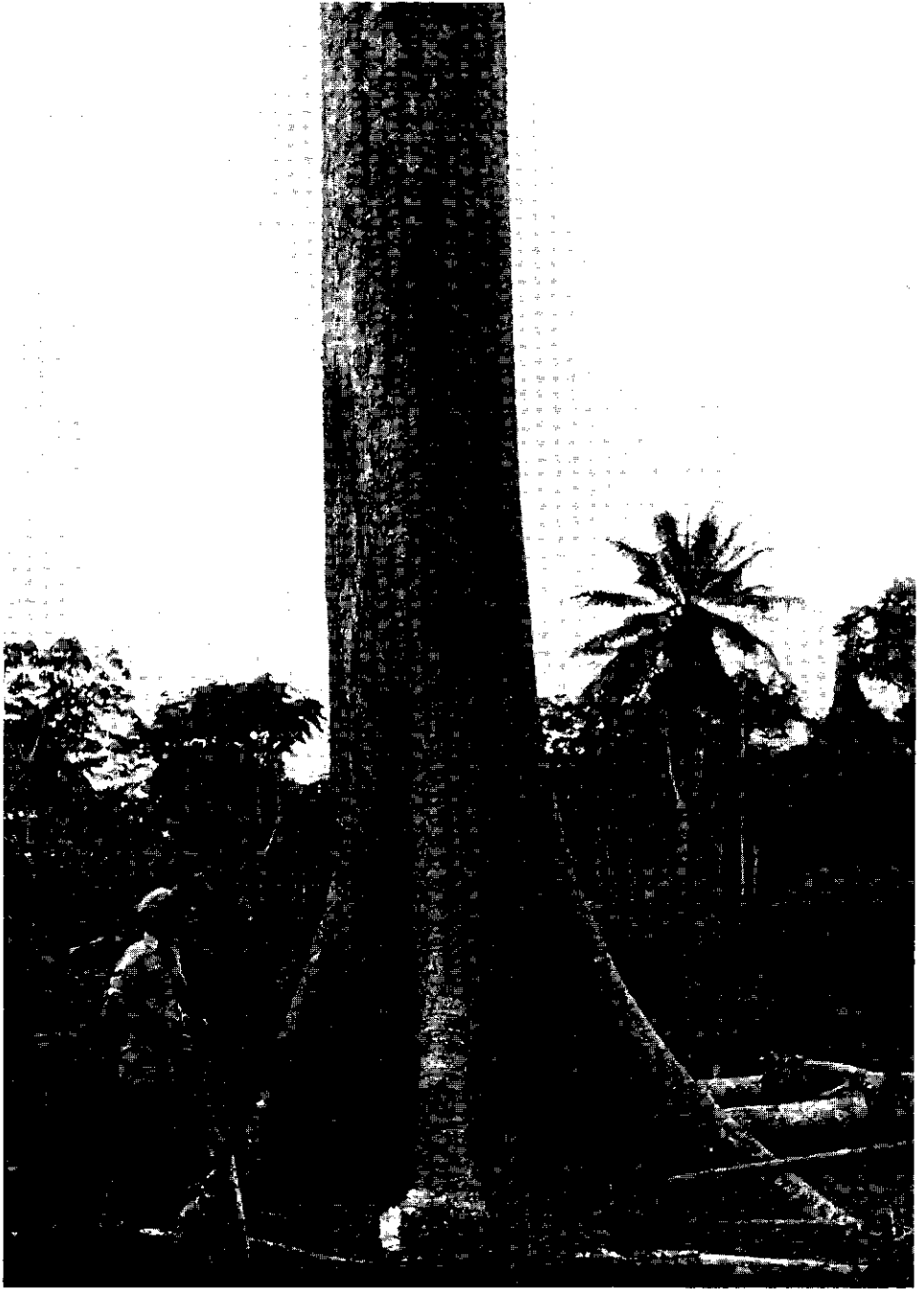
USES. The bark of *Alstonia* contains the alkaloid echitamine and has various medical

applications, viz. malaria, snake-bite etc. The wood is fine-textured, yellowish white, light and soft. It is used for bowls, toys, masks, canoes etc. Export prospects are doubtful; locally it has potentialities, being a light and soft wood: stools, domestic utensils, light carpentry, boxes, wood-wool for packing bananas, matches (?) etc.



1. *Ceiba pentandra* (L.) GAERTN.. Note the prickly bark habit of a young tree (see page 69).





2. *Rhodognaphalon brevicuspe* (SPRAGUE) ROBERTY. Note the heavy buttresses (see page 72).

## BOMBACACEAE

A large family of woody plants, mostly trees but also shrubs and climbers, in all tropics; in Africa only represented by the tribe *Adansonieae*. The *Adansonieae* are characterized by hermaphrodite, actinomorphic, pentamerous flowers. Calyx closed when young, opening irregularly. Petals 5, imbricate, at base adnate to the staminal tube. Stamens 5-∞, more or less united. Anthers with 1-2 or more thecae. Ovary 5-locular; style simple, stigma lobed. Seeds numerous. Fruits dry or fleshy, fusiform, either dehiscent or indehiscent; seeds usually embedded in a woolly tissue, known as kapok.

Trees with digitate leaves, large, coloured flowers and often a spiny stem. Only five species of the family are found in Liberia: *Bombax buonopozense* BEAUV., *Ceiba pentandra* (L.) GAERTN., *Rhodognaphalon brevicuspe* (SPRAGUE) ROBERTY, *Bombacopsis glabra* (PASQ.) A. ROBYNS, and *Adansonia digitata* L.. The latter two species have been introduced to Liberia. *Adansonia*, the Boabab, has its natural habitat in the dry woodland savanna in the larger part of Africa south of the Sahara, belonging to a vegetation type not occurring in Liberia. *Bombacopsis* is probably a South American species, although possibly also an African; its seeds are edible. Both species are found near villages.

*Ceiba pentandra* (L.) GAERTN.

[1, 3/39]

'*Ceiba*': according to Chevalier a name of Spanish origin; also regarded as a Latin form of an American vernacular name.

'*pentandra*': Gr. penta: five; Gr. andros: man; referring to the five stamens of the flower.

Gaertner, *Fructibus et Seminibus Plantarum*, II, p. 244, t. 133 (1791); Bakhuizen v. d. Brink, *Bull. Jard. Bot. Buitenzorg*, ser. III, vol. 6, 2, p. 194 (1924, lit!);

*Bombax pentandrum* LINNAEUS, *Species Plantarum*, 1st ed., I, p. 511 (1753), basionym; type: tab. 50 in Rheede tot Draakenstein 'Horti Malabarici', Vol. III (1682), lectotype;

*Eriodendron anfractuosum* DC., *Prod.*, I, p. 479 (1824); F.T.A., I, p. 213 (1868);

*Bombax guineense* THONN., *Beskr. Guin. Pl.*, II, p. 75, No. 189 (1827);

*Eriodendron guineense* (THONN.) G. DON., *Loud. Hort. Brit.*, p. 292 (1830);

*Ceiba thoningii* A. CHEV., *Rev. Bot. Appliq.*, 17, p. 249 (1937);

*Ceiba guineense* (THONN.) A. CHEV., *l.c.*, p. 261 (1937);

Synonyms on the authority of Bakhuizen v. d. Brink, 1924, *l.c.*

1913: Ulbricht, *Not. Bot. Gart. Berlin*, VI, No. 51, 52

1928: F.W.T.A., 1st ed., I, p. 259

1936: Aubréville, *F.F.C.I.*, 1st ed., II, p. 228

1936: Kennedy, *F.F.S.N.*, p. 70

1937: Dalziel, *U.P.W.T.A.*, p. 118

- 1937: Chevalier, l.c., p. 245–268 (*C. thoningii* + *C. guineense*)  
 1952: R. O. H. Runkel, Pulp from Tropical Woods (lit!)  
 1955: Normand, A.B.C.I., II, p. 105; Pl. XCVIII  
 1958: F.W.T.A., 2nd ed., I, p. 335  
 1959: Aubréville, F.F.C.I., 2nd ed., II, p. 264  
 1959: Kryn & Fobes, Woods of Liberia, p. 27  
 1959: H. G. Harris & B. J. Baker, Journ. W. Afr. Sc. Ass., V, I, p. 1–9  
 1960: Taylor, Syn. Silv. Ghana, p. 107  
 1960: Keay, Nigerian trees, I, p. 235  
 1961: Irvine, Woody plants of Ghana, p. 190–193  
 1963: de Saint Aubin, La Forêt du Gabon, p. 141

LOCAL NAMES: Cotton tree (generally used); gwèh (Gio)

TRADE NAME: Fromager; Ceiba; Cotton wood

GEOGRAPHICAL DISTRIBUTION: in all tropics

**BOTANY.** A large or emergent tree, up to 60 m ( $\approx 200'$ ) high and 2 m ( $\approx 7'$ ) in diameter, often with numerous prickles. Leaves alternate, digitately compound, stipulate, in clusters at the end of the branchlets. Branchlets glabrous; terminal bud covered with bud scales, pubescent outside. Stipules linear, c. 12 mm long, ciliate and stiffly pubescent, early caducous, leaving thin scars on the branchlets. Petiole (3.5–) 8–27 cm long, broadened at the top where the leaflets are attached, glabrous or with a fringe of hairs at the top when young. Leaflets petiolate, 5–9 (15, Ulbricht, l.c.), the central one largest, glabrous, glossy dark green above, lighter beneath. Petiolules 5–15 mm long. Blade narrowly obovate or narrowly elliptic, (3.5–) 11–18 cm long, (1–) 3–5.5 cm wide. Apex acuminate – caudate; margin entire or sometimes slightly dentate, decurrent; base cuneate. Leaflets of seedlings and saplings are sessile and have a serrate margin. Midrib prominent above, but more so beneath. Nerves 11–18 on each side of the midrib, slightly raised above and beneath, curved upwards and looped. Veins conspicuous beneath.

Inflorescences developing in the axils of the leaves which are about to be shed. Flowers in loose or dense axillary clusters, 3– $\infty$  together. Bracts not seen. Pedicel 2–2.5 (–8, Harris & Baker, l.c.) cm long, glabrous. Calyx green, closed in bud, splitting open irregularly with 3–5 lobes, c. 2 cm long, persistent, glabrous outside, silky pilose inside with erect hairs on the lower part and appressed hairs on the upper part. Petals 5, creamy yellow, free but the central part of the claw adnate to the staminal tube, imbricate and 1 cm wide, ovate, c. 2.5 cm long; the claw glabrous, the limb densely silky pubescent outside, glabrous inside, spreading or reflexing at anthesis. Stamens 5, glabrous, connate at base, forming a staminal tube of c. 8 mm long; free part of the filaments c. 2.5 cm long. Anther dorsifixed, with one long, twisted theca, opening lengthwise. Actually each stamen is formed by 1–3 connate stamens, as can be inferred from the lobed and twisted anther. Pistil glabrous. Ovary subinferior, 5-locular, multi-ovulate. Style c. 4 cm long, extending above the stamens at anthesis. Stigma capitate, 5-lobed at base.

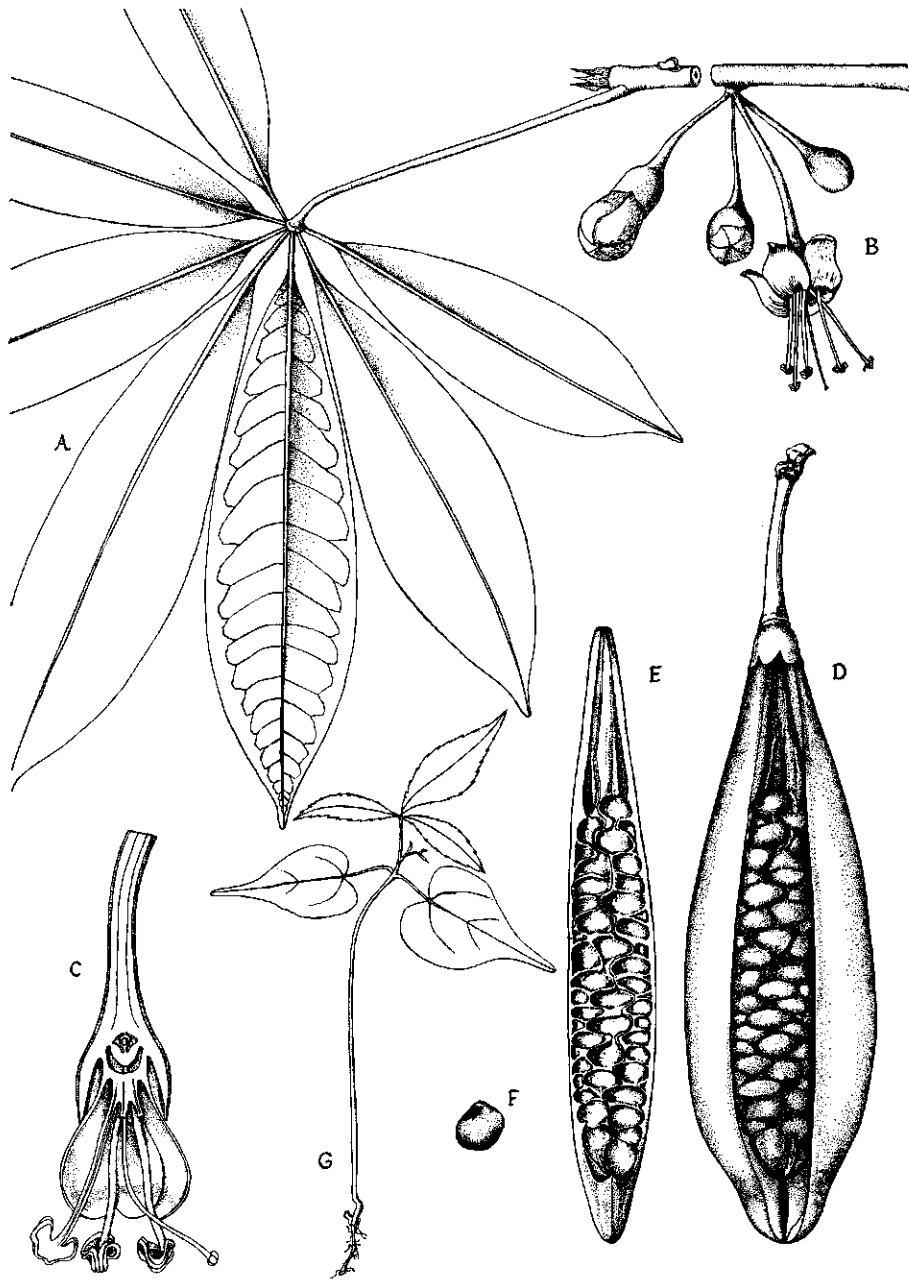


Fig. 3. *Ceiba pentandra* (L.) GAERTN. A: branchlet with leaf ( $\times \frac{1}{2}$ ); B: branchlet with inflorescence ( $\times \frac{1}{2}$ ); C: length section of flower ( $\times 1$ ); D: fruit, one valve removed ( $\times \frac{1}{2}$ ); E: valve of fruit ( $\times \frac{1}{2}$ ); F: seed ( $\times 1$ ); G: seedling ( $\times \frac{1}{2}$ ).

Fruit a stalked, elliptic, green capsule, 10–30 cm long, c. 6 cm thick, opening on the tree with 5 valves or dropping unopened. Seeds numerous, ovoid, c. 5 mm thick, black, embedded in a grey or white kapok, formed by the endocarp.

Seedling: germination epigeal. Hypocotyl 7–8 cm long, glabrous, but sometimes with prickles. Cotyledons foliaceous; petiole 0.8–1.5 cm long; blade broadly ovate, c. 4 cm long, c. 2.5 cm wide. Apex acuminate; margin entire; base broadly rounded – cordate. Venation palmate with 3 conspicuous nerves. Epicotyl 2–3 cm long. Leaves alternate, at first trifoliolate, stipulate. Stipules 2–3 mm long, slender, with a curved apex, ciliate. Petiole 2.5–4 cm long. Leaflets sessile, the central one largest, narrowly elliptic, 4–6 cm long, 1.5–2 cm wide, with a long acuminate apex, serrate margin, and cuneate base. The next leaves have 5 leaflets.

TAXONOMICAL NOTES. Linnaeus (1753, l.c.) described this species as: '*Bombax pentandrum*, foliis digitatis, caule inermis'. There is no type specimen in the Linnaean Herbarium, but Linnaeus referred to various earlier publications, viz. '*xylon foliis digitatis, caule inermis*' in '*Flora Zeylanica*', No. 220, p. 98 (1747), '*xylon caule inermis*' in '*Hortus Cliffortianus*', p. 75 (1737), and Rheede tot Draakenstein's '*Ponja*' in '*Horti Malabarici*', 3, p. 59 (1682). In the *Flora Zeylanica* he explicitly stated that his description was based on Rheede's '*Ponja*', which is accompanied by three illustrations, tabula 49 with the habit of the tree, tabula 50 with a branch with leaves, buds, and flowers, and tabula 51 showing a branch with leaves and fruits. Since Linnaeus gave his species the epithet '*pentandrum*', he must have based this name on tabula 50, which depicts an open flower with five distinct stamens. Consequently this tabula should be taken as the lectotype for *Bombax pentandrum* L., now *Ceiba pentandra* (L.) GAERTN. The descriptive term '*caule inermis*' (unarmed stem) has obviously been used by Linnaeus to differentiate this species from *Bombax ceiba*, which has densely prickled branches (Rheede, l.c., tab. 52), whereas tabula 50 shows no prickles on the branches. The '*xylon caule inermis*' from the *Hortus Cliffortianus* (l.c.) is typified by a seedling (*Herbarium Hortus Cliffortianus*, BM!), which without any doubt is a seedling of *Ceiba pentandra*.

The genus *Ceiba* is restricted to South and Central America except for *Ceiba pentandra*, which is pantropical. This is a strong argument in favour of those who believe that this species originates from America but was long ago introduced into the other tropics along routes, which cannot now be traced. Others believe that it originally came from Africa or S. E. Asia. Certainty in this matter will probably never be reached. Owing to its large distribution area there is a wide variety in the species, which is less expressed in the floral characteristics than in the fruits and the habit of the tree. This variability is also influenced by the fact that *Ceiba* is often cultivated from seeds or stumps. Prolonged selection, for example from trees which at an early stage produce numerous, indehiscent fruits, may have created a type, greatly different from the wild *Ceiba*. This is why so many species have been proposed which, however, are all synonyms of *Ceiba pentandra* (see synonyms), because no satisfactory delineation can be

given. From Africa various forms and varieties are described, largely based on the presence or absence of thorns and on the colour of the kapok, grey or white.

The present description and figures are based on the following material: Loma Nat. For. 747; Nimba area 883, 908; Bopolu Sawmill 940; Gio Nat. For. 239; N. Gio Nat. For. 157; Devilbush, Duport 431; Monrovia 757.

FIELD NOTES. When young, *Ceiba* usually has thick, regular buttresses, which may grow into huge, high, sinuous, branched and wide spreading plank-like buttresses on the mature tree. In the high forest very large trees with only moderate buttress development may also be found. The bole is straight and massive, but not always cylindrical, often rather bulgy, up to 35 m ( $\approx 120'$ ) to the first branches in the high forest, but with a deeper crown on open sites. Crown large, heavily branched and spreading, dome-shaped. The heavy branches are bracketed to the stem; sometimes the spreading branches send up vertical shoots, giving the crown a broom-like appearance. When young the stem is usually covered with sharp prickles which vanish gradually when the tree grows older or only remain on the buttresses and the lower part of the bole. Branches with or without prickles. Bark smooth, green when young, later ashy grey, horizontally striate when young, with vertical rows of lenticels when old, thick, fairly soft and fibrous. Slash pale- or pink-red with broad vertical stripes of softer, white or yellowish tissue (dilatation tissue). Ripple marks may be visible in the cambium. The slash on the buttresses may be darker than on the stem.

The optimal growth area for *Ceiba pentandra* seems to be the deciduous forest, but also in Liberia the tree is very common. It is an extreme light demander and its presence often indicates the secondary character of the forest, or even the site of a long forgotten village, because the tree is often planted or subspontaneous near villages. The tree sheds its leaves irregularly, November – December; new leaves appear in December–January, or after the fruits have been formed. It flowers in the dry season, December–January, on deciduous trees or bare branches. Flowering in the evergreen forest belt seems to be much less regular than in the savanna regions. The unarmed savanna species seem to flower every year, the prickly forest trees once every few years. Anthesis is at night, the flowers open about half an hour after dusk. The petals unfold rapidly and the flowers stay open during the night. The inside of the calyx secretes a nectar which runs off the corolla at anthesis, producing an unpleasant smell. Pollination is effected by bats which visit the flowers in the early evening to lap the nectar. Fertilization can only be effected when the night temperature is above 61 °F. (16 °C.). This seems to be the limiting factor for the distribution of *Ceiba* farther than 16 ° latitude north or south (cf. Harris & Baker, l.c.). The fruits ripen in February–March. Each fruit contains 120–175 seeds; there are c. 5000 seeds/lbs. Seeds can be kept viable for a long time. Seedlings are common on light places, especially where the soil has been disturbed (logging roads, old farms etc.). The tree coppices well and is easy to multiply by stumps from branches.

A tree which resembles *Ceiba* very much is *Bombax buonopozense* BEAUV., which has very similar digitately compound leaves. This tree has prickles on the branches but not on the bole; the buttresses are low but heavy and thick; the bark is grey, smooth, with vertical lines of dark-brown lenticels, thick, soft, and spongy. The slash is light-brown, with V-shaped vertical lines of pinkish white dilatation tissue, slowly turning dark-brown on exposure. During the flowering season the tree is easily recognised by its c. 10 cm large, bright red flowers standing erect on the barren branches.

**USES.** *Ceiba pentandra* is the producer of kapok, a kind of wool used for stuffing pillows and mattresses. The fibres are too smooth to be spun. Production is practically entirely concentrated in Java (Indonesia). The kapok has long, thin-walled fibres filled with air, which are impermeable to moisture. It is therefore very buoyant and used for life-belts, etc. The kapok seems to irritate the nose, so that the tree is unsuitable as a shade tree in towns and cities. In addition the dry kapok is very inflammable. The large spreading roots also tend to damage roads and buildings.

The wood is very light, cream or light-brown but soon attacked by sap-staining fungi. It is coarse with interlocked grain, perishable and moderately resistant to impregnation; it has poor bending qualities. It can be used for crates and boxes, perhaps for paper pulp, and plywood for core. Large trees are often rotten inside or have brittle heart. A possible large-scale industrial utilisation of this species in the future is not unlikely. For numerous local uses, see Irvine, l.c.

***Rhodognaphalon breviscuspe* (SPRAGUE) ROBERTY**

[2, 4/255]

'*Rhodognaphalon*': Gr. rhodon: rose; Gr. gnaphalon: wool; referring to the rose-red kapok of the fruits.

'*breviscuspe*': L. brevis: short; L. cuspis: point; referring to the short-pointed leaflets.

Roberty, Bull. I.F.A.N., 15, p. 1404 (1953); A. Robyns, Bull. Jard. Bot. Bruxelles, 33, fasc. 1 & 2 (revision of the genus *Bombax* L., s.l.); p. 255–258 (1963, lit!);

*Bombax breviscuspe* SPRAGUE, Kew Bull. 1909, p. 306 (basionym); type: Thompson 10, Ghana (K!); Ulbricht, Bot. Jahrb., XLIX, p. 516–546 (1913); A. Robyns, Bull. Jard. Bot. Bruxelles, 27, p. 655–668 (1957);

*Bombax chevalieri* PELLEGRIN, Bull. Mus. Nation. Hist. Paris, XXVII, p. 445 (1921); type: Chevalier 26598 (P!);

*Gossampinus chevalieri* (PELLEGR.) Chesq., Rev. Zool. Afr., XIV, 2, suppl. Bot., p. B 33 (1926).

The name *Bombax breviscuspe* is used in all works quoted below (except the last one).

1928: F.W.T.A., 1st ed., I, p. 258

1931: Cooper & Record, Evergr. For. Liberia, p. 48

1936: Aubréville, F.F.C.I., 1st ed., II, p. 226

1936: Kennedy, F.F.S.N., p. 69

1937: Dalziel, U.P.W.T.A., p. 116

1955: Normand, A.B.C.I., II, p. 106; Pl. XCIX

1958: F.W.T.A., 2nd ed., I, p. 335

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 264

1959: Kryn & Fobes, Woods of Liberia, p. 20

1960: Taylor, Syn. Silv. Ghana, p. 103

1960: Keay, Nigerian Trees, I, p. 234

1960: Holzzentralblatt, Stuttgart, No. 137

1961: Irvine, Woody Plants of Ghana, p. 188

1963: de Saint Aubin, La Forêt du Gabon, p. 142

(*Bombax chevalieri*)

LOCAL NAMES: swa-uh (Gio); ju-eh (Bassa, cf. Cooper, l.c.)

TRADE NAME: Alone

GEOGRAPHICAL DISTRIBUTION: Sierra Leone to Gabon

**BOTANY.** A large forest tree up to 45 m ( $\approx 150'$ ) high and 1.20 m ( $\approx 4'$ ) in diameter. Leaves alternate, digitately compound, stipulate. Twigs with leaves pilose with long brown hairs when young, glabrescent. Stipules linear, c. 8 mm long, densely pilose outside, less so inside, caducous, leaving annular scars on the branchlets. Petiole 2.5–6 cm long, flattened and with long brown hairs above, especially near the base and at the top, only slightly enlarged at the top where the leaflets are attached. Saplings with much longer (up to 17 cm) petioles, glabrous or nearly so (except at the top). Leaflets sessile, usually 7, the central one largest, obovate, 3–8.5 (–10) cm long, 1–3.5 cm wide, glossy dark green above, paler green with a reddish glow beneath. Apex rounded, shortly cuspidate, the very top with a little mucro; margin entire, base narrowly cuneate. Leaflets of saplings narrowly obovate, often larger, up to 14.5 cm long and 4 cm wide, longer cuspidate at the top. Midrib raised above, reddish, sparsely pubescent with long brown hairs; prominent beneath, red, with a few scattered hairs or glabrous. Nerves slightly raised above and beneath, 8–13 on each side of the midrib, looped at some distance from the margin.

Inflorescences axillary, flowers solitary or 2–3 together. Receptacle c. 2 mm long, outside glandular with black glands. Pedicel 0.5–1 cm long, sparsely pubescent. Buds oblong, up to 3.8 cm long. Calyx green, cupuliform when open; calyx tube 12 mm long with about 10 c. 1 mm long lobes, outside sparsely pubescent with minute stellate hairs, the inside long-sericeous, except at the base. Calyx persistent after flowering. Petals 5, free, imbricate, 4–6 cm long, c. 9 mm wide, linear – narrowly oblong; claw at the base adnate to the staminal tube; outside densely covered with long stellate hairs, inside glabrous but near the top sparsely pubescent. Petals reported to be pinkish red (Cooper, l.c.), white (Keay, l.c.) or whitish (Robyns, 1963, l.c.) when fresh. Stamens numerous, c. 200, united at their base to a staminal tube of c. 10 mm length at anthesis; free filaments grouped in c. 5 bundles, 3–4 cm long. Anthers dorsifixed, with one theca, c. 2 mm long, opening lengthwise. Ovary subinferior, glabrous, 5-celled, with numerous ovules. Style dull-red, c. 5 cm long at anthesis. Stigma capitate, c. 2 mm long, 5-lobed at the base.

Fruit a smooth, brown, obovoid capsule, c. 7 cm long, 4 cm in diameter, tapering to the base, rounded or obtuse at the top, opening on the tree with 5 valves, containing numerous seeds, imbedded in a bright coloured, reddish-brown kapok. Valves drop-



ping, leaving a 5-winged central column standing in the persistent calyx, surrounded by the fluffy kapok. Seeds ovoid, pointed at one end, c. 6 mm thick, c. 9 mm long, light-brown.

Seedling: germination epigeal. Hypocotyl 4.5–7 cm long. Cotyledons opposite, short-petiolate, foliaceous. Petiole 2–4 mm long. Blade very broadly ovate, c. 3 cm long, 3.6 cm wide; apex broadly cuspidate; margin entire, decurrent; base broadly truncate. Epicotyl 2.5 cm long. Leaves alternate, stipulate, petiolate, digitately compound with 3 or 5 leaflets. Stipules c. 4 mm long, linear. Petiole of the first leaf c. 2.5 cm long; leaflets sessile, narrowly elliptic, 1.5–3.5 cm long, 3–6 mm wide; apex long acuminate, base long cuneate, margin entire. Seedlings glabrous.

TAXONOMICAL NOTES. *Rhodognaphalon brevicuspe* was first described by Sprague (1909, l.c.) as *Bombax brevicuspe* SPRAGUE. The description was based on material collected in Ghana. Ulbricht (1913, l.c., p. 519) placed this species in the section *Rhodognaphalon*. He characterized this section as having red brown kapok, a smooth inside of the calyx tube and an undivided staminal tube. Roberty (1953, l.c.) elevated the section *Rhodognaphalon* to the rank of genus. This point of view was at first not accepted (Robyns 1957, F.W.T.A. 1958, Aubréville 1959, Taylor, Keay 1960), but in his revision of the genus *Bombax* s.l., Robyns (1963, l.c.) divided the genus in seven genera, one of which is *Rhodognaphalon*. Robyns stated that the inside of the calyx of all *Rhodognaphalon* species is silky with very appressed hairs, contrary to the description in F.W.T.A. (1958), and Keay (1960) (verbal communication).

*Rhodognaphalon* is distinct from *Bombax* on the following points: the trees are unarmed; the flower buds are oblong-linear; the calyx is persistent after flowering; the stamens are in one whorl, grouped in five bundles; the style is undivided; seeds are few and big; the kapok is fairly copious and reddish brown (Robyns 1963, l.c. p. 253). It should be noted that a juvenile specimen with prickles has been observed in Liberia (see field notes). Robyns and Taylor both describe the first leaf of the seedling as having three leaflets; from Liberia they show five leaflets.

Synonyms on authority of Robyns (1963, l.c.). Material on which the present description and figures are based: Gio Nat. For. 251; Bassa No. III 681; N. Gio Nat. For. 206; Chien area 652; Tapeta area 1054; Harley s.n.

FIELD NOTES. In the sapling and pole stage the tree may have prickles. In Gbarnga one tree of 20 cm ( $\approx 8''$ ) in diameter and 8 m ( $\approx 27'$ ) high was observed with numerous blunt, decaying prickles on the stem and branches. When older the tree is unarmed. The base has small buttresses when young, and heavy, thick, transversely striate buttresses when mature, up to 1.50 m ( $\approx 5'$ ) high and 10–20 cm ( $\approx 4-8''$ ) thick. The stem is usually straight and cylindrical, up to 27 m ( $\approx 90'$ ) free of branches. The crown is small and narrow, dark green with slender, spreading, recurved branches. The dark coloured bark sheds small scales when young, the scales leaving shallow or up to 1.5

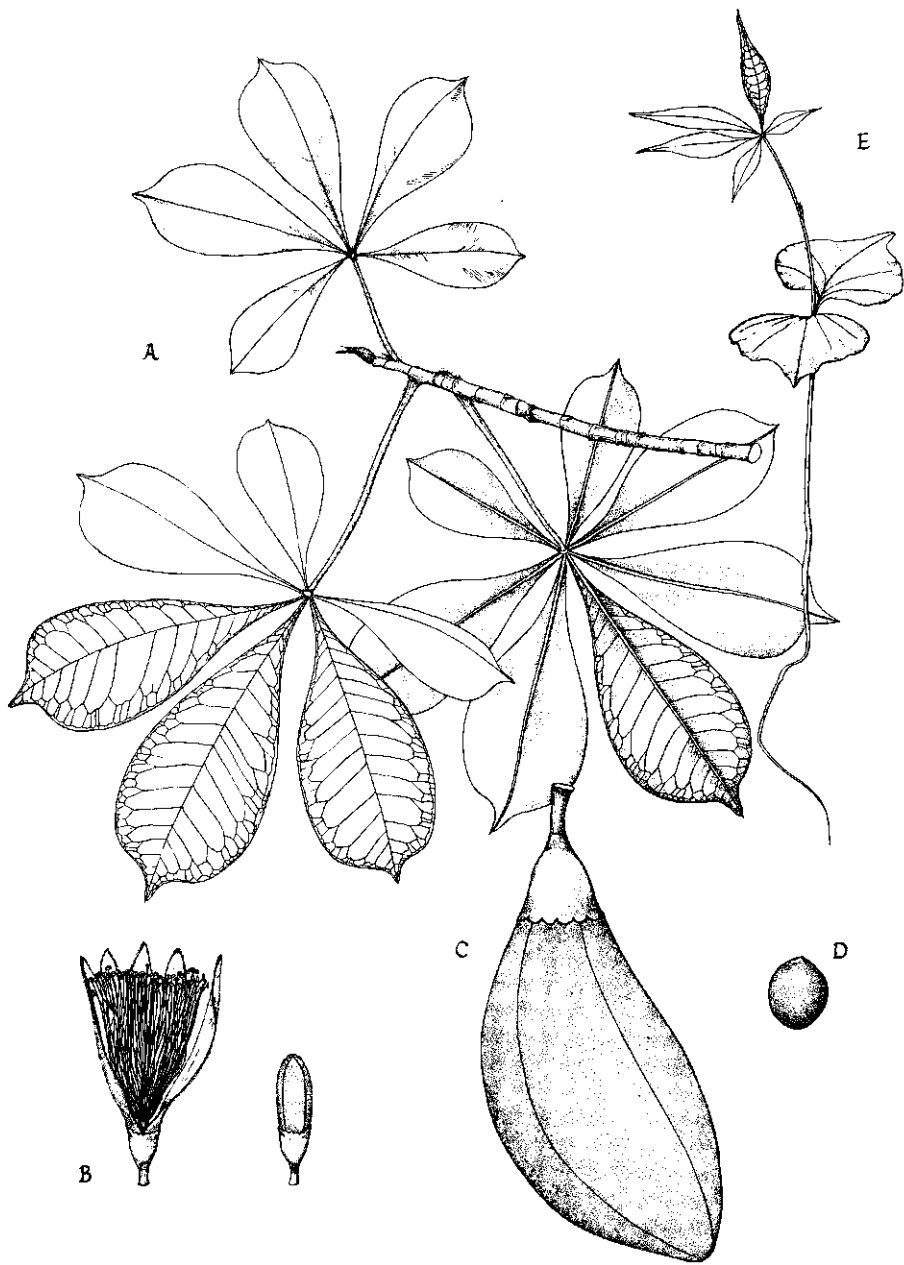


Fig. 4. *Rhodognaphalon brevicuspe* (SPRAGUE) ROBERTY A: branch with leaves ( $\times \frac{1}{2}$ ); B: open flower and bud ( $\times \frac{1}{2}$ ); C: fruit ( $\times 1$ ); D: seed ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ).

cm deep and 2–5 cm long pits in the bark; when the tree is older, the scales are larger, leaving slightly walled, shallow scars. The bark is thick and soft, brittle-fibrous, and can be easily torn off in long strips. The slash on the buttresses is pink with white stripes, on the stem dark purplish red with marked vertical, white-pinkish or red stripes of dilatation tissue. In the cambium ripple marks are conspicuous.

*Rhodognaphalon brevicuspe* grows in the evergreen forest and the semi-deciduous forest. In Liberia it is found throughout the country, scattered through the high forest, less common in the secondary forest. The flowering season is approximately in November, when the tree has shed its leaves. The fruits ripen during February and March; the tree then is marked by its numerous bright brown masses of fluff in the crown. Closed fruits are seldom found under the trees. Seedlings are found in abundance near the mother tree, shortly after the fruiting season.

The slash of *Bombax brevicuspe* slightly resembles that of *Lannea* sp. or *Entandrophragma angolense*, but the conspicuous ripple marks are diagnostic.

**USES.** Locally a red brown dye is prepared from the bark and the tree may be used for canoes.

The sapwood is wide and nearly white, the heartwood bright red when fresh, brown-red to brown-violet when dry. Growth rings are visible owing to the increased density of the pores. The wood is straight-grained, medium soft and readily workable with sharp tools. It is easily stained blue and liable to insect attack. It has at present no industrial value.

## BURSERACEAE

A large family, found in the tropics and subtropics, in rain forests and in dry areas. Large trees or shrubs, often deciduous, sometimes spiny, and secreting aromatic oil or resin. Leaves alternate, usually pinnately compound; stipules rarely present, rachis often winged. Flowers unisexual or rarely hermaphrodite, actinomorphic. Sepals and petals present, 3–5; sepals more or less connate at base, petals usually free. Disc present, annular or cup-shaped. Stamens the same or double the number of petals; filaments free, but at the base adnate to the disc; anthers 2-celled, opening lengthwise. Pistil 1; ovary superior, 2–5 celled, each cell with 2 ovules. Stigma usually lobed. Fruit a 1–5 seeded berry.

In West Africa this family is represented by five genera only, three of which are reported from Liberia, each by a single species. Not discussed below is *Santiria trimera* (OLIV.) AUBRÉV., a small understory tree, mostly in the coastal forest belt, but also found in the hinterland, with stilted roots, a strongly scented slash, and flattened, dark purplish-black, edible fruits. It is easily distinguished from *Xylopia staudtii* by its pinnately compound leaves.

### *Canarium schweinfurthii* ENGL.

[3, 5/123, 262]

'*Canarium*': originally a Malayan vernacular name, 'kanari'.

'*schweinfurthii*': referring to G. A. Schweinfurth, a German explorer and scientist (1836–1925), the collector of the type specimen.

Engler in DC. Mon. Phan., IV, p. 145 (1883); type: Schweinfurth 3324, Sudan (K!); *ibid.* in Bot. Jahrb., XV, p. 99 (1892); *ibid.* in Nat. Pfl.fam., 2nd ed., 19a, p. 446 (1931); Leenhouts in Blumea IX, 2, p. 382 (1959) (a revision of the genus *Canarium* L.).

*Canarium chevalieri* GUILLAUMIN in Mem. Soc. Bot. France, 8, p. 33, 34 (1908);

*Canarium thollonicum* GUILLAUMIN in Bull. Soc. Bot. France, 55, p. 266, 267 (1908);

*Canarium velutinum* GUILLAUMIN, l.c., p. 267;

*Canarium occidentale* A. CHEVALIER, Vég. Util., 5, p. 145 (1909).

1928: F.W.T.A., 1st ed., I, p. 487

1931: Cooper & Record, Evergr. For. Liberia., p. 89

1936: Aubréville, F.F.C.I., 1st ed., II, p. 107, 108

1936: Kennedy, F.F.S.N., p. 154

1937: Dalziel, U.P.W.T.A., p. 315

1941: Harley, Native African Medicine, p. 52, 53, 58, 87

1951: Eggeling & Dale, Indigenous Trees Uganda, p. 51

1955: Normand, A.B.C.I., II, p. 61; Pl. LXXXVII

1956: Handbook of Hardwoods, p. 64

1958: F.W.T.A., 2nd ed., I, p. 697

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 107

1959: Kryn & Fobes, Woods of Liberia, p. 26

1960: Taylor, Syn. Silv. Ghana, p. 112

1961: Irvine, Woody Plants of Ghana, p. 508–510

1963: de Saint Aubin, La Forêt du Gabon, p. 44

LOCAL NAMES: beeng (Gio); bi (Mano, cf. Harley); potu (Krahn); goe-kwehn (Bassa, cf. Cooper)

TRADE NAME: Aiélé; 'white mahogany' (name often used at local sawmills)

GEOGRAPHICAL DISTRIBUTION: Guinea to Ethiopia, Tanganyika, and Angola

**BOTANY.** A large, deciduous tree. Young branches with new leaves rusty pubescent, glabrescent. Shed leaves leaving marked scars. Leaves clustered at the end of the branchlets, imparipinnate, alternate, stipulate, 8–12 jugate, 15–60 cm long or longer (110 cm, teste Leenhouts). Stipules inserted on the petiole at 2–5 cm from its base, together with the broadened basal part of the petiole enclosing the terminal bud, usually early caducous, leaving a marked scar on the petiole, or sometimes still partially present. Petiole 5–10 cm long, flattened above and winged at the base up to the stipule scars, increasingly terete, rather densely pilose-pubescent, as is the rachis. Petiolules usually pilose-pubescent, 2–5 mm long, (5–) 15–18 mm for the terminal leaflet. Blade (4–) 6.5–30 cm long, (1.5–) 3–5 cm wide, proximal pairs smaller, (narrowly) ovate; distal pairs and terminal leaflet larger, (narrowly) oblong (rarely obovate). Leaflets opposite or nearly so, sparsely pubescent on midrib, nerves, and veins above, densely pilose – pubescent on midrib and nerves beneath. Base often unequal-sided, rounded – cordate, the terminal leaflet sometimes cuneate; margin entire; apex gradually or abruptly acuminate, acumen 1–1.5 cm long. Midrib and nerves slightly raised above, prominent beneath. Nerves (12–) 15–20 (–24) pairs, straight or curved upwards, at right or sharp angles with the midrib, usually not distinctly looped. Leaves of saplings and pole-stage trees longer, densely pilose; leaflets much larger, up to 30 cm long and 10 cm wide, with a slightly serrate margin.

Inflorescences in the axils of the leaves, racemose, minutely greenish pubescent, unisexual, 12–27 cm long. Male bracts ovate, up to 15 mm long, 8 mm wide, female bracts broadly ovate, c. 7 mm long, 6 mm wide. Pedicels up to 5 mm long. Flowers creamy white. Sepals 3, valvate, densely minutely tomentose outside and inside, ovate, with rounded apex; in the male flower c. 6 mm long, connate at the base for 1–2 mm; in the female flower c. 8 mm long, halfway connate, persistent and accrescent on the fruit. Petals 3, imbricate, minutely tomentose outside, glabrous inside, ovate, c. 10 mm long, apex rounded, with a little mucro. Stamens 6, anthers with a little mucro; in the male flower glabrous, c. 7 mm long, at the base for c. 2 mm adnate to the side of the disc (androphore); free filaments c. 3 mm long; anthers c. 2 mm long, introrse, basifixed, slightly bilobed at base, with two thecae, opening lengthwise. In the female flower stamens reduced, inserted on and between the lobes of the disc, filaments c. 1 mm, anthers



Fig. 5. *Canarium schweinfurthii* ENGL. A: branch with leaves ( $\times \frac{1}{2}$ ); B: infructescence ( $\times \frac{1}{2}$ ); C: part of male inflorescence ( $\times 1$ ); D: male flower, perianth partially removed ( $\times 2$ ); E: part of female inflorescence ( $\times 1$ ); F: female flower, perianth partially removed ( $\times 2$ ); G: cross-section of a fruit ( $\times 1$ ); H: nut ( $\times 1$ ); K: seedling ( $\times \frac{1}{2}$ ).

c. 1 mm, sterile, with some bristles on the thecae. Disc intrastaminal, in the male flower obconical, c. 2 mm high, thick, pubescent on top, carrying a pistillode in the centre; in the female flower sheath-like, 6-lobed, c. 2 mm high, glabrous, carrying the stamens. Pistil in the male flower as a pistillode on the centre of the disc; in the female flower complete, glabrous. Ovary c. 2 mm long, slightly 6-lobed, 3-locular, each locule with 2 ovules. Style stout, c. 1.5 mm long; stigma c. 1 mm, 3-lobed.

Infructescences with up to 12 fruits. Persistent calyx campanulate, with 3 bluntly triangular lobes. Ripe fruit a purplish, ellipsoid or obovoid drupe, round on cross-section, c. 1.5 cm through and c. 3 cm long, containing a fusiform, stone-hard nut, c. 2.5 cm long and 12 mm thick, rounded triangular on cross-section, acutely 6-ribbed near the apex. Each nut 3-celled, only one cell with one developed seed; sterile cells moderately reduced. Fleshy part of the fruit c. 2 mm thick, containing oil.

Seedling: germination epigeal. Hypocotyl 4–7 cm long, glabrous at base but increasingly pubescent. Cotyledons palmatipartite with 5 lobes, the two outer incisions reaching over 2/3 of the leaf, the two central ones nearly reaching the base. The lobes narrowly elliptic, 2–5 cm long, 2–5 mm wide, acute at the apex and with entire margin. Petiole c. 2 mm long, white-pubescent. Epicotyl 1–1.5 cm, whitish pubescent. First two leaves simple, opposite or subopposite, estipulate, rusty pubescent, especially on the midrib and nerves. Petiole 1–2 cm long. Blade ovate, 4–5 cm long, 2–2.5 cm wide, apex acute, margin dentate, base rounded-subcordate. Midrib prominent beneath. The following leaves alternate, gradually larger, the 7th or 8th trifoliolate etc. Leaves and stem densely pubescent.

**TAXONOMICAL NOTES.** The genus *Canarium* L. is widespread in S.E. Asia and tropical Australia (c. 70 species), but on the mainland of Africa only two species occur: *C. madagascariense* ENGL. in East Africa and *C. schweinfurthii* ENGL. in West and Central Africa.

The first description of the latter was published by Engler (1883, l.c.) without a description of the flower. This and the wide distribution area were the reasons why Guillaumin and Chevalier proposed various species, which afterwards turned out to be synonymous with *Canarium schweinfurthii*. An extensive study of the genus *Canarium*, including the species *C. schweinfurthii*, has been published by Leenhouts (1959, l.c.), on whose authority the synonyms are accepted.

The present description and drawings are based on material collected in Liberia: Bomi Hills 849; Bopolu 939 A; Bong Range 1181; Nimba area 1069; N. Gio Nat. For. 203; Gbi Nat. For. 570; Chien area 622; Putu area 307, 808, 1012, de Wilde 3708; Ganta, Harley s.n.

**FIELD NOTES.** *Canarium schweinfurthii* is a tree of the upper canopy of the forest, sometimes even emergent, up to 50 m ( $\approx$  160') high and 1.50 m ( $\approx$  5') in diameter, rarely up to 1.80 m ( $\approx$  6'). The base of the young tree is swollen or provided with low, thick,

spreading root swellings; when old these root swellings develop into heavy root ridges, up to 40 cm ( $\approx 16''$ ) thick, reaching as high as 90 cm ( $\approx 3'$ ) on the bole and often spreading in sinuous curves far from the tree, partially above the ground. Above the root swellings the bole is straight and cylindrical, up to 30 m ( $\approx 100'$ ) free of branches when fully mature. The crown, abruptly spreading from the end of the bole, is heavily branched and rounded, not very dense, and characterized by the tufts of leaves at the end of the branchlets. The bark is yellowish brown or light grey brown, sometimes longitudinally flaky or scaly, sometimes weathering on the tree, often yellowish on the spreading surface roots, c. 1 cm thick, rather hard and fibrous. The slash is light brown and has a strong turpentine smell. A grey, inflammable resin exudes slowly from the slash wound, forming large clumps of solidified resin at the base of the tree.

*Canarium schweinfurthii* is found in the evergreen forests, the semi-deciduous – and the gallery forests. In Liberia it is found throughout the country on various sites, from the border of swamps to steep rocky hills, but it prefers well-drained slopes. It is rather common in the high forest areas; values of 20–30 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile have been recorded.

The tree is deciduous in the first half of the dry season, October–January. The flowering season is from February–May. Fruits may be found from August–December. The seeds contain oil and are attractive to forest animals; empty nuts are often found under the tree. Despite this regeneration is usually common, especially on cleared sites such as logging roads, wind-throw areas and newly established farms.

At a distance the mature *Canarium* resembles *Entandrophragma utile* owing to the similar crown with tufted leaves, but the absence of buttresses and the smell of the slash are diagnostic. A young *Canarium* might be confused with *Dacryodes klaineana*, but the bark of the latter is very thin and the leaves are not clustered.

**SILVICULTURE.** Although the commercial future of *Canarium* is still doubtful, a few planting trials have been made. There are 160–270 seeds per pound (360–600/kg). The seeds remain viable for over two years. Germination is around 40%; it is advisable to let the seeds rot for some time before planting. Seedlings can also be collected in the forest, especially when the undergrowth below a mother tree has been cleared in advance. Planting is done with stumps or with saplings in baskets. Initial growth is fast, but no side branches are formed before the third year. This makes it necessary to mix the plantation with other species which will cover the ground, thus preventing dense weed growth. The young stems of *Canarium* are covered by a dense pubescence which is eaten by ants, but this does no harm to the plant.

**USES.** The resin of *Canarium* is used for candles, flares, and torches. It burns freely, giving off a black smoke. The soot is used for tattooing (cf. Cooper). The fruits are edible. An infusion of boiled bark is considered efficacious for the removal of intestinal parasites. The resin is sometimes eaten in small amounts as an antidote for gonorrhoea.



Leprosy: the inner bark is ground in a mortar and mixed with water, rubbed on the skin and dropped in ulcers twice daily. The patient is forbidden to eat catfish and sexual intercourse is taboo. A cure is promised within a year (cf. Harley). The bark may be used for the coagulation of *Funtumia* rubber.

The sapwood is up to 10 cm ( $\approx 4''$ ) wide, nearly white. The heartwood is pinkish – light brown. The wood is light and fairly soft, not very strong, Sp. G. c. 0.50. The texture is rather coarse, the grain straight or interlocked. Quarter-sawn timber gives a decorative striped figure; the wood has a satiny lustre. In Liberia it is used for furniture, but owing to its severe dulling effect on tools it is not very suitable for interior work, joinery and construction. The wood is perishable, likely to be stained and attacked by *Ambrosia* beetles or termites. It is extremely resistant to impregnation. In Europe it is sometimes used as core veneer and this might create a possible export market, as *Canarium* is fairly common in Liberia.

*Dacryodes klaineana* (PIERRE) H. J. LAM

[6/79, 123]

'*Dacryodes*': Gr. dakruon: tear, or also: everything produced in drops; referring to the resin, exuding in drops from the slash.

'*klaineana*': referring to Klaine (1842–1917), the collector of the type specimen, a Catholic father who spent 45 years in Gabon.

H. J. Lam, Bull. Jard. Bot. de Buitenzorg, ser. III, vol. 12, p. 336 (1932);

*Santiriopsis? klaineana* PIERRE, Bull. Soc. Linn. Paris, p. 1282 (1897), basionym; type: Klaine 230, Gabon (P!);

*Pachylobus klaineanus* (PIERRE) ENGLER in Bot. Jahrb., XXVI, p. 366 (1899);

*Pachylobus barteri* ENGLER, l.c.; type: Barter 1775 (K!);

*Pachylobus afzelii* ENGLER, l.c.; type: Afzelius s.n. (?);

*Dacryodes barteri* (ENGL.) H. J. LAM, l.c.;

*Dacryodes afzelii* (ENGL.) H. J. LAM, l.c.;

*Sorindeia deliciosa* A. CHEV. ex HUTCHINSON & DALZIEL in Kew Bull. 1929, p. 27; type: Chevalier 22638 (K!, P!);

*Haematostaphys deliciosa* (A. CHEV. ex HUTCH. & DALZ.) PELLEGRIN in Bull. Soc. Bot. France, 78, p. 441 (1931);

*Pachylobus deliciosus* (A. CHEV. ex HUTCH. & DALZ.) PELLEGRIN, l.c., 80, p. 714 (1934);

*Pachylobus paniculatus* HOYLE in Kew Bull. 1934, p. 187; type: Vigne 2535, Ghana (K!).

1928: F.W.T.A., 1st ed., I, p. 487 (*P. barteri* +  
*P. afzelii*)

1936: Aubréville, F.F.C.I., 1st ed., II, p. 110 (*P.*  
*deliciosus*)

1948: Bois & For. Trop., p. 342, 400

1955: Normand, A.B.C.I., II, p. 61; Pl. LXXVII

1958: F.W.T.A., 2nd ed., I, p. 696 (+ *D. afzelii*)

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 140

1959: Kryn & Fobes, Woods of Liberia, p. 39

1961: Irvine, Woody Plants of Ghana, p. 511

LOCAL NAMES: zeon (Gio); 'monkey plum' (general use)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone to Gabon

**BOTANY.** A medium-sized, rarely large, evergreen forest tree. Young branches densely rusty pubescent with minute stellate hairs. Leaves alternate, impari- or, through reduction, paripinnately compound with (2–) 3 (–4) pairs of leaflets and an odd one, 15–30 cm long, estipulate. Leaves of young trees with more pairs and longer (–60 cm). All parts of the leaf densely rusty stellate-scaly puberulous when young, glabrescent or, especially on the petiole, rachis and midrib with persistent hairs. Leaflets glossy, dark green above, paler beneath. Petiole 2.5–6.5 cm long, slightly flattened above or terete, sometimes with faint lateral ridges near the base, often jointed at the top. Rachis 2–8 cm long. Leaflets opposite, petiolules markedly jointed at the top, (0.2–) 0.8–1.4 cm long, 1–2.2 cm for the terminal leaflet. The lowest pair smaller and with shorter petiolules than the others; the second and third pair about equal in size or the third one smaller; terminal leaflet equal in size or smaller than the leaflets of the third pair. Leaflets widest below or about the middle, obliquely (narrowly) elliptic to (narrowly) ovate, 4.5–18.5 cm long, (1.5–) 2–6.5 cm wide; usually unequal-sided, the distal side distinctly broadened and rounded or broadly cuneate at base, the proximal side narrower, cuneate; margin entire; apex acutely or abruptly caudate, tip 0.5–1.5 cm long. Midrib and nerves slightly raised above, prominent beneath; nerves 6–12 pairs, markedly looped.

Inflorescences terminal, less commonly axillary, paniculate, 10–22 cm long, densely rusty stellate-scaly puberulous, bearing hermaphrodite flowers solitary or in few flowered fascicles and male flowers in fascicles. Flowers pale creamy. Bracts small, caducous. Pedicels 2–4 mm long. Sepals 3, c. 2 mm long, valvate in bud, shortly connate at base, broadly ovate, densely stellate-scaly puberulous outside, glabrous inside. Petals 3, c. 4 mm long, valvate in bud, free, ovate, densely stellate-scaly outside, papillate inside. Stamens 6, at the base adnate to the outside of the disc. Filaments minutely puberulous (papillate?), c. 1.5 mm long; anthers introrse, dorsifixed, papillate, truncate at base and apex, with 2 thecae. Disc intrastaminal, annular, swollen, 0.5 mm thick, glabrous, slightly lobed. Pistil much reduced in the male flower, complete in the female or hermaphrodite flower. Ovary densely stellate-scaly, 2-locular, c. 1.5 mm long. Style c. 1 mm long, compact, glabrous; stigma flattened, not lobed, truncate, glabrous.

Fruit an ovoid berry, c. 2 cm long and 1.5 cm thick, slightly pointed at the top, slightly laterally flattened, orange when ripe, with fleshy, fragrant, edible pulp ('monkey plum'), containing one nut. Nut thin-walled, hard-coriaceous, c. 1.8 cm long, 1.2 cm thick, ellipsoid, one side deeply grooved from base to top; one locule, containing one seed.

**Seedling:** germination epigeal. Hypocotyl 5–8 cm long, puberulous with simple hairs. Cotyledons spreading, thick coriaceous, palmatipartite with 5 lobes, sparsely puberulous at the base only. Lobes c. 1.5 cm long, 5–8 mm wide; base cuneate, apex acute. All parts above the cotyledons stellate puberulous. Epicotyl 2.5–3.5 cm long. First two

leaves opposite, simple, shortly petiolate. Blade ovate, c. 6 cm long and 2.5 cm wide. Base rounded; apex bluntly acuminate; margin entire.

TAXONOMICAL NOTES. The genus *Dacryodes* was first described by Vahl (1810, Skrift. Dansk Naturhist. Selsk. IV, p. 116). The name *Pachylobus* was first proposed for this genus by G. Don (1832, Gen. Syst. Gard. & Bot. II, p. 89), and the fact that *Dacryodes* has priority over *Pachylobus* has long been overlooked. This is why the African species of the genus have often been described as *Pachylobus* (see synonyms).

Lam (1932, l.c.) re-established the name *Dacryodes*, referring more than 30 species to this genus, and it appears that two species occur in tropical America, perhaps 19 in Africa and 13 in Asia; one species only is known at present from Liberia: *Dacryodes klaineana* (PIERRE) H. J. LAM. This species was first published as *Santiriopsis? klaineana* by Pierre (1897, l.c.), but transferred by Engler (1899, l.c.) to *Pachylobus* and finally referred to *Dacryodes* by Lam (1932, l.c.). Owing to its variable leaf morphology and, probably, a scarcity of complete material, several other species have been proposed, which proved to be synonymous with *D. klaineana*.

In the F.W.T.A., 2nd ed., 1958, I, p. 697, *Dacryodes afzelii* ENGL. is cited as an imperfectly known species of which the type specimen does not seem to be traceable. According to Engler's description of *Pachylobus afzelii* and *P. barteri* (= *D. klaineana*), the difference between *D. afzelii* and *D. klaineana* is based on minor leaf characters. Engler only saw fruits of the first species and flowers of the second (1899, l.c.).

The variation in the leaves of the Liberian collections completely covers the differences as described by Engler for the two species concerned. It therefore seems most likely that *Dacryodes afzelii* (ENGL.) H. J. LAM and *Pachylobus afzelii* ENGL. are also synonymous with *Dacryodes klaineana*.

The present description and drawings are based on the following specimens: Bomi Hills 136A, 836, 1018; Mtn. Coffee 471; Gbarnga 511; Chien area 630; Tapeta area 1229; Nimba area 887.

FIELD NOTES. *Dacryodes klaineana* occurs in Liberia most commonly as an understory tree of 30–60 cm ( $\approx$  1–2') in diameter and up to 25 m ( $\approx$  80') high. The pronounced caudate apex (drip-tip) of the leaflets indicates that the tree belongs to the B- or C-story of the forest, of which it may form a substantial part locally. Drip-tips are rare in the A-story of the forest. Sometimes a tree is found up to 90–1.20 m ( $\approx$  3–4') in diameter and 30 m ( $\approx$  100') high, as an A-story tree, for example in the single dominant forests of *Monopetalanthus compactus* in the Putu area.

The base of the tree is swollen with low root swellings or root spurs rarely higher than 60 cm ( $\approx$  2'), and markedly transversely striate, coiled or wrinkled, sometimes extending in widespread surface roots. The stem is usually straight and slightly angular on the lower part; the upper part is often twisted and soon branched. Very large specimens often have a hollow bole. The crown is narrow, rounded and dense. The thin

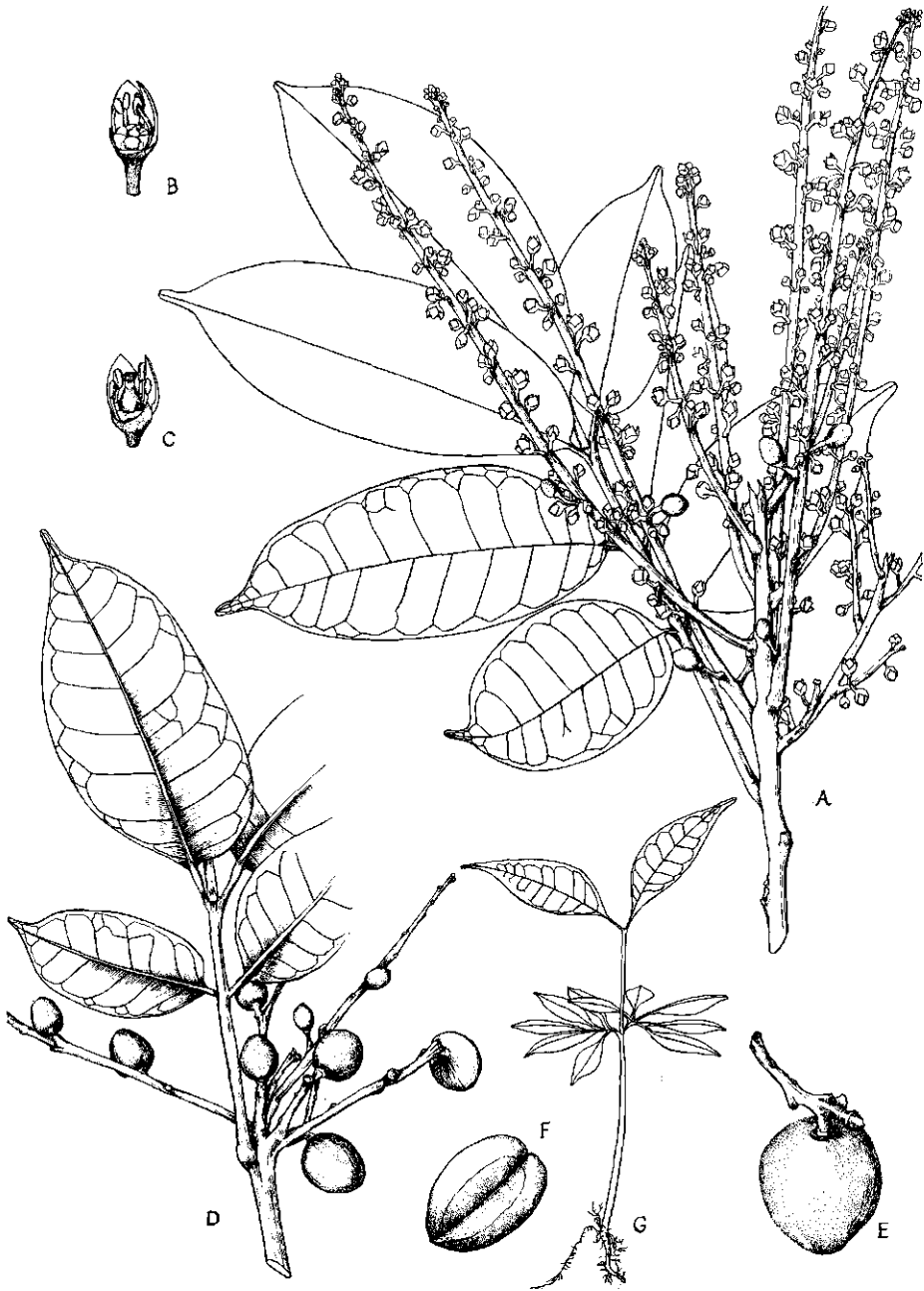


Fig. 6. *Dacryodes klaineana* (PIERRE) H. J. LAM A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: male flower, part of the perianth removed ( $\times 2$ ); C: female flower, part of the perianth removed ( $\times 2$ ); D: branch with leaf and infructescence ( $\times \frac{1}{2}$ ); E: fruit ( $\times 1$ ); F: nut ( $\times 1$ ); G: seedling ( $\times \frac{1}{2}$ ).

bark is grey-greenish or blackish, very scaly with irregular scales, leaving yellowish marks after being shed, giving the tree a 'patchy' habit. The slash is brittle outside, somewhat fibrous inside, pink brown or red brown, strongly fragrant (slightly like turpentine), and watery or slowly exuding a gummous liquid. Sometimes the bark may be fissured, but in this case the fissures are also noticeable as grooves in the wood under the cambium.

The tree flowers at the beginning of the dry season, October–November. The fruits are ripe in January–February. At that time the forest floor under the tree may be littered with the fruits of which the pulp has been eaten by small mammals. Seedlings were found in abundance under the tree during April.

**USES.** The wood is hard and heavy, difficult to work. The sapwood is thick, and marketable logs are mostly defective inside. In no way this species can be compared with *Dacryodes buettneri* (ENGL.) H. J. LAM, which is found in Gabon, and which produces a very good timber, Ozigo.

It is stated in 'Woods of Liberia' (Kryn & Fobes, 1959, l.c.) that 'it is considered promising for future specialized foreign or domestic use', but its future as a timber does not seem very promising.

## COMBRETACEAE

A pantropical family of trees and shrubs, often lianas. Leaves simple, alternate or opposite, estipulate, pinnately nerved. Inflorescences spikes or racemes. Flowers actinomorphic, hermaphrodite or unisexual. Sepals 4–5 (6); petals 4–5, sometimes connate at base, sometimes absent. Stamens 2–5, or twice the number of sepals. Disc present. Ovary inferior, 1-celled. Style 1. Fruit often winged, with only 1 seed.

With the exception of the species discussed below the following trees are recorded from Liberia: *Terminalia catappa* L., a native of India but commonly planted and sub-spontaneous. The seeds are edible (almond tree). *Strephonema pseudocola* A. CHEV., an understory tree of the rain forest, which, when wounded, exudes a copious, translucent jelly from the bark. The fruits are not winged, the seeds resemble Kola. *Pteleopsis hylodendron* MILDBR., a tree resembling *Terminalia ivorensis*, which may attain 1.20 m ( $\approx 4'$ ) in diameter. It is very rare in the evergreen forest and grows sporadically in the semi-deciduous forest. From Liberia it is only reported West of the Putu Range.

The genus *Terminalia* L. is widespread with numerous arborescent species in the savanna regions south of the Sahara, but in the rain forest belt along the Gulf of Guinea only the following two species are found: *Terminalia ivorensis* A. CHEV. and *Terminalia superba* ENGL. & DIELS.

*Terminalia ivorensis* A. CHEV.

[4, 7 A-D, 8 G/170, 352]

'*Terminalia*': referring to the leaves of *Terminalia catappa* L. which are clustered in terminal tufts.

'*ivorensis*': referring to Ivory Coast where Chevalier collected the type specimen.

A. Chevalier, Vég. Util., 5, p. 152 (1909); type: Chevalier 16153 (K!); M. E. Griffith, Journ. Linn. Soc. London, Bot., Vol. LV, No. 364, p. 876 (1959): A revision of the African species of *Terminalia* L..

1927: F.W.T.A., 1st ed., I, p. 224

1931: Cooper & Record, Evergr. For. Liberia p. 35, 36 (as *T. superba*)

1933: Chalk, Burt Davy, Twenty W. Afr. Timber Trees, p. 35

1936: Aubréville, F.F.C.I., 1st ed., III, p. 56

1936: Kennedy, F.F.S.N., p. 45

1937: Dalziel, U.P.W.T.A., p. 81, 82

1945: Kinloch, Silv. Notes Gold Coast Trees, p. 3–5

1954: F.W.T.A., 2nd ed., I, p. 279

1959: Aubréville, F.F.C.I., 2nd ed., p. 69

1959: Kryn & Fobes, Woods of Liberia, p. 111–113

1960: Normand, A. B. C. I., III, p. 45; Pl. CXXXVI

1960: Taylor, Syn. Silv. Ghana, p. 153

1960: Keay, Nigerian Trees, I, p. 153

1961: Irvine, Woody Plants of Ghana, p. 133

LOCAL NAMES: bai (Mano); bai-ti (Gio); blie (Krahn); baye (Bassa, cf. Cooper); bajj (Mendi)

TRADE NAME: Framiré; Black Afara

GEOGRAPHICAL DISTRIBUTION: Guinea – Cameroon

**BOTANY.** A large tree of the high and secondary forest. Young branchlets rusty brown tomentellous, glabrescent. Leaves simple, alternate, in tufts at the end of the branchlets, tomentellous when young on petiole, rachis and nerves, glabrescent, shiny, medium green above, paler beneath, coriaceous. Petiole 0.7–1.5 cm long, slender. Blade (narrowly) obovate, 5–10 (–15) cm long, 2.5–4.5 (–6) cm wide, gradually tapering to the cuneate and slightly decurrent base, rounded or shortly and abruptly acuminate at the apex; margin entire, slightly revolute when dry. Midrib and nerves impressed above, prominent beneath. Nerves 6–9 on each side of the midrib, steeply arching upwards but not looping. Veins obscure, best visible above. Leaves of saplings and water shoots more elliptic and longer acuminate, herbaceous.

Inflorescences 7–9 cm long, slender, axillary racemes; peduncle densely white-tomentose, the lower part flowerless. Bracts linear, 2–3 mm long, subulate, tomentose, soon caducous. Flower buds onion-shaped, apiculate. Pedicel not distinct from the receptacle; together at anthesis 1.5–3.5 mm long, 0.8 mm thick, soon accrescent when fruit is formed. Flowers pale yellow, the lower flowers hermaphrodite, the upper ones with fertile stamens and a reduced pistil. Calyx synsepalous, tomentose outside, woolly inside, saucer-shaped, c. 3 mm wide with 5 erect, 2 mm long, triangular and subulate lobes. Petals absent. Stamens 10, glabrous. Filaments 3–5 mm long, linear, subulate. Anthers basifixed, ovoid, 0.5 mm long, bilobed at base, with 2 thecae, opening with slits. Disc intrastaminal, annular, 0.5 mm thick, densely woolly pubescent. Ovary inferior, marked as a slightly swollen place in the middle of the pedicel (= actually the receptacle). Style glabrous, c. 3 mm long, tapering to the top. Stigma not distinct. Sometimes a flower with 10 calyx lobes, 20 stamens, a 2-locular ovary and 2 partially connate styles can be found.

The fruits are small, longitudinally winged nuts on slender, c. 1 cm long stalks, including the wing 5–7 (–10) cm long and 1.5–2 (–2.5) cm wide, densely bright brown puberulous. Wing formed by the receptacle, membranous, with a central nerve and slightly undulate margin. Nut elliptic, c. 1.5 cm long and 0.8 cm thick, containing only one seed.

Seedling: germination epigeal. Hypocotyl 4–7.5 cm long, increasingly pilose towards the cotyledons. Cotyledons spreading, herbaceous, opposite. Petiole c. 3 mm long, pilose. Blade transversely oblong, c. 1 cm long, 1.5 cm wide, broadly cuneate towards the base, truncate at the top, palmatinerved with c. 5 spreading nerves, pale green. Epicotyl c. 1 cm long, pilose. First two leaves alternate, short-petiolate, narrowly elliptic, 3–3.5 cm long, c. 1 cm wide. Following leaves progressively larger.

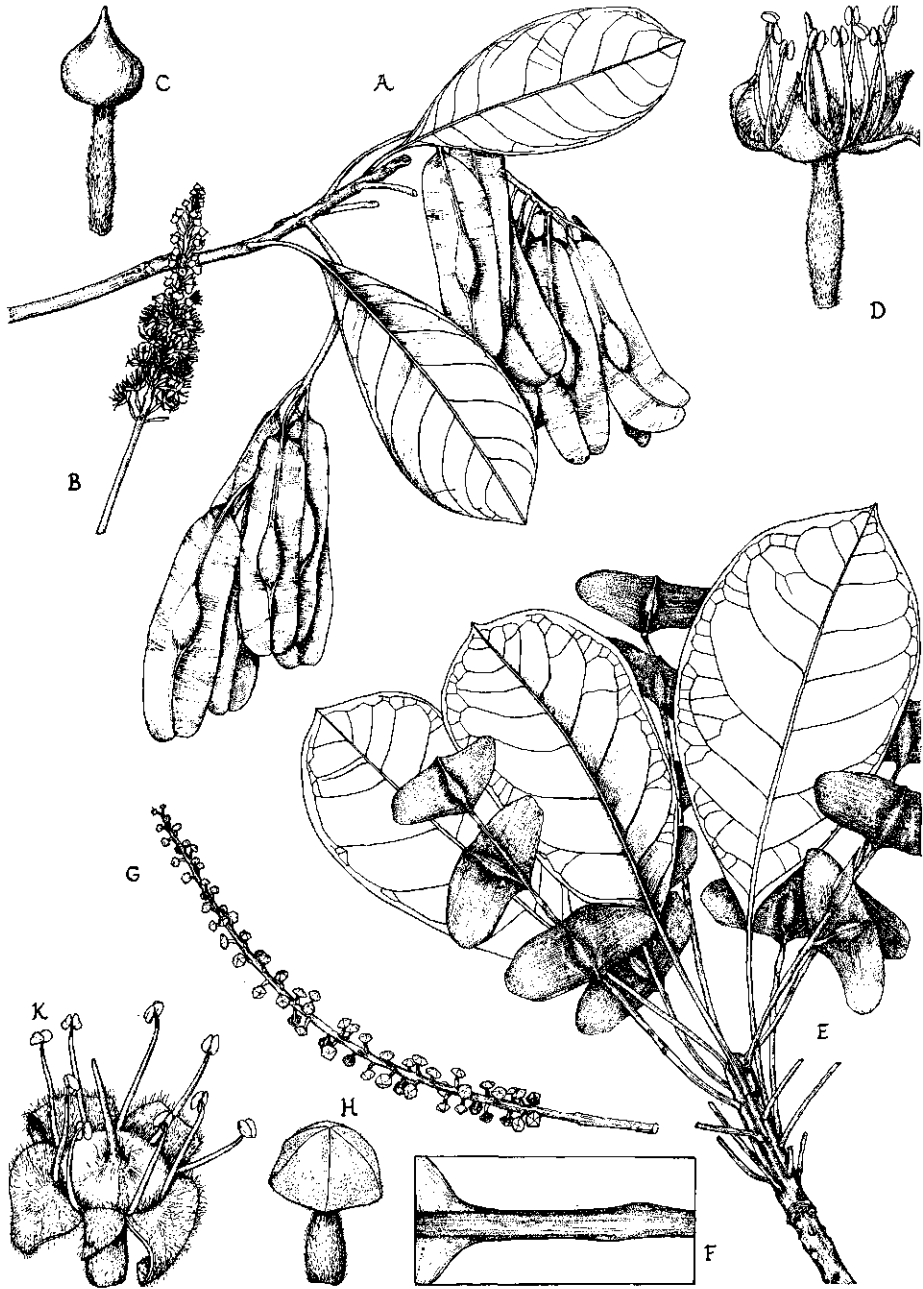


Fig. 7. *Terminalia ivorensis*. A. CHEV. A: branch with leaves and fruits ( $\times \frac{1}{2}$ ); B: inflorescence ( $\times \frac{1}{2}$ ); C: flower bud ( $\times 5$ ); D: open flower ( $\times 5$ ).

*Terminalia superba* ENGL. & DIELS E: branch with leaves and fruits ( $\times \frac{1}{2}$ ); F: detail showing the glands on the petiole ( $\times 2$ ); G: inflorescence ( $\times \frac{1}{2}$ ); H: flower bud ( $\times 5$ ); K: open flower ( $\times 5$ ).



The present description and figures are based on the following specimens: Zuole area 301, 1103, 1125; Gbi Nat. For. 581; Mtn. Nimba 899; Ganta 301A, Harley s.n.

In his type description Chevalier describes the bracts to be absent, but they are well-developed on young inflorescences, soon caducous.

FIELD NOTES. *Terminalia ivorensis* is found both in the high forest and in secondary formations, in evergreen forests and moist semi-deciduous forests; in the latter it seems to be most common. It prefers moist conditions but grows on various sites.

It may reach a height of 45 m ( $\approx 150'$ ) and a diameter of up to 1.20 m ( $\approx 4'$ ). The base of the tree is straight when young, but it has heavy root swellings of up to 1 m ( $\approx 3'$ ) high, sometimes extending in heavy surface roots, and is rather fluted when older. The bole is usually straight, rather angular near the base, cylindrical higher up, and may reach a height of 30 m ( $\approx 100'$ ) to the first branches. Overmature trees may often have a swollen and defective lower half of the bole and brittle heart. The crown of younger trees is formed by wide-spreading, whorled branches, forming characteristic, horizontal stories, but when the tree grows older the branches become more ascending and the storied character is more or less lost. The bright green leaves are markedly tufted. The bark on young trees is smooth and ashy grey, fairly thin, but when older (15-20 years) it becomes first longitudinally fissured, then deeply grooved, dark brown or even black. The bark on the root swellings is often transversely ridged. The slash is fairly soft and fibrous, sometimes slightly brittle and brown outside, dark or bright yellow inside, paler near the cambium, soon turning ochre yellow or dirty light brown on exposure.

The tree is deciduous and sheds its leaves for c. three months during the dry season. The Gio tribe distinguishes two kinds of 'bai': bai-ti (black *Terminalia*) takes a long time to change its leaves and bai-nasa (red *Terminalia*) takes only a very short time. This matter remains open to investigation (bai-nasa = *Pteleopsis*?). The new leaves appear around April, with the inflorescences. Flowering is in May and June. The young fruits soon appear, but are not ripe before December–January. They remain attached to the tree for a considerable time. Annual fruit production is copious. Sometimes the fruit is galled by insects. The galls are globular, about 2.5 cm ( $\approx 1''$ ) in diameter. The local inhabitants often regard them as the fruits of the tree. Regeneration is abundant on such open sites as abandoned farms and logging roads. Locally the secondary forest may be dominated by young trees of this species. The tree is very self-pruning and soon grows a clean, straight bole. It coppices easily.

In the young stage *Terminalia ivorensis* and *T. superba* are very similar. The seedlings are easily distinguished because the first pair of leaves is alternate in the present species, opposite in *T. superba*. A young *Terminalia superba* can be recognised by the longer stalked leaves, with a pair of glands, laterally on the petiole (see fig. 7 F). When old both species are very different. Full-grown specimens of *T. ivorensis* may resemble *Combretodendron macrocarpum*, which also has a dark grooved bark and a fluted base. However, the slash of this tree is very soft-fibrous and pink. Occasionally the tree may

resemble *Chlorophora* sp., but this species has a very hard, granular slash, exuding a white latex.

**SILVICULTURE.** The seeding age of the tree is six years. One pound contains 2500–2800 winged seeds (= 5500–6200/kg). Germination seems to be poor, but Taylor and Kinloch report that it can be raised to 40% when the seeds are pre-treated for a week by alternate soaking and sun-drying. The seeds are attacked by insect borers. Germination is irregular, with a variation from 15–50 days, owing to the hard coat of the fruit. The seedlings are susceptible to drought and nursery beds should be lightly shaded until seedlings are established.

For transplanting either stripped plants or stumps may be used, but nursery stock should not be planted out until the second rainy season, when the plants may be about 1 m ( $\approx 3.5'$ ) high. As the trees are susceptible to drought, they should be transplanted when the soil is moist, i.e. not before the rainy season has actually started. The roots should not be pruned too heavily. This species is a very fast grower and tends to suppress other vegetation. With a spacing of  $3 \times 3$  m ( $\approx 10 \times 10'$ ) an area may be covered in three years. Hence it should not be mixed with other species unless these are good shade bearers.

The drawback of the cultivation of *Terminalia ivorensis* is that after a certain age the trees are attacked by an insect which may cause severe damage to the plantation. Therefore monocultures are too great a risk, but wide line plantings in young secondary forest, or mixed plantations may be successful.

**USES.** The wood is pale yellowish brown, and provides an excellent timber for general use: fine carpentry, joinery, building, flooring. It is also suitable for plywood fabrication.

*Terminalia superba* ENGL. & DIELS

[5, 7 E-K, 8 F/33, 88]

'*Terminalia*': see p. 85.

'*superba*': L. magnificent, referring to the imposing habit of the tree.

Engler & Diels, Mon. Afr. Pfl.fam. und -gatt., IV, p. 26 (1900); type: Zenker 1871, Cameroon (K!); M. E. Griffith, Journ. Linn. Soc. London, Bot., Vol. LV, No. 364, p. 860–864 (1959): A revision of the African species of *Terminalia* L.;

*Terminalia altissima* A. CHEVALIER in Vég. Util., 5, p. 151 (1909); type: Chevalier 16104 (P!).

1927: F.W.T.A., 1st ed., I, p. 224

1933: Chalk, Burt Davy, Twenty W. Afr. Timber Trees, p. 30

1936: Aubréville, F.F.C.I., 1st ed., III, p. 58

1936: Kennedy, F.F.S.N., p. 44

1937: Dalziel, U.P.W.T.A., p. 83

1945: Kinloch, Silv. Notes Gold Coast Trees, p. 6

1954: F.W.T.A., 2nd ed., I, p. 277

1959: Aubréville, F.F.C.I., 2nd ed., III, p. 70

1959: Kryn & Fobes, Woods of Liberia, p. 114-115  
 1960: Normand, A.B.C.I., III, p. 45; Pl. CXXVI

1960: Taylor, Syn. Silv. Ghana, p. 155  
 1960: Keay, Nigerian Trees, I, p. 153  
 1961: Irvine, Woody Plants of Ghana, p. 135

LOCAL NAME: guwing, going (Gio)

TRADE NAME: Limba

GEOGRAPHICAL DISTRIBUTION: Guinea – Angola

**BOTANY.** A large tree of the high forest and secondary formations. Leaves simple, alternate, in tufts at the end of the branchlets, rusty tomentose when young, soon glabrescent, medium green, thin coriaceous, leaving marked round scars on the branchlets when shed. Petiole (1.5–) 3–5 (–7) cm long, flattened above, with a pair of subopposite, not always distinct, lateral glands slightly below the blade. Blade obovate, (4–) 6–12 (–17) cm long, 2.5–7 cm wide. Base cuneate, more or less unequal-sided and decurrent. Apex rounded, abruptly and shortly acuminate. Midrib and nerves flat above, prominent beneath. Nerves 4–7 on each side of the midrib, arching upwards, not looping. Reticulation fine, inconspicuous. Leaves of saplings and water shoots elliptic, often larger and more densely pubescent, herbaceous.

Inflorescence a 7–15 (–18) cm long, slender, axillary, laxly flowered spike; peduncle tomentose, the first 1–3 cm flowerless. Bracts very soon caducous, not seen by me. Flower buds bluntly conical, flowers sessile. Receptacle at anthesis 1.5–2.5 mm long, tomentose outside. Calyx synsepalous, tomentose outside, woolly inside. Calyx tube saucer-shaped, c. 3 mm across. Calyx lobes (4–) 5 (–6), triangular, c. 1.5 mm long, valvate in bud, recurving at anthesis. Petals absent. Stamens twice the number of the calyx lobes, in 2 whorls, glabrous. Filaments c. 3 mm long, subulate. Anthers basifixed, bilobed, with 2 thecae, opening lengthwise. Disc intrastaminal, annular, flattened, 0.3 mm thick, densely woolly pubescent. Ovary inferior, marked by a slightly swollen part at the base of the receptacle. Style sparsely pilose, c. 2 mm long, tapering towards the top. Stigma not distinct.

The fruits are small, transversely winged, sessile, golden brown nuts, including the wing 1.5–2.5 cm long, 4–7 cm wide, glabrous. Wing formed by the receptacle, membranous, transversely striate. Nut c. 1.5 cm long, 0.7 cm thick, rounded triangular on cross-section, containing 1 seed.

Seedling closely resembling that of *T. ivorensis* but first two leaves opposite, with slender, c. 1 cm long petioles, elliptic, c. 3 cm long, 2 cm wide when full-grown. Following leaves progressively larger, alternate. Young leaves reddish brown tomentose.

The present description is based on the following specimens: 20 miles W. of Zwedru 627, 1003; Ganta 301B; Tapeta 1306; Zuole area 4, 266, 257; Loma Nat. For. 744; Gbarnga, Harley s.n.; Ivory Coast: Leeuwenberg 3956; Wageningen greenhouse, Leeuwenberg V17.

The presence of six calyx lobes has not been noted before and was observed only in a few flowers of No. 1306 (spirit coll., WAG).

FIELD NOTES. In Liberia *Terminalia superba* is concentrated in the moist semi-deciduous forests, but it occurs scattered in the northern parts of the evergreen forest. It is found both in the high forest and in secondary formations. The tree is very common in the Ganta – Tapeta – Chien area, but is even more abundant between Zorzor and Voinjama.

It is a large or emergent tree which may reach a height of 45 m ( $\approx 150'$ ) and a diameter of 1–1.5 m ( $\approx 3$ –5'). The base of the tree has none or only low buttresses when young, well-developed, fairly thick, plank-like, steep buttresses when full-grown. The buttresses may reach as high as 3.5 m ( $\approx 12'$ ), sometimes extending in butt flares up to 6 m ( $\approx 20'$ ). The bole is straight and slender, cylindrical, only slightly tapering, up to 30 m ( $\approx 100'$ ) to the first branches. The crown has a storied habit owing to the whorled, horizontal branches; it is fairly small, open and, unlike *Terminalia ivorensis*, the storied character is not lost when old. The leaves are in tufts. The bark is smooth and greyish when young, shallowly grooved and scaly when old, with thin, longitudinal, more or less rectangular, brownish grey scales, under which the bark is smooth, pale brown. This gives the bark a characteristic grey to pale brown patched habit. On old trees the bark scales may be irregularly rounded. The slash is medium thick, soft-fibrous, brownish outside, pale yellow inside.

*Terminalia superba* seems to prefer fresh, clayish, fertile soils, and to avoid sandy sites. The tree is deciduous and sheds its leaves around the middle of the dry season. New leaves are reddish; they appear around February–March, with the inflorescences. Flowering is from February–April. The fruits ripen from December–February. Annual seed production is copious. Regeneration on open sites is very common and secondary forest may be dominated by regeneration of this species. The tree coppices easily.

When young both species of *Terminalia* look very similar. When old the light coloured bark and well-developed buttresses of *Terminalia superba* are quite distinct from *T. ivorensis*, with its dark brown-black bark and fluted base.

SILVICULTURE. Because of its fast growth and sound commercial prospects, *Terminalia superba* has become one of the few tree species, of which large scale plantations have been established in tropical Africa. The outline of the silviculture, as given below, is based on experience gained in various countries, and could also be tried out in the moist semi-deciduous forest of Liberia. It is doubtful whether plantations should be established in the evergreen forest since the tree seems to need a period of dormancy during the dry season, which is less outspoken in this forest type.

Trees may bear seeds after 6 years. There are 3700–4000 dewinged seeds per pound (c. 8100/kg). Collection of the fruits is in December–January, when the seeds are brown. Selection of good mother trees is important, since defects may be partially

hereditary. Best is to collect fruits from felled trees, which enables to control the wood quality of the mother tree. After collecting, the seeds are sun-dried for a few days, in order to prevent fermentation or fungus attack during storage. It is not necessary to dewing the fruits, though winged fruits take more place when stored.

The seeds keep their full germination power for at least a month. Normally 10–15% of the seeds are sterile, occasionally this figure can rise to 30%, owing to bad weather conditions at anthesis. Germination of fresh seeds is 80–90%, but will reduce slowly to 30–50% after one year. No special pre-treatment of the seeds is required before sowing.

The seeds are sown during the dry season and the seedbeds should be shaded lightly and watered daily. The nursery soil should be somewhat clayish. Spacing in the seedbeds is close,  $5 \times 5$  cm ( $\approx 2 \times 2$ "'). The seeds are covered by a thin layer of sand; they germinate in 10–20 days. The seedlings are transplanted after six to seven weeks, when they have three or four leaves and are 5–8 cm ( $\approx 2$ –3"') high. Transplanting should be done carefully, in order not to damage the young tap root. The seedlings are transplanted in nursery beds with a spacing of 20 cm ( $\approx 8$ "') in the line and 50 cm ( $\approx 20$ "') between the lines. The nursery beds should be lightly shaded, but this shade may be gradually lifted, so that after three to four weeks, when the plants are fully established, they receive full light. Side shade from surrounding bush should be cleared away. The plants remain in the nursery for a full year, during which period they may reach a height of 1.80–2.10 m ( $\approx 6$ –7'') and a diameter of 1 cm ( $\approx 0.4$ "') at a height of 1 m ( $\approx 3$ ''). The nursery needs little care, but one should be on guard against insects attacking the saplings.

When seed supply is abundant, seeds may be sown directly in the nursery beds, in the lines c. 10 cm ( $\approx 4$ "') apart. When the seedlings are 10–15 cm ( $\approx 4$ –6"') high, the best seedlings are maintained, the others thinned out (perhaps to be replanted in other beds). One can also wait until the seedlings are c. 30 cm ( $\approx 1$ '') high before thinning the lines. At the beginning of the next rainy season, when the plants are c. 18 months old, they are transplanted in the field as stumps. The area to be planted is first carefully selected for its quality (fresh, medium deep soils), then prepared during the previous dry season: cutting of the low vegetation, poisoning and girdling of the higher trees and burning of the dead material. Five or six days before transplanting the trees in the nursery are cut at c. 1 m ( $\approx 3$ '') height, where the diameter is about 1 cm ( $\approx 0.4$ "'). The tap root is pruned with a shovel and should remain 40 cm ( $\approx 16$ "') long. These stumps are transplanted as soon as the first buds appear at the top of the stump. Spacing in the field is  $12 \times 12$  m ( $\approx 40 \times 40$ '') (65 trees/ha or 27 trees/acre) which will make expensive later thinnings unnecessary. If the plants are more densely spaced this does not harm growth during the first 4–5 years, but afterwards growth will be severely retarded. The stumps are planted in planting holes of  $40 \times 40 \times 40$  cm ( $\approx 16 \times 16 \times 16$ "'). Care should be taken not to bend the tap root when planting the stump. 80% of the plants may succeed, but success has been found to depend largely on careful planting and

favourable (viz. wet) weather. To avoid having to return the following year for beating up, two plants are planted on the same site, but at an interval of two weeks and by different crews. Usually at least one of the two plants succeeds, and if both succeed, the better one is maintained, and the poorer cut off. Growth is fast and the forest may be closed in 10 years, but during the first four or five years the plantation should be cleared in the lines from all regrowth and between the lines from such fast growing trees as *Musanga* and *Harungana*. These clearings may be necessary three times a year.

No injurious insect, threatening the whole plantation, such as found in *Terminalia ivorensis*, has been observed to date. Termites tend to attack just planted stumps, and the base of the stump should be protected with an insecticide.

**USES.** *Terminalia superba* can be an effective substitute for imported softwood when given a preservative dip directly after conversion of the logs into sawn timber. It is mainly a timber for domestic use. It would be suitable for local plywood manufacture. On the world market it is in great demand for peeling and slicing for core and face veneer.

## EUPHORBIACEAE

A very large family of trees, shrubs, lianas and herbs, mainly in the tropics and subtropics. Leaves as a rule simple, alternate, stipulate, pinnately nerved, but sometimes opposite and/or digitately compound. Flowers usually very small, unisexual, as a rule monoecious, sometimes dioecious, usually apetalous. Stamens 1–∞. Ovary usually 3-locular with only 1 or 2 ovules in each locule. Fruits often 3-locular. Sometimes the bark contains a milky juice.

The *Euphorbiaceae* form the second largest family of woody plants in the Liberian forest. The number of large trees, however, is relatively small, most species growing in the B- or C-story of the high forest or belonging to the secondary forest. The most important tree of this family in Liberia is at present the rubber tree, *Hevea brasiliensis* (A. JUSS.) MÜLL. ARG., native of South America, and introduced for rubber production. The tree is readily recognised by its trifoliolate leaves and copious latex flow when slashed.

A common tree in the coastal savanna is *Anthostema senegalense* A. JUSS., characterized by its long, slender twigs with distichous leaves. The white latex is reported to be harmful to the eyes.

A much noticed understory tree is *Maesobotrya barteri* (BAILL.) HUTCH., generally known as 'Bush cherry'. The bright red fruits are delicious and are a welcome refreshment for thirsty travellers.

A rare but large tree is *Sapium aubrevillei* LÉANDRI, which has a swollen base or low buttresses. The bark is brown and scaly and rather untidy. The slash is a dirty yellow-brown, brittle-fibrous, slowly exuding a little white latex. The leaves have a slightly crenate margin and a pair of obscure glands on the margin near the base.

A common understory tree is *Drypetes aubrevillei* LÉANDRI, commonly known as 'pepper stick' because the bark has an extremely hot taste.

For the other numerous trees and shrubs, except those discussed below, reference is made to Aubréville's *Flore Forestière de la Côte d'Ivoire*, 1959, volume II.

*Bridelia grandis* PIERRE EX HUTCH.

[8]A-E/50

'*Bridelia*' after S. E. Bridel, a Swiss, who wrote on mosses (1761–1828).

'*grandis*': L. *grandis*: large; referring to the fact that this species is large, whereas most African *Bridelia* species are shrubs or small trees.

Hutchinson, F. T. A., VI, 1, p. 1042 (1913); J. Léonard, Bull. Jard. Bot. Bruxelles, 25, p. 368–369

(1955); type: Klaine 423 (K!, BR!, isotypes);

*Bridelia aubrevillei* PELLEGRIN in Bull. Soc. Bot. France, 78, p. 683 (1932); type: Serv. For. 423; Chevalier 22359 (P!, syntypes).

1928: F.W.T.A., 1st ed., I, p. 279 (*B. aubrevillei*)

1936: Aubréville, F.F.C.I., 1st ed., II, p. 36 (*B. aubrevillei*)

1955: Normand, A.B.C.I., II, p. 37; Pl. LIX (*B. aubrevillei*)

1958: F.W.T.A., 2nd ed., I, p. 370

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 47 (*B. aubrevillei*)

1959: Kryn & Fobes, Woods of Liberia, p. 22

1960: Keay, Nigerian Trees, I, p. 272

1961: Irvine, Woody Plants of Ghana, p. 217

LOCAL NAME: doaandoh, duaandoh (Gio)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Congo

**BOTANY.** A medium-sized tree, usually in the secondary forest. Branchlets densely rusty-brown villous when young, glabrescent. Leaves simple, alternate, stipulate, distichous, dark green above, paler beneath, thin coriaceous; very young leaves red. Stipules 6–10 mm long, linear, subulate, densely villous, caducous. Petiole 4–8 mm long, densely villous. Blade (narrowly) elliptic – (–) obovate, 6–14 cm long, 2–6 cm wide. Base rounded – broadly cuneate. Margin entire, slightly revolute on dry material. Apex acuminate. Midrib and nerves slightly raised above, very prominent beneath. Nerves 8–10 (–13) on each side of the midrib, fairly steeply ascending, joining a thin, marginal nerve. Veins more or less parallel, transverse with the nerves, slightly raised above and beneath. Pubescence sparse and, except on the midrib, vanishing above, villous – pilose, persistent beneath, spread over the blade.

Flowers in small, compact clusters in the axils of the leaves, unisexual, monoecious. Male flowers: pedicel c. 1.5 mm at anthesis. Receptacle flat, 1.2 mm across. Sepals 5, valvate in bud, spreading when flowering, with a few scattered hairs inside and outside, triangular, c. 1.5 mm long, 0.6 mm wide at base. Petals 5, elliptic, 0.7 mm long, acuminate. Disc extra-staminal, swollen, annular, c. 1 mm in diameter, glabrous, surrounding the androphore, which at anthesis is 0.5 mm long. Stamens 5, spreading from the top of the androphore; filaments c. 1 mm long, subulate; anthers basifixed, 0.5 mm long, with 2 thecae, opening by slits. The top of the androphore carrying an 0.3 mm long rudimentary ovary. Female flower subsessile. Receptacle saucer-shaped, c. 1.5 mm across, glabrous. Sepals 5 (6), valvate in bud, spreading at anthesis, triangular, c. 1 mm long, and wide at the base, with a few scattered hairs. Petals 5 (6), elliptic, 0.7 mm long, acuminate. Stamens absent. Disc urceolate, surrounding the ovary, finely dentate on the margin. Ovary sessile, c. 1 mm thick and long, glabrous, 2-locular. Style very short; stigmas 2, deeply bilobed.

Fruit a nearly globular drupe, c. 7 mm thick, dark purple when ripe. The mesocarp fleshy, the endocarp hard, enclosing only one seed.



Seedling: germination epigeal. Hypocotyl 3–4.5 cm long. Cotyledons foliaceous, spreading; petiole 1.5 mm long; blade transversely oblong, c. 8 mm long, 15 mm wide, broadly cuneate towards the base, concavely truncate at the apex (obreniform). Venation palmate. Epicotyl 8–12 mm long. Leaves alternate, stipulate. Stipules about 3 mm long, subulate. Petiole 1.5–2.5 mm long. Blade elliptic, the first leaf c. 1.5 cm long, 0.5 cm wide. Next leaves progressively larger. Apex acute, margin entire, base blunt-rounded. Seedlings densely pale brown tomentellous.

TAXONOMICAL NOTES. *Bridelia grandis* was first described in 1913 by Hutchinson, who adopted the epithet proposed by Pierre (in herb.), based on material collected in Gabon. The veins of the present specimens are more conspicuous than suggested in the type description. The species was again described as *B. aubrevillei* PELLEGRIN (1932, l.c.). Léonard (1955, l.c.) proposed two subspecies: *B. grandis* subsp. *grandis*, occurring from Sierra Leone to Gabon, and subsp. *puberula* J. LÉONARD, localized in Congo, differing from subsp. *grandis* in a more persistent, shorter pubescence of the branchlets, tomentellous, later puberulous pedicels, male and female buds and female receptacle.

Three other species of *Bridelia* may be found in Liberia: *B. atroviridis* MÜLL. ARG., of which the nerves do not reach the leaf edge to form a marginal nerve; *B. micrantha* (HOCHST.) BAILL. and *B. stenocarpa* MÜLL. ARG. which show a marginal nerve. *B. micrantha* is a species of the savanna. The leaves are nearly glabrous beneath, the reticulation is distinct; *B. stenocarpa* is a species of secondary forests. The leaves are appressed-puberulous beneath, the reticulation is very faint.

The present description and figures are based on the following specimens: 18 M. W. of Chien 671; Diala 1011; Kuindin 289; Devilbush, Duport 1120A, 1191.

FIELD NOTES. *Bridelia grandis* is a forest tree which may occasionally reach a diameter of over 90 cm ( $\approx 3'$ ) and a height of up to 30 m ( $\approx 100'$ ) although it is usually smaller; when young it may have spines on the stem. The base of the tree is provided with low, stout stilt-roots (but sometimes with numerous fine roots), usually not higher than 60 cm ( $\approx 2'$ ), extending in irregular ridges along the stem up to 1.20 m ( $\approx 4'$ ). Sometimes stilt-roots are lacking, in which case the base is provided with thick root spurs.

The bole of the tree is straight, fairly cylindrical, usually short, up to 15 m ( $\approx 50'$ ) to the first branches. The crown is heavily branched, fairly open, rounded, the distichous leaves creating the impression of pinnate leaves. Branches are often closely armed with sharp, straight spines. The bark is dark brown-black, rough, deeply lengthwise fissured and fairly thick. The slash is red outside, red-brown or pinkish brown inside, long-fibrous but fairly brittle, and has a definite smell, somewhat like cyanic acid. *Bridelia grandis* is evergreen. Flowers were found from May to June, ripe fruits in October. The tree is not very common and is mostly found in older secondary forests, rarely in primary high forest.



5. *Terminalia superba* ENGL. & DIELS. Note the light, patchy bark habit (see page 91).



6. *Uapaca guineensis* MÜLL. ARG., Note the high stilt-roots and scaly bark (see page 105).

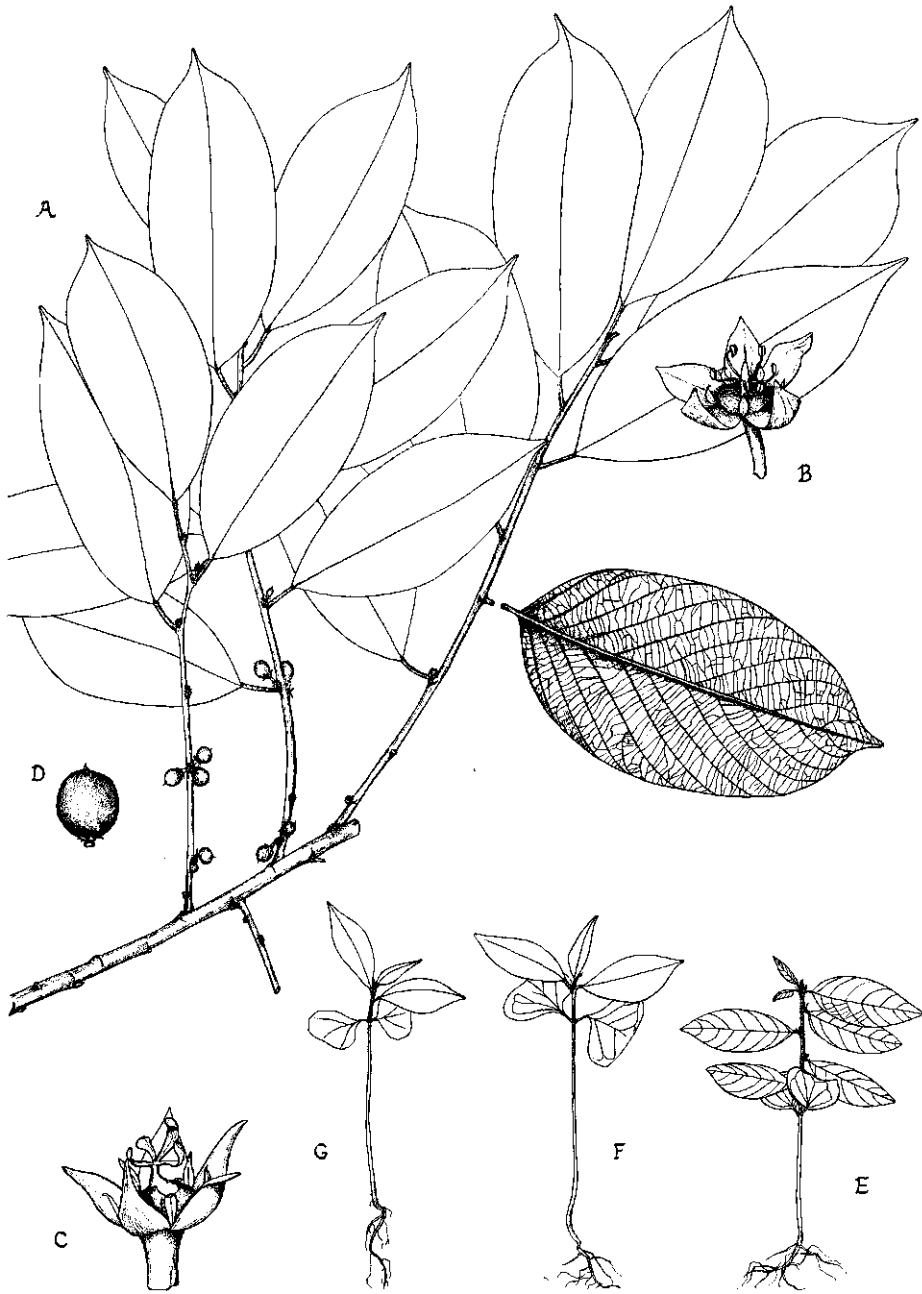


Fig. 8. *Bridelia grandis* PIERRE ex HUTCH. A: branch with leaves and fruits ( $\times \frac{1}{2}$ ); B: open male flower ( $\times 8$ ); C: open female flower ( $\times 8$ ); D: fruit ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ); F: seedling of *Terminalia superba* ENGL. & DIELS ( $\times \frac{1}{2}$ ); G: seedling of *Terminalia ivorensis* A. CHEV. ( $\times \frac{1}{2}$ ).

USES. The bark is sometimes added to palm wine used by women (to promote lactation?). It is also boiled with or without plantains and the decoction is drunk as an antidote for dysentery. The wood is of a pleasant greyish brown colour, medium hard and heavy. It is possibly termite-resistant. In Sierra Leone it is generally used for furniture making.

*Oldfieldia africana* BENTH. & HOOK. f.

[9/38]

'*Oldfieldia*': referring to Richard Albert Oldfield, in 1850 Marshal of the Mixed Commission and Vice-Admiralty Courts at Sierra Leone, who collected the type specimen.

'*africana*': referring to Africa.

Bentham & Hooker f., *Kew Journ. Bot.*, II, p. 184, t. 6 (1850); type: Oldfield s.n., Sierra Leone (K!); Pax & Hoffman, in *Engl. Pflanzenreich, Euphorbiaceae*, IV, 147, XV, p. 297 (1922); *ibid.*, in *Nat. Pfl.fam.*, 19c, p. 78 (1931); J. Léonard, *Bull. Jard. Bot. Bruxelles*, 26, p. 335–339 (1956).

1928: F.W.T.A., 1st ed., I, p. 279

1931: Cooper & Record, *Evergr. For. Liberia*, p. 54

1936: Aubréville, *F.F.C.I.*, 1st ed., II, p. 22

1937: Dalziel, *U.P.W.T.A.*, p. 156

1955: Normand, *A.B.C.I.*, II, p. 35; Pl. LXVII

1958: F.W.T.A., 2nd ed., I, p. 368

1959: Aubréville, *F.F.C.I.*, 2nd ed., II, p. 30

1959: Kryn & Fobes, *Woods of Liberia*, p. 78

LOCAL NAMES: rla (Gio); saintue (Krahn); pau-lai (Bassa, cf. Cooper)

TRADE NAME: African Oak

GEOGRAPHICAL DISTRIBUTION: Sierra Leone, Liberia, Ivory Coast, Cameroon

BOTANY. A large high forest tree. Branches densely rusty-brown puberulous when young, glabrescent, when older with marked scars of shed leaves. Leaves digitately compound, with (3–) 5–8 (–9) leaflets, opposite, estipulate, puberulous when young, glabrescent. Petiole 4–10 cm long, terete, slightly jointed at base, broadened at the top where the leaflets are attached. Petiolules c. 5 mm long, grooved above, rugose. The lateral leaflets much smaller than the central one. Blade (narrowly) elliptic, 4–16 cm long, 1.5–6 cm wide, coriaceous, glossy dark green above, paler beneath. Apex acuminate; margin entire; base narrowly cuneate, decurrent. Midrib slightly raised above, prominent beneath. Nerves slightly raised on both sides, 6–15 pairs, straight, anastomosing at some distance from the edge; reticulation of veins fine. Leaves of saplings larger, with longer petioles and more papery leaflets.

Tree dioecious. Male inflorescence dichasial, multiflowered, 2–6 cm long, 1 or 2 developing in the axil of the shed leaves from buds, laterally of the central axillary bud. Peduncles and pedicels densely rusty-brown, puberulous. Pedicel 0.4–4 mm long. Bracts and bracteoles absent. Calyx puberulous inside and outside; calyx tube 0.5 mm



Fig. 9. *Oldfieldia africana* BENTH. & HOOK. f. A: branch with leaves and fruits ( $\times \frac{1}{2}$ ); B: male flowers ( $\times 5$ ); C: fruit, top view ( $\times 1$ ); D: opened fruit with seeds ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ); F: leaflets of *Ricinodendron heudelotii* (Baill.) PIERRE ex PAX ( $\times \frac{1}{2}$ ).

high, calyx lobes 0.2–0.4 mm long. Petals absent. Stamens 2–10, free, glabrous. Filaments c. 2 mm long; anthers with 2, free, 0.6 mm long thecae, opening by slits. Disc intrastaminal, partially surrounding the base of the stamens, spongy, villous. Female inflorescences with only 2–3 flowers. Bracts present. Flowers unknown. Peduncle accrescent, 2–4.5 cm long, marked with scars of the shed bracts.

Fruits (ovoid)-globular capsules, 1.7–2.5 cm long, 2–2.5 cm thick, orange when ripe, with 2 or 3 (rarely 4) faint grooves, (2–) 3 (–4) locular, dehiscent with thick, coriaceous valves, each locule containing 1 or 2 seeds. Seeds orange when ripe, c. 1 cm long, laterally flattened, c. 8 mm wide.

Seedling: germination epigeal. Hypocotyl 7–9 cm long, increasingly villous towards the top, woody. Cotyledons opposite, foliaceous, spreading. Petiole 2–3 mm long. Blade broadly obovate, c. 2 cm long, 2–2.5 cm wide, palmatinerved, with 3 nerves, the central one most prominent, branching dichotomous. Apex truncate; base rounded; margin entire. Epicotyl 0.5–1 cm long, villous. Leaves first alternate, eventually opposite. The first leaf unifoliolate; petiole 0.5–0.8 cm long; blade narrowly elliptic, c. 4 cm long, 1 cm wide. Second leaf uni- or trifoliolate. Third and following leaves bi- or trifoliolate, progressively larger, about the 8th leaf with 4 or 5 leaflets. Young parts villous pubescent, glabrescent.

**TAXONOMICAL NOTES.** *Oldfieldia* BENTH. & HOOK. f. was first believed to be a monotypic genus, confined to Sierra Leone, Liberia and Ivory Coast, but in Paris I saw collections from Cameroon.

Milne-Redhead (Kew Bull. 1948, p. 456–457) found the genus *Cecchia* CHIOV. to be congeneric with *Oldfieldia*, and Léonard (1956, l.c.) found the same for the genus *Paivaeusa* WELW.. The genus therefore now includes four species: one West African *O. africana* BENTH. & HOOK. f.; two Central African: *O. dactylophylla* (WELW. ex OLIV.) J. LÉONARD, and *O. macrocarpa* J. LÉONARD; one East African: *O. somalensis* (CHIOV.) MILNE-REDHEAD.

The present description and figure rest on the following specimens: Bomi Hills 61, 822, de Wilde 3820; Devilbush, Duport 294, 1017; Bong Range 1177; 18 M. W. of Chien 641.

**FIELD NOTES:** *Oldfieldia africana* is a large tree, found both in the evergreen and the moist semi-deciduous forest. It may reach a diameter of over 1.20 m ( $\approx 4'$ ) and a height of up to 36 m ( $\approx 120'$ ). The base of the tree has heavy root swellings or swollen root spurs, extending in spreading surface roots. Thick, heavy buttresses of up to 1 m ( $\approx 3.5'$ ) high are only occasionally found.

The bole is straight and cylindrical, over 20 m ( $\approx 66'$ ) to the first branch. The crown is fairly narrow, with rather dense, dark green, ascending, heavy branches. The bark on the root swellings is markedly coiled. On the bole it is yellowish brown, vertically fissured, thin scaly, with longitudinal scales, often loosening at the base and, while

remaining attached at the top, recurving backwards. The slash is rough-fibrous but brittle, brown with darker and paler stripes and a purplish tinge, dark outside, pale near the cambium, fairly soft, medium thick, very bitter when tasted.

*Oldfieldia africana* is found scattered or in small groups in the high forest, occasionally in the secondary forest, seemingly without preference for site, but not in swamps. The tree does not shed its leaves in the evergreen forest, but is deciduous for a short period in the drier forest types. Young leaves are pale reddish brown, appearing with the inflorescences around April-May, but fruits are found during the larger part of the year (August-February), so the flowering season may be much longer.

*Oldfieldia* should not be mistaken for a species of *Vitex* L. (*Verbenaceae*), which also have opposite, digitate leaves. The only large *Vitex* in Liberia, *Vitex micrantha* GÜRKE, has dentate leaflets, and the other species of *Vitex*, mostly shrubs or small trees, often have glandular points or a pubescence on the leaflets (see Aubréville F.F.C.I., 1959, III, p. 226–234).

Another euphorbiaceous tree, occurring in Liberia, which has digitate leaves, is *Ricinodendron heudelotii* (BAILL.) PIERRE ex PAX, which is sometimes common in secondary formations; it has alternate, stipulate leaves, the leaflets having black glandular points on the margin (see fig. 9 F). The slash of the tree is soft, red, and quite moist; the wood is soft.

USES. The wood of *Oldfieldia* is brown or reddish brown; the texture is medium to fine and the grain irregular, often interlocked. The timber is very hard, heavy, tough and strong, Sp. G. c. 0.97. It is difficult to work when dry. It is one of the best timbers for heavy, durable construction, and very suitable for constructions affected by water, e.g. bridges, bridge floor planking, shipyards etc. It has been used in ship building.

*Uapaca guineensis* MÜLL. ARG.

[6, 10/51]

'*Uapaca*': vernacular name from Madagascar.

'*guineensis*': referring to West Africa, often called 'Upper Guinea' by 19th century authors.

Müller Argoviensis, *Flora* 47, p. 517 (1864); type: Mann 74, lectotype (K!); Pax & Hoffman in Engl. Pflanzenreich, *Euphorbiaceae*, IV, 147, XV, p. 306 (1922, lit!); *ibid.*, Pfl.fam., 19c, p. 76 (1931);

*Antidesma guineensis* DON ex HOOK. f. in HOOK. f., *Fl. Nigrit.*, p. 515 (1848, nomen nudum);

*Uapaca mole* Pax in Bot. Jahrb., XIX, p. 79 (1894); type: Pogge 1635 (?);

*Uapaca laurentii* DE WILDEMAN, Et. Fl. Bas- et Moy. Congo, II, p. 272, t. 69 (1908); type: M. Laurent s.n. (BR?);

*Uapaca bingervillensis* BEILLE in Mém. Soc. Bot. France, 8, p. 66 (1908); type: Chevalier 15415 (P!);

*Uapaca perrottii* BEILLE, l.c., p. 67; type: O. Caille 14790 (P!).

1928: F.W.T.A., 1st ed., I, p. 292

1931: Cooper & Record, Evergr. For. Liberia,  
p. 57

1936: Aubréville, F.F.C.I., 1st ed., II, p. 30

1936: Kennedy, F.F.S.N., p. 77

1937: Datzief, U.P.W.T.A., p. 165



1955: Normand, A.B.C.I., II, p. 41; Pl. LXX  
 1958: F.W.T.A., 2nd ed., I, p. 390  
 1959: Aubréville, F.F.C.I., 2nd ed., II, p. 40  
 1959: Kryn & Fobes, Woods of Liberia, p. 121

1960: Taylor, Syn. Silv. Ghana, p. 166  
 1960: Keay, Nigerian Trees, I, p. 277  
 1961: Irvine, Woody Plants of Ghana, p. 257

LOCAL NAMES: soang-nasa or swoang-nasa (Gio); brue (Krahn); be-yor (Bassa, cf. Cooper)

TRADE NAME: Rikio

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Congo

BOTANY. A medium-sized tree. Leaves simple, alternate, stipulate, glabrous, crowded towards the end of the long, slender, sparsely pubescent, glabrescent branches, which are marked by numerous large scars of shed leaves, and are hollow inside when dry. Terminal bud sticky. Stipules 1.5–5 mm long, acicular, present on fresh shoots, caducous or persistent. Petiole (0.8–) 1.5–4 cm long, terete, markedly jointed at the top. Blade obovate, (5–) 9–24 cm long, (2–) 4–10 cm wide, papery or thin-coriaceous, glossy medium or dark green above, dull pale green beneath, on both sides with numerous minute glandular points. Base narrowly cuneate. Margin entire, markedly undulate. Apex rounded or shortly and bluntly acute. Midrib raised above, very prominent beneath. Nerves slightly raised or flat above, prominent beneath, 5–10 pairs, steeply ascending, arching till near the edge, not looping. Veins finely raised beneath. Young shoots waxy. Trees dioecious. Inflorescences solitary, axillary, on the leaf bearing part and the upper bare part of the branches. Male inflorescences: peduncle below the bracts glabrous, 1–2.5 cm long. Bracts c. 10, elliptic, concave, 5–10 mm long, 2–7 mm wide, glabrous or ciliate, yellow, enclosing the flowers in bud. Peduncle above the bracts pubescent, c. 2 mm long. Flowers sessile in dense, globular heads 4–7 mm across. Calyx pubescent outside; calyx tube 0.7 mm long, calyx lobes 5, obovate, truncate, 0.7 mm long. Petals 5, 0.5–1 mm long, 0.2 mm wide, pilose, alternating with the calyx lobes. Stamens 5, c. 1 mm long; filaments strap-shaped, glabrous; anthers basifixed, with 2 free thecae, 0.5 mm long, opening with slits. Ovary rudimentary, c. 1 mm long, peltate or tri-lobed, pilose. Female flower: peduncle 0.5–1 cm long, stout, glabrous. Bracts as in the male flowers. Calyx tube 0.8 mm long, very shortly lobed, sparsely ciliate. Within the calyx tufts of hairs alternating with the calyx lobes. Ovary sessile, globular, c. 3 mm across, 3-locular, glabrous, crowned by 3 strap-shaped, bi- or trifid, c. 5 mm long styles.

Fruits globular, 2–2.5 cm across, glabrous, warty, containing 3 seeds. Seed c. 1.5 cm long, c. 1.2 cm wide, c. 7 mm thick, with 2 marked dorsal grooves. Seedling unknown to me.

TAXONOMICAL NOTES. Pax and Hoffman (1922, l.c.) cite the author of this species as (DON) MÜLL. ARG., referring to *Antidesma guineensis* DON ex HOOKER f. in Niger. Fl.

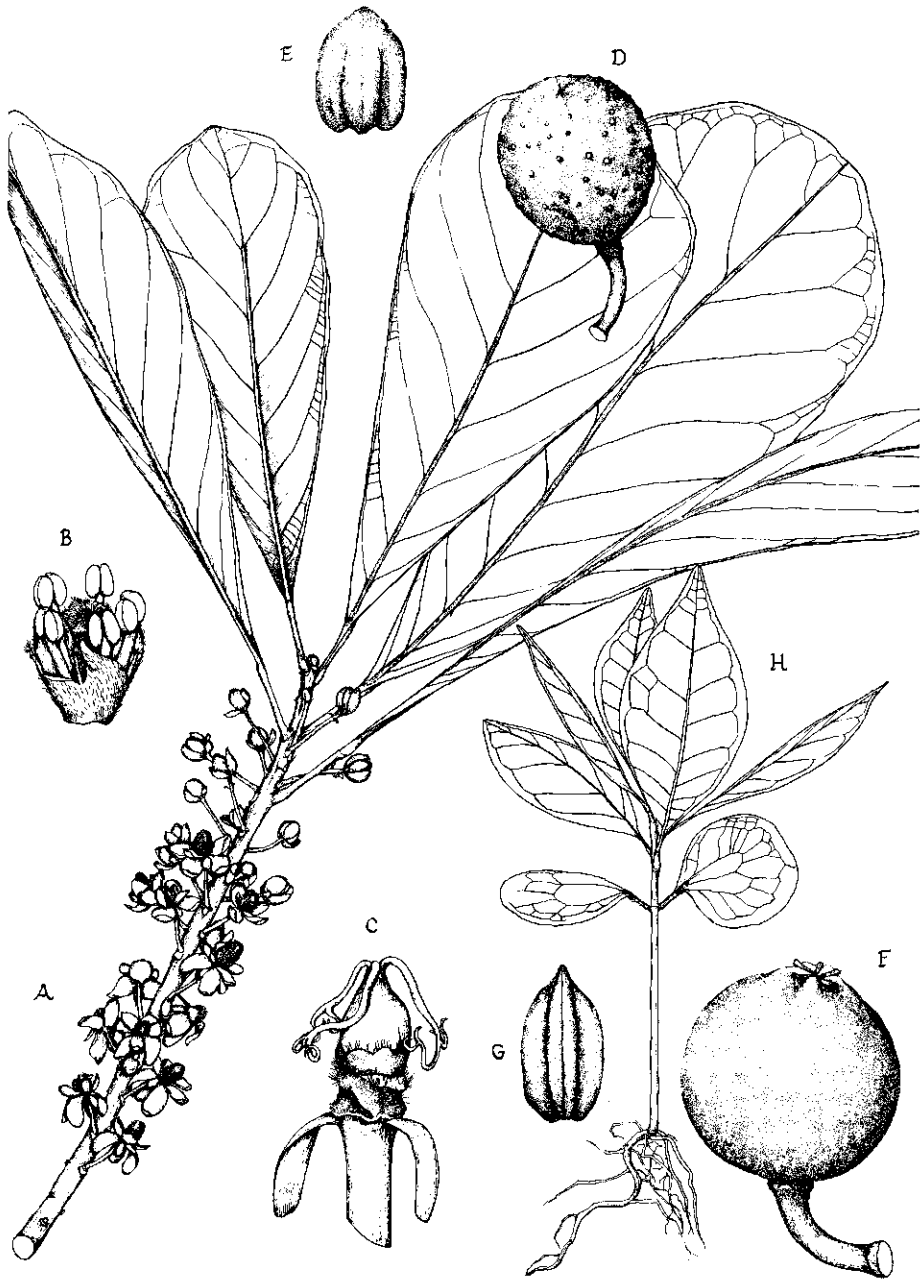


Fig. 10. *Uapaca guineensis* MÜLL. ARG. A: branch with leaves and male inflorescences ( $\times \frac{1}{2}$ ); B: male flower ( $\times 10$ ); C: female flower ( $\times 4$ ); D: fruit ( $\times 1$ ); E: seed ( $\times 1$ ).  
*Uapaca corbisieri* DE WILD. F: fruit ( $\times 1$ ); G: seed ( $\times 1$ ); H: seedling ( $\times \frac{1}{2}$ ).

p. 515 (1849) as basionym. However, Hooker noted concerning this plant: ‘A specimen in leaf only, from Sierra Leone, Don, called by him *Antidesma guineensis*, and another in the same state, evidently belonging to the same species, from Fernando Po, Vogel, but both very different in appearance from any *Antidesma* known to me’. This cannot possibly be considered as a valid publication of the name *Antidesma guineensis*, which therefore remains a nomen nudum. The connection of Don with the actual author, Müller Argoviensis, is therefore contrary to the Code.

Pax and Hoffman (1922, l.c. p. 298) characterize the genus *Uapaca* as: ‘Flores dioici, apetalii...’ However, the presence of petals has been observed in the male flowers of numbers 771, 787, and 1293, of the material cited below. In the female flower of No. 141 the calyx lobes alternate with tufts of hairs, implanted at the base of the inside of the calyx. This was also observed by Aubréville (1959, l.c. p. 34, fig. 134 g, p. 35).

At present only five species of *Uapaca* are known to occur in Liberia: *U. guineensis* MÜLL. ARG.; *U. corbisieri* DE WILD.; *U. paludosa* AUBRÉV. & LÉANDRI; *U. heudelotii* BAILL.; *U. togoensis* PAX. The first two species are by far the most common and are easily distinguished as follows:

	<i>Uapaca guineensis</i>	<i>Uapaca corbisieri</i>
Leaves:	Papery or thin-coriaceous, with undulate margin, apex (rounded) – bluntly acute; veins finely raised beneath. Leaves as a rule smaller, averaging c. 15 cm in length. Stipules present, caducous or persistent. Young shoots waxy.	Thick coriaceous, margin not or hardly undulate, apex rounded; veins slightly impressed beneath. Leaves as a rule larger, averaging c. 25 cm in length. Stipules absent. Young shoots not waxy.
Flowers:	Male flower heads 4–7 mm across. Calyx pilose outside, c. 1.5 mm long. Petals (sometimes?) present. Bracts 0.5–1 cm long.	Male flower heads c. 13 mm across. Calyx ciliate, less than 1 mm long. Petals absent. Bracts c. 1.5 cm long.
Fruits:	Globular, 2–2.5 cm across, warty. Seeds 3 in each fruit, c. 1.5 cm long, with 2 dorsal grooves. Fruit stalk c. 1 cm long.	Globular–ovoid, 3–6 cm long, c. 3 cm thick, not warty, smooth, crowned by the remnants of 5 styles. Seeds 4–5 in each fruit, c. 3 cm long, with 2 dorsal grooves. Fruit stalk c. 2 cm long.
Habit:	Bark dark brown, blackish, as a rule rough, cracked or scaly. Slash on the roots red.	Bark dark grey-black, smooth, horizontally striate. Slash on the roots pink and white mottled, or pinkish red, rapidly turning brown on exposure.

I saw the type of *Uapaca corbisieri* in Brussels and was unable to detect any characters

that would differentiate my Liberian samples from this species. *Uapaca esculenta* AUBRÉV. & LÉANDRI from Ivory Coast, a later name, may well prove conspecific.

The other species may be briefly characterized as follows: *U. paludosa*: leaves large, broadly obovate, densely pubescent beneath. Fruits containing 4 seeds. Tree always in swamps.

*U. heudelotii*: leaves resembling those of *U. guineensis*, but somewhat smaller and with tufts of red hairs in the axil. Fruit c. 3.5 cm long, ovate, resembling that of *U. esculenta* but slender-stalked and crowned with the remnants of only 3 styles. Seeds 3 in each fruit. Tree always in the neighbourhood of water.

*U. togoensis*: Leaves coriaceous, obtuse or rounded at the base. Fruit slightly pubescent. Tree of the savanna, often without stilted roots, also found in the coastal savanna near Monrovia. This tree may resemble *Terminalia catappa* owing to its tufted leaves, but it lacks the characteristic whorled branches of a *Terminalia*.

The descriptions and figures are based on the following specimens: *U. guineensis*: Duport 779; Mtn. Coffee, Todee District, Greene 9, Wright 14; N. Gio Nat. For. 141; Mtn. Nimba 921, 1197, Leeuwenberg 4684; Zuole 771, 787, 1129; Kanweake, Putu District 1293. *U. corbisieri*: Bassa No. III, Siga 688; Bong Range 1185; Mtn. Nimba 1196; Gbi Nat. For., E. of Cestos River 554, 557; Diala 1008. *U. paludosa*: Duport 783; Kanweake, Putu District, de Wilde 3666.

FIELD NOTES. *Uapaca guineensis* may grow to a height of 30 m ( $\approx 100'$ ) and the bole may attain a diameter of 1 m ( $\approx 3.5'$ ) or more. The base of the tree has very highly developed stilt-roots, reaching 3.5 m ( $\approx 12'$ ) in full grown specimens. The stilt-roots are very variable in size, usually rounded, but the heavier ones laterally flattened at the top. Bole straight, somewhat angular, up to 15 m ( $\approx 50'$ ) free of branches, but usually less. Crown heavily branched, globular, dense, quite deep; leaves markedly tufted. As a rule the bark on the stilted roots is smooth, greyish; on the stem it is dark brown blackish, rough, cracked, scaly or flaky, with a few lenticels, often grown over with numerous epiphytic ferns and mosses. The slash on the roots and on the stem is bright red or dark red, medium thick, brittle, granular, some clear or red sap collecting in the slash wound.

The tree is evergreen. It occurs all over Liberia, mostly in older secondary forest types, apparently without a marked preference for site, but not in deep swamps. Flowering and fruit bearing is irregular, spread over the year. The male inflorescence suggests to be a single flower with numerous stamens, the bracts forming the perianth.

*Uapaca corbisieri* is as common as *U. guineensis*, and both trees often grow together, sometimes forming rather gregarious *Uapaca* stands. For the distinction between the two species, see Taxonomical notes.

Four other species may show a growth habit similar to that of an *Uapaca*: *Santiria trimera* (OLIV.) AUBRÉV. and *Xylopija staudtii* ENGL. & DIELS which are easily recognized by the strong scent of the slash; *Symphonia globulifera* LINN. f., which exudes a pale

yellow latex from the slash wound; its simple leaves are opposite; *Macaranga barteri* MÜLL. ARG., usually a small tree of secondary formations, but occasionally a tree of up to 20 m ( $\approx$  66') high and 50 cm ( $\approx$  1.5') in diameter, with stilt-roots up to 1 m ( $\approx$  3.5') high. The leaves are less tufted as in *Uapaca*, shortly auriculate with a pair of glands at base. The slash is brown.

USES. The fruits of *U. guineensis*, *U. corbisieri* and *U. heudelotii* are reported to be edible.

The wood is greyish red to chocolate brown, moderately hard and heavy. It has no special characters, that would make it a desirable timber for export, but it may be used locally for sawn timber. It provides a good charcoal.

## GUTTIFERAE

A large family of trees, shrubs, climbers and herbs, cosmopolite but mostly tropical. Leaves as a rule simple, pinnately nerved, opposite or in whorls, estipulate, often with translucent, glandular points or resin ducts. Flowers actinomorphic, hermaphrodite or unisexual, monoecious. Sepals imbricate or decussate. Petals imbricate. Stamens as a rule numerous, free or united at base, in bundles or in a tube. Disc often present. Ovary superior, as a rule with numerous ovules. Styles free or connate. Fruit a berry, drupe or capsule.

The family is easily recognised by its opposite leaves and the yellowish or orange latex, exuding from the slash wound. The branchlets are often hollow. In Liberia four large forest trees are found: *Allanblackia floribunda* OLIV., *Mammea africana* SABINE, *Pentadesma butyracea* SABINE, and *Symphonia globulifera* LINN. f. Smaller representatives of the family are: *Garcinia* spp., *Harungana madagascariensis* LAM. ex POIR., and *Vismia guineensis* (L.) CHOISY. The two latter species are often considered to belong in a separate family, the *Hypericaceae*. *Mammea* and *Pentadesma* are discussed at length below.

The other species may be briefly characterized as follows: *Allanblackia floribunda*: a rare, large, evergreen forest tree, up to 30 m ( $\approx 100'$ ) high (Aubréville mentions that locally the tree may be very abundant). Leaves with very numerous, fine, parallel nerves, resembling those of *Mammea*, but with very fine resin ducts, crossing the nerves, best visible on the lower surface of the leaf near the midrib, and lacking the glandular cells of *Mammea*. The base of the tree is straight or with low root swellings. The bark is rough, the slash reddish, the latex pale yellow or clear and very slow in appearing. The fruits are very large, 25–50 cm long, 8–14 cm across, with 40–80 large seeds, which are 2–4 cm long, 1.5–2.5 cm thick.

*Symphonia globulifera*: a medium-sized or large tree, growing in swamps or marshy sites, up to 25 m ( $\approx 80'$ ) high and 75 cm ( $\approx 2.5'$ ) in diameter, with low or well-developed stilt-roots. The crown is characteristic, formed by short, horizontal, whorled branches. The bark is fairly smooth, the slash and the latex pale yellow. The leaves are usually smaller than those of *Pentadesma*, and lack resin ducts. At the time of flowering the tree is very conspicuous with its clusters of red flowers. The fruits are ellipsoid or depressed globose, crowned with the remnants of the styles (see fig. 11 F). The tree is very common in the coastal swamps in the vicinity of Monrovia.

*Harungana madagascariensis*: a very common tree of the secondary forest, in the early stage of succession on a clearance often forming single dominant stands, growing up to 12 m ( $\approx 40'$ ) high and 15 cm ( $\approx 6''$ ) in diameter; also common as a roadside shrub.

The large, ovate leaves have numerous translucent points. The latex is orange or red and is used as an anodyne, being applied to circumcision wounds.

*Mammea africana* SABINE

[11/36]

'*Mammea*': latinised vernacular name from the Caribbean area.

'*africana*': referring to Africa, as opposed to *M. americana* L., the type species of the genus, found in America.

Sabine, Trans. Hort. Soc. London, V, p. 457 (1824); type: G. Don s.n., Sierra Leone (?); P. Staner, Bull. Jard. Bot. Bruxelles, 13, p. 101 (1934, lit!); J. J. F. E. de Wilde, Acta Bot. Neerl., V, 5 (2), p. 171–178 (lit!); *Ochrocarpus africanus* OLIVER in F.T.A., I, p. 169 (1863); type: Mann 1119 (K!); Engler in Nat. Pfl.fam., 2nd ed., XXI, p. 192 (1925, lit!).

*Mammea ebboro* PIERRE in Bull. Soc. Linn. Paris, t. 11, p. 1223 (1889); type: Klaine 27, 176, Gabon (P!); Engler l.c. p. 190;

*Mammea gillettii* DE WILDEMAN in Bull. Jard. Bot. Bruxelles, 4, p. 168 (1914); type: Gillett, Congo (BR!); Engler, l.c. p. 191;

*Mammea giorgiana* DE WILDEMAN, l.c. p. 169; type: de Giorgi 167, Congo (BR!); Engler l.c. p. 191.

- |   |  |
|---|--|
| 1927: F.W.T.A., 1st ed., I, p. 235 ( <i>O. africanus</i> )                          | 1951: Eggeling & Dale, Ind. Trees Uganda, p. 153 |
| 1931: Cooper & Record, Evergr. For. Liberia, p. 4 ( <i>O. africanus</i> )           | 1954: F.W.T.A., 2nd ed., I, p. 293               |
| 1933: Chalk & Burt Davy, Twenty W. Afr. Timber Trees, p. 54 ( <i>O. africanus</i> ) | 1955: Normand, A.B.C.I., II, p. 127; Pl. CX      |
| 1936: Aubréville, F.F.C.I., 1st ed., II, p. 284                                     | 1959: Aubréville, F.F.C.I., 2nd ed., II, p. 328  |
| 1936: Kennedy, F.F.S.N., p. 55 ( <i>O. africanus</i> )                              | 1959: Kryn & Fobes, Woods of Liberia, p. 69      |
| 1937: Dalziel, U.P.W.T.A., p. 92 ( <i>O. africanus</i> )                            | 1960: Taylor, Syn. Silv. Ghana, p. 174           |
| 1949: Bois & Forêts Trop., p. 433   | 1960: Keay, Nigerian Trees, I, p. 179            |
|   | 1961: Irvine, Woody Plants of Ghana, p. 148      |
|   | 1963: de Saint Aubin, La Forêt du Gabon, p. 161  |

LOCAL NAMES: mung (Gio); kunfe (Krahn), kaikumba (Mendi, cf. Cooper) bahn (Bassa, cf. Cooper); Mammee apple (popular name)

TRADE NAME: Oboto

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Congo, Uganda

BOTANY. A medium-sized to large tree. Branchlets slightly flattened and with an interpetiolar line at the nodes, slightly striate when young, lenticellate when older. Terminal bud sharp-pointed. Leaves simple, opposite, estipulate, thick-coriaceous, shining dark green above, medium green beneath, glabrous. Petiole 0.4–1.5 cm long, stout, grooved above. Blade narrowly elliptic, 12–26 cm long, 4–10 cm wide. Base obtuse – cuneate; margin entire, decurrent, slightly revolute; apex bluntly acute – abruptly acuminate. Midrib flat or impressed above, prominent beneath. Nerves numerous, very fine, slightly raised on both sides, ascending, anastomosing at some distance from the edge. Resin ducts usually absent, but sometimes present, crossing the nerves. Blade densely dotted with slightly raised glandular cells, translucent in not too old leaves.

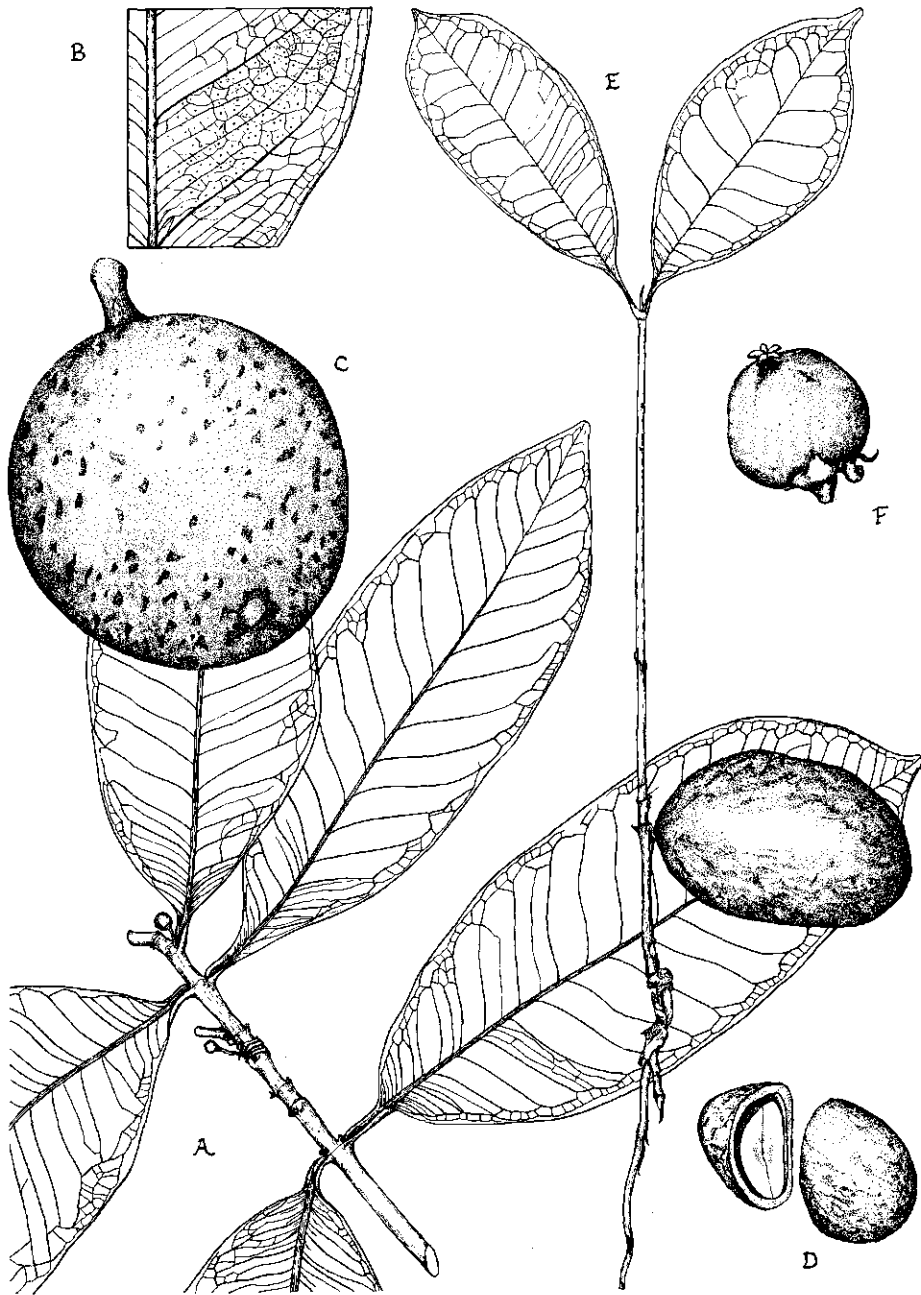


Fig. 11. *Mammia africana* SABINE A: branch with leaves and flower buds ( $\times \frac{1}{2}$ ); B: lower leaf surface detail, showing the glandular points ( $\times 1$ ); C: fruit ( $\times \frac{1}{2}$ ); D: split nut showing the seed inside ( $\times \frac{1}{2}$ ); E: seedling ( $\times \frac{1}{2}$ ); F: fruit of *Symphonia globulifera* LINN. f. ( $\times \frac{1}{2}$ ).



Flowers axillary, on leafy shoots and cauliflorous, hermaphrodite or unisexual (male). Hermaphrodite flowers solitary. Pedicel 3–4 cm long. Buds globular, the calyx closed in bud, opening with 2–3 valves. Petals 4, imbricate in bud, spreading when flowering, c. 3 cm long, 2 cm wide, white, very caducous. Stamens in a ring around the ovary, shortly connate at base; filaments c. 1 cm long. Anthers basifixed, laterally dehiscent. Ovary sessile, 2-locular with 2 ovules in each locule, or 4-locular by the formation of false septa, each locule with 1 ovule. Style compressed, thick. Stigma bilobed, the lobes spreading, 5 mm long and wide. Male flowers in fascicles of 1–7, much smaller than the hermaphrodite flowers. Pedicel 0.7–1 cm long. Petals c. 1 cm long, 0.5 cm wide. Stamens c. 5 mm long.

Fruit a large, more or less elliptic or globular drupe, 7–10 cm long, 5–8 cm across, pale yellow with numerous small, brown warts. Exocarp coriaceous. Mesocarp juicy, fibrous, pale yellow. Endocarp very hard and compact-fibrous, ellipsoid, 5–6 cm long, 3–4 cm across, forming separate coats around each seed. Seed in the endocarp c. 3 cm long, laterally flattened, 1.5–2.5 cm thick, with a thin testa and thick, slightly unequal-sized cotyledons.

Seedling: germination hypogeal, the cotyledons remaining enclosed in the endocarp. Epicotyl 15–30 cm long, with 3–5 pairs of opposite, pointed, black scales, at regular distances of 2–8 cm. Leaves opposite, with a reddish brown glow beneath when young. Base narrowly cuneate, the leaves narrowly obovate, papery.

**TAXONOMICAL NOTES:** The name *Mammea africana* was first published in an article by Sabine (1824, l.c.) dealing with the edible fruits of Sierra Leone. It is therefore incorrect to cite G. Don as author (Gen. Syst., I, p. 619, 1829), as was done by Staner (1936, l.c.).

Oliver (1863, l.c.) placed this species in the genus *Ochrocarpus* THOUARS, misinterpreting the seeds; he regarded the cotyledons as the radicle, and the radicle as reduced cotyledons.

Staner (1936, l.c.) argued that *Ochrocarpus africanus* was a synonym of *Mammea africana*, and de Wilde (1956, l.c.) demonstrated that *Ochrocarpus* could not be maintained as a separate genus.

The present description of the flower is mainly based on the literature, as only poor flowering material was collected in Liberia. The other descriptions are based on the following Liberian specimens: Zuole 1032, de Wilde 3753; Bong Range 348; Bomi Hills, de Wilde 3822.

**FIELD NOTES.** *Mammea africana* may grow up to a height of 40 m ( $\approx 130'$ ) and attain a diameter of 1 m ( $\approx 3.5'$ ) above the butt flares. When young the tree has heavy, low root swellings, which develop into narrow, thick and at the base knotty or bulging butt flares up to 3.5 m ( $\approx 12'$ ) high on old trees. The bole is straight, up to 27 m ( $\approx 90'$ ) to the first branches, cylindrical or somewhat angular. The crown is small, dense, dark green, with short, spreading, heavy branches. The leaves tend to droop. The bark is

fairly smooth, grey-brown on young trees, but soon scaly, dark brown; it is fairly thick, sometimes rough-scaly with large, irregular scales, leaving shallow, yellowish coloured impressions, which gives the bark a pitted appearance; sometimes there is a thick layer of dead, nearly black bark tissue.

The slash on the buttresses is pale to bright red, on the bole dark red, fibrous, fairly soft. In the slash wound the yellow latex first appears as small pin points, only after a while exuding slowly.

*Mammea africana* is found throughout Liberia, scattered through the high forest. Locally it may be fairly common. In the Nimba area it was observed at 900 m ( $\approx$  3000') above sea level. It seems to prefer moist, alluvial sites and may occur in swampy valleys. Flowering is irregular; flowers were collected during April. Fruits were found in January–February and June–July. Regeneration may occasionally be fairly abundant under the mother tree, c. 2 months after the fruits are shed, but usually the seeds are eaten by small mammals.

The tree is evergreen. New leaves appear in deep red flushes.

**SILVICULTURE** (cf. Taylor): *Mammea africana* has been used for underplanting purposes. It is a good shade-bearing species, growing slow but straight. For this purpose striplings of 1.5–2 years old from a nursery may be used, or the seeds are sown at stake. There are c. 12 seeds to a pound. Germination is irregular and may take 8 months; it may probably be stimulated by carefully filing a hole in the hard endocarp. Seed beds should have light overhead shade.

**USES:** The fruit-pulp of *Mammea* is edible, tasting sweet, somewhat stringy. It seems to be comparable in quality with the American Mammee apple (*Mammea americana*), but it is less in quantity. The bark is boiled to bring out the latex; this is collected and applied to skin infested with jiggers, which are killed. The bark is also used for catching fish, which are not killed but only stunned when the bark is placed in water of a dammed creek.

The wood is medium heavy, moderately hard, strong and tough. The frequent gumminess of the wood is an export drawback, but locally it may be used as a general utility timber.

*Pentadesma butyracea* SABINE

[12/35]

'*Pentadesma*': Gr. penta: five; Gr. desme: bundle. Referring to the stamens, which are grouped in five bundles.

'*butyracea*': L. butyrum: butter; referring to the yellow juice contained in the fruits and the seeds, which produces an edible fat.

Sabine in Trans. Hort. Soc. London, V, p. 457 (1824); type: G. Don s.n. (K!); Oliver, F.T.A., I, p.

164 (1863); Engler & Prantl, Nat. Pfl.fam., 2nd ed., XXI, p. 232 (1925, lit!);

*P. leucantha* A. CHEVALIER in Vég. Util., 5, p. 166 (1909); type: Chevalier 16290 (P!).

1927: F.W.T.A., 1st ed., I, p. 233

1931: Cooper & Record, Evergr. For. Liberia, p. 42

1936: Aubréville, F.F.C.I., 1st ed., II, p. 282

1936: Kennedy, F.F.S.N., p. 54

1937: Dalziel, U.P.W.T.A., p. 93

1941: Harley, Nat. Afr. Med., p. 52, 84

1954: F.W.T.A., 2nd ed., I, p. 291

1955: Normand, A.B.C.I., II, p. 129; Pl. CXI

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 326

1959: Kryn & Fobes, Woods of Liberia, p. 87

1960: Taylor, Syn. Silv. Ghana, p. 176

1960: Keay, Nigerian Trees, I, p. 177

1961: Irvine, Woody Plants of Ghana, p. 149

1961: Walker, Pl. Util. Gabon, p. 200

1963: de Saint Aubin, La Forêt du Gabon, p. 163

LOCAL NAMES: (u)wee-ti (Gio); waye, waye-kpay (Bassa, cf. Cooper)

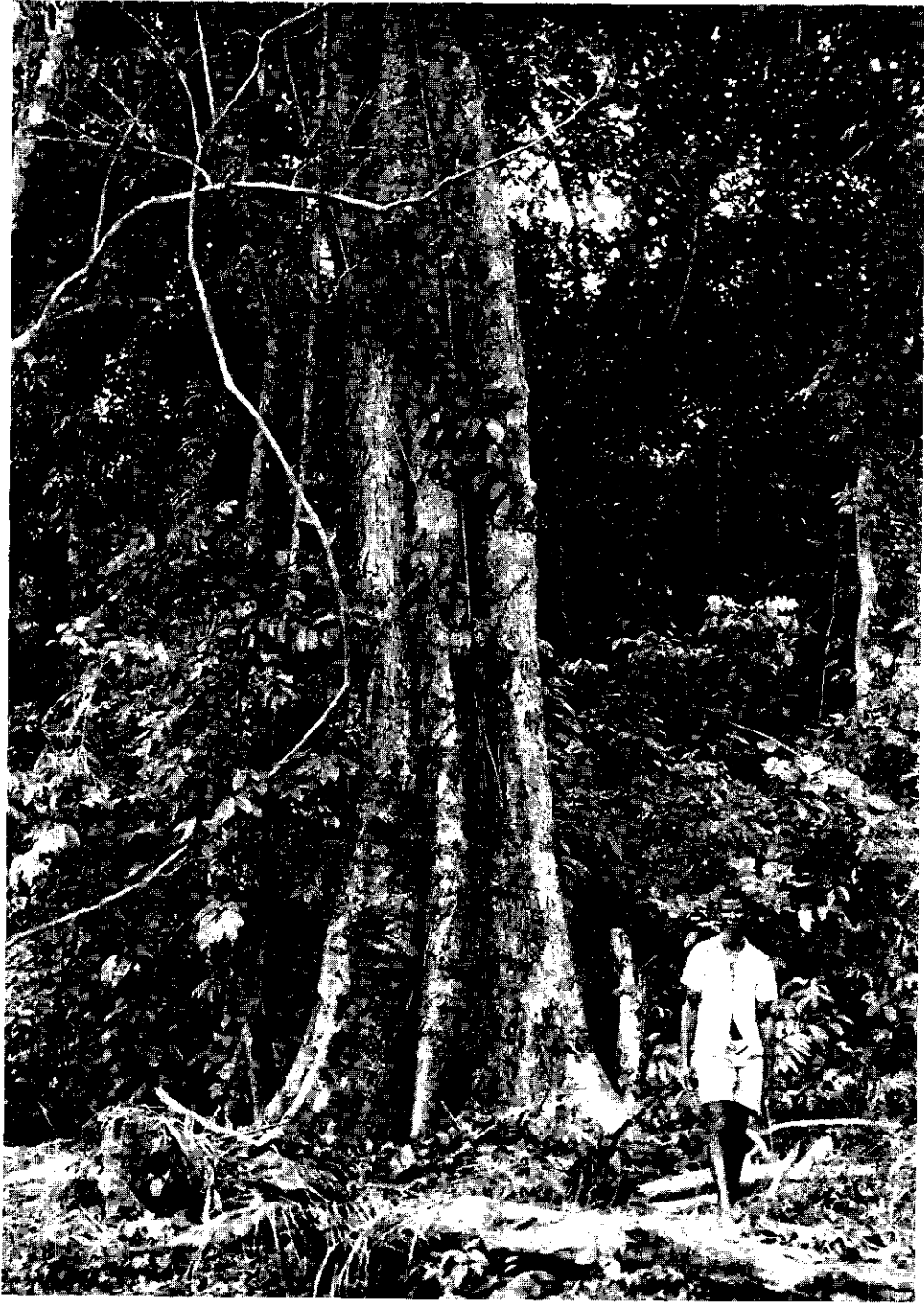
TRADE NAME: Kiasoso

GEOGRAPHICAL DISTRIBUTION: Guinea to Cameroon, (Congo?)

**BOTANY.** A medium-sized tree. Branchlets more or less angular, flattened at the nodes. Leaves simple, opposite, coriaceous, glabrous, shiny dark green above, pale beneath. Petiole 0.5–1 cm long, grooved above, the leaf margin distinctly decurrent. Blade (narrowly) elliptic to (–) obovate, 7–18 (–22) cm long, 3–7 cm wide. Base cuneate; margin entire, revolute; apex bluntly acute, often slightly recurved. Midrib finely raised or slightly impressed above, prominent beneath. Nerves numerous, very fine, scarcely raised on either side, ascending, parallel, joining a submarginal nerve. Network of resin ducts visible beneath as thin, wavy lines between the nerves, which are rarely crossed. New flushes of leaves dark red.

Inflorescences paniculate, stout, terminal, up to 35 cm long, few-flowered. Flowers large and showy, cream-coloured, solitary on 1–1.5 cm long secondary peduncles, nodding. Pedicels 2–3 cm long, slightly angular, broadened and articulate at base. Sepals 5, unequal-sized; the outer 2 not enclosing the corolla in bud, c. 3 cm long, 2 cm wide, concave, often with a notched apex; the inner 3 imbricate, enclosing the corolla in bud, in the open flower 4–6 cm long, 2–4 cm wide, broadly ovate, hardly different from the petals. Petals 5, imbricate, broadly ovate, 4–6 cm long, 2–4 cm wide, concave. Stamens numerous, grouped in 5 bundles, united at the base for c. 5 mm, slightly exserting from the flower at anthesis. Anthers c. 1 cm long, thin, hardly distinct from the filaments. Ovary sessile, ovoid, gradually tapering into a thick, elongated style, terminated by 5 linear, spreading lobes.

Fruit large and pendulous, ellipsoid or ovoid, up to 15 cm long and 10 cm across, crowned by the remnants of the style, at the base with the persistent sepals and the remnants of the stamen bundles. The skin is coriaceous, finely cracked, rough, brown. The fruit contains a variable number (3–15) of angular, often pyramidal, light brown seeds, 2–3 cm thick, imbedded in a yellow pulp, giving out a copious yellow, greasy juice when cut. Cotyledons not differentiated.



7. *Sacoglottis gabonensis* (BAILL.) URB.. Note the deeply ingrown bark (see page 119).



8. *Beilschmiedia mannii* (MEISN.) BENTH. & HOOK. f. (see page 123).

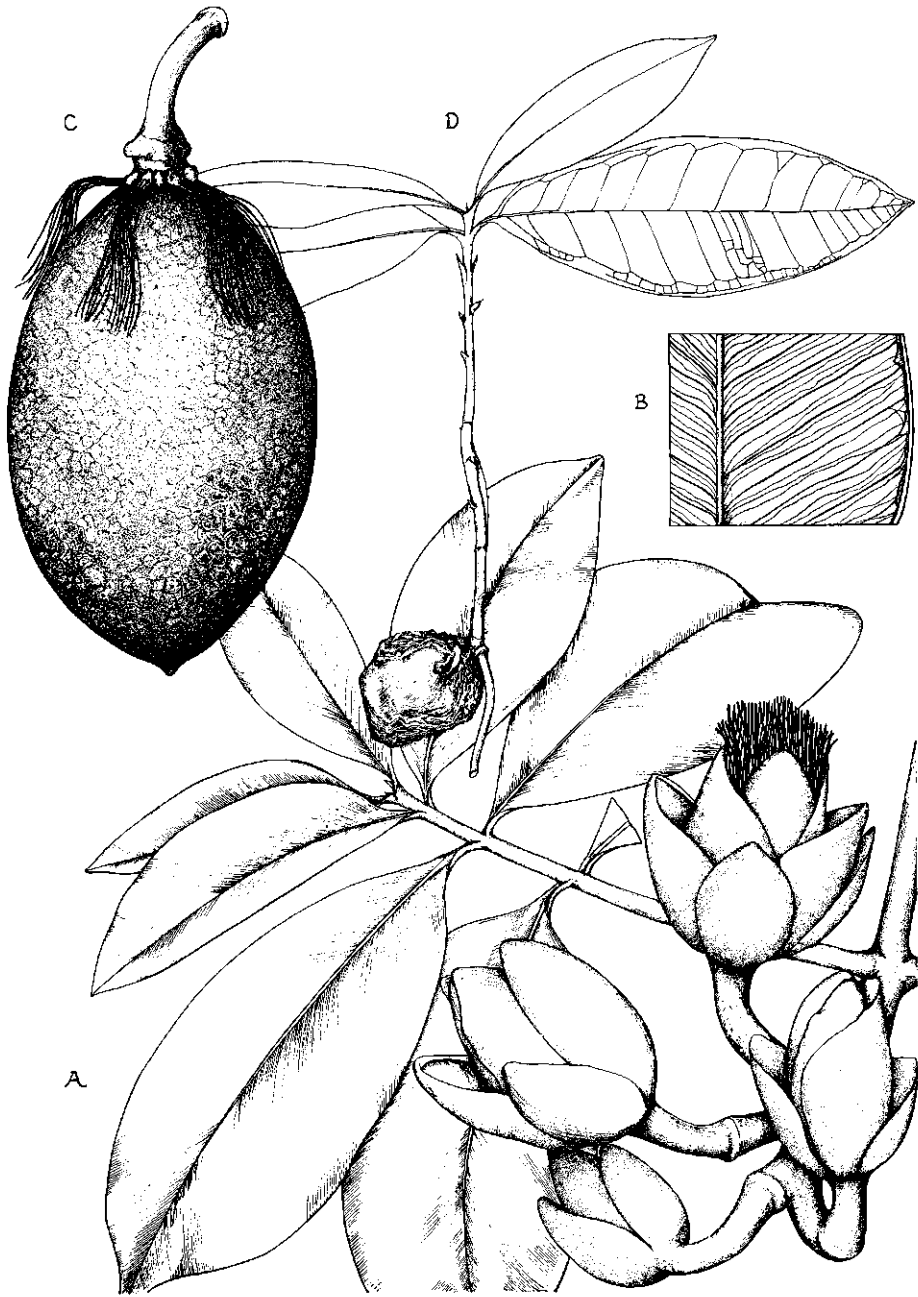


Fig. 12. *Pentadesma butyracea* SABINE A: branch with leaves and flowers ( $\times \frac{1}{2}$ ); B: lower leaf surface, showing the resin ducts between the nerves ( $\times 1$ ); C: fruit ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ).

Seedling: germination hypogeal, the cotyledons remaining in the seed coat. Epicotyl 8–15 cm long, reddish purple, red at the tip, with c. 8 pairs of small pointed scales at regular distances. Leaves opposite, papery, pink-red when young, similar to full grown leaves, but resin ducts crossing the nerves and glandular points sometimes present.

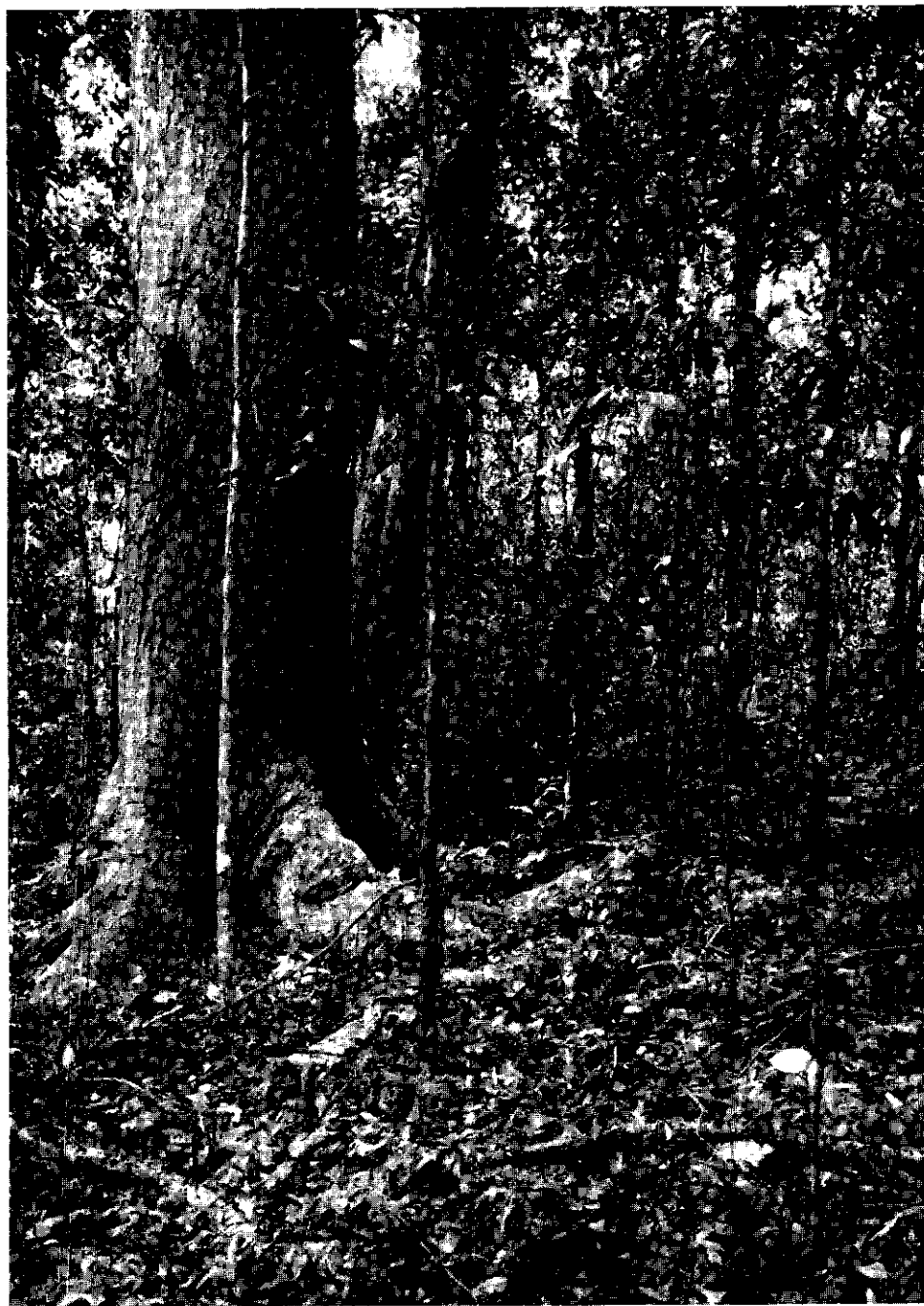
TAXONOMICAL NOTES. In F.W.T.A. (1954, l.c.) *Pentadesma grandifolia* BAK. f., *P. nigrifolia* BAK. f. and *P. kerstingii* ENGL. are cited as synonyms of *P. butyracea*. I was unable to trace the types of the third (Kersting 15, 452, Schröder 38, Doering 238, Togo). I have seen the fruits of *P. grandifolia* (Talbot 159, BM!) and found them very similar to the fruits of *P. exelleana* STANER of Congo: grooved and top-shaped, and altogether different from the fruits of *P. butyracea*. The type of *P. nigrifolia* (Talbot 1742, BM!) looks very similar to *P. butyracea*. The genus will be revised in a monograph to be published in the near future.

The present description and figures are based on the following specimens: Zuole area 10; Kle 432; Nyein 470; Nimba 913.

FIELD NOTES. *Pentadesma butyracea* is a medium-sized tree, which may reach a height of 30 m ( $\approx 100'$ ) and attain a diameter up to 75 cm ( $\approx 2.5'$ ). The base of the tree usually has low, thin root swellings when young, narrow buttresses or butt flares when old. It may occasionally be found with stilt-roots. The bole is straight and slender, or slightly sinuous, somewhat angular. The crown is small, dark green, with short, whorled, spreading, at the end slightly drooping branches. The bark is dark brown or nearly black, flaky with fairly large bark flakes and large, scattered lenticels, or fissured and with rectangular scales, medium thick. The slash is soft and brittle, not fibrous, light red or bright red, often with alternating tangential layers of darker and lighter tissue, yellow near the cambium. A pale, yellow latex exudes from the slash wound, most abundantly from the cambium layer.

*Pentadesma butyracea* is found throughout Liberia, both in the high forest and in secondary formations. Although as a rule growing scattered, it may form rich stands locally. In such a stand in the southern part of the Gbi National Forest it was observed that the bark of the trees was frequently stripped off by the elephants, that visited this forest at the fruiting season. This gave all the trees a rather knotty, rough-barked base. In addition, nearly all trees were forked in two or three part-stems, directly above the ground, or higher, up to a level of 3 m ( $\approx 10'$ ). The tree has a strong taproot and young trees, which are fairly common in secondary forest, may be difficult obstacles when the bush is cleared.

*Pentadesma* is an evergreen, shade-bearing tree. The flowering season more or less coincides with the rainy season. Immature fruits are often found under the trees between July and September. The main fruiting season is from October–March. The fruits fall complete, but the fat-containing seeds are soon eaten, and natural regeneration is poor. If the fruit remains unimpaired, the seeds germinate in the fruit, and up to



3. *Canarium schweinfurthii* ENGL.. Note the heavy, spreading surface roots (see page 78).





4. *Terminalia ivorensis* A. CIEV.. Note the dark, deeply grooved bark (see page 88).

six seedlings may be seen which are pushing their way up through the skin of the fruit.

USES. The yellow juice, exuded by the fruit and the seeds, contains a fat which is suitable for food or soap. The seeds have a red cross-section and have been used to adulterate true Kola, but they are easily distinguished as the cotyledons do not differentiate.

The wood is rather hard and heavy, and has a coarse structure. It is without any known commercial applications, but poles can be used as pit props.

## HUMIRIACEAE

A small family of woody plants, shrubs or trees, occurring in tropical South America (48 species, arranged in 8 genera) and in Africa along the gulf of Guinea, represented by a single species. Leaves alternate, simple, often distichous, pinnately nerved. Stipules present or absent. Flowers hermaphrodite, actinomorphic. Sepals 5, persistent, more or less connate. Petals 5, free. Stamens monadelphous, numerous and pluriseriate, or more definite in number (30–10) and 1–2 seriate. Ovary superior, as a rule formed by 5 carpels, 5-locular, each locule with 1 or 2 ovules. Fruits drupaceous; endocarp hard, often with resin-filled, round cavities.

This family is an important constituent of the American rain forest and other vegetation types.

*Sacoglottis gabonensis* (BAILL.) URB.

[7, 13/22, 242]

'*Sacoglottis*': Gr. sakos, sakkos: sack; Gr. glota: tongue; referring to the tongue-like connective separating the two pollen chambers.

'*gabonensis*': referring to Gabon, where the type specimen was collected.

Urban, *Martius Flora Braziliensis*, 12 (2), p. 449 (1877); Winkler in *Engl. & Harms Pfl.fam.*, 19a, p. 128 (1931); J. Cuatrecasas, *Contr. U.S. Nat. Herb.*, Vol. 35, part 2, A taxonomic revision of the *Humiriaceae*, p. 172 (1961, lit!);

*Aubrya gabonensis* BAILL., *Adansonia*, 2, p. 266 (1862), basionym; type: Aubry le Comptes.n., Gabon (P!); Oliver, *F.T.A.*, I, p. 275 (1868);

*Houmiri gabonensis* BAILL., *Hist. Pl.*, 5, p. 52 (1874).

1928: F.W.T.A., 1st ed., I, p. 274

1931: Cooper & Record, *Evergr. For. Liberia*, p. 49

1936: Aubréville, *F.F.C.I.*, 1st ed., I, p. 306

1936: Kennedy, *F.F.S.N.*, p. 72

1937: Dalziel, *U.P.W.T.A.*, p. 134

1950: Normand, *A.B.C.I.*, I, p. 146; Pl. LVI

1951: Exell & Mendonca, *Consp. Fl. Angol.*, I, p. 249

1958: F.W.T.A., 2nd ed., I, p. 355

1959: Aubréville, *F.F.C.I.*, 2nd ed., I, p. 368

1959: Kryn & Fobes, *Woods of Liberia*, p. 97

1960: Taylor, *Syn. Silv. Ghana*, p. 179

1960: Keay, *Nigerian Trees*, I, p. 237

1961: Irvine, *Woody Plants of Ghana*, p. 205

1961: Walker, *Pl. Utiles Gabon*, p. 203

1963: de Saint Aubin, *La Forêt du Gabon*, p. 170

LOCAL NAMES: dôh (Gio); tobœ (Krahn); dauh (Bassa, cf. Cooper); wuwi (Kpelle); k'wuo (Gola)

TRADE NAME: Ozouga; (Cherry)

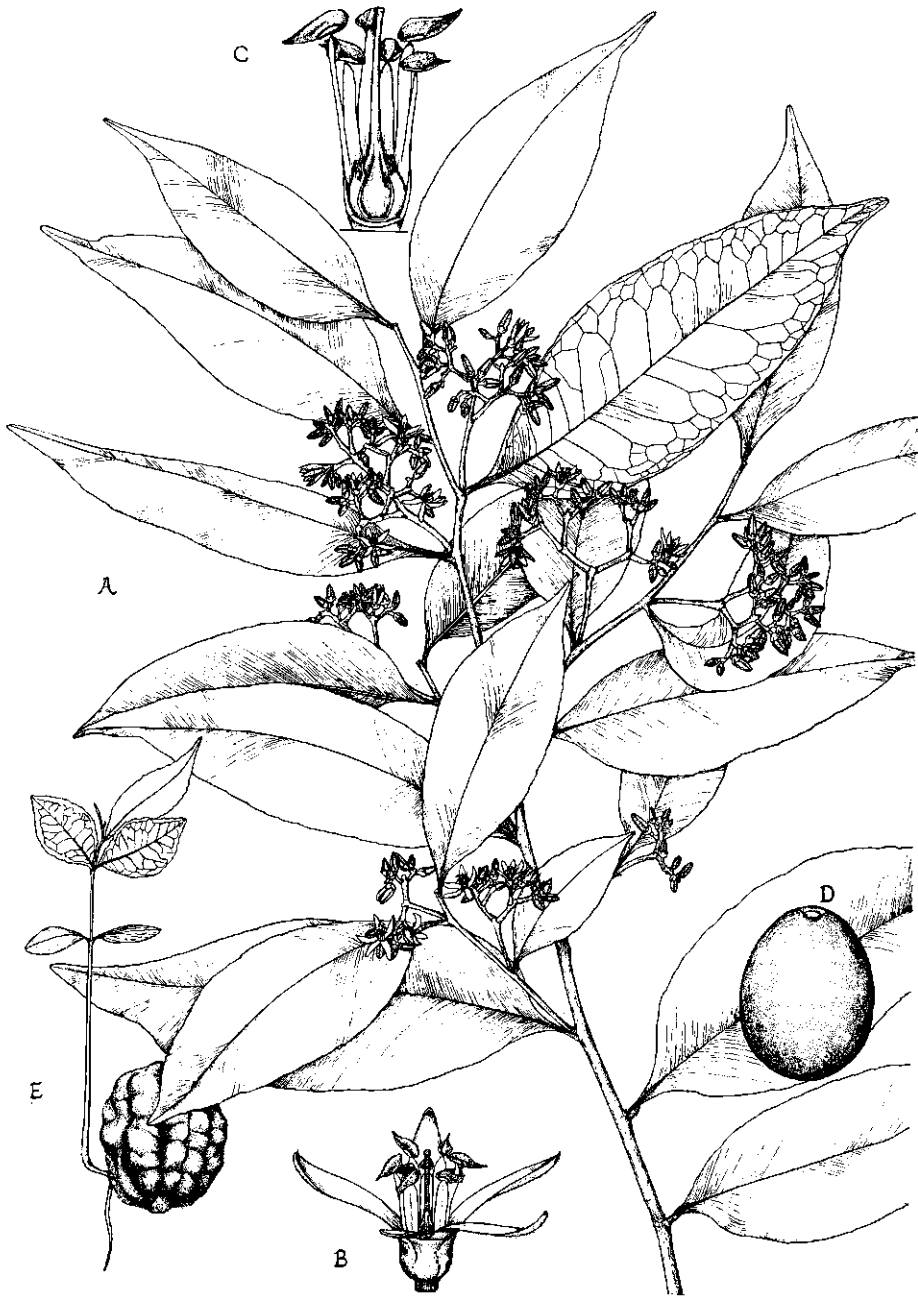


Fig. 13. *Sacoglottis gabonensis* (BAILL.) URB. A: branch with leaves and inflorescences ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: flower detail, showing stamens, laciniate disc and pistil ( $\times 5$ ); D: fruit ( $\times \frac{1}{2}$ ); E: seedling with nut ( $\times \frac{1}{2}$ ).

**GEOGRAPHICAL DISTRIBUTION:** Along the Gulf of Guinea, from Sierra Leone to Angola

**BOTANY.** A large forest tree. Leaves simple, alternate, more or less distichous, thin-coriaceous, dull, medium green. Stipules present, c. 1 mm long, very caducous (only present on young shoots and seedlings). Petiole 6–10 mm long, flat above, twisted at base, narrowly winged towards the top (margin decurrent). Blade (narrowly) ovate, (–) elliptic or (–) oblong, 6–15 cm long, 2.5–6 cm wide. Base (abruptly) cuneate; margin finely or distinctly crenate; apex acuminate – caudate. Midrib flat or slightly raised above, prominent beneath. Nerves rather faint, 6–12 pairs, anastomosing at some distance from the edge. Veins laxly reticulate.

Flowers hermaphrodite, in axillary cymes (compound dichasia). Peduncles stout finely puberulous. Bracts present, 1–2 mm long, c. 1 mm wide at base, slightly carinate, concave, puberulous outside, ciliate, caducous. Pedicel 0.5–1.5 mm long, stout, articulate at base, puberulous. Sepals 5, imbricate, not enclosing the corolla in bud, broadly orbicular, 1–1.5 mm long, puberulous outside, ciliate. Petals 5, imbricate in bud, slightly spreading at anthesis, linear, c. 7 mm long, c. 2 mm wide at base, tapering towards the apex, pubescent outside. Stamens 10, shortly connate at base, bimorph; filaments strap-shaped. Long stamens opposite the sepals, c. 5 mm long, 0.6 mm wide at the base, gradually tapering towards the top. Shorter stamens opposite the petals, c. 3.5 mm long, c. 1 mm wide, abruptly tapering at the apex. Anthers dorsifixed, with 2 ellipsoid thecae. Connective thick and prolonged, tongue-shaped, pointing outwards, c. 2 mm long on the larger stamens, laterally flattened and c. 1.5 mm long on the shorter stamens.

Disc intrastaminal, membranous, laciniate, 0.8–1.5 mm high. Ovary sessile, ovoid, c. 2 mm long, 1.5 mm across, glabrous, 5-locular, each locule with 1 ovule. Style grooved at base, c. 4 mm long, thick. Stigma terminal.

Fruit an ellipsoid or subglobose drupe, 3–4 cm long, 2.4–3.5 cm wide. Exocarp smooth, green or yellowish when ripe. Mesocarp fleshy-fibrous, hard when dry, 2–3 mm thick. Endocarp woody, bullate, slightly 10-sulcate, with resinous cavities. Seeds 1–3 (5?) in each nut, c. 1.5 cm long, c. 3 mm across.

Seedling: germination epigeal. The nut splits open (septicide) but the seed remains in the nut. Hypocotyl 6–9 cm long, glabrous. Cotyledons foliaceous, spreading, sessile, ovate, c. 1.5 cm long, 0.6 cm wide, palmate-veined. Epicotyl c. 2 cm long. First 2 leaves opposite, simple, sessile, ovate, 2–2.5 cm long, 1–1.5 cm wide, with dentate margin. Following leaves alternate, progressively larger, narrowly elliptic.

**TAXONOMICAL NOTES:** Cuatrecasas (l.c.) describes the shorter anthers with laterally flattened connective on the long stamens, the longer anthers on the short stamens, in contrast with what was observed in the Liberian material. He suggests that this African species and the American species *Sacoglottis amazonica* MART. are of common stock. Floating seeds of the ancestor of both species may have been carried to Africa by the

Brazilian current at some time in the Tertiary, to establish themselves on the African coast, evolution leading to the present closely related species on both continents.

The present description and figures are based on the following Liberian collections: Bong Range 32; Chien area 649; Duport 755=1055; Nimba 896; Bassa No. III, Siga 1104; Bomi Hills, v. Dillewijn 75; Bopolu, J. A. White s.n.

FIELD NOTES. *Sacoglottis gabonensis* is a large tree, reaching a height of up to 40 m ( $\approx$  130') and a diameter of up to 1.80 m ( $\approx$  6'); the largest specimen, recorded from Liberia, measured 4.5 m ( $\approx$  15') across above the buttresses. The base of the tree is irregular; it may have wide-spreading surface roots, thick and stout, narrow or spreading, transversely ridged buttresses, or it may be deeply fluted. The buttresses may be as high as 2.5 m ( $\approx$  8'), extending along the bole in heavy, swollen ridges. The bole is rarely straight, often crooked and knotty, sometimes angular but mostly deeply fluted, usually branched at a fairly low level. Occasionally relatively well-shaped trees with a free bole up to 20 m ( $\approx$  66') are found. The crown is very large and wide-spreading, heavily branched, rounded, fairly open. Several trees with a crown were observed, covering nearly half an acre. The bark of young trees may be fairly smooth, with broad, horizontal lenticels. Older trees have a (dark) brown, medium thick, very scaly bark with longitudinal scales and numerous pustulate lenticels. The bark has often an untidy habit. The slash is brittle-fibrous, brown to red-brown, producing a hissing sound for a few minutes after being slashed. The slash wound is moist or exudes a clear, sticky amber-brown sap, often with an odour somewhat resembling sugar cane.

The tree is evergreen; it is very common throughout Liberia. The flowering season lasts from December–March. The fruits are ripe in September–October. Fruit-bearing is copious. The tree may be quite gregarious; it is often found on bottom lands, but also on higher grounds and rocky hills. Rich stands were found in the southern part of the Gbi National Forest, crossed by a dense labyrinth of wide bush roads. During the months September and October elephants visit these forests in quest of the fruits, which are then abundant. The mesocarp of the fruits is edible and sweet.

The tree is unique in its poor shape and not likely to be confused with any other species. From a silvicultural point of view the tree is less desirable, dominating with its large crown considerable parts of the forest and repressing any regeneration of valuable timber species. The deeply fluted stem and furrowed and ingrown bark make it difficult to eliminate by poisoning. Felled trees tend to coppice. The natural regeneration is not very abundant, the seeds often being bored by insects. Taylor reports that three to five nuts weigh one ounce and that the germination period is c. four months.

USES. The bark of the tree is sometimes added to palm wine for use by men. It seems to make the wine bitter and to act as a strong aphrodisiac.

The wood is hard and heavy. Commercial utilisation of the timber seems unfeasible, owing to the poor shape of the bole, but the wood is reported to give a good charcoal,

## LAURACEAE

A mostly tropical and subtropical family, poorly represented in Africa, in Liberia only by trees and shrubs of the genus *Beilschmiedia* NEES, and a parasitic herb, *Cassytha filiformis* L.. Leaves simple, alternate or subopposite, pinnately nerved, or reduced (in *Cassytha* L.). Stipules absent. Flowers small, hermaphrodite, actinomorphic. Calyx lobes usually 6, petals absent. Stamens in 4 whorls of 3, the inner whorl as a rule reduced to staminodes; filaments often glandular at base. Anthers continuous with the filaments, introrse, or the third whorl extrorse, the thecae opening from the base upwards by flaps. Ovary superior, 1-celled, with 1 ovule.

All parts have aromatic oil-glands, and the crushed leaves and the slash are fragrant.

*Beilschmiedia mannii* (MEISN.) BENTH. & HOOK. f. [8, 14 A-D/28, 258]

'*Beilschmiedia*': named after Karl Traugott Beilschmied (1793–1848), a German chemist and author of a number of books on the geography of plants.

'*mannii*': named after G. Mann (1835–1916), a German gardener and plant collector who took part in an expedition to the Gulf of Guinea (1859–1862), collecting many new species.

Bentham & Hooker f. in *Genera Plantarum*, 3, I, p. 158 (1880); Kostermans, *Revision of the Lauraceae* V, Med. Bot. Mus. Herb. Rijksuniv. Utrecht, 48, p. 837–865 (1938); Robyns & Wilczek, *Bull. Jard. Bot. Bruxelles*, 19, p. 459 (1949); 20, p. 197 (1950);

*Oreodaphne mannii* MEISSNER in *DC. Prod.*, XV, 1, p. 130 (1864); type: Mann, Gabon (K!);

*Beilschmiedia elata* SCOTT ELLIOTT in *Journ. Linn. Soc.*, XXX, p. 96 (1895); type: Scott Elliott 4400, 5125, Sierra Leone (K!);

*Afrodaphne mannii* (MEISN.) STAFF in *Journ. Linn. Soc.*, XXXVII, p. 111 (1905);

*Afrodaphne elata* (SC. ELLIOTT) STAFF, l.c.;

*Tylostemon mannii* (MEISN.) STAFF in *F.T.A.*, VI, 1, p. 178 (1913);

*Tylostemon longipes* STAFF non BENTH., 1913, l.c.; type: Mann 2255 (K!);

*Tylostemon stapfiana* ROBYNS & WILCZEK, 1949, l.c. = *T. longipes* STAFF;

*Beilschmiedia djalonensis* A. CHEVALIER in *Fl. Viv.*, I, p. 40 (1938), illegitimate name (French description only), partly, quoad Chevalier 18888 (P!);

? *Beilschmiedia bitehi* AUBRÉV., in *F.F.C.I.*, 2nd ed., I, p. 162 (1959) (French description only).

1928: *F.W.T.A.*, 1st ed., I, p. 61 (*T. mannii*, *T. longipes*)

1931: Cooper & Record, *Evergr. For. Liberia*, p. 20 (*T. mannii*)

1936: Aubréville, *F.F.C.I.*, 1st ed., I, p. 128 (*T. mannii*)

1938: A. Chevalier, *Fl. Viv. Afr. Occ. Fr.*, I, p. 35

1950: Normand, *A.B.C.I.*, I, p. 89; Pl. XIX

1951: Robyns & Wilczek, *Fl. Congo Belge*, II, p. 409–442

1954: *F.W.T.A.*, 2nd ed., I, p. 57



Fig. 14. *Beilschmiedia mannii* (MEISN.) BENTH. & HOOK. f. A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: open flower, some parts removed ( $\times 8$ ); C: fruit ( $\times \frac{1}{2}$ ); D: seed, with 2 distinct cotyledons ( $\times \frac{1}{2}$ ).

*Combretodendron macrocarpum* (P. BEAUV.) KEAY E: branch with leaves and fruits ( $\times \frac{1}{2}$ ); F: lower leaf surface, showing the pits in the axils of the nerves ( $\times 2$ ); G: open flower ( $\times 2$ ).



1959: Aubréville, F.F.C.I., 2nd ed., I, p. 162 (*B. bitehi*)

1960: Keay, Nigerian Trees, I, p. 64

1961: Irvine, Woody Plants of Ghana, p. 26

LOCAL NAMES: kwintofi (Gio); zoe-kpoe (Bassa, cf. Cooper); Cedar

TRADE NAME: Kanda

GEOGRAPHICAL DISTRIBUTION: Guinea–Congo

**BOTANY.** A medium-sized or large tree. Young branchlets and buds densely pubescent, glabrescent. Leaves alternate or subopposite, simple, when young pubescent on petiole and midrib, glabrescent. Petiole 0.8–1.5 cm long. Blade elliptic, (4–) 7–20 cm long, (2–) 3.5–8 cm wide, markedly folded and recurved, arcuate, coriaceous, glossy above, slightly so beneath, fragrant when crushed. Base obtuse – cuneate; margin slightly decurrent along the petiole; top acute to acuminate. Midrib flat above, prominent beneath. Nerves not very prominent beneath, 5–10 pairs, anastomosing at some distance from the edge. Reticulation of veins distinct.

Inflorescences axillary, towards the top of the branchlets, racemose, 4–15 cm long; when young the primary peduncles densely pubescent, the ultimate peduncles, pedicels, and flower buds with scattered hairs; at anthesis the inflorescence glabrous. Bracts c. 5 mm long, 2.5 mm wide, acute, caducous. Pedicel 1–3 mm long, articulate at the top. Perianth, including the 6 ciliate, c. 1 mm long, imbricate lobes 2–3 mm long, greenish, cupuliform, pubescent inside. Fertile stamens 9, in 3 whorls. Filaments of the outer 2 whorls laterally flattened, conical, pubescent on both sides, c. 1 mm long and 1 mm wide at base. Anthers sessile, 0.5 mm long, introrse, apiculate, opening with 2 flaps. Filaments of the inner whorl narrower, with 2 dorsal, glabrous, more or less reniform, 0.5 mm large glands, attached at the base. Anthers 0.3 mm long, sessile, lateral or subextrorse. Staminodes 3, between the inner whorls of stamens, 1 mm long. Pistil sessile, glabrous. Ovary globular, 1 mm across, 1-locular, containing 1 ovule. Style c. 1.5 mm long, tapering; stigma small.

Fruit red when ripe and fresh, 4–5.5 cm long, 1.5–2.2 cm thick, spindle-shaped or often slightly oblique, containing a single seed. When dry the thin testa becomes detached from the two thick, conical-shaped cotyledons, which are easily separated.

**TAXONOMICAL NOTES.** The African species of the pantropical genus *Beilschmiedia* NEES have been dealt with to some extent by Robyns & Wilczek (1949, 1950, l.c.) but their treatise, prepared for the Congo species, does not cover the West African species. In particular pubescence and habit of the inflorescences seem to be variable and depending on age. *Beilschmiedia djalonensis* A. CHEV., in F.W.T.A. 1954 cited as an imperfectly known species, is based on a mixture of species, of which I identified Chevalier 18888 as *B. mannii*, and Chevalier 34574 as *B. foliosa* (S. MOORE) ROBYNS & WILCZEK, using the key in F.W.T.A., l.c.

According to the description of Aubréville (1959, l.c.) the species *B. bitehi* AUBRÉV. must be identical with the present species.

The present description and figures are based on the following specimens: Tapeta area 147; Chien area 644; Kanweake 999; Bomi Hills 839, de Wilde 3831; Voinjama area, Baldwin 9880 (K); Du River, Cooper 384 (K).

FIELD NOTES. *Beilschmiedia mannii* may reach a height of 35 m ( $\approx 120'$ ), and occasionally a diameter of 1 m ( $\approx 3.5'$ ), though trees are not usually so heavy. The base is provided with heavy root swellings or low, sharp, narrow buttresses up to 1 m ( $\approx 3.5'$ ) high, which occasionally may form butt flares of up to 3 m ( $\approx 10'$ ) high on steep slopes. The bole may be straight and cylindrical, up to 20 m ( $\approx 66'$ ) to the first branches, but more commonly it is slightly angular and sinuous. The crown is fairly narrow, dense and dark green. The bark is grey-brown or brown, often with large, thin, irregular bark scales, under the scales densely covered with numerous small lenticels. The slash is thin to medium thick, pinkish red to pinkish brown, turning red-brown on exposure, brittle, moist, with a strong cedar-like smell, somewhat like a 'plum' (*Mangifera indica* L.).

The tree is evergreen. It is found scattered throughout the high forest in Liberia, though locally it may be more abundant (south of the Putu range). The flowering season is from January to April. Ripe fruits were found in November. The tree is not very conspicuous in the forest, but the strong fragrant slash is diagnostic, differing from the other trees with a fragrant slash (*Pachypodanthium*, *Canarium*, *Dacryodes*, *Entandrophragma cylindricum*, *Lovoa*, *Guarea cedrata*, *Turraeanthus*) in being red-brown in colour.

USES. The flowers are used to spice rice (cf. Cooper). The fruits are one of the ingredients of 'palaver sauce'. The wood makes a pleasant, red-brown, medium hard and medium heavy, scented timber, which keeps its fragrance after being sawn and dried. It is very easy to work. The sapwood is distinct, pale yellow or creamy, nearly odourless.

## LECYTHIDACEAE

A pantropical family of trees and shrubs. Leaves simple, alternate, pinnately nerved, estipulate. Flowers hermaphrodite, usually rather large and showy, actinomorphic or zygomorphic. Sepals 4–6; petals 4–6, rarely more or absent, free or united in a campanulate tube, and then with many ribs. Stamens numerous, in several series, sometimes the outer ones sterile, resembling a corona. Filaments mostly basally united. Anthers basifixed, opening by slits. Disc present. Ovary inferior or subinferior, 2- or more celled, with 1–∞ ovules. Style mostly simple. Fruit a berry or fibrous or woody, indehiscent or opening apically.

The family is represented in Liberia by two genera: *Combretodendron* A. CHEV. and *Napoleona* P. BEAUV.. *Napoleona leonensis* HUTCH. & DALZ. is a shrub or small understory tree with flowers, sitting like medals on the branches or the old wood.

*Combretodendron macrocarpum* (P. BEAUV.) KEAY

[14 E-G/88, 170]

'*Combretodendron*': *Combretum*, a genus of the *Combretaceae*; Gr. dendron: tree; 'tree resembling a *Combretum*', referring to the very similar fruits of both taxa.

'*macrocarpum*': Gr. makros: large; Gr. karpos: fruit; 'with large fruits'.

Keay in F.W.T.A., 2nd ed., I, p. 761 (1958).

*Combretum macrocarpum* P. DE BEAUVOIS in Fl. Owar., 2, p. 90, t. 118, fig. 2 (1820); type in G;

*Petersia africana* WELW. ex BENTH. & HOOK. f. in Gen. Pl., I, p. 721 (1867); type: Welwitsch s.n. (K!);

*Petersia minor* NIEDENZU, Engl. & Prantl. in Nat. Pfl.fam., III, 7, p. 31, fig. 12 (1892); type: the cited figure;

*Combretodendron viridiflorum* A. CHEV. in Vég. Util., 5, p. 150 (1909); type: Chevalier 16102 (P!);

*Petersia viridiflora* (A. CHEV.) A. CHEV., l.c. p. 301;

*Petersianthus africanus* (WELW. ex BENTH. & HOOK. f.) MERRILL, in Philipp. Journ. Sci., 11 C, p. 201 (1916);

*Petersianthus minor* (NIEDENZU) MERRILL, l.c.;

*Combretodendron africanum* (WELW. ex BENTH. & HOOK. f.) EXELL in J. Bot., 68, p. 182 (1930).

1927: F.W.T.A., 1st ed., I, p. 204 (*Petersia africana*)

1936: Aubréville, F.F.C.I., 1st ed., III, p. 35 (*P. africana*)

1936: Kennedy, F.F.S.N., p. 40 (*C. africanum*)

1937: Dalziel, U.P.W.T.A., p. 69 (*P. africana*)

1941: Harley, Native Afr. Med., p. 50 etc. (*C. africanum*)

1954: F.W.T.A., 2nd ed., I p. 242 (*C. africanum*)

1959: Aubréville, F.F.C.I., 2nd ed., III, p. 45 (*C. africanum*)

1959: Kryn & Fobes, Woods of Liberia, p. 34 (*C. africanum*)

1960: Normand, A.B.C.I., III, p. 34; Pl. CXXI

1960: Taylor, Syn. Silv. Ghana, p. 181 (*C. africanum*)

1960: Keay, *Nigerian Trees*, I, p. 134

1961: Walker, *Pl. utiles Gabon*, p. 214 (*C. africanum*)

1961: Irvine, *Woody Plants of Ghana*, p. 106

LOCAL NAMES: pèh (Gio); kpa (Mano); tuntue, tutwo (Krahn)

TRADE NAME: Abale

GEOGRAPHICAL DISTRIBUTION: Guinea – Angola

**BOTANY.** A large forest tree. Young shoots finely puberulous, more or less glabrescent. Very young shoots have a pair of minute scales at the base of the petiole, suggesting rudimentary stipules. Leaves more or less in terminal tufts, simple, alternate, puberulous on the petiole, with scattered hairs on the blade when young, glabrescent, papery, medium green. Petiole 0.5–1 cm long, narrowly winged. Blade (narrowly) elliptic or obovate, (3–) 6–16 cm long, (1–) 4–7 cm wide. Base narrowly cuneate; margin entire or slightly undulate, decurrent; apex obtusely acute to acuminate. Midrib raised above, prominent beneath. Nerves prominent beneath, 6–10 pairs, not markedly looping, each nerve with a large glandular pit in the axil.

Inflorescences short (sub)terminal racemes, up to 10 cm long, puberulous. Bracts and bracteoles 3–4 mm long, c. 1 mm wide, caducous. Pedicels 1.5–2 cm long, puberulous, jointed below the middle, where the bracteoles are attached, the lower part persistent when the flowers are shed, the upper part accrescent when a fruit is formed. Receptacle winged with 4 ciliate wings, alternating with the sepals. Sepals 4, broadly ovate, c. 2 mm long and wide, broadly attached to the receptacle, finely ciliate, not covering the corolla in bud. Petals 4, white – pale green, imbricate in bud, broadly elliptic, c. 7 mm long and wide, concave, minutely dentate, very caducous. Stamens numerous, united at base, forming a staminal tube of c. 2 mm high; free filaments c. 8 mm long, folded in bud, sinuous at anthesis. Anthers basifixed, 0.5 mm long, with 2 free thecae, opening by slits. Stamens very caducous. Disc intrastaminal, swollen. Ovary inferior, 2-locular; style straight, c. 10 mm long.

Fruit spindle-shaped, 3–5 cm long, papery and fibrous, with 4 thin, papery, half-orbicular, up to 7 cm long and 3.5 cm wide, reticulately veined wings, containing only one seed or very often sterile.

Seedling (cf. Taylor): germination epigeal. Hypocotyl c. 5 cm long, green. Cotyledons foliaceous, sessile, spreading, elliptic, c. 1.7 cm long, 0.8 cm wide. Base broadly cuneate, apex obtuse. Leaves spirally arranged immediately above the cotyledons, progressively larger, with a serrulate margin.

**TAXONOMICAL NOTES.** The fruits of *Combretodendron* A. CHEV. closely resemble those of *Combretum* LOEFL. (the wings of *Combretum* fruits are not reticulately veined). Having only fruits at his disposal, Palisot de Beauvois thought he was dealing with a species of *Combretum*, and named it *Combretum macrocarpum* P. BEAUV. (1820, l.c.).

The same species was again described as *Petersia africana* by Bentham and Hooker f. (1867, l.c.) this time correctly in the family *Lecythidaceae*. Chevalier (1909, l.c.) when describing his collections from Ivory Coast at first made the same mistake as P. de Beauvois when he described a monotypic new genus *Combretodendron* (a single species, *C. viridiflorum* A. CHEV.), in *Combretaceae*. However, later in the same publication (l.c. p. 301) he corrected this mistake, asked his readers to ignore his remarks about *Combretodendron*, and renamed his species *Petersia viridiflora* (A. CHEV.) A. CHEV..

Merrill (1916, l.c.) while studying the only other species of this genus, which occurs on the Philippines, concluded that the name *Petersia* could not be maintained for this genus, since Klotsch had used the name six years before Bentham & Hooker for a genus of *Capparidaceae* (in Peters, *Reise Mossamb. Bot.*, p. 168, 1861). Merrill therefore renamed the genus *Petersianthus*, creating the new combination *Petersianthus africanus* (WELW. ex BENTH. & HOOK. f.) MERRILL. Exell (1930, l.c.) argued that if *Petersia* was not to be maintained, the name *Combretodendron* of Chevalier had priority over *Petersianthus*, and he created the new combination *Combretodendron africanum* (WELW. ex BENTH. & HOOK. f.) EXELL, placing *C. viridiflorum*, *Petersia* and *Petersianthus* in synonymy. Keay, while working on the revision of the F.W.T.A., identified the *Combretum macrocarpum* of P. de Beauvois as a *Combretodendron*. Since the name *Combretum* had to be maintained for the genus of the *Combretaceae*, *Combretodendron* is the correct generic name. However, the specific epithet *macrocarpum* has priority over *africanum*, and the correct name of the tree is *Combretodendron macrocarpum* (P. BEAUV.) KEAY.

The present description and figures are based on the following Liberian collections: Zuole area 192, 759, 1132, 1278; Nimba area 1068; Chien area, s.n.; Ganta, Harley s.n.

**FIELD NOTES.** *Combretodendron macrocarpum* may reach a height of 45 m ( $\approx$  150') and occasionally a diameter of 1.80 m ( $\approx$  6'), though usually trees are not over 1.20 m ( $\approx$  4') thick. The base of the tree has heavy root swellings, sometimes forming short, heavy buttresses or butt flares up to 3.5 m ( $\approx$  12'). The bole may reach a free height of 24–30 m ( $\approx$  80–100'); the lower part is often fluted with heavy ridges, the upper part straight and cylindrical. The crown is fairly dense, with ascending branches, not spreading. The bark is dark or medium brown, fairly thick, as a rule fairly deeply grooved and flaky with longitudinal flakes. The slash is soft and long-fibrous, pink or pinkish red on younger trees, nearly white on older trees, yellowish near the cambium, often with pale yellow vertical stripes of dilatation tissue under the bark grooves.

In Liberia the tree seems to be most common in the northern regions, in the moist semi-deciduous forest. It becomes less common in the evergreen forest. It grows scattered or in groups, and avoids swamps. The tree stands bare for a short time at the end of the dry season, the leaves becoming red before they are shed (a rare phenomenon in

the tropical rain forest). Flowering is irregular, and may occur at all seasons but seems more usual from November–January and April–June. At this time the ground under a flowering tree is covered by a carpet of shed petals and staminal crowns, and the air is heavy with a penetrant, quite unpleasant smell. Fruit bearing is also irregular; the fruits remain attached to the tree for a long time; they are dispersed by wind. Regeneration is rather scarce, most of the fruits being empty or deteriorating as soon as they fall. Yet Aubréville (1959, l.c.) reports the tree as invading secondary formations. There are c. 300 seeds to an ounce; the germination period is about three weeks (cf. Taylor). Felled trees may coppice.

The tree should not be confused with *Erythroxylum mannii* OLIV.. As a rule this is a smaller tree, but when large it may also have a fluted base, a dark, grooved bark and a soft, fibrous slash. However, its slash is pink or pinkish brown, rapidly turning bright brown on exposure, and the leaves are narrowly elliptic, with a pair of false nerves, parallel to the midrib.

**USES.** The bark of the tree is used for various medical purposes (see Irvine, 1961, l.c.).

The wood is hard and heavy, and has a strong tendency to split. It is therefore less suitable for railway sleepers and heavy construction timber. It is liable to fungus attack, but resists insects, including termites; it has so many unfavorable characteristics that it is not likely to be of value for general use. It seems to provide a good fuel wood. It has an extremely unpleasant smell when sawn fresh. In Ghana it is called 'stinkwood'.

## LEGUMINOSAE

A large, cosmopolite family of trees, shrubs, climbers, and herbs. Leaves pinnately nerved, simple, pinnate or bipinnate, alternate, stipulate, sometimes with stipels. Inflorescences paniculate, racemose or spicate. Flowers hermaphrodite, actinomorphic or zygomorphic, with a pistil, formed by a single, superior, 1-celled carpel. Fruit a dehiscent or indehiscent legume.

The *Leguminosae* are subdivided in three sub-families, which are distinguished as follows:

1. a. Flowers actinomorphic; the often synpetalous corolla valvate in bud; leaves mostly bipinnate, very often gland bearing *Mimosoideae*
- b. Flowers zygomorphic; the nearly always choripetalous corolla predominantly imbricate in bud; leaves as a rule not bipinnate 2
2. a. The adaxial petal innermost *Caesalpinioideae*
- b. The adaxial petal outermost; corolla papilionaceous (the two abaxial petals connate, forming the keel) *Papilionoideae*

The three sub-families are often treated as three independent families, or as two families, viz. *Mimosaceae* and *Papilionaceae*, the *Caesalpinioideae* incorporated in the *Papilionaceae*.

### Sub-family CAESALPINIOIDEAE (family CAESALPINIACEAE)

A pantropical sub-family of trees and shrubs, rarely herbs or lianas. Bracteoles sometimes large and enclosing the bud, sometimes small or absent. Sepals 5 or 4 (then the adaxial sepals united), imbricate or valvate in bud, free or partially connate, sometimes much reduced or absent in which case their function is taken over by the bracteoles. Petals 5 or less or absent, imbricate. Stamens usually 10, sometimes less, rarely numerous, free or variously connate. Anthers usually opening by slits, sometimes by pores.

This sub-family forms the dominant factor in the upper stratum of the Liberian high forests. At present 55 tree-forming species, divided over 29 genera, are known from Liberia, and this number will undoubtedly increase.

Of these 55 species at least 37 may grow into the A-story of the high forest, and a few of these are emergent trees (*Amphimas*, *Brachystegia*, *Daniellia*). The other 18 species usually belong to the B-story of the forest. In the C-story this family is poorly represented; young trees of the upper story species, however, are frequently seen.

The trees are for the larger part evergreen; new flushes of limp, pendent leaves are often red, or purple, more rarely pallid or speckled. Many species flower inconspicuously, owing to the generally small and dull coloured flowers; however, quite a few species have showy flowers: *Polystemonanthus dinklagei* HARMS (yellow-brown); *Gilbertiodendron splendidum* (A. CHEV. ex HUTCH. & DALZ.) J. LÉONARD, *G. ivorense* (A. CHEV.) J. LÉONARD (pink); *Berlinia* spp. (white); *Afzelia* spp. (red); *Bussea* (bright yellow); *Cryptosepalum* (white); *Paramacrolobium coeruleum* (TAUB.) J. LÉONARD (blue); *Amphimas* (cream); *Chidlowia sanguinea* HOYLE (wine red). The bark often is smooth and greyish, especially when young. Buttresses are less common than in *Mimosoideae*, but if present mostly heavy and fairly low, rarely plank-like and high reaching as is usual in *Mimosoideae*. Ripple marks are always present in a number of species, present or absent in a few, or not present at all.

The sub-family is mostly found in the high forest; in secondary forest and low bush it is poorly represented (*Crudia senegalensis* BENTH., *Anthonotha macrophylla* P. BEAUV., *Amphimas*). Only a few species grow in swamps (*Gilbertiodendron* spp., *Loesenera kalantha* HARMS), but many are most commonly found at river borders (*Monopetalanthus pteridophyllus* HARMS, *Plagiosiphon emarginatus* (HUTCH. & DALZ.) J. LÉONARD, *Didelotia afzelii* TAUB., *Afzelia bracteata* T. VOGEL ex BENTH.). Some species are gregarious and locally form dominant forests (*Chidlowia sanguinea* HOYLE and *Stachyothyrsus stapfiana* (A. CHEV.) J. LÉONARD & VOORHOEVE in the B-story of the forest, *Cynometra* spp., *Gilbertiodendron preussii* (HARMS) J. LÉONARD, *Loesenera kalantha*, *Monopetalanthus compactus* HUTCH. & DALZ., *Tetraberlinia tubmaniana* J. LÉONARD in the A-story of the forest). A few species, which are large trees in the inland high forest occur as small shrubby trees in the coastal belt (*Daniellia thurifera* BENN., *Didelotia idae* OLDEMAN, DE WIT & LÉONARD, *Berlinia confusa* HOYLE).

21 tree species are discussed at some length below; reference is made to 23 other species. In F.W.T.A., 2nd ed., p. 439–484, 7 more tree species than in this book are cited as occurring in Liberia. In addition another four species have proved to be present: *Tessmannia baikiaeoides* HUTCH. & DALZ. (Nimba); *Chidlowia sanguinea* HOYLE (wide-spread); *Gilbertiodendron aylmeri* (HUTCH. & DALZ.) J. LÉONARD (Bong Range, Bomi Hills), and *G. limba* (SC. ELLIOTT) J. LÉONARD (N. Gio Nat. For.).

*Afzelia bracteata* T. VOGEL ex BENTH.

[9, 15/43]

'*Afzelia*': named in honour of Adam Afzelius, a Swedish botanist (1750–1837) who visited Sierra Leone in 1792 and from 1794 to 1796. His first collection was destroyed when the French captured and destroyed Freetown, but his second collection is preserved at Uppsala (Sweden).

'*bracteata*': referring to the large persistent bracts in the inflorescences.

Benthams in Hooker Ic. Pl., t. 790 (1848); type: T. Vogel s.n., Sierra Leone (K!); *ibid.* in Hooker Niger Flora, p. 325, t. 34–35 (1849); Baker f., Leg. Trop. Afr., p. 701 (1930); J. Léonard, Reinwardtia, Vol. I,



p. 61–66 (1950); *ibid.*, G.C.A.a., p. 106–108 (1957, lit!).

*Intsia bracteata* (VOGEL ex BENTH.) O. KUNTZE, *Rev. Gen. Pl.*, I, p. 192 (1891).

1868: F.T.A., 2, p. 301

1928: F.W.T.A., 1st ed., I, p. 344

1931: Cooper & Record, *Evergr. For. Liberia*, p. 60

1936: Aubréville, F.F.C.I., 1st ed., I, p. 216

1937: Dalziel, U.P.W.T.A., p. 172

1950: Normand, A.B.C.I., I, p. 127; Pl. XXXIII

1958: F.W.T.A., 2nd ed., I, p. 461

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 264

1959: Kryn & Fobes, *Woods of Liberia*, p. 4

LOCAL NAMES: smar ne-eh (Bassa, cf. Cooper); glegonyangga-gli (Gio); pabetue (Krahn)

TRADE NAME: Doussié; *Afzelia*

GEOGRAPHICAL DISTRIBUTION: From Senegal to S.W. Ivory Coast

**BOTANY.** A small or medium-sized, occasionally large tree of the secondary- and high forest. Branches bearing the leaves glabrous. Leaves paripinnately compound, alternate, stipulate. Stipules intrapetiolar, only present in seedlings, water shoots and very young branchlets, up to 15 mm long, 5 mm wide, sickle-shaped, the proximal margin straight, the distal margin curved, connate at their base, early caducous but the basal part persistent as a small rim in the leaf axil. Leaves 10–18 cm long, with (2–) 3–5 pairs of leaflets or longer and with 6 pairs in saplings and young trees; 3-jugate leaves usually at the top of the branchlets, carrying the axillary inflorescences. Petiole 1.3–3.7 cm long, jointed at base; petiole and rachis with a thin groove above; upper part of the rachis sometimes sparsely pubescent when young. Petiolules 2–5 mm long, twisted, glabrous or sparsely pubescent. Leaflets opposite, ovate–elliptic or oblong or obovate, coriaceous, glabrous, 4–10 (–12.5) cm long, 1.5–4 cm wide, medium green, rather conspicuously reticulate on both surfaces, especially on the lower surface, glossy above, dull or slightly glaucescent beneath, more or less oblique. Base rounded or obtusely cuneate; apex obtuse and shortly cuspidate or bluntly acute. Midrib flat or slightly impressed above, prominent beneath. Nerves not pronounced beneath, 6–9 (–15) pairs.

Inflorescences axillary or terminal, branched or unbranched racemes; peduncle, bracts, pedicel, bracteoles, and outer surface of the calyx densely grey-greenish puberulous. Bracts present, green, up to 10 mm long and 7 mm wide, normally a bit smaller, soon recurved and persistent until the time of flowering, sometimes longer persistent. Pedicels 5–8 mm long; bracteoles c. 7 mm long, 4 mm wide, opposite, imbricate in bud, soon caducous. Calyx tube 1–1.5 cm long, 2–3 mm thick, hollow; inside pubescent near the throat, elsewhere glabrous except the trace of the stipe. Calyx lobes 4, yellowish green, imbricate in bud, spreading when flowering, glabrous inside except at the base and on the margin, obovate, 1–1.4 cm long, 0.8–1 cm wide, with rounded apex and truncate base. Petal one, well developed; claw pale yellowish green outside, 2–4 cm long, c. 2 mm wide, outside and margin pilose, inside glabrous; lamina transversely elliptic, c. 1 cm long and 2 cm broad, bilobed, reniform, carmine-red inside, white out-

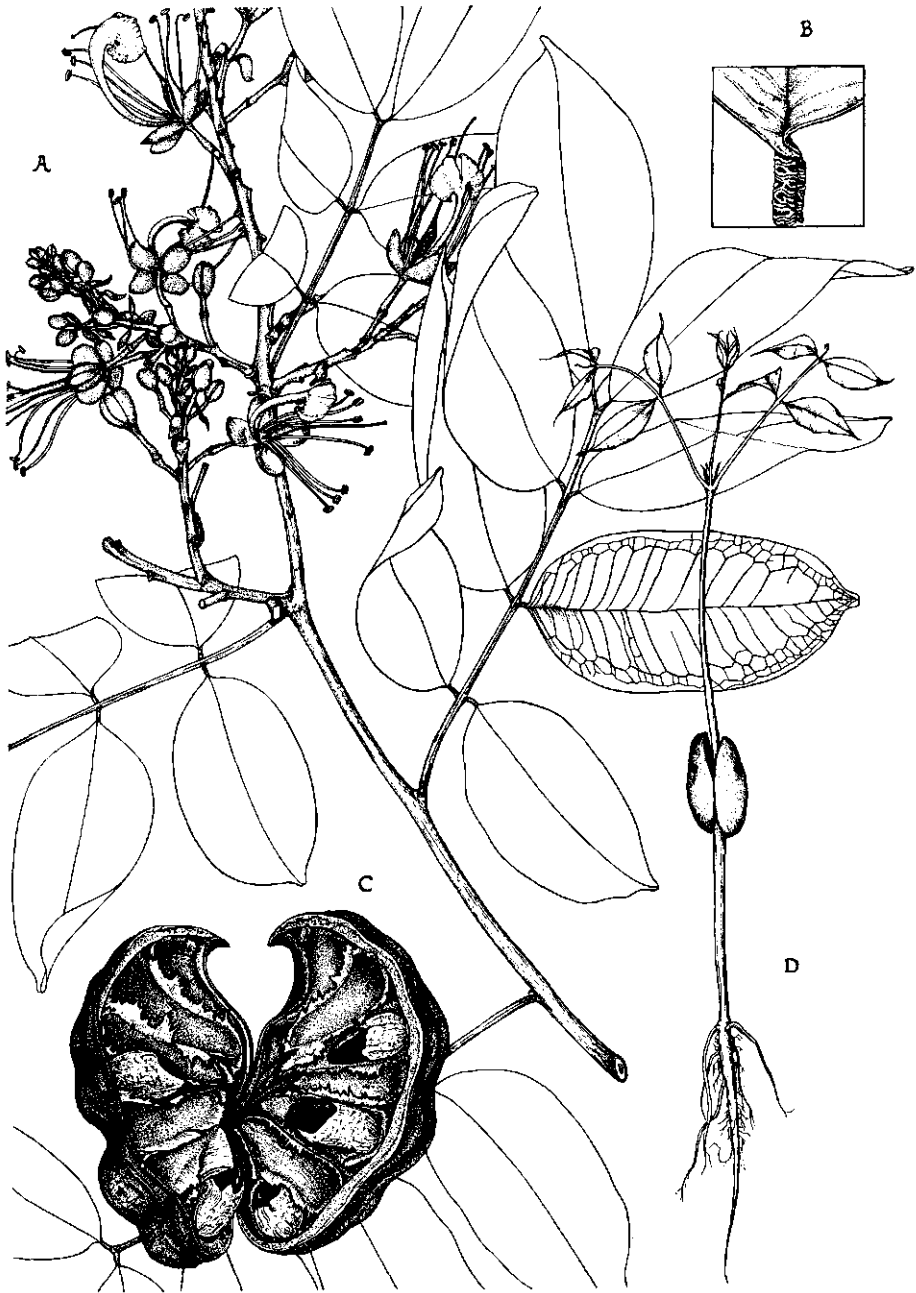


Fig. 15. *Afzelia bracteata* T. VOGEL ex BENTH. A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: twisted petiolule ( $\times 4$ ); C: open fruit with seeds ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ).

side. Stamens 7, sometimes with one or two staminodia present at the base of the claw, shortly connate at base except the stamens adjacent to the petal. Filaments at base pilose and purplish, otherwise glabrous, yellowish green, slender, 2.5–3.5 cm long. Anthers dorsifixed, c. 2 mm long, opening by slits. Pistil stipitate; stipe c. 2 mm, pilose. Ovary flattened, one-celled, villous on the ventral suture. Style at anthesis slightly exceeding the stamens, pilose on the lower part. Stigma: the slightly increased top of the style, minutely papillate.

Fruit when ripe a thick, laterally flattened, black, woody, curved, stoutly and laterally stalked, dehiscent pod, up to 12 cm long, 5.5 cm broad and 3 cm thick, containing 4–9 black, arillate seeds. Seeds rounded or laterally flattened, 2–3.5 cm long, up to 1.8 cm broad and 1 cm thick; aril bright orange-red, covering the seed totally on one side and more or less half on the other.

Seedling: germination epigeal. Hypocotyl c. 12 cm long, glabrous, light brown. Cotyledons sessile, thick and fleshy, elliptic, base and apex rounded, 2–3 cm long, 1 cm wide, not spreading, pressed against the 12–17 cm long, glabrous, green epicotyl. First pair of leaves opposite, 1–2 (4, Léonard, 1957, l.c.) jugate, petiolate, stipulate. Stipules linear, 5–8 mm long. Petiole 3–3.5 cm long, rachis up to 3.5 cm long, terminated by an 0.5–1.5 cm long, linear point. Petiolules 2–3 mm long, twisted. Leaflets opposite, as described above but with a long acuminate apex. Following leaves alternate.

TAXONOMICAL NOTES. *Afzelia bracteata* is generally reported as a small tree, usually on river banks, occurring from Senegal to Ivory Coast. *Afzelia bella* HARMS var. *gracilior* KEAY is described as a tall forest tree, occurring from Liberia to Ghana. The two species may be distinguished as follows:

*A. bracteata*:

Inflorescences with bracts up to 1 cm long, persistent until flowering, sometimes longer. Calyx tube up to 1.5 cm long.

*A. bella* var. *gracilior*:

Inflorescences with small, extremely caducous bracts. Calyx tube over 1.5 cm long.

The leaflets of *A. bracteata* tend to be more elliptic (even slightly obovate) and obtuse than the leaves of *A. bella* var. *gracilior*, which are more oblong and bluntly acute. These differences, however, are bridged by a series of intermediate forms. The reticulation of the leaflets varies between very faint and conspicuous. In Liberia, where the two species meet, the leaflets are not suitable for identification.

The fruits resemble each other. The pod of *A. bella* var. *gracilior* is reported to be small, and generally contains few seeds but exceptions are known. *A. bracteata* usually has a well-developed fruit, but may bear small and few-seeded pods.

*A. bella* HARMS var. *bella* which occurs from Nigeria to Congo, has a calyx tube of 1–2 cm long, and so represents an intermediate form between *A. bracteata* and *A. bella* var. *gracilior*. It may therefore be asked whether the three taxa (*A. bella* var. *bella*, var. *gracilior*, and *A. bracteata*) form one species occurring from Senegal to Congo, possi-

bly with three varieties. Pending further information (which would necessitate long and detailed research in a botanical garden) the generally adopted view is followed. At any rate *A. bracteata* will be maintained, being the first name for the combined taxa, or as a separate species.

*A. bella* var. *gracilior* was reported by Karl Mayer (9) from the western province; it was found by me in the Gio Nat. Forest as an understory tree. Most specimens of *Afzelia*, collected in Liberia, represent *A. bracteata*.

Cooper (1931, l.c.) describes the tree as 70–80 ft. high, and in 1962 de Wilde collected material from a tree, 25 m ( $\approx 80'$ ) high. Unfortunately no flowering specimens were collected from forest trees over 30 m ( $\approx 100'$ ) high, which still leaves open the question whether the tallest *Afzelia*'s in the high forest of Liberia are *A. bracteata* or *A. bella* var. *gracilior*, or both. Based on the collection of leaves and fruits of a tall tree (No. 586), which were tentatively identified as *A. bracteata*, the assumption is made here that *A. bracteata* reaches its optimal growth in the wet evergreen forest, but does not grow high in the drier regions of its distribution area, and that it is *A. bracteata* which is most commonly found in the Liberian high forest. It is very doubtful that *A. africana* Sm. would occur in Liberia (reported by Karl Mayer (9) and referred to by Kryn & Fobes (l.c.)).

The present descriptive data, considerations, and figures are based on the following specimens:

*A. bracteata*: Liberia: Bomi Hills 137 A; Zuole area 211, 600, 1226, de Wilde 3751; Paynesville 496, 1134; Gbi Nat. For. 586, 593 (alc. coll.); Bopolu 944; W. Nimba Nat. For. 107; Haindee, Leeuwenberg 4971; Cess R., Baldwin 11266 (K); Ganta, Harley 1361; Sierra Leone: Thomas 911 (K); Senegambie: Heudelot 882 (P); Ivory Coast: Aubréville 1325 (P).

*A. bella* var. *gracilior*: Liberia: Gio Nat. Forest 288; Ivory Coast: Aubréville 190, 581 (P); Chevalier 16589 (P); Chevalier 22478 (K); Ghana: Andoh 5815 (P); Andoh 5811 (K, type).

*A. bella* var. *bella*: Nigeria: F.H.I. 30141 (K); Br. Cameroons: sine collectore, 142 (K); Cameroon: Zenker 347 (WAG); Congo: Corbisier 1722 (G).

FIELD NOTES. *Afzelia bracteata* occurs as a small tree near rivers and in fringing forest but also as a medium-sized or large tree in the evergreen and moist semi-deciduous high forest, up to 35 m ( $\approx 110'$ ) high and 0.60–1 m ( $\approx 2$ –3') in diameter (but see also taxonomical notes). The base of the tree has usually medium-sized, concave, thick and narrow buttresses (sometimes rather developed and as high as 2 m ( $\approx 7'$ )) extending as ridges on the bole). Bole often poorly shaped, curved and angular, but sometimes straight and round, usually short and early forked. Crown quite deep, with heavy, ascending branches. Bark medium-thick, fairly hard, with numerous small, brown lenticels and a characteristic yellowish brown colour, especially on the lower part of the stem, which makes the tree easily detectable. The bark is rough and irregularly scaly,

the scales leaving walled, shallow, more or less parallel or concentric scars, 'mussel-shell markings'. Slash with a fresh smell, dark yellow, fine-granular outside, fibrous inside. Fine, usually wavy ripple marks often conspicuous in the cambium.

The tree is deciduous for a short period in October–November. The flowering season is from April–September, fruits were found from August–December. The fruits open on the tree with two valves and remain attached long after the seeds have dropped. The seeds are eaten by monkeys. Regeneration is rare in the high forest, not uncommon in secondary bush.

**USES.** The bark of *Afzelia* is used in a craw-craw medicine (Gio). Sapwood and heartwood are distinct, the sapwood straw-coloured, the heartwood reddish brown–dark brown. It is rather hard and heavy, coarse-textured and with straight or interlocked grain. The sapwood is stained by fungi, the heartwood is durable and decay resistant. It is suitable for building, cabinet making, etc.

*Amphimas pterocarpoides* HARMS

[16/41, 262]

'*Amphimas*': Gr. amphi: all around; Gr. imas: strap, lash; referring to the strap-like lobes of the petals, surrounding the central part of the flower.

'*pterocarpoides*': Gr. pteris: wing; Gr. karpos: fruit; referring to the papery, winged fruits, which characterize *Pterocarpus* JACQ., a papilionaceous tree.

Harms, Fedde Rep., XII, p. 12–13 (1913); type: Mildbraed 4515, S. Cameroon (?); Baker f., Leg. Trop. Afric., p. 690 (1930); Wilczek, Fl. Congo Belge, III, p. 548 (1952).

1928: F.W.T.A., 1st ed., I, p. 371

1931: Cooper & Record, Evergr. For. Liberia, p. 74

1936: Aubréville, F.F.C.I., 1st ed., I, p. 183

1936: Kennedy, F.F.S.N., p. 119

1937: Dalziel, U.P.W.T.A., p. 227

1950: Normand, A.B.C.I., I, p. 121; Pl. XXXII

1958: F.W.T.A., 2nd ed., I, p. 448

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 252

1959: Kryn & Fobes, Woods of Liberia, p. 11

1961: Irvine, Woody Plants of Ghana, p. 363

**LOCAL NAMES:** gworluh, guorluh (Gio); vahn-chu (Bassa, cf. Cooper)

**TRADE NAME:** Bokanga

**GEOGRAPHICAL DISTRIBUTION:** Guinea to Cameroon, Congo, and Sudan

**BOTANY.** A medium-sized or large tree. Young shoots densely brown pubescent. Branchlets shortly brown pubescent, glabrescent; older branches slightly scurphy, sometimes with scattered hairs. Leaves in tufts at the end of the branches, imparipinnately compound, stipulate, sparsely pubescent, glabrescent. Stipules c. 1 cm long, 0.5 cm wide, acuminate, brown pubescent, enclosing the terminal bud, caducous, leaving scars on the branchlets at the base of the petiole. Stipels 2–4 mm long, filiform, pubescent, ca-

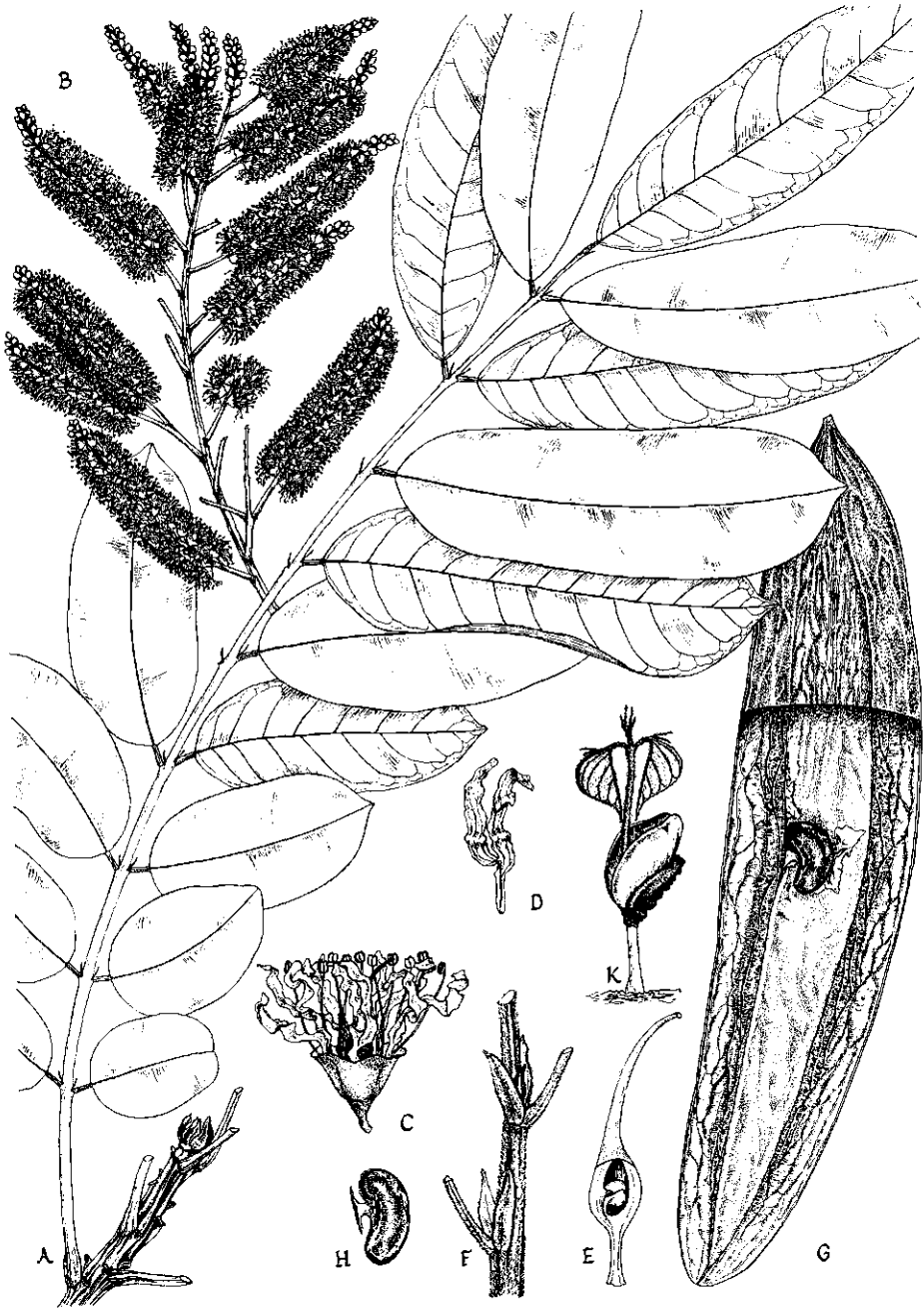


Fig. 16. *Amphimas pterocarpoides* HARMS A: branch with leaf ( $\times \frac{1}{2}$ ); B: inflorescence ( $\times \frac{1}{2}$ ); C: open flower ( $\times 3$ ); D: petal ( $\times 3$ ); E: length section of ovary ( $\times 5$ ); F: young shoot with large stipules ( $\times \frac{1}{2}$ ); G: fruit, partially opened ( $\times \frac{1}{2}$ ); H: seed ( $\times \frac{1}{2}$ ); K: seedling, first stage ( $\times 1$ ).

duccous. Petiole 2.5–4.5 cm long, rachis 12–30 cm long (sometimes longer). Leaflets opposite or almost so, distinctly reticulate on both surfaces, 13–19, the lower pairs smaller than the upper pairs, often different in shape, (2–) 4.5–12 cm long, (1.5–) 2–4 cm wide, on the lower part of the leaf ovate to broadly or narrowly elliptic; at the middle and upper part (narrowly) elliptic–oblong or obovate. Terminal leaflet often obovate. Petiolules 2–4 mm long. Base of leaflet rounded or cordate; apex bluntly acute, retuse or emarginate. Midrib flat or slightly impressed above, prominent beneath, puberulous or glabrous. Nerves conspicuous beneath or rather faint, 7–10 (–15) on each side of the midrib. Stellate-scaly hairs sometimes present beneath near the midrib. Leaves of water shoots often much larger and more densely pubescent, except on the leaflets above, with rather persistent stipules up to 2 cm long, and persistent stipels up to 0.8 cm long. Leaflets subopposite or alternate, 7–21, very variable,  $2.5 \times 1$  cm –  $22 \times 12.5$  cm large, rounded or cordate at base, bluntly acute or acuminate at the top.

Inflorescences compound, terminal racemes, c. 20 cm long, sometimes with very small (c. 10 cm long) pinnate leaves on the peduncle. Peduncle, pedicels and the outside of bracts and calyx densely brown puberulous. Bracts 1–1.5 mm long (7 mm, F.W.T.A. 1958, l.c.), glabrous inside, caducous. Bracteoles absent. Pedicel c. 1 mm long. Receptacle funnel-shaped, c. 1 mm high, papillate inside, carrying the calyx, petals and stamens on the rim. Calyx closed in bud, splitting open with 5 short, regular, flat, triangular lobes, pale villous inside; calyx tube c. 1.5 mm long, c. 2 mm wide when open. Petals 5, pale cream coloured, c. 6 mm long, glabrous; claw c. 1.5 mm long, 0.2 mm wide; lamina c. 4.5 mm long, deeply bilobed with c. 3.5 mm long, 1 mm wide lobes. Stamens 10, c. 5 mm long, glabrous, slightly connate and not swollen at their base, forming a staminal tube of 0.3 mm high. Filaments subequal. Anthers dorsifixed, with two bean-shaped thecae, 0.4 mm long, opening by slits. Pistil c. 7 mm long, glabrous. Ovary stipitate, c. 2.5 mm long, flattened, containing two ovules; stipe c. 1 mm long; style c. 3.5 mm long, slightly curved; stigma concave, hardly thicker than the style.

Fruit a stiff-papery, thin, flat, pendulous pod, golden brown when dry, 12–22 cm long, 4–5.5 cm wide, with a c. 1 cm broad, smooth margin and a reticulate central part, opening by two valves, each or only one with one dark brown, flattened, reniform seed, c. 2 cm long and 0.8 cm thick.

Seedling: germination epigeal. All young parts are densely ferruginous pubescent except the leaves, which are glabrous above. Hypocotyl 3–4 cm long, soon woody. Cotyledons curved sideways, slightly spreading, 1.5–2 cm long, c. 6 mm wide, thick and fleshy, green, rounded at the apex, shortly sagittate at base. Epicotyl 5–6 cm long. First two leaves simple, opposite, stipulate. Stipules interpetiolar, c. 8 mm long, parallel veined, bifid at the apex. Petiole 1–1.8 cm long, with two filiform stipels at the top. Petiolule 2 mm long; blade very broadly ovate to orbicular, c. 5 cm long, 3.5–4.5 cm wide; apex long acuminate to caudate; margin ciliate, base cordate. Following leaves alternate, normally stipulate, the third and the fourth leaves unifoliolate, the fifth trifoliolate etc.

TAXONOMICAL NOTES. The name *Amphimas* was first used by Pierre, a French botanist, who attached this name to herbarium material collected by Klaine in Gabon (1899). The name was first (not validly) published in Dalla Torre and Harms, Gen. Siphon., III, p. 220, 1901.

In 1908 Harms described the genus, including two species: *A. klaineanus* PIERRE ex HARMS and *A. ferrugineus* PIERRE ex HARMS (Nat. Pfl. fam., Nachtr. III, z. III, p. 157). Harms was not sure of the systematical position of this genus within *Leguminosae* and placed it tentatively in the tribe *Sophoreae* (*Papilionatae*): 'For the time being I have placed them in the *Sophoreae*, which already include so many different things' (translated).

Pellegrin in Not. Syst., II, p. 266 (1911) completed the genus and species descriptions, based on new material received from Africa, and created the tribe *Amphimanteae* in *Caesalpinioideae* for this genus. Harms (1913, l.c.) added two more species to the genus: *A. tessmannii* HARMS and *A. pterocarpoides* HARMS.

Baker (1926, l.c.) maintained the four species. Wilczek (1952, l.c.) considered the differences between *A. klaineanus* and *A. ferrugineus* to be insufficient for two distinct species and maintained only *A. ferrugineus*.

*A. ferrugineus* and *A. pterocarpoides* differ by ferruginous-pubescent leaflets, a pubescent ovary and stamens with a thickened base, united in a tube of 1–2 mm (in *A. ferrugineus*). *A. tessmannii* (Type Tessmann 6, (?)) has not been mentioned in the literature since Baker. According to the description it might be synonymous with *A. pterocarpoides*. In this case the specific name '*pterocarpoides*' is likely to be maintained.

The present description and figures are based on the following Liberian specimens: Bong Range 337; N. Gio Nat. For. 152, 197, 1058; Zuole area 598; Nimba area 880.

FIELD NOTES. In Liberia *Amphimas pterocarpoides* is found all over the country, perhaps more frequently in the drier regions. It may be a very large tree of the high forest, sometimes reaching a height of 50 m ( $\approx$  160') and a diameter above the buttresses rarely exceeding 1.20 m ( $\approx$  4'), but it is more common as a medium-sized tree in secondary formations. Large forest trees have well-developed, narrow or spreading, straight buttresses, up to 1.50–2 m ( $\approx$  5–7') high and 10 cm ( $\approx$  4") thick. The bole is straight and cylindrical, up to 25 m ( $\approx$  80') to the first branches; trees in young secondary forest are often crooked. The crown is dense, dark green, half globular with ascending branches in the high forest, but almost globular when the tree is standing free. The bark of young trees is smooth and grey, but soon becomes scaly. Mature trees are dark brown, scaly, often with a thick layer of dead bark. The slash is medium thick, brittle, mottled white, orange, brown, and black; dominant colour orange-brown. A blood-red sticky sap slowly exudes from the slash wound. Ripple marks are fairly conspicuous. This characteristic slash type is most unusual in the Liberian forest; only once a papilionaceous tree was found with a similar slash.

The tree is deciduous in October, November. The flowers open when the leaves are



shed and at that time the trees are well marked in the landscape as creamy white patches extending above the low bush. The flowers are heavily and sweetly fragrant and seem to attract mosquitos. New leaves appear during December–January. The fruits ripen in January–February. They may be widely dispersed by the wind, owing to their thin papery quality. The tree is a light demander and regeneration is most common in the low bush and on open places. Germination is fast, but the seedlings rest for a few weeks after the first pair of leaves is formed. Saplings are straight and unbranched until a few feet high.

USES. The red sap is used for treating dysentery (cf. Cooper). The wood is hard and heavy, yellowish brown. The parenchyma is distributed in broad, tangential bands of a lighter colour. Sawn timber has a lively striped pattern. It is only occasionally utilized in Liberia.

*Anthonotha fragrans* (BAK. f.) EXELL & HILLCOAT [17, 18 A/42, 344]

'*Anthonotha*': Gr. anthos: flower; Gr. nothos: false; probably referring to the large bracteoles, which suggest to be part of the perianth.

'*fragrans*': referring to the strongly fragrant flowers.

Exell & Hillcoat, Bol. Soc. Bot. Brot., ser. 2, XXIX, p. 39 (1955);

*Macrolobium fragrans* BAK. f., Journ. Bot. suppl. Polyp., p. 140 (beginning of July 1928, basionym); type: Gossweiler 7577, Cabinda (BM!);

*Macrolobium chrysophylloides* HUTCH. & DALZ., Kew Bull. 1928, p. 400 (end of July, synonym); type: Aylmer 261 (K!).

1928: F.W.T.A., 1st ed., I, p. 347 (*M. chrysophylloides*)

1957: J. Léonard, G.C.A.a., p. 201–215; 220

1958: F.W.T.A., 2nd ed., I, p. 473

1931: Cooper & Record, Evergr. For. Liberia, p. 67 (*M. heudelotii* = *A. explicans*)

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 281

1960: Taylor, Syn. Silv. Ghana, p. 119

1936: Aubréville, F.F.C.I., 1st ed., I, p. 238 (*M. chrysophylloides*)

1961: Irvine, Woody Plants of Ghana, p. 272

1950: Normand, A.B.C.I., I, p. 131; Pl. XLVI (*M. chrysophylloides*)

LOCAL NAME: gbung gon(g) (Gio)

TRADE NAME: Kibakoko

GEOGRAPHICAL DISTRIBUTION: along the Gulf of Guinea from Sierra Leone to Congo, in the rain forest belt

BOTANY. A medium-sized or large tree of the high forest, less common in the secondary forest. Branches carrying the leaves densely dark-brown puberulous; older branches

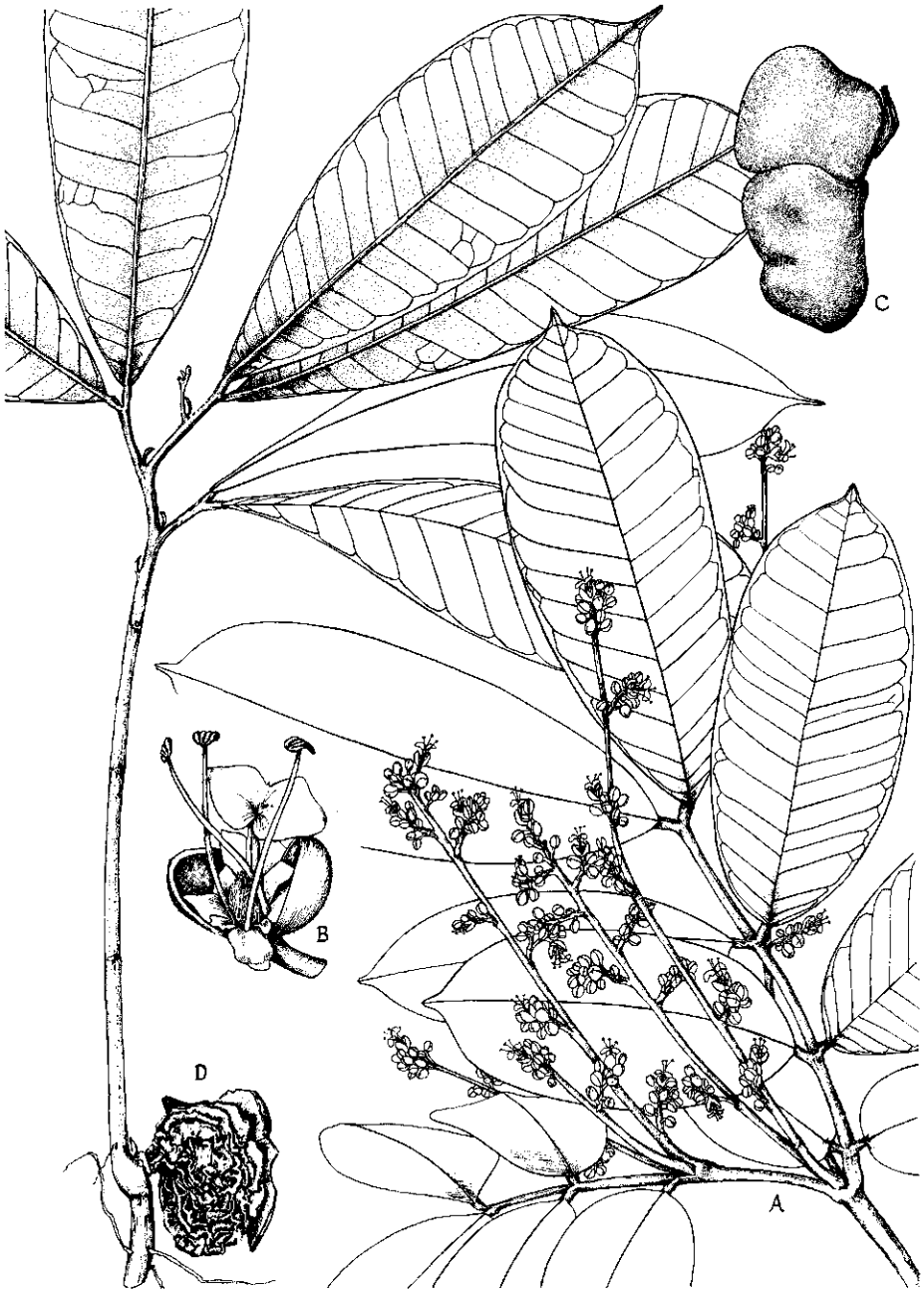


Fig. 17. *Anthonotha fragrans* (BAK. f.) EXELL & HILLCOAT A: branchlet with leaves and inflorescences ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: 2 seeds from 1 pod ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ).

grey, glabrous. Leaves paripinnately compound, alternate, stipulate (1–) 3–4 (–5) jugate, 10–40 cm long. Petiole, rachis and petiolules densely brown puberulous. Stipules intrapetiolar, early caducous, only seen on seedlings. Petiole 0.4–4 cm long, jointed at base. Leaves at the end of the branchlets, subtending inflorescences, usually very short petiolate; other (shadow?) leaves longer petiolate. Petiole and rachis slightly grooved or terete. Petiolules stout, 3–7 mm long. Leaflets opposite, 4–20 cm long, 2–11 cm wide, coriaceous. Proximal pair smallest, narrowly to broadly elliptic, rarely orbicular or broadly ovate. Distal pair largest (narrowly) obovate or elliptic. Middle pair(s) intermediate in form and size. Leaves of saplings larger with leaflets up to 30 cm long and 12 cm wide, less coriaceous. Base of the leaflet rounded to bluntly cuneate; margin entire, slightly recurved; apex rounded and short-cuspidate or slightly emarginate by growth inhibition. Midrib slightly impressed above, very prominent beneath. Nerves flat above, prominent beneath, 10–16 on each side of the midrib, ascending, straight till near the margin, then looped. Veins rather reticulate beneath. Leaflets glabrous, glossy dark green above, densely dark-brown or golden brown pubescent beneath.

Inflorescences terminal or axillary racemes, in the leaf axils or on older, barren branches, solitary or in small clusters, erect or bent, not pendulous, 10–20 (–35) cm long; lateral panicles 2–10 cm long. Peduncle, bracts, pedicels and bracteoles (abaxial surface) densely dark-brown pubescent. Flowers strongly and sweetly fragrant. Bracts c. 2 mm long, concave-triangular, 2 mm broad at the base, caducous. Pedicels 2–5 mm long. Bracteoles 2, opposite, valvate in bud, spreading when open, persistent, broadly elliptic, c. 5 mm long, 4 mm wide, concave, glabrous inside. Receptacle obliquely cupuliform, 1–1.5 mm deep, glabrous on both sides, carrying the sepals, petals, and stamens on its edge. Sepals 5, glabrous, free but the 2 adaxial ones shortly connate at their base, 3 mm long, 1.5 mm wide, elliptic, acuminate, margin slightly undulate, imbricate in bud, recurved when open. Petals 5, glabrous, the adaxial well-developed, c. 7 mm long; claw stout, c. 4 mm long, c. 1.5 mm broad, canaliculate; lamina c. 3 mm long, c. 6 mm wide, folded around the stamens and ovary in bud, spreading when open, deeply bilobed, the lobes rounded. Other petals much reduced, c. 1.5 mm long, 1 mm wide. Fertile stamens 3, 7 mm long, curved, pubescent at the base, subulate. Anthers dorsifixed, versatile, 1 mm long, bilobed on both ends, with 2 thecae, opening by slits. Staminodes 4–6, much reduced, 1 mm long. Pistil shortly stipitate, stipe partly adnate to the adaxial part of the receptacle, c. 1 mm long. Ovary 1.5 mm long, laterally flattened, densely tomentose. Style glabrous, 6–7 mm long, coiled on top of the ovary, uncoiling after the anthers opened. Stigma hardly thicker than the style, capitate.

Fruit a thick-coriaceous pod up to 10 cm long, 5 cm wide, and 3 cm thick, gradually dehiscent after being dropped, densely dark-brown pubescent, shortly and stoutly stalked, with two prominent dorsal ridges spreading from the base along the back and joining at the top, branching with numerous curved, anastomosing ridges over the sides. Seeds thick, laterally flattened or angular, with a hard, thick, brown testa.

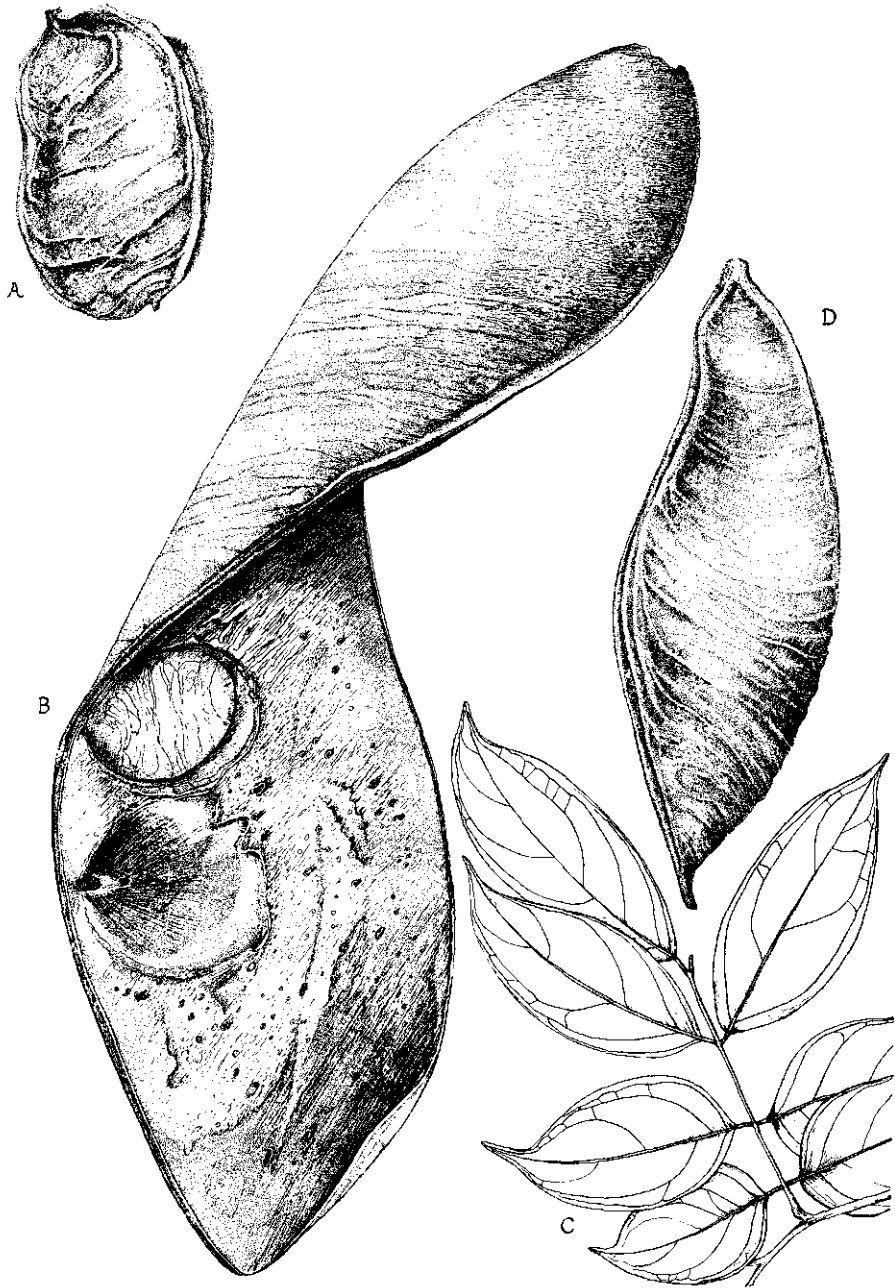


Fig. 18. A: *Anthonotha fragrans* (BAK. f.) EXELL & HILLCOAT, fruit ( $\times \frac{1}{2}$ ); B: *Berlinia confusa* HOYLE, valve of fruit ( $\times \frac{1}{2}$ ); C: *Anthonotha explicans* (BAILL.) J. LÉONARD, leaf ( $\times \frac{1}{2}$ ); D: idem, fruit ( $\times \frac{1}{2}$ ).

Seedling: germination hypogeal, the cotyledons remaining within the testa. Epicotyl very variable, 7–17 cm long, glabrous at the base, increasingly pubescent towards the first leaf, with 5–7 scales placed at regular distances. Leaves alternate, the first one unifoliolate or pinnate, 1- or 2-jugate, stipulate, all parts brown pubescent except for the upper surface of the leaflets. Stipules intrapetiolar, 4–6 mm long, linear, thick, slightly curved. Petiole 1.5–2.5 cm long; leaflets obovate, 6–16 cm long, 2.5–5.5 cm wide, cuneate at base, rounded at the top with an acuminate tip, otherwise as described above. First internodes with a zig-zag pattern; sapling with a semi-pendulous habit.

TAXONOMICAL NOTES. *Anthonotha fragrans* (BAK. f.) EXELL & HILLCOAT was based on *Macrolobium fragrans* BAKER f. nov. sp. (1928), published only a few weeks before Hutchinson and Dalziel proposed the name *M. chrysophylloides* for the same species.

*Macrolobium* SCHREB., as a genus, included both African and American species. In 1949 Louis stated already, that the African species of this genus ought to be referred to *Anthonotha* BEAUV., but did not publish the necessary new combinations (Louis and Fouarge, Publ. I.N.E.A.C., Ess. for. Bois Congo, 6, p. 5–13, 1949). Beauvois had described *Anthonotha* as a monotypic genus, based on *A. macrophylla* BEAUV. (Fl. Ow. Benin, p. 70, t. 42, 1806).

When revising the American species of the genus *Macrolobium*, Cowan came to the same conclusion as Louis, viz. that the African species ought not to be included in the genus *Macrolobium* (Cowan in Mem. N.Y. Bot. Gard. VIII, 4, p. 257 ff., 1953). This view was only partly accepted by Léonard, who studied the African species of *Macrolobium* s.l. for the Flora of Belgian Congo.

He published a new genus *Gilbertiodendron* for species of *Macrolobium* which had glandular points on the margin of the leaflets and longitudinal ridges on the pod; he retained the name *Macrolobium* for the other species (in Bull. Jard. Bot. Brux., 22, p. 188–191 (1952) and Fl. Congo Belge, III, p. 409–436). However, when more material of African *Macrolobium* s.l. became available Léonard proposed two new monotypic genera, being *Paramacrolobium* (Bull. Jard. Bot. Brux., 24, p. 348, 1954) and *Pellegriniodendron* (Bull. Jard. Bot. Brux., 25, p. 203, 1955) while he referred 15 more species to *Anthonotha* BEAUV. (1955, l.c., p. 201–203). As a result *Anthonotha* BEAUV., *Gilbertiodendron* J. LÉONARD, *Paramacrolobium* J. LÉONARD and *Pellegriniodendron* J. LÉONARD came to represent the genus *Macrolobium* s.l. in Africa. A detailed account of the various studies and considerations on which these decisions are based is given by Léonard (1957, l.c.).

The genus *Anthonotha* is in Liberia represented by five species. Most common is *A. macrophylla* BEAUV., a small understory tree. Occasionally *A. vignei* (HOYLE) J. LÉONARD is found, also a small under story tree, at least in Liberia (cf. F.W.T.A., 2nd ed., 1958, p. 473 'a tree, to 80 ft. high').

The only species besides *A. fragrans* which becomes a really large forest tree is *A. explicans* (BAILL.) J. LÉONARD. Although referred to as 'scandent shrub or small tree'

(F.W.T.A., l.c.), it is also a forest tree which may reach up to 30 m ( $\approx 100'$ ) and attain 1 m ( $\approx 3'$ ) in diameter (it is possible that descriptive sentences for *A. vignei* and *A. explicans* have been transposed). The tree more or less resembles *Berlinia confusa*.

*A. explicans* (fig. 18 C, D). Leaves glabrous, margin of leaflets revolute, 3–4 pairs of nerves. Inflorescences glabrous, up to 50 cm long, pendulous. Flowers strongly fragrant like cocos, flowering in the early morning, dropping at noon. Sepals 4, pale green. Petals 5, 3 developed, 2 minute, pale yellow. Stamens 3, filaments red, anthers pale brown. Fruits brown pubescent, markedly pointed at the top, with less distinct ridges as *A. fragrans*. Large specimens were observed in the Gola Nat. For. near Bomi Hills (No. 1299), near Zoi and near Gelahun (western province). The wood is hard, dark brown with purplish strikes and without gum.

The three other genera, formerly representing *Macrolobium* in Africa, are also found in Liberia (*Gilbertiodendron* cf. p. 196, *Pellegriniodendron*, cf. p. 199). *Paramacrolobium coeruleum* (TAUB.) J. LÉONARD was observed as a medium-sized tree of 28 m ( $\approx 90'$ ) high and 75 cm ( $\approx 2.5'$ ) in diameter with buttresses like *Piptadeniastrum* (Nyein, Todie District, No. 465). The tree occurs also in the Loma National Forest.

The present description and drawings of *Anthonotha fragrans* are based on the following Liberian specimens: Zuole area 146, 603; Bong Range 60, 1179; Chien area 639; Nimba area 1170; Bomi Hills 596.

FIELD NOTES. *Anthonotha fragrans* is found in Liberia scattered throughout the high forest as a medium-sized, rarely really large tree, up to 1.20 m ( $\approx 4'$ ) diameter (though usually less) above the buttresses, and up to 38 m ( $\approx 125'$ ) high.

The base of the tree has sharp, narrow root ridges, which may develop into medium high, thick, narrow, concave buttresses, only occasionally developed up to 1.80 m ( $\approx 6'$ ). Bole usually straight and round, up to 18 m ( $\approx 60'$ ) to the first branch. Crown rather deep, rounded, dense, seen from below reddish or rusty brown; foliage deciduous in December for a short period. Bark dull greyish brown, rather smooth or thin scaly, somewhat patchy, rarely with large bark plates. Slash hard, fibrous, fairly compact, light-medium brown, sometimes with a pinkish or reddish tinge, occasionally exuding a creamy gum. Ripple marks rarely visible, and if so, always wavy. The tree is rather inconspicuous in the forest except for the reddish glow of the leaves, which makes it easily detectable when one looks upwards. *A. fragrans* should not be confused with *Chrysophyllum delevoiyi* or *C. perpulchrum* which have similar but darker reddish leaves. However, these trees have simple leaves, and a white latex exudes from the slash. Their bark is usually dark and grooved.

USES. A case of poisoning with *A. fragrans* has been reported, but it is not known which parts were used. The wood is not very hard; there is no sharp division between sapwood and heartwood. The wood contains tangential layers of gum ducts, exuding a sticky, light brown or creamy gum. The wood is attacked by borers immediately after felling.

*Berlinia confusa* HOYLE

[10, 18 B, 19/143]

'*Berlinia*': named after Berlin, a pupil of Linnaeus.

'*confusa*': L. *confusus*: confused, mixed; referring to the fact that much of the material formerly attributed to *B. auriculata* BENTH. and *B. acuminata* HOOK. f. was a mixture of these species with the present one(?).

Hoyle in Kew Bull. 1934, p. 184; type: J. Smith 54, Nigeria (K!).

*Berlinia acuminata* SOL. ex HOOK. f. in Fl. Nigril., p. 326 (1849), partly; Baker f., Leg. Trop. Afr., p. 683 (1930), excl. var. *velutina*;

*Berlinia auriculata*, F.W.T.A., 1st ed., I, p. 343, partly.

1931: Cooper & Record, Evergr. For. Liberia, p. 61 (*B. auriculata* = *B. confusa*; *B. bracteosa* = *B. grandiflora* = *B. occidentalis*, teste F.W.T.A., 2nd ed., I, p. 470, 1958).

1936: Aubréville, F.F.C.I., 1st ed., I, p. 220 (*B. acuminata*)

1950: Normand, A.B.C.I., I, p. 132; Pl. XXXIV (*B. acuminata*)

1958: F.W.T.A., 2nd ed., I, p. 470

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 276

1959: Kryn & Fobes, Woods of Liberia, p. 17

1960: Taylor, Syn. Silv. Ghana, p. 122

1961: Irvine, Woody Plants of Ghana, p. 274

LOCAL NAMES: ponyere (Krahn); gbung-gong (Gio)

TRADE NAME: Ebiara

GEOGRAPHICAL DISTRIBUTION: Sierra Leone to Gabon

**BOTANY.** A medium-sized, occasionally large or even emergent tree. Young branches brown pubescent, glabrescent. Leaves alternate, stipulate, paripinnately compound, 2- to 4-, usually 3-jugate, 15–30 cm long, rusty brown puberulous when young, glabrescent. Stipules intrapetiole, caducous except for the base, which remains as a small slip in the leaf axil. Petiole slender, terete, 2.5–5 cm long, jointed at base. Rachis terete. Petiolules 5–10 mm long. Leaflets coriaceous, glossy, dark green with the nerves lighter green above, paler green beneath, opposite to subopposite, slightly but distinctly falcate with the midrib arched, ovate to (narrowly) elliptic or obovate, 5–15 cm long, 2–7 cm wide, the lower pair smallest, the upper pair largest. Base of the leaflets slightly unequal-sided or not, rounded or broadly cuneate; margin entire, more or less undulate; apex bluntly acuminate–caudate, the very tip square-cut; apex rarely rounded or emarginate. Midrib flat above, prominent beneath. Nerves slightly raised above, slightly prominent beneath, 4–9 on each side of the midrib, strongly arched upwards but not looping. Veins reticulate above.

Inflorescences axillary or terminal panicles or broad racemes, up to 16 cm long, slightly grooved. Peduncles and outside of the bracts densely brown pubescent. Bracts 1.5 mm long and wide, triangular with rounded top, glabrous inside, caducous. Pedicel and outside of the bracteoles densely greyish green pubescent. Pedicel 1–3 cm long, c.



9. *Afzelia bracteata* T. VOGEL ex BENTH.. Note the mussel-shell markings (see page 133).





10. *Berlinia confusa* HOYLE. An unusually tall specimen (see page 147).



Fig. 19. *Berlinia confusa* HOYLE A<sup>1</sup>: flowering branch with leaves ( $\times \frac{1}{2}$ ); A<sup>2</sup>: open flower ( $\times \frac{1}{2}$ ); B: seedling ( $\times \frac{1}{2}$ ); C: leaflet of *Berlinia occidentalis* KEAY ( $\times \frac{1}{2}$ ).

2 mm thick. Bracteoles 2, opposite, valvate in bud, spreading and recurving when open, 3–4 cm long, c. 1.5 cm wide, obovate, creamy tomentose inside. Calyx tube 1–1.3 cm long, tubular, glabrous outside or with a few scattered hairs on one side, glabrous inside. Calyx lobes 5, pale green, imbricate in bud, c. 1.5 cm long, 3 mm wide, with creamy, membranous, ciliate margin, otherwise glabrous. Petals 5, white; 4 less developed, c. 15 mm long, c. 3 mm wide, with membranous margin, glabrous; the posterior petal large, 4–6 cm long, clawed, yellowish or pale green in the centre, leaning backwards and spreading when open. Claw 2–3 cm long, 5–8 mm wide, with dorsal pubescence and membranous margin; lamina 2–3 cm long, 4–6 cm wide, palmateveined, more or less bilobed, membranous, with undulate margin. Stamens 10, all fertile, subequal, 5–6.5 cm long; the posterior stamen free, the other 9 shortly connate at their base, all pilose towards the base, white, slightly curved and subulate. Anthers dorsifixed, c. 2 mm long, c. 1.5 mm broad, bilobed at both ends, with two thecae, opening by slits. Pistil stipitate, stipe c. 8 mm long, densely pubescent, partly adnate to the proximal part of the receptacle. Ovary flattened, c. 7 mm long, 2 mm wide, densely brownish pubescent, with a ventral groove. Style slightly exceeding the stamens, pubescent towards the base. Stigma terminal, small, slightly bilobed.

Fruit a large flat pod, 7–11 cm wide, 25–40 cm long, standing at right-angles to the stout stalk, minutely puberulous when young, glabrescent, hardly or slightly grooved and winged on the back, the sides smooth, shallowly and obliquely grooved, lenticellate. Pod opening on the tree into two valves, twisting corkscrew fashion, the force of the movement ejaculating the seeds far from the tree. Valves dropping after dehiscence, curling into spirals when drying. Inside of the valves pale brown, corky and papillate. Seeds disc-shaped, round or elliptic, 3.5–5 cm in diameter, smooth, pale brown, with a thin testa.

Seedling: germination epigeal, the cotyledons remaining on the ground but spreading partially, thick and fleshy, shortly petiolate with a 2–3 mm long, c. 5 mm thick petiole. At germination the testa forms an opaque, slimy mucous secretion, surrounding the cotyledons and hypocotyl. Hypocotyl c. 1 cm long. Epicotyl 20–30 cm long, woody, pubescent – glabrescent, at regular intervals with linear scales introducing the intrapetiolar stipules. Leaves alternate, stipulate, pinnate, 1–2 jugate, more or less pubescent except for the surface of the leaflets. Stipules intrapetiolar, c. 6 mm long, linear, shortly bifid at the top. Petiole 3–4 cm long. Leaflets papery, (narrowly) elliptic, 7–10 cm long, 3–5 cm wide, cuneate at the base, long acuminate at the apex; only 4 nerves on each side of the midrib. Young sapling with a zig-zag stem.

**TAXONOMICAL NOTES.** The present description is based on the following Liberian collections: Zuole area 189, 261, 786; Sanokole 927; Bong Range 60A, 932; Lofa river 810.

There are some differences with the type description of Hoyle (1934, l.c.): the leaflets of the cited material are rarely emarginate, usually obtuse and shortly caudate; the

calyx tube is glabrous or only sparsely pubescent on one side; the sepals are glabrous except for the margin. According to F.W.T.A., 1958, p. 469, the calyx tube is 'usually more or less puberulous'. Aubréville (1959, l.c.), however, described the leaflets as acuminate, calyx tube as glabrous, and the flowers as very variable. This is also demonstrated by the fact that a flower with four well-developed petals was once observed on an inflorescence with otherwise normal flowers (No. 932). The same has been observed by Keay in material of Chevalier No. 19149 of the closely related species, *Berlinia tomentella* KEAY (Kew Bull. 1954, p. 271). This species, which also occurs in Liberia, is a small tree, usually found in wet places. It differs from *B. confusa* in its pubescent calyx tube, its usually smaller flowers, tomentellous fruits, and larger leaflets. A third species of *Berlinia*, occurring in Liberia and found both as a medium-sized forest tree and a small tree or shrub in low bush is *B. occidentalis* KEAY. It is characterized by non-falcate, thick-coriaceous leaves, a flower with five large white petals, and glabrous fruits resembling those of *B. confusa* but with a broad, winged, and grooved ventral edge.

The peculiar pock-marked inner surface of the valves of the pod seems to form part of the opening mechanism of the fruit, acting somewhat like suction cavities.

FIELD NOTES. *Berlinia confusa* is found all over Liberia. Although usually a medium-sized tree, it may grow to a height of 40 m ( $\approx 130'$ ) and a diameter of over 1 m ( $\approx 3.5'$ ). The tree is evergreen, seems to prefer well-drained sites and grows scattered in the high forest, although here and there it may be fairly common (Bong Range). The base of the tree has narrow, thin root ridges, or sometimes narrow, thin, high reaching butt flares, but rarely real buttresses. The stem is often crooked, ridged, and early branched, seldom producing good logs, but trees are occasionally straight and cylindrical with a free bole up to 23 m ( $\approx 75'$ ). The crown is rather dense, obconical. The bark is light coloured, yellowish brown or greenish with algae, about 5 mm thick, smooth or irregularly thin-scaly, the scales leaving shallow marks. The slash is pinkish brown, paler near the cambium, long-fibrous, slightly sticky, and has a fresh smell resembling string beans.

The flowering season lasts from January to April, during which period the tree is easily recognised by the large white clusters of flowers in the surface of the crown. The shed white petals cover the ground below, thus marking the site of the tree. The fruits are ripe from July to September. They stand out horizontally on the surface of the crown. When ripe they open with a loud report, immediately followed by the rustling sound of the dropping seeds and valves. Regeneration is fairly common, but the seedlings soon perish. Saplings are mostly found in secondary forest adjacent to the high forest.

A tree resembling *B. confusa* is *Anthonotha explicans*. This tree also has thin root ridges, a thin, scaly bark and a rather poorly shaped trunk. The slash, however, is red brown and is without the characteristic string-bean smell of *B. confusa* (see also p. 143, and fig. 18 C and D).

USES. The wood is moderately hard and heavy, red to dark red-brown with purplish streaks, coarsely textured and its grain interlocked. Brittle heart may occur in large logs. The timber has at present no export value, but it could be used locally for sleepers, building, rough carpentry and furniture.

*Brachystegia leonensis* HUTCH. & B. DAVY

[11, 20/187, 216]

'*Brachystegia*': Gr. brachys: short; Gr. stachys: spike; referring to the short spikes of the inflorescences.

'*leonensis*': referring to Sierra Leone, where the type specimen was collected.

Hutchinson & B. Davy, Kew Bull. 1923, p. 156; type: Lane Poole 188, Sierra Leone (K!); Baker f., Leg. Trop. Afr., 3, p. 724 (1930); J. Léonard, G.C.A.a., p. 248 (1957); not of Kennedy in F.F.S.N., p. 103 (1936).

1928: F.W.T.A., 1st ed., I, p. 348

1958: F.W.T.A., 2nd ed., I, p. 479

1936: Aubréville, F.F.C.I., 1st ed., I, p. 242

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 296

1937: Dalziel, U.P.W.T.A., p. 176

1959: Kryn & Fobes, Woods of Liberia, p. 21, 22

1950: Normand, A.B.C.I., I, p. 133; Pl. XXXV

1961: Holzzentralblatt, Stuttgart, No. 21, p. 314

LOCAL NAMES: bondu (Gola); woronggonoh (Bassa); poli (Krahn); goeguehn (Gio); guoong (Kpelle)

TRADE NAME: Naga

GEOGRAPHICAL DISTRIBUTION: Sierra Leone, Liberia, and S.W. Ivory Coast, in evergreen forests

BOTANY. A large or emergent rain forest tree, the largest species of the sub-family of the *Caesalpinioideae* found in Liberia. Leaf bearing branchlets sparsely pubescent (short and long hairs). Leaves paripinnately compound, alternate, stipulate, (7-) 8-12 (-13) jugate, 17-35 cm long, glossy dark green above, paler green beneath, drooping. Young leaves rather densely brown pilose on all parts, gradually glabrescent, except the midrib of the leaflets. Stipules intrapetiolar, membranous, parallel-nerved, narrowly oblong, 3-10 cm long, 0.8-2 cm wide, densely brown puberulous at base, elsewhere sparsely pubescent on the nerves only, pale green; base shortly auriculate; margin ciliate; apex bilobed, lobes 1.5-2 cm long, acuminate. Stipules enclosing the leaf buds, caducous when the leaves flush, the very base thick and woody, persistent in the axil. Petiole 1-3 cm long, jointed at base, terete; rachis 15-28 cm long, subterete, obscurely canaliculate towards the base. Leaflets opposite, sessile, contiguous, narrowly elliptic, (1.5-) 3.5-9 (-12) cm long, (0.5-) 1-2.5 (-4.5) cm wide, slightly oblique, progressively larger from the base to the middle of the whole leaf, thence slowly decreasing to the smaller terminal pair. Base rounded or broadly cuneate, distinctly unequal-sided, the

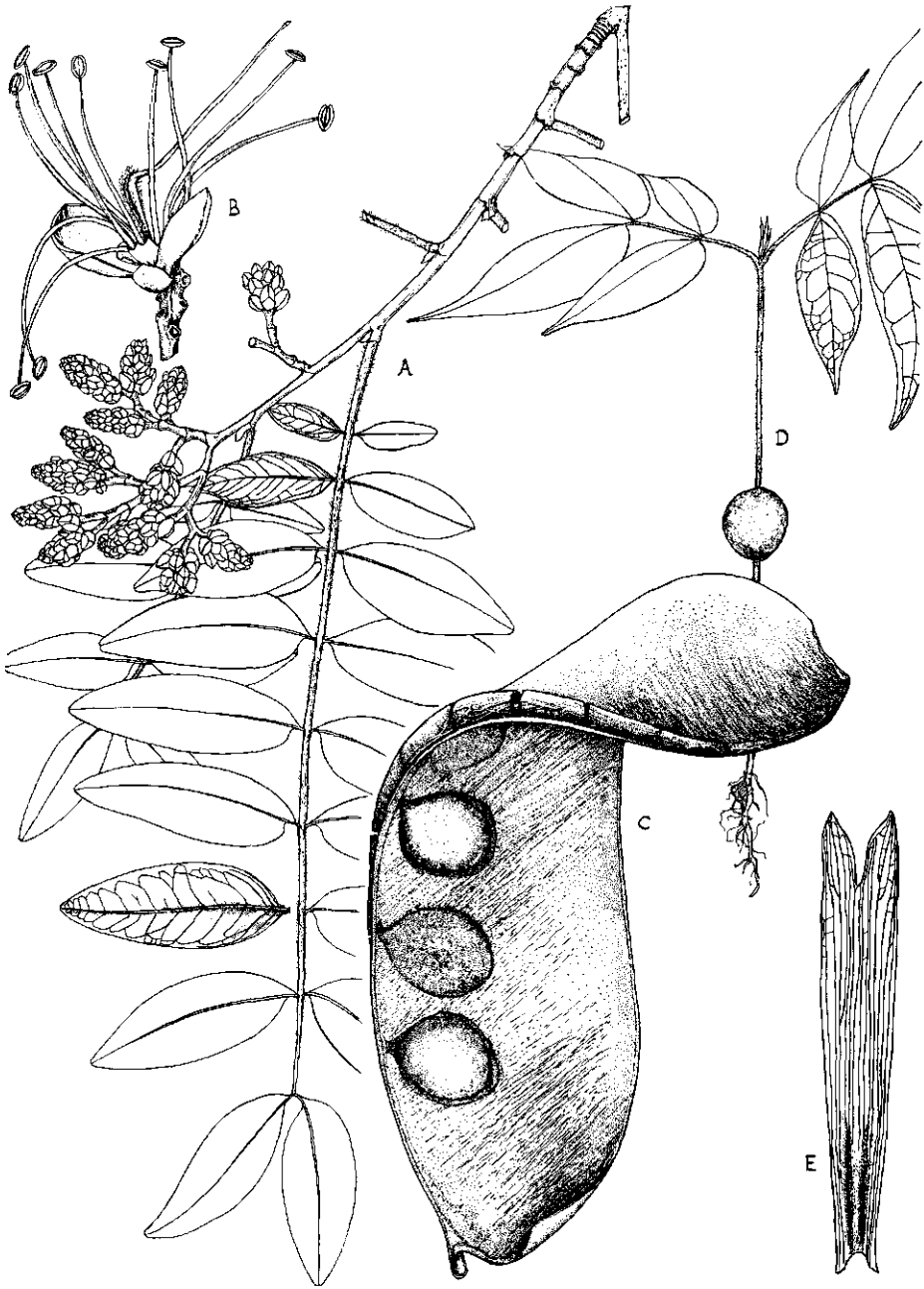


Fig. 20. *Brachystegia leonensis* HUTCH. & B. DAVY A: branchlet with leaves and inflorescence, flowers in bud ( $\times \frac{1}{2}$ ); B: open flower ( $\times 2$ ); C: one valve of a pod, with seeds ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ); E: intrapetiolar stipule ( $\times \frac{1}{2}$ ).

proximal edge reaching the rachis, the distal edge joining the midrib c. 2 mm from the rachis; apex bluntly acute, obtuse or retuse. Midrib flat above, raised beneath, slightly arched. Nerves slightly raised on both sides, 2 (3) departing fanwise from the proximal part of the base, 4–6 on both sides of the midrib, ascending, looping at some distance from the edge. Veins fairly reticulate. Leaves of saplings and young trees often with fewer pairs of larger and more markedly oblique leaflets.

Inflorescences dense, terminal or axillary, spicigerous, 15–20 cm long, densely brown puberulous. Lateral spikes branched or not, 2–5 cm long. Bracts concave, c. 3 mm long and wide, glabrous inside, caducous or persistent until flowering. Flowers sessile. Bracteoles 2, brownish green, opposite, valvate in bud, spreading when flowering, elliptic, c. 10 mm long, 4 mm broad, slightly asymmetric with the midrib on the proximal side, densely brown tomentellous outside, sparsely pubescent inside. Receptacle short-cupuliform. Perianth pale greenish yellow, formed by (4–) 5 (–6) petaloid sepals, imbricate, broadly ovate, 2–2.5 mm long, 1–2 mm wide, with a broad, membranous, sparsely ciliate margin, the upper half incised or even slightly bifid. Stamens 10, glabrous, for less than 0.5 mm connate at their base, c. 1.5 cm long, abruptly tapering at the end. Anthers dorsifixed, c. 1.5 mm long, versatile, with 2 thecae opening lengthwise. Disc intrastaminal, annular, c. 0.2 mm thick, glabrous, slightly lobed. Pistil in the centre of the receptacle, stipitate. Stipe c. 3 mm long, glabrous; ovary flattened, c. 4 mm long, brown-pilose on the edges; style at right-angles to the ovary or at an angle of c. 45°, c. 12 mm long, glabrous. Stigma terminal or slightly lateral, minutely truncate and bilobed.

Fruit a dark, purplish brown, thick, woody pod, standing at right-angles with the stout woody stalk, 12–30 cm long, 4–8 cm broad; ventral edge broadly winged, the wings curled inwards; side finely and obliquely striate, minutely lenticellate. Pod opening on the tree, the valves twisting corkscrew fashion, dropping after dehiscence. Inside of the valves dark brown, not papillate as *Berlinia confusa*. Seeds nearly round, flattened like a disc, c. 2 cm in diameter, 4 mm thick, with a smooth brown testa.

Seedling: germination epigeal. Hypocotyl 5–7.5 cm long, densely brown puberulous. Cotyledons sessile, eccentrically peltate, attached c. 4 mm above the base, glabrous, round, c. 1.5 cm broad, pressed against the epicotyl. Epicotyl 6–9 cm long, brown pilose. First two leaves opposite, stipulate, 2–3 jugate. Stipules intrapetiolar, 1–1.5 cm long, bipartite; slips linear, c. 1.5 mm wide, parallel nerved, ciliate on the margin, acute. Leaves pilose on petiole, rachis and midrib, elsewhere glabrous. Petiole 1–1.5 cm long, jointed at base. Leaflets opposite, sessile, elliptic – (obovate), 2.5–7.5 cm long, 1–3.5 cm broad, markedly falcate with a large glandular cell near the proximal side of the base; leaflets of the first pair smallest. Base rounded, unequal-sided; margin entire; apex long acute – acuminate. Following leaves alternate, gradually with more pairs of leaflets.

TAXONOMICAL NOTES. *Brachystegia* BENTH. is an African genus, most widely represent-

ed in the woodland savannas of Central Africa. The number of high forest species is small, only two are reported from West Africa: *Brachystegia leonensis* HUTCH. & B. DAVY from Sierra Leone, Liberia and the Ivory Coast, and *B. kennedyi* KEAY from Nigeria. There seems to be very little difference between these two species, except that the stamens of *B. kennedyi* are connate for about 2–3.5 mm at their base and the leaves normally have about 6–8 pairs of leaflets.

It may be noted that in the key to the genera in the F.W.T.A., 2nd ed., p. 442 (1958), *Brachystegia* is characterized by the absence or extreme reduction or the sepals and by similar sepals and petals. The F.W.T.A. speaks of 'tepals'. Of the present (4) 5 (6) 'tepals' however, normally none is inserted in an adaxial position. If, rarely, a tepal occupies an adaxial position, it is not situated like the standard of caesalpiniaceous corolla, viz. before the adjacent lateral perianth lobes. Therefore the 'tepals' do not represent petals and should be rather considered as sepals.

The distinctive character of the angle at which the style leaves the ovary, as used in the F.W.T.A., 2nd ed., p. 479 (1958), to differentiate between *Brachystegia leonensis* and *B. kennedyi*, is no criterion as both characters were found in flowers of a single inflorescence of *B. leonensis*. The specimens collected and my field observations do not support the suggested possibility that two related species occur (see foot note, F.W.T.A., 1958, l.c.). The tribal names of *Brachystegia leonensis* and *Didelotia idae* are often identical, and this may have contributed to the suggestion.

The present description is based on the following specimens: Bomi Hills 695, 852, 60A, J. White s.n.; Bong Range 755, 937; Bopolu 945; Kanweake 1294; Putu area, de Wilde 3679.

FIELD NOTES. *Brachystegia leonensis* is one of the largest trees of Liberia. It may reach a height of 45 m ( $\approx 150'$ ) and measure up to 1.80 m ( $\approx 6'$ ) in diameter, although trees are not usually over 1.20 m ( $\approx 4'$ ) thick. When young or medium-sized, the tree has low, heavy, sometimes wide spreading root swellings or root spurs. When old the tree may have thick, heavy buttresses up to 1.80 m ( $\approx 6'$ ), (see Woods of Liberia (1959), photograph facing p. 116, which is not *Tetraberlinia* but *Brachystegia*). The bole is well-formed, straight and cylindrical, up to 30 m ( $\approx 100'$ ) to the first branches. The crown is moderately sized in relation to the size of the tree, with ascending branches, fairly open with dark green foliage; twigs and especially the leaves drooping, giving the tree a characteristic crown habit. *Brachystegia leonensis* is evergreen although it sheds all its leaves in August-September, reddish-green or brown flushes of new leaves appearing immediately after.

The bark is thick, bright grey, smooth, and with vertical rows of light brown lenticels when young, dark grey-brown when older, with very numerous small lenticels, smooth, rough or with irregularly formed scales. Sometimes the bark peels off in narrow bark-plates several feet long, detaching in an upward direction. The slash is hard and dense, fibrous, bright red-brown or dark red, turning dark brown on exposure, exuding



a small amount of clear, red, sticky sap. Ripple marks usually present, slightly wavy.

The tree seems to prefer well-drained soils. It only occurs in the evergreen forest and does not extend north of the line Zwedru–Suakoko. Here and there it may be very common, but it does not form single dominant forests. The flowering season lasts from February–April. The fruits, standing horizontally in the surface of the crowns, ripen from July to November. Regeneration is common on open places where the soil has been disturbed, such as old logging roads. The young saplings have a shrubby character, and no stout central stem.

The tree could be confused with *Didelotia idae*, which has a habit, very similar to the younger *Brachystegia*. However, *Didelotia* has simple leaves, less heavy root swellings if any, and a brighter red slash; *Didelotia* does not grow as large as *Brachystegia*.

USES. The sapwood is c. 12 cm ( $\approx 5''$ ) wide, white, distinct from the heartwood. Heartwood turning red brown, not equally coloured all over. Sp. G. about 0.75. Wood is medium hard, fairly rough. It should be dried slowly to prevent checking on ends. It has a blunting effect on saws and is sometimes difficult to work. Owing to the irregular grain it is difficult to make smooth surfaces, but it is easy to bore and to nail; it does not splinter. It is very resistant to impregnation and fairly gummy.

*Bussea occidentalis* HUTCH. & DALZ.

[21/47]

'*Bussea*': named after Dr. W. C. O. Busse (1865–1933), a German plant collector, who collected the type of the genus, *Bussea massaiensis* HARMS, in East Africa (1901).

'*occidentalis*': L. occidentis: West; unlike *B. massaiensis* this species is found in West Africa.

Hutchinson & Dalziel, Kew Bull. 1928, p. 400; type: Chipp 715, Ghana (K!).

1928: F.W.T.A., 1st ed., I, p. 350

1931: Chevalier & Normand, Rev. Bot. Appl.,  
p. 569–573

1931: Cooper & Record, Evergr. For. Liberia,  
p. 62

1936: Aubréville, F.F.C.I., 1st ed., I, p. 268

1937: Dalziel, U.P.W.T.A., p. 177

1941: Harley, Native Afr. Med., p. 79, 86

1950: Normand, A.B.C.I., I, p. 125; Pl. XXXV

1958: F.W.T.A., 2nd ed., I, p. 483

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 326

1959: Kryn & Fobes, Woods of Liberia, p. 23

1960: Taylor, Syn. Silv. Ghana, p. 125

1961: Irvine, Woody Plants of Ghana, p. 277–  
278

LOCAL NAMES: pah-kloh (Gio); dahn-kay (Bassa, cf. Cooper)

TRADE NAME: Samanta

GEOGRAPHICAL DISTRIBUTION: Guinea – Ghana

BOTANY. Medium-sized, rarely a large tree of the high forest. Leaf bearing branchlets

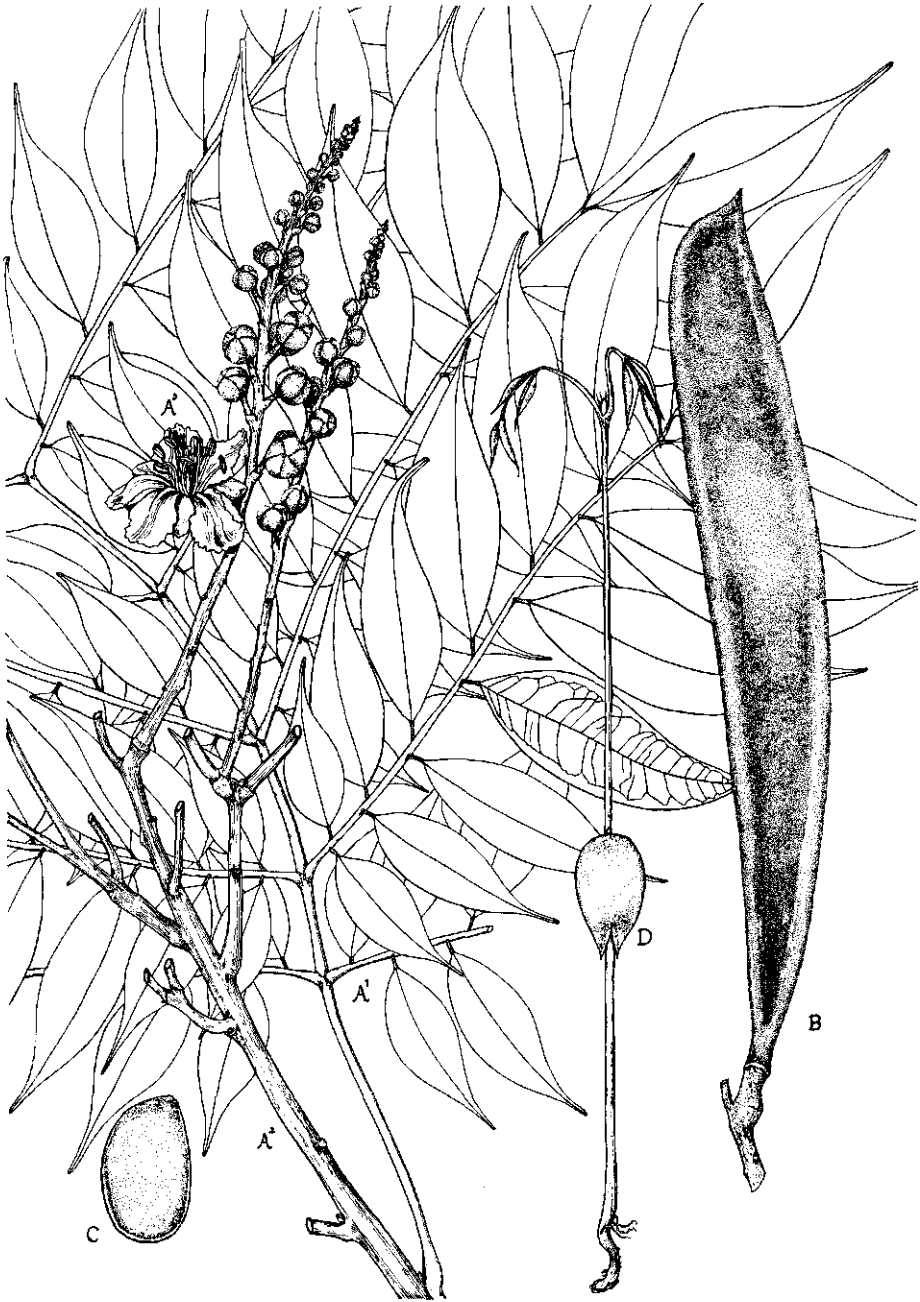


Fig. 21. *Bussea occidentalis* HUTCH. & DALZ. A<sup>1</sup>: leaf ( $\times \frac{1}{2}$ ); A<sup>2</sup>: branch with inflorescences ( $\times \frac{1}{2}$ ); A<sup>3</sup>: open flower ( $\times \frac{1}{2}$ ); B: fruit ( $\times \frac{1}{2}$ ); C: seed ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ).

densely brown tomentose, glabrescent. Leaves bipinnately compound, alternate, stipulate; petiole, rachises and petiolules rusty brown tomentose, glabrescent when old. Stipules subulate, terete, 4–8 mm long, curved towards each other. Petiole c. 10 cm long, finely striate, jointed at base. Primary rachis 6–23 cm long, finely striate, with 4–6 (sub)opposite pairs of pinnae. Rachises of the pinnae jointed at base, 8–25 cm long, with 12–22 subopposite to alternate leaflets; the second pair of pinnae usually the largest. Petiolules 2–4 mm long, rugose. Leaflets papery, (narrowly) elliptic – (narrowly) oblong, 4–10 cm long, 1.5–3.8 cm wide, gradually larger towards the top of the pinna, slightly oblique, the proximal half narrow at base, broader near the top, the distal half broadened in the lower half, narrowing towards the top; blade puberulous but glabrescent, distinctly reticulate on both sides, glossy, dark green above, dull green beneath. Base slightly unequal-sided, (broadly) cuneate; apex long acuminate – cuspidate, slightly curved. Midrib impressed above, prominent beneath. Nerves slightly raised above and beneath, 6–10 on each side of the midrib. Leaves of saplings often larger, with larger leaflets.

Flowers in axillary or terminal, up to 30 cm long racemes or panicles. Peduncles, bracts and pedicels densely reddish brown tomentose. Pedicels 0.4–0.8 (–1) cm long. Bracteoles absent. Receptacle saucer-shaped, c. 10 mm wide. Sepals 5, free, 0.7–1.5 cm long, 0.6–0.8 cm wide, imbricate in bud, recurving at the time of flowering, outside reddish brown pubescent on the exposed parts, glabrous on the overlapped membranous margin, which is present on 3 sepals; inside puberulous near the base. Petals 5, shortly clawed; 4 subequal, obovate, c. 2.5 cm long, 1.5 cm broad; the adaxial petal smaller, c. 2 cm long, 0.8 cm wide. Claw c. 5 mm long, 3 mm wide, rusty brown villous, the pubescence extending on the inside of the lamina with a c. 1 cm long, villous wedge. Lamina palmatinerved, membranous, bright yellow, rugose, the outside villous at base and on the central part. Margin incised, villous only at base. Stamens subequal in bud, 10, free, in the open flower with swollen, villous bases of c. 3 mm long, surrounding the ovary. Filaments departing with an angle from the swollen base, glabrous, c. 7 mm long. Anther dorsifixed, with 2 thecae, 3–4 mm long, bilobed at base, terminated by a small mucro. Pistil in the centre of the receptacle, villous except the top of the style and the stigma. Ovary sessile, c. 5 mm long, 2 mm thick; style c. 7 mm long, zig-zagged. Stigma peltate-capitate, c. 1 mm thick, the margin folded back against the style.

Fruit stalk c. 1 cm long, 0.5 cm thick. Fruit a thick, woody, flattened, narrowly obovate, reddish brown tomentose pod, 15–23 cm long, c. 3 cm wide and 1 cm thick, tapering towards the base, terminating in a blunt mucro, standing erect on the surface of the crown, containing 1 or 2 seeds, opening with a loud crack, the valves splitting from the top, recurving, remaining attached at base and dropping later. Seeds yellowish brown, c. 3.5 cm long, 2 cm broad, flat.

Seedling: germination epigeal. Hypocotyl 5–9 cm long, light brown, glabrous. Cotyledons sessile, thick and fleshy, glaucous, rounded at the apex, sagittate at base, 2–2.5 cm long, c. 1.5 cm wide, pale green. Epicotyl 14–18 cm long, light brown pubescent, finely

ribbed. First two leaves opposite, once pinnate, 2–3 jugate, covered with soft, shiny, light brown hairs, but glabrous on the upper surface of the leaflets. Stipules linear, c. 8 mm long. Petiole c. 4 cm long; rachis 4–5 cm long, terminating in an 8 mm long, linear point. Leaflets thin papery, opposite, the first pair largest. Petiolules c. 3 mm long; blade narrowly ovate, 3–4.5 cm long, c. 1 cm wide, long acuminate at the apex, cuneate at base. Internode above the first pair of leaves secreting nectar; 3rd leaf once pinnate, 4th leaf bipinnate with one pair of pinnae, etc.

**TAXONOMICAL NOTES.** The genus *Bussea* HARMS is only found in Africa. The number of species is small. *Bussea occidentalis* is the only species of the genus found in West Africa. In Gabon and Congo *B. gossweileri* BAK. f. occurs, which is mainly different from *B. occidentalis* in having opposite, less acuminate leaflets and only 2–3 pairs of pinnae (see Fl. Congo Belge, III, p. 255, 1952).

The type description of Hutchinson (1928, l.c.) differs from the specimens cited below in stating that the filaments and style are densely villous, whereas they are partly glabrous.

The present description is based on the following specimens: Bomi Hills 1149; Bong Range 1318; Loma Nat. For. 719; Nimba area 925; N. Gio Nat. For. 7, 11, 156; Duport 343, 430, 1033; Harley s.n.

**FIELD NOTES.** *Bussea occidentalis* is found all over Liberia; it is perhaps more common in the northern areas, scattered in the high forest, not common in secondary forest. It is a medium-sized tree, rarely larger than 75 cm ( $\approx 2.5'$ ) in diameter, reaching a height up to 30 m ( $\approx 100'$ ). The base of the tree has root spurs, rarely small buttresses up to 1 m ( $\approx 3'$ ) or thin butt flares. The stem is usually straight, sometimes crooked or knotty. The crown is dense, rounded and small. The bark is smooth, dark grey-greenish, c. 1 cm thick. The slash is hard and granular, light or pale brown; a bit clear, watery sap makes the slash wound wet. The tree is evergreen. Flowering season is from June–October. The bright yellow flowers are slightly fragrant.

The fruits are ripe in December–January.

**USES.** Fresh or roasted seeds of *Bussea* are edible. The bark, together with the bark of *Distemonanthus*, is used for treating sleeping sickness and jaundice (Harley, l.c.).

The sapwood is whitish brown, the heartwood blackish – dark reddish brown. The grain is interlocked. The wood is very hard and heavy, difficult to work, strong and tough. Locally it is used for the manufacture of native axe-handles. Unlike the heavy European axe, which is swung from a greater distance and has an impact determined by its own momentum, the native axe is used for felling trees by means of a swift succession of short, hard blows, the force of which solely depends on the muscular endeavour of the feller. Consequently a stout, strong axe-handle is more highly esteemed than the long, flexible imported handles.

*Copaifera salikounda* HECKEL

[12, 22/42, 43]

'*Copaifera*': kopallis (Mexico): copal, a yellowish resin; fera: from L. ferre: to carry, to produce.  
'*salikounda*': vernacular name from Guinea.

Heckel, Ann. Fac. sci. Marseille, III, 4, t. 16 (1893); type: Poisson s.n., Sierra Leone (K!); Baker f., Leg. Trop. Afr., 3, p. 752 (1930); J. Léonard, Bull. Jard. Bot. Bruxelles, 19, p. 391 (1949); *ibid.*, G.C. A.a., p. 84, 87 (1957); not of Kennedy, F.F.S.N., p. 95 (1936); not of Pellegrin, Leg. Gabon, p. 118 (1948).

*Copaiba salikounda* (HECKEL) TAUB., Bot. Centralblatt, LX, p. 154 (1894);

*Detarium chevalieri* HARMS, Journ. de Bot., sér. 2, II, p. 113 (1909); type: Chevalier s.n. (K!).

1928: F.W.T.A., 1st ed., I, p. 338

1936: Aubréville, F.F.C.I., 1st ed., I, p. 260

1937: Dalziel, U.P.W.T.A., p. 185

1948: Normand, Bois & For. Trop., 6, p. 145–157

1950: J. Léonard, Etude bot. Copal, Congo Belge, p. 58

1950: Normand, A.B.C. I., p. 119; Pl. XXXVIII

1958: F.W.T.A., 2nd ed., I, p. 457

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 316

1959: Kryn & Fobes, Woods of Liberia, p. 35

1960: Taylor, Syn. Silv. Ghana, p. 127

1961: Irvine, Woody Plants of Ghana, p. 292

LOCAL NAME: yorgbiensagli (Gio); teedeh (Gola)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Guinea – Ghana

**BOTANY.** Medium-sized or large forest tree. Young branches light brown pubescent, glabrescent. Leaves paripinnately compound, alternate, stipulate, with 3–8, usually 6 pairs of leaflets, 7–19 cm long. Stipules caducous, only seen on seedlings and water shoots, on the latter linear, c. 2 cm long, 5 mm wide, finely puberulous, slightly falcate, pressed against the branch. Petiole 1–1.5 cm long, jointed at base. Petiole and rachis greenish brown puberulous, also when old, canaliculate above. Leaflets opposite (sub-opposite on water shoots), sessile, coriaceous, glossy above, dull green beneath, more or less equal-sized, the proximal pair slightly smaller, (narrowly) oblong, 1.5–5 cm long, 0.8–3 cm wide, the distal half slightly broadened near the base. Base unequal-sided, twisted, puberulous; margin with a strong marginal nerve, puberulous; apex truncate, emarginate. Blade glabrous on both sides except near the base and on the margin, dotted with glandular points, translucent in young leaves. Midrib slightly impressed above, prominent beneath. Nerves slightly raised on both sides, 10–20 pairs, fairly straight and parallel, joining the marginal nerve or branching. Veins reticulate on both sides. Leaflets of saplings, young trees and water shoots often more papery and narrower.

Inflorescences pale green, axillary or terminal, flat, spicigerous, up to 10 cm long; lateral spikes up to 3 cm long, with the sessile, fragrant flowers in two series along the puberulous peduncle. Bracts caducous, concave, c. 2 mm long and wide, ciliate. Bracteoles concave, triangular, c. 1 mm long, ciliate, not enclosing the bud, persistent for

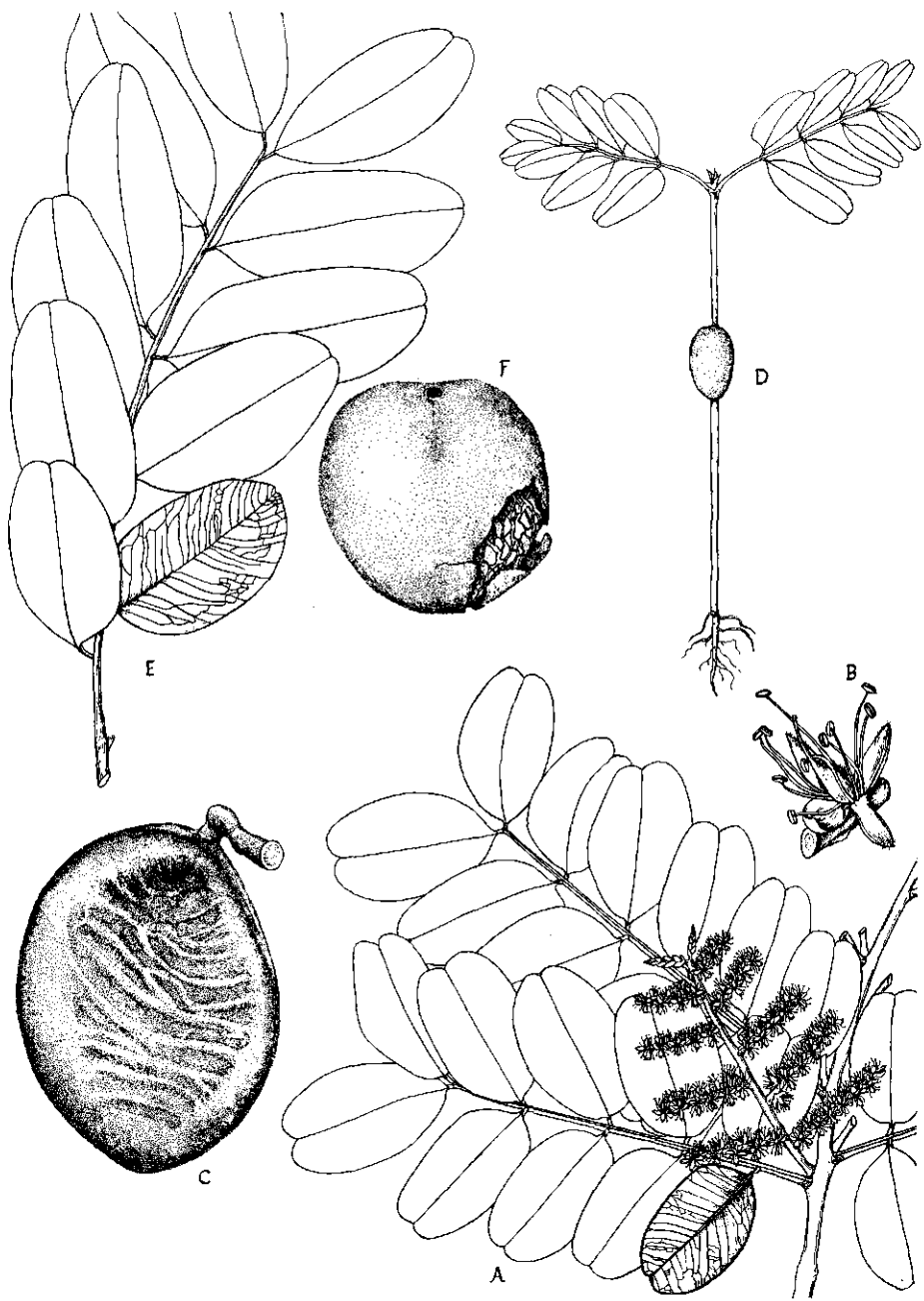


Fig. 22. *Copaifera salikounda* HECKEL. A: branchlet with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: fruit ( $\times 1$ ); D: seedling ( $\times \frac{1}{2}$ ).  
*Detarium senegalense* J. F. GMEL. E: leaf ( $\times \frac{1}{2}$ ); F: fruit ( $\times \frac{1}{2}$ ).

some time. Receptacle flat, c. 2 mm across. Sepals 4, valvate in bud with imbricate margins near the base, spreading when flowering, c. 3 mm long, elliptic, acute, pale brown puberulous outside, white villous inside; adaxial sepal c. 2 mm wide, the 2 lateral sepals c. 1 mm wide, the distal sepal c. 1.5 mm wide. Petals absent or sometimes 1 (–4) present as 1 mm long, acicular organs, alternating with the sepals. Stamens 10, free, c. 5 mm long, glabrous. Filaments filiform, straight, subulate. Anthers dorsifixed, versatile, c. 1 mm long, bilobed at base and top, the two thecae opening with slits. Disc absent. Pistil in the centre of the receptacle. Ovary sessile, c. 2 mm long, 1.5 mm wide, flattened, brown hirsute, especially at base and on the edges. Style glabrous, c. 3 mm long. Stigma terminal, capitate.

Fruit greenish – reddish when ripe, drying black, thick coriaceous, flattened, elliptic, 3–4.5 cm long, 2.5–3.5 cm wide, the ventral edge c. 1 cm thick, opening from the rounded top with two valves but only for half or two-third of the length. Stalk of the pod c. 3 mm long. The single seed flat, black, c. 2.5 cm long, 1.5 cm wide, attached with a fairly long funicle, covered by a thin, waxy, red aril.

Seedling: germination epigeal. Hypocotyl (3.5–) 5–6 cm long, brown puberulous. Cotyledons thick and fleshy, sessile, pressed against the epicotyl, attached at the slightly sagittate base, c. 1.8 cm long, 1 cm wide, with a rounded top. Epicotyl puberulous, 4.5–7.5 cm long. First two leaves opposite, with c. 4 mm long, pilose stipules. Leaves 4–5 jugate, c. 10 cm long. Leaflets papery, with numerous translucent points, similar to the mature leaflets. Next leaves alternate.

**TAXONOMICAL NOTES.** The genus *Copaifera* L. is largely confined to South America, where about 25 species occur. Only 5 species have been found in Africa, one of these occurring in Liberia, *Copaifera salikounda* HECKEL. The other species are found from Nigeria to Congo.

The genus *Copaifera* is narrowly related to *Guibourtia* BENN. (see tax. notes *Guibourtia*). *Copaifera salikounda* is referred to by Kennedy (1936, l.c.), but this reference concerns *C. mildbraedii* HARMS (cf. Léonard, 1950, l.c.). Pellegrin (1948, l.c.) mentions *C. salikounda* for Gabon, but this species was later described as *C. religiosa* J. LÉONARD. *C. religiosa* may have the same reduced petals, unusual for the genus, as *C. salikounda*. It may be noted that a disc has not been observed in the Liberian material, although it is described in the literature. In the key to the genera in F.W.T.A., 1958, p. 440, the presence of a disc leads to *Copaifera*, its absence to *Detarium*.

The present description and figures are based on the following specimens: Chien area 648, 1003; N. Gio Nat. For. 187, 193; Bong Range 1319; Bomi Hills 815, 1173.

**FIELD NOTES.** *Copaifera salikounda* is found scattered in the high forest; it is possibly slightly more common in the drier forest types. It prefers well-drained sites, but also occurs near rivers on periodically inundated lands. The tree develops in the shadow and may become a large forest tree of the A-story, up to 40 m ( $\approx$  130') high and with a di-

iameter of over 1 m ( $\approx 3.5'$ ) above the buttresses. The base of the tree is swollen, or has low, narrow root ridges when young, developing into thick, narrow, transversely striate buttresses up to 1.80 m ( $\approx 6'$ ) when old. The bole is straight and cylindrical, up to 25 m ( $\approx 80'$ ) to the first branches. The crown is fairly small when the tree is still in the B-story, but heavily branched and spreading when in the A-story, fairly open, with light green foliage.

The bark is grey brown to dark brown, irregularly scaly, fairly thin, fibrous, with thin bark scales. Near roads and trails the base of the trunk and the buttresses often are knotty and rough because passing travellers strip off the bark (see uses). The slash is hard, compact, reddish – light brown or pink brown, with a characteristic smell, somewhat like sweet, mixed tobacco. There may be similar scented compounds in the gum as occur in e.g. *Dipteryx odorata* (AUBLET) WILLD., a South American coumarin producing tree which is also used for scenting tobacco (Tongka beans). A clear, brown, fragrant, sticky gum slowly exudes from the slash wound (copal).

The tree is deciduous for a short period at the beginning of the rainy season, before flowering. Flowering trees were observed in May and August. Ripe fruits were collected in October and November. Seedlings are often abundant near the mother tree, especially on exposed places as logging roads, etc. Burt Davy (Tropical Woods 20, p. 17, 1920) reports that the aril surrounding the seed may form a kind of membranous wing when dry, which would contribute to the dispersion possibilities of the seeds.

A tree with a certain similarity to *Copaifera* in the forest, is *Detarium senegalense* J. F. GMEL.. This species also has emarginate leaflets with translucent points, also visible on older leaflets, but the leaflets are alternate. The fruits somewhat resemble a small, unripe 'plum' (*Mangifera indica* L.). *Detarium* may grow even larger than *Copaifera*, but has less pronounced buttresses, and the slash lacks the characteristic smell of *Copaifera* (see figure 22 E, F).

USES. The bark of *Copaifera* is stripped from the base of the tree, beaten in a mortar and rubbed on the skin, being used as a perfume. The dried pulverised seeds are used for scenting snuff (cf. *Dipteryx*, mentioned above). The gum outflow of bark and wood is too limited for commercial utilisation.

The heartwood is red or reddish brown, hard and heavy, with tangential zones of gum ducts. It has no known commercial applications, but see Normand, 1948, l.c.

*Crudia gabonensis* PIERRE ex HARMS

[23/43, 208]

'*Crudia*': named after Dr. J. W. Crudy (1753– $\pm$ 1810), a plant collector who lived on the Bahamas.  
'*gabonensis*': referring to Gabon, where the type material was collected.

Harms in Not. Bot. Gart. Berlin, app. 21, p. 49 (1911); type: Klaine 3083, pro parte (K!, P!); Baker f.



in Leg. Trop. Afr., p. 738–740 (1930); Pellegrin in Leg. Gabon, p. 129 (1948); J. Léonard in G.C.A.a., p. 134 (1957).

1936: Aubréville, F.F.C.I., 1st ed., I, p. 256

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 310

1950: Normand, A.B.C.I., I, p. 128; Pl.XXXVIII

1961: Irvine, Woody Plants of Ghana, p. 293

1958: F.W.T.A., 2nd ed., I, p. 467

LOCAL NAME: gbaye (Krahn)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Liberia, Ivory Coast, Ghana, Gabon

**BOTANY.** Medium-sized, occasionally large tree of the rain forest. Branchlets with leaves villous pubescent, gradually glabrescent, sometimes with scales on the internodes. Leaves pinnately compound, alternate, stipulate, 8–15 cm long, with 6 or 7 (–11) alternate leaflets, (densely) greenish brown villous or pilose when young, glabrescent on the upper surface of the leaflets only. Stipules intrapetiolar, 0.5–1 cm long, villous, bipartite; the acute, linear slips c. 1.5 mm wide, early or later caducous; the base remaining as a little rim in the axil of the leaf. Petiole 0.5–1.5 cm long, jointed at base. Rachis 4.5–7.5 cm long, straight or slightly zig-zag. Petiolules 1.5–4 mm long, markedly twisted. Leaflets dark green, glossy above, dull beneath, (narrowly) obovate or (–) elliptic, (1.5–) 2.5–7.5 cm long, (0.7–) 1.5–3.5 cm wide. The (4) 5 upper leaflets more or less equal in size, sometimes the terminal largest; the two lower leaflets smaller. Base of the first leaflet rounded – broadly cuneate, increasingly cuneate in the following leaflets; apex bluntly acuminate – obtuse with a caudate tip of 5–7 mm long. Midrib slightly impressed above, prominent beneath. Nerves not pronounced on either side, 5–8 on each side of the midrib, looping at some distance from the edge.

Inflorescences slender, drooping, loosely flowered, axillary or terminal racemes, 10–18 cm long. Peduncle brownish pilose. Bracts and bracteoles 2–2.5 mm long, 0.5–1 mm wide, densely pilose, caducous. Pedicel 1–2 cm long, pilose, with the two bracteoles on the lower half, not attached at the same height. Receptacle obconical, pilose outside, glabrous inside, c. 1.5 mm high and wide, carrying the sepals and the stamens on the edge. Sepals 4, imbricate in bud, concave, broadly elliptic, c. 5 mm long and wide, with a rounded apex, minutely puberulous outside, glabrous inside. Petals absent. Stamens 10, free, twisted in bud, soon shed from the open flower; filaments filiform, c. 12 mm long, glabrous; anthers dorsifixed, versatile, elliptic, c. 1 mm long, with 2 thecae opening lengthwise. Disc very short and thin, intrastaminal. Pistil adnate to the side of the receptacle, shortly stipitate. Stipe c. 1 mm long, glabrous. Ovary c. 4 mm long, woolly pubescent; style developing after the stamens, c. 18 mm long, glabrous except at the base, slightly canaliculate; stigma terminal, minutely horseshoe-shaped.

Fruits flat, woody, dehiscent pods, containing 1–2, rarely more seeds, up to 25 (–30, Irvine) cm long, 5–8 cm wide, the sides obscurely obliquely striate, minutely pale brown



11. *Brachystegia leonensis* HUTCH. & B. DAVY. Young specimen without buttress development (see page 151).



12. *Copaifera salikounda* HICKEL. An unusually tall specimen (see page 158).



Fig. 23. *Crudia gabonensis* PIERRE ex HARMS A: branchlet with leaves ( $\times \frac{1}{2}$ ); B: inflorescences ( $\times \frac{1}{2}$ ); C: open flower, stamens already shed ( $\times 2$ ); D: fruit ( $\times \frac{1}{2}$ ); E: seed ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ); G: *Hymenostegia afzelii* (OLIV.) HARMS: leaf ( $\times \frac{1}{2}$ ).

villous, finely lenticellate; the ventral edge slightly broadened with a wing, up to 8 mm wide or entirely without broadening; apex apiculate. Seeds disc-shaped, c. 2 cm in diameter, marginate.

Seedling: germination epigeal. Hypocotyl c. 5 mm long, glabrous. Cotyledons remaining flat on the ground within the testa, attached to the seedling with a petiole of c. 4 mm long. Epicotyl c. 14 cm long, puberulous, with a number of scales at regular intervals of 1–2 cm, and a collar just above the cotyledons. First 2 leaves alternate with (2–) 4 opposite or alternate leaflets. Stipules c. 5 mm long, 1 mm wide, caducous. Leaflets as described above but longer acuminate. The scales on the epicotyl all have a bud in the axil, which may develop into the leading shoot when the top of the seedling is damaged. Under abnormal conditions the scales may develop into bifoliate leaves.

TAXONOMICAL NOTES. The specimens, collected as Klaine 3083, represented 2 species which both served as type material, viz. *Crudia klainei* PIERRE ex DE WILD. (1920) and *Crudia gabonensis* PIERRE ex HARMS (1911).

The genus *Crudia* SCHREB. is pantropical and represented in Africa by about half a dozen species. At present only two species are known from Liberia: *C. gabonensis* and *C. senegalensis* PLANCH., whereas *C. klainei* is most likely to occur also. *Crudia senegalensis* is fairly common in several areas, along streams and in secondary forest (Tahn-Gondoja road). It has more and larger leaflets than *C. gabonensis*, foliaceous, persistent stipules, short, thick fruits with c. 5 cm long and 2 cm thick, shiny, brown seeds. There are some closely related species in central Africa, *C. zenkeri* HARMS and *C. harmsiana* DE WILD., which differ mainly by vegetative characters from *C. gabonensis*. A revision of the genus might show that some of the species accepted at present are identical, but the name *Crudia gabonensis* will be retained, being the older one.

The present description is based on the following specimens: Bomi Hills 1152, van Dillewijn 51. The type description of Harms (1911, l.c.) differs in describing the leaves as glabrous; however, a second description of the type by de Wildeman (Bull. Jard. Bot. Bruxelles, 7, p. 247–252, 1920) based on the same material (Klaine 3083) refers to the leaves as pubescent on rachis and underside of the leaflets, which is in accordance with the present description. Some authors erroneously cite de Wildeman as the author of the species.

FIELD NOTES. *Crudia gabonensis* is an inconspicuous tree and not easily recognised owing to the lack of characteristic features. Once its habit is familiar, it proves to be much more common than anticipated. It may be a large tree, up to 40 m ( $\approx$  130') high, apparently occurring in the evergreen forest, or at any rate not observed in the drier parts of Liberia. Especially south of the Putu Range large individuals were observed; the tree is also fairly common in Bomi Hills. Unlike *C. senegalensis* and *C. klainei*, which seem to prefer moist habitats (river borders), *C. gabonensis* is found on higher grounds, slopes and plateaux. It grows scattered or in small groups, never gregarious.

The base of the tree is quite variable, with low, heavy, spreading buttresses, narrow butt flares or thin, narrow, high reaching buttresses up to 5 m ( $\approx$  16'), which may extend along the ground in high, plank-like surface roots.

The bole is straight, up to 1 m ( $\approx$  3') in diameter, sometimes free of branches for 16 m ( $\approx$  50'), but often forked at a low level with steeply ascending part-stems, usually not cylindrical but angular. The crown is dense and dark green, characterized by steeply ascending, heavy branches with drooping smaller branches, twigs and leaves, the leaves not evenly spread but massed in groups.

The bark of young trees is fairly smooth and finely longitudinally fissured; the bark of older trees is rough, pitted, weathering on the tree or finely scaly, yellowish – greyish brown, medium thick. The slash is compact, brittle to fibrous, pale or dull brown, smelling slightly like fresh fish, sometimes slowly exuding a clear, sweet sap; ripple marks wavy when present. The tree is deciduous for a short period in the dry season; young leaves are red-brown. Flowers were collected during March; Pellegrin (1948, l.c.) reports the flowers to be reddish. Ripe fruits are found in June–July and February. Seedlings germinate on mineral, sun-exposed soils.

**USES.** The wood is reported to be extremely hard. Of three logs brought to the sawmill at Bomi Hills, two were discarded after the first nearly ruined the saw. A heavy beam of *Crudia* wood is used in the Bomi Hills iron mine as a bumper for the ore trucks delivering their load to the crusher. No other uses for the timber are known.

*Cryptosepalum tetraphyllum* (HOOK. f.) BENTH.

[24/187, 216]

'*Cryptosepalum*': Gr. *kryptos*: hidden; referring to the very small (hidden) sepals.

'*tetraphyllum*': referring to the four leaflets of the leaf.

Bentham in Trans. Linn. Soc., XXV, p. 315, t. 43 B (1866); Oliver, F.T.A., II, p. 304 (1871); Baker f., Leg. Trop. Afr., p. 743 (1930); J. Léonard, G.C.A.a., p. 270 (1957, lit!).

*Cynometra? tetraphylla* HOOK. f. in Fl. Nigrit., p. 329 (1849); type: Don s.n. (BM!).

1928: F.W.T.A., 1st ed., I, p. 347

1958: F.W.T.A., 2nd ed., I, p. 480

1936: Aubréville, F.F.C.I., 1st ed., I, p. 238

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 293

1950: Normand, A.B.C.I., I, p. 123; Pl. XXXIX

**LOCAL NAMES:** guewèh (Gio); guéleh (Gola)

**TRADE NAME:**

**GEOGRAPHICAL DISTRIBUTION:** Guinea – Ivory Coast

**BOTANY.** A medium-sized tree in the lowland high forest, in mountainous areas small trees or shrubs. Leaf-bearing branchlets slender, tapering and sometimes zig-zag to-

wards the top, tomentellous, lenticellate with small, brown lenticels, bearing 6–12 leaves, progressively smaller towards the top of the twig. Older branchlets gradually glabrescent. Leaves paripinnately compound, alternate, stipulate, 2-(rarely 1- or 3-) jugate, tomentellous on petiole and rachis. Stipules early caducous, only seen on seedlings. Petiole 2–7 mm long, jointed at base. Rachis 0.5–2 cm long, canaliculate above, on very young leaves with minute, 0.2 mm long, glabrous or sparsely pubescent, caducous stipellae at the base of the leaflets. Lower pair of leaflets sessile, subopposite, (broadly) obliquely ovate, 6–18 mm long, 5–12 mm wide; apex and base rounded, glabrous except the pubescent lower half of the midrib and the ciliate inner margin. Upper pair of leaflets opposite, sessile, very obliquely elliptic, 2–5 cm long, 0.8–2 cm wide; apex acute or obtuse; base cuneate on the inner side, rounded on the proximal side, slightly twisted. Midrib excentric towards the ciliate inner margin, flat above, prominent beneath, tomentellous on the lower half. Nerves 1 or 2, steeply ascending from the base. Reticulation very fine.

Buds enclosed in glabrous, concave, parallel-nerved, caducous bud scales up to 5 mm long. Flowers in small, 1.5–2.5 cm long, axillary, glabrous racemes. Bracts not seen, very early caducous. Pedicels 6–12 mm long. Buds covered by persistent, valvate, concave, white bracteoles, puberulous on the margin, spreading when flowering, broadly elliptic, c. 5 mm long and wide. Receptacle cupuliform, glabrous, c. 1 mm high, c. 2 mm wide, thick-walled. Sepals 4, c. 0.5 mm long, squamiform, glabrous. Petal 1, adaxial, white, membranous, very broadly ovate, c. 4 mm long, 5 mm wide, shallowly bilobed, palmateveined. Disc absent. Stamens 3, free, glabrous; filaments c. 5 mm long; anthers dark purple, dorsifixed, versatile, with 2 thecae splitting lengthwise. Pistil adnate to the adaxial side of the receptacle, stipitate. Stipe c. 1 mm long, glabrous; ovary c. 1.5 mm long, flattened, pilose on the edges; style c. 4 mm long, glabrous; stigma terminal, capitate-peltate.

Fruits smooth, dehiscent pods, containing 1, rarely 2 or 3 seeds, 5–10 cm long, 3–4.5 cm wide, laterally attached to the stalk. Base rounded; apex wider than the base, rounded, often with a short mucro; the valves finely lenticellate outside, spongy inside, curling when dry. Seeds round, disc-shaped or irregularly formed, c. 2 cm long, 1–1.8 cm wide, with a smooth, dark brown margin and finely striate central part; testa not loosening when dry.

Seedling: germination epigeal. Hypocotyl c. 10 cm long, puberulous, angular or slightly winged, the thin outer bark flaking. Cotyledons sessile, pressed against the epicotyl, glabrous, slightly sagittate. Epicotyl 1.5–3 (–4.5) cm long, tomentose. First two leaves opposite, (3–) 4 (–5) jugate. Stipules very small, caducous. Petiole and rachis tomentose. Leaflets sessile, opposite, obliquely elliptic, more or less like the leaflets as described above. Third and following leaves alternate, 2-jugate, as described above, but the upper pair sometimes long acuminate. On very young shoots stipules present, linear, c. 5 mm long, 1 mm wide. Young saplings of a shrubby character, with scandent branches.

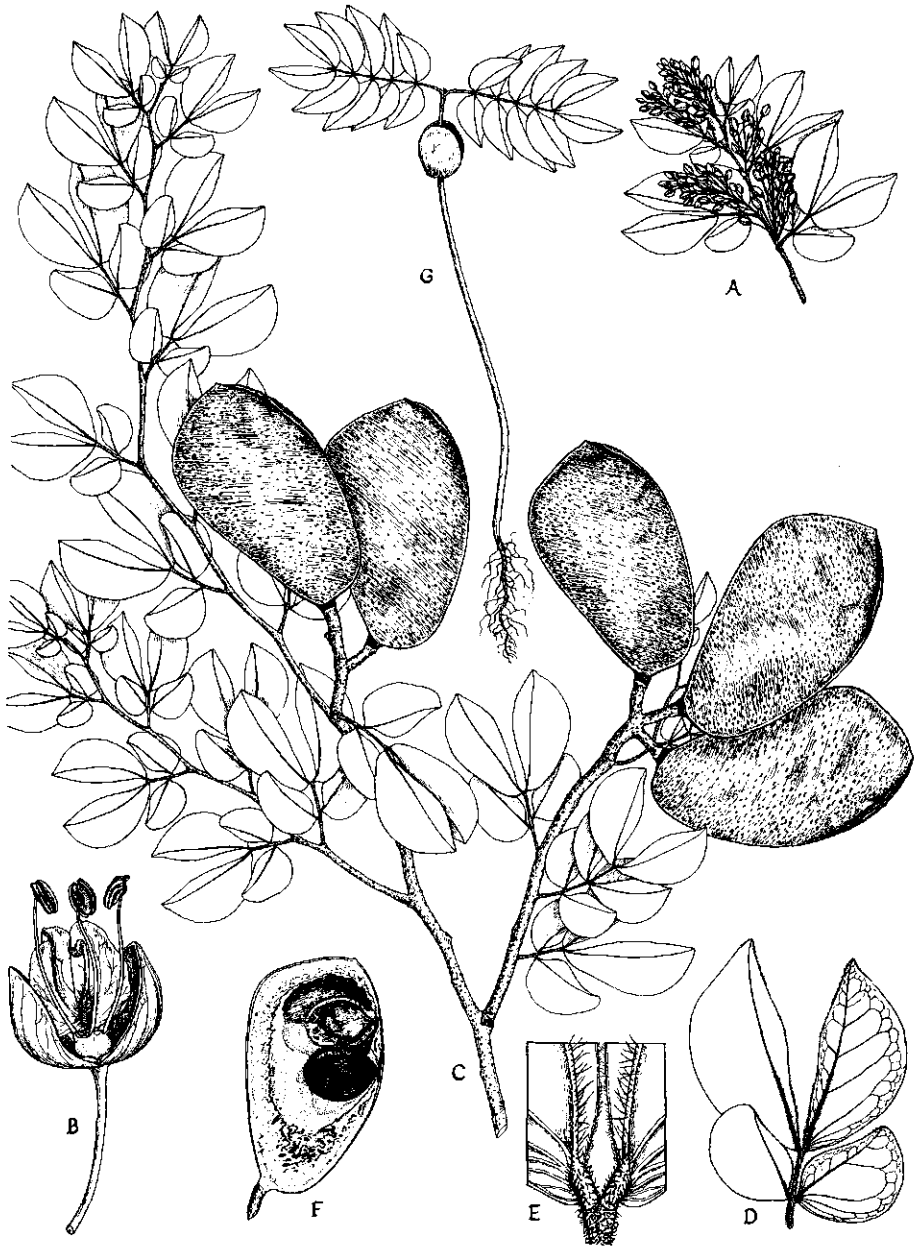


Fig. 24. *Cryptosepalum tetraphyllum* (HOOK. f.) BENTH. A: branchlet with inflorescences ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: branchlet with fruits ( $\times \frac{1}{2}$ ); D: leaf ( $\times 1$ ); E: top of rachis and base of leaflets beneath ( $\times 5$ ); F: one valve of a fruit + seed ( $\times \frac{1}{2}$ ); G: seedling ( $\times \frac{1}{2}$ ).



TAXONOMICAL NOTES. This species, for which Hooker tentatively proposed the name *Cynometra? tetraphylla*, because his type material consisted of leaves only and he was unable to classify the plant without flowers, served as type specimen for the new, African genus *Cryptosepalum*, proposed by Bentham (1865, l.c.). At that time *Cryptosepalum tetraphyllum*, occurring in Sierra Leone, Liberia, and Ivory Coast, was the only known species of the genus. At present it is known that six species occur in West and Central Africa, and about five to seven in East Africa.

Léonard (1954, l.c.) described the pods as having a subwinged ventral edge. The pods observed in Liberia did not show this character. A second species of *Cryptosepalum*, that might occur in Liberia, in the Grebo Nat. For. or on the Putu Range, is *C. minutifolium* HUTCH. & DALZ., a large tree found once in the Ivory Coast by Chevalier (No. 19579), in the Cavally region, about the height of Grabo, in a mountainous region. The leaves have only two leaflets, resembling the upper pair of leaflets of *C. tetraphyllum*, but smaller, c. 2 cm long and 0.9 cm wide.

The present description and figures are based on the following specimens: Bomi Hills 844, 847, 848; Bong Range 31, 74, 1061, Leeuwenberg 4926; Totota Range 418; Nimba Mtn. 900; Gio Nat. For. 255; Gbi Nat. For. 572; Cestos river, de Wilde 3741.

FIELD NOTES. *Cryptosepalum tetraphyllum* can reach a height of 30 m ( $\approx 100'$ ) and a diameter of 80 cm ( $\approx 2.5'$ ), but usually it is smaller. The base of the tree has sharp root swellings, root spurs, or rounded claws, rarely small buttresses up to 75 cm ( $\approx 2.5'$ ) high. The bark on the base is conspicuously transversely striate. The bole is up to 16 m ( $\approx 50'$ ) free of branches, but usually shorter, straight or slightly sinuous, cylindrical. The crown is fairly small in the high forest trees, open, light green, with a very fine texture, owing to the fine structure of the leaves. The bark is smooth, grey greenish, superficially cracked with lighter patches of lichens, slightly horizontally striate-lenticellate, medium thick. The slash is hard-fibrous, pale pink – pinkish red; it exudes slowly a brown, sticky gum, used locally as a cosmetic.

The tree is deciduous for a short period in November. New leaves appear soon, bright red and glossy. The tree flowers from March – July; at the time of flowering small flowering twigs are frequently found under the tree. The small white flowers with their dark purple anthers are among the prettiest to be found in the forest.

Fruits ripen from August to February. The seedlings are quite common in the forest, betraying the presence of the tree in the immediate neighbourhood; they rarely grow higher than 50 cm ( $\approx 1.5'$ ).

*Cryptosepalum* is found scattered throughout the high forest; it often accompanies *Tetramerlinia*, from which it is easily differentiated by its reddish slash and root spurs. In the northern parts of the country the tree adopts a more shrubby habit, growing along streams but also forming gregarious stands on rocky mountains: Mtn. Bidi, Loma Nat. For. The leaf of *Cryptosepalum* could be confused with that of *Hymenostegia afzelii* (OLIV.) HARMS, but the rachis of this leaf is markedly winged (see fig. 23 G).

USES. The tree is utilised locally together with *Tetraberlinia*, *Didelotia*, and *Brachystegia* under the misleading name ‘African pine’. It is lighter coloured and of poorer quality than the other species.

*Cynometra ananta* HUTCH. & DALZ.

[25/40, 208]

‘*Cynometra*’: Greek translation of the Malayan name ‘Puki Andjing’; andjing = Gr. kunos: dog; puki = Gr. metra: womb, uterus; referring to the fruit of a Malayan species, which has a fruit resembling the genitals of a bitch.

‘*ananta*’: vernacular name from Ghana (Fante).

Hutchinson & Dalziel, Kew Bull. 1928, p. 381; type: Chipp 11, Ghana (K!); J. Léonard, Bull. Jard. Bot. Bruxelles, 21, p. 373–400 (1951, lit.!).

1928: F.W.T.A., 1st ed., I, p. 331

1928: Bull. Imp. Institute, 26, p. 285–288

1931: Cooper & Record, Evergr. For. Liberia, p. 63

1936: Aubréville, F.F.C.I., 1st ed., I, p. 244

1937: Dalziel, U.P.W.T.A., p. 185

1950: Normand, A.B.C.I., I, p. 124; Pl. XXXIX

1958: F.W.T.A., 2nd ed., I, p. 458

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 298

1959: Kryn & Fobes, Woods of Liberia, p. 38

1960: Taylor, Syn. Silv. Ghana, p. 129

1961: Irvine, Woody Plants of Ghana, p. 293

LOCAL NAMES: sunguh (Gio); tutwo (Krahn); dah (Bassa, cf. Cooper)

TRADE NAME: Apomé

GEOGRAPHICAL DISTRIBUTION: Liberia, Ivory Coast, Ghana

BOTANY. A large forest tree, often gregarious. Leaf-bearing twigs lenticellate, glabrous. Leaves paripinnately compound with only one pair of leaflets, alternate, stipulate, glabrous. Stipules triangular, c. 1 mm long, caducous. Petiole 3–5 mm long, terete. Petioles 2–4 mm long. Leaflets thinly coriaceous, 3.5–10 cm long, 1–4 cm wide, widest in the middle, distinctly falcate or sickle-shaped, the outer margin convex, the inner margin straight or concave, rarely convex; the midrib curved, a little nearer to the inner margin. Base twisted, unequal-sided, the outer margin broadly cuneate, decurrent up to the petiole, the inner margin cuneate. Apex bluntly acute – acuminate. Midrib and nerves flat above, slightly raised beneath. No prominent nerves originating from the base. Lateral nerves 5–8 on each side of the midrib; reticulation faint. Leaflets of saplings papery, much larger, up to 18 cm long and 7.5 cm wide, long acuminate at the apex, the inner margin usually convex.

Inflorescences densely flowered, axillary or terminal, erect, up to 7 cm long panicles, solitary or with a few together. Peduncles, outside of the bracts, and pedicels yellowish tomentose. Bracts 0.5 mm long, concave triangular, early caducous. Pedicels c. 5 mm long, 0.5 mm thick. Bracteoles 2, attached near the middle of the pedicel, but not at

equal height, concave-triangular, c. 1 mm long and wide, tomentose outside, ciliate on the margin, caducous. Receptacle cupuliform, c. 1 mm high, and c. 1 mm wide at the top, tomentose outside, glabrous inside, with a broad rim. Sepals 4 (rarely 5, the two adaxial not connate), white, free, imbricate in bud, recurved when open, c. 4 mm long, 2.5 mm wide, concave, glabrous but sparsely ciliate on the margin. Petals 5, white, 3–4 mm long, c. 1.5 mm wide, membranous, the midrib slightly asymmetric. Stamens 10, free, glabrous. Filaments curved, c. 5 mm long, subulate; anthers basifixed, rotundate, deeply bilobed at base, with 2 thecae opening lengthwise. Disc not seen. Pistil on the base of the receptacle, shortly stipitate. Stipe 0.5 mm long, glabrous; ovary c. 1 mm long, villous; style c. 3 mm long, slightly curved, glabrous; stigma terminal, inconspicuous.

Fruit a flat, smooth, brown, slightly laterally attached pod, containing 1–2 seeds, 8–10 cm long, 4–5 cm wide, broadest above the middle, c. 2 cm wide and rounded at the base, with a slightly winged, c. 5 mm broad ventral edge, an apiculate apex and slightly nervous sides. Seeds round – elliptic, disc-shaped, 2–2.5 cm long, 1.5–2.5 cm wide, light brown.

Seedling: germination epigeal. Hypocotyl 7–9 cm long, brown. Cotyledons sessile, shortly sagittate at base, rounded at the top, 1.5–2 cm long, 1–2 cm wide, pressed against the epicotyl. Epicotyl 12–18 cm long. First two leaves opposite, similar to the mature leaves but the inner margin convex and the apex long acuminate. Stipules triangular, c. 1 mm long, ciliate on the margin. Following leaves alternate. Young saplings with a shrubby character.

TAXONOMICAL NOTES. The genus *Cynometra* L. is pantropical; the type specimen for the genus came from India. According to the revision of Léonard (1951, l.c.) about 25 African species, mostly from Central and East Africa, are referred to this genus. However, Léonard divided the African species into three groups, and only the first group, including six species, has fruits similar to the Indian *Cynometra* species (swollen, bulate or tuberculate). The other two groups have smooth, flat pods and according to Léonard they form one or two distinct genera. Léonard refrained from publishing new combinations because a world-wide revision of the genus *Cynometra* would be necessary to establish the correct taxonomy. However, as both *Cynometra ananta* and *C. leonensis* belong to the last two groups, it is to be expected that their generic name is liable to change. A representative of the 'true' *Cynometra* group, *Cynometra megalophylla* HARMS, has not yet been found in Liberia, but may occur in the northern regions bordering Guinea and Ivory Coast. The tree grows on river banks.

The present description of *Cynometra ananta* is based on the following Liberian collections: N. Gio Nat. For. 167; Tiatown, 10 M. E. of Tapeta 1280.

FIELD NOTES. *Cynometra ananta* is a large forest tree, which may reach a height of 36 m ( $\approx 120'$ ) and a diameter of 1.20 m ( $\approx 4'$ ). The base of the tree is provided with



Fig. 25. *Cynometra ananta* HUTCH. & DALZ. A: branch with leaves and inflorescences (flowers in bud) ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: pod ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ); E: *Guibourtia leonensis* J. LÉONARD: branch with leaves and fruits ( $\times \frac{1}{2}$ ).

well-developed, thin buttresses up to 3 m ( $\approx 10'$ ), often extending along the ground in widely spreading surface roots. The bole is often straight, not cylindrical, but angular and knotty, rarely over 18 m ( $\approx 60'$ ) free of branches, usually forked at a low level, with steeply ascending part-stems. The crown is heavily branched, rounded, dense. The bark is grey when young and when exposed to sunlight, reddish brown when old, rough or irregularly scaly with small bark scales leaving shallow, red coloured scars when shed, giving the bark a patchy or pock-marked habit. The bark on the buttresses is transversely striate. The slash on the buttresses is thin, pinkish white, soon turning red-brown. On the stem it is pottery red, turning reddish brown on exposure, compact-fibrous, fairly thick. Ripple marks usually present, slightly wavy.

The tree is typical for the evergreen forest of the eastern and central province, although isolated patches may occur in the moist semi-deciduous forest (N. Gio National Forest!). In the western province its place is taken by *Cynometra leonensis*. It often forms gregarious stands on the slopes towards creeks, in valleys and on small plateaux, where it even may have a semi-single dominant character. A 100% enumeration of all trees over 24" diameter in an area of 20  $\times$  20 chains (40 acre), east of the Sapo National Forest, showed the following results (data E.A.C.):

<i>Cynometra ananta</i>	48 trees
<i>Piptadeniastrum africanum</i>	28 trees
<i>Calpocalyx aubrevillei</i>	20 trees
<i>Tetraberlinia tubmaniana</i>	10 trees
<i>Erythrophleum ivorense</i>	10 trees
<i>Gilbertiodendron preussii</i>	8 trees
<i>Combretodendron macrocarpum</i>	8 trees
<i>Parinari glabra</i>	8 trees
<i>Uapaca</i> spp.	8 trees
<i>Canarium schweinfurthii</i>	3 trees
<i>Guarea cedrata</i>	2 trees
<i>Entandrophragma angolense</i>	1 tree
<i>Nauclea diderrichii</i>	1 tree
<i>Terminalia ivorensis</i>	1 tree
Miscellaneous	35 trees
Total	191 trees

*Cynometra* accounted for 25% of all trees over 24" in diameter. The average diameter of *Cynometra* was 31", the maximum 47". One tree produced 8 half-logs (8 ft. long), but the average yield was 3.5 half-logs per tree. The gregarious character of the tree is accentuated by the fact that a similar square of 20  $\times$  20 chains directly south of this area did not include a single *Cynometra*. In the whole option area of the E.A.C. (84,100 acre) *Cynometra* was 7th with 125 trees/1000 acres (4% of the total) and 361.2 bdf/acre (2.3% of the total).

The tree is evergreen; the shedding of the leaves is directly followed by a new flush of brilliant red leaves, gradually turning dark green. The flowering season lasts from September to November. During this period the ground below the tree is littered with shed, white flowers. The fruits ripen from December–January. Regeneration is usually quite common under the trees, but saplings rarely grow larger than 2 m ( $\approx 7'$ ) high.

The pod of *Cynometra ananta* is similar in appearance to that of *Tetraberlinia tubmaniana*, but is without the faint lateral ridge of the latter species. Only a few trees in Liberia have bifoliolate leaves like *Cynometra ananta*. *Guibourtia leonensis* shows the closest resemblance, but these leaves have a much longer petiole (see fig. 25 E). The leaves of *Guibourtia ehie* and *G. dinklagei* differ in having 2–3 prominent nerves, originating from the base. The leaves of *Pellegriniodendron diphyllum* differ in not being falcate and having a horny mucro on the apex and 2 little thorns on the top of the petiole (see fig. 33 G).

USES. Cooper and Record (1931, l.c.) report: 'When a man wants to get a message to a friend far away or wants this person to return to the village, he makes a snuff out of the dried leaves and blows it from his hand in the direction of the far-off friend, at the same time calling his name or giving the message.'

The wood is red – reddish brown, hard and heavy, durable. It is difficult to work with hand tools, but more amenable to machine tools. The wood is stiff and very strong in transverse bending and compression parallel to the grain. Resistance to compression perpendicular to the grain, shear and indentation is fairly high. The wood has a slight tendency to check, and shrinks considerably when dried from the green condition. It is fairly hard to cut with hand saws, moderately easy with machine saws. It is not easy to plane, 'picks up' badly on the rd. surface. Hand boring is difficult, machine boring is easy, but the tools heat up and the wood steams. It is too hard for nailing. Screws can be driven in and hold firmly when adequate holes are bored. The wood is difficult to glue. The timber is used in bridge building, railway work and heavy construction (cf. B.I.L., 1928, l.c.).

*Cynometra leonensis* HUTCH. & DALZ.

[26/43, 186]

'*Cynometra*': see p. 167

'*leonensis*': referring to Sierra Leone, where the type specimen was collected.

Hutchinson & Dalziel, Kew Bull. 1928, p. 381; type: Aylmer 136 (K!); J. Léonard, Bull. Jard. Bot. Bruxelles, 21, p. 392 (1951).

1928: F.W.T.A., 1st ed., I, p. 331

1958: F.W.T.A., 2nd ed., I, p. 458

LOCAL NAMES:

## TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone and W. Liberia

**BOTANY.** A medium-sized or large forest tree. Leaf bearing branchlets sparsely puberulous when young, glabrescent, pale brown lenticellate. Leaves paripinnately compound, alternate, stipulate, (3–) 4–6 jugate, 5–9 cm long. Stipules intrapetiolar, bilobed, the lobes linear, c. 6 mm long, 1 mm wide at the base, acuminate, ciliate, caducous. Petiole 4–6 mm long, jointed and rugose at the base only. Petiole and rachis narrowly winged, sparsely tomentose above. Petiolules very short, c. 1 mm long, rugose, twisted, sparsely tomentose. Leaflets opposite, (narrowly) oblong, (0.8–) 1.5–5 cm long, (0.4–) 0.8–1.8 cm wide, the lower pair smaller, the upper pairs more or less equal in size. Base unequal-sided, the proximal edge cuneate, decurrent up till the rachis, the distal edge straight, broadly truncate – cuneate, more or less parallel to the rachis. Apex truncate and minutely mucronate or emarginate. Midrib straight, flat above, prominent beneath, sparsely puberulous. Nerves only slightly raised beneath, straight, only slightly ascending, anastomosing inconspicuously; sometimes one more prominent nerve departing from the proximal side of the base, ascending more steeply than the other nerves (see also field notes, leaf of *Didelotia engleri*).

Inflorescences crowded, axillary or terminal panicles, up to 7 cm long, solitary or in clusters. Peduncles, bracts and petioles pale brown tomentose. Bracts small, caducous. Pedicels c. 5 mm long, articulate beneath the flower, persistent on the peduncle after the flowers are shed. Bracteoles 2, c. 2 mm long, 1 mm wide at the base, acuminate, ciliate, attached near the middle of the pedicel. Receptacle obconical, c. 1 mm long, c. 1 mm wide at the top, sparsely tomentose outside. Sepals 4 (rarely 5, when the 2 posterior sepals are not connate), imbricate in bud, spreading when open, broadly elliptic, c. 3 mm long, 2–2.5 mm wide, membranous, white, ciliate. Petals (4) 5, imbricate in bud, spreading when open, narrowly elliptic, 4–5 mm long, c. 1.5 mm wide, membranous, white, the posterior petal slightly smaller than the others or absent. Stamens 10 (11), glabrous, free or sometimes 2 partially connate. Filaments c. 7 mm long, slightly curved, subulate; anthers basifixed, rounded, bilobed at the base, with 2 thecae, opening lengthwise. Disc not seen. Pistil in the centre of the ovary, stipitate. Stipe c. 1.5 mm long, glabrous; ovary villous, c. 2 mm long, 1.5 mm wide, containing 2 ovules; style 4–5 mm long, glabrous; stigma terminal, inconspicuous.

Fruit a flat, woody pod, containing 1–2 seeds, c. 7 cm long, 3 cm wide (or larger?), rounded at the base, with a slightly laterally attached stalk, shortly mucronate at the apex, with a hardly broadened ventral edge and slightly nervose sides. Seeds not seen.

Seedling: germination epigeal. Hypocotyl 5–6 cm, glabrous. Cotyledons not seen. Epicotyl c. 6.5 cm long, minutely puberulous towards the top, finely lenticellate. First two leaves opposite, 3–4 jugate, as described above but stipules smaller and apex of the leaflets obtuse. Following leaves alternate.

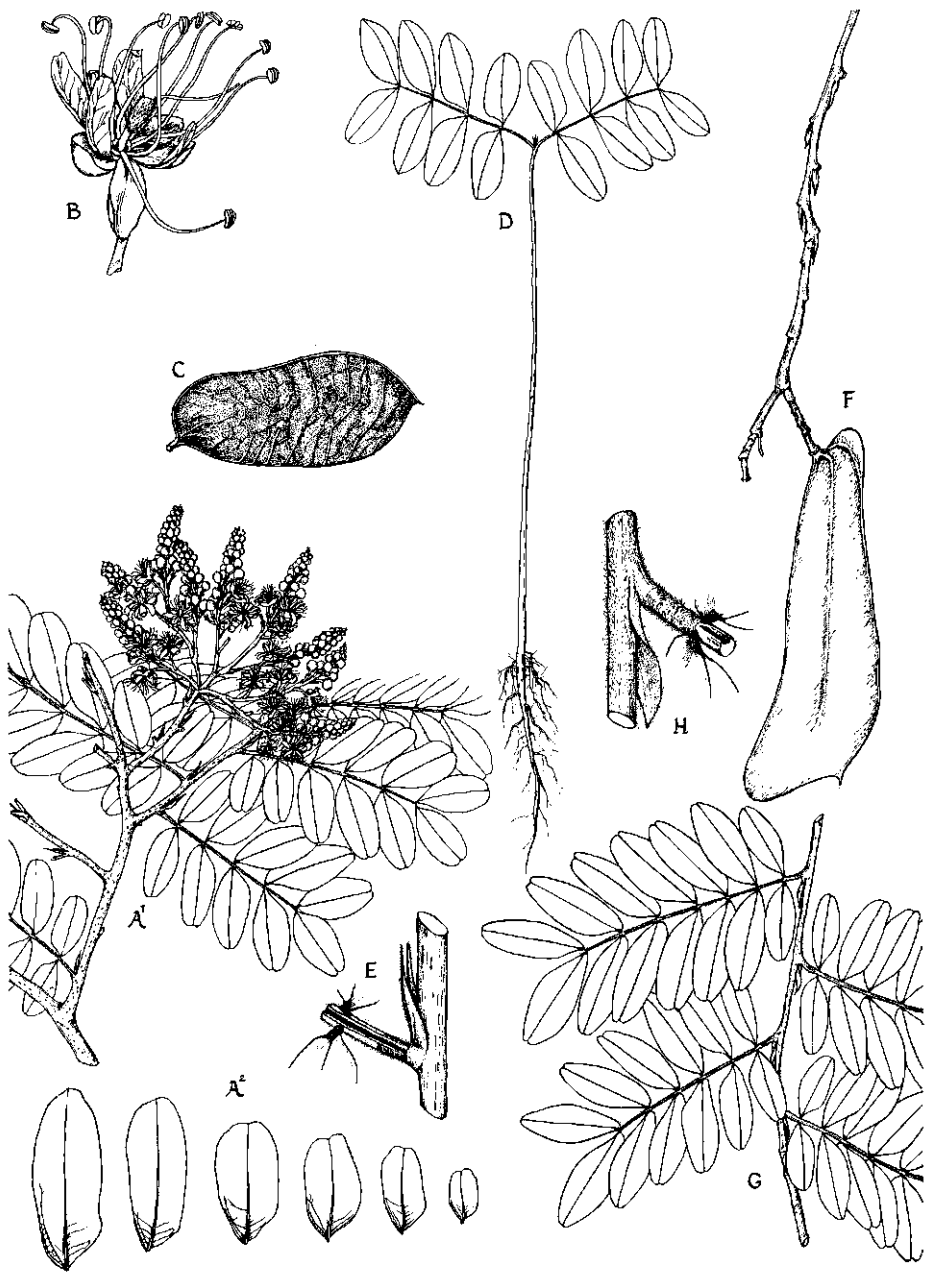


Fig. 26. *Cynometra leonensis* HUTCH. & DALZ. A<sup>1</sup>: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); A<sup>2</sup>: series of leaflets, showing the variation ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: fruit (immature,  $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ); F: *Didelotia engleri* DINKL. & HARMS, branch with leaves ( $\times \frac{1}{2}$ ); F: idem, fruit ( $\times \frac{1}{2}$ ).



TAXONOMICAL NOTES. In the F.W.T.A., 1958, l.c., p. 457, the species of *Cynometra* are first divided into two groups, with 6-or more jugate leaves or with 4-or less jugate leaves. *C. leonensis* is classified under the first group. However, the number of juga is usually 5, ranging from 3–6 and this entrance to the key needs to be revised. See also taxonomical notes *Cynometra ananta*.

The present description and figures are based on the following specimens: Bopolu 943; Gola Nat. For. 1275; Maher river, railway bridge 1303; White s.n.

FIELD NOTES. *Cynometra leonensis* is a medium-sized tree of river borders, but also a large tree of the high forest up to 30 m ( $\approx 100'$ ) tall and over 1 m ( $\approx 3.5'$ ) in diameter. The base of the tree has low, spreading buttresses, sometimes reaching up to 1.80 m ( $\approx 6'$ ) on the stem. The bole may be straight and free of branches up to 14 m ( $\approx 45'$ ) high, but usually the stem is forked at a low level or divided above the buttresses into as many as seven part-stems. Suckers from the base or on the stem are common and may develop into quite heavy branches. The crown of the tree is fairly dense, bright green. The bark on the edge of the buttresses is pale- or reddish brown, slightly like *Piptadeniastrum*. On the stem the bark is grey – reddish brown, smooth but finely and densely striate. The slash is fairly thin, light red, a little darker than *Monopetalanthus compactus*, fibrous. Seedlings are common in the forest.

The tree is often found along rivers, where it may be dominant with *Monopetalanthus pteridophyllus*. It may also form gregarious stands, even with a single dominant character, on the undulating lowlands of the western province, both in the high forest and in secondary forest formations. It replaces more or less *C. ananta* although this tree is not common in secondary forest. The St. Paul river seems to form the eastern boundary of the distribution area of *C. leonensis*. In the Gola National forest the tree was not observed north of Gbai, a small half town on the Mano river, one day travel south of Zoi. New leaves are brilliant red. The tree flowers abundantly from January to March; the flowers are white. The leaves should not be confused with those of *Didelotia engleri* (see fig. 26 E), which have a petiole, the whole of which forms a joint, unlike the petiole of *C. leonensis*, which is jointed at base only.

USES. No data available.

*Daniellia ogea* (HARMS) ROLFE ex HOLL.

[27/44, 129]

'*Daniellia*': named in honour of Dr. W. F. Daniell (1818–1865), who collected plants in West Africa between 1841 and 1853.

'*ogea*': Nigerian name for the 'ogea copal' gum exuding from the bark.

Holland in The Useful Pl. Nig., p. 268, Kew Bull., Add. ser. IX (1911); Rolfe, Kew Bull. 1912, p. 97; Baker f., Leg. Trop. Afr., p. 694 (1930); Keay, Kew Bull. 1953, p. 491–492; J. Léonard, G.C.A.a., p. 114 (1957).

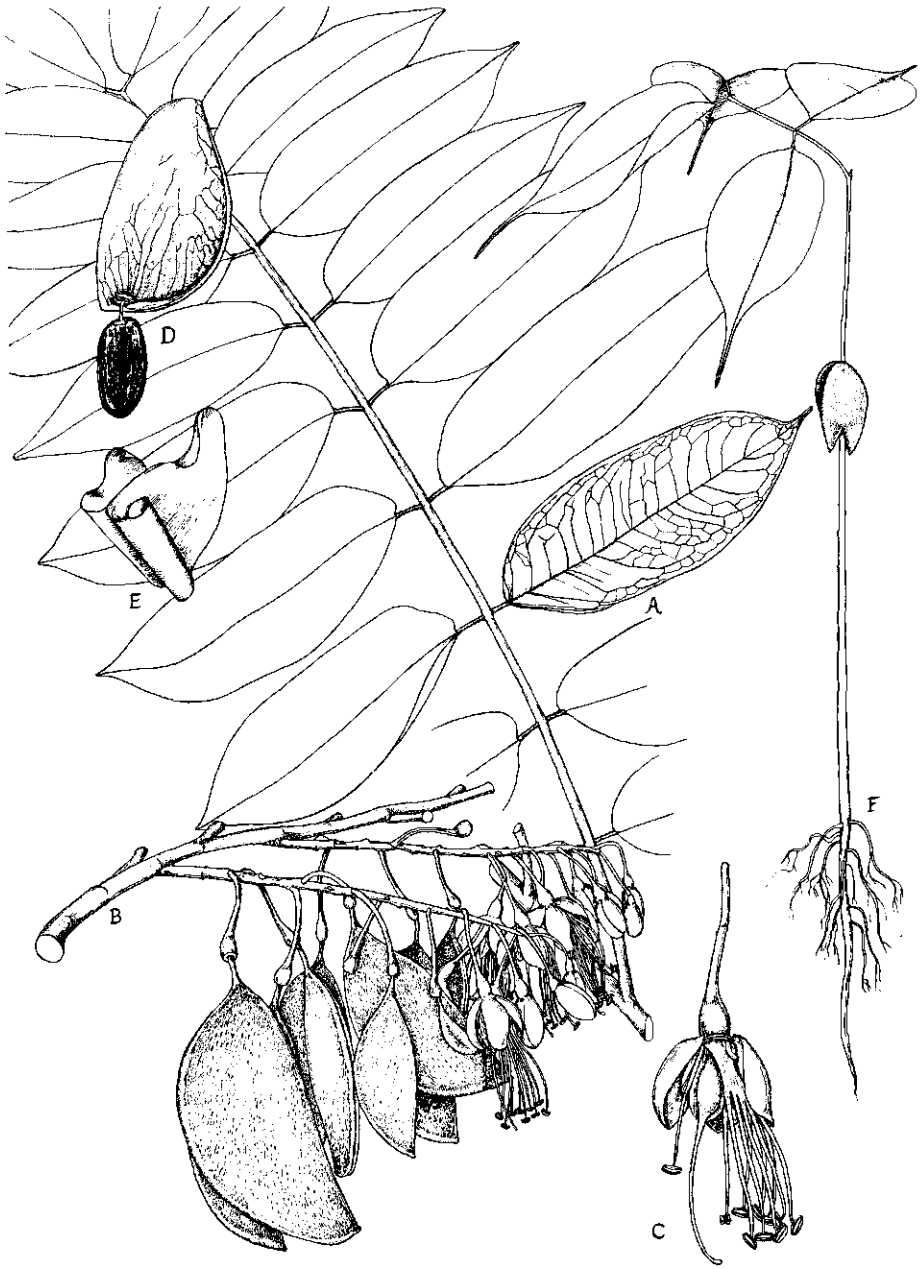


Fig. 27. *Daniellia ogea* (HARMS) ROLFE ex HOLL. A: leaf ( $\times \frac{1}{2}$ ); B: inflorescence with flowers and fruits ( $\times \frac{1}{2}$ ); C: open flower ( $\times 1$ ), one sepal and one petal removed; D: valve with seed hanging from its funiculus ( $\times \frac{1}{2}$ ); E: coriaceous endocarp ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ).

*Cyanothyrus ogea* HARMS in Bot. Jahrb., 26, p. 270 (1899, basionym); type: Millen 191, Nigeria (K!);  
*Daniellia caudata* CRAIB ex HOLL., l.c., p. 268, partly, excl. leaves (= *Clitandra barberi* STAFF);  
*Daniellia fosteri* CRAIB ex HOLL., l.c., p. 268; type: Foster 156, Nigeria (K!);  
*Daniellia punchii* CRAIB ex HOLL., l.c., p. 269, partly, excl. leaves (= *Crudia* sp.);  
*Daniellia similis* CRAIB ex HOLL., l.c., p. 269; type: Dudgeon 5 (K!);  
*Daniellia thurifera* J. J. BENN. var. *Chevalieri* J. LÉONARD in Bull. Jard. Bot. Bruxelles, 19, p. 407 (1949), partly, excl. leaves (= *D. oliveri* (ROLFE) HUTCH. & DALZ.). (Synonyms teste Keay, l.c.).

- |   |  |
|---|--|
| 1928: F.W.T.A., 1st ed., I, p. 341 (+ <i>D. caudata</i> ,<br><i>D. fosteri</i> , <i>D. similis</i> , <i>D. punchii</i> )  | p. 90–108 (+ <i>D. caudata</i> , <i>D. thurifera</i> var.<br><i>chevalieri</i> , <i>D. fosteri</i> , <i>D. punchii</i> , <i>D. similis</i> ) |
| 1931: Cooper & Record, Evergr. For. Liberia, p. 63 ( <i>D. similis</i> )  | 1950: Normand, A.B.C.I., I, p. 118; Pl. XLI ( <i>D. similis</i> )  |
| 1936: Aubréville, F.F.C.I., 1st ed., I, p. 211, 212 ( <i>D. aff. similis</i> )  | 1955: Bois et For. Trop., 44, p. 17–20   |
| 1936: Kennedy, F.F.S.N., p. 97  | 1958: F.W.T.A., 2nd ed., I, p. 463   |
| 1937: Dalziel, U.P.W.T.A., p. 186, 187 (+ <i>D. caudata</i> , <i>D. fosteri</i> , <i>D. punchii</i> , <i>D. similis</i> ) | 1959: Aubréville, F.F.C.I., 2nd ed., I, p. 262   |
| 1950: J. Léonard, Etud. Bot. Cop. Congo Belge,  | 1959: Kryn & Fobes, Woods of Liberia, p. 40  |
|   | 1960: Taylor, Syn. Silv. Ghana, p. 132   |
|   | 1961: Irvine, Woody Plants of Ghana, p. 294  |

LOCAL NAME: blaang (Gio); serouwe, glotue (Krahn)

TRADE NAME: Faro

GEOGRAPHICAL DISTRIBUTION: Senegal to Gabon

**BOTANY.** A large, sometimes emergent tree. Branchlets glabrous, with transverse scars of shed stipules and bud scales, waxy and tomentose, glabrescent when very young. Buds enclosed by stipule-like bud scales; axillary buds c. 5 mm above the leaf axil. Leaves paripinnately compound, alternate, 5–9 jugate, sparsely pubescent, glabrescent except on the stipules, 15–35 cm long, greyish green above, pale green beneath. Stipules intrapetiolar, enclosing the terminal bud, early caducous, usually small or up to 3 cm long, tomentose inside, glabrous outside except near the base, glaucous-waxy. Petiole 1.5–4 cm long, jointed and rugose at base. Leaflets opposite. Petiolules 3–6 mm long. Blade (narrowly) obovate or (–) oblong, the upper pairs sometimes elliptic, 3–9 cm long, 1–3.5 cm wide, dotted with numerous translucent points, not always visible in old leaves. The middle pairs largest, upper and lower pairs smaller. Base unequal-sided, the proximal edge broadly cuneate, the distal edge rounded. Apex abruptly acuminate. Midrib slightly raised above, prominent beneath. Nerves only slightly raised above and beneath, 5–9 on each side of the midrib, looping at some distance from the edge. Reticulation fairly conspicuous. Leaves and leaflets of saplings and water shoots much larger.

Inflorescences axillary or terminal panicles; lateral racemes more or less in a horizontal plane, with the flowers hanging downwards. Peduncle and pedicels white velutinous. Bracts and bracteoles very early caducous; bracteoles attached near the middle of the c. 1.5 cm long pedicel, not enclosing the bud. Flowers lilac or pinkish purple. Recep-

tacle c. 5 mm long, the rim c. 2 mm high, velutinous outside, villous inside. Sepals 4, imbricate in bud, spreading when open, glabrous inside, the outer 2 velutinous outside, the inner 2 velutinous only on a thin line in the centre. Petals 5; the adaxial petal c. 8 mm long, 4 mm wide, villous, specially near the base, very concave; the 2 lateral petals 10–13 mm long, c. 7 mm wide, villous on both sides, elliptic; the 2 abaxial petals reduced, c. 1 mm long and wide, glabrous. Stamens 10, the adaxial stamen free, the 9 other stamens increasingly connate towards the abaxial stamen; staminal sheet c. 7 mm long, villous on both sides. Free filaments c. 2 cm long, villous on the lower half, subulate. Anthers dorsifixed, versatile, c. 2 mm long, elliptic, with 2 thecae, opening lengthwise. Pistil in the centre of the receptacle, stipitate, densely villous except the upper part of the style and the stigma. Stipe c. 5 mm long, ovary c. 7 mm long, 3 mm wide, flattened, containing c. 6 ovules. Style c. 1.8 cm long; stigma terminal, capitate. Inflorescence slightly lignifying after flowering.

Fruit a flat, glabrous, stiff-papery or parchment-like pod, 6–9 cm long, 3–4 cm wide, the ventral suture slightly thickened, curved like a half circle, the other edge thin and straight or slightly 'S'-shaped. The sides of the pod finely lenticellate. Stalk c. 1 cm long, pubescent, glabrescent. Endocarp thick-coriaceous, detaching separately from the valves. Seed one, attached by a c. 1 cm long funiculus near the top of one of the valves, elliptic, 2.5–3 cm long, c. 1.5 cm wide, purplish brown, flattened, with a swollen hilum at the base.

Seedling: germination epigeal. Hypocotyl c. 9 cm long, brown, the outerbark defoliating. Cotyledons sessile, slightly spreading, c. 2.5 cm long, 1.2 cm wide, thick and fleshy, rounded at the top, sagittate at base. Epicotyl c. 6 cm long, glabrous. Leaves alternate, the first leaf 2-jugate; petiole c. 2.5 cm long, jointed at base; rachis c. 2 cm long; leaflets broadly elliptic – orbicular, 5–9 cm long, 4–5 cm wide, with a 2–3 cm long caudate tip. Following 3 leaves 1-jugate, the internodes with 2 alternate scars of bud scales. Translucent points in all leaflets numerous.

TAXONOMICAL NOTES. The genus *Daniellia* was first proposed in 1854 by Bennett, based on material of *Daniellia thurifera*, which also occurs in Liberia (see below). *Daniellia ogea* was first described as *Cyanothyrsus ogea* by Harms (1899, l.c.), but *Cyanothyrsus* was found to be congeneric with *Daniellia* by Rolfe (1912, l.c.). Since Holland (1911, l.c.) used Rolfe's new combination before Rolfe published his notes, the name became *Daniellia ogea* (HARMS) ROLFE ex HOLL. Owing to the fact that *Daniellia* usually flowers when all leaves are shed, some species were described, based on mixed specimens, consisting of flowers of *Daniellia* and leaves of other species. This caused numerous synonyms in *Daniellia ogea* (see Keay, 1953, l.c.).

*Daniellia thurifera* BENN. is also found in Liberia. The leaves are practically identical to those of *D. ogea*. One young shoot was observed with stipules up to 14 cm long and 2 cm wide (col. No. 753), but this might also occur on similar material of *D. ogea*. The inflorescence of *D. thurifera* is glabrous. The pedicels are c. 1 cm long. The 4 sepals are

elliptic, up to 1.8 cm long and 1.2 cm wide, ciliate on the margin, otherwise glabrous. The adaxial petal is c. 1.3 cm long, very concave, more or less glabrous on the back. The lateral petals are c. 1.3 cm long, 1 cm wide, villous. The 2 abaxial petals are c. 2 mm long. The pistil is entirely glabrous. Fruits and seeds are practically identical to those of *D. ogea*.

In the Nimba area *D. oliveri* (ROLFE) HUTCH. & DALZ. was observed. The leaflets are larger than those of the preceding species and more roughly textured; the rachis and midrib on the lower surface of the leaflets is pubescent.

The present description and figures are based on the following specimens: *D. ogea*: Tiatown, 10 M. E. of Tapeta 517; Loma Nat. For. near Basiweng 721, 735; de Wit & v. Zee K 25, seedling; Nimba 902; Bassa No. III 701. *D. thurifera*: Bong Range 1020, 1320, 753; S. of Tobli, c. 25 M. E. of Tapeta 1322 (WAG, alc.). *D. oliveri*: Nimba 916.

FIELD NOTES. *Daniellia thurifera* is a species of the evergreen forest, *D. ogea* of the moist semi-deciduous forest, but the species may occur together in the transition between these two forest types. Except for the differences in the flowers as pointed out before, there is very little difference between the trees and an identification without the flowers is always doubtful. The bark of *D. ogea* may possibly be more distinctly horizontally striate and the slash may have a lighter brown tone than *D. thurifera*. In the following field description the two species are treated as one.

*Daniellia* is a large or emergent tree of the high forest, sometimes reaching a height of 45 m ( $\approx 150'$ ) and a diameter at breast height of over 1.20 m ( $\approx 4'$ ). The base of the tree is straight, without buttresses, sometimes swollen but usually with low, thick, heavy root swellings, which occasionally may extend in wide-spreading surface roots. The bole is straight and cylindrical, column-like, up to 30 m ( $\approx 100'$ ) free of branches, only slightly tapering. It is one of the most beautiful stems of the high forest, extending without a fault to the highest layers of the canopy. The crown is fairly small, deltoid, flattened, fairly open. Farmers often leave the tree standing when cutting the forest for farming, because the small crown does not throw much shade. The tree has a strong taproot which leaves a deep, round hole with a straight, smooth side after the tree has died, so forming a dangerous trap for solitary huntsmen.

The bark is ash-grey, sometimes yellowish grey, medium thick, sometimes very smooth, but usually striate or warty, with fine, horizontal ridges, formed by the lentils. The bark may be flaky with thin, papery flakes. When old the bark at the base of the tree sheds large bark plates, leaving parallel or concentric scars, slightly like the oyster-shell markings of *Azelia*. When the tree is dying, the bark becomes rough, dark and pitted, like the bark of *Erythrophleum*. The slash is compact-fibrous, bright brown – darker brown, brittle inside, yellowish and fine granular outside. The cambium is nearly white; ripple marks are very conspicuous in bark and wood.

*Daniellia* is often found in the neighbourhood of water, in marshy valleys, and on rocky slopes. The tree sheds its leaves at the beginning of the dry season, when the

flowers appear. Flowering trees rarely have any leaves left, in any case not on flowering branches. New, brilliant red leaves are formed at the end of the flowering season. Flowering is from October–January. The fruits are ripe from January–March. When the fruit dries the coriaceous endocarp is detached from the exocarp and starts curling, beginning from the top. This causes the exocarp to open with two valves, first at the top, later completely, thus releasing the single seed, which remains attached to one of the valves by a funiculus, but hangs down out of the fruit. The endocarp drops separately when the fruit is open. The valve to which the seed is attached breaks from the fruit stalk, often by force of the wind. The other valve remains attached and drops later. When it falls, the valve with the seed starts to rotate rapidly like the horizontal propeller of a helicopter, thus braking its fall and enabling it to sail with the wind far from the mother tree. Complete fruits are therefore rarely found in the forest, but either the curled endocarp, or a single valve with or without seed.

The tree is a light demander and regeneration in the high forest is not common. On the Bong Range a rich, even dominant regeneration in the secondary forest was observed of *D. thurifera*. The tree is mature at an early age; fruit bearing trees of c. 10 m ( $\approx 30'$ ) high were observed.

USES. Near the base of the tree a hole is cut up to the centre. A brown, fragrant resin slowly exudes from the wood. This is collected and used as scent. The tree does not yield copal in commercial quantities. It may exude from the bark and form clumps at the base of the tree, when the bark is attacked by boring beetles.

The sapwood is 10–15 cm ( $\approx 4$ –6") wide, nearly white or greyish, perishable. The heartwood is light or dark red-brown, with darker striping. The grain is shallowly interlocked or straight, the texture medium coarse. Compression failures may occur near the centre. The wood is light, Sp. G. about 0.50, and has medium strength properties. It is perishable and resistant to impregnation. It might be used for interior joinery, cabinet work, handicraft, boxes and crates, light construction, and as plywood core. It is possibly too gummy for general use.

*Dialium aubrevillei* PELLEGRIN

[28/46]

'*Dialium*': Latin form of the Greek plant name 'dialion', used by Linnaeus indiscriminately for this genus.

'*aubrevillei*': named in honour of Mr. A. Aubréville, a famous French forester (1897– ).

Pellegrin, Bull. Soc. Bot. France, 80, p. 463 (1933); type: Aubréville 534 (P!); Steyaert, Bull. Soc. Roy. Bot. Belge, 84, p. 29–45 (1951).

1936: Aubréville, F.F.C.I., 1st ed., I, p. 202

1960: Taylor, Syn. Silv. Ghana, p. 134–135

1958: F.W.T.A., 2nd ed., I, p. 448–449

1961: Irvine, Woody Plants of Ghana, p. 299

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 256–260

LOCAL NAMES: gia kaba (Gio: 'thin bark'); ciania (Krahn)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Ghana

**BOTANY.** Medium-sized or large high forest tree. Branchlets puberulous when young, soon glabrescent, with scattered lenticels. Leaves puberulous when young, glabrescent, 8–18 cm long, pinnately compound, nearly always with 5 alternate, rarely subopposite leaflets. Stipules 2–3 mm long, c. 1 mm wide, slightly curved, blunt, caducous. Petiole (0.8–) 1.3–2.8 cm long, jointed and rugose at base. Rachis 3–5 cm long, straight or slightly zig-zag. Leaflets progressively larger from the base to the top of the leaf. Petiolules 4–7 mm long, rugose, slightly grooved above. Leaflets (broadly) obovate or (–) elliptic, 4–11 cm long, 2–4.5 cm wide, rounded – (broadly) cuneate at the base (often the lower leaflets more obovate and broadly cuneate than the upper leaflets). Apex (long) acuminate with a blunt tip, or caudate. Midrib inconspicuous above, prominent beneath. Nerves only slightly more pronounced than the veins, 4–9 on each side of the midrib; veins markedly reticulate above and beneath. Leaves and leaflets of saplings and water shoots larger; leaflets up to 16 cm long and 6 cm wide, long-caudate at the apex.

Inflorescence flattened, axillary or terminal, paniculate, tomentellous, densely flowered. Bracts soon caducous, not seen (2 mm long, cf. Pellegrin). Pedicels 2–3 mm long, markedly articulate at the top; bracteoles 2, inserted near the base of the pedicel, smaller than 0.5 mm, triangular, soon caducous. Receptacle saucer-shaped, flat, c. 1.5 mm in diameter. Sepals 5, imbricate in bud, greyish tomentellous on the exposed parts, finely villous on the overlapped parts and inside, spreading or recurved when flowering, broadly elliptic, c. 2.5 mm long, c. 1.5 mm wide. Petal one, pale yellow, adaxial, spatulate, shortly clawed, glabrous except on the inner surface on and above the claw, 2–3 mm long, 1 mm wide. Stamens 2, glabrous, laterally of the petal, c. 2 mm long. Filament with a thickened base of c. 1 mm, above the basal swelling geniculate. Anther c. 1 mm long, basifixed, slightly triangular, bilobed at base, with 2 thecae opening with slits. Disc present, intrastaminal, convex, finely villous, carrying the pistil slightly eccentric on the ventral side. Pistil curved towards the dorsal side, tomentellous on the lower half, c. 2 mm long. Stigma terminal, minute.

Fruit a small, black, indehiscent pod, sessile on the woodified platform of the receptacle, 1.5–2.2 cm long, 1.5–1.8 cm wide, c. 7 mm thick, containing one, rarely two seeds. Exocarp fairly hard, sparsely puberulous, with a sharp dorsal and ventral edge. Seed a small, flattened bean, c. 9 mm long, 7 mm wide, 3 mm thick, with a glossy, finely veined, brown, extremely hard testa, imbedded in a spongy, c. 2 mm thick, acid tasting endocarp, which is edible. Cotyledons in the seed green.

Seedling: germination epigeal. Hypocotyl 4–6 cm long, slightly winged, the outer bark defoliating. Cotyledons sessile, spreading, elliptic, c. 8 mm long, 5 mm wide. Epi-

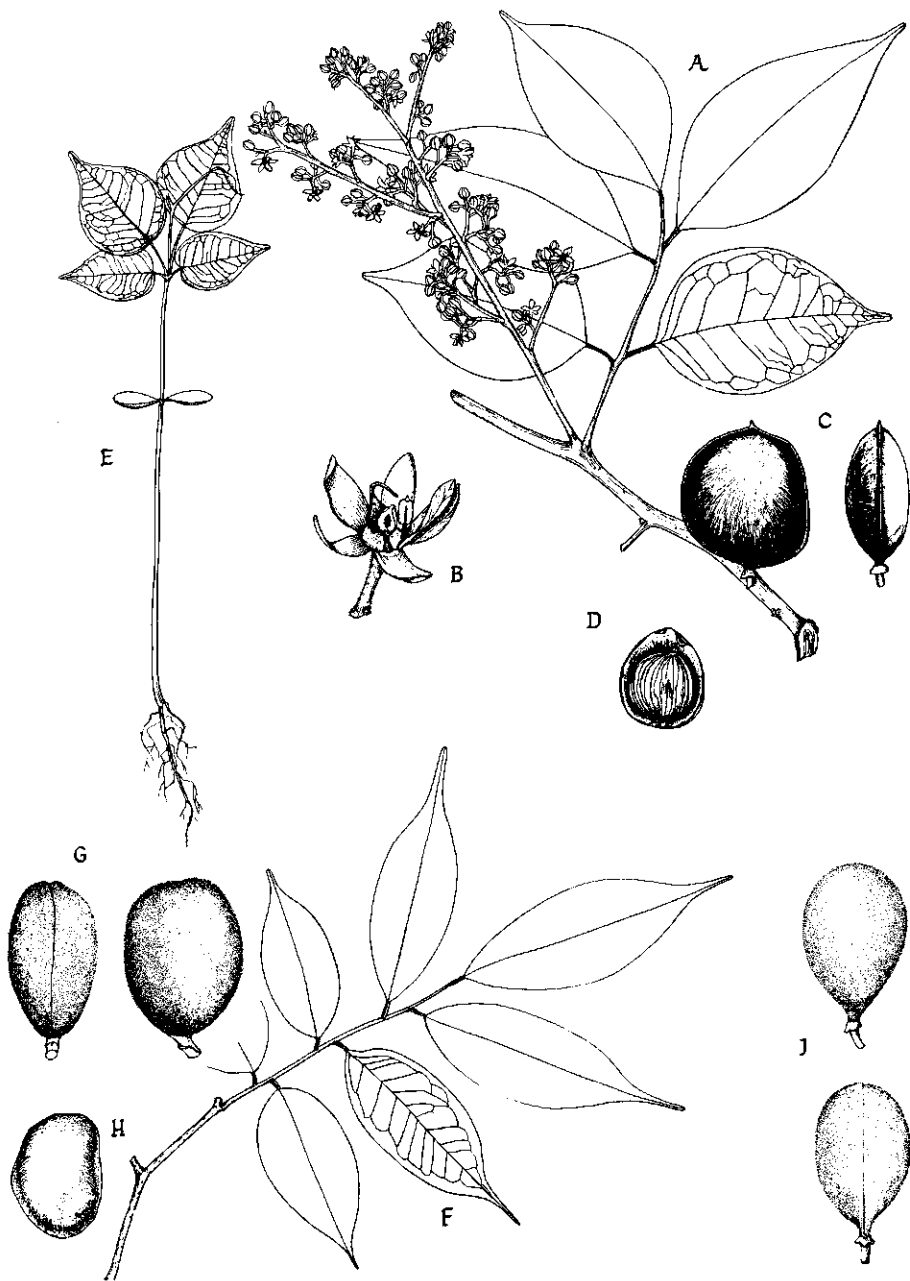


Fig. 28. *Dialium aubrevillei* PELLEGR. A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: fruit, front and side view ( $\times 1$ ); D: open fruit with seed ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ); F: *Dialium guineense* WILLD., branch with leaf ( $\times \frac{1}{2}$ ); G: fruit, front and side view ( $\times 1$ ); H: seed ( $\times 1$ ); J: *Dialium dinklagei* HARMS, fruit, front and side view ( $\times 1$ ). See also fig. 30 E.



cotyl 2–3.5 cm long. First 4 leaves simple, in 2 opposite pairs so close together, that they seem to stand in one whorl of 4, the lower pair being smaller and having shorter petioles than the upper pair. Petioles 0.3–1.3 cm long. Stipules subulate, c. 1.5 mm long. Leaflets broadly ovate, 2.5–3.5 cm long, 1.5–2.5 cm wide, rounded or cordate at base, long caudate at the apex. Following 4–6 leaves alternate, larger, simple; about the 8th or the 10th leaf trifoliolate etc. Leaves reticulated like the mature leaves. Young parts of seedlings puberulous with glandular hairs.

TAXONOMICAL NOTES. The genus *Dialium* L. is most widespread in Africa with about 30 species (Asia 3 species, South America 1 species). Of the African species only 3, possibly 4 occur in Liberia: *D. aubrevillei* PELLEGR., *D. dinklagei* HARMS, *D. guineense* WILLD., and possibly *D. pobeguini* PELLEGR.. The latter species is known from Sierra Leone and Guinea and might be found in the north-western region of Liberia. Its lax reticulation distinguishes it from the other species. The 3 other species are easily distinguished:

- A. Leaflets alternate or subopposite, 5, obovate to elliptic, 4–11 cm long, 2–4.5 cm wide, shortly caudate, nearly glabrous. Filaments geniculate, ovary sessile. Fruit nearly glabrous, flattened, disc-shaped, about 2 cm in diameter, black when ripe, sessile: *D. aubrevillei*
- B. Leaflets alternate, (5–) 7 (–9), narrowly elliptic, 4–10 cm long, 1.5–3 cm wide, long caudate, pilose beneath. Filaments straight, ovary shortly stipitate. Fruit subglobose – ovoid, 1.5–2.5 cm long, 1–1.5 cm in diameter, densely black velutinous, very shortly stipitate: *D. guineense*
- C. Leaflets opposite or subopposite, 7–10 pairs and a terminal one, narrowly oblong (– obovate), 2–6 cm long, 1–1.5 cm wide, acute at the apex, pilose beneath. Filaments straight, ovary sessile. Fruit globular – ovoid, 1–1.5 cm long, c. 1 cm in diameter, densely bright brown velutinous, sessile: *D. dinklagei*

The type description of Pellegrin (1933, l.c.) differs with regards to the petals, which Pellegrin describes as glabrous, but which are pubescent on the claw, and the fruit, which is not glabrous but sparsely puberulous when studied with a lens. According to Aubréville (1959, l.c.) the difference in leaves between *D. aubrevillei* and *D. guineense* is exactly the reverse of what is described above, *D. aubrevillei* having lanceolate, long acuminate leaflets, *D. guineense* oblong – elliptic leaflets, shortly acuminate or obtuse (see also figures on p. 259, F.F.C.I., 1959, l.c.). Intermediate forms of leaves are found. Aubréville suggested the possibility of hybridization between the two species. Taylor (1960, l.c.) states that *D. guineense* has only five leaflets, notably in two opposite – subopposite pairs + one terminal leaflet. All these data indicate that the leaf form of both species is very variable, though the differences, as given above, seem to be rather constant in Liberia.

*D. aubrevillei* is closely related to *D. corbisieri* STANER, which occurs in Congo. The

leaves and flowers of *D. corbisieri* are slightly larger than those of *D. aubrevillei*, and the petal is more truncate at the base of the lamina. The two taxa could possibly be considered as two varieties of one species.

The present description and figures are based on the following Liberian collections: *D. aubrevillei*: Bomi Hills 52; Bopolu 941; Bong Range 71; N. Gio Nat. For. 142; Diala 524; Chien area 651; Putu area, de Wilde 3663. *D. guineense*: N. Gio Nat. For. 144; Putu area 1255; Diala 525 A. *D. dinklagei*: Careysburg 403; Bassa No. III, Siga 692.

FIELD NOTES. *Dialium aubrevillei* occurs scattered throughout the rainforest and moist semi-deciduous forest. It may reach a height of 36 m ( $\approx 120'$ ) and a diameter of over 90 cm ( $\approx 3'$ ). The base has low, spreading, transversely striate, concave buttresses, which may grow quite large on old specimens or steep slopes. The stem is angular, often straight but sometimes crooked and branched at low level. The crown is fairly small, half globular. The bark is only 3–4 mm thick, irregularly-, usually longitudinally and thin scaly, covered with numerous small, black lenticels, grey, the shedding bark scales leaving bright brown, yellow-brown rimmed patches; this gives the bark a typical patchy habit. The slash is very brittle, yellowish on the outside, reddish on the inside; a red juice slowly exudes from the slash wound, solidifying black; very fine ripple marks are conspicuous in bark and wood. The tree is evergreen. The flowering season lasts from July to October. The fruits ripen from January–March. Regeneration is not very common. Seedlings seem to prefer mineral soil under shade.

*Dialium guineense* is more a riparian tree, but is also found in the high forest. It does not grow as large as *D. aubrevillei*. The base is provided with less pronounced buttresses, more with narrow, thin butt flares. The bark is less scaly and lacks the numerous black lenticels. The slash is more yellow. The local name in Gio, pia-gi, means 'making the axe blunt', referring to the extreme hardness of the wood.

*Dialium dinklagei* is also found all over the country, but it seems to reach its greatest dimensions in the northern regions: up to 30 m ( $\approx 100'$ ) high and nearly 90 cm ( $\approx 3'$ ) in diameter. It rarely has buttresses, but thick, heavy root swellings. The bark is smooth, grey, transversely striate. The slash is c. 8 mm thick, the outer layer yellow, granular, the inner layer reddish, brittle.

All three species have in common the very fine ripple marks and the red sap exuding from the slash wound. The *Dialium* species occupy a major place in the middle story of the high forest. Values of 70–350 trees of 40–60 cm ( $\approx 16$ –24")  $\varnothing$ /sq. mile were recorded, and 30–70 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile.

USES. The wood is very hard and at present has no known uses,

*Didelotia idae* OLDEMAN, DE WIT & LÉONARD

[13, 29/151, 152]

'*Didelotia*': dedicated to Baron Didelot.

'*idae*': named after Mrs. Ida Voorhoeve, wife of the collector of the type specimen.

Oldeman, de Wit & Léonard in Oldeman, *Blumea* XII, p. 227, fig. 7, 8 (1964): A revision of the genus *Didelotia* BAILL; type: Voorhoeve 1160, Liberia (WAG).

*Didelotia unifoliolata* AUCT., not J. LÉONARD, as far as material from Sierra Leone, Liberia or Ivory Coast is concerned.

1936: Aubréville, F.F.C.I., 1st ed., I, p. 240 (aff. *Didelotia*)      1959: Aubréville, F.F.C.I., 2nd ed., I, p. 294–296 (*D. unifoliolata*)

1958: F.W.T.A., 2nd ed., I, p. 480–481 (*D. sp. nr. unifoliolata*)

LOCAL NAMES: bondu (Gola); woronggonoh (Bassa); ngoo (Kpelle)

TRADE NAME: Bondu (proposed)

GEOGRAPHICAL DISTRIBUTION: Sierra Leone, Liberia, S.W. Ivory Coast

**BOTANY.** Large tree of the evergreen forest. Young twigs slender, finely puberulous, glabrescent, the outerbark defoliating; when older the branchlets with scattered, small, bright brown lenticels. Buds of shoots enclosed by caducous, parallel-veined bud scales, which are ciliate on the margin and leave small scars on the internodes. Leaves simple, alternate, stipulate. Stipules intrapetiolar, 2–4 mm long, parallel-veined, ciliate on the margin, soon caducous except for the base, remaining as a little rim in the leaf axil. Petiole finely puberulous when young, glabrescent, rugose, 2–5 mm long, with 2 stipellae at the top, which are present on young shoots, caducous, usually absent on older leaves, 1–2 mm long, acute or blunt, round or flattened. Blade ovate – elliptic, (2–) 5–10 cm long, (1.5–) 2.5–6 cm wide, glabrous except at the very base when young, glossy dark green above, paler beneath. Base rounded – broadly cuneate, rarely slightly asymmetric. Apex gradually tapering from the middle or slightly below the middle, acute, rarely acuminate. Midrib flat or slightly raised above, prominent beneath; 3 or 4 nerves spreading fanwise from the base on each side of the midrib. Lateral nerves from the midrib less conspicuous, 2–5 pairs. Reticulation faint. Leaves of saplings and suckers much larger, up to 21 cm long and 10 cm wide.

Inflorescence an axillary or terminal panicle, 6–15 cm long; lateral racemes c. 2 cm long. Peduncles, bracts, pedicels, and outside of the bracteoles densely puberulous. Bracts 0.5 mm long and wide, caducous. Pedicels 4–9 mm long, slender. Bracteoles valvate, enclosing the bud, recurved when flowering, brownish red, parallel-veined, pilose near the top inside, broadly elliptic, concave, c. 4 mm long and wide. Receptacle undeeply cupuliform, c. 1.5 mm wide, puberulous inside. Sepals 5, c. 1 mm long, nearly 1 mm wide, ciliate, purplish red. Petals 5, filiform, subulate, c. 2 mm long. Stamens

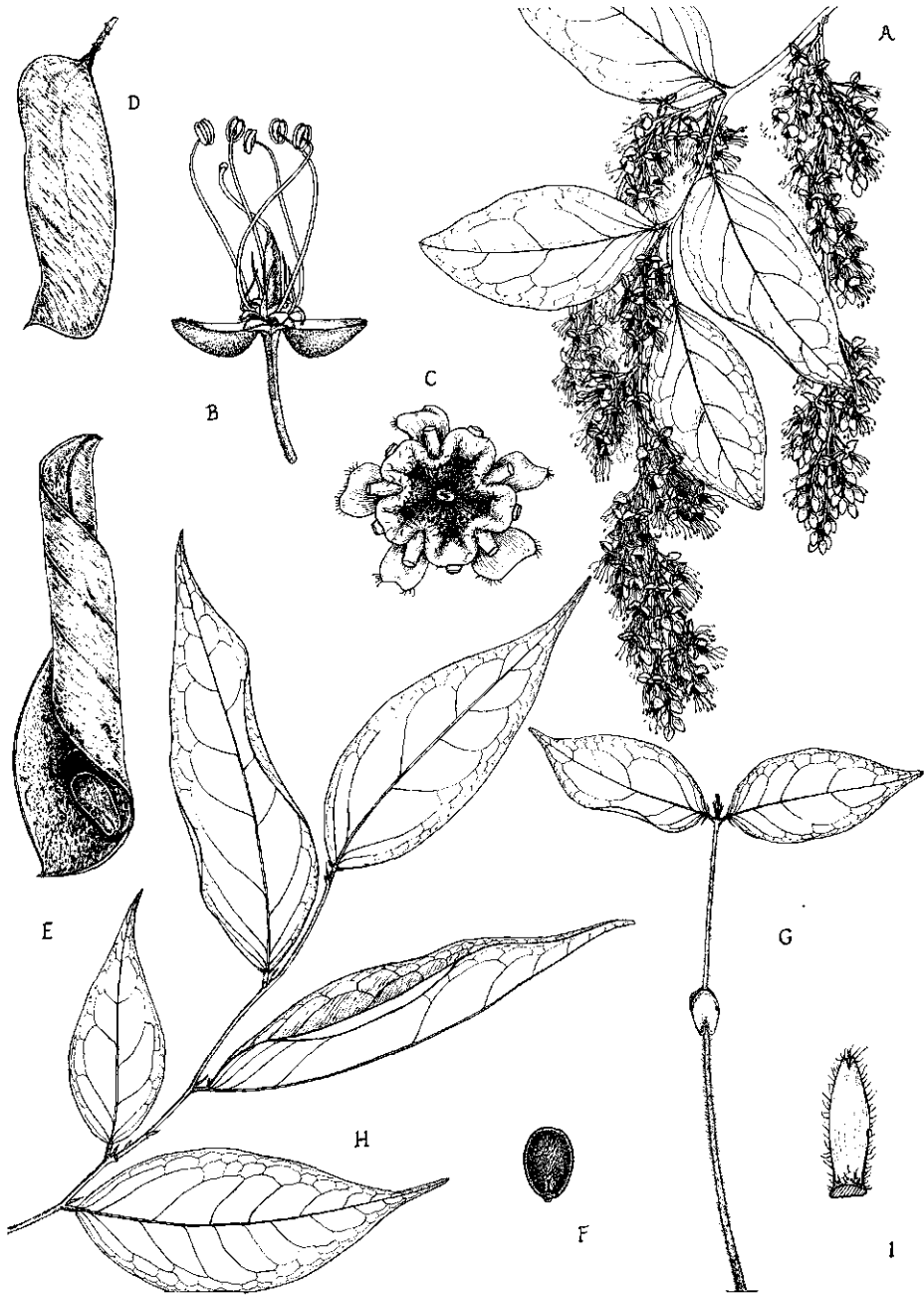


Fig. 29. *Didelotia idae* OLDEMAN, DE WIT & LÉONARD A: branch with leaves and inflorescences ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: disc, top view ( $\times 9$ ); D: young fruit ( $\times \frac{1}{2}$ ); E: open fruit ( $\times \frac{1}{2}$ ); F: seed ( $\times \frac{1}{2}$ ); G: seedling ( $\times \frac{1}{2}$ ); H: twig of a young plant ( $\times \frac{1}{2}$ ); I: intrapetiolar stipule of young twig ( $\times 4$ ).

5, glabrous. Filaments 10–12 mm long, subulate, pale purple; anthers elliptic, c. 1 mm long, dorsifixed, versatile, white, with 2 thecae, opening lengthwise. Disc present, intrastaminal, swollen, yellow, 5-lobed, with scattered hairs. Pistil shortly stipitate, placed in the centre of the receptacle. Stipe 0.5 mm long, pilose; ovary c. 2 mm long, 1 mm wide, light green, pilose at the base, along the ventral and dorsal edge, and along 1 or 2 lines on the side; style c. 8 mm long, glabrous; stigma terminal, capitate. When fruit is not formed, the receptacle becomes woody and swollen.

Fruit a yellowish brown, smooth pod, up to 11 cm long, 3–4 cm wide, opening with 2 valves, containing about 3 seeds. Stalk c. 3 cm long and thick, laterally attached; dorsal and ventral sutures straight; apex shortly apiculate. Sides of the pod with a faint, lateral ridge, rarely 2 and if so, the second ridge only visible near the base. Sometimes the lateral ridges are entirely absent. Inside of the valves papillate. Seed disc-shaped or elliptic, dark brown, c. 1.8 cm long and 1.4 cm wide, flattened, with a smooth testa.

Seedling: germination epigeal. Hypocotyl 5–10 cm long, pale brown tomentose, the pubescence more or less concentrated in longitudinal lines. Cotyledons sessile, slightly spreading, thick and fleshy, c. 12 mm long, 6 mm wide, rounded at the top, bluntly sagittate at base. Epicotyl 4.5–6.5 cm long, tomentose. First two leaves simple, opposite. Stipules intrapetiolar, c. 4 mm long, bifid, the lobes subulate. Leaves like the mature leaves, but the apex more with a caudate tendency. The stipellae not at the top of the petiole but 0.5 mm beneath the blade, green, c. 3 mm long, subulate. Following leaves alternate. Internodes with persistent bud scales.

**TAXONOMICAL NOTES.** The African genus *Didelotia* BAILL. counts at present 8 species, of which 4 are represented in Liberia. *Didelotia idae* is closely related to *D. unifoliolata* J. LÉONARD, a small tree found in Gabon and Congo. Until 1962 it was not sure whether the species was different at all, but flowering material collected by myself in Liberia proved that this species differs from *D. unifoliolata* in having a deeply lobed disc and a pilose ovary. The stipels are probably reduced leaflets.

The other 3 species, found in Liberia, are:

*Didelotia engleri* DINKL. & HARMS, a small tree with leaves resembling those of *Cynometra leonensis* (see fig. 26 E, F).

*Didelotia brevipaniculata* J. LÉONARD, a large, gregarious tree, in Liberia up till now only found c. 20 miles N. of Greenville. The leaflets resemble those of *Monopetalanthus compactus*, but are emarginate and have a median midrib (see fig. 34 I).

*Didelotia afzelii* TAUB., a small or medium-sized tree on river banks, with leaves resembling those of *Tetraberlinia tubmaniana*, but different in having an emarginate apex (see fig. 36 G).

The present description is based on the following specimens: E.L.W.A., Paynesville 495; Totota Range 411; South of Putu Range 1210 B; Niabo, E. of Zwedru 1324; Gbi Nat. For. 585; Bong Range 33, 938, 1068, 1182; Bomi Hills v. Dillewijn 17; Gbarnga Baldwin 10517 (K!).

FIELD NOTES. *Didelotia idae* is a medium or large-sized tree of the evergreen forest. It may reach a height of 45 m ( $\approx 150'$ ) and a diameter up to 1.20 m ( $\approx 4'$ ). It does not grow on marshy soils, but otherwise seems to have little preference for site: it is found in flat valleys, on slowly rolling country, and on steep rocky slopes. The base of the tree is swollen for the first 1–1.20 m ( $\approx 3$ – $4'$ ), has very low, thick root swellings, or is entirely straight. The bole is straight and cylindrical, up to 25 m ( $\approx 80'$ ) to the first branches (or longer in very large specimens). The crown is deltoid, with fairly ascending branches, fairly open, dark green, rather small. The leaves tend to grow in two rows along the slender twigs, creating the appearance of pinnately compound leaves. Bark smooth or with finely rough surface, but not cracked or scaly, or only so when very old; horizontal ridges are present. Bark colour sometimes dark brown, usually grey-greenish with light patches of lichens. Slash hard and compact-fibrous, medium thick, bright red, turning brown red on exposure, lighter near the cambium, sticky to the touch. Young trees have a paler slash than older ones. After a while a brown, sticky gum may slowly exude from the inner bark.

*Didelotia idae* is evergreen; the change of leaves is very rapid. New leaves are brilliant red. The tree has been found flowering in May (Bong Range) and August (Putu), during the rainy season. The flowers are inconspicuous and flowering specimens are difficult to detect. Fruits were found from October–January. Seedlings were found in abundance in the neighbourhood of the mother trees during March. They are easily recognised by the characteristic texture of the basal nerves of the leaves. The tree grows scattered throughout the evergreen forest, often in the single dominant forests of *Tetraberlinia tubmaniana*. Its principal growth area seems to be S.E. of Chien, where values of over 100 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile were recorded.

*Didelotia afzelii*, although usually a small river border tree, may grow up to 20 m ( $\approx 66'$ ) high and 60 cm ( $\approx 2'$ ) in diameter. It closely resembles *D. idae*, but the slash is darker red, the leaves are pinnately compound and also the habitat is typical (fig. 36 G).

*Didelotia idae* may resemble a young *Brachystegia leonensis*, which not yet has developed buttresses. Tribal names for the two species are often similar. Other trees with a more or less similar smooth, grey-greenish bark are: *Cryptosepalum tetraphyllum*, distinguished by its root spurs and pink slash; *Tetraberlinia tubmaniana*, distinguished by its more pronounced root swellings and pale brown slash; *Cassipourea nialatou*, distinguished by its swollen, coiled base and granular, yellow slash.

USES. The tree is often sawn by pit sawers. They refer to it as: 'good stick for planks'. It is not very hard, not too heavy, and has a pleasant brown colour. In Bomi Hills it is one of the four species sawn under the common (and misleading) name of 'African Pine'.

*Distemonanthus benthamianus* BAILL.

[30/155]

'*Distemonanthus*': Gr. dis: double; Gr. stema: male organ; Gr. anthos: flower; flower with a double male organ, referring to the two thecae, which are sharply divided, or to the two stamens of the flower. '*benthamianus*': in honour of Mr. George Bentham (1800–1884), a famous English botanist.

Baillon, *Hist. Pl.*, II, p. 135, 191 (1869); type: Mann 1844, Corisco Bay, Gabon (P!); Baker f., *Leg. Trop. Afr.*, p. 642 (1930); Pellegrin, *Leg. Gabon*, p. 120 (1948);

*Distemonanthus laxus* OLIVER in *F.T.A.*, II, p. 282 (1871); type: Mann 1844 (K!).

1928: *F.W.T.A.*, 1st ed., I, p. 336

1936: Aubréville, *F.F.C.I.*, 1st ed., I, p. 202

1936: Kennedy, *F.F.S.N.*, p. 90

1937: Dalziel, *U.P.W.T.A.*, p. 191

1941: Harley, *Native Afr. Med.*, p. 18, 79, 86, 113, 115, 118

1950: Normand, *A.B.C.I.*, p. 119; *Pl. XLII*

1958: *F.W.T.A.*, 2nd ed., I, p. 449

1959: Aubréville, *F.F.C.I.*, 2nd ed., I, p. 254–256

1959: Kryn & Fobes, *Woods of Liberia*, p. 43

1960: Taylor, *Syn. Silv. Ghana*, p. 137–138

1961: Irvine, *Woody Plants of Ghana*, p. 301

1963: de Saint Aubin, *La Forêt du Gabon*, p. 66

LOCAL NAMES: gwadau (Gio); waiba yidi – 'monkey can't climb' (Mano, cf. Harley)

TRADE NAME: Movingui; African or yellow satinwood

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Gabon

**BOTANY.** Medium-sized or large tree from the high forest and secondary forest. Leaf bearing branches brown tomentose when young, glabrescent, soon with a reddish, smooth, more or less lenticellate bark. Leaves pinnately compound with alternate leaflets, tomentose on all parts when young, the upper surface of the leaflets glabrescent. Stipules narrowly oblong, c. 7 mm long, 2 mm wide, blunt at the top, caducous. Petiole (1–) 2–4 cm long, hardly jointed at base. Rachis 6–10 cm long, with (4–) 7–10 (–11) leaflets. Petiolules 3–5 mm long, rugose, slightly grooved above. Leaflets ovate – (narrowly) elliptic, (3.5–) 5–10 cm long, (1.5–) 2.5–5 cm wide; the lower leaflets usually ovate – elliptic, smaller, the upper leaflets (narrowly) elliptic, somewhat larger. Base of the blade rounded – broadly cuneate. Apex (bluntly) acute – slightly acuminate. Midrib slightly impressed above, prominent beneath. Nerves prominent beneath, 8–13 on each side of the midrib, arching graciously upwards, looping near the edge. Reticulation fairly conspicuous. A tertiary reticulation of veinules visible on the lower surface.

Axillary inflorescence a dichasium; terminal inflorescence a floral axis bearing 3–4 times branched dichasia. Floral axis, peduncles and pedicels brown tomentose. Bracts 0.5 mm long, 1 mm wide, densely tomentose, at the base of the pedicel, caducous. Pedicel 5–8 mm long. Bracteoles absent. Receptacle obconical, cupuliform, c. 1 mm deep, tomentose outside, carrying the sepals and petals on the rim, the stamens and staminodes within the rim. Sepals 5, reddish brown, imbricate in bud, recurved when flowering, sparsely tomentose outside, ciliate, glabrous inside, c. 10 mm long, acute;

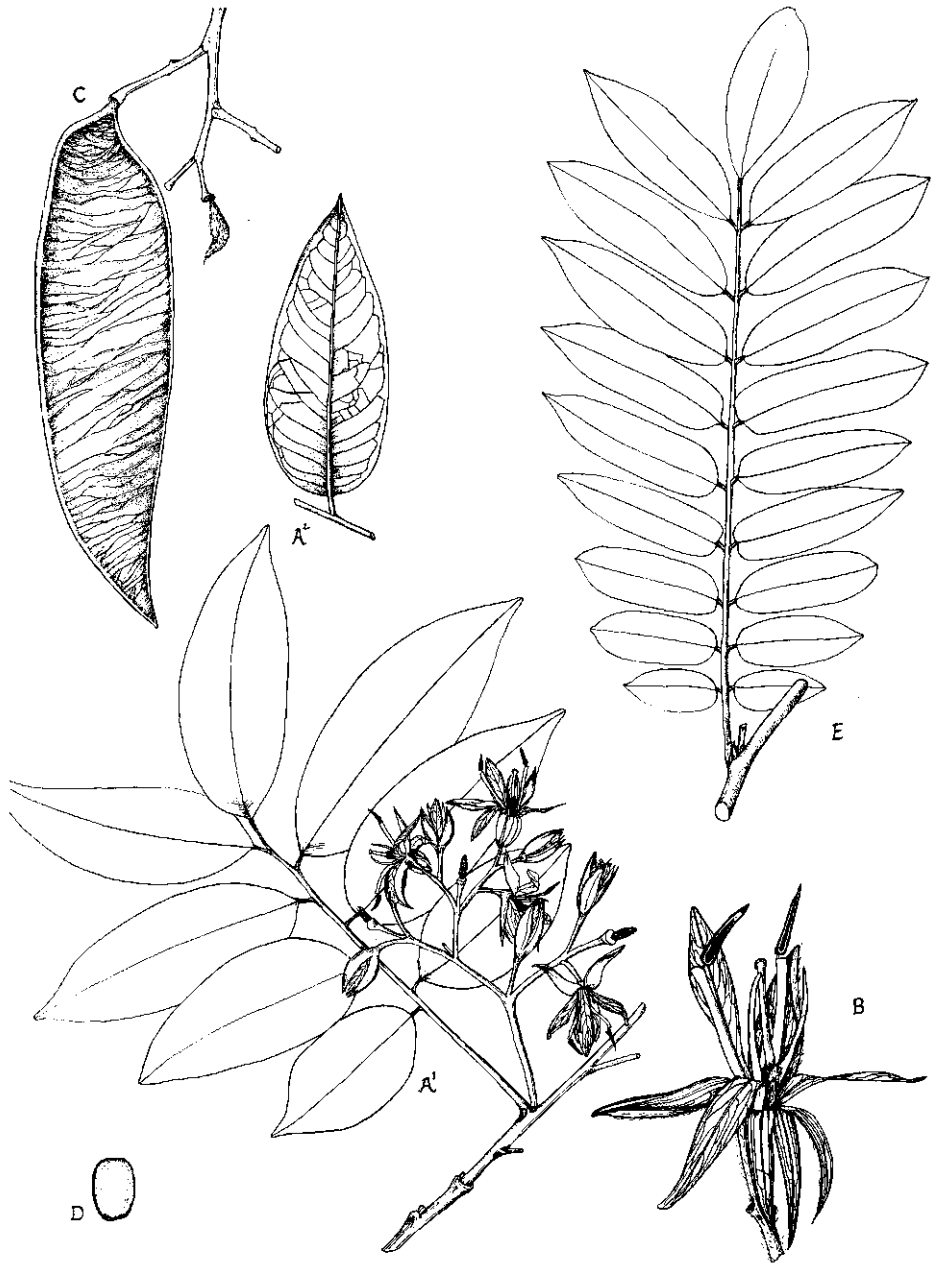


Fig. 30. *Distemonanthus benthamianus* BAILL. A<sup>1</sup>: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); A<sup>2</sup>: leaflet ( $\times \frac{1}{2}$ ); B: open flower ( $\times 2$ ); C: fruit ( $\times \frac{1}{2}$ ); D: seed ( $\times 1$ ); E: *Dialium dinklagei* HARMS, branch with leaf ( $\times \frac{1}{2}$ ). See also fig. 28.



the 2 adaxial sepals c. 4 mm wide, the 3 others c. 1.5 mm wide. Petals 3, white, glabrous, membranous, narrowly elliptic, long acute, c. 12 mm long, the adaxial petal c. 3 mm wide, the two lateral ones c. 2 mm wide. Stamens 2, between the adaxial and the lateral petals, short in bud, up to 15 mm long at anthesis. Filament white, c. 10 mm long, 1 mm thick, straight, broadly attached to the anther. Anther purple, c. 5 mm long, c. 1 mm wide at base, subulate, with two thecae, opening with 2 introrse pores at the top. Staminodes 3, white; 1 petaloid staminode at the base of the adaxial petal, c. 6 mm long, 1 mm wide; 2 acicular staminodes at the base of the lateral petals, subulate, c. 10 mm long. Disc not present. Pistil adnate to the abaxial side of the receptacle, very shortly stipitate. Ovary densely dark brown hirsute, c. 5 mm long. Style c. 6 mm long, glabrous, with a fine, ventral groove; stigma terminal, horseshoe-shaped, finely papillate.

Fruit a papery, indehiscent pod, containing 2–3 seeds, pale brown, very light when dry, 7–13 cm long, 2.5–3.5 cm wide, transversely reticulate on the sides. Seeds pale brown, glossy with a yellowish margin, elliptic, c. 10 mm long, 5 mm wide, flattened, c. 1 mm thick, attached to the ventral suture with a c. 6 mm long, very thin funicle, which disappears when the seed is ripe.

Seedling: germination epigeal. Hypocotyl c. 4.5 cm long. Cotyledons spreading, sessile, obovate, c. 1.7 cm long, 0.8 cm wide, with a rounded apex, broadly cuneate base, dull green. Epicotyl c. 5 mm long. First two leaves subopposite, simple, dark red when young. Petiole c. 8 mm long; blade nearly orbicular, c. 1 cm across, with rounded base and apex. Following leaves alternate, progressively larger. The shoot, petioles, and underside of the leaflets sparsely pilose. About the 8th leaf bifoliolate, the next trifoliolate etc.

TAXONOMICAL NOTES. The genus *Distemonanthus* was proposed by Bentham (1868, Gen. Pl., I, p. 573) without giving a specific name to his type specimen. Baillon (1870, l.c.) therefore proposed the name '*benthamianus*'. This is the only species of the genus.

The present description is based on the following specimens: N. Gio Nat. For. 190; Tapeta – Zuole road 531 A; Ganta, Harley s.n.; Nimba Mtn. 907, Leeuwenberg 4681.

FIELD NOTES. *Distemonanthus benthamianus* is a fairly rare, medium or large-sized tree of the high forest, and not an uncommon tree in secondary forest. In the high forest the tree may reach a height of 36 m ( $\approx 120'$ ) and a diameter of up to 90 cm ( $\approx 3'$ ), rarely more. The base of the tree is usually provided with low, heavy, fairly spreading buttresses up to 1.20–1.50 m ( $\approx 4$ – $5'$ ), but heavily buttressed trees with butt flares up to 7 m ( $\approx 20'$ ) have been observed. Young trees may have a nearly straight base. The bole is usually slightly angular, slightly sinuous or straight, up to 20 m ( $\approx 60'$ ) free of branches. Old trees may show a defective basal part of the stem. The crown is fairly light, rounded or slightly spreading; the foliage is medium green. The bark of the tree has a very characteristic red or reddish-brown colour, especially on the upper part of the stem and on the branches, and usually where the bark is exposed to the sun. The

outer bark defoliates in very small, paper thin, red flakes. The underlying bark is smooth, green. The very fine bark flakes cause the bark to be very smooth, which gives the tree its name: ‘monkey can’t climb’. The lower part of the stem is yellowish or grey greenish, with large, irregular scales, which may leave oyster-shell shaped scars, or with small scales or thin bark flakes. Under the scales the bark is paler, with numerous small, red-brown lenticels. The slash is thin, brittle, only fibrous near the cambium, pale yellowish or pinkish, interspersed with white near the cambium, sticky. Fine ripple marks are conspicuous in bark and wood.

In the low bush the trees are usually smaller and have less pronounced buttresses or none at all. The tree is deciduous in the dry season, but the deciduous period is irregular. The new leaves appear in bronze-coloured flushes, about at the time of flowering: January–February. Ripe fruits have been found in October, on leafless trees. There are c. 540 seeds to an ounce (cf. Taylor, l.c.). Regeneration in the high forest is scarce.

The tree grows scattered, rarely in groups, and has no particular preference for site, but does not grow in swamps. From observations in Liberia the impression was obtained that the tree is more common in the moist semi-deciduous forest than in the evergreen forest.

The tree seems to bear a resemblance to *Pericopsis laxiflora* (BENTH. ex BAK.) v. MEEUWEN (formerly *Afrormosia*), a tree from the savanna forests, which is not likely to occur in Liberia. Even so, timber cruisers from Ghana and Nigeria have wrongly identified the tree as *Afrormosia*, misled by its large growth and especially the pronounced buttress development, which seems to be an uncommon feature in the other parts of Africa where the tree occurs.

USES. Owing to its smoothness and inaccessibility the tree is believed to be invulnerable and to have a strong spirit. It has therefore numerous applications in native medicine (see Harley, l.c.).

The heartwood has a yellowish colour; it is moderately hard and heavy, Sp. G. c. 0.7; it is stiff and strong, with finely interlocked grain; it is fairly resistant, dries reasonably well and resists impregnation; it works moderately easily and cuts with a fine, lustrous surface; it peels easily and can be used as veneer, but appears to be unsuitable for plywood. It can be used in structures, carpentry, cabinet work and turnery.

*Erythrophleum ivorense* A. CHEV.

[14, 31/47]

‘*Erythrophleum*’: Gr. *eruthros*: red; Gr. *phloios*: bark; referring to the bark of *E. suaveolens* (GUILL. & PERR.) BRENNAN, containing a red dye.

‘*ivorense*’: referring to Ivory Coast, where Mr. Chevalier collected the type specimen.

A. Chevalier in *Vég. Util.*, 5, p. 178 (1909); type: Chevalier 16220, Ivory Coast (K!, isotype); *E. micranthum* HARMS ex HOLL., *Kew Bull.*, Add. Ser. IX, p. 279 (1911); type: Mann 482 (K!).

- 1928: F.W.T.A., 1st ed., I, p. 350  
 1931: Cooper & Record, Evergr. For. Liberia, p. 65 (as *E. guineense*)  
 1936: Aubréville, F.F.C.I., 1st ed., I, p. 270–271  
 1936: Kennedy, F.F.S.N., p. 106 (*E. micranthum*)  
 1937: Dalziel, U.P.W.T.A., p. 193–194  
 1950: Normand, A.B.C.I., I, p. 127; Pl. XLIV (*E. micranthum*)  
 1956: Handbook of Hardwoods, p. 153  
 1958: F.W.T.A., 2nd ed., I, p. 484  
 1959: Aubréville, F.F.C.I., 2nd ed., I, p. 328–331  
 1959: Kryn & Fobes, Woods of Liberia, p. 49, 50  
 1960: Taylor, Syn. Silv. Ghana, p. 141  
 1961: Irvine, Woody Plants of Ghana, p. 307  
 1963: de Saint Aubin, La Forêt du Gabon, p. 74 (*E. micranthum*)

LOCAL NAMES: gluu, gli (Gio); zutu (Krahn); sasswood tree (general use)

TRADE NAME: Tali; sasswood

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Gabon

**BOTANY.** A large tree, common in the high forest. Young branches minutely brown puberulous, glabrescent, lenticellate. Leaves bipinnately compound with 2–4 pairs of opposite pinnae. Stipules minute, less than 1 mm long, only seen on seedlings. Petiole 2–7 cm long, jointed at base. Petiole and rachis finely puberulous, longitudinally striate. Rachis 5–15 cm long. Rachises of the pinnae 7–17 cm long, jointed at base, sparsely puberulous, glabrescent. The lower pinnae shorter than the upper ones. Leaflets alternate, 8–14 on each pinna, glossy dark green. Petiolules 2–4 mm long, rugose, sparsely puberulous, glabrescent, canaliculate above. Blade obliquely (narrowly) elliptic, rarely obliquely ovate, 2.5–8.5 cm long, 1.5–4 cm wide. Base asymmetrical, the proximal side cuneate, the distal side rounded – bullate. Apex bluntly acute – caudate, the very tip retuse. Midrib flat or slightly impressed above, prominent beneath. Nerves 6–8 on each side of the midrib, looping at some distance from the edge, slightly raised beneath. Reticulation lax, conspicuous on both sides. Leaflets glabrous or sparsely puberulous on the midrib beneath and on the margin near the base, glabrescent.

Inflorescences much branched, axillary or terminal, densely flowered racemes, densely and finely reddish tomentellous, lenticellate on the floral axis. Bracts at the base of the pedicel, concave triangular, 0.4 mm long, puberulous outside, persistent till after the flowers drop. Pedicel c. 1 mm long, densely tomentellous, markedly articulate at the top, persistent when the flower is shed. Bracteoles absent. Receptacle obconic, tomentellous outside, c. 1 mm long, cupuliform, 0.4 mm deep. Calyx yellowish green, campanulate, 5-partite, the calyx tube and lobes 0.5 mm long, densely tomentellous outside, glabrous inside, not closed in bud, not spreading at anthesis. Petals 5, yellow, imbricate in bud, erect when flowering, villous outside, glabrous inside, narrowly obovate, c. 2 mm long, 0.6 mm wide. Stamens 10, unequal in size, 4, 5, or 6 longer than the others, 2–3.5 mm long, glabrous. Filaments white. Anthers yellow, nearly round, dorsifixed, introrse with 2 thecae opening with slits. Disc intrastaminal, lobed, glabrous. Pistil in the centre of the receptacle, stipitate. Stipe 1 mm long, glabrous; ovary 1 mm long, woolly pubescent; style and stigma very short, after the development of the stamens 0.5 mm long, glabrous, blunt.



Fig. 31. *Erythrophleum ivorense* A. CHEV. A<sup>1</sup>: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); A<sup>2</sup>: lower surface of base of a leaflet ( $\times 2$ ); B: bud and open flower ( $\times 4$ ); C: fruit ( $\times \frac{1}{2}$ ); D: seed ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ); F: *Erythrophleum suaveolens* (GUILL. & PERR.) BRENAN, leaflet ( $\times \frac{1}{2}$ ) and lower surface of base of leaflet ( $\times 2$ ); G: fruit ( $\times \frac{1}{2}$ ).

Fruit a glabrous, greyish black, thick-coriaceous pod, 5–10 cm long, 3–5 cm wide, containing 2–6 seeds. Pod opening only along the dorsal suture; apex blunt or rounded; ventral suture slightly thickened; base rounded; stalk attached at the base of, and in line with the ventral suture; sides finely reticulate. Seeds not dropping when the fruit opens, often remaining in the fruit until this is shed from the tree. Seeds attached to the ventral suture with a short, thick funicle, black, with a hard, shiny testa, c. 13 mm long, 9 mm wide, 5 mm thick, rounded quadrangular.

Seedling: germination epigeal. Hypocotyl 6–10 cm long, glabrous, narrowly winged, the outerbark defoliating. Cotyledons accrescent but not foliaceous, elliptic, 1.5–2 cm long, 0.8–1 cm wide, rounded at the apex, slightly sagittate at base, thickly coriaceous, glabrous. Epicotyl 7–10 cm long, increasingly pubescent. First 2 leaves opposite, pinnately compound, estipulate. Petiole 8–15 mm long, puberulous. Rachis 4–5 cm long, with 7–8 alternate, rarely opposite leaflets, puberulous, terminated by a 4 mm long subulate point. Petiolules 1–1.5 mm long, puberulous. Leaflets obliquely ovate, 2.5–3.5 cm long, 1–1.5 cm wide, long acuminate, ciliate, rounded and slightly asymmetric at the base. Leaflets thinly herbaceous. Following leaves alternate.

TAXONOMICAL NOTES. The genus *Erythrophleum* R. BR. is paleotropical: about 5 species are found in Asia, 1 in Australia and about 4 in Africa. The bipinnate leaves and the regular, small flowers, standing in crowded, branched racemes could indicate that the genus belongs to the *Mimosoideae*, but the petals are imbricate, a character of the *Caesalpinioideae*, as opposed to the valvate petals of the *Mimosoideae*. In Liberia only 2 species are represented: *E. ivorense* A. CHEV. and *E. suaveolens* (GUILL. & PERR.) BRENNAN ( $\equiv$  *E. guineense* G. DON, see Taxon IX, p. 194, 1960; however, the author of *Erythrophleum* is Robert Brown in Denham, Clapperton & Oudney, Trav. N. & Centr. Afr., Journ. Excurs., p. 235, 1826). These two species are closely related and can be distinguished as follows:

*E. ivorense*

Pedicels up to 1 mm long.

Flowering racemes c. 1 cm thick.

Petals densely villous outside.

Leaflets glabrous or with scattered hairs on midrib beneath and on the margin.

Fruit stalk in line with the ventral suture.

Distal side of the leaflet slightly broadened near the base.

*E. suaveolens*

Pedicels 1–2 mm long.

Flowering racemes c. 1.5 cm thick.

Petals puberulous on the edge and midrib.

Midrib of the leaflets markedly puberulous on both sides, especially near the base.

Fruit stalk perpendicular to the ventral suture.

Distal side of the leaflet markedly broadened near the base.

However, intermediate forms of leaflets are found, so that an identification, based on these only, is always somewhat doubtful.

Cooper & Record (1931, l.c.) record the species *E. guineense*. However, one of the

cited herbarium numbers, No. 386, is cited in F.W.T.A. (1958, l.c.) under *E. ivorens*. Considering the area where Cooper collected (Firestone plantations), the species is, in fact, most likely to be *E. ivorens*.

The present description is based on the following material: Devilbush, Duport 323, 1210; Bopolu sawmill 938A; Bomi Hills 53, v. Dillewijn 100; N. Gio Nat. For. 160; Nimba 1202; Putu 1267; Arthington, Wright 18. *E. suaveolens*: Nimba 897.

**FIELD NOTES.** *Erythrophleum ivorens* is common all over Liberia, in the evergreen forest and the moist semi-deciduous forest, in the high forest and in the secondary forest. The tree may reach a height of 40 m ( $\approx 130'$ ) and a diameter up to 1.20 m ( $\approx 4'$ ), rarely more. The base of the tree has low root swellings when young, high, heavy root ridges or narrow, thick buttresses when old, often extending in heavy ridges along the stem; sometimes far spreading surface roots are present. The bole may be straight and cylindrical, but more often it is crooked, angular and branched. Old trees very often have heart rot. The crown is very dense, dark green, heavily branched, half globular. The bark of young trees is grey greenish, not cracked but rough with corky, 2–10 mm wide, horizontal lenticels. When old, the bark becomes very rough, dark brown, with irregular, small, greyish bark scales, which leave deep pits in the bark when shed; the bark is covered with numerous small, corky, yellow or light brown lenticels. Slash of young trees rough-granular, purplish pink-brown, with some milky sap in the slash wound. When old the slash is hard, brittle, granular, red-brown, often with a purplish gleam, exuding a red, sticky sap; the cambium is white, soft and fibrous; ripple marks are often present but wavy, rarely straight.

*E. suaveolens* seems to have a much smoother bark, remaining grey and uncracked until the tree is very large, with lenticels more or less in vertical lines. The slash is more purplish pink, thick and fairly soft. Young trees of both species probably look very similar. *E. suaveolens* does not penetrate into the evergreen forest. Its area reaches from the woodland savanna to the moist semi-deciduous forest. In this forest type the two species may occur together.

*E. ivorens* is evergreen. New foliage has a dark greenish red colour. The tree flowers during the rainy season, from May to September. At that period the crown is covered with reddish inflorescences. The fruits remain on the tree, often for a full year, so that flowering trees with mature fruits may be found. The tree is one of the commonest in the evergreen forest. Enumeration results indicate that young trees of 40–60 cm  $\varnothing$  ( $\approx 16$ –24") are far less abundant than trees over 60 cm  $\varnothing$  ( $\approx 24$ "); values of 9–40 trees/sq. mile were recorded for the first category, 50–180/sq. mile for the second. This unusual diameter distribution may be an indication that *Erythrophleum ivorens* is essentially a tree of old secondary forests.

**USES.** The well-known practice of the sasswood ordeal, in which decoction of the bark is used to prove an accused guilty or innocent, according to whether he is poisoned or

not, is reported to be performed with the bark of *E. suaveolens*. There seems, however, to be some doubt on the subject. Cooper (1931, l.c.) describes the practice with reference to the species *E. guineense* (= *E. suaveolens*), but his material, col. No. 386, has later been identified as *E. ivorensense*. The practice is well-known all over Liberia, also in those regions, where *E. suaveolens* does not occur. It is a known fact that the bark used is taken from younger trees. The young trees of both species, however, look very similar. As a matter of fact, one young tree in the Devilbush near Duport (10 miles E. of Monrovia), was indicated as 'usable' (coll. No. 323), whereas another, old specimen was 'no good to talk – it will kill you' (coll. No. 1210); the bark of a large tree apparently is too poisonous to cast judgement, killing the victim immediately. Both trees were *E. ivorensense*. Irvine refers to both species for the sasswood practice.

The wood is very hard, heavy, and resistant. It is practically only used for railway sleepers and bridging timbers. It seems to produce an excellent charcoal. The sawdust may severely irritate the mucous membranes.

*Gilbertiodendron preussii* (HARMS) J. LÉONARD

[32/44, 142]

'*Gilbertiodendron*': Gr. dendros: tree; genus named in honour of Professor Gilbert, a Belgian forester (1907– ).

'*preussii*': named after the collector of the type specimen, Preuss.

J. Léonard, Bull. Jard. Bot. Bruxelles, 24, p. 59 (1954); type: Preuss 449 (K, lectotype!); *ibid.*, G.C.A.a., p. 201–215, 239;

*Macrobium preussii* HARMS, Bot. Jahrb., 26, p. 270 (1899); Baker f., Leg. Trop. Aft., p. 675 (1930); *Gilbertiodendron taiense* AUBRÉVILLE, F.F.C.I., 2nd ed., I, p. 292; type: Aubréville 1229 (P!, illegitimate name).

1958: F.W.T.A., 2nd ed., I, p. 477

1959: Kryn & Fobes, Woods of Liberia, p. 54, 55

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 292 (*G.*

1960: Taylor, Syn. Silv. Ghana, p. 147

*taiense*)

1961: Irvine, Woody Plants of Ghana, p. 308

LOCAL NAMES: sèhmèh (Gio); damakpende (Gola); gosalah (Kpelle); gboitu, gboye (Krahn); red oak (generally used at sawmills)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Gabon

BOTANY. A medium-sized or large tree of the high forest. Young branches sparsely puberulous, glabrescent. Older branchlets lenticellate. Leaves pinnately compound, (2–) 3–5 jugate, alternate, stipulate, sparsely puberulous when very young, glabrous when older, 13–27 cm long. Stipules 1.8–2.8 cm long, 4–5 mm wide, parallel-veined, ciliate on the margin, slightly sickle-shaped, acute at the apex, without ear-like appen-

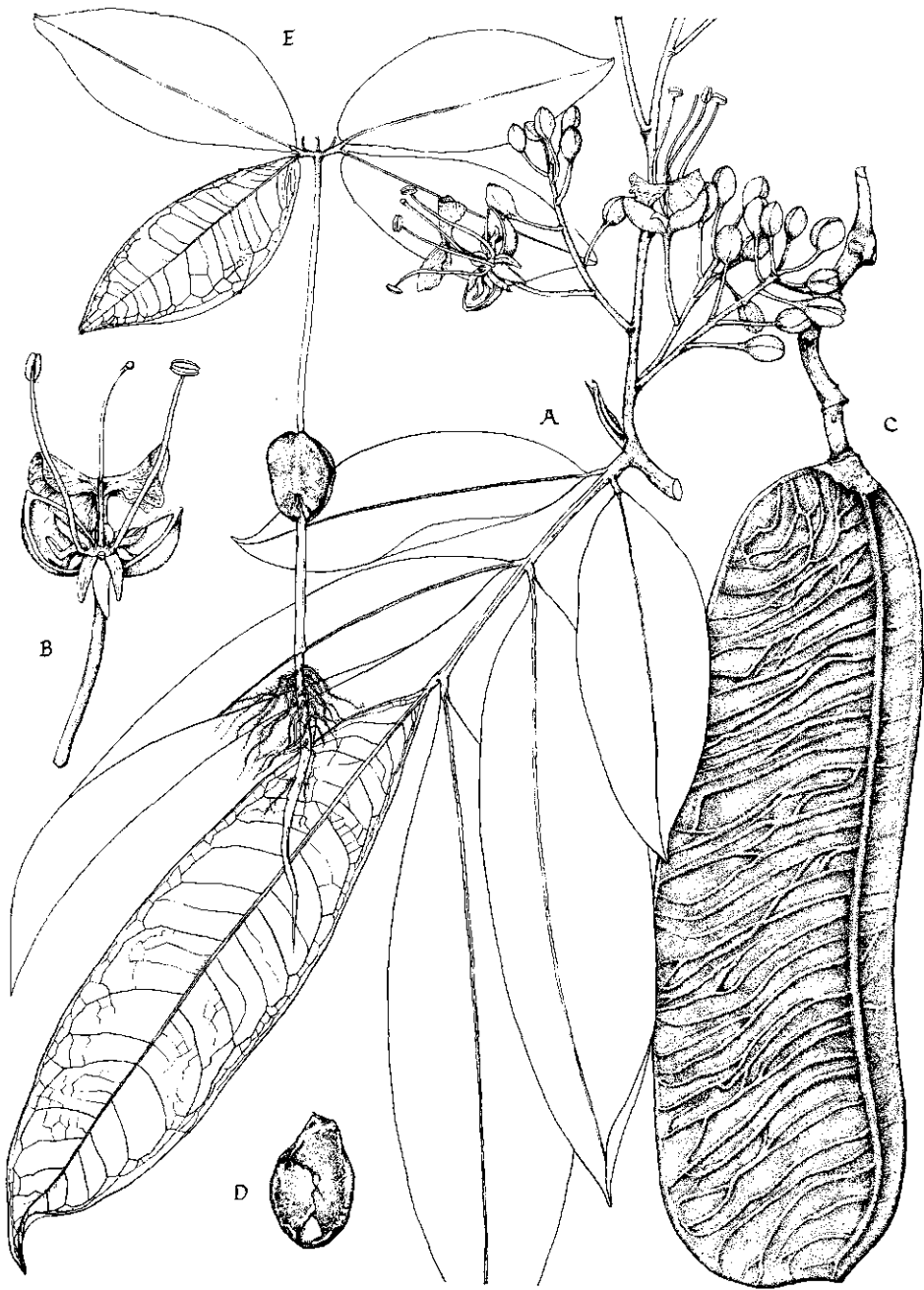


Fig. 32. *Gilbertiodendron preussii* (HARMS) J. LÉONARD A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: open flower, one stamen removed ( $\times 1$ ); C: fruit ( $\times \frac{1}{2}$ ); D: seed ( $\times \frac{1}{2}$ ); E: seedling ( $\times \frac{1}{2}$ ).



dages at base, connate along the larger part of the inner margin, so forming an intrapetiolar sheath, enclosing the terminal bud, very early caducous, rarely persistent until flowering. Petiole (0.2–) 0.5–1 cm long, 2–3 mm thick. Rachis flattened or slightly canaliculate above. Leaflets opposite, progressively larger from the base towards the top of the whole leaf, dark green above, paler beneath, coriaceous. Petiolules c. 5 mm long, slightly twisted or not. Blade usually narrowly elliptic, sometimes elliptic, (4–) 7–19 cm long, (1.8–) 2.5–5 cm wide. Base (broadly) cuneate, rarely rounded. Margin entire, with or without one or a few scattered glandular points. Apex acute–acuminate, less commonly blunt or rounded, the very tip often damaged or eaten, but if not so, formed by a little horny mucro. Midrib slightly raised and grooved above, more prominent beneath, straight or slightly curved. Nerves 6–11 on each side of the midrib, not very prominent, slightly ascending, looping near the edge. Reticulation of veins conspicuous on both sides. Leaves and leaflets of saplings larger, thinly coriaceous.

Inflorescences axillary or terminal clusters of panicles. Peduncles sparsely – densely rusty brown tomentose. Bracts concave, c. 5 mm long, 3 mm wide, caducous, slightly apiculate, densely tomentellous outside and inside. Pedicels 1.5–2.5 cm long, densely brown-villous. Bracteoles 2, valvate, enclosing the flower in bud, spreading at anthesis, densely villous inside and outside, slightly obliquely elliptic, very concave, 0.8–1.5 cm long, 0.5–1 cm wide, 1–1.5 mm thick. Receptacle obconical, c. 1 mm high, 2 mm wide. Sepals 5, pale yellow, glabrous, valvate in bud, recurving when flowering, c. 5 mm long, 3 mm wide at base, tapering, obtuse at the top. Petals 5, pale yellow, glabrous; the adaxial petal large, clawed. Claw a c. 6 mm long tube with an open seam, when unfolded c. 3 mm wide. Lamina transversely elliptic, c. 1.2 cm long, 1.8 cm wide, bilobed at the top, at anthesis spreading perpendicularly to the claw. The other 4 petals closely resembling the 5 sepals. Occasionally the two petals left and right of the adaxial petal developing with a claw and a lamina, which in that case is similar to only the left or right half of the large petal, and all petals are smaller. Fertile stamens usually 3, rarely 5, 6 or 7, implanted on the edge of the disc, opposite the 3 abaxial sepals, glabrous. Filaments curved in bud, c. 2 cm long at anthesis, subulate. Anthers dorsifixed, versatile, elliptic, c. 4 mm long, 2 mm wide, with a few scattered hairs on the back. Staminodes usually 6, as very short acicular points on the centre of the disc. Disc flattened, slightly swollen, horseshoe-shaped, with the opening towards the large petal. Pistil sessile. Ovary c. 5 mm long, 2.5 mm wide, flattened, brown hirsute. Style departing under an angle from the ovary, c. 2.5 cm long, glabrous. Stigma terminal, capitate.

Fruit a yellowish – medium brown, fairly thin-walled, woody pod, containing 3–5 seeds. Apex of the pod shortly apiculate; edges straight, not swollen; base rounded. One strong lateral ridge running from the base to the apex, parallel to and c. 1 cm distant from the ventral suture; from this ridge numerous minor, obliquely transverse, anastomosing ridges running towards the dorsal suture. Fruit opening with two valves, turning corkscrew fashion. Inside of the fruit pale brown, smooth apart from the spongy partitions between the seeds and a c. 1 cm wide spongy and papillate zone along

the sutures. Seeds elliptic or irregularly formed, 2.5–3.5 cm long, c. 2.5 cm wide, with a dark brown, thin testa, loosening when drying.

Seedling: germination epigeal. Hypocotyl 3–6 cm long, densely rusty brown pubescent, glabrescent. Cotyledons elliptic, 1.5–2 cm long, 1–1.5 cm wide, about 2 mm thick, not spreading, rounded at the top, rounded-sagittate at base. Epicotyl 5–11 cm long, rusty pubescent, glabrescent. First 2 leaves opposite, pinnately compound. Stipules tiny, about 1–2 mm long, caducous or absent. Petiole, rachis, and petiolules at first rusty pubescent, glabrescent. Leaf with 2 pairs of opposite leaflets, the lower pair usually reduced to 2 about 2 mm long, thorn-like appendices, with 1 or 2 honey secreting glands, but sometimes developing into real leaflets like the upper pair but smaller. Upper pair glabrous, obliquely (narrowly) elliptic, 4.5–9 cm long, 1.5–4 cm wide. Glandular points and mucro present on margin and apex. Following leaves alternate.

**TAXONOMICAL NOTES.** This species was described by Harms (1899, l.c.) as *Macrolobium preussii*, but the African species of *Macrolobium* have been transferred to four other genera: *Gilbertiodendron*, *Anthonotha*, *Paramacrolobium*, and *Pellegriniodendron* (see taxonomical notes *Anthonotha*, and Léonard, l.c.). The genus *Gilbertiodendron* includes 26 species, mostly from the moist forest regions around the Gulf of Guinea; 7 of these species are found in Liberia (see F.W.T.A., 1958). It has to be noted that in very young shoots of *G. preussii* glandular hairs were found on the articulation of the petiolules and on the tip of the rachis. These glandular hairs, which are extremely caducous, at first sight appear to resemble stipels, but cannot be considered as such as they are in groups of 1–4, or scattered on the rachis tip. Leaves in bud of all species of *Gilbertiodendron* and related taxa should be studied to ascertain whether they are a generic characteristic. Though less prominent, they have been observed on *Gilbertiodendron deweyrei* (DE WILD.) J. LÉONARD, and on *Gilbertiodendron* seedlings from Ivory Coast.

*Pellegriniodendron diphyllum* (HARMS) J. LÉONARD is closely related to *Gilbertiodendron*, but distinct in having a smooth pod and seedlings with the first pair of leaflets alternate. It is a shrub or small tree with bifoliolate leaves (see fig. 33 G); the glandular points are in the blade, not on the margin.

The present description and figures are based on the following specimens: Stewards Restaurant near Suakoko 510, 605, 674, 1205; Firestone Timber Reserve 326; Bong Range 1047; N. Gio Nat. For. 1279; Gio Nat. For. 243; Diala 1007; Zuole 597; Gbi Nat. For. 531, 577, 594. *Pellegriniodendron diphyllum*: Bassa III, L.A.C.O. 675 C.

**FIELD NOTES.** *Gilbertiodendron preussii* is a medium-sized or large tree of the rain forest, but it also occurs in the moist semi-deciduous forest; it may reach a height of up to 35 m ( $\approx 120'$ ), with a diameter up to 1.20 m ( $\approx 4'$ ), rarely more. The base of the tree is straight, without root swelling. The bole is straight, not cylindrical but slightly angular, up to 24 m ( $\approx 80'$ ) free of branches but usually less, often forked at a rather low level. The crown is fairly small, dense, dark green.

The bark has a characteristic yellowish colour; it flakes off with numerous, irregular, thin flakes, covered with many small, brown lenticels. This gives the tree often a shaggy habit. The flakes are easy to rub off, leaving shallow scars. Sometimes the bark does not shed the flakes owing to dense epiphytic vegetation: it is then grey greenish, with a thick layer of dead bark. The slash is medium thick, hard, compact-fibrous, pinkish brown or red-brown.

The tree is evergreen; flushes of new leaves are dark red. The flowering season is from October–December. Ripe fruits are found from July–September. The fruits open with a loud crack, the seeds being forcibly ejected far from the tree. Seedlings are common on sites exposed to sun, such as logging roads. *Gilbertiodendron preussii* is one of the commonest trees of Liberia; it has a very gregarious habit. Valleys and slowly rolling country may be covered with extensive single dominant forests of *Gilbertiodendron*, *Tetraberlinia*, *Cynometra* or *Monopetalanthus*; where the terrain becomes steeper and rocky usually only *Gilbertiodendron* is able to maintain its gregarious stands.

Owing to its characteristic bark, the tree cannot be mistaken for any other species, except *Gilbertiodendron splendidum* and *G. bilineatum*. These two species are very similar to *G. preussii*, but grow under swampy conditions or on river borders. Their slash is paler pinkish brown. *G. splendidum* has large, brown-villous fruits, up to 60 cm long and 12 cm wide, with two lateral ridges. *G. bilineatum* has smaller fruits, also with two lateral ridges; this species may also grow gregarious.

USES. The wood is hard and heavy, Sp. G. c. 0.75. It is locally used as construction timber (red oak), but export prospects are doubtful as the timber has to be sawn soon after felling. If the logs are kept too long, they check thoroughly and may fall to pieces when sawn.

*Guibourtia ehie* (A. CHEV.) J. LÉONARD

[33/40, 171]

'*Guibourtia*': in honour of Mr. Guibourt, a pharmacologist who lived in the 19th century.

'*ehie*': vernacular name from Ivory Coast.

J. Léonard, Bull. Jard. Bot. Bruxelles, 19, p. 404 (1949); *ibid.*, l.c., 20, p. 276 (1950); *ibid.*, Etude Bot. Cop. Congo Belge, p. 67–78 (1950); *ibid.*, G.C.A.a., p. 137–156 (1957).

*Copaifera ehie* A. CHEVALIER in Bull. Soc. Bot. France, 61, 1914, Mém. 8e, p. 258 (1917); type: Chevalier 22447, Ivory Coast (P, K!); Baker f., Leg. Trop. Afr., p. 751 (1930);

*Copaifera guibourtiana*, AUCT. non BENTH., F.W.T.A., 1st ed., I, p. 338, partly.

1936: Aubréville, F.F.C.I., 1st ed., 1, p. 262 (*Copaifera ehie*)

1948: Pellegrin, Leg. Gabon, p. 117 (*Copaifera ehie*)

1950: Normand, A.B.C.I., I, p. 121–122; Pl. LI

1958: F.W.T.A., 2nd ed., I, p. 465

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 320

1960: Taylor, Syn. Silv. Ghana, p. 149–150

1961: Irvine, Woody plants of Ghana, p. 310

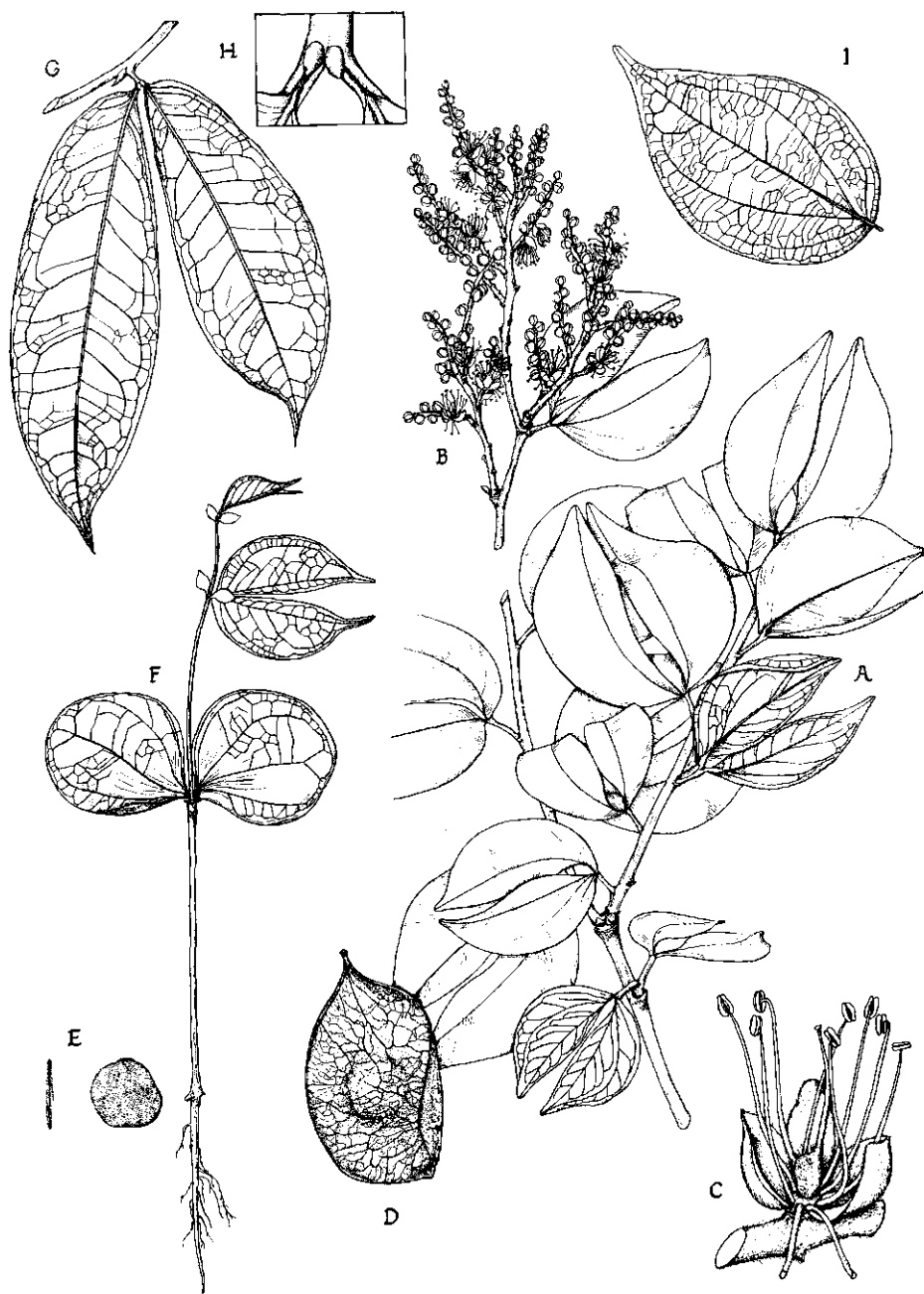


Fig. 33. *Guibourtia ehie* (A. CHEV.) J. LÉONARD A: branch with leaves ( $\times \frac{1}{2}$ ); B: inflorescence ( $\times \frac{1}{2}$ ); C: open flower ( $\times 4$ ); D: fruit ( $\times \frac{1}{2}$ ); E: seed, front and side view ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ); G: *Pellegriniodendron diphyllum* J. LÉONARD, branchlet with leaf ( $\times \frac{1}{2}$ ); H: top of the petiole with stipels ( $\times 4$ ); I: leaf of *Guibourtia dinklagei* (HARMS) J. LÉONARD ( $\times \frac{1}{2}$ ).

LOCAL NAME: pia pia (Gio)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Liberia to Ghana; occurrence in Gabon still doubtful

**BOTANY.** A large high forest tree. Young branchlets puberulous and pilose, glabrescent. Leaves pinnately compound with 1 pair of leaflets, alternate, stipulate, distichous, when young puberulous and pilose on petiole and midrib, soon glabrescent. Stipules very early caducous, only seen on seedlings. Petiole 5–8 mm long, slightly rugose, markedly articulate at base and top. Leaflets sessile, obliquely elliptic, falcate, 3–7.5 cm long, 1.5–3.5 cm wide, glossy green above, paler beneath, drying black. Base very unequal-sided; the proximal edge rounded, reaching till the petiole; the distal edge cuneate, joining the midrib c. 3 mm above the base. The inner margin straight or slightly convex, not concave; the outer margin nearly a half circle. Apex acute – acuminate, the very tip blunt. Midrib flat above, prominent beneath, thickened at base, straight, excentric towards the inner margin. Two, rarely three, strong nerves rising from the base, curving upwards. The upper, strongest nerve reaching over  $\frac{2}{3}$  of the length of the leaflet; the second nerve reaching halfway or lower. Lateral nerves of the upper part of the midrib less pronounced, 1–2 on each side; reticulation lax.

Inflorescences axillary or terminal, branched spikes, 4–9 cm long; spikelets 1.5–4 cm long. Primary peduncle velutinous; secondary peduncles sparsely velutinous. Bracts and bracteoles very caducous. Flowers sessile in more than 2 series, white when open. Flower buds globular, 2–3 mm in diameter, with 3–4 shallow grooves, finely knotty. Sepals 3 or 4, unequal-sized, imbricate in bud, spreading when flowering, villous inside, the exposed parts thick, sparsely velutinous, the overlapped parts thin and tomentose outside. Petals 0. Stamens 10, free, glabrous. Filaments c. 7 mm long, subulate. Anthers dorsifixed, versatile, elliptic, c. 1 mm long, bilobed at base. Disc present, intrastaminal, annular, sparsely pubescent. Ovary sessile, broadly elliptic, flattened, c. 1 mm long, sparsely pilose. Style 4–5 mm long, glabrous. Stigma terminal, flattened.

Fruit a thin, papery, indehiscent, black pod, rounded – quadrangular, 4–6 cm long, 3–4 cm wide, containing one seed, the ventral suture curved and winged, dividing the wing from the reticulate body. Seed thin, round, c. 1.5 cm in diameter, brown, with a thin testa.

Seedling: germination epigeal. Hypocotyl 7–12 cm long, with a collar c. 1.5 cm above the ground. Outer bark with the collar defoliating. Cotyledons soon caducous, not seen. Epicotyl 2–3 mm long, pubescent. First leaf sessile, bifoliolate; leaflets nearly round to transversely broadly oblong, 3–3.5 cm long, 2–4.5 cm wide, palmatinerved with 3–5 strong nerves. The sessile leaflets create the impression of being opposite, simple leaves. Following leaves petiolate, stipulate. Stipules foliaceous, ovate, c. 5 mm long, 3 mm wide. Leaflets as the mature leaflets but long caudate at the apex and with numerous translucent points.

TAXONOMICAL NOTES. The genera *Guibourtia* BENN. and *Copaifera* L. are closely related; from 1865–1949 they were even considered to form one genus, *Copaifera*. Léonard (1949, l.c.) clearly demonstrated that the two taxa are really two genera. The main differences are:

<i>Guibourtia</i>	<i>Copaifera</i>
Bifoliolate leaves.	Multifoliolate leaves.
Flowers not distichous.	Flowers distichous.
Sepals imbricate in bud.	Sepals subvalvate in bud.
Wood without tg. layers of gum ducts.	Wood with tg. layers of gum ducts.
Largely an African genus.	Largely an American genus.

Taylor in his description of the seedling misinterpretes the first leaf as being the two foliaceous cotyledons.

In Liberia two other species of *Guibourtia* are found: *G. leonensis* J. LÉONARD and *G. dinklagei* (HARMS) J. LÉONARD. *G. leonensis* is a small tree, found on rocky sites in the northern parts of the country: Loma National Forest (coll. No. 713) and Gio National Forest (coll. No. 305). The bifoliolate leaves resemble those of *Cynometra ananta*, but are long-petiolate (see fig. 25 E). *Guibourtia dinklagei* is a shrub or small tree with simple or bifoliolate leaves; the latter are similar to those of *G. ehie*, but have numerous translucent points. The Grand Bassa County is up till now the only locality from where this species is known (see fig. 33 I).

The present description and figures are based on the following specimens: Zuole 1277; N. Gio Nat. For. 188; Nimba 893, 1024.

FIELD NOTES. *Guibourtia ehie* is a medium-sized or large tree of the moist semi-deciduous forest, up till now in Liberia only found in the region between Tapeta and Nimba. The tree is not gregarious but grows in small groups or scattered. It may reach a height of 45 m ( $\approx 150'$ ) and a diameter of over 1 m ( $\approx 3.5'$ ). The base of the tree has well-developed buttresses, narrow but fairly high, reaching up to 2.5 m ( $\approx 8'$ ) on large trees, straight or concave, fairly thick. The bole is straight and cylindrical, up to 25 m ( $\approx 80'$ ) to the first branch. The crown is fairly small and open, flattened, finely branched; the leaves create the impression of being round with a slit in the centre. The bark is yellowish grey, grey-greenish or dark grey, fairly smooth, not cracked or scaly, but with thin horizontal ridges, fairly thick. The bark on the buttresses is very striate. The slash is medium brown, brittle and granular on the outside, dark brown and fibrous on the inside, sticky to the touch, often fragrant. Slash on the buttresses much paler. Ripple marks absent. A fragrant gum may exude from the cambium, but not from the wood, as in *Copaifera*.

The tree flowers in November. After the flowering period the tree is deciduous and the ground below the tree is black with shed leaves. New leaves appear in red flushes when the fruits are ripening, January – February.

Seedlings are very common in the forest under the mother trees, but seldom grow much larger than 30 cm ( $\approx 1'$ ) high.

USES. *Guibourtia ehie* produces small quantities of a gum, which, however, is not of economic importance. The copal producing *Guibourtia copallifera* J. J. BENNETT has not yet been recorded from Liberia. The seeds of *Guibourtia* are reported to be edible.

The wood is hard and heavy, dark brown with vertical black streaks.

*Monopetalanthus compactus* HUTCH. & DALZ.

[34/22, 41]

'*Monopetalanthus*': Gr. monos: single; Gr. anthos: flower; 'flower with a single petal'.

'*compactus*': dense, referring to the dense, strobiliform inflorescences or to the dense arrangement of the leaflets along the rachis?

Hutchinson & Dalziel, Kew Bull. 1928, p. 397; type: Aylmer 30, Sierra Leone (K!); Pellegrin, Bull. Soc. Bot. France, 89, p. 118–121 (1942); *ibid.*, Leg. Gabon, p. 75 (1948); J. Léonard, G.C.A.a., p. 256 (1957).

1928: F.W.T.A., 1st ed., I, p. 342

1958: F.W.T.A., 2nd ed., I, p. 478

LOCAL NAMES: fian (Gio); gbang (Kpelle); k'pai (Gola)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – S. W. Ivory Coast

BOTANY. A medium-sized or large tree. Branchlets brown velutinous, glabrescent. Branches grey-brown, markedly lenticellate, and with circular scars of shed stipules and bud scales. Older, heavier branches yellowish, horizontally lenticellate. Buds of the new leafy shoots cone-like, the bud scales distichous, progressively larger towards the top. When the new shoots flush, the lower part of the shoots without leaves but with c. 7 bud scales. Twigs golden brown velutinous. Leaves distichous, stipulate, paripinnately compound. Stipules intrapetiolar, similar to the bud scales but larger, obovate, c. 2 cm long, 1 cm wide, tapering towards the base, acute at the apex, concave, finely parallel-veined, long-sericeous at the base and on the margin, short-sericeous on the back and towards the apex, shortly or non-auriculate. Bud scales and stipules soon caducous. Young leaves folded, pale yellow–pinkish, sericeous with long, golden brown hairs on the central rachis and the margin. Fully grown leaves with 11–23 juga, in its totality narrowly elliptic, 2.5–8 cm long, glossy dark green above, paler beneath. Petiole c. 2 mm long, forming a joint. Petiole and rachis brown velutinous beneath, sparsely so above.

Leaflets placed along the rachis with intervals of 3–4 mm, opposite, sessile, attached

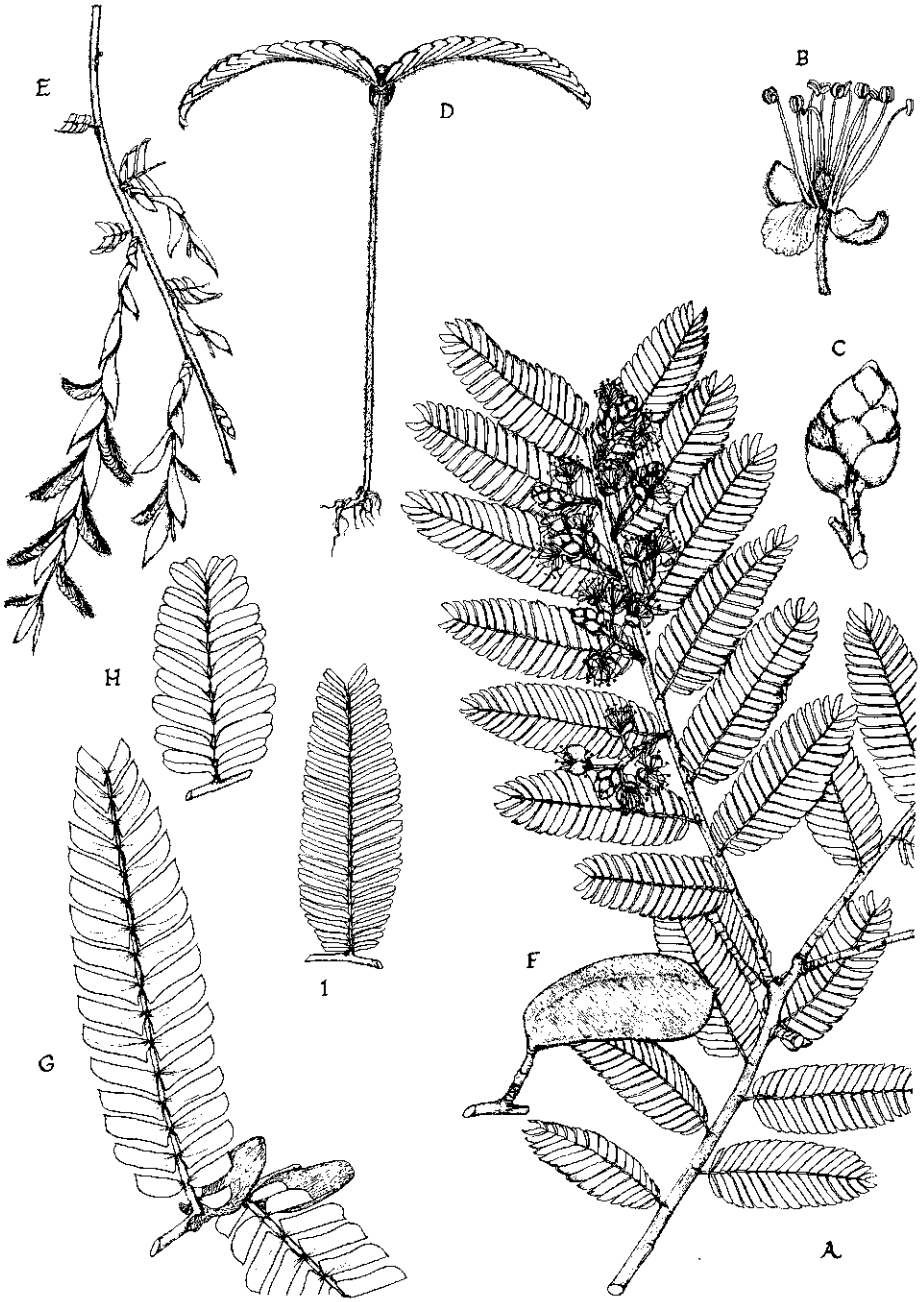


Fig. 34. *Monopetalanthus compactus* HUTCH. & DALZ. A: branch with leaves and inflorescences ( $\times \frac{1}{2}$ ); B: open flower ( $\times 2$ ); C: bud ( $\times 2$ ); D: seedling ( $\times \frac{1}{2}$ ); E: flush of new leaves ( $\times \frac{1}{2}$ ); F: pod ( $\times \frac{1}{2}$ ); G: *Monopetalanthus pteridophyllus* HARMES, leaf with stipules ( $\times \frac{1}{2}$ ); H: *Plagiosiphon emarginatus* (HUTCH. & DALZ.) J. LÉONARD, leaf ( $\times \frac{1}{2}$ ); I: *Didelotia brevibracteata* J. LÉONARD, leaf ( $\times \frac{1}{2}$ ).



to the rachis at the base of the distal edge, narrowly oblong, 6–14 mm long, 2–3 mm wide. Distal margin straight, proximal margin slightly sinuous and rounded towards the apex, auriculate and parallel to the rachis at base. Apex sometimes shortly apiculate. Leaflets palmatinerved, c. 6 nerves spreading fanwise from the base, the strongest nerve forming the distal edge of the leaflet; the other nerves hardly visible above, only slightly raised beneath. Reticulation lax. Leaves of saplings identical, not larger.

Inflorescences short, axillary racemes, up to 4 cm long. Buds of the inflorescences covered by bud scales, similar to those of the leafy shoots. Peduncle golden brown velutinous. Bracts long sericeous outside, glabrous inside, concave, c. 4 mm long and wide, caducous. Pedicel c. 5 mm long, velutinous. Bracteoles 2, valvate in bud, spreading when flowering, white, concave, c. 5 mm long, long sericeous outside, glabrous inside. Receptacle saucer-shaped with a thick edge. Sepals absent or minute and laterally of the petal, glabrous or ciliate, or larger, up to 1.5 mm long and 0.3 mm wide. Petal 1, white, membranous, shortly clawed, obovate, c. 6 mm long, 4 mm wide. Stamens 10, glabrous; 9 for 1–1.5 mm connate at their base, forming an open ring, with the opening to the petal, adnate to the base of the bracteoles; 1 free, opposite the petal, standing inside the open ring formed by the other 9 stamens, adnate with its base to the lower half of the stipe. Filaments c. 7 mm long, subulate. Anthers dorsifixed, versatile, bilobed at base, broadly elliptic, c. 1 mm long, with 2 thecae, opening lengthwise. Disc absent. Pistil shortly stipitate, stipe c. 1 mm long. Ovary 1.5–2 mm long, c. 1 mm wide, densely long-sericeous; style c. 5 mm long, filiform, with a few scattered hairs at base and on the ventral side; stigma terminal, capitate.

Fruit a small, brown, glabrous, woody pod, elliptic, 4–5 cm long, 2–2.5 cm wide, flat, opening with 2 valves, containing 1 or 2 seeds. Fruit stalk c. 5 mm long, obliquely attached. Ventral suture curved; dorsal suture first straight, then abruptly curved towards the apiculate apex. Valves finely obliquely lenticellate, with a faint longitudinal nerve from the base to the apex, parallel to and c. 5 mm distant from the ventral suture. Inside of the valves spongy. Seeds ovate, c. 1.5 cm long, c. 1 cm wide, glossy brown.

Seedling: germination epigeal. Hypocotyl 5–10 cm long, densely light brown velutinous. Cotyledons sessile, not spreading, orbicular, 6–8 mm in diameter, 1 mm thick, hard, soon caducous. Epicotyl less than 1 mm long. First two leaves opposite, paripinnately compound, stipulate; stipules not intrapetiolar, c. 5 mm long, 1 mm wide, parallel-veined, ciliate. Petiole 1 mm long. Rachis 4–7 cm long, golden brown sericeous beneath, glabrous on top, with 14–18 pairs of opposite sessile leaflets, identical to the mature leaflets. First internode densely brown puberulous, with 2–3 scales at regular distances. Following leaves alternate, with intrapetiolar stipules.

**TAXONOMICAL NOTES.** The genus *Monopetalanthus* HARMS includes at present 13 species, mainly occurring in rain forests along the Gulf of Guinea. Only two species are found in Liberia: *M. compactus* HUTCH. & DALZ. and *M. pteridophyllus* HARMS. The

latter served as type specimen for the genus. Both species are known from Sierra Leone and Liberia; *M. pteridophyllus* does also occur in Congo.

In the type description of *M. compactus* and also in the F.W.T.A., Hutchinson and Dalziel (1928, 1958, l.c.) report the number of stamens to be 8, but their analysis was based on a figure (F.W.T.A., l.c.) which erroneously showed the presence of only 8 stamens. The actual number is 10, as I was able to ascertain with the type specimen.

Two closely related species are *M. microphyllus* HARMS from Cameroon, Gabon and Congo, and *M. pectinatus* A. CHEV. from Gabon. The latter species is distinct in having persistent, auriculate stipules. *M. microphyllus* is difficult to distinguish from *M. compactus*. According to Léonard, Fl. Congo Belge, III, p. 445, 1952, the seedling has an epicotyl of 2–2.5 cm long, whereas it is very short in *M. compactus*. The flowers of *M. microphyllus* are slightly larger.

*Monopetalanthus pteridophyllus* (see fig. 34 G) is distinct from *M. compactus* by: its larger leaves of 10–22 cm long, with auriculate, persistent stipules at the base; its larger mucronulate leaflets, 1–3 cm long and 0.4–1.2 cm wide, placed at intervals of 5–12 mm along the rachis; its larger flowers with 5 sepals present (of which the 2 adaxial are united); its fruit, which is similar in form to *M. compactus*, but densely dark brown sericeous. It should be pointed out here that in the key to the genera of the *Caesalpinaceae* in the F.W.T.A., (1958, p. 442), *Monopetalanthus* is characterized by the absence or extreme reduction of the sepals, whereas *M. pteridophyllus* has 5 good sepals. With this species the key would lead to either *Julbernardia* PELLEGR. or *Paraberlinia* PELLEGR., but these genera are different by other characteristics, and are not recorded from Liberia.

The present description and figures are based on the following specimens: Firestone Plantation, Harley 1485; Bong Range 939, 1145, Leeuwenberg 4927; Nimba area 1083; 20 M. S. E. of Tapeta 298; Gbi Nat. For. southern part, 584, 587; S.E. of the Putu Range 1013, de Wilde 3659.

*M. pteridophyllus*: Bomi Hills, Mahe river 60; Robertsfield 1194.

FIELD NOTES. *Monopetalanthus compactus* is a medium-sized or large forest tree, which may reach a height of 35 m ( $\approx 120'$ ) and a diameter of 1 m ( $\approx 3'$ ), rarely more. The base of the tree has well-developed, medium high, thin, not very wide spreading buttresses, up to 1.50–1.80 m ( $\approx 5$ –6') high. The bole is straight, not cylindrical but a bit irregular on cross-section, up to 18 m ( $\approx 60'$ ) free from branches, but usually less, often forked at a height of 15 m ( $\approx 50'$ ) about. Small twigs often sprout from the bole, especially on exposed places such as windthrow areas and road sides. The crown is fairly open, light, not heavily branched, rather obconical and flattened. It has a lacy texture owing to the fine leaves. The bark on the buttresses is very striate perpendicularly to the edge. On the young trees the bark is smooth, grey-greenish or yellowish; on older trees scaly. Mostly scales are irregularly rounded, about 2–3 cm ( $\approx 1''$ ) in diameter, giving the tree a shallowly pitted, red-patched habit, because the fresh bark under

the scales is brick red. This sometimes gives the tree a habit similar to *Cynometra ananta*. Sometimes the bark peels off in large bark plates, leaving oyster-shell markings. It is covered with numerous small, red-brown lenticels. The slash is not very hard, compact-fibrous, pale pink to reddish pink; in the cambium faint, fine and wavy ripple marks are visible.

The tree is evergreen. New leaves appear in pale pink flushes all over the tree. This has been observed in April and October. The flowering season is from March–May. Fruits ripen from August to November. Seedlings are very common in the forest, growing up to 1 m ( $\approx 3.5'$ ) high, forming a dense canopy of undergrowth, suppressing everything else, but only a few saplings emerge from this mass of regeneration. In the evergreen forests *Monopetalanthus* has an extremely gregarious tendency, especially on the slightly rolling areas of the Liberian lowlands. It may form single dominant forests of vast extension, mixed with *Erythrophleum ivorense*, *Dacryodes klaineana*, *Crudia gabonensis* and various other species. Where the terrain becomes steeper, *Gilbertiodendron preussii* often takes over. On rocky hills the tree may be common, but not so gregarious (Bong Range). The single dominant forests have a peculiar light, open character, because the dominant tree does not grow very high and has a light crown. In the western province between Tahn and Gondoja and in the Gola National Forest near Gbai, very young, pure stands of *M. compactus*, respectively of c. 16 m ( $\approx 50'$ ) and c. 10 m ( $\approx 30'$ ) high were observed in secondary formations. This raises the question whether all single dominant forests of this species might not be relics of ancient shifting cultivation.

In the more deciduous forest the tree retreats from the high forest to the gallery forest, taking the place of *M. pteridophyllus*, growing smaller and finally disappearing. The tree has been found in the West Nimba National Forest, in moist conditions.

The related species *M. pteridophyllus* seems to be entirely confined to the evergreen forest. In the lowlands it may be a buttressed tree up to 75 cm ( $\approx 2.5'$ ) in diameter and over 30 m ( $\approx 100'$ ) high, often growing in small groups. However, it is most common as a small tree on river banks.

One should not confuse *Monopetalanthus compactus* with two other species, which also have pinnately compound leaves with small leaflets.

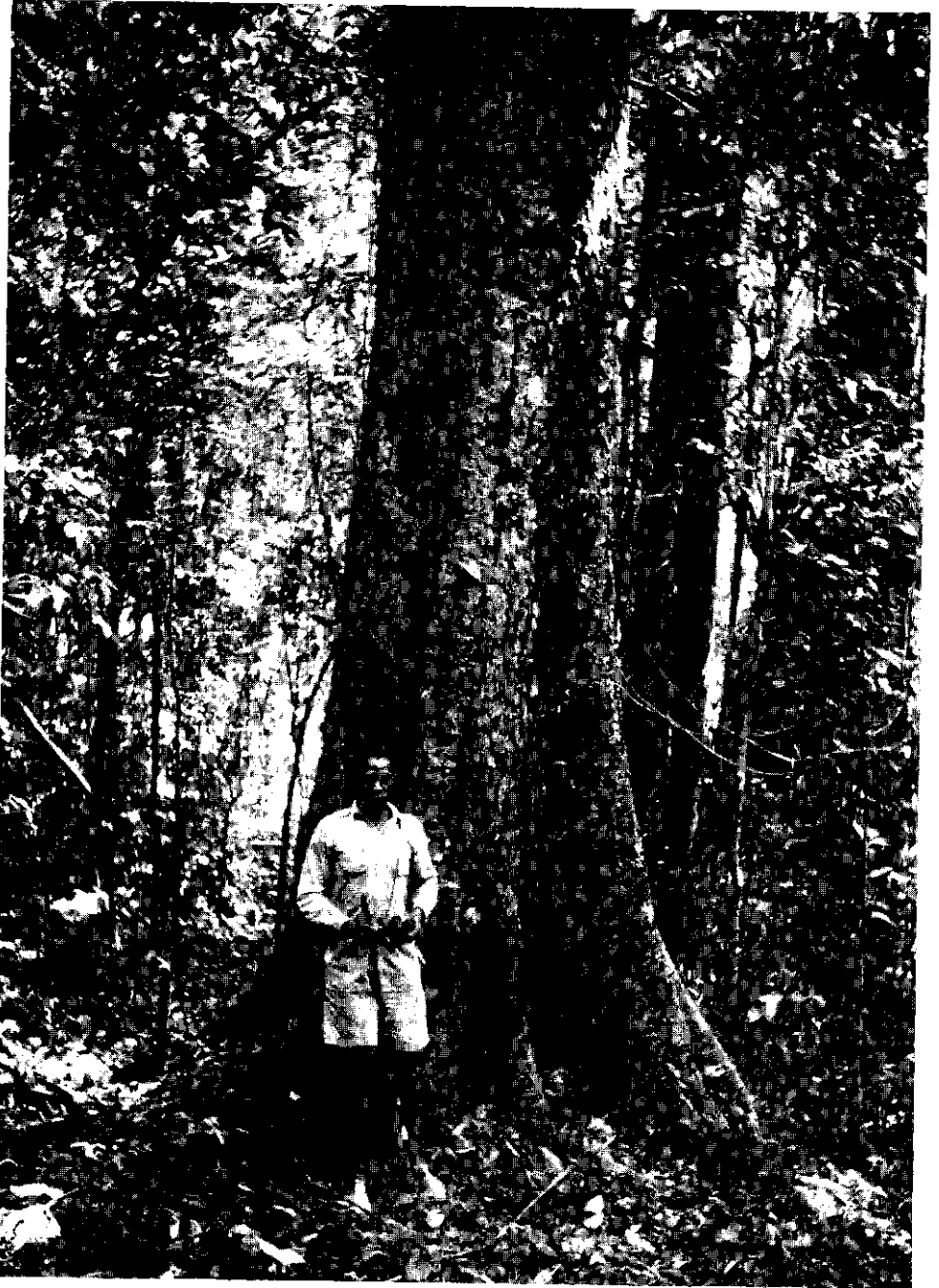
*Plagiosiphon emarginatus* (HUTCH. & DALZ.) J. LÉONARD, a small tree with blunt spines on the stem and branches, usually on river banks, although sometimes growing in gregarious stands on rocky hills. The leaflets are emarginate at the apex and stand in 8–12 opposite pairs along the rachis (see fig. 34 H).

*Didelotia brevipaniculata* J. LÉONARD, a large, gregarious tree, hitherto in Liberia only observed c. 20 miles N. of Greenville. It also has small, emarginate leaflets, but in 16–22 opposite pairs on each leaf (see fig. 34 I).

USES. The wood of *Monopetalanthus* is pinkish brown, hard, very tough, with interlocked grain. It has at present no known applications.



13. *Didelotia idae* OLDEMAN, DE WIT & LÉONARD. Note the straight base and the smooth bark with patches of lichens (see page 187).



14. *Erythrophleum ivorense* A. CHEV., Note the rough bark texture (see page 195).

*Stachyothyrsus stapfiana* (A. CHEV.) J. LÉONARD & VOORHOEVE [35/44, 129]

'*Stachyothyrsus*': Gr. stachys: spike; Gr. thyrsos: panicle; referring to the inflorescence, which is a spike-bearing panicle.

'*stapfiana*': named in honour of Otto Stapf (1857–1933), a German botanist.

J. Léonard & A. G. Voorhoeve, Bull. Jard. Bot. Bruxelles, 34, p. 422 (1964);

*Oxystigma stapfiana* A. CHEVALIER, Bull. Soc. Bot. France, 58, Mém. 8, p. 166 (1912); type: Chevalier 19528, Ivory Coast (P!); Baker f., Leg. Trop. Afr., p. 774 (1930);

*Kaoue stapfiana* (A. CHEV.) PELLEGRIN, Bull. Soc. Bot. France, 80, p. 464, 465 (1933); Wilczek, Fl. Congo Belge, III, p. 239 (1952); J. Léonard, G.C.A.a., p. 279 (1957).

1928: F.W.T.A., 1st ed., 1, p. 336 (*Oxystigma stapfiana*)

1931: Cooper & Record, Evergr. For. Liberia, p. 69 (*O. stapfiana*)

1936: Aubréville, F.F.C.I., 1st ed., I, p. 252 (*Kaoue stapfiana*)

1937: Dalziel, U.P.W.T.A., p. 198 (*Oxystigma stapfiana*)

1950: Normand, A.B.C.I., I, p. 122; Pl. XLV (*Kaoue stapfiana*)

1958: F.W.T.A., 2nd ed., I, p. 456 (*Kaoue stapfiana*)

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 308–310 (*Kaoue stapfiana*)

LOCAL NAME: kahn (Bassa, cf. Cooper)

TRADE NAMES:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone, Liberia, Ivory Coast

**BOTANY.** A common understory tree in the forest. Leaves alternate, paripinnately compound, (2–) 3–4 jugate, glabrous. Just above the leaf axil usually 1–3 small, black, hard excrescences (dormant flower buds) on the branch, in a vertical line. Stipules not seen. Petiole very short and thick, 0.5–1 cm long, rugose, forming a joint, or 3.5–6 cm long when the first pair of leaflets is missing, then jointed at the base only. Rachis 4–20 cm long. Leaflets opposite, progressively larger to the top of the whole leaf. Petiolules c. 5 mm long, rugose. Blade narrowly elliptic, (4.5–) 10–20 cm long, (1.5–) 3–7 cm wide, glossy medium–dark green above, paler beneath, coriaceous. Base rounded–(bluntly) cuneate; apex bluntly acute. Midrib flat or slightly raised above, prominent beneath, straight or, in the upper jugum, slightly curved. Nerves 6–10 on each side of the midrib, slightly raised above and beneath, ascending at an obtuse angle, looping near the edge. Reticulation strong, visible above and beneath. Leaves of saplings and coppice shoots much larger, with a thick petiole swollen at base, and leaflets up to 50 cm long and 15 cm wide, thick–coriaceous.

Inflorescences axillary or terminal panicles or spike-like racemes, 4–16 cm long, densely puberulous. Bracts c. 1.5 mm long, triangular, persistent after the flowers are shed. Bracteoles absent. Pedicel c. 1 mm long, puberulous. Sepals 5, white, largely connate, sparsely puberulous, glabrescent; the 5 calyx lobes imbricate on very young buds only,

soon separate, rounded, 0.7 mm long at anthesis. Calyx tube campanulate, c. 1.5 mm long at anthesis. Petals 5, white, equal-sized, imbricate in bud, narrowly obovate, c. 5 mm long, c. 2 mm wide, with a rounded apex, tapering towards the base, recurved at anthesis. Stamens 10, unequal in size; 5 long ones between the petals, c. 10 mm long, geniculate in bud and sometimes in the open flowers, the filaments broadening towards the top; 5 shorter ones in front of the petals, c. 5 mm long, the filaments filiform, pale-pink, glabrous. Anthers shortly stipitate, dorsifixed, c. 1.5 mm long, sometimes apiculate, with 2 introrse thecae, opening lengthwise. Pistil shortly stipitate, glabrous, red at base. Stipe 0.5 mm; ovary c. 2 mm long, slightly flattened; style c. 2 mm long, hardly distinct from the ovary; stigma terminal, not distinct. Inflorescence accrescent, lignifying after flowering.

Fruit a flat, brown, woody, slightly sickle-shaped, dehiscent pod, c. 18 cm long, 4–4.5 cm wide, opening with 2 valves, containing 1 or 2 seeds. Fruit stalk 1.5–2 cm long, 4 mm thick. Base of the fruit narrow, the upper part broad, containing the seeds. Ventral suture slightly thickened, canaliculate, concave-curved. Dorsal suture hardly thickened, convex-curved. Apex shortly apiculate. Valves finely reticulate outside. Seeds dark brown-black, irregularly shaped, c. 3 cm long, 1.5–2 cm wide; little or no loosening of the testa when drying.

Seedling: germination epigeal. Hypocotyl c. 1 cm long. Cotyledons transversely oblong, c. 1 cm long, 2 cm wide, remaining pressed against each other, bent sideways on c. 5 mm long, flat petioles. Epicotyl c. 12 cm long, with a few scales at regular intervals. Leaves alternate, estipulate, petiolate, the first bifoliolate. Petiole c. 3 cm long. Leaflets on c. 2 mm long petiolules; blade narrowly elliptic, c. 10 cm long, 3.5 cm wide, cuneate at base, long acuminate at the top. Seedling glabrous.

**TAXONOMICAL NOTES.** *Stachyothyrsus stapfiana*, described by Chevalier (1912, l.c.) as *Oxystigma stapfiana*, was placed by Pellegrin (1933, l.c.) in the new, monotypic genus *Kaoue*. This name was used until recently, but Léonard and Voorhoeve (1964, l.c.) finally published the new combination of *Stachyothyrsus stapfiana*, believing *Kaoue* and *Stachyothyrsus* to be congeneric. *Stachyothyrsus* HARMS had to be used as it was the older name (Harms in Engl. & Prantl, Nat. Pfl. fam., Nachtr. I zu II–IV, p. 198, 1897). A detailed account of all considerations which led to this new combination are given by Léonard & Voorhoeve, l.c.

*Stachyothyrsus stapfiana* should also occur in Sierra Leone, considering the abundance of the species in the Liberian part of the Gola forest. The present description is based on the following specimens: Zuole 231; Firestone Timber Reserve 328, Wright 15; Bomi Hills 135, 830; Gbama-Lofa road, de Wilde 3813.

**FIELD NOTES.** *Stachyothyrsus stapfiana* is a small or medium-sized, rarely a large tree, both in the high forest and in the secondary forest, reaching a height of 25 m ( $\approx$  80') and a diameter of 60 cm ( $\approx$  2'). The base of the tree has sharp root ridges but no but-

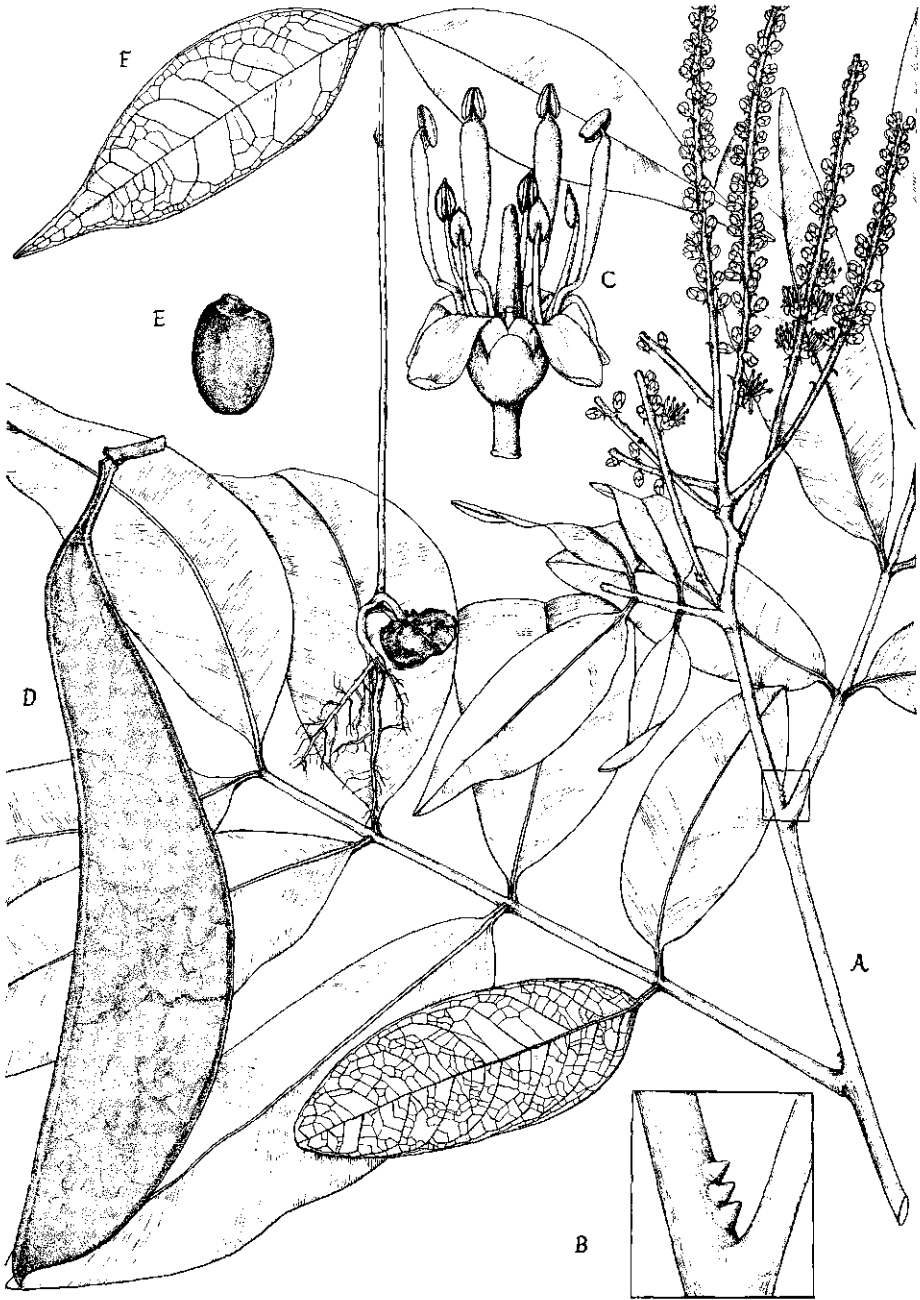


Fig. 35. *Stachyothyrsus stapfiana* (A. CHEV.) J. LÉONARD & VOORHOEVE A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: axillary buds ( $\times 2$ ); C: open flower ( $\times 4$ ); D: fruit ( $\times \frac{1}{2}$ ); E: seed ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ).



tresses; quite often the base of the tree is provided with low stilt-roots. In the high forest the bole may be straight and free of branches up to 16 m ( $\approx 50'$ ), when the tree grows into the upper canopy. Understory and secondary forest trees usually have a very bad stem form, angular, knotty, and branched. The crown is small, dense, and rounded. The bark is fairly smooth, grey or brown, finely lenticellate. The slash is fibrous on older individuals, brittle on young ones, light or bright brown, somewhat sticky.

The tree is evergreen. Flowering takes place during March and April. The white flowers are very fragrant. Fruits are ripe from July – November. Regeneration is common on moist places. The tree has a gregarious tendency and often forms a major part of the understory of the forest. Locally it can be considered as a single dominant species of the B-story of the evergreen forest. There seems to be little preference for site; the tree grows under swampy conditions, on rolling country and on steep rocky hills, both in the evergreen forest and in the moist semi-deciduous forest. It coppices extremely well. The leaves might be mistaken for those of *Gilbertiodendron* spp., but the axillary buds are diagnostic.

USES. The very large leaves are used for thatching roofs. Locally a kind of coppice forest exists which is solely used for the production of large leaves for thatch. The neighbourhood of old town sites may be marked by the presence of pure stands of *Stachyothyrsus* in the secondary bush. The tree has no value as timber. Its good coppicing qualities might be tried out in coppice forests for fuel production.

*Tetraberlinia tubmaniana* J. LÉONARD

[36/44, 170]

'*Tetraberlinia*': originally a section of the genus *Berlinia*; Gr. tetra: four; referring to the four sepals, as distinct from the five sepals of *Berlinia*.

'*tubmaniana*': named in honour of President William V. S. Tubman (1895– ) during whose 'open door policy' after the second World War the Liberian forests were opened for utilisation.

J. Léonard, Bull. Jard. Bot. Bruxelles, 34, 1 (1965); type: Voorhoeve 310 (BR!); *Didelotia?* sp., F.W.T.A., 2nd ed., I, p. 481, party, not from Sierra Leone.

1958: Normand, Journ. d'Agric. Trop. et de Bot., p. 297–302      1964: Voorhoeve, Comm. For. Rev., 43 (1), p. 17–24

1959: Kryn & Fobes, Woods of Liberia, p. 116, 117

LOCAL NAMES: ho (Gio, Kpelle, Gola, Bassa)

TRADE NAME: the name 'Gola' has been proposed as trade name, referring to the first area in Liberia where the tree was utilised, near Bomi Hills in the Gola country.



Fig. 36. *Tetraberlinia tubmaniana* J. LÉONARD A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: flower bud ( $\times 2$ ); C: open flower ( $\times 2$ ); D: fruit ( $\times \frac{1}{2}$ ); E: seed ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ); G: *Dide-lotia afzelii* TAUB., leaf ( $\times \frac{1}{2}$ ); H: *Loesenera kalantha* HARMS, leaf ( $\times \frac{1}{2}$ ).

## GEOGRAPHICAL DISTRIBUTION: Liberia

**BOTANY.** A medium-sized or large evergreen forest tree. Branchlets sparsely puberulous, glabrescent, lenticellate. Buds of leafy shoots covered by small bud scales. When the new shoot flushes out, there are up to 7 scars of the shed scales on the new, villous branchlets. The upper scales have the character of intrapetiolar stipules without a leaf, being foliaceous, c. 7 mm long, bifid at the top, puberulous on the back, ciliate. Leaves alternate, stipulate, paripinnately compound, 4–6 jugate, 7–13 cm long. Stipules seemingly not intrapetiolar, but actually connate at their base for only a fraction of a millimetre, foliaceous, obliquely narrowly ovate, 8–11 mm long, 3–4 mm wide, the inner margin straight, the outer margin convex, rounded at base, acute at the apex, ciliate, early caducous, only seen on very young shoots. Petiole 3–5 mm long, rugose, forming a joint. Rachis 4–8 cm long, puberulous, grooved above. Leaflets sessile, opposite, attached to the rachis at intervals of 13–20 mm, the intervals increasing from the base to the top. Leaflets progressively larger from the first to the one but last pair; the last pair usually a bit smaller. Blade basically rhombic in form, but the corners often so rounded, that the form may become (obliquely) elliptic or even slightly falcate, (1.5–) 2.5–6 cm long, 1–2.3 cm wide. Base unequal-sided, the proximal side slightly auriculate, the distal side cuneate. Margin entire, slightly revolute on dry material, ciliate on very young leaves, glabrescent. Apex bluntly acute – acuminate. Midrib diagonal, raised above and beneath. Nerves only slightly raised on both surfaces, 1 or 2 spreading from the proximal side of the base, 5–7 on each side of the midrib, looping at some distance from the edge. Reticulation lax, rather faint.

Inflorescences terminal or axillary panicles, up to 9 cm long, rusty brown velutinous. Bracts very concave, 3–5 mm long and wide, golden brown sericeous outside, glabrous inside. Flowers sessile in bud, shortly pedicellate when flowering. Pedicel c. 3 mm long. Bracteoles 2, sericeous outside, glabrous inside, c. 7 mm long and wide, very concave, with an excentric dorsal ridge (carinate), valvate in bud, not completely spreading when flowering, for c. 2 mm adnate to the receptacle. Receptacle cupuliform, c. 2 mm deep, hirsute and grooved inside. Sepals 4, sericeous outside; 3 are 5 mm long, 2 mm wide; the adaxial one 5 mm long and 3 mm wide, bifid at the top, actually formed by two connate sepals. Petals 5, pale yellow. The adaxial one shortly clawed. The claw glabrous, c. 1 mm long and wide at the base, broadening into the lamina, which is c. 7 mm long, 3 mm wide, slightly undulate, hirsute on the lower part of the margin, truncate at the apex. The other 4 petals linear, c. 3 mm long, 0.5 mm wide, glabrous. Stamens 10, glabrous, pinkish, 10–12 mm long, filiform, subulate. One free stamen in the axil of the adaxial petal; the other 9 shortly connate at their base. Anthers basifixed, deeply bilobed at the base, elliptic, c. 2 mm long. Pistil stipitate, slightly obliquely attached at the centre of the receptacle. Stipe densely brown pilose, c. 2 mm long; ovary densely brown pilose, c. 5 mm long, flattened, containing 2–3 ovules; style c. 9 mm long; stigma terminal, capitate, c. 1 mm wide, 0.5 mm thick.

Inflorescences accrescent, lignifying. Stipe accrescent, up to 2 cm long, villous. Fruit a flat, woody pod, (6–) 10–13 cm long, 4–5 cm wide, dehiscent, containing 1–3 seeds. Stalk laterally attached. Base narrow. The dorsal suture first straight, then abruptly curved near the apex with a nearly right angle. Ventral suture strongly curved near the base, gently convex towards the apex, strongly canaliculate and slightly winged. Apex apiculate, apicula c. 5 mm long. The valves with a marked lateral ridge from the base to the apex, more or less in the middle or excentric towards the ventral suture. As they open the valves turn corkscrew fashion, ejaculating the seeds. Seeds disc-shaped, 1.5–2 cm in diameter, bright brown, the testa loosening when dry.

Seedling: germination epigeal. Hypocotyl 5–8 cm long, densely velutinous. Cotyledons sessile, not spreading, attached about 3 mm above the base, nearly round, 12–15 mm wide, 15–20 mm long. Epicotyl 3–6 cm long, densely pilose. First two leaves opposite, pinnately compound, with 6–8 opposite pairs of leaflets. Stipules in pairs at the base of each leaf, pale green, 3 mm long, 1.5 mm wide, ciliate. Leaf as the mature leaves, but leaflets smaller.

TAXONOMICAL NOTES. *Tetraberlinia tubmaniana* J. LÉONARD is a species of the very complicated 'Berlinia complex', a group of species with valvate bracteoles, enclosing the flower bud, well-developed sepals, and 10 (–13) fertile stamens. The attempts to find a satisfactory taxonomy for this group are numerous (see Léonard, G.C.A.a., p. 180, 1957). *Tetraberlinia* (HARMS) HAUMAN originally formed the section *Tetraberlinia* of the genus *Berlinia* (Harms, in Engler, Pfl. welt Afr., III, I, p. 466–472, 1915), including the species *B. micrantha* HARMS, *B. polyphylla* HARMS and *B. bifoliolata* HARMS. *B. micrantha* has been placed in the genus *Oddoniodendron* DE WILD.: *O. micranthum* (HARMS) BAK. f. Troupin (Bull. Jard. Bot. Bruxelles, 20, p. 319–320, 1950) included the two remaining species in *Julbernardia* PELLEGR., but Hauman (Bull. Inst. Roy. Col. Belge, XXIII, p. 477–478, 1953) placed the former *B. bifoliolata* in the new genus *Tetraberlinia*, and the former *B. polyphylla* in the new genus *Michelsonia* HAUMAN. According to the latest concept (Léonard 1965, l.c.) however, *M. polyphylla* would belong to *Tetraberlinia* which at present includes the following species: *T. bifoliolata* (HARMS) HAUMAN, *T. polyphylla* (HARMS) J. LÉONARD and *T. tubmaniana* J. LÉONARD. It is very doubtful whether *Michelsonia* can be maintained as a separate genus, and a thorough revision of the whole *Berlinia* complex may find *Michelsonia* and *Tetraberlinia* congeneric.

Another closely related genus of *Tetraberlinia* is *Microberlinia* A. CHEVALIER (in Rev. Int. Bot. Appl. & Agric. Trop., 289, 290, p. 587, 1946), which is distinguished from *Tetraberlinia* in having a distinct calyx tube up to 8 mm long. It is not impossible that new discoveries will change the latest concept of Léonard, but at present the Liberian species certainly belongs to the genus *Tetraberlinia*.

The present descriptions are based on the following material: Bomi Hills 310, 446, 850, 851, 1043, 1115, Wright 1; Bassa III, Siga 690; Bong Range 31; Gbi Nat. For. 621,

FIELD NOTES. *Tetraberlinia tubmaniana* may reach a height of 42 m ( $\approx 140'$ ) and a diameter of 1 m ( $\approx 3.5'$ ), rarely more. The base of the tree has low, thick root swellings or root spurs up to 50 cm ( $\approx 1.5'$ ) high, but never real buttresses. The bole is straight and cylindrical, up to 20 m ( $\approx 66'$ ) or more to the first branches, though minor branchlets and twigs may occur on the upper part of the bole. The crown is small and rounded, with ascending branches, fairly open: only very large trees have a widely expanding crown. The bark is ashy-grey or grey-greenish, medium thick, smooth when young, not cracked but fairly rough or shallowly fissured when old, not scaly but with corky pustules, striate on the root spurs, fairly so on the bole. Slash compact-fibrous, pale brown – bright brown, sometimes yellowish brown; the dead outer layer is very thin. When affected or suddenly sun-exposed, the bark exudes a dark brown gum.

The tree is evergreen. The flowering season lasts from April–June. The flowers are sweetly fragrant. Young trees of 8 cm ( $\approx 3''$ ) thick and 9 m ( $\approx 30'$ ) high are already flowering. The fruits are ripe from November–January. Seedlings are very abundant in the forest, where the C-story is not too dense; in a strip of 200  $\times$  25 ft of *Tetraberlinia* forest 2245 seedlings up to 1 m ( $\approx 3.5'$ ) high were counted, and 99 saplings from 1–4.5 m ( $\approx 3.5'$ –15') high.

*Tetraberlinia* is confined to the evergreen forest belt of Sierra Leone (?) and Liberia; it does not appear to penetrate into the moist semi-deciduous forest. The eastern boundary of its distribution area seems to be more or less the western boundary of the drainage area of the Cavally river. In the high forest the tree is very gregarious, forming small stands or extensive single dominant forests, especially on bottom lands and slightly undulating country with a sandy loamy soil. The structure of the single dominant forest of *Tetraberlinia* is somewhat different from the other gregarious species, such as *Monopetalanthus compactus* and *Gilbertiodendron preussii* etc. Besides an abundant regeneration in the D-story (herbs and small shrubs story), the tree is equally well-represented in the C- and the B-story with medium-sized trees. This favourable distribution of diameter (and age) classes, often lacking in the single dominant forest of the other species cited, affords prospects for a possible selection system for the utilisation of this forest type. It should be borne in mind that the trees seem to suffer when suddenly exposed to full light, and that the low cutting limit permitted at present results in a complete destruction of the forest, if not by direct damage to the remaining stand, then by the after-effects of full exposure.

*Tetraberlinia* with its grey bark is easily confused with *Cryptosepalum tetraphyllum*, *Didelotia idae*, or *Brachystegia leonensis*. For diagnostic features see these species. The tree shown in the photograph, facing page 116 in 'Woods of Liberia', is a *Brachystegia*, not a *Tetraberlinia*.

In the eastern province gregarious stands were observed of one species, which resembles *Tetraberlinia* very much: *Loesenera kalantha* HARMS. This tree may reach a diameter of up to 60 cm ( $\approx 2'$ ) and a height of up to 28 m ( $\approx 90'$ ). The base has short and thick root swellings. The bark is smooth and grey, finely flaky. The slash is granular

outside, fibrous inside, pinkish brown, turning bright brown on exposure. The leaves are slightly similar to those of *Tetraberlinia* but have a gland on the lower surface at the top of the twisted petiolule (see fig. 36 H). New leaves appear in drooping, pink-red flushes in March, colouring the forest red. The tree grows under moist conditions, in swampy valleys and along creeks, a habitat where *Tetraberlinia* is found rarely. *Didelotia afzelii*, also a riparian species, resembles *Tetraberlinia* in its leaf shape, but the tip of its leaflet is retuse (see fig. 36 G).

USES. The wood is used in Liberia under the misleading name of 'African pine' for general purposes, construction, carpentry etc. It is fairly hard, Sp. G. 0.65, and moderately coarse-textured. The colour is a pleasant pale brown, slightly pinkish. It has been tried as a veneer with good results, but has not yet an established value on the world market.

#### Sub-family MIMOSOIDEAE (family MIMOSACEAE)

Trees, shrubs, and climbers, rarely herbs, mostly tropical and subtropical; trees often with buttresses. Leaves bipinnate. Flowers as a rule 5-merous. Sepals united in a 5-toothed or 5-lobed calyx tube; lobes as a rule valvate. Petals free or connate into a short tube, valvate. Stamens free or partly connate, as many as the petals or more. Staminodes sometimes present. Anthers small, often with a caducous gland on the top of the connective.

In the family *Leguminosae*, this sub-family takes the second place in the high forest of Liberia, after the *Caesalpinioideae*: at least 11 genera with 16 species are represented. However, none of these species are locally dominant unlike many species of *Caesalpinioideae*. Only the following species sometimes occur more or less gregariously: *Piptadeniastrum africanum* and *Calpocalyx aubrevillei* in the high forest, *Cathormion altissimum* along rivers, and *Albizia* spp. in secondary formations.

The economic interest of this family is limited.

#### *Albizia ferruginea* (GUILL. & PERR.) BENTH.

[37/48]

'*Albizia*': named after F. del Albizzi, a nobleman of Florence, who in 1749 took part in an expedition to Turkey where he collected many seeds, including those of the first described species of the genus, *A. julibrissin* DURAZZ..

'*ferruginea*': L. ferrugo: iron-rust; referring to the rusty pubescence of the inflorescences.

Benthams in Hook. Lond. Journ. Bot., III, p. 88 (1844), and in Trans. Linn. Soc., XXX, p. 563 (1875), partly, excl. syn.

*Inga ferruginea* GUILLEMIN & PERROTET in Florae Senegambiae Tentamen, p. 236 (1833, basionym); type: Leprieur s.n., Senegal (L, isotype!);

*Acacia malacophylla* STEUD.; Oliver, F.T.A., II, p. 361 (1871), partly; Hutchinson, Kew Bull. 1916, p. 238;

*Albizia angolensis* WELW. ex OLIVER in F.T.A., II, p. 361 (1871); type: Welwitsch 1766, Angola (K!);

*Albizia corbisieri* DE WILDEMAN in Pl. Bequaert, III, p. 47 (1925); type: Goossens 1607 (BR!).

1928: F.W.T.A., 1st ed., I, p. 363

1936: Aubréville, F.F.C.I., 1st ed., I, p. 172

1936: Kennedy, F.F.S.N., p. 115

1937: Dalziel, U.P.W.T.A., p. 210

1948: Pellegrin, Leg. Gabon, p. 12

1950: Aubréville, F.F.S.G., p. 299

1950: Normand, A.B.C.I., I, p. 106; Pl. XXIV

1951: Eggeling & Dale, Ind. Trees Uganda, p. 219

1952: Fl. Congo Belge, III, p. 185

1958: F.W.T.A., 2nd ed., I, p. 502

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 210

1959: Kryn & Fobes, Woods of Liberia, p. 6

1960: Taylor, Syn. Silv. Ghana, p. 217

1961: Irvine, Woody Plants of Ghana, p. 332

LOCAL NAMES: za-tong (Gio)

TRADE NAME: Musase

GEOGRAPHICAL DISTRIBUTION: Senegal – Oubangui Chari and Angola

**BOTANY.** A large tree. Branchlets densely rusty tomentose. Older branches tomentose and with large, pale lenticels. Leaves bipinnately compound, alternate, stipulate, with (2–) 4–6 (–7) pairs of opposite pinnae, each pinna with (5–) 6–13 opposite pairs of leaflets, rusty tomentose on stipules and petiole, paler tomentose on all other parts. Petiole (2–) 3–4 (–6) cm long, jointed at base, above with a c. 1 mm thick, globose, sessile gland on the middle. Rachis (2–) 4–15 cm long, with or without a gland just below the terminal pair of pinnae. Rachis of a pinna (2.5–) 5–13 cm long, distinctly jointed at base, with a pair of reduced, very caducous leaflets just above the joint, and glands just below the upper 0–7 pairs of leaflets. Leaflets of one pinna nearly equal-sized, but the first and last pair smaller, sessile, (obliquely, narrowly) oblong, (0.7–) 1.2–2.5 cm long, 0.5–1 cm wide. Base obliquely truncate; apex rounded – obtuse, sometimes apiculate. Midrib median, flat above, prominent beneath. Nerves 5–7 pairs, not prominent; reticulation faint. Water shoots with much larger leaves, densely velutinous.

Inflorescences axillary, shorter than the leaves. Peduncle straight, 5–6.5 cm long, densely rusty tomentose, with a c. 7 mm long, 3 mm wide bract c. 1 cm beneath the flowerheads. Flowers capitate, crowded at the end of the peduncle, subtended by linear, spatulate, c. 5 mm long bracteoles. Terminal flower sessile; calyx tube c. 5 mm long, 3 mm wide, calyx lobes 5, c. 1 mm long; calyx densely rusty tomentose outside, glabrous inside, for c. 1.5 mm adnate to the staminal tube; petals 5, c. 12 mm long, c. 1 mm wide, at the lower part united and adnate to the staminal tube, membranous, tomentose outside; staminal tube c. 25 mm long, c. 1.5 mm wide, exerted above the petals; free filaments wrinkled, c. 15 mm long; anthers minute; ovary completely lacking. Lateral flowers smaller; staminal tube not exerting above the petals, free filaments up to 3 cm

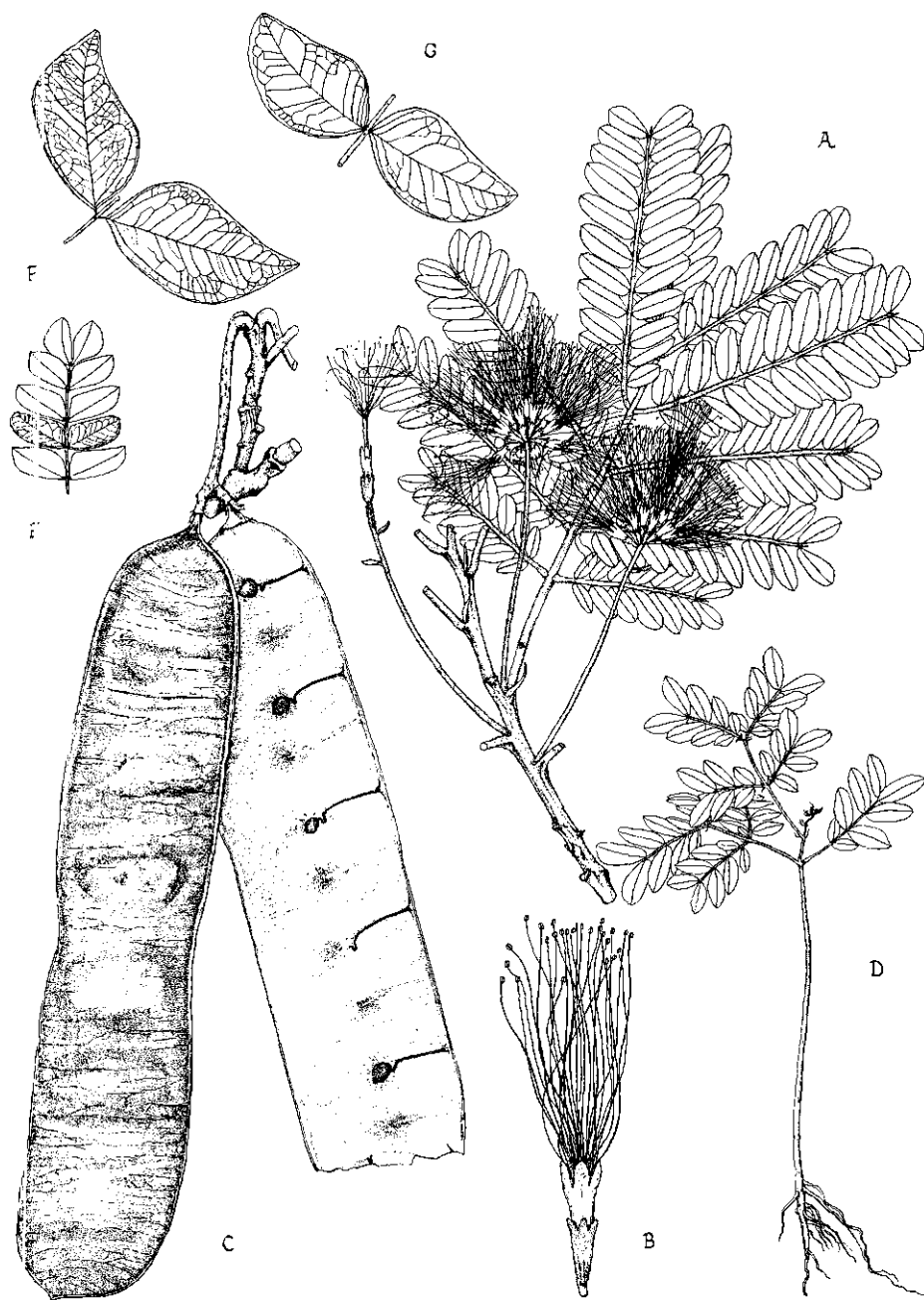


Fig. 37. *Albizia ferruginea* (GUILL. & PERR.) BENTH. A: branch with leaf and inflorescences ( $\times \frac{1}{2}$ ); B: open flower ( $\times 2$ ); C: open fruit ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ); E: leaflets of *Albizia adianthifolia* (SCHUM.) W. F. WIGHT ( $\times \frac{1}{2}$ ); F: leaflets of *Albizia glaberrima* (SCHUM. & THONN.) BENTH. ( $\times \frac{1}{2}$ ); G: leaflets of *Albizia zygia* (DC.) J. F. MACBR. ( $\times \frac{1}{2}$ ).



long, wrinkled; anthers c. 0.1 mm long, with 2 thecae, each theca with only 2 pollen grains; ovary c. 3 mm long, c. 1 mm wide, appressed puberulous, shortly stipitate, gradually tapering in a wrinkled, up to 3 cm long style; ventral suture of the ovary in bud and at anthesis open, the margins pressed together but not connate.

Fruit a flat, papery pod, up to 20 cm long and 5 cm wide, sparsely pubescent and red when young, glabrous and yellow brown when ripe, with a strong marginal nerve, transversely striate, opening with 2 valves. Seeds remaining attached to the valves, flat, c. 9 mm long, 7 mm wide.

Seedling: germination epigeal. Hypocotyl c. 6 cm long, increasingly tomentellous. Cotyledons not seen. Epicotyl c. 2.5 cm long. First 2 leaves opposite; one pinnate with a petiole of c. 1 cm and 4–6 pairs of leaflets; the other bipinnate with a longer petiole with (1–) 2 pairs of pinnae, each pinna with c. 5 pairs of leaflets. Stipules filiform. Following leaves alternate, bipinnate. All parts tomentellous.

TAXONOMICAL NOTES. It should be noted here that the ovary, described as glabrous by Guillemin & Perrottet and also by Bentham, is in fact minutely appressed puberulous. The observation of an open carpel in Voorhoeve 924 seems to be new for this species and perhaps for the genus. It was not observed in *A. adianthifolia*, *A. lebbeck*, and *A. zygia*.

Five representatives of *Albizia* occur in Liberia. They are characterized as unarmed trees with bipinnate leaves, capitate flowers, stamens united in a tube, and thin, flat, papery, dehiscent fruits. *A. lebbeck* BENTH. was introduced into Africa from India. This species is now widespread in the drier areas of West Africa, and in Liberia it can be found as an ornamental tree in towns and villages. The other four species are indigenous: *A. adianthifolia* (SCHUM.) W. F. WIGHT, *A. ferruginea* (GUILL. & PERR.) BENTH., *A. glaberrima* (SCHUM. & THONN.) BENTH., and *A. zygia* (DC.) MACBRIDE. They may be distinguished as follows:

A. Pinnae with 2–6 pairs of leaflets; leaves with 1–4 pairs of pinnae.

1. Leaflets (sub)sessile, midrib broadened at base; rachises finely puberulous. Stamens united in a tube exerted from the corolla at anthesis: *Albizia zygia*

2. Leaflets with 1–2 mm long, thin petiolules; rachises practically glabrous; staminal tube not exerted from the corolla at anthesis: *Albizia glaberrima*

B. Pinnae with 6–20 pairs of leaflets; leaves with (2–) 4–8 pairs of pinnae.

3. Leaflets rhombic, the midrib diagonal; one basal nerve parallel to the proximal edge; staminal tube exerted from the corolla at anthesis: *Albizia adianthifolia*

4. Leaflets (obliquely) elliptic, midrib median; no basal nerve parallel to the proximal edge; staminal tube not exerted from the corolla at anthesis: *Albizia ferruginea*

*Albizia adianthifolia* (za-nasa in Gio) is the most common species. Restricted to the secondary forest, low bush and coastal savannas it rarely grows to a medium-sized tree. *Albizia glaberrima* is the rarest species, only found in semi-deciduous forest. It

closely resembles the third species, *A. zygia* (za-ti in Gio). The latter is a very common, medium-sized tree in secondary forests, perhaps more common in the moist semi-deciduous forest belt. The bark is grey-greenish, as a rule not scaly but rough with numerous vertical rows of brown lenticels. The slash shows the for *Albizia* characteristic feature: orange-brown with darker vertical stripes.

The present descriptions and figures are based on the following collections: *A. ferruginea*: Nimba mountains 888, 924; Chien area 625; Mtn. Wutivi, v. Dillewijn s.n.; Ganta, Harley s.n.; Sierra Leone: King 148 (K). *A. adianthifolia*: Ganta, Harley 1138; Duport 864, 948; Kanweake 979; Nimba area 1099. *A. glaberrima*: Zuole area 1297. *A. zygia*: Duport 863, 428; Ganta, Harley 1139; Zuole area 219, 227; Kanweake 1001, 973.

**FIELD NOTES.** *Albizia ferruginea* can grow large, up to 40 m ( $\approx 130'$ ) high and 1.20 m ( $\approx 4'$ ) in diameter, but such large trees are rare. The base of the tree has narrow, thick buttresses of up to 1.50 m ( $\approx 5'$ ). The bole is straight, round or somewhat angular, up to 20 m ( $\approx 66'$ ) to the first branch. The crown is heavily branched, fairly spreading, dark, with clusters of leaves. The bark is yellowish brown, thick, very rough-scaly and pitted, shaggy, often with a fairly thick layer of dead bark. Slash long-fibrous, yellowish to orange-brown, paler near the cambium, with tangential layers of darker tissue, especially near the outer bark, exuding slowly a clear or honey-coloured, sticky gum. Ripple marks are reported to be present. The leaves of this species (and of the other *Albizias*) show sleep movements at night.

In Liberia *A. ferruginea* is confined to the moist semi-deciduous forest, where it is found scattered. Unlike the other *Albizia* species, it is more frequent in high forest than in secondary forest. It changes its leaves after the rainy season. New flushes of leaves are red. Flowering is in February–March, when the crown is covered by ochre-yellow inflorescences; the flowers are white, tinged with green.

Fruits ripen from December–February. They open on the tree and the valves together with the attached seeds are spread by wind. Fruit production is copious and seedlings are produced in abundance, but the majority soon perishes through lack of light as this species is a great light demander. There are c. 6500 seeds/lbs.; germination takes 4–10 days. Felled trees coppice well from the base and form shoots from the bole when left in the forest.

One tree with leaflets which in size and shape resemble those of *A. ferruginea* is *Tetrapleura tetraptera* (SCHUM. & THONN.) TAUB., but its leaves have no glands on the rachis, the leaflets are alternate, the fruits are thick and markedly 4-winged (transverse section cross-shaped), and the slash has a characteristic caramel scent.

**USES.** The leaves contain small amounts of saponine and lather slightly in water. The sapwood is pale yellow, fairly narrow. The heartwood is dark red-brown. It is medium light and –hard, and easily worked. It has a coarse texture and interlocking grain. It is

resistant to decay but not to termites; it is very suitable for general exterior and interior work, house-building and carpentry.

*Aubrevillea platycarpa* PELLEGR.

[38/48, 240]

'*Aubrevillea*': see page 179.

'*platycarpa*': Gr. *platus*: broad, flat; Gr. *karpos*: fruit; referring to the broad, flat fruits of this species.

Pellegrin in Bull. Soc. Bot. France, 80, p. 466, 467 (1933); type: Aubréville 990, Ivory Coast (P!, lecto-type).

1936: Aubréville, F.F.C.I., 1st ed., I, p. 188

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 230

1948: Pellegrin, Leg. Gabon, p. 27

1959: Kryn & Fobes, Woods of Liberia, p. 16

1950: Normand, A.B.C.I., I, p. 107; Pl. XXVI

1960: Taylor, Syn. Silv. Ghana, p. 222

1952: Fl. Congo Belge, III, p. 227

1961: Irvine, Woody Plants of Ghana, p. 336

1958: F.W.T.A., 2nd ed., I, p. 492

LOCAL NAMES: bee-èh ti (Gio); wai-ti beda (Mano)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Congo

**BOTANY.** A large tree. Leaves bipinnately compound, alternate, stipulate, 20–40 cm long, with (3–) 4–8 pairs of (sub)opposite pinnae, each pinna with (6–) 8–15 pairs of opposite, sessile leaflets. Stipules minute, acicular points, swollen at base, very caducous. Young leaves brilliantly red. Petiole 5–11 cm long, slightly swollen at base, terete or slightly flattened, striate, finely puberulous. Rachis (6–) 12–26 cm long, broadly grooved above with transverse ridges between the pinnae, and with lateral length ribs, finely puberulous. Rachises of the pinnae (4–) 6–16 (–18) cm long, the central pinnae longest, jointed at base, finely grooved and pubescent above. Leaflets (narrowly) oblong – (narrowly) obovate, 1.5–3.5 (–4) cm long, 0.5–1.5 (–2) cm wide, progressively larger from the base to the top of the pinna, glossy dark green above, obtusely unequal-sided at base, apex obtuse – truncate – emarginate. Midrib curved and excentric towards the distal edge, slightly raised on both sides. Nerves numerous, steeply ascending, raised on both sides. Leaves of saplings and young trees bright green, up to 50 cm long, with up to 12 pairs of pinnae, each pinna with up to 25 pairs of narrowly oblong leaflets, 1.5–3.5 cm long, 0.5–0.8 cm wide, obtusely acute at the top.

Inflorescences up to 40 cm long, terminal panicles with lateral racemes up to 22 cm long. Peduncles densely rusty tomentellous. Bracts caducous. Bracteoles 0.5 mm long, caducous. Pedicel and calyx densely tomentose. Pedicel c. 1 mm long, articulate at base. Calyx tube 1–1.5 mm long, shortly dentate. Petals 5, united at the base in a swollen tube of c. 1 mm long, partly adnate to the calyx tube. Free corolla lobes 2–2.5 mm long, 0.8 mm wide, tomentose on both sides. Stamens 10, united at base and adnate to the corolla

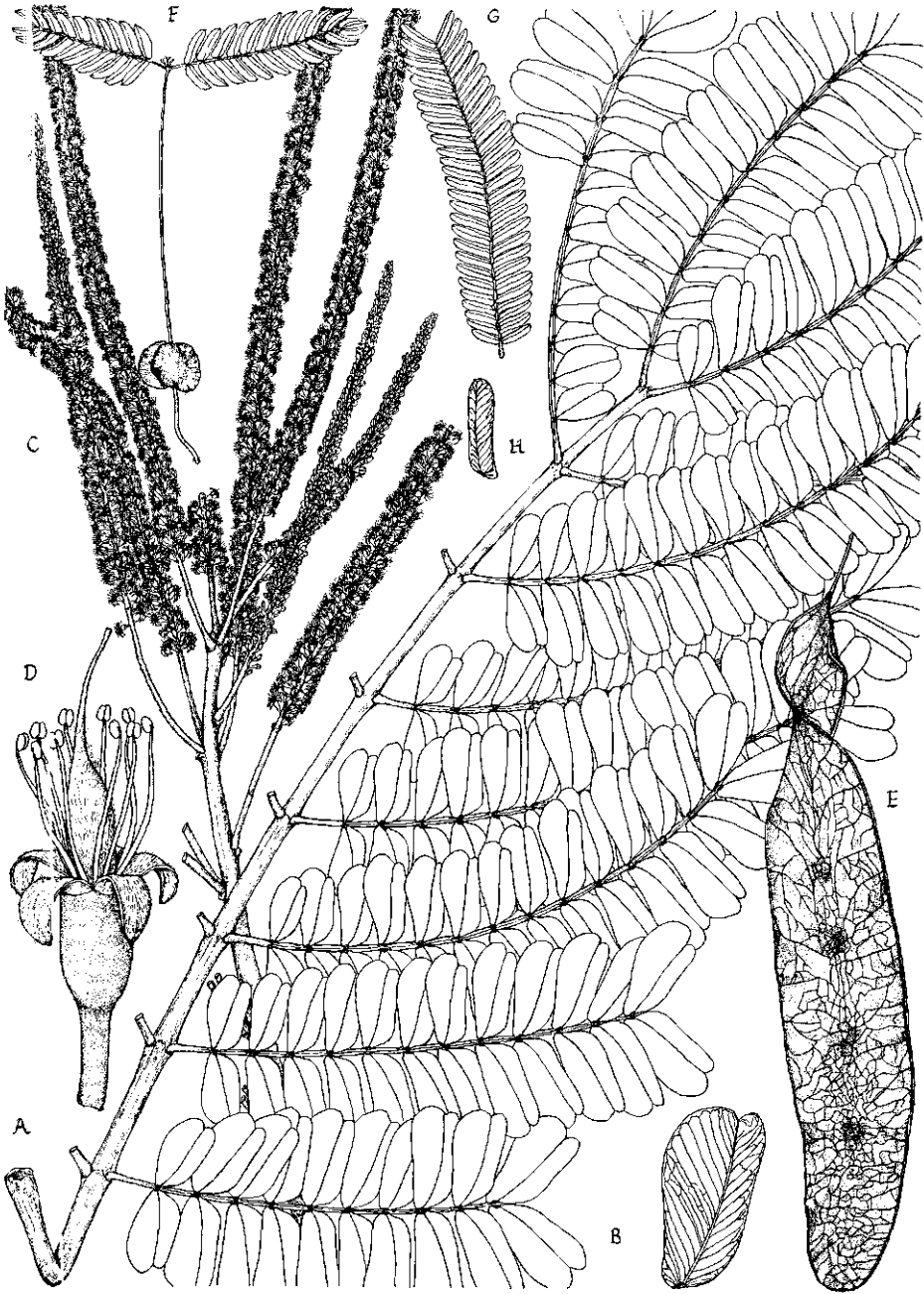


Fig. 38. *Aubrevillea platycarpa* PELLEGR. A: leaf ( $\times \frac{1}{2}$ ); B: leaflet ( $\times 1$ ); C: inflorescence ( $\times \frac{1}{2}$ ); D: open flower ( $\times 10$ ); E: fruit ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ); G: pinna of a leaf of *Aubrevillea kerstingii* (HARMS) PELLEGR. ( $\times \frac{1}{2}$ ); H: leaflet ( $\times 1$ ).

tube; free filaments c. 3 mm long, twisted, subulate. Anthers c. 0.5 mm long, dorsifixed. Ovary flattened, c. 2.5 mm long, sparsely villous, especially on the upper part, containing 3–4 ovules. Style c. 2 mm long, sparsely villous on the lower part; stigma minute.

Fruit a thin-coriaceous or papery, indehiscent pod, 15–22 cm long, 3.5–5 cm wide, pale yellow when ripe, with a thin, c. 2 cm long stipe, cuneate and markedly twisted at base, rounded at the top, with a strong marginal nerve and conspicuously reticulate sides, containing 1–3 seeds. Seeds thin and flat, round or reniform, c. 1 cm long, 1–1.5 cm wide.

Seedling: germination epigeal. Hypocotyl up to 1 cm long, glabrous. Cotyledons not spreading, reniform. Epicotyl 5–8 cm long, ribbed, with 2 lines of hairs. First 2 leaves opposite, pinnate. Stipules filiform, c. 2 mm long. Petiole 3–6 mm long. Rachis c. 5 cm long, with 8–13 pairs of opposite, sessile leaflets, progressively smaller towards the top of the whole leaf. Leaflets oblong, 6–12 mm long, 3–4 mm wide. Next leaves alternate, first still pinnate, eventually bipinnate.

TAXONOMICAL NOTES. The genus description, as given by Pellegrin (1933, l.c.), was for the flowers based on *A. kerstingii* (HARMS) PELLEGR. only. Pellegrin stated: 'ovarium 5–7 ovulatum'. In *A. platycarpa* No. 785, quoted below, the number of ovules observed was never more than four. It seems unlikely that the flowers are subsessile (cf. Fl. Congo Belge, 1952, l.c.), as the numbers 785 and 920, quoted below, show the presence of a definite pedicel.

Karl Mayer (9) reported the other species of this genus, *A. kerstingii*, from Kpandamai (western province). It is possible that he wrongly identified a young specimen of *A. platycarpa*, but if his identification is correct the tree must be very rare in Liberia, only occurring in the driest parts, bordering Guinea. *A. kerstingii* has much smaller leaflets, 1–2 cm long and 2–4 mm wide, in 16–30 pairs per pinna. Leaves of young trees and saplings of *A. platycarpa* often has smaller and more numerous leaflets than of the full grown tree. There is a possibility that sapling leaves are believed to represent *A. kerstingii*, which however always has smaller leaflets and, when young, up to 18 pairs of pinnae in a leaf (see figure 38 G). Nor should *A. kerstingii* be confused with *Cathormion altissimum* (HOOK. f.) HUTCH. & DANDY, a large riparian tree, with leaflets resembling those of *A. kerstingii* but with glands between the upper pairs of pinnae.

The present description and figures are based on the following Liberian collections: Bong Range 785; Nimba area 920, 1201; Ganta, Harley 2500; Putu area 860, 1029.

FIELD NOTES. *Aubrevillea platycarpa* is a large or emergent tree up to 40–50 m ( $\approx$  130'–160') high, attaining a diameter over 1 m ( $\approx$  3.5'), rarely up to 1.50 m ( $\approx$  5') above the buttresses. Buttresses fairly narrow, thick, up to 3 m ( $\approx$  10') high, often extending in butt flares along the bole. Stem straight and cylindrical or somewhat irregular on cross-section, up to 24 m ( $\approx$  80') to the first branches. Crown with heavy, ascending bran-



15. *Piptadeniastrum africanum* (HOOK. f.) BRENAN. Note the spreading crown habit and the fine foliage (see page 242).



16. *Haplomosia monophylla* (HARMS) HARMS. A typical site: river border (see page 246).

ches, dome-like, dense and dark green, the leaves rather tufted. The bark on the buttresses is striate; on the bole it is scaly with small, roundish scales, leaving red or red-brown patches when shed. When many scales are shed simultaneously the tree trunk may assume a distinctly red colour, though normally it is grey and red-brown patched. When young the tree is smooth and grey, and may resemble *Piptadeniastrum*. The slash is fairly thin, fibrous but brittle, pale red outside, pale yellow with darker stripes inside; it has a sweet taste.

In Liberia *Aubrevillea platycarpa* is found scattered throughout the high forest, rarely in groups. Flowering is in December–January. The tree changes foliage in January–March; at that time the crown is a brilliant red dome. Fruits are ripe in March–April. At that time the crown is covered by pale yellow flushes of fruit bunches, and when seen from the air the tree is easily detected and found to be more common than anticipated. Seedlings may be abundant in the neighbourhood of the mother trees; they resemble those of *Monopetalanthus compactus*, but the position of the cotyledons is diagnostic. Saplings are fairly common in low bush.

The habit of *Aubrevillea* (well-developed buttresses, mounted by a long, straight bole) sometimes resembles a *Klainedoxa*, but the slash of *Klainedoxa* fills up immediately with a clear sap.

USES. The wood has a very pleasant grey brown colour with a violet tinge, striped (owing to interlocked grain). The tree is not utilised at present.

*Calpocalyx aubrevillei* PELLEGR.

[39, 40F/47, 170]

'*Calpocalyx*': Gr. kalpe: urn; referring to the urceolate calyx.

'*aubrevillei*': see page 179.

Pellegrin in Bull. Soc. Bot. France, 80, p. 467 (1933); type: Aubréville 1222 (P!, lectotype).

1936: Aubréville, F.F.C.I., 1st ed., I, p. 190

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 232

1950: Normand, A.B.C.I., I, p. 103; Pl. XXVII

1959: Kryn & Fobes, Woods of Liberia, p. 24

1958: F.W.T.A., 2nd ed., I, p. 488

LOCAL NAMES: mah (Gio, Bassa); matu (Krahn); baah (Kpelle); k'dèh (Gola)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Ivory Coast

BOTANY. A medium-sized tree. Young branchlets and leaf buds finely tomentellous, glabrescent. Leaves bipinnately compound with only 1 pair of pinnae, each pinna with (3–) 4–6 pairs of opposite leaflets. Stipules c. 7 mm long, c. 2 mm wide, subulate, cadu-



cous. Petiole 1–2 (–2.5) cm long, stout, jointed at base, broadening at the top, with a large, 3–5 mm wide, flat gland just below the junction of the 2 pinnae. Rachis of a pinna 13–25 cm long, markedly jointed at base, with a large flat gland between the upper 3 (4) pairs of leaflets. Petiolules 5–8 mm long, rugose, finely grooved above. Leaflets progressively larger from the base to the top of the whole pinna, (3.5–) 6–20 cm long, 3–8 cm wide, (narrowly) ovate – (narrowly) elliptic, long acuminate at the apex or terminated by a caudate tip of 1–2 cm long. Margin entire, slightly revolute. Base rounded – broadly cuneate. Midrib impressed above, prominent beneath. Nerves 6–8 pairs, prominent beneath, looping. Reticulation dense, finely raised above and beneath. Branchlets sometimes with a series of buds above the leaf axil. Water shoots may have pinnae up to 50 cm long, with up to 8 pairs of leaflets.

Inflorescences erect, terminal panicles up to 40 cm long, with lateral spikes 10–16 cm long. Principal peduncle grooved, tomentellous when young, glabrescent. Bracts c. 7 mm long, 3 mm wide, caducous. Peduncle of the spikes densely pilose. Very young spikes with c. 2 mm long, geniculate bracteoles, thin at base, swollen in the centre, subulate and recurved at the top, tomentose, longer than the flower buds, soon caducous. Calyx closed in very young buds, soon opening at the top, urceolate and shortly 5-dentate, golden-yellow sericeous outside, c. 2.5 mm long at anthesis. Petals 5, sericeous outside, glabrous inside, united in a tube of c. 2.5 mm long, with 5 lobes of c. 2 mm long. Stamens 10, slightly swollen and adnate to the corolla tube at base, 4–5 mm long, subulate. Anthers dorsifixed, bilobed at base, finely apiculate at the top, 0.8 mm long. Ovary sessile, c. 2 mm long, densely long-sericeous, containing c. 10 ovules. Style c. 6 mm long, glabrous, subulate. Stigma minute, not distinct.

Fruit a thick, woody pod, 20–28 cm long, narrow at base, 5–9 cm wide near the rounded top, with a thickened, flattened, slightly winged ventral edge and smooth or striate sides, opening on the tree, recurving strongly, containing 1–3 seeds. Seeds irregularly shaped, up to 4 cm long, 2.5 cm wide and 1 cm thick, with a white hilum and a dark, purplish brown, thick testa, loosening when drying.

Seedling: germination epigeal. Hypocotyl 3–6 cm long, pubescent. Cotyledons sessile, thick and fleshy, 2–3.5 cm long, rounded at the top, sagittate at base. Epicotyl 7–18 cm long, pubescent, glabrescent. First two leaves opposite, pinnately compound, with 2 (–3) pairs of opposite leaflets. Stipules acicular, c. 8 mm long. Petiole 3–6 cm long. Rachis with conspicuous glands between the leaflets. Leaflets ovate – elliptic, 6–12 cm long, 2.5–5 cm wide, long caudate. Following leaves alternate, at first still pinnate, eventually bipinnate.

TAXONOMICAL NOTES. In Liberia *Calpocalyx* HARMS is represented by only one more species, *C. brevibracteatus* HARMS, a common understory tree, rarely reaching 60 cm ( $\approx 2'$ ) in diameter. This species has bipinnate leaves with only 2 pairs of pinnae, 4–6 leaflets to each pinna. The slender petiole is (1.5) 3–6 cm long and bears a small gland at the top. The rachises of the pinnae are 10–18 cm long; inconspicuous glands occur



Fig. 39. *Calpocalyx aubrevillei* PELLEGR. A: leaf ( $\times \frac{1}{2}$ ); B: detail of rachis, showing the gland between the leaflets ( $\times 2$ ); C: inflorescence ( $\times \frac{1}{2}$ ); D: open flower ( $\times 5$ ); E: pistil ( $\times 5$ ); F: seed ( $\times \frac{1}{2}$ ); G: seedling ( $\times \frac{1}{2}$ ). For fruit see fig. 40 F.

between the upper pairs of leaflets. The leaflets are (narrowly) elliptic or (–) ovate, 2–12 cm long, 1.5–4.5 cm wide. In very young inflorescences the bracteoles are shorter than the flower buds. The fruits are up to 15 cm long, obliquely tapering in the lower half, and in the upper half 2–3 cm wide.

The present description and figures are based on the following Liberian collections: *C. aubrevillei*: Bomi Hills 311, de Wilde 3845; Zuole 602; Bassa III, Siga 686; Nimba 1072, Kanweake 975, 1028. *C. brevibracteatus*: Bong Range 72; Bassa III, River Sro 66; Chien area 637.

FIELD NOTES. *Calpocalyx aubrevillei* is a medium-sized tree, up to 30 m ( $\approx$  100') high and rarely with a diameter over 1.10 m ( $\approx$  3.5'). The base has narrow, thin buttresses, usually up to 1–1.50 m ( $\approx$  3–5'), occasionally with butt flares up to 3 m ( $\approx$  10'), and wide-spreading surface roots. The bole is sometimes straight and cylindrical, up to 18 m ( $\approx$  60') to the first branches, but often curved and forked at a lower level. The crown is fairly small. The pale grey bark on the buttresses is markedly striate, perpendicular to the edge; the bark on the bole is smooth, medium – dark grey on the lower part, clear grey or nearly white on the upper part and on the branches, with numerous small brown lenticels and horizontal ridges. The slash is pale brown on the buttresses, darker brown on the bole, granular outside, fibrous inside, with vertical zones of lighter coloured, softer dilatation tissue, sticky on touch. Young trees have a clearer bark colour.

*Calpocalyx aubrevillei* is widespread throughout Liberia, scattered or in rich stands, but nowhere as a single dominant, often in the vicinity of water, but not necessarily so. It is one of the commonest trees of the Liberian evergreen forest, where values of more than 100 trees  $>$  60 cm ( $\approx$  24")  $\varnothing$ /sq. mile have been recorded; it is slightly less abundant in the moist semi-deciduous forest.

The tree is evergreen; it flowers during the rainy season, April–November. Fruits are found practically the whole year round. They open on the tree with a loud crack, ejaculating the seeds with force, then shedding the loose valves, which are a practically never failing means of identification under the tree. Regeneration is locally abundant, but needs light for healthy development.

Only a few trees have bipinnate leaves with only two pairs of pinnae. They are: (1) *Calpocalyx brevibracteatus* (long, slender petiole, smaller leaflets, low root spurs, dark bark and dark slash; see also taxonomical notes). The bark of this common understory tree is used for cough medicin. (2) *Xylia evansii* HUTCH., a large tree with irregular, often stepped buttresses, a brown, rough-scaly bark, a light brown, fibrous slash, capitate inflorescences and a thick, woody pod, slightly resembling that of *C. aubrevillei*, but thicker, narrower, c. 5 cm wide, not flattened and winged on the edge but rounded, containing more and smaller seeds than *C. aubrevillei*. Leaves with swollen glands at the top of the petiole and between the upper pairs of leaflets. Leaflets in 9–16 pairs, 3–7 cm long, 1–2 cm wide. See also *Newtonia elliottii* HARMS, *N. duparquetiana* (BAILL.) KEAY, and *Cylicodiscus gabunensis* HARMS.

USES. *Calpocalyx aubrevillei* and *Xylia evansii* were formerly used to obtain country salt. The wood was burnt and the ashes leached out. The evaporated leach gave a residue of salt. The wood of *C. brevibracteatus* is reported to be very hard. *Calpocalyx aubrevillei* is softer and lighter, not resistant to insect or fungus attack. Sawn timber warps badly.

*Newtonia aubrevillei* (PELLEGR.) KEAY

[40/49, 242]

'*Newtonia*': named after the famous English scientist Newton (1643–1727).

'*aubrevillei*': see page 179.

Keay in Kew Bull. 1953, p. 488; *Piptadenia aubrevillei* PELLEGRIN in Bull. Soc. Bot. France, 80, p. 466 (1933), basionym; type: Aubréville 861 (P!, lectotype; K!).

1936: Aubréville, F.F.C.I., 1st ed., I, p. 184    1958: F.W.T.A., 2nd ed., I, p. 489

(*Piptadenia aubrevillei*)

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 226

LOCAL NAMES: gohna gluu (Gio, meaning 'man tree')

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Ivory Coast

BOTANY. A medium-sized tree. Leaves bipinnately compound with (2–) 3–4 pairs of opposite pinnae, each pinna with 3–5 pairs of opposite, sessile leaflets. Stipules minute, 0.5 mm long, caducous. Petiole rusty tomentose, jointed at base, without glands (!). Rachis (1–) 2–6 cm long, rusty tomentose, ribbed, above with or without small, smooth swollen glands between the pinnae. Rachises of the pinnae 2–8 cm long, rusty tomentose, without glands between the leaflets. Leaflets glossy above, mat beneath, progressively larger from the base to the top of the pinna, rhombic–obliquely elliptic or obliquely ovate, the terminal pair of each pinna often falcate, 1.5–5.5 (–7) cm long, (0.5–) 1–3 (–4) cm wide. Base unequal-sided, the proximal side subauriculate, the distal side cuneate. Margin entire, ciliate. Apex obtuse – rounded. Midrib more or less diagonal, tomentose at the base, flat above, slightly raised and tomentose but glabrescent beneath. Nerves slightly raised beneath, looping. Reticulation faint. Leaves of saplings larger, with up to 7 leaflets per pinna.

Inflorescences axial or terminal, spicigerous; spikes up to 10 cm long. Peduncles finely hirsute. Bracteoles 0.5 mm long, persistent. Flowers sessile, articulate at base. Calyx cupuliform, c. 1 mm long at anthesis, nearly glabrous, with a truncate or shortly dentate, more or less ciliate edge. Petals 5, c. 3 mm long, 0.8 mm wide at anthesis, ciliate, sparsely pubescent at the top only, at the base adnate to the disc. Stamens 10, implanted on the rim of the disc. Filaments glabrous, c. 4 mm long at anthesis. Anthers

0.5 mm long, dorsifixed, with an apical, stipitate gland, present in bud, caducous at anthesis. Disc swollen, 0.5 mm high. Pistil stipitate. Stipe 0.5 mm high, glabrous; ovary c. 1 mm long, densely villous, containing 8–10 ovules; style with a few scattered hairs, c. 3 mm long; stigma minute.

Fruit a 13–22 cm long, c. 3 cm wide, flat and straight, thin-woody pod, with a rounded apex, thickened margin, cuneate base, and faintly reticulate sides, opening along one edge only. Seeds very thin and flat, bright red-brown, including the wing 7–10 cm long, 1.5–2 cm wide, attached at the end with a c. 2.5 cm long, thin funicle.

Seedling: germination epigeal, but the cotyledons remain in the testa and the hypocotyl does not develop. Epicotyl 5–7 cm long, increasingly pubescent towards the top. First two leaves opposite, pinnate, 3.5–5.5 cm long, with 4–6 pairs of small, rhombic leaflets. Following leaves alternate, bipinnate, first with only one pair of pinnae (not to be confused with seedlings of *Albizia zygia*, which have a gland on the petiole).

**TAXONOMICAL NOTES.** The genus *Newtonia* BAILL. is closely related to *Piptadeniastrum* BRENNAN, but may be distinguished by its glandular leaves, a pubescent ovary, and seeds attached at the top (see also taxonomical notes: *Piptadeniastrum*).

In Liberia *Newtonia* is represented by one, possibly by two more species: *N. duparquetiana* (BAILL.) KEAY and *N. elliottii* (HARMS) KEAY. The latter species is only known from Sierra Leone, but since it is found on the Mano river, it very probably also occurs in the western province of Liberia, at least in the Mano river drainage. It is distinct from *N. aubrevillei* in having only one pair of pinnae. In this connection it is necessary to mention *Cylicodiscus gabunensis* HARMS, which I never found in Liberia, but was reported by Karl Mayer (9) from Bai, on the Mano river. The leaves of *Cylicodiscus* also have only one pair of pinnae, but the leaflets are alternate; the fruits and seeds resemble those of *Newtonia*. Mayer collected leaves and fruits which I did not see. It is possible that *Newtonia elliottii* was erroneously identified as *Cylicodiscus gabunensis*.

*Newtonia duparquetiana* is distinct from all other *Newtonias* in having only two leaflets on each pinna. Two distinct forms are recognised: a. leaves with one pair of pinnae and a short, up to 1 cm long, stout petiole and petiolules, and b. leaves with two pairs of pinnae and longer, slender petiole and petiolules. The two forms were never found to occur on the same tree, and seedlings of both forms show the same characteristic differences. The form with only one pair of leaflets has often reduced bipinnate leaves with only three or two leaflets. The fruits and seeds of the two forms are not distinct. A closer study is necessary to establish the proper relationship between the two forms.

The present description and figures are based on the following specimens: *N. aubrevillei*: Bomi Hills s.n.; Bong Range 1049, de Wilde 3877; Nyein 468; Bassa III, Siga 691; Ganta, Harley s.n.; Putu area 788. *N. duparquetiana*: Bomi Hills 451, 845, 1037, 1281, de Wilde 3837; Putu area 804.

**FIELD NOTES.** *Newtonia aubrevillei* may attain 33 m ( $\approx 110'$ ) in height and a diameter of

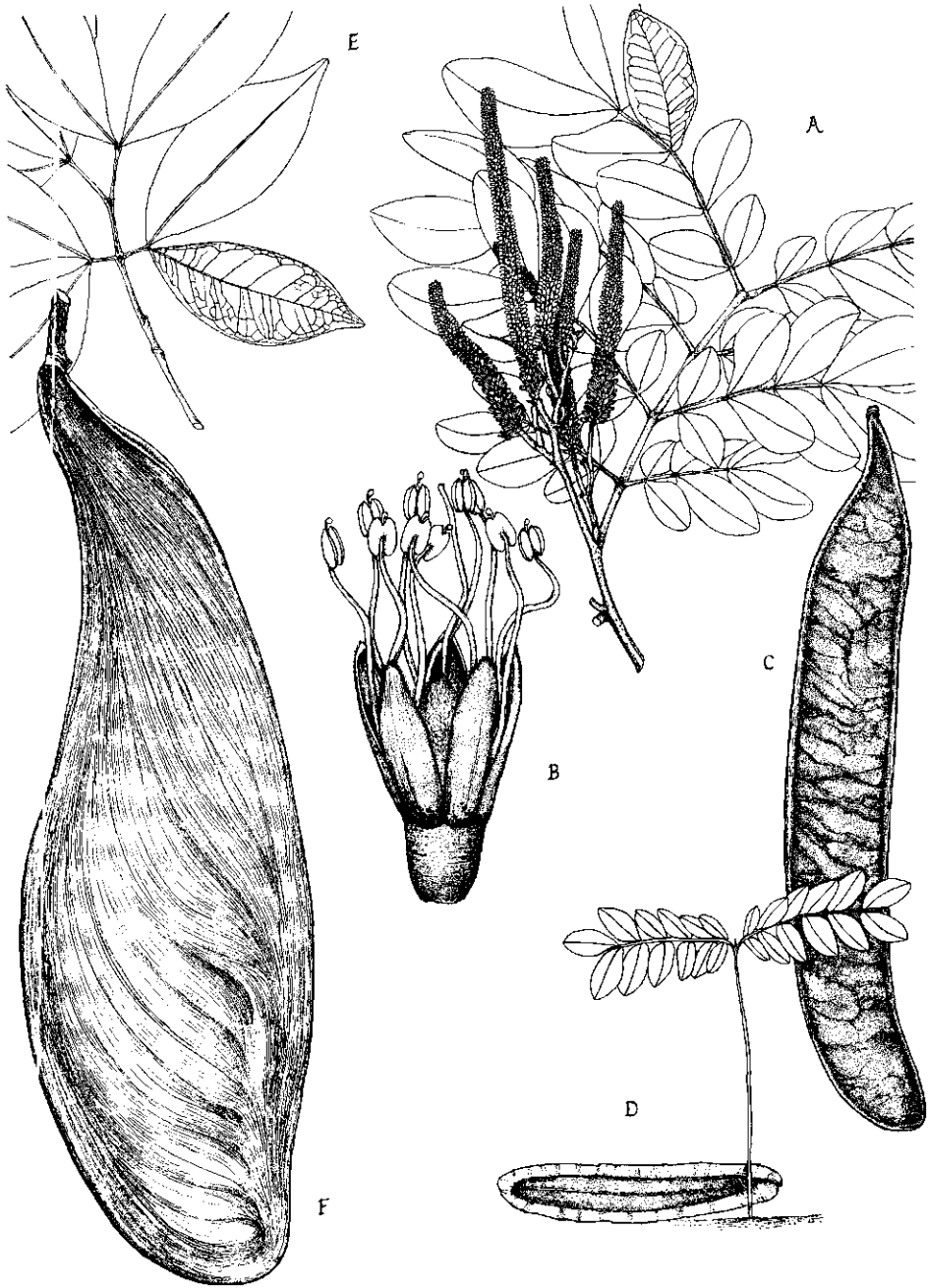


Fig. 40. *Newtonia aubrevillei* (PELEGR.) Keay A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 10$ ); C: fruit ( $\times \frac{1}{2}$ ); D: seedling with seed ( $\times \frac{1}{2}$ ); E: leaf of *Newtonia duparquetiana* (BAILL.) KEAY ( $\times \frac{1}{2}$ ); F: fruit of *Calpocalyx aubrevillei* PELEGR. ( $\times \frac{1}{2}$ ).

90 cm ( $\approx 3'$ ), rarely more. The base has narrow, steep buttresses, sometimes extending in spreading surface roots, or high, steep butt flares up to 6 m ( $\approx 20'$ ). The bole is irregular, rather short. The crown is fairly small, open. The bark on the edges of the buttresses is yellowish brown, elsewhere smooth and grey, horizontally striate. The slash is thin, pale or medium brown, fibrous, sticky, with a strong scent of old cheese; it slowly exudes a honey-coloured, clear, sticky gum.

The tree is found throughout Liberia in high forests and older secondary forests. When standing near trails the bark on the base is often cancerous as passers-by are in the habit of tearing off strips of the bark; chewing the inner bark is thought to ensure successful intercourse. The tree flowers from August–September. Fruits are ripe in December–January. Seedlings were found in abundance during April.

*Newtonia duparquetiana* closely resembles *N. aubrevillei* in habit, but the smell of the slash is less distinct. This tree sometimes has one or a few stilted roots. The seeds of *N. duparquetiana* are perhaps more dark red-brown, unlike the bright red-brown seeds of *N. aubrevillei*, but this character has not been fully checked.

*N. aubrevillei*, as regards the trunk, resembles *Piptadeniastrum*, but the smelling slash, the exuded gum, and the larger leaflets are diagnostic. The leaf of *N. aubrevillei* should not be confused with that of *Albizia zygia*, which is distinct in having a gland on the petiole, and with that of *Tetrapleura chevalieri* (HARMS) BAK. f., which has alternate leaflets.

USES. Apart from the above mentioned use as an aphrodisiac, no information is available on the utilisation of the tree. It is relatively scarce and the bad stem habit makes commercial utilisation less feasible.

***Parkia bicolor* A. CHEV.**

[41/48]

'*Parkia*': named after Mungo Park (1771–1806), a Scottish surgeon who when exploring the Niger basin (1804–1806) was drowned in this river during an attack of the local inhabitants.

'*bicolor*': L. bis: twice; L. color: colour; 'having two colours', referring to the inflorescences.

A. Chevalier in Bull. Soc. Bot. France, 55, Mém. 8, p. 34 (1908); type: Chevalier 13389 (P), 13547 (P, BR, K, isosyntypes); Baker f. in Leg. Trop. Afr., p. 782 (1930); Hagos, Acta Bot. Néerlandica, 11, p. 246 (1962, lit.!).

*Parkia agboensis* A. CHEVALIER l.c. p. 35 (1908); type: Chevalier 16925, 16981 (P);

*Parkia zenkeri* HARMS in Notizbl. Bot. Gart. Berlin, App. XXI, p. 34 (1911); type: Zenker 3498 (BM, BR, GOET, L, M, W, isosyntypes). (Synonyms on authority of Hagos, l.c.).

1928: F.W.T.A., 1st ed., I, p. 353

1937: Dalziel, U.P.W.T.A., p. 217

1931: Cooper & Record, Evergr. For. Liberia, p. 71

1948: Pellegrin, Leg. Gabon, p. 7

1936: Aubréville, F.F.C.I., 1st ed., I, p. 196

1950: Normand, A.B.C.I., I, p. 105; Pl. XXVIII

1952: Fl. Congo Belge, III, p. 144

1936: Kennedy, F.F.S.N., p. 107

1958: F.W.T.A., 2nd ed., I, p. 487

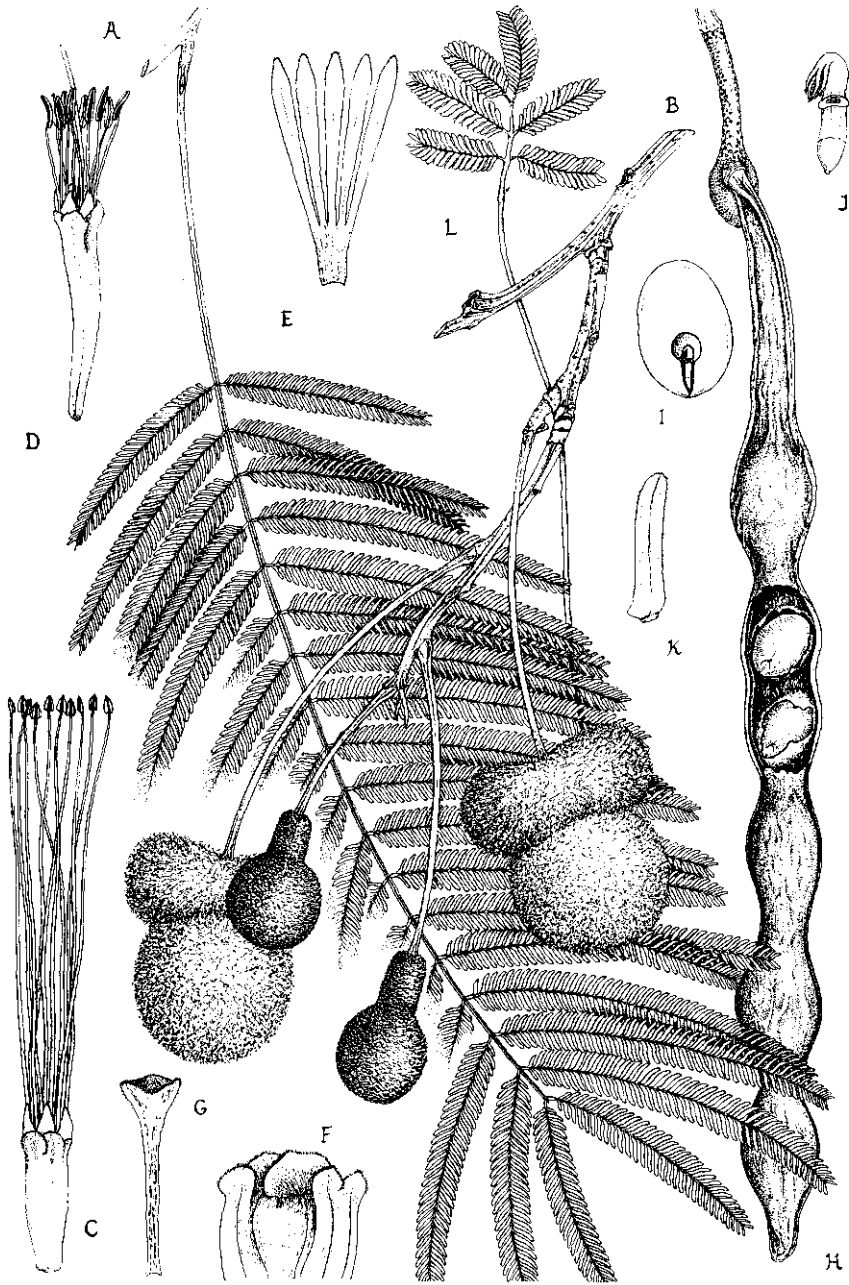


Fig. 41. *Parkia bicolor* A. CHEV. A: branch with leaf ( $\times \frac{1}{2}$ ); B: branch with inflorescences ( $\times \frac{1}{2}$ ); C: sterile flower ( $\times 3$ ); D: fertile flower ( $\times 3$ ); E: opened corolla ( $\times 3$ ); F: upper part of calyx ( $\times 6$ ); G: bract ( $\times 3$ ); H: pod ( $\times \frac{1}{2}$ ); I: opened seed ( $\times 1$ ); J: embryo ( $\times 3$ ); K: leaflet ( $\times 3$ ); L: seedling ( $\times \frac{1}{2}$ ).



1959: Aubréville, F.F.C.I., 2nd ed., I, p. 238  
 1959: Kryn & Fobes, Woods of Liberia, p. 84  
 1960: Taylor, Syn. Silv. Ghana, p. 229

1961: Irvine, Woody Plants of Ghana, p. 347  
 1963: de Saint Aubin, La Forêt du Gabon, p. 106

LOCAL NAMES: gworluu (Gio)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: West Africa S. of the Sahara and Central Africa

**BOTANY.** A large tree. Branchlets densely rusty puberulous. Leaves bipinnately compound, alternate, stipulate, up to 40 cm long, with (11–) 16–20 (–26) pairs of opposite or alternate pinnae, each pinna with 28–50 pairs of opposite leaflets. Stipules acicular, c. 5 mm long. Petiole 5–10 cm long, jointed at base, flattened above, with a flat gland just above the joint, densely rusty puberulous, as is the angulate, ribbed rachis. Glands sometimes present between the upper pairs of pinnae. Rachises of the pinnae increasing in length from the base towards the middle of the whole leaf from 4 to 13 cm; from there towards the top decreasing to 6 cm; rachises jointed at base, brown puberulous, ribbed. Leaflets of one pinna largest near the middle, decreasing towards the base and the top, linear, 5–10 mm long, 1–2 mm wide, slightly sinuous, unequal-sided at base, the proximal part finely auriculate, the distal part obtuse. Apex obtuse – rounded. Margin entire, ciliate on young leaflets, glabrescent. Midrib and nerves inconspicuous. Leaves of saplings as a rule with less pinnae and less leaflets, but leaflets larger, up to 15 mm long and 3 mm wide.

Flowers in dense, pink-red flowerheads at the end of a 10–23 cm long, pendent peduncle. When still in bud flower-head with a narrower cylindrical basal part and a globose terminal part. At anthesis the basal part broader than the terminal part, formed by neutral flowers with long-exserted stamens; terminal part formed by fertile flowers with shorter stamens. Bracts about as long as the calyx tube, linear, gradually broadening towards the ladle-shaped, puberulous top. Neutral flower: calyx tube c. 6 mm long, crowned by 5 puberulous lobes. Corolla lobes 5, exserting from the calyx for c. 1 mm, sparsely pubescent at the top. Corolla tube at the base adnate to the stamens. Stamens 10, c. 3 cm long at anthesis, united at base. Anthers minute, 0.5 mm long. Fertile flower: calyx and corolla as in the neutral flower, but up to 1 cm long. Stamens up to 1.5 cm long. Anthers c. 1.5 mm long. Pistil stipitate; stipe c. 1 mm long; ovary 1.5–3 mm long. Style developing after the stamens, eventually exserting; stigma minute, inconspicuous.

Fruit a strap-shaped, indehiscent pod, 20–40 cm long, 1.5–2 cm wide, laterally compressed and slightly depressed between the seeds, first orange-yellow, later purplish black when ripe. Seeds imbedded in a yellowish, mealy pulp; the smooth, green cotyledons detached from the thin, membranous testa.

Seedling: germination epigeal. Hypocotyl 6–7 cm long, minutely puberulous. Cotyle-

dons thick and fleshy, with a rounded apex and sagittate base. Epicotyl 5–7 cm long. Leaves alternate. First leaf with 2–3 pairs of pinnae, each pinna with 15–18 leaflets; glands present between 1–3 pinnae, but not on the petiole. Second leaf with 2–3 pairs of pinnae, a gland on the petiole and between the terminal pair of pinnae. Ants visit the glands.

**TAXONOMICAL NOTES.** Hagos (1962, l.c.) distinguishes two varieties within this species, *P. bicolor* var. *bicolor* and var. *agboensis* (A. CHEV.) HAGOS & DE WIT. The two taxa are identical but for the inflorescences: the neutral flowers bluish red and the fertile flowers pink-red in var. *bicolor* (this gave the species its name), and all flowers concolorous pink-red or nearly so, in var. *agboensis*. Hagos suggested that var. *agboensis* occurs in the evergreen forest, var. *bicolor* in the deciduous forest and savanna, but only field observations can establish this point as the colour differences are lost in dried samples. As for Liberia, it is most likely that var. *agboensis* is the most common representative.

The present description is based on the following specimens: Putu area 1019; Chien area 628; Gbi Nat. For. 574; Bomi Hills 854; Loma Nat. For. 676, 742.

**FIELD NOTES.** *Parkia bicolor* may reach a height of 40 m ( $\approx 130'$ ) and a diameter of 1.20 m ( $\approx 4'$ ), rarely more; young trees have already marked buttresses, which on old trees may grow as high as 6 m ( $\approx 20'$ ); usually buttresses are 2–3 m ( $\approx 6.5$ – $10'$ ) high, thin and fairly spreading. The bole is often slanted and twisted or curved, irregular on cross-section and forked at low level. Well-shaped trees are relatively rare. The crown is spreading, with heavy, ascending branches, fairly light and finely textured. The bark may be smooth or shallowly cracked with numerous small, brown lenticels, but as a rule it is red-brown, irregularly and thinly scaly, brighter brown under the shed scales, shallowly pitted and with numerous pustulate, brown lenticels. The slash is fairly thin, rough-fibrous, (pale) reddish brown outside, clearer, sometimes yellowish near the cambium, exuding a small amount of clear, sticky sap.

The tree is deciduous after the rainy season. New bronze-red flushes appear in December. Flowering is from December–February. Fruits are found from February–April. Regeneration is fairly common in secondary forest and low bush. *Parkia bicolor* is often found near creeks, rivers, and in swamps, but not necessarily so. It is a common, but not gregarious tree.

Few trees can be confused with *Parkia*, its finely divided leaves being diagnostic. *Piptadeniastrum* and *Samanea* have much narrower leaflets. *Aubrevillea kerstingii* (see fig. 38 G) has larger leaflets, which have a characteristic, ascending reticulation. A possible source of error is the apparently strictly riparian species *Cathormion altissimum* (HOOK. f.) HUTCH. & DANDY, which, however, has only 5–7 (–8) pairs of opposite pinnae, large glands between the 2 terminal pinnae, each pinna with 12–25 leaflets, which are 1–1.5 cm long, c. 4 mm wide. Its short-stalked flower heads are white and its fruit is distinctly segmented.

USES. The fresh seeds of *Parkia* are used for fishing bait. The heartwood is light, Sp. G. 0.4–0.5, light brown with darker irregular streaks. The sapwood is nearly white. The texture is coarse, the grain interlocked or straight. The timber is easy to cut but saws rather woolly. It is not durable. In Liberia its superficial similarity to *Heritiera utilis* gave the timber the misleading name of Bastard Whismore (one of the many kinds of Bastard Whismore).

***Pentaclethra macrophylla* BENTH.**

[42/48]

'*Pentaclethra*': Gr. penta: five; Gr. kleithron: bolt; referring to the five stamens(?).

'*macrophylla*': Gr. makros: long, often erroneously used for large; Gr. phullon: leaf; referring to the long leaves of this species.

Bentham in Hooker Journ. Bot. 1842, p. 330; type: Heudelot 825, Guinea (P!); *ibid.*, Trans. Linn. Soc., 30, p. 360 (1875).

1871: F.T.A., II, p. 322

1928: F.W.T.A., 1st ed., I, p. 352

1931: Cooper & Record, Evergr. For. Liberia, p. 72

1936: Aubréville, F.F.C.I., 1st ed., I, p. 192

1936: Kennedy, F.F.S.N., p. 106

1937: Dalziel, U.P.W.T.A., p. 220

1941: Harley, Native Afr. Med., p. 83, 87, 102

1948: Pellegrin, Leg. Gabon, p. 5

1950: Normand, A.B.C.I., I, p. 105; Pl. XXX

1952: Fl. Congo Belge, III, p. 140

1958: F.W.T.A., 2nd ed., I, p. 487

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 234

1959: Kryn & Fobes, Woods of Liberia, p. 85

1960: Taylor, Syn. Silv. Ghana, p. 231

1961: Irvine, Woody Plants of Ghana, p. 349

1961: Walker, Pl. Utiles Gabon, p. 244

LOCAL NAMES: gbiah (Gio); kue (Mano); locust bean (general use)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Senegal – Angola

BOTANY. A large tree. Young shoots with a dense brown indumentum of stellate hairs. Leaves bipinnately compound, alternate, stipulate, up to 40 cm long, glossy, medium green, with 9–13 pairs of opposite pinnae, each pinna with (6–) 8–14 (–18) pairs of opposite, sessile leaflets. Stipules acicular, 3–5 mm long, caducous, swollen and with a gland at the base. The glands secrete drops of a clear liquid which is licked by small black ants. Petiole 3–6 (–8) cm long, markedly swollen and jointed at base, shallowly grooved, finely lenticellate with stellate hairs, especially above. Rachis 12–25 (–30) cm long, markedly ridged and stellate pubescent above. Rachises of the pinnae (2–) 5–10 (–15) cm long, markedly jointed at base, with two acicular, reduced, caducous leaflets just above the joint, markedly ridged, with stellate hairs above. Lower 2 (–3) pinnae shorter than the upper ones. Leaflets of one pinna more or less equal-sized, but the terminal and lower 1 (2) pairs somewhat smaller, rhombic, (0.8–) 1.2–2.5 cm long, (3–)

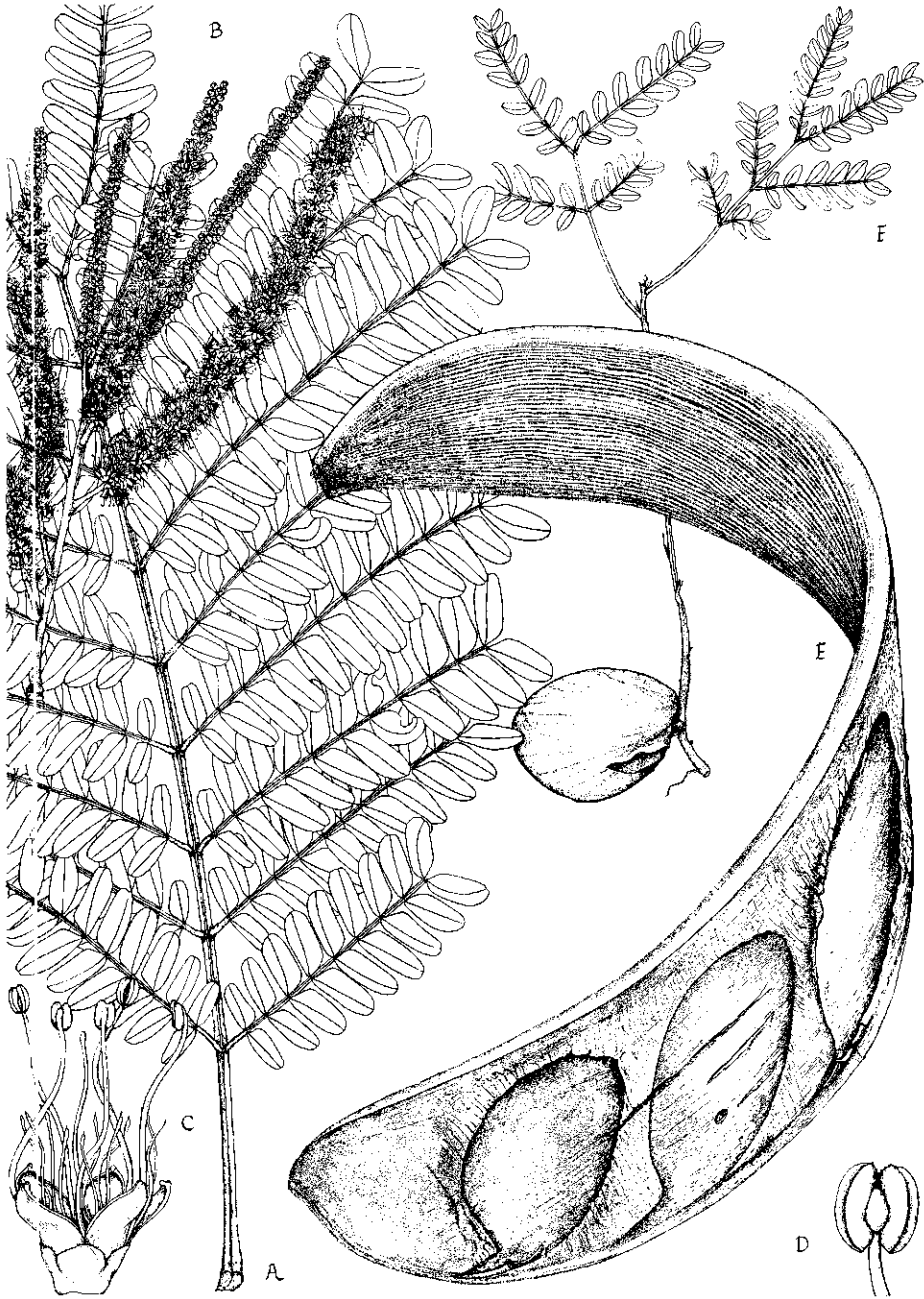


Fig. 42. *Pentaclethra macrophylla* BENTH. A: leaf ( $\times \frac{1}{2}$ ); B: inflorescence ( $\times \frac{1}{2}$ ); C: open flower ( $\times 5$ ); D: anther ( $\times 15$ ); E: one valve of a pod ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ).

5–8 (–13) mm wide, glabrous, except for some scattered hairs on the margin and the midrib beneath. Base unequal-sided, the proximal side shortly auriculate, the distal side cuneate, parallel to the rachis. Apex rounded – obtuse, slightly emarginate or not. Midrib diagonal, slightly raised above and beneath. Reticulation of nerves and veins fine. Saplings and water shoots with larger leaves and leaflets up to 4 cm long.

Inflorescences terminal or axial, spicigerous panicles, up to 30 cm long, the lateral spikes up to 15 cm long. Peduncles densely stellate tomentose. Flowers sessile. Calyx tube 0.7 mm long, crowned by 5 very broadly elliptic, 0.5 mm long calyx lobes, ciliate on the margin. Petals 5, c. 3 mm long, glabrous, at base slightly swollen and connate for c. 1 mm. Fertile stamens 5, c. 5 mm long, wrinkled, implanted on the rim of the corolla tube. Anthers 0.6 mm long, with a large orange gland between the thecae. Staminodes 10–15, filiform, between the stamens. Ovary (sub)sessile, glabrous or sparsely pubescent when young, densely pubescent when developing. Style developing after the flower opens. Stigma terminal, hardly distinct.

Fruit a pod up to 50 cm long, 7–10 cm wide, c. 2 cm thick, woody, dark brown, rounded at the top, gradually tapering to the base, with longitudinally ribbed sides, opening on the tree, recurving strongly, containing 5–8 seeds. Seeds 3.5–6 cm long, 2.5–3.5 cm wide, up to 1 cm thick, with a smooth, purplish brown testa.

Seedling: germination epigeal, with the cotyledons remaining in the testa and the hypocotyl not developing. Epicotyl 8–10 cm long, with several subulate scales at regular distances. Leaves alternate; the first leaf bipinnate with 2 pairs of pinnae, the lower pinna with 4 pairs of leaflets, the upper pinna with c. 7 pairs. Following leaves with 3 pairs of pinnae etc. All parts except the leaflets densely covered with stellate hairs.

TAXONOMICAL NOTES. *Pentaclethra* BENTH. counts only three species, two in Africa and one, *P. macroloba* (WILLD.) O. KUNTZE, in South America. The second African species, *P. eetveldeana* DE WILD. & TH. DUR. occurs in Gabon and Congo. It is mainly distinct in having simple, not stellate hairs, and much smaller, not rhombic leaflets.

The present description and figures are based on the following specimens: Bomi Hills 1050; Farmington River, Firestone, Wright 3; Sanokole 931A; Kanweake 976; Gio Nat. For. 240; Diala 233; Chien area 636; Nimba area 886.

FIELD NOTES. *Pentaclethra macrophylla* may be a fairly large tree, up to 36 m ( $\approx 120'$ ) high, and over 1 m ( $\approx 3.5'$ ) in diameter. The base of the tree has irregular, thick buttresses, low or reaching up to 3 m ( $\approx 10'$ ), not far spreading. The bole is often gnarled, twisted and forked at low level, rarely straight and clean. Water shoots often sprout from the base. The crown is heavily branched, dense. The bark of young trees may be quite smooth and grey, but older trees are brown and irregularly scaly, the scales leaving shallow, yellowish pits, somewhat like *Azalia*. The buttresses are often covered with yellow, warty lenticels. The slash is medium thick, fibrous, bright brown outside, pale brown inside.

*Pentaclethra* is found all over Liberia in high forest and secondary forest. It also is quite common on the coastal savannas. It prefers the vicinity of water and is often found beside creeks and rivers. The tree is evergreen. Flowering is from February–April. The pale yellow flowers are very fragrant. The fruits are ripe from September–December. The pods open with a crack, ejaculating the seeds far from the tree.

*Pentaclethra* should not be confused with *Albizia adianthifolia*, which also has marked ly rhombic leaflets with a diagonal midrib. However, this *Albizia* species has glands on the rachis and petiole, and lacks the stellate hairs of *Pentaclethra*.

USES. The seeds of *Pentaclethra* are roasted and eaten; they are very rich in proteins. To facilitate seed collection, the low bush under trees in the vicinity of villages is often cleared away. Harley reports: because the tree always has a ‘hump’ or twist in the trunk, the bark is used for treating hunchback, which is thought to be the result of magic. It is also used for treating leprosy.

The sapwood is grey or nearly white. The heartwood is reddish brown, hard and heavy. The texture is coarse, the grain interlocked. It seems to be resistant to insect and fungus attack; it is not easy to work. It is only locally used and in view of the bad shape of the trunk commercial prospects seem doubtful.

*Piptadeniastrum africanum* (HOOK. f.) BRENNAN

[15, 43/48, 170]

‘*Piptadeniastrum*’: Gr. *piptein*: to fall; Gr. *aden*: gland; referring to the anther glands, which fall off at anthesis. The suffix ‘*astrum*’ suggests similarity to *Piptadenia* BENTH., a S. American genus. ‘*africanum*’: referring to Africa.

Brennan in Kew Bull. 1955, p. 179; *Piptadenia africana* HOOK. f. in Niger Fl., p. 330 (1849), basionym; type: Vogel, Ansell s.n. (K!); Baker f., Leg. Trop. Afr., p. 790–795.

- |   |  |
|---|--|
| 1871: F.T.A., II, p. 328 ( <i>Piptadenia</i> )                                    | 1950: Normand, A.B.C.I., I, p. 104; Pl. XXIX ( <i>Piptadenia</i> )     |
| 1928: F.W.T.A., 1st ed., I, p. 354 ( <i>Piptadenia</i> )                          |  |
| 1931: Cooper & Record, Evergr. For. Liberia, p. 72 ( <i>Piptadenia</i> )          | 1951: Eggeling & Dale, Ind. Trees Uganda, p. 228 ( <i>Piptadenia</i> ) |
| 1933: Chalk & Burt Davy, Twenty W. Afr. Timber Trees, p. 70 ( <i>Piptadenia</i> ) | 1952: Fl. Congo Belge, III, p. 226 ( <i>Piptadenia</i> )               |
| 1936: Aubréville, F.F.C.I., 1st ed., I, p. 182 ( <i>Piptadenia</i> )              | 1958: F.W.T.A., 2nd ed., I, p. 489                                     |
| 1936: Kennedy, F.F.S.N., p. 109 ( <i>Piptadenia</i> )                             | 1959: Aubréville, F.F.C.I., 2nd ed., I, p. 224                         |
| 1937: Dalziel, U.P.W.T.A., p. 221 ( <i>Piptadenia</i> )                           | 1959: Kryn & Fobes, Woods of Liberia, p. 88                            |
| 1946: Kinloch, Silv. Notes Gold Coast Trees, p. 22 ( <i>Piptadenia</i> )          | 1960: Taylor, Syn. Silv. Ghana, p. 233 ( <i>Piptadenia</i> )           |
| 1948: Pellegrin, Leg. Gabon, p. 22 ( <i>Piptadenia</i> )                          | 1961: Walker, Pl. utiles Gabon, p. 245 ( <i>Piptadenia</i> )           |
|   | 1961: Irvine, Woody Plants of Ghana, p. 352                            |
|   | 1963: de Saint Aubin, La Forêt du Gabon, p. 104                        |

LOCAL NAMES: bee-eh (Gio); kee or koe (Krahn); gaw (Bassa, cf. Cooper)

TRADE NAME: Dabema

GEOGRAPHICAL DISTRIBUTION: Senegal – Sudan and Angola

**BOTANY.** A large tree. Leaf bearing twigs puberulous, lenticellate. Leaves bipinnately compound, alternate, stipulate, bright green, 10–17 cm long, with 8–30 alternate or subopposite pinnae, each pinna with 24–50 pairs of opposite, sessile leaflets. Stipules minute, only seen on seedlings. Petiole 0.7–1.5 (–3) cm long, jointed at base. Petiole and rachises eglandular, puberulous. Principal rachis grooved above, 6–15 cm long. Rachises of pinnae progressively longer from the base to about the middle of the whole leaf, from there decreasing towards the apex, (1.5–) 2–6 cm long. Leaflets linear, 3–8 mm long, 0.8–1.2 mm wide, progressively smaller from the base to the top of the pinna. Base auriculate at the proximal side; margin entire, ciliolate; apex rounded. Midrib excentric towards the distal edge. Reticulation of nerves inconspicuous. The leaflets fold up at sunset. Leaves of saplings and water shoots up to 30 cm long, with slightly larger leaflets.

Flowers in terminal or axial, brown-tomentose panicles of spikes, up to 30 cm long; spikes up to 10 cm long. Pedicels 0.5 mm long, articulate at the top. Flower buds bluntly pointed. Calyx tube 0.8 mm long, shortly and bluntly 5-dentate, ciliate. Corolla tube slightly swollen, 0.6 mm long. Corolla lobes c. 1.5 mm long. Stamens 10, at the base united and adnate to the corolla tube. Free filaments glabrous, 3–4 mm long, subulate. Anthers dorsifixed, 0.2 mm long, mounted by a subsessile gland about as large as the anther, present in bud, caducous at anthesis. Ovary subsessile, glabrous. Style short, 0.5 mm long; stigma terminal, slightly swollen.

Fruit a smooth, brown, flat, thin-woody pod, 20–30 cm long, 2–3 cm wide, straight or slightly curved, rounded at the top, with a slightly swollen margin, cuneate and very shortly stipitate at base, reticulate on the sides, opening along one side, containing up to 12 seeds. Seeds flat and winged, including the wing 4.5–7.5 cm long, c. 2.5 cm wide, rounded – truncate at both ends, bright brown, attached at the middle with a long, thin funicle. The seed itself thin and flat, ovate – elliptic, 1.5–2.5 cm long, 1–1.4 cm wide.

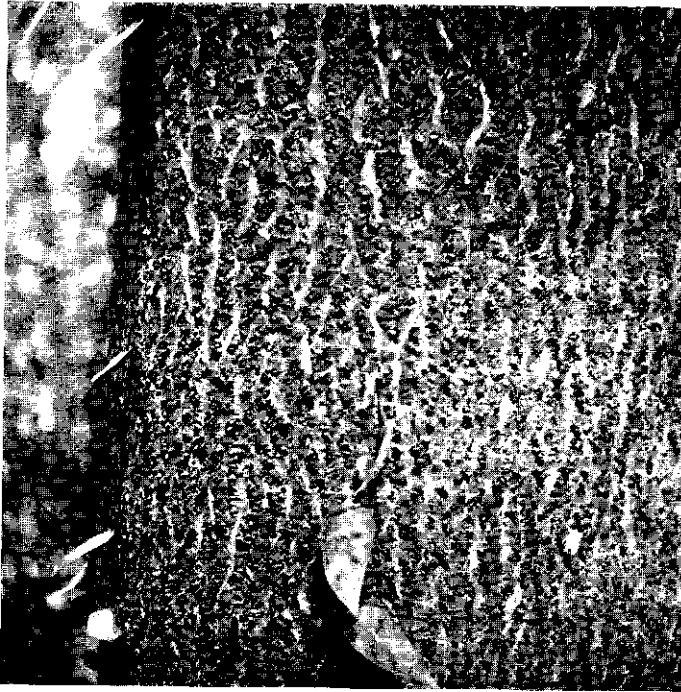
Seedling: germination epigeal. Hypocotyl c. 3 cm long, glabrous. Cotyledons thin and coriaceous, transverse-elliptic, sagittate at base. Epicotyl 2.5 cm long, puberulous. Leaves alternate, the first 5 (6) semi-whorled, pinnate, similar to a pinna of a full grown leaf. Stipules acicular, minute. The sixth or seventh leaf bipinnate with only 2 pinnae. Next leaf with 4 pinnae etc. Young sapling shrubby, drooping, the central stem with a zig-zag habit.

**TAXONOMICAL NOTES.** *Aubrevillea* PELLEGR. and *Piptadeniastrum* BRENAN were originally included in the genus *Piptadenia* BENTH., and also *Newtonia* BAILL. was placed there by Baker (1930, l.c.). *Aubrevillea* was detached by Pellegrin (Bull. Soc. Bot. France, 80, p. 466, 1933), and Keay re-established *Newtonia* (Kew Bull. 1953, p. 488).



7. *Eitandrophragma candollei* HARMS. Note the heavy root swellings (see page 256).





18. *Entandrophragma cylindricum* (SPRAGUE) SPRAGUE. Below: zig-zag bark pattern of a young tree (see page 258).

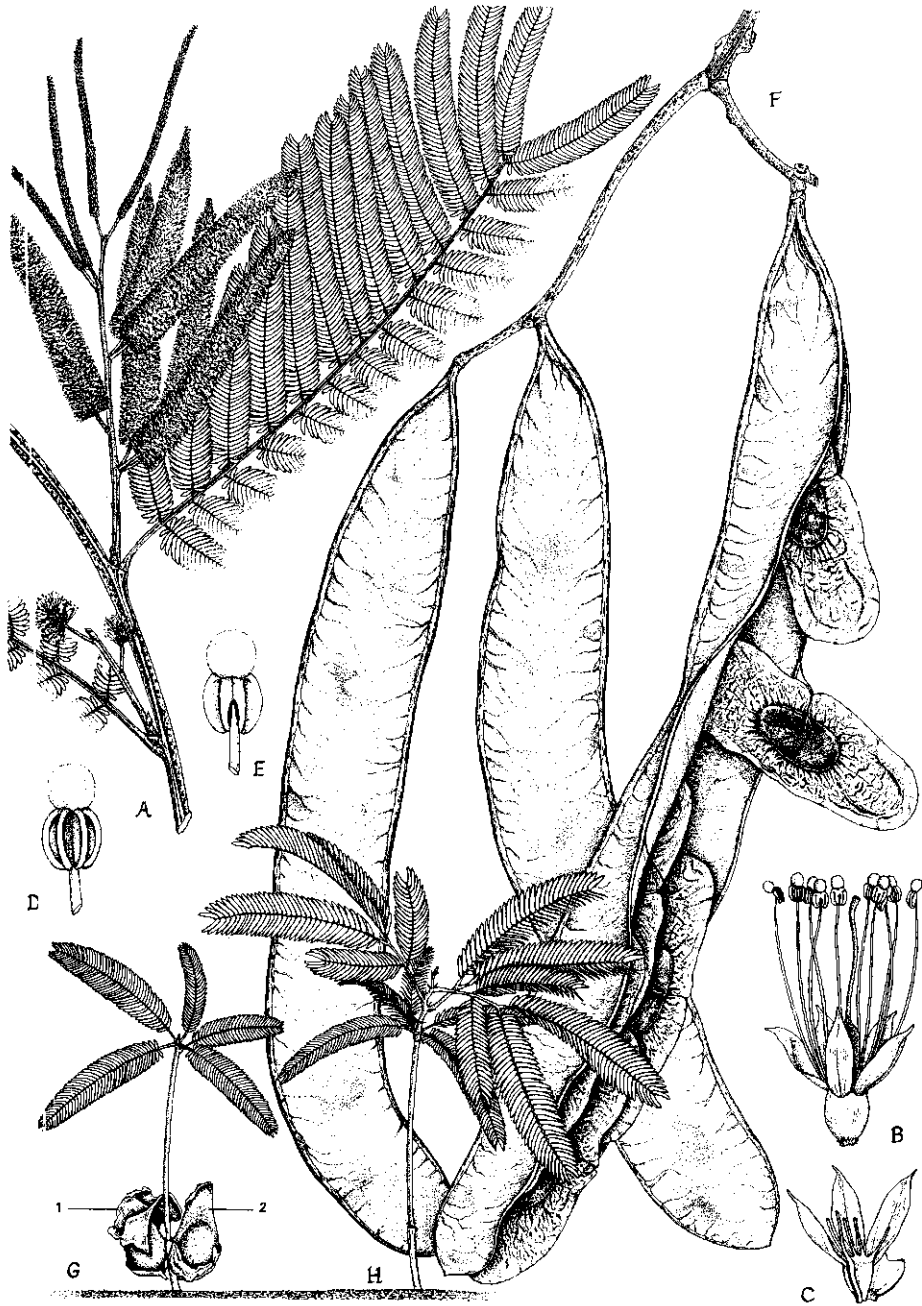


Fig. 43. *Piptadeniastrum africanum* (HOOK. f.) BRENNAN A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: flower ( $\times 8$ ); C: opened flower ( $\times 8$ ); D & E: anthers, with apical glands ( $\times 24$ ); F: pods with seeds ( $\times \frac{1}{2}$ ); G: seedling with (1) testa and (2) cotyledons ( $\times \frac{1}{2}$ ); H: older seedling ( $\times \frac{1}{2}$ ).

In 1955 Brenan, l.c., published a study of *Piptadenia* and related genera. He concluded that *Piptadenia* was restricted to South America, and that the African species represented a monotypic African genus which he called *Piptadeniastrum*, or 'false *Piptadenia*'. This genus differs from *Piptadenia* in the absence of glands on the leaf and the dehiscence of the fruit, along one suture in this genus, along both sutures in *Piptadenia*. *Newtonia* and *Piptadeniastrum* are closely related, but differ by the presence of glands on the leaves, the pubescence of the ovary, and the apical attachment of the seeds in *Newtonia*.

The present description is based on the following specimens: Gbi Nat. For. 576, 537; Kanweake 1027; Zuole area 1165; Bassa III, Siga 658; Chien area 699; Ganta 216, Harley 1222; Mtn. Coffee 474; Nimba 1203, 889.

FIELD NOTES. *Piptadeniastrum africanum* is a large, often emergent tree, reaching up to 50 m ( $\approx 160'$ ) high and attaining a diameter up to 1.80 m ( $\approx 6'$ ). The base of the tree has well-developed, thin, sharp, often branched buttresses, reaching up to 4.5 m ( $\approx 15'$ ) and on large trees extending along the bole up to 8 m ( $\approx 26'$ ) and along the ground in widespread plank roots. The bole may be straight and cylindrical, up to 20 m ( $\approx 66'$ ) above the buttresses, but often trees are slightly sinuous and forked at a lower level. The crown is formed by steeply ascending, heavy branches; it is rounded on young trees, flat and spreading in trees of the upper canopy; seen from below it has a lace-like texture owing to the fine leaflets and slender branchlets. The bark on the buttresses is grey, perpendicularly striate to the yellowish brown cracked edge, often densely lenticellate. The bark on the bole is smooth and grey, horizontally striate, medium thick. The slash is pale yellow-brown, granular outside, fibrous inside.

*Piptadeniastrum africanum*, a light-demanding species, is found throughout Liberia, both in the high forest and in secondary forest. It is less common in the coastal zone, but may form gregarious stands up country. Stock densities varying between 100 and 250 trees over 60 cm ( $\approx 24''$ )  $\varnothing$ /sq. mile were recorded.

With *Lophira alata*, *Sacoglottis gabonensis*, *Calpocalyx aubrevillei*, *Gilbertiodendron preussii*, and *Parinari excelsa* this is one of the most common large trees of Liberia. The tree is not very exacting to site, but prefers deep, moist soils. It is briefly deciduous in January. Flowering is in the middle of the rainy season, June–August. At that time the crown is covered by a pale yellow layer of inflorescences. The flowers have a strong, unpleasant smell. Fruits ripen from December–March. They open on the tree and the broadly winged seeds, spread by the wind, are attacked by insects soon after coming to the ground. Regeneration is, however, quite common, especially in open places. Fresh seeds germinate in one to two weeks but the viability is rapidly diminishing. Growth is at first quick, followed by a period of slow progress for root establishment.

*Piptadeniastrum* should not be confused with *Samanea dinklagei* (HARMS) KEAY, usually a smaller tree, but occasionally growing large. The buttresses are less developed; the bark is irregularly scaly; the slash is pale yellow, moist, and shows the presence of

ripple marks. The leaves of *Samanea dinklagei* are also different in having opposite, more numerous pinnae, shorter, narrower, 3–4 mm long leaflets, and marked glands on the rachis between the upper pinnae. Its inflorescences are capitate. Another (small) tree with very fine bipinnate leaves is *Dichrostachys glomerata* (FORSK.) CHIOV., a common roadside shrub or tree with sharp spines and bicoloured inflorescences.

USES. The sapwood is fairly wide, nearly white. The heartwood is light brown–golden brown, fairly hard and heavy. It has practically only local applications for heavy construction and flooring. It should not be used for small dimension stock. It is one of the species used by LAMCO for the production of sleepers. It has a reputation for being fairly resistant to termite attack, but sleepers have to be impregnated. The sawdust may be irritating. A decoction of the bark is used for treating toothache. A decoction of the cambium of *Samanea dinklagei* is used as a purgative (applied rectally) against worms, gonorrhoea and ‘stomach trouble’.

#### Sub-family PAPILIONOIDEAE (family PAPILIONACEAE or FABACEAE)

A cosmopolite taxon. Trees, shrubs, climbers, and herbs. Leaves often imparipinnate or trifoliolate, sometimes simple, frequently provided with stipellae on the rachis. Sepals 5, more or less connate. Petals 5, as a rule free, the adaxial (upper) petal being called the ‘standard’, the two lateral are the ‘wings’, the lower two are connate by their lower margin, and called the ‘keel’. Stamens 10, rarely free, often monadelphous. Wood with ripple marks.

This sub-family plays a minor role in the evergreen forest, but is much more important than the other *Leguminosae* in the secondary formations and the savanna regions. In the high forest of West Africa only a few large trees occur of this sub-family. The most important, *Pericopsis elata* (HARMS) v. MEEUWEN (synonym: *Afrormosia elata* HARMS), does not occur in Liberia. It is restricted to the true deciduous forest and has a wide but disjunct distribution.

In Liberia *Haplormosia monophylla* (HARMS) HARMS is the only important large tree of this sub-family. In the secondary forest various species of *Erythrina* L., characterized by trifoliolate leaves and prickly trunk and branches, may grow fairly large. Commonly known is *E. senegalensis* DC., which is used to mark boundaries. A former export product of Liberia, camwood, was produced by *Baphia nitida* LODD., a small tree with simple leaves and white flowers, often grown in villages. A well-known tree of river borders, with characteristic orange flowers and bullate-globose, winged fruits is *Pterocarpus santalinoides* DC., of which the seeds are edible (see fig. 44 G). This species may occasionally grow in the high forest as a medium-sized tree. The economical interest of this sub-family, as far as the timber is concerned, is very limited.

*Haplormosia monophylla* (HARMS) HARMS

[16, 44/32]

'*Haplormosia*': Gr. haplous: simple; '*Ormosia* with simple leaf'. *Ormosia* JACKS. (from hornos, Gr. for chain) seeds are used to make necklaces.

'*monophylla*': Gr. monos: single; Gr. phullos: leaf; 'with one leaf'.

Harms, in Engl. Pfl.welt Afr., 3, 1, p. 532 (1915) and Fedde Rep., 15, p. 23 (1918); M. S. Knaap-van Meeuwen, Bull. Jard. Bot. Bruxelles, 32, p. 215 (1962);

*Crudia? monophylla* HARMS in Bot. Jahrb., 30, p. 80 (1902), basionym; type: Dinklage 1912, Liberia (K!);

*Ormosia monophylla* (HARMS) HARMS in Nat. Pfl.fam., Nachtr. III, p. 158 (1906);

*Haplormosia ledermannii* HARMS in Fedde Rep., l.c.; type: Ledermann 492, Cameroon (?).

1928: F.W.T.A., 1st ed., I, p. 371

1931: Cooper & Record, Evergr. For. Liberia  
p. 75

1936: Aubréville, F.F.C.I., 1st ed., I, p. 274

1936: Kennedy, F.F.S.N., p. 120

1937: Dalziel, U.P.W.T.A., p. 243

1948: Pellegrin, Leg. Gabon, p. 258

1950: Normand, A.B.C.I., I, p. 141; Pl. LII

1958: F.W.T.A., 2nd ed., I, p. 510

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 338

1959: Kryn & Fobes, Woods of Liberia, p. 58

1961: Irvine, Woody Plants of Ghana, p. 384

1961: Walker, Pl. Utiles Gabon, p. 253

1963: de Saint Aubin, La Forêt du Gabon, p. 109

LOCAL NAME: kah (Bassa, cf. Cooper); black gum (general use)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Gabon

**BOTANY.** A small or medium-sized tree, rarely large. Young shoots sparsely pubescent, glabrescent. Terminal branchlets slightly angular and compressed. Leaves simple, alternate, stipulate. Stipules minute, triangular. Petiole 1.5–4 cm long, jointed at the base and at the top, grooved above, with 2 tiny, 1–1.5 mm long, needle-shaped stipels just below the blade. Blade (narrowly) elliptic–obovate, 4.5–14 (–18) cm long, 3.5–6.5 (–9) cm wide. Base broadly cuneate–obtusely. Margin entire, undulate. Apex obtusely acuminate or obtuse and shortly caudate. Midrib impressed above, prominent beneath. Nerves 5–9 pairs, prominent beneath, looping. Leaves coriaceous, very glossy, medium – dark green above, paler beneath; shed leaves drying bright brown; new leaves brilliant red.

Flowers in lateral, up to 12 cm long, few-flowered racemes. Peduncles practically glabrous. Bracts and bracteoles 1.5 mm long, ovate, sparsely pubescent as are the 0.8–1.2 cm long pedicels. Calyx abruptly narrowed at base, dark purplish red, persistent in fruit; receptacle shallowly saucer-shaped, c. 3 mm wide. Calyx tube c. 3 mm long at anthesis. Calyx lobes 5, imbricate in bud, recurving at anthesis, 3–5 mm long, the dorsal two largely connate, glabrous outside, woolly pubescent inside. Petals 5, imbricate in bud, purplish blue, clawed with a claw of 2–3 mm long, c. 1 mm wide. The upper (adaxial) petal (standard) with a transversely elliptic lamina, c. 12 mm long, c. 15 mm wide. The lateral petals (wings) unequal-sided, the lamina c. 12 mm long, c. 8 mm wide.



Fig. 44. *Haplormosia monophylla* (HARMS) HARMS A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: top of petiole showing pair of stipellae ( $\times 10$ ); C: flower ( $\times 2$ ); D: fruit ( $\times \frac{1}{2}$ ); E: seed, not yet fully covered by the aril ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ); G: fruit of *Pterocarpus santalinoides* L'HÉR. ex DC. ( $\times \frac{1}{2}$ ).

The lower 2 petals connate along the upper half of their adjacent margin, so forming the keel, with an oblique lamina, c. 12 mm long, c. 6 mm wide. Keel folded around the stamens and ovary. Stamens 10, free but at the base adnate to the intrastaminal disc, 10–13 mm long, 1 mm wide at the base, subulate, glabrous. Anthers basifixed, 1 mm long, ovate. Pistil stipitate; stipe 3–4 mm long, sparsely pubescent. Ovary 3–4 mm long, flat, with a few scattered hairs. Style c. 7 mm long, strongly curved. Stigma minute, inconspicuous.

Fruit an elliptic–obovate, thick coriaceous pod, 7–8 cm long, c. 5 cm wide, rounded and apiculate at the top, with a slightly broadened ventral edge, and a c. 5 mm long stipe, dehiscent (?), containing one seed. Seed c. 5 cm long, 2–3 cm wide, completely enveloped by an aril, green inside.

Seedling: germination epigeal. Hypocotyl 1.5–2 cm long, densely pubescent. Cotyledons thick and fleshy, sagittate at base, not spreading. Epicotyl c. 7 cm long, sparsely pubescent, pale brown. First leaves reduced to pubescent scales. Leafless shoot above the epicotyl c. 20 cm long, with c. 10 scales at regular intervals. First fully developed leaves rarely opposite, simple, as the full grown leaves but usually shorter petiolate and broader.

**TAXONOMICAL NOTES.** Harms (1902, l.c.) tentatively placed this species in the genus *Crudia* SCHREB., not knowing the flowers, but after he received additional flowering material, he transferred it to the genus *Ormosia* JACKS. (1906, l.c.). Finally Harms decided that the genus *Ormosia* ought to be restricted to America and Asia and thus did not occur in Africa. He proposed a monotypic new genus, *Haplormosia*, for this species (1916, l.c.). M. S. Knaap-van Meeuwen (1962, l.c.) demonstrated that the other species of the *Ormosia* group, placed by Harms in the genus *Afrosormosia*, should be reduced to *Pericopsis* THWAITES.

The present description is based on the following specimens: Paynesville, de Wilde 3626; Bomi Hills 950, 1041, de Wilde 3848.

**FIELD NOTES.** *Haplormosia* is found as a small tree or high shrub directly near the coast, along creeks, rivers and lagoons, but apparently always in fresh water. Further up country it may grow much larger, up to 30 m ( $\approx 100'$ ) high and attaining a diameter up to 80 cm ( $\approx 2.5'$ ) (3–4', cf. Cooper, l.c.). The base has low, thick and twisted root spurs or buttresses, often extending in far spreading, gnarled, thick surface roots. The bole is irregular, fluted and angular, but fairly straight, short. The crown is compact, with ascending branches. The bark is fairly smooth or slightly furrowed and thin-scaly, with longitudinal scales, grey-brown. The slash is fibrous but a bit brittle, yellow-orange, turning orange-brown, very bitter when tasted, with conspicuous, fine and straight ripple marks; cambium pale yellow.

The tree seems to occur only in the evergreen forest zone. It is found on river banks and in swampy valleys, where it may form small groves. The tree is briefly deciduous in

November–December. It is found flowering in April. Fruits are found in December. Regeneration in the high forest is rare, on sandy river banks it may be abundant.

*Haplormosia* cannot be mistaken for any other species, owing to its characteristic habitat, slash and leaves.

USES. *Haplormosia monophylla* or Black Gum is locally used and much appreciated for furniture. The wood is beautifully striped darker and lighter brown, with a very fine figure owing to the storied tissue. It works fairly well and readily accepts a good finish. It is hard and heavy, shrinks considerably on seasoning and should be stacked for over a year before being used. It is very resistant, even to termites. Stocks are limited.



## MELIACEAE

A mainly tropical family of trees and shrubs. Leaves as a rule pinnately compound, estipulate, alternate. Flowers actinomorphic, as a rule hermaphrodite, 4- or 5-merous; calyx often small, more or less synsepalous; petals free or partially connate, imbricate or valvate. Stamens mostly twice the number of petals, with (partially) connate filaments, forming a staminal tube, carrying the anthers inside the tube or on the rim. Disc often present. Ovary superior, 3–5 celled, crowned with a disciform or capitate stigma. Fruit a berry or a capsule, sometimes with an enlarged central axis (columella); seeds sometimes winged.

Economically this family includes the most important timber trees of West Africa: *Khaya* A. JUSS., *Entandrophragma* DC., *Guarea* ALLEM., *Lovoa* HARMS. Most of these meliaceous species, however, prefer the moist semi-deciduous forest type above the evergreen forest, as found predominantly in Liberia, and extensive stocks of these valuable timbers, as found in Ivory Coast, Ghana, and Nigeria, are not present in Liberia; the richest *Meliaceae* forests are found in the drainage area of the Cavally river, between Tapeta and Zwedru, and east of Zwedru (Chien district).

The species treated beneath excepted, the following species have to be mentioned: *Trichilia heudelotii* OLIV. and *T. heudelotii* var. *zenkeri* (HARMS) AUBRÉV., understory trees, quite common in secondary forests, conspicuous when in fruit, the black seeds being partially covered by a bright red aril (the latter taxon is probably a distinct species). *Trichilia lanata* A. CHEV., a rare but large tree, slowly exuding a white latex when slashed; leaves densely villous beneath. *Trichilia martineaui* AUBRÉV. & PELLEGR., a medium-sized or large forest tree, not yet recorded from Liberia, but found in Sierra Leone and Ivory Coast. This tree also exudes some latex when slashed, but the latex is coffee-coloured and has an unpleasant smell. *Ekebergia senegalensis* A. JUSS.; this common tree of the savanna regions has once been found in Liberia as a large tree of about 36 m ( $\approx$  120') high (Voorhoeve 250); it is rare.

The true mahoganies of South America and the Caribbean area are produced by *Swietenia mahagoni* L. and *S. macrophylla* KING. *Cedrela mexicana* M. J. ROEM, a fast growing species from Central America has been introduced for reforestation purposes, but trials in Liberia have not yet succeeded.

## The genus ENTANDROPHRAGMA DC.

The name '*Entandrophragma*' (from Gr. 'en': in; Gr. 'andros': man, referring to the staminal tube; Gr. 'pragma': partition) refers to the small partitions between the inside of the staminal tube and the disc (fig. 45 D).

*Entandrophragma* DC. is a strictly African genus, but closely related to the American genus *Swietenia* JACQ.. Many species of *Entandrophragma*, all tall trees, produce a valuable timber with qualities which in many respects are comparable with true mahogany (*Swietenia*). About 30 species have been described, but the actual number of species is probably about eight, only four of which are represented in Liberia, or, more generally, in West Africa: *Entandrophragma angolense* (WELW.) DC., *E. candollei* HARMS, *E. cylindricum* (SPRAGUE) SPRAGUE, and *E. utile* (DAWE & SPRAGUE) SPRAGUE. The large number of synonyms is due to the intraspecific variation, as a result of which extreme forms were mistaken for separate species. The descriptions given are only of local value, and may differ on detailed points from material from other countries.

De Candolle, Bull. Herb. Boissier, II, p. 582 (1894); Staner, Bull. Jard. Bot. Bruxelles, 16, p. 224, 232, 239, 242 (1940); Hairs in Nat. Pl.fam., 2nd ed., 19 B 1, p. 55, lit! (1940).

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|---|---|
| 1928: F.W.T.A., 1st ed., I, p. 495  | 1955: Normand, A.B.C.I., II, p. 73; Pl. LXXX, LXXXI |
| 1936: Aubréville, F.F.C.I., 1st ed., II, p. 134–148                                       | 1958: F.W.T.A., 2nd ed., I, p. 700, 701             |
| 1936: Kennedy, F.F.S.N., p. 168–180   | 1958: Fl. Congo Belge, VII, p. 182, 184, 189, 190   |
| 1937: Dalziel, U.P.W.T.A., p. 320–322   | 1959: Aubréville, F.F.C.I., 2nd ed., II, p. 167–180 |
| 1946: Kinloch, Silv. Notes Gold Coast Trees, p. 33–42                                     | 1959: Kryn & Fobes, Woods of Liberia, p. 45–49      |
| 1947: Bois & For. Trop., 3, p. 39 ( <i>E. utile</i> ); 4, p. 41 ( <i>E. cylindricum</i> ) | 1960: Taylor, Syn. Silv. Ghana, p. 184–197          |
| 1948: Bois & For. Trop., 8, p. 395 ( <i>E. angolense</i> )                                | 1961: Irvine, Woody Plants of Ghana, p. 516–518     |
| 1950: Bois & For. Trop., p. 251 ( <i>E. candollei</i> )                                   | 1963: de Saint Aubin, La Forêt du Gabon, p. 128–131 |
| 1951: Eggeling & Dale, Indigenous Trees Uganda, p. 176–183 (excl. <i>E. candollei</i> )   |   |

**BOTANY.** The leaves are pinnately compound and markedly clustered at the end of the branches. Leaves of saplings and young trees are often much longer than those of mature trees. The pale green, scented flowers, borne in long panicles, have a very short, cupuliform, and 5-dentate calyx. The 5 petals are free, imbricate in bud. The stamens are united in a staminal tube, which carries the introrse anthers on the rim; the inside of the base is connected to the disc with 10 partitions, alternating with the anthers (see figure 45 D). The disc is swollen and carries the sessile ovary, thus forming a gynophore. The ovary is 5-locular (or sometimes 6-locular in *E. candollei*?). The stigma is round and flat, fairly thick, slightly exceeding the stamens at anthesis. The fruits are fusiform capsules with a thick central column, the columella, formed by soft, spongy tissue. The winged seeds are attached to the top of the columella with the wing

pointing to the base (unlike *Lovoa*, in which the seeds are attached with the top of the wing, which points to the top of the columella). Germination of the seeds is epigeal; the cotyledons remain inside the testa and soon shrivel. The first two leaves are opposite and simple, the following leaves alternate, eventually pinnate.

The trees have an imposing habit. The bole is nearly always straight, the crown dome-like and heavily branched.

**SILVICULTURE.** The silviculture of *Entandrophragma*, except perhaps for *Entandrophragma candollei*, is very important to West Africa, as this genus provides very valuable export timbers, and stocks are rapidly becoming depleted. All species are light demanders but able to stand shade for a while when young. A natural regeneration can be stimulated by the Tropical Shelterwood System.

Artificial regeneration: seed collection is difficult, because seeds are dispersed by wind and soon attacked by insects. The bush under mother trees has to be cleared away at the fruiting season and seeds must be collected daily. *Entandrophragma angolense* and *E. utile* have c. 1000 winged seeds to a pound, *E. cylindricum* c. 1200. Germination takes two to three and a half weeks and is usually above 75 % when seeds are fresh, but viability decreases rapidly. Seed beds should be lightly shaded. The seedlings form a strong tap root but only few side roots. The saplings take twelve to eighteen months to reach a height of 0.75–1.50 m ( $\approx$  2.5–5') and can be transplanted to the field, either as stumps or as striplings, although striplings seem to be preferable. Stumps and striplings should be about 2–3 cm ( $\approx$  1") thick at base. Stumpage, stripping and trimming of the roots should be done a month before transplanting. This promotes the formation of a strong bud (on stumps) and a dense root system near the tap-root, which is essential for the young plant to become successfully established.

When planted in taungya the secondary vegetation should not be given any chance to overgrow the initially fairly slow-growing saplings. When grown in a mixture, for example with *Nauclea diderrichii*, *Entandrophragma* should be given a one year's start. The tree grows high and slender with a small crown, not forming a closed canopy, which makes a natural or planted understory necessary. When planted in enrichment line plantings, the surrounding forest should be thinned to provide sufficient light, for example by cutting all trees below 30 cm ( $\approx$  1') diameter. After one to two years the canopy should be gradually lifted by girdling or poisoning the remaining stand, which will die gradually, thus improving the light conditions for the plantation. The *Entandrophragma* species prefer sandy-loamy soils; *E. angolense* and *E. cylindricum* seem to be able to stand drier sites than *E. utile*.

*Entandrophragma candollei* is reported to be easier to plant and to grow faster than the others, but owing to its less desirable qualities its cultivation is still unattractive.

In Liberia the area for large-scale plantations of *E. utile* and *E. cylindricum* is likely to be restricted to the northern half of the country, but *E. angolense* might also be tried out in the evergreen forests.

## KEYS

## I. FOLIAR CHARACTERS

1. a. Leaflets with more than 15 pairs of very prominent and yellowish brown nerves beneath *E. candollei*
- b. Leaflets with less than 15 pairs of nerves; nerves not very prominent 2
2. a. Leaf rachis glabrous; leaflets with only slightly raised nerves and a faint venation; apex of blade often with a folded apicula *E. angolense*
- b. Leaf rachis more or less puberulous; nerves distinctly raised on the lower surface of the blade; tip not folded 3
3. a. Leaflets 8–13 pairs; on the lower surface tufts of hairs in the axil of the nerves *E. utile*
- b. Leaflets 5–7 (–9) pairs; nerves not with tufts of hairs in the axil *E. cylindricum*

## II. FLORAL CHARACTERS

1. a. Staminal tube deeply incised, with 10 slips, each carrying 1 anther on top; petals woolly pubescent *E. candollei*
- b. Staminal tube entire or slightly lobed 2
2. a. Stigma (sub)sessile; staminal tube urceolate, c. 2 mm long *E. cylindricum*
- b. Stigma on a distinct, stout style; staminal tube oblong, c. 4 mm long 3
3. a. Petals glabrous; calyx ciliolate on the rim only *E. angolense*
- b. Petals and calyx tomentose outside *E. utile*

## III. FRUCTAL CHARACTERS

1. a. Fruit 6–10 (–15) cm long, purplish black; inside of the valves speckled pale and darker brown; columella broadened at base, pale yellowish brown; seeds pale brown; hilum linear, 2–3 mm long *E. cylindricum*
- b. Fruit more than 15 cm long; inside of valves not speckled. Columella not swollen at base 2
2. a. Fruit very narrow at base, opening from the top, valves strongly recurving; columella stipitate, pale yellowish brown, as are the seeds; hilum round, c. 1.5 mm across *E. candollei*
- b. Fruit not very narrow at base; columella not stipitate, red-brown; seeds red-brown 3
3. a. Fruit club-shaped, rounded – obtuse at the top, opening from the top. Valves c. 1 cm thick, woody, not recurving, on the outside with numerous warty lenticels; seed red-brown, hilum elliptic, 2–5 mm long, c. 1 mm wide *E. utile*
- b. Fruit spindle-shaped (fusiform), acute at the top, opening from the base; valves finely lenticellate outside, c. 6 mm thick, strongly recurving, seeds red-brown, hilum linear, c. 8 mm long *E. angolense*

## IV. FIELD CHARACTERS

1. a. Slash granular, pinkish light brown, with inclusions of orange stone cells, not scented *E. candollei* 2
  - b. Slash fibrous
2. a. Slash strongly cedar-scented, pinkish brown, with distinct, straight ripple marks *E. cylindricum*
  - b. Slash not strongly cedar-scented, ripple marks either absent or wavy when present. 3
3. a. Bark smooth with irregular bark scales, leaving shallow pits when shed; slash red and, especially on the buttresses, of the 'bacon' type; no ripple marks *E. angolense*
  - b. Bark vertically grooved, with oblong bark plates; slash pink-red, not of the 'bacon' type; ripple marks wavy when present *E. utile*

*Entandrophragma angolense* (WELW.) DC. [45 A-D, 48 A-B/74, 271]

'*angolense*': referring to Angola, where the type specimen was collected.

De Candolle, Bull. Herb. Boissier, II, p. 582 (1894);

*Swietenia angolensis* WELWITSCH in Ann. Conselho Ultramar 1858, p. 561, basionym; type: Welwitsch 1313 (BM!, isotype);

*E. candolleianum* DE WILD. & DUR., Ann. Mus. Cgo., S. II, I, p. 14, (1899) = *E. casimirianum* DE WILD. & DUR., Ann. Mus. Cgo., S. I, I, p. 125 (1900); type: A. Dewèvre s.n. (BR!);

*Leioptyx congoensis* PIERRE ex DE WILDEMAN in Ann. Mus. Cgo., S. V, II, p. 259 (1908); type: Pynaert 367 (BR?);

*E. macrophyllum* A. CHEVALIER in Vég. Util., 5, p. 196 (1909); type: A. Chevalier 16146 (K!);

*E. septentrionale* A. CHEVALIER, l.c., p. 205 (1909); type: Chevalier 16145 (K!);

*E. congoense* (PIERRE ex DE WILD.) A. CHEVALIER, l.c., p. 204 (1909);

*E. rederi* HARMS in Notizbl. Bot. Gart. Berlin, V, p. 189 (1901); type: Reder 1965 (?);

*E. leplaei* VERMOESEN in Rev. Zool. & Bot. Afr., IX, p. B 48 (1921); type: Vermoesen 1548, 1838, 1850 (BR!);

*E. gregoireanum* STANER, Rev. Zool. & Bot., XX, p. 97 (1930); type: Lebrun 1252 (BR!).

LOCAL NAMES: bee-a (Gio); doetue (Krahn)

TRADE NAME: Tiama; (Edinam)

GEOGRAPHICAL DISTRIBUTION: Guinea – Uganda and Angola

**BOTANY.** A large tree. Branchlets glabrous, below the leaf clusters with marked scars of shed leaves. Leaves pinnately compound, up to 50 cm long, with 7–11 pairs of leaflets. Petiole broadened and slightly flattened at base, often lenticellate beneath, 8–17 cm long, with faint lateral ridges. Rachis terete, glabrous. Leaflets coriaceous, dark green above, opposite or not, progressively larger from the base to the one but last pair, the

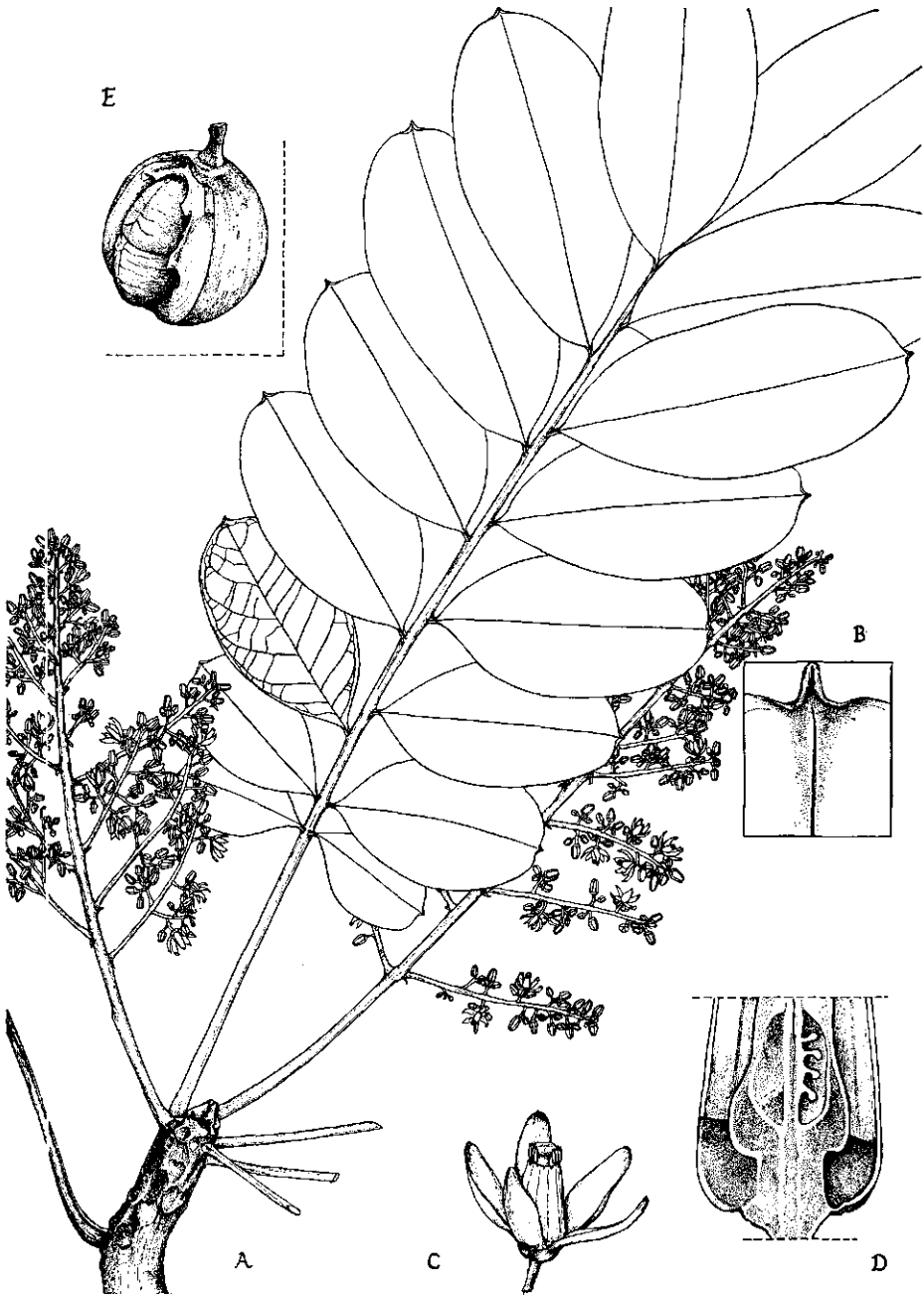


Fig. 45. *Entandrophragma angolense* (WELW.) DC. A: top of a branch with leaf and inflorescences ( $\times \frac{1}{2}$ ); B: detail showing folded edge of cuspidate top of leaflet ( $\times 2$ ); C: open flower ( $\times 3$ ); D: longitudinal section of lower part of flower, showing the partitions (shaded) ( $\times 10$ ); E: fruit of *Guarea thompsonii* SPRAGUE & HUTCH. ( $\times \frac{1}{2}$ ).

terminal pair smaller. Petiolules 1–2 mm long, canaliculate. Blade (narrowly) elliptic, (–) oblong or (–) obovate, 3.5–12 (–15) cm long, 2–4 (–5.5) cm wide, often slightly asymmetrical, the midrib excentric towards the proximal side. Base (obtusely) cuneate. Margin entire, decurrent. Apex rounded, the extreme top shortly apiculate, the margin of the apicula often folded; the apicula sometimes reduced and the leaflets slightly emarginate. Midrib flat or slightly impressed, glabrous above, prominent and pubescent beneath. Nerves 6–10 (–12) pairs, not very prominent beneath. Reticulation of veins obscure. Leaves of saplings and young trees up to 1 m long, with larger leaflets up to 22 cm long and 9 cm wide.

The 20–35 cm long, densely flowered panicles stand with 6–10 together above the leaves at the end of the branchlets. Peduncles finely scurphy, with a few, scattered stellate hairs. Bracts 1–2 mm long. Pedicels 0.5 mm long. Calyx cupuliform, 0.5 mm long, ciliolate on the edge. Petals spreading at anthesis, c. 4 mm long, glabrous. Staminal tube very shortly incised. Anthers c. 1 mm long, sessile, with 2 thecae, each theca apiculate. Disc shortly stipitate, swollen, orange in the fresh flower. Style short and thick, exceeding the stamens. Stigma capitate, just fitting in the circle formed by the anthers.

Fruit pendulous, 15–20 cm long, c. 4 cm thick, pointed at the top, obtuse – rounded at base, finely lenticellate, nearly black, opening from the base with 5 strongly recurving, c. 6 mm thick and 2–3 cm wide, woody valves, remaining joined at the apex for some time, then dropping separately from the columella. Columella dark red-brown, 5-angulate with sharp edges, bluntly pointed or obtuse at both ends, the upper part with 5–6 impressions on each face, caused by the seeds, which are broadly attached to the columella (hilum 7–9 mm long) and, including the thin papery wing, c. 7 cm long, redbrown.

Seedling: germination epigeal. Hypocotyl 2–2.5 cm long. Epicotyl 5–10 cm long. First 2 leaves simple, elliptic, opposite, c. 6 cm long, caudate, papery. Seedlings glabrous.

The present description is based on the following specimens: Liberia: Tapeta 1312; Nimba 914; Ganta, Harley s.n.; N. Gio Nat. For. 149. Ivory Coast: de Wilde 3912, Leeuwenberg 2493, 2558. Ghana: Brenan 8822 (K).

FIELD NOTES. *Entandrophragma angolense* is a true emergent tree, attaining a height of up to 50 m ( $\approx$  160') or more, and a diameter of over 1.80 m ( $\approx$  6'). The base has the most developed buttresses of all four *Entandrophragma* species in Liberia, reaching 6 m ( $\approx$  20') high and extending in far spreading surface roots which on very old trees may sometimes form a wall 50 cm ( $\approx$  1.5') thick and 60–1.50 m ( $\approx$  2–5') high, extending for more than 20 m ( $\approx$  1 chain) beyond the tree. The bole is straight and cylindrical, up to 30 m ( $\approx$  100') to the first branches. The crown is dome-like, dense. The bark is fairly smooth, greyish or yellowish brown, sometimes reddish brown, with scattered lenticels, peeling off in irregular, thin and large bark plates, leaving shallow, bright and light brown mussel-shell markings. This gives the tree a characteristic patched habit. The slash on the stem is red, on the buttresses and the stem of young trees red or pur-

plish red, interspersed with white streaks of dilatation tissue, a 'bacon type' slash; it is fibrous, brittle on the outside, fairly soft and sometimes somewhat sticky, not fragrant but very bitter and without ripple marks.

Of all four *Entandrophragma* species this one penetrates deepest into the evergreen forest, occurring on the Bong Range and even reaching the coast (Cape Mount). It is found scattered, usually growing on well-drained soils (not in marshy areas). Values of 7–8 trees over 60 cm ( $\approx 24''$ )  $\phi$ /sq. mile were found in the evergreen forest, this figure rising to 13 in the drier forests of the eastern province. The tree is deciduous for a short period after the rainy season. Flowers were found during February, and ripe fruits in October and February. Fruits may drop unopened from the tree when ripe, when the atmosphere is still too moist for the fruit to dehisce (October). Regeneration is scarce.

The leaflets of *Entandrophragma angolense* resemble those of *Khaya anthotheca*, but are in more pairs (7–11). The 'bacon type' slash is quite rare: *Rhodognaphalon brevicuspe* is distinct in showing conspicuous ripple marks. Another tree with a similar slash is *Lansea welwitschii* (HIERN) ENGL.; it is distinct in having less developed buttresses and imparipinnate leaves with 2–4 pairs of leaflets and a terminal one.

**USES.** The red brown timber is much used for furniture, cabinet making, interior decoration, shop, boat, and ship fittings. It is said to provide a good quality plywood, but is not very good for sliced veneer. The wood is fairly light, Sp. G. 0.55–0.65, coarse and even textured, fairly soft. Only fully seasoned wood should be used, or trouble may be caused by warping.

***Entandrophragma candollei* HARMS**

[17, 46 G-H, 47 D-E/42, 250]

'*candollei*', named after Casimir de Candolle, a famous botanist (1835–1918).

Harms in Notizbl. Bot. Gart. Berl., I, p. 181 (1896); type: Staudt 459, Cameroon (K!);

*E. ferruginea* A. CHEVALIER in Vég. Util., 5, p. 195 (1909); type: Chevalier 16261 (K!, P!);

*E. choiandrum* HARMS in Mildbraed Wiss. Erg. Deutsch. Zentr. Afr. Exp. 1907–1908, Bot. II, p. 430 (1912); type: Mildbraed 2342 (HBG?).

**LOCAL NAMES:** bee-a (Gio); doetue (Krahn)

**TRADE NAME:** Kosipo; (heavy Sapele)

**GEOGRAPHICAL DISTRIBUTION:** Guinea – Congo

**BOTANY.** A large tree. Terminal branchlets stout, densely brown puberulous or villous. Older branchlets glabrescent, with marked scars of shed leaves. Leaves paripinnately compound, 20–50 cm long, with 5–10 pairs of (sub)opposite, somewhat bullate, often galled leaflets. Petiole 8–15 cm long, often slightly winged, flattened above, broadened



at base, brown tomentose – puberulous, as is the angular rachis. Leaflets stalked at the base, progressively larger and more sessile towards the top of the whole leaf; petiolules 7–1 mm long, puberulous. Blade (narrowly) elliptic, (–) oblong or (–) obovate, 5–16 cm long, 2.5–6 cm wide. Base rounded – cuneate. Margin entire, undulate. Apex rounded – obtusely acute. Midrib and nerves impressed above, very prominent and puberulous beneath. Nerves (10–) 15–20 (–22) pairs, yellow-brown, straight, looping near the edge. Venation lax, slightly raised beneath.

Flower panicles lax, 10–30 cm long, the lateral branches shorter towards the top. Peduncles densely rusty puberulous. Pedicel 1–3 mm long, rusty tomentose, as is the c. 2 mm long calyx. Petals free or sometimes 2 partly connate, c. 6 mm long, recurving at anthesis, tomentose outside, woolly inside. Staminal tube c. 5 mm long, glabrous, lacinate, with 10 3–4 mm long slips, each carrying 1 basifixed, obtuse anther. Disc c. 1 mm long. Ovary sessile. Style c. 2 mm long; stigma capitate, just exerted above the anthers, puberulous.

Fruit a fusiform capsule, 17–23 cm long, 3–5 cm thick, rounded at the top, narrowly tapering at base, opening from the top with 5 recurving valves, c. 2 cm wide at the widest part, c. 5 mm thick. Columella pale brown with 5 (–6) faces, tapering into a c. 2.5 cm long stipe at the base, obtuse at the top, with 3–10 seeds impressed against the upper part of each face. Seeds pale yellowish brown, including the wing 8–12 cm long, with a round hilum of c. 1.5 mm across.

Seedling: germination epigeal. Epicotyl 5–8 cm. First pair of leaves opposite, with c. 10 pairs of prominent nerves. Young shoots densely brown pubescent.

The present description and figures are based on the following specimens: Liberia: Nimba 881; Tapeta 1310; Ganta, Harley 2141. Ivory Coast: Leeuwenberg 2495. Ghana: Chipp 106 (K). Nigeria: FHI 25596 (K).

**FIELD NOTES.** *Entandrophragma candollei* may attain a height of more than 45 m ( $\approx$  150') and a diameter of 1.80 m ( $\approx$  6'). The base usually has thick, heavy root swellings, rarely very pronounced buttresses. The bole is straight and cylindrical. The bark is yellowish grey or dark grey, irregularly scaly, the roundish scales leaving shallow pits when shed. The slash is pinkish light brown, granular, with orange inclusions of stone cells; it is not fragrant, but after a while may exude a clear gum. There may be a wavy ripple mark structure in the wood.

This species is the rarest of the Liberian *Entandrophragmas*. It seems to be confined to the moist semi-deciduous forest, rarely penetrating into the evergreen forest; it is found scattered. The tree is deciduous after the rainy season and flowers in November–December. Fruits were observed in May and August.

**USES.** The wood is less esteemed than the other *Entandrophragmas*, being heavier, darker, showing less figure. Nevertheless it is a good timber for carpentry and cabinet-making.



19. *Entandrophragma utile*. (DAWE & SPRAGUE) SPRAGUE. Note the leaves in terminal clusters. (see page 262).



20. *Guarea cedrata* (A. CHEV.) PELLEGR.. Note the typical mussel-shell markings (see page 267).

***Entandrophragma cylindricum* (SPRAGUE) SPRAGUE [18, 46 A-F/123, 267]**

'*cylindricum*': Gr. kulindros: cylindrical; referring to the fusiform, cylindrical fruits.

Sprague in Kew Bull. 1910, p. 180;

*Pseudocedrela cylindrica* SPRAGUE in Kew Bull. 1908, p. 257, basionym; type: Thompson 16 (K!);

*E. rufa* A. CHEVALIER in Vég. Util., 5, p. 201 (1909); type: Chevalier 16166 (P!, K!);

*E. tomentosum* A. CHEV. ex HUTCH. & DALZ., F.W.T.A., 1st ed., I, p. 495 (1928); type: Chevalier 16132, 16140 (P!);

*E. pseudocylindricum* VERMOESEN in Rev. Zool. & Bot. Afr., IX, p. B 52 (1921) (no type cited);

*E. lebrunii* STANER, Rev. Zool. & Bot. Afr., XIX, p. 425 (1930); type: Lebrun 1015 (BR!).

LOCAL NAMES: bee-a ti (Gio); dotue (Krahn)

TRADE NAME: Sapelli; Aboudikro

GEOGRAPHICAL DISTRIBUTION: Guinea – Uganda and Congo

**BOTANY.** A large tree. New branchlets and terminal buds pale brown puberulous. Leaves paripinnately compound, 20–35 (–55) cm long, with 5–7 (–9) pairs of opposite or alternate leaflets. Petiole 7–12 cm long, broadened at base, slightly winged, puberulous, as is the slightly grooved rachis. Leaflets stalked or subsessile, coriaceous, glossy dark green above, progressively larger from the base to the one but last pair, the terminal pair smaller. Petiolules 1–3 mm long, grooved above. Blade ovate, (narrowly) elliptic or (–) oblong, 4–15 cm long, 2–4.5 cm wide, asymmetrical. Base unequal-sided, the proximal side (obtusely) cuneate, the distal side obtuse – rounded, more or less broadened. Margin entire. Apex (bluntly) acute – obtusely acuminate. Midrib flat or slightly impressed above, prominent beneath, often excentric to the proximal side, sparsely puberulous. Nerves 6–10 (–12) pairs, prominent beneath.

Flower panicles lax and slender. Peduncles and pedicels sparsely puberulous. Pedicels 1–1.5 mm long, articulate at base. Calyx and corolla sparsely puberulous outside. Calyx 0.5 mm long, petals c. 3 mm long, spreading at anthesis. Staminal tube urceolate, c. 2 mm long, with a slightly lobed edge, glabrous outside, tomentose at base inside. Gynophorous disc not stipitate, 0.5 mm thick. Ovary glabrous, crowned by the (sub)sessile stigma.

Fruit capsule 6–10 cm long, rarely longer, purplish black outside, broadened at base, tapering to the obtuse apex, opening more or less simultaneously at base and the top, with 5 recurving valves. Valves c. 1.5 cm wide in the middle, with an indistinct median ridge on the outside, smooth and shiny, pale and medium brown speckled inside. Columella pale yellowish grey, 5-angular, without sharp edges, broadened at the base, obtuse at the apex, with only 1–4 seeds deeply impressed in each face. Seeds pale brown, including the wing 5–8 cm long; hilum narrow, 2–3 mm long.

Seedling: resembling that of *E. angolense*, but the first pair of leaflets more ovate, with

only 5 pairs of nerves, the epicotyl c. 8 cm long, and the shoots brown puberulous.

The present description and figures are based on the following specimens: Liberia: N. Gio Nat. For. 194, 195. Ivory Coast: Leeuwenberg 2483. Nigeria: FHI 43352 (WAG).

FIELD NOTES. *Entandrophragma cylindricum* may reach a height of over 50 m ( $\approx 160'$ ) and a diameter of over 1.80 m ( $\approx 6'$ ) but such large trees are relatively rare in Liberia. The overall impression gained from many field trips is that trees around 50–80 cm ( $\approx 1.5$ – $2.5'$ ) diameter are best represented. Buttresses up to 1.80 ( $\approx 6'$ ) (on steep slopes up to 3.5 m ( $\approx 12'$ )) may occur, but as a rule the tree has low buttresses, root spurs or a swollen base with heavy root swellings. The bole is straight and cylindrical, and may reach over 30 m ( $\approx 100'$ ) to the first branches. The bark of young specimens, or even on trees up to 90 cm ( $\approx 3'$ ) diameter, has often a characteristic zig-zag pattern of smooth, grey strips, alternating with rough, brown-lenticellate bark. The bark has an overall dark impression (in Gio bee-a ti, or black bee-a). When fully mature the bark is yellowish brown, scaly with irregular scales, leaving shallow mussel-shell markings or shallow 2.5–5 cm (1–2") wide pits when shed. The bark under the shed scales is yellow-grey, with numerous lenticels. The slash is fibrous but brittle on the outside, pinkish light brown, soon turning a darker brown tinge on exposure; it has a very strong cedar scent and straight ripple marks are conspicuous. When the sun's rays strike on the bark a widespread odour is released. Younger trees often have paler stripes of dilatation tissue in the slash.

In Liberia the tree is very rare in the evergreen forest; it grows commoner in the moist semi-deciduous forest. Its southern boundary may be tentatively indicated by a line drawn from Kanweake via Grandtown to Gelahun (see map). Inventory results show a value of 0.6–3 trees over 60 cm ( $\approx 24"$ )  $\varnothing$ /sq. mile south of the Putu Range, which figure may rise to 6 in the area N.E. of Chien, bordering the Cavally river. The tree is found scattered, and does not grow in marshy sites. It is deciduous in October–November. It was found flowering in February and March (N. Gio Nat. For.), and ripe fruits were found during the same period. The natural regeneration is reported to be abundant under the mother trees, but this has not yet been confirmed in Liberia.

Its characteristic ripple marks easily distinguish this species from other trees which have a fragrant slash: *Guarea cedrata*, *Turraeanthus africanus*, *Beilschmiedia mannii* etc.

USES. *Entandrophragma cylindricum*, Sapelli, is a much sought after timber, resembling Honduras mahogany. It is heavily scented, with a persistent fragrance. The heartwood is pinkish when fresh, darkening to a typical mahogany colour. The sapwood is thick, pale yellowish. The grain is very fine, very regularly interlocked, which gives the quarter-sawn timber a markedly striped aspect. Some logs may be beautifully figured. The wood is fairly hard and fairly heavy, Sp. G. 0.70–0.75. It works quite well with any

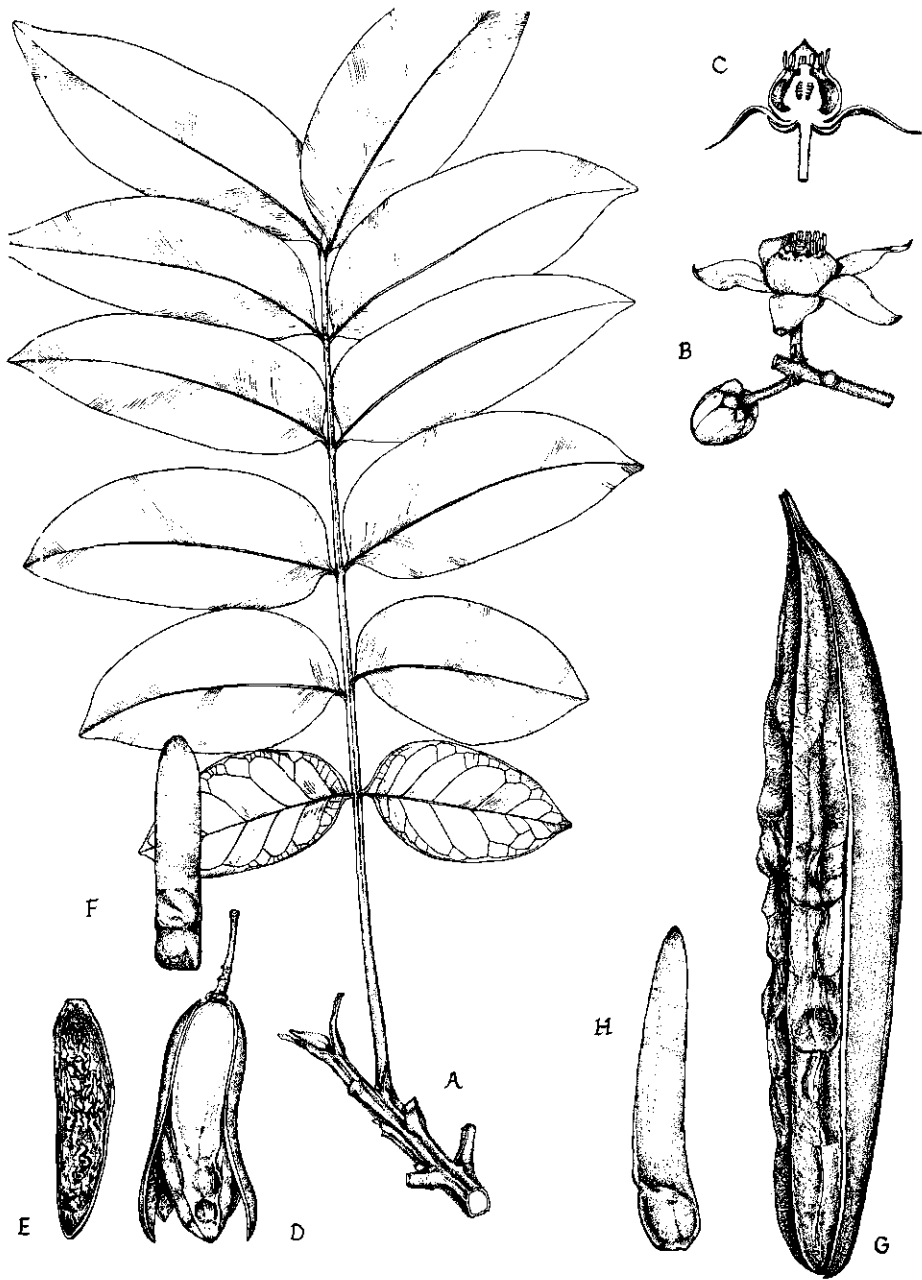


Fig. 46. *Entandrophragma cylindricum* (SPRAGUE) SPRAGUE A: top of branch with leaf ( $\times \frac{1}{2}$ ); B: flower bud and open flower ( $\times 4$ ); C: longitudinal section of flower ( $\times 4$ ); D: partially opened fruit ( $\times \frac{1}{2}$ ); E: inner face of a fruit valve ( $\times \frac{1}{2}$ ); F: seed ( $\times \frac{1}{2}$ ); G: fruit of *Entandrophragma candollei* HARMS ( $\times \frac{1}{2}$ ); H: seed ( $\times \frac{1}{2}$ ).

tool: it nails, screws and polishes well. It is much used, both massive and as veneer (generally sliced) in interior decorations, cabinet-making, furniture, panelling, boat-making etc.

*Entandrophragma utile* (DAWE & SPRAGUE) SPRAGUE

[19, 47 A-C, 48 C-D/41, 79]

'*utile*': L. utilis: useful; referring to the valuable timber.

Sprague, Kew Bull. 1910, p. 180;

*Pseudocedrela utilis* DAWE & SPRAGUE in Journ. Linn. Soc., XXXVII, p. 511 (1906), basionym; type: Dawe 358 (K!);

*E. macrocarpum* A. CHEVALIER in Vég. Util. 5, p. 203 (1909); type: Chevalier 16390 (P!);

*E. roburoides* VERMOESEN in Rev. Zool. & Bot. Afr. IX, p. B 53 (1921); type: Vermoesen 1983 (BR!);

*E. thomasi* LEDOUX in Rev. Agr. & Bot. Kivu, I, p. 10 (1932); type: Gillardin 50 (BR!).

LOCAL NAMES: bee-a puh (Gio); doetue (Krahn)

TRADE NAME: Sipo

GEOGRAPHICAL DISTRIBUTION: Guinea – Uganda and Angola

**BOTANY.** A large tree. Terminal, leaf-bearing part of the branchlet and the terminal bud densely brown pubescent; lower part glabrescent, with marked scars of shed leaves. Leaves pinnately compound, up to 60 cm long, with 8–13 pairs of opposite – alternate leaflets. Petiole 6–15 cm long, broadened at base, with 2 faint lateral ribs, puberulous, as is the grooved, angular rachis. Leaflets stalked, smallest at the base, largest at about 2/3 of the length of the whole leaf, glossy, medium green above, thinly coriaceous. Petiolules 1–5 mm long, shallowly grooved above. Blade (narrowly) ovate or (–) oblong, 5–12 cm long, 2–5.5 cm wide, often asymmetrical, sometimes slightly curved. Base unequal-sided, slightly cordate to rounded or cuneate. Margin entire. Apex obtuse to acute or shortly acuminate. Midrib flat or slightly impressed above, prominent and pubescent, glabrescent beneath. Nerves 10–15 pairs, prominent and with tufts of hairs in the axils beneath.

Flower panicles long and slender. Peduncles puberulous. Pedicel c. 2 mm long, articulate at base, puberulous, as is the 0.5 mm long calyx. Petals only slightly spreading at anthesis, c. 5 mm long, puberulous. Staminal tube 3–4 mm long, oblong, glabrous outside, pubescent at the base inside. Anthers with apiculate thecae. Ovary conical. Style short and stout. Stigma capitate, exceeding the stamens.

Fruit an 18–28 cm long, c. 6 cm thick, club-shaped, woody capsule, rounded to obtuse at the top, widest above the middle, tapering to the broad base, black, with numerous brown, warty lenticels. The fruit opens from the top with 5 hardly recurving,



Fig. 47. *Entandrophragma utile* (DAWE & SPRAGUE) SPRAGUE A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 4$ ); C: lower surface of leaflet, showing the tufts of hairs in the axils of the nerves ( $\times 3$ ).

*Entandrophragma candollei* HARMS D: leaf, showing lower surface ( $\times \frac{1}{2}$ ); E: flower ( $\times 4$ ).



straight valves. Valves 2–3 cm wide, c. 1 cm thick in the middle, pointed at the top, smooth and shiny brown inside. Columella cigar-shaped, smooth and shiny, greyish brown, rounded at the top. Seeds shallowly impressed in the columella, 4–6 on each face, medium – dark brown, broadly attached (hilum 2–5 mm long, c. 1 mm wide), including the wing 8–10 cm long.

Seedling: hypocotyl 5–6 cm long, puberulous. Epicotyl c. 2.5 cm long, puberulous. Blade of first pairs of leaves elliptic, c. 8 cm long, c. 4 cm wide, with an acute apex. Midrib with a bristle of white hairs above.

The present description and figures are based on the following specimens: Liberia: Ganta, Harley 470 A, Voorhoeve s.n.; Nimba 903; N. Gio Nat. For. 196. Ivory Coast: Leeuwenberg 2510, 3061.

FIELD NOTES. *Entandrophragma utile* is a giant tree, which may reach a height of 60 m ( $\approx 200'$ ) or more, and a diameter over 2.50 m ( $\approx 8'$ ). The base of the tree has well-developed, heavy buttresses up to 2.5–3 m ( $\approx 8$ – $10'$ ) on large trees, occasionally higher, but not extending in excessive surface roots like *E. angolense*. The bole is straight and cylindrical, hardly tapering, over 30 m ( $\approx 100'$ ) free of branches. The crown is dense and dark, dome-like. The bark is grey, sometimes yellowish on the buttresses, shallowly or deeply vertically grooved, thick, with longitudinal, thin barkplates. The slash is red or pinkish red on the outside, paler inside, fibrous, not fragrant.

This tree penetrates deeper into the evergreen forest than *E. cylindricum*, but not so far as *E. angolense*. In the moist semi-deciduous forest it is the commonest of the four species, and values of more than 40 trees over 60 cm ( $\approx 24''$ )  $\varnothing$ /sq. mile have been recorded in the forests N.E. of Zwedru, bordering the Cavally river. The tree is found less scattered than the other species; it avoids marshy sites, and shows relatively little preference for site, although well-drained, deep soils seem to be favoured.

The tree is deciduous between November and February. Flowers appear with the leaves, January–February, and ripe fruits may be found on the trees at the same time. Fruits often fall unopened from the tree and may be found long after the real fruiting season, the capsules not perishing as soon as those of the other species (the valves are much more lignified). Regeneration seems to be scarce, the fat containing seeds being eaten by animals.

From a distance the habit of *Entandrophragma utile* (and more or less of the other three species) resembles *Canarium schweinfurthii* or *Amphimas pterocarpoides*, owing to the clustered habit of the leaves. From nearby the species are not likely to be confused, the bark and slash habit of all being diagnostic.

USES. The wood of *Entandrophragma utile*, Sipo, is lighter than that of Sapelli, but used very much for the same purposes. It also finds a wide application as replacement of Acajou (*Khaya* sp.), and as a plywood veneer.

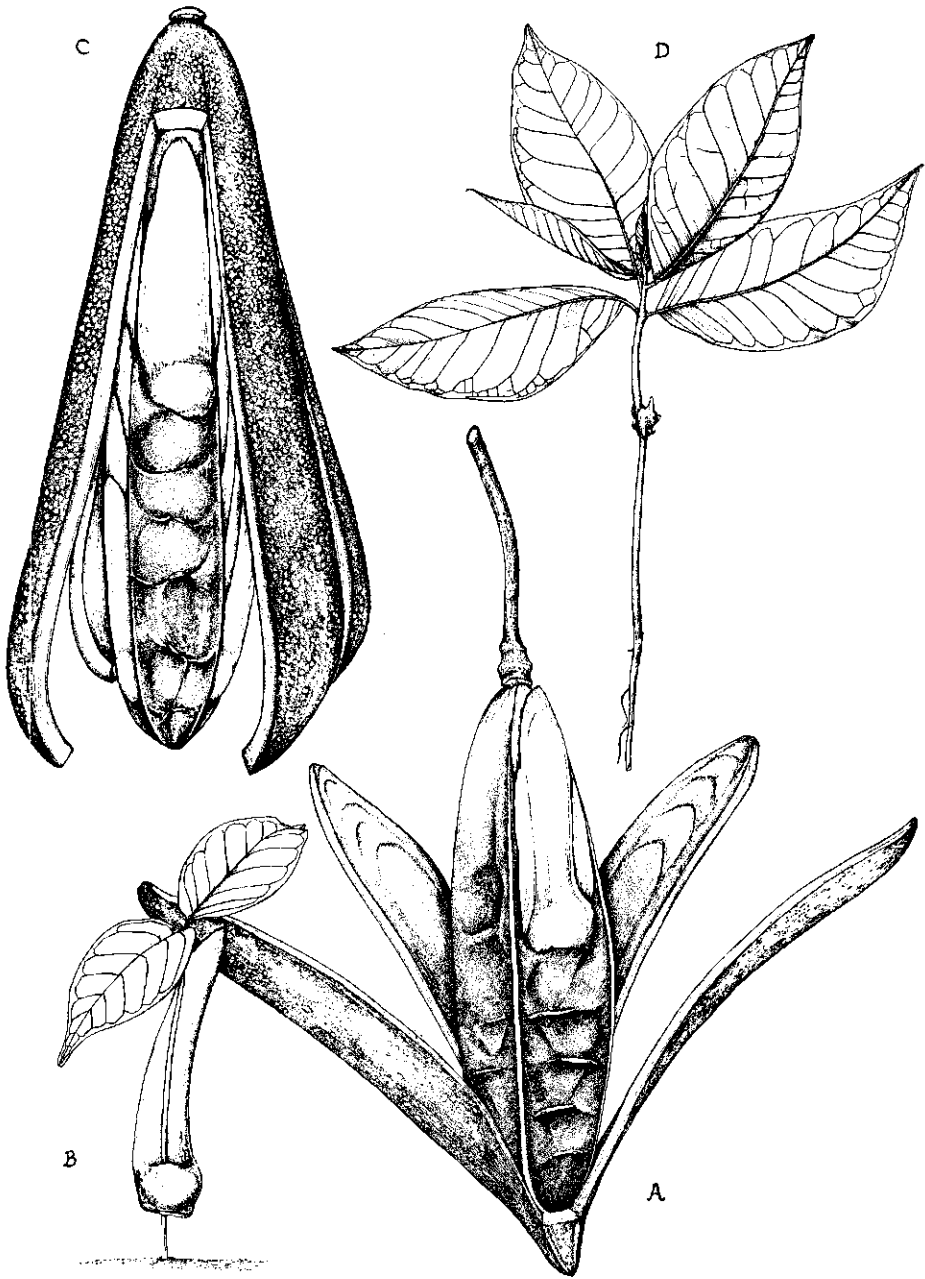


Fig. 48. *Entandrophragma angolense* (WELW.) DC. A: fruit ( $\times \frac{1}{2}$ ); B: seed and seedling ( $\times \frac{1}{2}$ ).  
*Entandrophragma utile* (DAWE & SPRAGUE) SPRAGUE C: fruit ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ).

*Guarea cedrata* (A. CHEV.) PELLEGR.

[20, 49/123, 258]

'*Guarea*': latinized version of the South American vernacular name Guaré.

'*cedrata*': Gr. kedros: name of various softwood trees with a fragrant, 'cedar-like' wood.

Pellegrin in Bull. Soc. Bot. France, 75, p. 180 (1928); *ibid.*, l.c., Vol. 86, p. 146 (1939); Harms in Nat. Pfl.fam., 2nd ed., 19 B 1, p. 135 (1940); Staner, Bull. Jard. Bot. Bruxelles, 16, p. 187 (1940); *Trichilia cedrata* A. CHEVALIER in Vég. Util., 5, p. 214 (1909), basionym; type: Chevalier 16171 (K!); *Khaya canaliculata* DE WILDEMAN in Miss. de Briey, p. 168 (1920); type: Comte J. de Briey 220 (BR!); *G. alatipetiolata* DE WILDEMAN in Ann. Soc. Scient. Brux., L, B, p. 71 (1930); type: Goossens 4514 (BR!).

1928: F.W.T.A., 1st ed., I, p. 493 (*Trichilia cedrata*)

1936: Aubréville, F.F.C.I., 1st ed., II, p. 130

1936: Kennedy, F.F.S.N., p. 162

1937: Dalziel, U.P.W.T.A., p. 322

1946: Kinloch, Silv. Notes Gold Coast Trees, p. 43

1951: Eggeling & Dale, Ind. Trees Uganda, p. 184

1951: Bois & For. Trop., p. 251

1955: Normand, A.B.C.I., II, p. 75; Pl. LXXXII

1958: F.W.T.A., 2nd ed., I, p. 706

1958: Fl. Congo Belge, VII, p. 204

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 160

1959: Kryn & Fobes, Woods of Liberia, p. 55 (only *G. thompsonii*)

1960: Taylor, Syn. Silv. Ghana, p. 197

1961: Irvine, Woody Plants of Ghana, p. 519

LOCAL NAMES: goh-ko (Gio); doetue (Krahn)

TRADE NAME: Bossé

GEOGRAPHICAL DISTRIBUTION: Guinea – Uganda and Congo

**BOTANY.** A large forest tree. Branchlets densely pale brown tomentose, gradually glabrescent. Terminal bud enclosed by the petiole wings of the developing leaf. Young leaves first reddish with pale green nerves, later pale green, soft. Leaves imparipinnately compound, alternate, with 2–5 (–7) pairs of (sub)opposite leaflets and a terminal one, which is sometimes absent. Petiole 2.5–5 cm long, densely tomentose, markedly winged above, the wings curling inwards. Rachis (1.5–) 2.5–10 (–15) cm long, sparsely tomentose, flattened above, slightly ridged beneath the petiolules. The lower pair of leaflets smallest, the terminal leaflet largest. Petiolules (0.2–) 0.5–1.5 cm long, –2 cm for the terminal leaflet, slightly grooved above, more or less rugose and articulate at base, sparsely pubescent. Blade as a rule narrowly elliptic or narrowly oblong, sometimes ovate, elliptic or oblong, 4–28 cm long, 2–9 cm wide, coriaceous, medium green. Base as a rule unequal-sided, the proximal side cuneate, the distal side broadly cuneate – rounded, decurrent along the petiole. Margin entire, often markedly undulate. Apex long-acuminate – caudate. Midrib flat or impressed above, prominent beneath, often slightly curved, pubescent when young, glabrescent. Nerves 10–16, flat or finely raised above, prominent beneath, straight and ascending, curved and anastomosing near the edge, not markedly looping. Reticulation of the veins finely but markedly raised on the

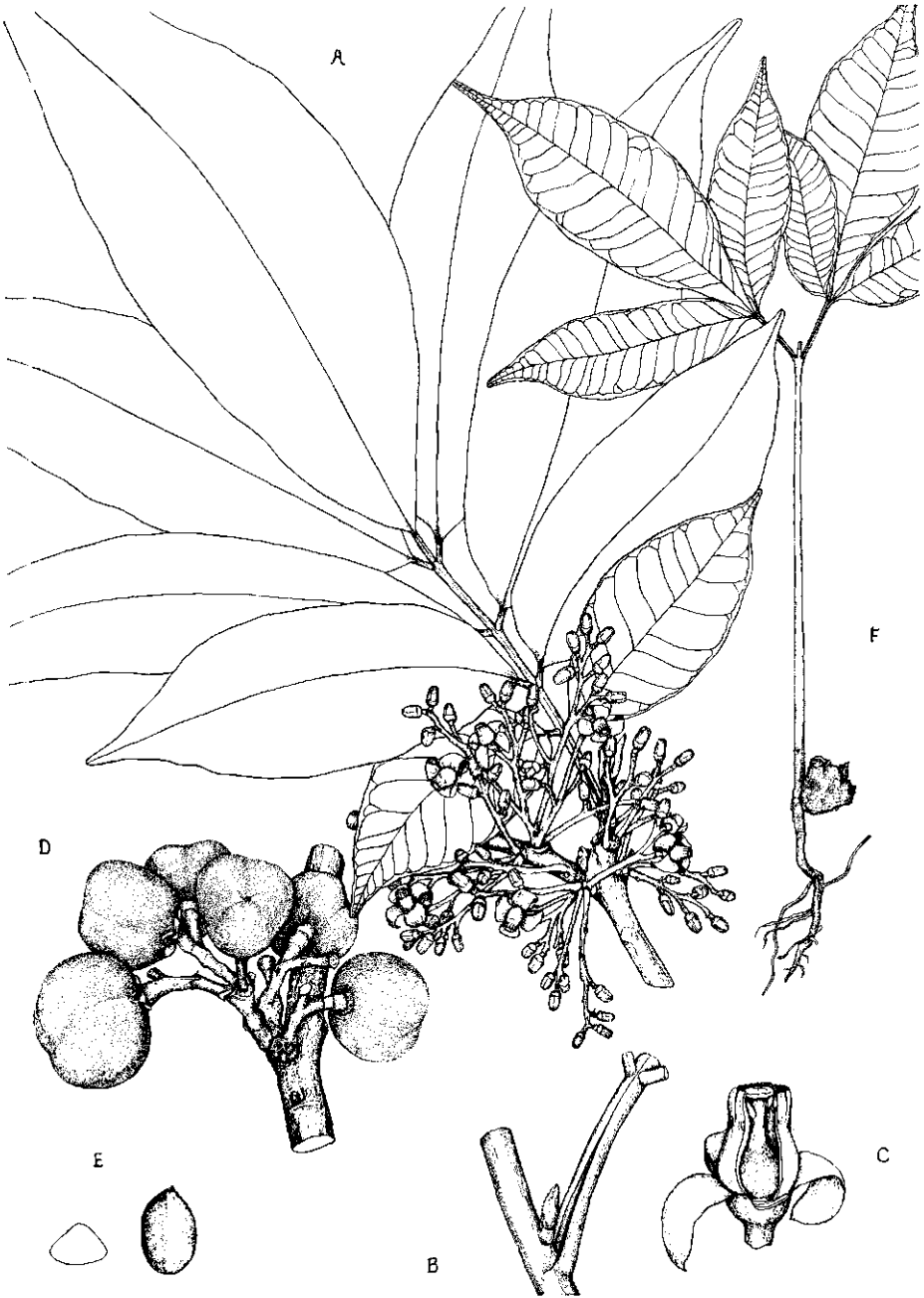


Fig. 49: *Guarea cedrata* (A. CHEV.) PELLEGR. A: branch with leaf and inflorescences ( $\times \frac{1}{2}$ ); B: detail showing the deeply grooved petiole ( $\times 1$ ); C: open flower ( $\times 2$ ); D: branch with fruits ( $\times \frac{1}{2}$ ); E: seed, side and top view ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ).

lower surface. Leaves of saplings much larger with larger leaflets.

Inflorescences paniculate, axillary, in small clusters or solitary, on the latest shoots and on older branches, 1.5–7 cm long. Peduncles, bracts, and calyx densely tomentose. Bracts very broadly elliptic, c. 1 mm long, 1.5 mm wide, caducous. Pedicel c. 1 mm long, articulate at base. Calyx synsepalous, cupuliform, c. 1 mm high, very shortly 4–(5-) lobed. Petals 4 (5), imbricate in bud, spreading and recurving, pale yellow at anthesis, 5–9 mm long, densely tomentose outside, glabrous inside. Stamens united in an urceolate, c. 5 mm long staminal tube, crowned by 8–12 slightly emarginate lobes of c. 1.5 mm long. Anthers attached inside the staminal tube, alternating with the lobes, sub-basifixed, c. 1 mm long, finely bilobed at the top, with 2 thecae, opening by slits. Ovary on a c. 1 mm long gynophore, conical, c. 2.5 cm long, 2 mm across, densely sericeous, 4- or 5-locular, each locule with 1 ovule. Style c. 2.5 mm long, 1 mm thick. Stigma peltate, 0.5 mm thick, 1.5 mm across, just exserted above the staminal tube.

Fruit a subglobose capsule, (2-) 3–4 lobed, slightly flattened or impressed at the top, 2.5–4 cm across, densely pubescent, yellowish when ripe, opening with 2–4 thick, coriaceous valves, containing 2–4 seeds. Seeds rounded triangular on cross-section, 1.5–3 cm long, c. 1.5 cm across, completely enclosed by a bright red aril.

Seedling: germination epigeal, but the cotyledons remain enclosed inside the testa and the hypocotyl does not develop. Epicotyl 8–12 cm long, finely puberulous. First 2 leaves opposite, as a rule trifoliolate, sometimes simple (in dense shade). Petiole c. 1.5 cm long grooved. Leaflets sessile, narrowly elliptic, c. 5 cm long, 1.5–2 cm wide. Following leaves alternate, at first simple.

**TAXONOMICAL NOTES.** Although as a rule the flower seems to be 4-merous, 5 calyx lobes and 5 petals are not uncommon, and in the cited material Voorhoeve 1160 all ovaries dissected counted 5 locules. The anthers may be 8–12, apparently without strict correlation to the number of petals.

Two more species of *Guarea* ALLEM. are found in Liberia, *Guarea leonensis* HUTCH. & DALZ., a small understory tree, and *G. thompsonii* SPRAGUE & HUTCH., a tall forest tree. The latter has a petiole of 7–14 cm long without wings but with 2 lateral ribs; leaflets are obtuse – acute, rarely acuminate, and the leaf margin is less undulate than that of *G. cedrata*; the nerves are raised beneath, not very pronounced; the reticulation of veins is hardly raised beneath, very inconspicuous. The calyx tube is truncate, hardly dentate; the petals have a line of hairs in the centre only; the ovary is sparsely pilose, each locule with 2 ovules. The fruit is globular, glabrous, slightly pustulate, opening with 2–3 valves, each cell with 1 or 2 seeds enclosed in a bright red aril (fig. 45 E).

The present descriptions and figures are based on the following collections: *G. cedrata*: Liberia: Kanweake 908 A; Diala 1160; Blepie, W. of Tapeta 300; Ganta, Harley s.n.; Bopolu, J. White 2. Ivory Coast: Leeuwenberg 3114. *G. thompsonii*: Liberia: Loma Nat. For. 740; Gbama 752. Ivory Coast: Leeuwenberg 2648; Voorhoeve s.n.

FIELD NOTES. *Guarea cedrata* may reach a height of 40 m ( $\approx 130'$ ), sometimes more, and attain a diameter of over 1 m ( $\approx 3.5'$ ) above the buttresses. The base of a full grown tree has well-developed, thin, concave, spreading buttresses up to 3 m ( $\approx 10'$ ); on younger trees they are less developed. The bole is as a rule straight and cylindrical, or on the lower part somewhat angular, up to 25 m ( $\approx 80'$ ) to the first branches. The crown is fairly open, not very spreading. The bark is of a pale yellow–yellowish brown colour, fairly smooth and often with c. 1 cm ( $\approx 2/5''$ ) deep, longitudinal pits in the bark on younger trees, but older trees are scaly with large, irregular scales, leaving concentric or parallel ridges, ‘mussel-shell markings’ on the stem. Lenticels are present in vertical rows. The slash is fibrous, fairly thick, pinkish light brown, moist, with a characteristic, strong, sweet cedar scent. When fresh the sapwood is yellowish white, the heartwood pinkish brown, also strongly fragrant.

In Liberia *Guarea cedrata* occurs scattered in the moist semi-deciduous forest and, in the eastern province, locally more abundant in the evergreen forest, on well-drained soils. Soundings c. 50 miles N. of Greenville, in the evergreen forest, resulted in c. 40 trees over 60 cm ( $\approx 24''$ )  $\varnothing$ /sq. mile, but enumerations in the Putu and Chien areas varied from 2–12 exploitable trees/sq. mile. Data from the Central province are missing, but here the high forest is mostly destroyed or broken up. The occurrence in the western province is known (Bopolu), but here the tree seems to be very rare. In the Nimba mountains the tree was observed at 930 m ( $\approx 3100'$ ) above sealevel. Flowering trees were observed in July; the flowers are sweetly scented. Fruits were collected during May and October. The seeds are eaten by birds and monkeys, duiker and porcupines. Natural regeneration is reported to be quite abundant. The tree is evergreen.

*Guarea cedrata* is difficult to confuse with other trees, but sometimes a mixup is made with *Entandrophragma cylindricum*, which also has a strongly fragrant slash. However, the latter species has its leaves clustered in terminal tufts and the ripple marks in cambium and wood are diagnostic.

*Guarea thompsonii* is very different in habit from *G. cedrata*. Large trees have short, thick buttresses. The bark is grey to purplish dark brown, scaly, the scales leaving ‘mussel-shell markings’. The slash is pale brown, granular, not fragrant or only slightly so, exuding slowly a small quantity of white latex. Only a few other trees with pinnate leaves present a latex outflow when slashed: *Trichilia lanata*, of which the latex is yellowish, and the leaves are densely pubescent beneath, and *Trichoscypha* spp., which have long leaves, clustered in terminal tufts, and a red, fibrous slash. *Guarea thompsonii* is rather inconspicuous, but may be as common as *G. cedrata*. It has been observed in the Putu area, Chien area, Bong Range, Bomi Hills, and Loma National Forest.

SILVICULTURE. There are c. 225 seeds per pound; germination is slow and irregular, in 20–45 days; c. 50% germinate within 10 weeks. The seedbeds should be shaded. *Guarea cedrata* is essentially a shade bearing species, and able to survive under dense shade for a long time, but more favorable light conditions are necessary for further

healthy development. Plantation trials were limited, as the species seems to grow rather slow.

USES. *Guarea cedrata* is locally used for mortars. The sapwood is 5–10 cm wide, and useless. The heartwood is clear pinkish brown, scented with a persistent fragrance. The grain is rather fine, often interlocked. The wood is fairly light, Sp. G. about 0.6. It works easily, finishes and polishes well. It takes paint and varnish without difficulties. It may split when nailed or screwed. The wood is resistant against insect attack; it is not difficult to saw, but the sawdust irritates the mucous membrane. It is an excellent timber for carpentry and furniture making. It can be used for plywood, cigar boxes, and boat-making.

The timber of *Guarea thompsonii* is heavier than of *G. cedrata*, not scented. It is less in demand than *G. cedrata*, which also has a restricted market.

***Khaya anthotheca* (WELW.) DC.**

[50/45, 255]

'*Khaya*': latinized version of the vernacular name from Senegal, Cañl.

'*anthotheca*': Gr. anthos: flower; Gr. theke: box, crate, in botany also used for capsule; referring to the open fruit, suggesting a flower, or to the box-like staminal tube (?).

C. de Candolle, Monogr. Phan., I, p. 721 (1878); Harms in Nat. Pfl.fam., 2nd ed., 19 B 1, p. 51–54, lit! (1940); Staner in Bull. Jard. Bot. Bruxelles, 16, p. 214 (1940); Pellegrin in Not. Syst. 9, p. 30 (1939).

*Garretia anthotheca* WELWITSCH in Ann. Conselho Ultramar 1858, p. 587, basionym; type: Welwitsch 1314 (K!, BM!);

*Khaya eurphylla* HARMS in Notizbl. Bot. Gart. Berlin, III, p. 169 (1902); type: Staudt 667 (K!);

*Khaya mildbraedii* HARMS, l.c. VII, p. 223 (1917); type: Mildbraed 8698 (?);

*Khaya agboensis* A. CHEVALIER in Rev. Bot. Appl., 8, p. 209 (1928); type: Chevalier 22342 (K!, BR!);

*Khaya wildemannii* GHESQUIÈRE in Rev. Zool. & Bot. Afr., XIII, p. B 29 (1926); type: Ghesquière 62 (BR!).

1928: F.W.T.A., 1st ed., I, p. 490

1936: Aubréville, F.F.C.I., 1st ed., II, p. 118–124

1937: Dalziel, U.P.W.T.A., p. 324

1946: Kinloch, Silv. Notes Gold Coast Trees, p. 49

1951: Eggeling & Dale, Ind. Trees Uganda, p. 185

1955: Normand, A.B.C.I., II, p. 70; Pl. LXXXIII

1958: F.W.T.A., 2nd ed., I, p. 699

1958: Fl. Congo Belge, VII, p. 176

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 147–156

1959: Kryn & Fobes, Woods of Liberia, p. 59

1960: Taylor, Syn. Silv. Ghana, p. 201

1961: Irvine, Woody Plants of Ghana, p. 520

LOCAL NAMES: bee-a nasa (Gio); doetue (Krahn)

TRADE NAME: Acajou-blanc

GEOGRAPHICAL DISTRIBUTION: Guinea – Uganda and Angola

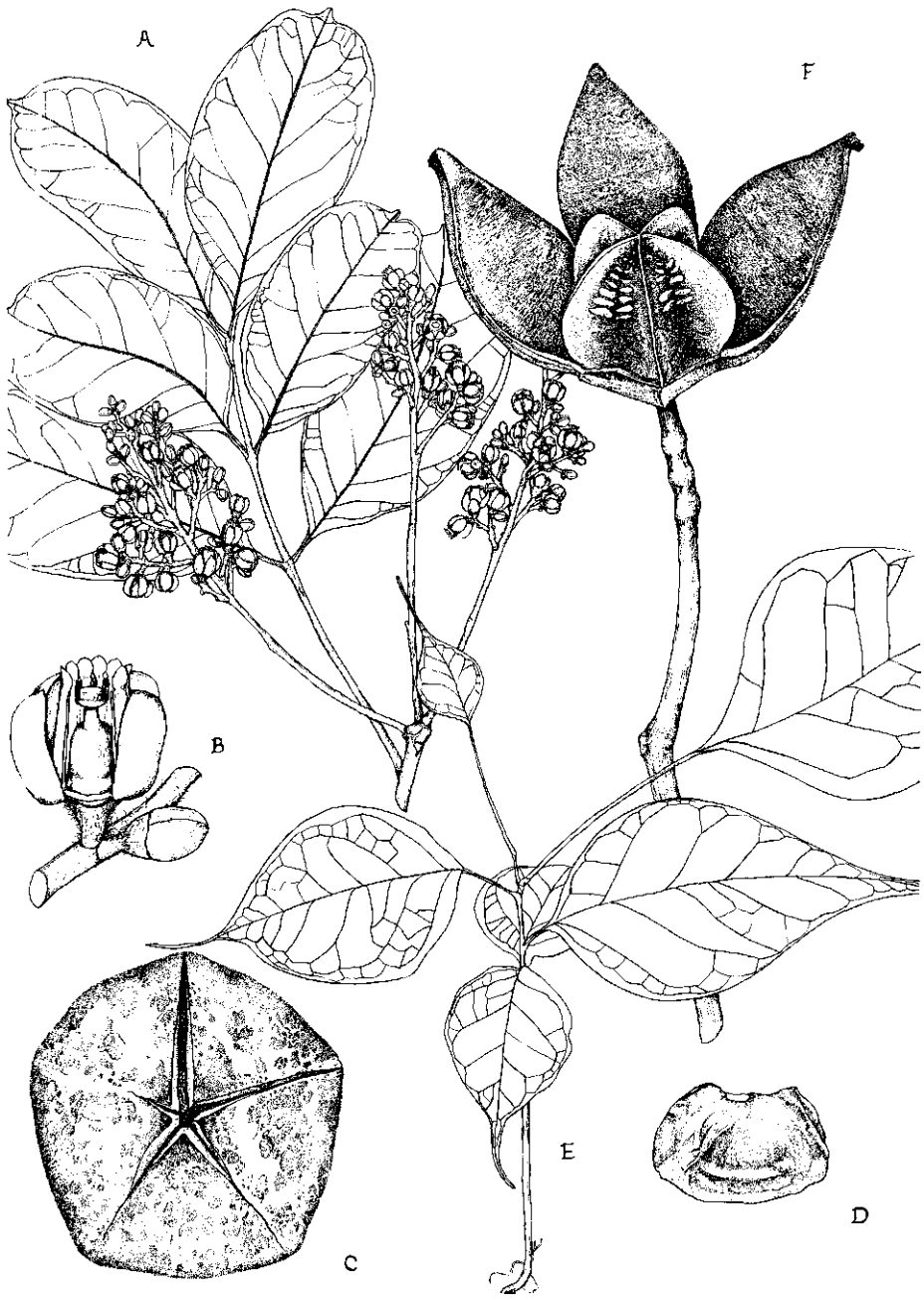


Fig. 50. *Khaya anthotheca* (WELW.) DC. A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: closed fruit, top view ( $\times \frac{1}{2}$ ); D: seed ( $\times \frac{1}{2}$ ); E: seedling ( $\times \frac{1}{2}$ ); F: open fruit of *Khaya ivorensis* A. CHEV. ( $\times \frac{1}{2}$ ).



**BOTANY.** A large or emergent tree. Branchlets and leaves glabrous. Leaves paripinnately compound, alternate, more or less in terminal tufts, with 2–4, usually 3 pairs of (sub)opposite leaflets, bright green above, mat pale green beneath. Petiole 3.5–7 cm long, slightly swollen at base, more or less flattened above; rachis 2–10 cm long. Petioles 0.5–1.2 (–1.8) cm long, slightly grooved above. Leaflets elliptic, oblong or obovate, 5–10 (–15) cm long, 2.5–5.5 cm wide, the middle pair usually largest. Base (broadly) cuneate, unequal-sided, the distal side often more obtuse. Apex obtuse with a blunt caudate tip of 2–5 mm long. Midrib flat above, prominent beneath, often slightly excentric towards the proximal edge. Nerves flat above, slightly raised beneath, 5–8 pairs. Veins faint, reticulation dense, finely impressed beneath. Leaves of saplings much larger, with more and larger leaflets.

Inflorescences: 6–25 cm long, glabrous racemes or panicles, several together crowded at the end of the branchlets. Bracts present as c. 1 mm long, persistent scales. Pedicel c. 1.5 mm long. Sepals 4–5, imbricate, very broadly ovate, c. 1 mm long, 2 mm wide, with a membranous margin. Petals 4–5, imbricate in bud, elliptic, 4–5 mm long, 3–4 mm wide, concave, white. Stamens united in a 3–5 mm long staminal tube, crowned by 8, 9 or 10 lobes, imbricate in bud, spreading at anthesis. Anthers 8, 9 or 10, attached inside the staminal tube, alternating with the lobes, stipitate on an 0.5 mm long filiform stipe, dorsifixed, c. 1 mm long, with 2 apiculate, parallel thecae, opening with slits. Disc intrastaminal, c. 1 mm thick. Ovary sessile, conical, 1–2 mm long and thick, 4–5 locular, each locule with  $\infty$  ovules. Style c. 1 mm long and thick. Stigma capitate, c. 1 mm thick, 1.5 mm across, not exerted above the staminal tube.

Fruit a smooth, grey, woody capsule, slightly appressed globose, 5–7 (–8) cm thick, 6–8 (–10) cm across, more or less 4–5 angular, standing erect on a c. 5 mm long, stout stalk, opening with 4 or 5 spreading valves. Columella 2.5–3.5 cm long, markedly 4–5 winged. Seeds, including the broad membranous wing, transversely oblong, 2–2.5 cm long, 3.5–5 cm wide, very thin, bright brown, sessile, packed above each other between the wings of the columella.

Seedling: germination epigeal, but the hypocotyl does not develop and the cotyledons remain enclosed in the testa. Epicotyl 5–8 cm long, red when young. First 2 leaves opposite, simple. Petiole c. 2 mm long. Blade broadly ovate, including the long-caudate tip c. 5 cm long, 3 cm wide. Following leaves progressively larger, markedly long-caudate, with a slender, up to 5 cm long petiole. Pinnate leaves developing later.

**TAXONOMICAL NOTES.** The isotype of *Khaya anthotheca* in the British Museum (BM!) has 6 pairs of leaflets, the isotype in Kew (K!) 5 pairs.

*Khaya anthotheca* is narrowly related to *K. ivorensis* A. CHEV.. The occurrence of this species has not been checked by the author through collection of sample material, but reports of timber cruisers, working S. of the Gbi National Forest mention the tree. Karl Mayer (9) reports the tree from the Dugbe river drainage (eastern province). All my *Khaya* collections concern *K. anthotheca*, and the occurrence of *K. ivorensis*

still needs further confirmation. It is distinct from *K. anthotheca* in having (4–) 5–6 (–7) pairs of leaflets. The texture of the leaflets closely resembles that of *K. anthotheca*, but the petiolule is only c. 6 mm long, the base as a rule is rounded, and the caudate tip is 0.5–1 cm long. The fruit of this species has a stout stalk of c. 2 cm long, and may be markedly apiculate. The bark of the tree is pitted owing to the shedding of circular scales, and the slash is red with a pink inner layer, scented and bitter.

The present descriptions and figures are based on the following specimens: *Khaya anthotheca*: Liberia: N. Gio Nat. For. 150, 202; Tapeta area 1129; Ivory Coast: Leeuwenberg 3744. *Khaya ivorensis*: Ivory Coast: Leeuwenberg 3955.

**FIELD NOTES.** *Khaya anthotheca* is a large or emergent tree of up to 45 m ( $\approx$  150') and over, which may attain a diameter above the buttresses of over 1.20 m ( $\approx$  4'). The base of the tree has low or well-developed buttresses, which are straight or concave and fairly thick, up to 3 m ( $\approx$  10') high, sometimes extending in far-spreading plank-like surface roots. The bole is straight or cylindrical or somewhat sinuous, up to 25 m ( $\approx$  80') or more to the first branches. The crown is rounded with stout branches. The bark is smooth and grey or, especially on older trees, peeling off with small circular scales of c. 2 cm ( $\approx$  3/4") in diameter, leaving shallow, walled pits of a yellow or light brown colour. This gives the tree a markedly pitted and patchy habit. The slash on the buttresses is pink, on the bole pinkish red – bright red, moist, brittle outside, fibrous inside, faintly scented or not, slightly bitter when tasted or not.

In Liberia the tree is found mostly in the moist semi-deciduous forest, more or less north of a line Putu – Suakoko. Data concerning the western province are not available. In the eastern province values ranging from 13–36 trees  $>$  60 cm ( $\approx$  24")  $\varnothing$ /sq. mile were recorded in the drier forest types. The tree grows scattered, often in the vicinity of water, on slopes towards creeks and river borders. The flowering season seems to be divided over two periods: September–October and January–February. Ripe fruits were found during January. The opened fruits stand like stars upright in the crown of the tree. A deciduous tree was observed during February; new leaves are pale green. *Khaya ivorensis* (see taxonomical notes) is distinct from *K. anthotheca* in having longer leaves, with more leaflets, a more scaly bark habit, a scented and bitter slash. It is a tree of the evergreen forest. *Khaya anthotheca* may occasionally be mistaken for *Entandrophragma angolense*, when the latter species has a finely scaly bark habit. The slash of this tree, however, is interspersed with vertical white stripes, and the leaves have 7–10 pairs of leaflets, which make distinction of mature trees easy. Younger trees of *Khaya* which still have large leaves with numerous pairs of leaflets may be difficult to separate from a young *Entandrophragma angolense*, which also has larger leaves.

**SILVICULTURE.** There are c. 2000 seeds per pound. Seed collection is difficult, because the seeds are widely dispersed by wind and attacked by insects when come down. The

germination percentage of fresh seeds is high, c. 70 %, but viability decreases rapidly. Germination takes 8–20 days. In the nursery seeds should be covered by only a thin layer of soil or be partially uncovered. Too deep sowing reduces germination results. Seed beds are lightly shaded or without shading. Transplanting in line plantings or taungya is practised with stumps or striplings, the latter giving better results. The growth habit of young trees is to form a long, slender bole with a small crown, until the upper canopy is reached. Then the crown expands and diameter growth increases. Overhead light is therefore necessary for successful plantations. *Khaya anthotheca* is more a light demander than *K. ivorensis*. The latter species might be more suitable for plantations in the evergreen forest zone. A drawback of the culture of *Khaya* is that young plants are susceptible to attack by a topshoot borer, *Hypsipyla* sp. Insufficient side shade and too dense planting are reported to stimulate attack.

USES. *Khaya anthotheca*, also known as Acajou blanc, does not produce as good a timber as *K. ivorensis*, the true African Mahogany or Africa-Acajou. It is slightly heavier, the texture coarser; it is in demand on the timber market and the demand will probably increase when stocks of *K. ivorensis* become exhausted. It is used for plywood, furniture, panelling and interior work.

*Lovoa trichilioides* HARMS

[21, 51/42, 123]

'*Lovoa*': referring to the river Lovoi in Congo, where the type specimen was collected.

'*trichilioides*': resembling *Trichilia*; *Trichilia* BROWNE is an other genus of *Meliaceae*. Its name (from the Greek word tricha, divided into three) refers to its, as a rule 3-locular, fruit (but not so in *Lovoa*)

Harms in Bot. Jahrb., 23, p. 165 (1896); type: Marques 232 (COI); Harms in Nat. Pfl.fam., 2nd ed., 19 B 1, p. 74 (1940, lit!); Staner in Bull. Jard. Bot. Bruxelles, 16, p. 246 (1940); Pellegrin in Not. Syst., 9, p. 34 (1939);

*L. klaineana* PIERRE ex SPRAGUE, Journ. Linn. Soc., 37, p. 509 (1906); type: Klaine 1440 (K!, BM!, P!, BR!);

*L. pynaertii* DE WILDEMAN in Ann. Mus. Cgo Bot., S. V, II, p. 260 (1908); type: Lebrun 493 (BR!);

*L. corbisieriana* STANER, Rev. Zool. Bot. Afr., XIX, p. 428 (1930); type: Lebrun 1001 (BR!);

*L. leplaenana* STANER, l.c., p. 430 (1930); type: Lebrun 1065, 1066 (K!, BR!);

*L. mildbraedii* HARMS in Notizbl. Bot. Gart. Berlin, VII, p. 225 (1917); type: Mildbraed 8469 (BR!);

*L. angulata* HARMS, l.c. (1917); type: Mildbraed 8800 (BR!).

1928: F.W.T.A., 1st ed., I, p. 493 (*Lovoa klaineana*)

1933: Chalk & Burtt Davy, Twenty W. Afr. Timber Trees, p. 59 (*Lovoa klaineana*)

1936: Aubréville, F.F.C.I., 1st ed., II, p. 133 (*Lovoa klaineana*)

1936: Kennedy, F.F.S.N., p. 164 (*Lovoa klaineana*)

1937: Dalziel, U.P.W.T.A., p. 326 (*Lovoa klaineana*)

1946: Kinloch, Silv. Notes Gold Coast Trees, p. 52 (*Lovoa klaineana*)

1948: Bois & For. Trop. 5, p. 41 (*Lovoa klaineana*)

1955: Normand, A.B.C.I., II, p. 73; Pl. LXXXV (*Lovoa klaineana*)



21. *Lovoa trichiloides* HARMS (see page 274).



22. *Antiaris toxicaria* (RUMPH. ex PERS.) LESCH. var. *welwitschii* (ENGL.) CORNER. Note the lenticellate bark (see page 284).

1958: F.W.T.A., 2nd ed., I, p. 702

1958: Fl. Congo Belge, VII, p. 194

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 166

1959: Kryn & Fobes, Woods of Liberia, p. 65

1960: Taylor, Syn. Silv. Ghana, p. 208 (*Lovoa klaineana*)

1961: Irvine, Woody plants of Ghana, p. 524

LOCAL NAMES: blitue (Krahn)

TRADE NAME: Dibetou

GEOGRAPHICAL DISTRIBUTION: From Sierra Leone to Angola

**BOTANY.** A large forest tree. Branchlets glabrous, smooth or with longitudinal lenticels. Leaves pari- or imparipinnately compound, alternate, glabrous, with (2-) 3-5 (-7) (sub)opposite pairs of leaflets. Petiole 3-7 cm long, flattened and narrowly winged above, only slightly swollen at base. Rachis (1.5-) 4-14 (-19) cm long, flattened above and narrowly winged, especially just below the petiolules. Petiolules 2-4 mm long, grooved above. Leaflets (narrowly) elliptic- (-) obovate, (3-) 6-20 cm long, (1.5-) 3-8 cm wide, the lowest pair smallest, the terminal largest, dark glossy green above, thick coriaceous. Base (broadly) cuneate. Margin entire, decurrent at base, distinctly revolute. Apex obtuse - obtusely acuminate, the extreme tip retuse. Midrib flat above, prominent beneath, often slightly recurved, the blade slightly folded. Nerves flat above, raised beneath, 8-14 pairs, ascending, slightly curved, looping c. 2 mm from the edge. Reticulation faint. Leaves of young trees much longer, up to 1 meter, with more and larger leaflets. Shed leaves drying dark reddish brown.

Inflorescences (sub) terminal, paniculate, 15-40 cm long, glabrous, the lower branches subtended by reduced, caducous leaves. Peduncles ribbed. Bracts minute, 0.5 mm long scales. Pedicels c. 1 mm long, articulate at base. Sepals 4, imbricate, transversely elliptic, c. 1 mm long, 2 mm wide. Petals 4, imbricate in bud, spreading at anthesis, elliptic, 4-6 mm long, c. 2 mm wide, white. Filaments united in a cylindrical staminal tube, c. 2.5 cm long, more or less dentate at the edge. Anthers 8, attached on the rim of the tube, (sub) basifixed, introrse, c. 1 mm long, opening with slits. Disc intrastaminal, slightly swollen, orange. Ovary sessile, globular, 4-locular; style c. 1 mm long, stout; stigma globose.

Fruit a spindle-shaped, 3.5-5 (-6) cm long, 1-1.5 cm thick, purplish black capsule, 4-sided, rounded at both ends, swollen at base, opening with 4 coriaceous valves from the base, each valve covering 1-2 (-4) winged seeds. Seeds c. 6 mm broad, slightly impressed above each other in the soft tissue of the pale brown, quadrangular columella, attached to the top of the columella by the end of the 2-3 cm long, c. 7 mm wide wing.

Seedling: germination epigeal. Hypocotyl 3-4 cm long, green. Cotyledons often remaining within the testa, sessile, c. 8 mm long, 6 mm wide. Epicotyl 2-3 cm long. First 2 leaves opposite, pinnate with 2 pairs of leaflets. Petiole and rachis markedly winged, rachis elongated by a winged point. Leaflets sessile, ovate, 1-2 cm long, 0.8-1 cm wide. Following leaves alternate, progressively larger and with more pairs of leaflets.

**TAXONOMICAL NOTES.** Many species of *Lovoa* HARMS have been described, with the leaves as main differentiating character. However, the great variability of the vegetative parts makes it impossible to attach much value to these characters. The actual number of species is probably about three: *Lovoa trichilioides* HARMS in the given distribution area, *L. swynnertonii* E. G. BAKER in Congo, and *L. brownii* SPRAGUE in Uganda.

The present description is based on the following collections: Bong Range 766; Bassa III, Siga 707; Blepie, W. of Tapeta 299; Ganta, Harley s.n.; Kanweake 1022.

**FIELD NOTES.** *Lovoa trichilioides* is a large or emergent forest tree, reaching a height of 45 m ( $\approx 150'$ ) or more, and attaining a diameter of 1 m ( $\approx 3.5'$ ) or more. The base of the tree has concave, thick buttresses, 1–1.5 m ( $\approx 3$ –5') high but sometimes higher, extending as narrow butt flares up to 3 m ( $\approx 10'$ ); there may be heavy, spreading surface roots. The bole is straight and cylindrical, up to 25 m ( $\approx 80'$ ) to the first branches. The crown is rather heavily branched, fairly open, not very large on younger trees, expanding and dome-like on emergent trees. The medium thick bark is rather smooth and grey on younger trees, grey brown or dark brown and scaly on older trees. Scales are as a rule small, leaving undep pits, or larger, leaving brown, ridged scars. Brown, scattered lenticels are common. The fibrous slash ranges from pinkish red to red-brown, with a thin white layer against the cambium and white vertical streaks of dilatation tissue; it is moist and has a strong cedar-like scent. In the forest the tree is easily detected by the shed, diagnostic leaflets.

*Lovoa* is found throughout Liberia in the high forest, mostly scattered, sometimes in small groups. In the Nimba mountains it was observed up till 810 m ( $\approx 2700'$ ) above sealevel. It seems to prefer good, humid, deep soils. The tree seems to be more common in the wetter forest types. In the evergreen forest it may average 30 exploitable trees/sq. mile, which figure may rise locally to 65; in the moist semi-deciduous forest the average is 15, ranging from 6–30. The tree is evergreen. Flowering takes place in November–December; at this time the crown of the tree is a white mark in the landscape. Fruits are ripe in February–March. As a rule fruits open on the tree; however, unopened fruits are often found in abundance under the tree; when dropping the winged seeds start turning like a horizontal propeller, thus sailing far from the mother tree. Regeneration in the high forest and adjacent low bush may be rather abundant locally. The saplings are able to stand shade for a long period; when the overhead canopy is opened, they start to grow vigorously, forming a long, slender bole, terminated by a small crown of very large leaves.

**SILVICULTURE.** *Lovoa* is one of the few valuable timber species, native to the evergreen forests of Liberia. It is therefore one of the species most suitable for regeneration and enrichment programmes, eventually to be carried out by the Liberian Bureau of Forest Conservation.

The collection of seeds is apt to be difficult, because top seeding years occur every

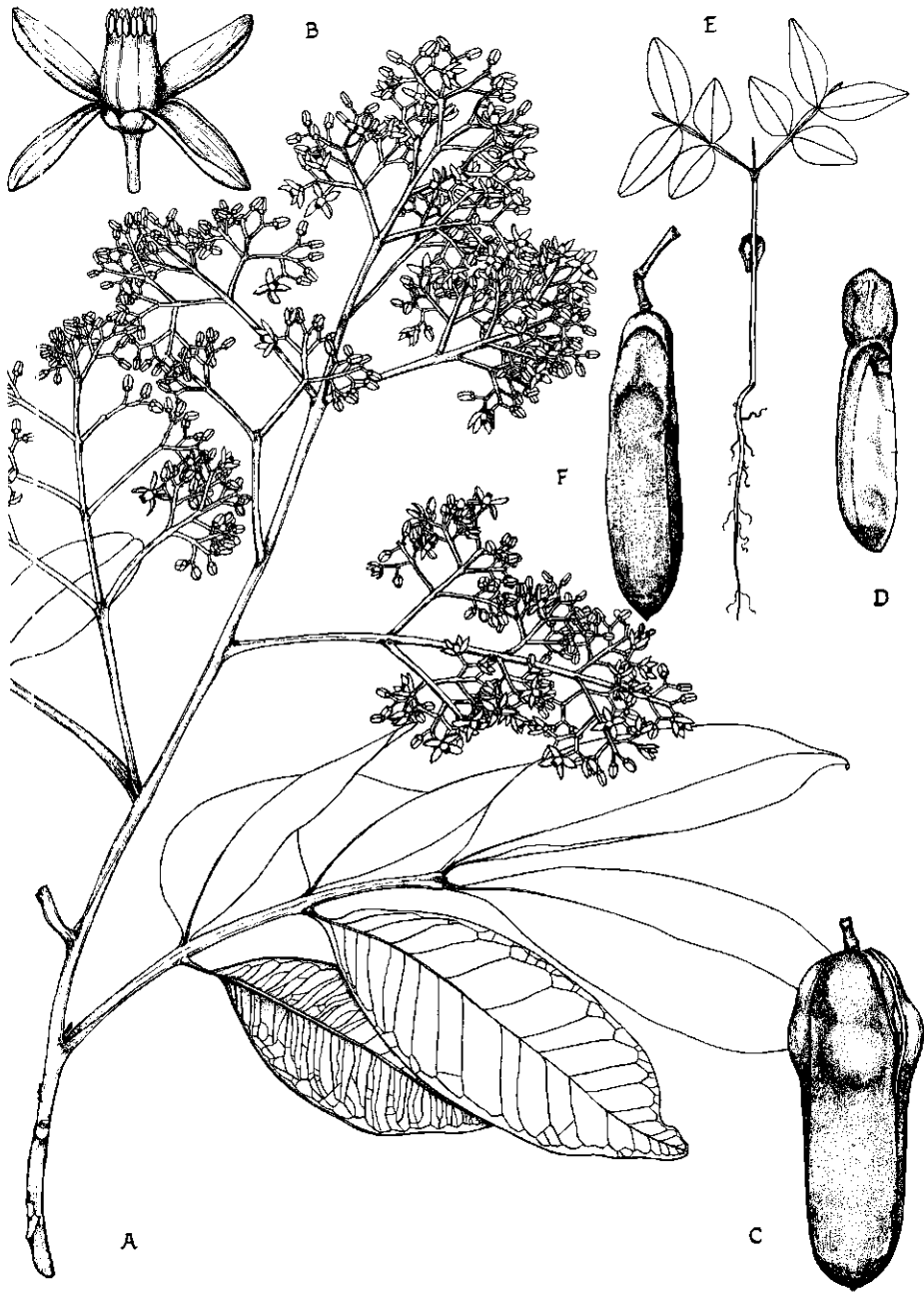


Fig. 51. *Lovoa trichilioides* HARMS A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 4$ ); C: fruit ( $\times 1$ ); D: seed ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ); F: columella ( $\times 1$ ).



3–4 years, seed production is spread over a few weeks, and the winged seeds are carried far from the mother tree by wind. In addition most of the seeds are attacked by insects as soon as they come down. Collection of the dropped, unopened fruits is possible, provided the fruits are opened immediately and the healthy seeds taken out, because these fruits are often attacked by insects. Fresh seeds have a high germination percentage, but viability decreases rapidly. Germination takes 10–16 days. When to procure seeds is impracticable, seedlings can be collected from the forest with good results. The markedly winged rachis of the pinnate leaves makes possible the correct identification of *Lovoa* seedlings. Transplanted in a nursery they should be watered abundantly. The first three to four months growth is slow but increases afterwards. After one year saplings may be 1–2.5 m ( $\approx$  3–8') high. Transplanting in the forest can be carried out with stumps, or striplings of c. 1.50–1.80 m (5–6') high. The planting lines should be given good overhead clearance. Growth is vigorous and in a few years the crown may extend above the competing secondary bush, provided the plantation is well looked after.

USES. Though often referred to as 'African Walnut', *Lovoa* has no connections with true walnut and no characters of the wood may be deducted from the name except the colour, which is yellowish brown with dark veins, suggesting true walnut. The wood is moderately hard and moderately heavy. The grain is usually interlocked, giving a marked ribbon stripe on the quarter. Texture is moderately coarse. When stacked properly, the wood air-seasons without difficulties. It is moderately resistant to decay and termites, but subject to damage by ambrosia beetles. It is extremely resistant to impregnation. The wood is fairly easy to work with hand and machine tools, when tools are kept sharp; it finishes cleanly. It is used for furniture, cabinet work, panelling, high class joinery. It produces a decorative veneer.

*Turraeanthus africanus* (WELW. ex DC.) PELLEGR.

[52/123, 258]

'*Turraeanthus*': Gr. anthos: flower; '*Turraea* resembling flower'. *Turraea* L. was named after one Prof. Turra, Director of the Botanical Garden at Padua (Italy) in the middle of the 17th century.

'*africanus*': referring to Africa.

Pellegrin, Not. Syst., 2, p. 16 & 68 (1911); *ibid.*, l.c., 9, p. 8 (1940); Harms in Engl. & Prantl, Pfl.fam., 19 B 1, p. 149 (1940); Staner in Bull. Jard. Bot. Bruxelles, 16, p. 210 (1940);

*Guarea africana* WELW. ex DC., in Monogr. Phan., I, p. 576 (1878), basionym; type: Welwitsch 1306 (BM!);

*T. zenkeri* HARMS in Bot. Jahrb., 23, p. 156 (1896); type: Zenker 763 (K!);

*Bingueria africana* (WELW. ex DC.) A. CHEVALIER in Vég. Util., 5, p. 189 (1909);

*T. vignei* HUTCH. & DALZ. in F.W.T.A., 1st ed., I, p. 496 (1928); type: Vigne 948 (K!);

*T. klainei* PIERRE ex DE WILDEMAN in Ann. Mus. Cgo Bot., Ser. V, I, p. 272 (1906); type: Klaine 961 (K!);

*T. malchairsi* DE WILDEMAN in Et. Fl. Bang. & Ub., p. 332 (1911); type: Malchair 281 (BR!).

- 1928: F.W.T.A., 1st ed., I, p. 495 (*T. vignei* + *T. zenkeri*)  
 1931: Cooper & Record, Evergr. For. Liberia, p. 91  
 1936: Aubréville, F.F.C.I., 1st ed., II, p. 126  
 1937: Dalziel, U.P.W.T.A., p. 330 (*T. vignei*)  
 1946: Kinloch, Silv. Notes Gold Coast Trees, p. 54  
 1955: Normand, A.B.C.I., II, p. 74; Pl. LXXXVIII  
 1956: Bois & For. Trop. 49, p. 19  
 1958: F.W.T.A., 2nd ed., I, p. 707  
 1958: Fl. Congo Belge, VII, p. 200  
 1959: Aubréville, F.F.C.I., 2nd ed., II, p. 158  
 1960: Taylor, Syn. Silv. Ghana, p. 210  
 1961: Irvine, Woody Plants of Ghana, p. 532

LOCAL NAMES: payee (Krahn); the name blimah-pu, as given by Cooper, possibly refers to a *Trichoscypha* species and is a Gio name.

TRADE NAME: Avodiré

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Angola

**BOTANY.** A medium-sized, rarely large tree. Branchlets and petioles densely rusty puberulous when young, glabrescent. Terminal bud enclosed by the broadened petiole base of the developing leaf. Leaves clustered in lax groups at the end of the branches, pinnately compound, alternate, with 8–24 (–30) alternate or subopposite leaflets. Petiole 5–17 cm long, swollen and slightly winged at base, flat or slightly grooved, with 2 more or less developed ridges above. Rachis 8–50 cm or longer. Leaflets progressively larger from the base to the top of the whole leaf, glossy dark green above, paler beneath, coriaceous. Petiolules 0.2–1 (–1.5) cm long, grooved above. Blade narrowly oblong, 6–25 cm long, 2–5.5 (–8) cm wide. Base rounded – cuneate. Margin entire, decurrent, more or less revolute. Apex rounded – acute with a caudate tip of 0.5–1 cm long, of which the margins are folded. Midrib impressed above, very prominent beneath. Main nerves 10–25 (–30) pairs, slightly prominent beneath. Reticulation of veins rather faint.

Inflorescences: lateral panicles, up to 70 cm long, on older branches. Peduncles and pedicels densely rusty tomentellous. Bracts present as minute scales. Pedicel c. 2 mm long, articulate at base. Calyx synsepalous, saucer-shaped, 1–1.5 mm high, the edge truncate, densely pale brown-greenish tomentose outside. Petals 5, united in an 1.5–2 cm long, c. 0.5 cm wide tube, crowned by 5 obovate corolla lobes, c. 8 mm long, c. 5 mm wide, valvate in bud, spreading at anthesis. Corolla densely creamy tomentose outside; inside long pubescent with the hairs pointing downwards at the lower part of the tube. Staminal tube partly adnate to the corolla tube, the free part c. 5 mm long, implanted in the throat of the corolla tube, glabrous, creamy yellow, with a slightly undulate edge. Anthers attached inside the staminal tube, sessile, the upper part just exerted above the edge. Ovary conical, c. 3 mm wide at the base, gradually tapering into the c. 2 mm long, 1.5 mm thick style, 5-locular, each locule with 2 ovules and a rim of hairs. Ovary and style densely tomentose. Stigma peltate, 0.5 mm thick, 2 mm across, slightly exerting from the staminal tube.

Fruit a subglobose capsule, puberulous, glabrescent, 2–5 lobed, impressed at the top, with a thick coriaceous exocarp, orange when ripe, opening at the top, containing 2–5 seeds. Seeds rounded triangular on cross-section, 1.8–2.5 cm long, c. 1.2 cm across, enclosed in a yellow aril.

Seedling: germination hypogeal. Epicotyl c. 6 cm long, dull green. Leaves alternate. First leaf simple; petiole c. 6 mm long, finely grooved; blade elliptic, 5–8 cm long, c. 2–2.5 cm wide, with a long caudate tip. Following leaves simple, progressively larger, characterized by the long caudate tip. Pinnate leaves formed later.

TAXONOMICAL NOTES. Harms (1940, l.c.) summarizes all described species of *Turraeanthus* BAILL., some of which are synonyms of *T. africanus*. However, a revision is needed to clarify some remaining doubtful points in the taxonomy of this genus.

The present description and figures are based on the following collections: Liberia: Nimba 1169; Bong Range 1174. Ivory Coast: de Wilde 3133, Leeuwenberg 3751.

FIELD NOTES. *Turraeanthus africanus* is a medium-sized tree, rarely growing up to 35 m ( $\approx 120'$ ) high or attaining a diameter of 1 m ( $\approx 3.5'$ ). The base of the tree has low, thick root spurs or small buttresses up to 1 m ( $\approx 3.5'$ ) which on old trees may extend in widespread surface roots and in heavy ridges on the stem. The bole may reach a free height of 18 m ( $\approx 60'$ ) but as a rule it is shorter, rarely straight, usually slightly sinuous. The crown is irregular with ascending branches, very characteristic by the terminal clusters of long, pinnate leaves. The bark is fairly smooth, vertically and shallowly grooved, sometimes with vertical rows of lenticels, grey – light brown, fairly thick, more scaly on old trees. The slash is pale yellow – pale brown, often with scattered white streaks of soft dilatation tissue, moist, brittle – granular outside, fibrous inside, with a strong, sweet cedar-like smell. The wood is soft, yellowish, with a high lustre.

In Liberia *Turraeanthus* may occur in fairly rich stands but as a rule it grows scattered throughout the high forest zone. It is reported to prefer sandy soils. In Nimba it was observed up to 1080 m ( $\approx 3600'$ ) above sealevel. The tree is evergreen. Flowering and fruiting season in Liberia are as yet unknown, but Aubréville reports that flowering, though continuing practically the whole year, is most abundant in March–April; main fruiting season from August–October. Natural regeneration is reported to be abundant under the mother tree; in its initial stages it needs a dense shade and a moist soil. More light is needed for a healthy development of the saplings, though it is essentially a shade bearing species.

For its smell, clear bark and slash *Turraeanthus* should not be confused with *Entandrophragma cylindricum*, which tree has marked ripple marks in the cambium and wood, and much shorter leaves. Certain *Trichoscypha* species have a crown habit, resembling *Turraeanthus*: very long pinnate leaves, in terminal clusters. The slash of both trees, however, is diagnostic, that of *Trichoscypha* being red-brown, slowly exuding an ochre-coloured, thick gum, and not scented.

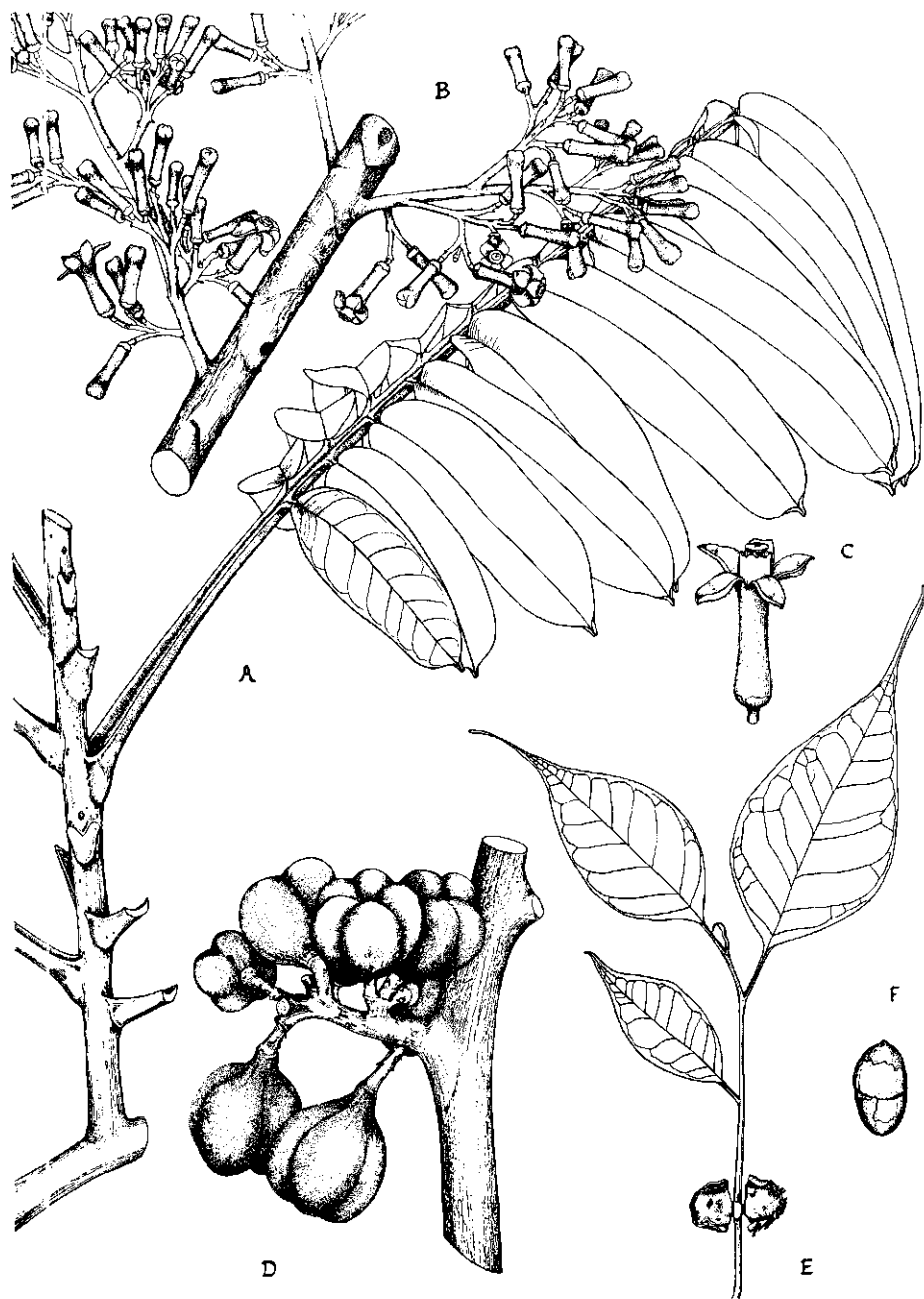


Fig. 52. *Turraeanthus africanus* (WELW. ex DC.) PELLEGR. A: leaf ( $\times \frac{1}{2}$ ); B: inflorescence ( $\times \frac{1}{2}$ ); C: open flower ( $\times 1$ ); D: fruits ( $\times \frac{1}{2}$ ); E: seedling ( $\times \frac{1}{2}$ ); F: seed ( $\times \frac{1}{2}$ ).

**SILVICULTURE.** There are c. 400 seeds to a pound. Seeds should be sown fresh, as they have a short viability. Germination per cent is high, 80 % in about 5 weeks or less; seed beds should be well-shaded. Collection of seedlings from the forest is difficult as the tender seedlings are susceptible to drought. This shade bearing species might be used as a second culture under light demanding species. If there is too much light, trees tend to branch heavily.

**USES.** The sapwood is not distinct from the heartwood. The wood has a light yellow colour and is very lustrous. It is fairly light, Sp. G. c. 0.55, soft and fine-grained. It works little with changing humidity. It is rapidly and fairly easily sawn. It is an excellent timber for light carpentry and furniture making, and provides a pleasant light veneer.

## MORACEAE

A large, tropical and subtropical family of woody plants, rarely herbs, as a rule with latex. Leaves simple, rarely digitately compound, pinnately – or palmately nerved, alternate, stipulate. Flowers unisexual, often dioecious, much reduced, in catkins, heads, disks or hollow receptacles. Perianth segments often 4, or reduced, imbricate or valvate. Stamens often 4, opposite the perianth segments. Anthers 2-celled. Ovary inferior or superior, usually 1-celled, of the 2 carpels 1 often abortive; styles usually 2, or 1 reduced. Ovary as a rule solitary and pendulous. Fruit a small achene, nut or drupe, often part of a larger infructescence.

The most common trees of this family in the Liberian high forest are: *Antiaris toxicaria* (RUMPH. ex PERS.) LESCH. var. *welwitschii* (ENGL.) CORNER, *Chlorophora excelsa* (WELW.) BENTH., and *Chlorophora regia* A. CHEV., discussed below.

In W. Africa the most characteristic member of this family is *Musanga cecropioides* R. BR. (formerly *M. smithii* R. BR.), the umbrella or corkwood tree (by Corner, see taxonomical notes *Antiaris*, referred to the *Urticaceae*). This colonising, gregarious tree with its characteristic peltately digitate leaves and stilt-roots, often forms pure stands in young secondary forest, along roads and on clearings. It is sometimes used as a shade tree in coffee plantations. It does not grow old and large specimens in older secondary forest are rare.

The genus *Ficus* L. is well-represented in Liberia, both as large tree species (*F. mucoso* WELW. ex FICALHO, a smooth, red-barked tree with copious white latex, turning brown, and *F. exasperata* VAHL, the tree with sand-paper leaves), and as small or straggling trees or epiphytes. These epiphytes eventually totally enclose and kill their host, thus creating the impression of being independent, often very large but hollow trees. When slashed they produce a copious white latex. The fruits of *Ficus* (figs) are often borne in bunches on the stem.

*Treculia africana* DECNE may occasionally be found in the high forest. It is characterized by its extremely fluted bole, and its large, 10–20 cm ( $\approx$  4–8") thick, globular fruits, containing numerous edible seeds resembling the peanut.

*Bosqueia angolensis* FICALHO and *Morus mesozygia* STAPP, both trees of the more deciduous forest type, have been recorded from the area around Diala, near Tapeta.

*Antiaris toxicaria* (RUMPH. ex PERS.) LESCH. var. *welwitschii* (ENGL.) CORNER  
[22, 53 A-D/26]

'*Antiaris*': latinized form of the Malayan name 'antiar'.

'*toxicaria*': from toxicum, the Latin form of Gr. toxikon, arrow poison, referring to the fact that in Asia some trees of this species seem to have a poisonous latex.

'*welwitschii*': referring to Welwitsch (1806–1872), an Austrian botanist and professor at Lisbon, who made extensive collections in Angola.

Corner in Gardens' Bulletin, 19, p. 248 (1962);

*Antiaris welwitschii* ENGLER in Bot. Jahrb., 33, p. 118 (1902); type: Welwitsch 2593 (K!);

*Antiaris usambarensis* ENGLER, l.c.; type: Scheffler 216 (K!).

In most works, quoted beneath, the name *Antiaris welwitschii* has been used.

1917: F.T.A., VI, II, p. 224

1936: Aubréville, F.F.C.I., 1st ed., I, p. 41

1948: Fl. Congo Belge, I, p. 93

1950: Normand, A.B.C.I., I, p. 69; Pl. IV

1951: Eggeling & Dale, Ind. Trees Uganda, p. 233

1958: F.W.T.A., 2nd ed., I, p. 613

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 58

1959: Kryn & Fobes, Woods of Liberia, p. 14

1960: Taylor, Syn. Silv. Ghana, p. 244

1961: Irvine, Woody Plants of Ghana, p. 425

LOCAL NAME: kpu (Gio)

TRADE NAME: Ako

GEOGRAPHICAL DISTRIBUTION: West and Central Africa in the evergreen forests

**BOTANY.** A large tree. Young branchlets, buds and leaves puberulous, soon glabrescent. Leaves simple, stipulate, alternate, often somewhat distichous. Stipules about 1 cm long, narrowly ovate, acute, soon caducous, leaving distinct scars at the nodes. Petiole 0.6–1.2 cm long, slightly grooved above. Blade coriaceous, medium green, sub-orbicular or broadly elliptic to ovate, rarely obovate, often more or less oblique, 4–13 cm long, 3–9 cm wide. Base as a rule slightly cordate, sometimes rounded or cuneate, often unequal-sided, with one side cordate and the other side cuneate. Apex obtuse to acute. Midrib and nerves flat or only slightly raised above, prominent beneath, the nerves in 5–12 pairs, looping near the edge. Reticulation of veins hardly raised. Leaves of young shoots and saplings densely hairy or scabrous, more narrowly elliptic, and with a dentate margin.

Tree dioecious, the inflorescences usually at base of short lateral twigs. Male flowers crowded in greenish, c. 6 mm thick heads, on a puberulous peduncle of 8–12 mm long; receptacle flat, surrounded by 2 whorls of c. 1.5 mm long bracts. Perianth segments c. 1.5 mm long, with a linear claw, broadening into the ladle-shaped lamina. Stamens 4, subsessile, c. 1.5 mm long. Female flowers solitary on a short, puberulous pedicel. Style with 2 subfiliform lobes. Fruit a scarlet, velvety drupe, c. 1.5 cm long and 1 cm thick, containing a round or ellipsoid seed.

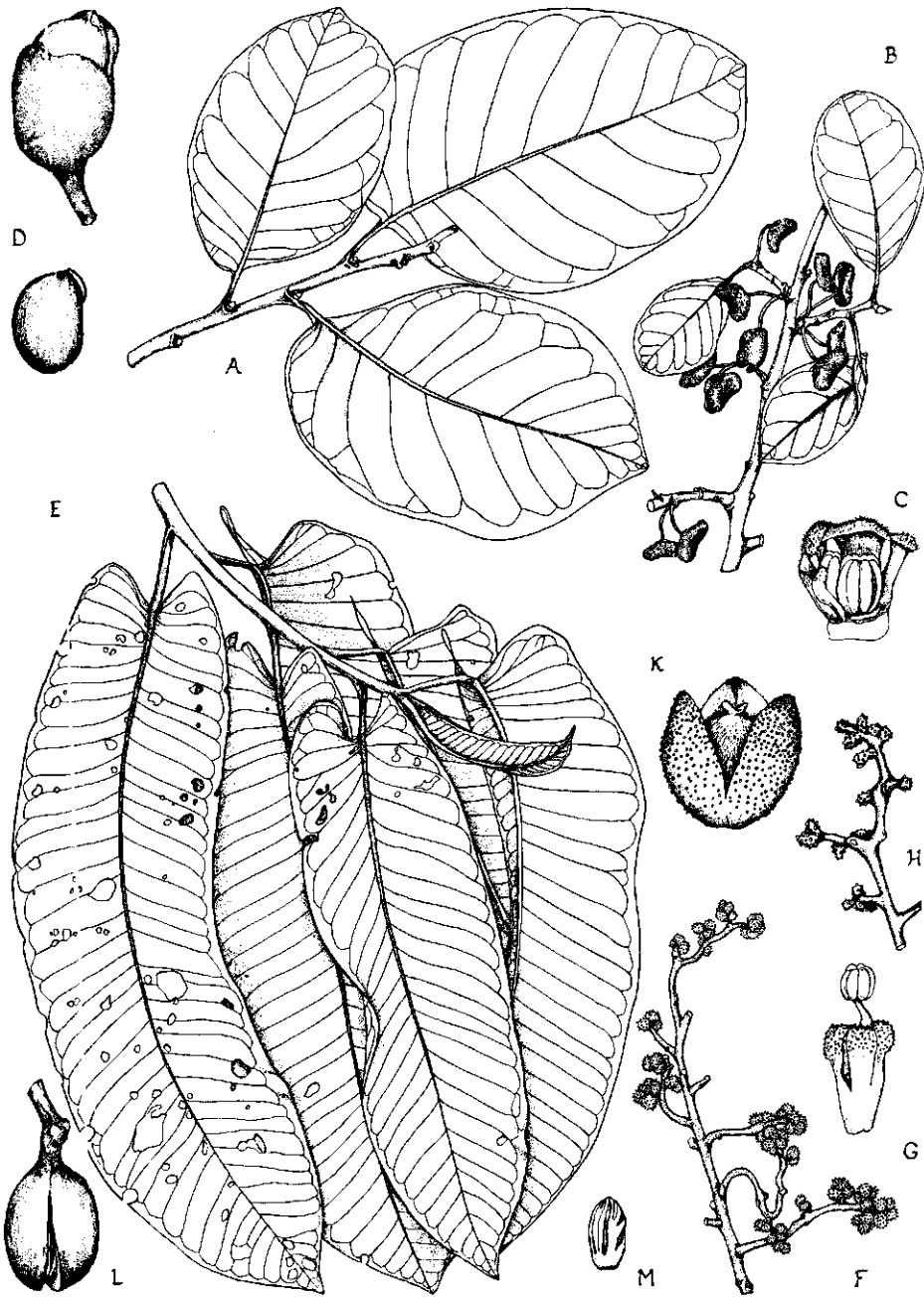


Fig. 53. *Antiaris toxicaria* (RUMPH. ex PERS.) LESCH. var. *welwitschii* (ENGL.) CORNER A: branch with leaves ( $\times \frac{1}{2}$ ); B: male inflorescence ( $\times \frac{1}{2}$ ); C: male flower ( $\times 20$ ); D: fruit and seed ( $\times 1$ ). *Pycnanthus angolensis* (WELW.) WARB. E: branch with leaves ( $\times \frac{1}{2}$ ); F: male inflorescence ( $\times \frac{1}{2}$ ); G: male flower ( $\times 20$ ); H: female inflorescence ( $\times \frac{1}{2}$ ); K: female flower ( $\times 20$ ); L: fruit ( $\times \frac{1}{2}$ ); M: seed ( $\times \frac{1}{2}$ ).



TAXONOMICAL NOTES. In a recent study: 'The classification of *Moraceae*' (Gardens' Bulletin, vol. 19, p. 244–249, 1962), E. J. H. Corner published his review of the genus *Antiaris* L.. He concluded that it was impossible to separate the Asiatic species *A. toxicaria* (RUMPH. ex PERS.) LESCH. and the African *A. welwitschii* ENGL. but for the fact that the latter has fruits 10–15 mm long and 7–12 mm wide, the former fruits 12–25 mm long and 11–20 mm wide. Therefore he reduced *A. welwitschii* to a variety of *A. toxicaria*. Corner refers to *Antiaris kerstingii* ENGL. as a synonym of *A. toxicaria* var. *welwitschii*, but the type drawing (Engl., Veg. Erd, 9, 3 (1), p. 33, 1915) hardly warrants identifying this species either as *A. toxicaria* or as *A. africana*. He maintained the other African species, *A. africana* ENGL., which is distinct from *A. toxicaria* var. *welwitschii* in the leaves, which are scabrid on both surfaces and have a prominent reticulation by veins on the lower surface. *A. africana* is a tree of the drier forest types, hardly represented in Liberia. It is recorded from the Nimba area only. Seedlings and saplings from both species are hardly distinct (see also note on p. 613 in F.W.T.A., 1958).

The present description and figures are based on the following specimens: Liberia: Bong Range s.n.; Loma Nat. For. 708; N. Gio Nat. For. s.n.; Boabli 654. Uganda: Egging 702 (K), Snowden 728 (K). Congo: Toka 26 (WAG).

FIELD NOTES. *Antiaris toxicaria* var. *welwitschii* may reach a height of 40 m ( $\approx 130'$ ), possibly more. The base has well-developed, transversely striate, sharp buttresses, sometimes extending in spreading surface roots. Buttresses up to 8 m ( $\approx 25'$ ) were once recorded on a tree, growing on a steep, rocky slope, but normally they do not exceed 3.5 m ( $\approx 12'$ ). The bole is straight and cylindrical; a free length of 33 m ( $\approx 110'$ ) was once recorded. The crown is fairly small, dome-like. The distichous, often suborbicular leaves give the crown a characteristic pattern. The bark is smooth and thick, grey-greenish, with numerous large, rounded lenticels, often in vertical rows. The slash is ochre-yellow, hard and granular on the outside, very fibrous inside, exuding a watery, creamy latex, turning brown.

*Antiaris toxicaria* var. *welwitschii* is found all over Liberia, but perhaps more common in the moist semi-deciduous forest than in the evergreen forest. The tree seems to be most common in old secondary formations. It prefers well-drained sites. It sheds its leaves for a short period during October–November, and flowers when the tree is still bare or starts to grow new leaves.

Fruits were found during February–March; seed production is copious, and soon there is a prolific regeneration which, in the high forest, is bound to die by lack of light. The ripe fruits attract antilopes and monkeys. The seeds are also dispersed by birds and regeneration in secondary forest may be common.

USES. Formerly the very fibrous innerbark was used to prepare a strong fibrous tissue by beating the bark, loosening it from the bole, and washing out all granular particles. This tissue served for clothing, hammocks, sacks etc.

The wood is soft and light, white or greyish yellow, with little distinction between sapwood and heartwood. It is perishable and has to be converted as soon as possible to prevent staining. It is very permeable to preservatives. It might be a good substitute for imported soft woods, in particular when treated with a preservative. It is used as a general utility timber where lightness and little strength is demanded: doors, benches, canoes, boxes. It peels well and is suitable for locally fabricated plywood.

*Chlorophora regia* A. CHEV.

[23, 54/26, 88]

'*Chlorophora*': Gr. chloros: yellowish green; Gr. pherein: to carry, to bear. Referring to the yellowish green inflorescences.

'*regia*': Latin for royal, referring to the imposing habit of the tree.

A. Chevalier in Bull. Soc. Bot. France, 58, Mém. 8, p. 209 (1912), excl. species from Dahomey; type: Chevalier 12505, holotype (?), 12464, paratype (P!).

- |  |   |
|--|---|
| 1928: F.W.T.A., 1st ed., I, p. 424 (partly, as <i>C. excelsa</i> )         | 1958: F.W.T.A., 2nd ed., I, p. 595            |
| 1931: Cooper & Record, Evergr. For. Liberia, p. 17 (as <i>C. excelsa</i> ) | 1959: Aubréville, F.F.C.I., 2nd ed., I, p. 49 |
| 1936: Aubréville, F.F.C.I., 1st ed., I, p. 34                              | 1959: Kryn & Fobes, Woods of Liberia, p. 29   |
|  | 1960: Taylor, Syn. Silv. Ghana, p. 245        |
|  | 1961: Irvine, Woody Plants of Ghana, p. 428   |

LOCAL NAMES: guuw (Gio); ge-ay (Bassa, cf. Cooper); mulberry tree

TRACE NAME: Iroko

GEOGRAPHICAL DISTRIBUTION: Gambia – Ghana

**BOTANY.** A large tree. Leaves simple, alternate, stipulate. Stipules up to 3 cm long and 1.5 cm wide, parallel-nerved, enclosing the terminal bud, caducous, leaving distinct, but not annular scars on the nodes. Petiole 2–3 (–6) cm long, sparsely pubescent. Blade suborbicular or (broadly) ovate to (broadly) elliptic, 8–18 cm long, 7–14 cm wide, as a rule more or less cordate, sometimes rounded, unequal-sided or oblique at base, acute – acuminate at the top. Midrib flat above, prominent, reddish, and sparsely pubescent beneath, as the 6–10 pairs of prominent nerves. Reticulation of veins very close, but not prominent beneath, glabrous. Leaves of saplings and young trees narrower, with a serrate margin.

Trees dioecious. Male inflorescence a c. 15 cm long, slender, c. 6 mm thick, yellow catkin; stalk of the catkin 1–1.5 cm long, densely pubescent. Peduncle tomentellous, with a longitudinal groove; bracts present, broadly elliptic, 1.5–2.5 mm long, tomentose outside. Flowers sessile; tepals 4, c. 2 mm long, 1 mm wide, membranous, ciliate, tomentose outside. Stamens 4, opposite the tepals, c. 4 mm long, glabrous. Anthers basifixed, with 2 reniform, c. 1 mm long thecae, opening with slits. Ovary rudimentary,

membranous (pistillode). Female catkins green, 5–8 cm long, 1–1.5 cm thick; stalk c. 1.5 cm long, tomentose. Peduncle velutinous. Bracts 1–2.5 mm long, 1–2 mm wide, tomentellous. Flowers sessile; tepals imbricate, 4, 3–6 mm long, obovate, slightly succulent at the top, tomentellous. A fringe of hairs surrounding the pistil. Ovary sessile, flat, c. 2 mm long, ovate, containing 1 ovule; styles 2, but 1 reduced, the other slightly obliquely attached, c. 10 mm long. Infructescence 5–8 cm long, c. 2 cm thick, pulpy, containing numerous, c. 3 mm long, pale brown nuts.

Seedlings are pale green, herbaceous, pubescent. Germination epigeal. Hypocotyl 1.5–2.5 cm long, pubescent. Cotyledons foliaceous, spreading, elliptic, 6–8 mm long, 4 mm wide, with minute stipules. Epicotyl 0.8–1 cm long. First pair of leaves opposite; stipules c. 2 mm long. Petiole c. 3 mm long; blade ovate, 1 cm long, 0.5 cm wide, with a serrate margin. Following leaves alternate, progressively larger, (narrowly) ovate to (–) elliptic, with a serrate margin.

**TAXONOMICAL NOTES.** *Chlorophora regia* is confined to the wet parts of the West African rain forest, whereas *Chlorophora excelsa* (WELW.) BENTH. is found in the more deciduous forest types from Senegal to Mosambique. The two species are mainly different in their leaves, those of *C. excelsa* being more elliptic, with (10–) 14–18 pairs of prominent nerves, a close, prominulous reticulation of veins, and a characteristic indumentum of minute hairs between the veins (visible with a good lens). The female flowers of *C. excelsa* have a rim of hairs around the perianth, but this character may also occur in *C. regia*. The ovary of *C. excelsa* is subsessile. Aubréville (1959, l.c.) states that the style is very obliquely attached in *C. regia*, and only slightly so in *C. excelsa*, but also this character is not constant, and was found quite reverse in the Liberian samples. The male flowers of both species are identical.

Recently E. J. H. Corner (Gardens' Bulletin vol. 19, p. 235–240, 1962) published his review of the genus *Maclura* NUTT., in which he sunk the genera *Chlorophora* GAUD., *Cardiogyne* BUR., and *Cudrania* TRÉC., extending the limits of *Maclura* so that it became a pantropical genus with 12 species. When Corners views are adopted, the correct names for the *Chlorophora* species in Liberia are: *Maclura regia* (A. CHEV.) CORNER, and *Maclura excelsa* (WELW.) BUR. I did not follow Corner, because I did not find in *C. regia* the immersed yellow glands in the tepals, apparently the main character which holds these genera together. It has to be noted that *C. regia*, contrary to Corners definition of his section *Chlorophora*, has a divided style with two arms, one of which is more or less reduced.

The present description and figures are based on the following specimens: *Chlorophora regia*: Paynesville 947; Loma Nat. For. 715; Mtn. Wutivi, v. Dillewijn 32; Sanokole 926; Nimba 1171; Zuole area 170, 180, 248, 1057; Chien area 662; Poli, S.W. of Tobli 564; Kanweake 968. *Chlorophora excelsa*: Loma Nat. For. 716; Baila 874; Poli, S.W. of Tobli 563.

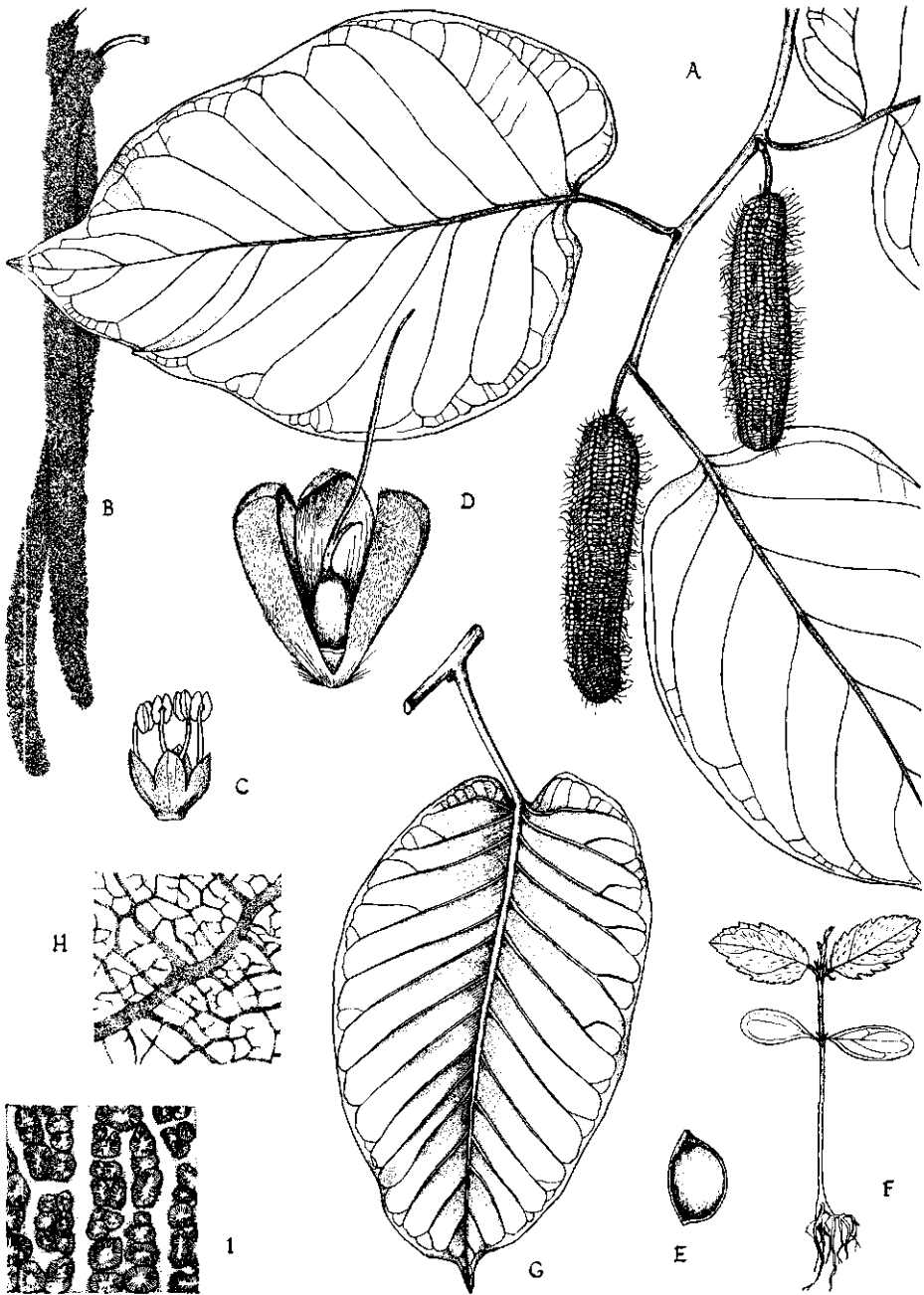


Fig. 54. *Chlorophora regia* A. CHEV. A: branch with leaves and female inflorescences ( $\times \frac{1}{2}$ ); B: male inflorescence ( $\times \frac{1}{2}$ ); C: male flower ( $\times 4$ ); D: female flower ( $\times 4$ ); E: seed ( $\times 4$ ); F: seedling ( $\times 1$ ); G: leaf of *Chlorophora excelsa* (WELW.) BENTH. ( $\times \frac{1}{2}$ ); H: venation of *C. regia* ( $\times 10$ ); I: venation of *C. excelsa* ( $\times 10$ ).

FIELD NOTES. *Chlorophora regia* is found all over Liberia, *C. excelsa* is confined to the moist semi-deciduous forest zone. In the field the trees are not to be separated but for their leaves (see taxonomical notes), and the present notes apply to both species.

*Chlorophora* may grow very large, up to a height of 45 m ( $\approx 150'$ ), and with a diameter over 1.20 m ( $\approx 4'$ ). The base of the tree has very heavy root swellings, often extending in far spreading, heavy surface roots, and in thick, narrow butt flares, sometimes as high as 3.5 m ( $\approx 12'$ ) along the bole. The bole is straight, often somewhat angular, with a free length of 20–25 m ( $\approx 66$ – $80'$ ). The crown has a characteristic deltoid and fastigiate habit, with straight, steeply ascending branches. When fully mature the crown becomes more flattened.

In the forest the bark of *Chlorophora* is dark brown to black, but in open situations it is more grey; it is thick and rough, scaly and pitted or sometimes grooved, often with numerous large, yellow or pale brown lenticels, specially on the spreading surface roots. The slash is as hard as a stone, granular, yellowish brown with white streaks, exuding a white or creamy, sometimes pale yellow latex.

The tree is deciduous for a short period at the beginning of the dry season, and flowers from January–March. The pulpy fruits are found in March–April, but soon perish or are eaten. *Chlorophora* is a light demander, and regeneration is fairly common, specially in such open places as logging roads and low bush. Seedlings resemble those of *Trema guineensis* (SCHUMM. & THONN.) FICALHO, a very common low bush shrub or small tree, of which the leaves are distinctly 3-nerved at base.

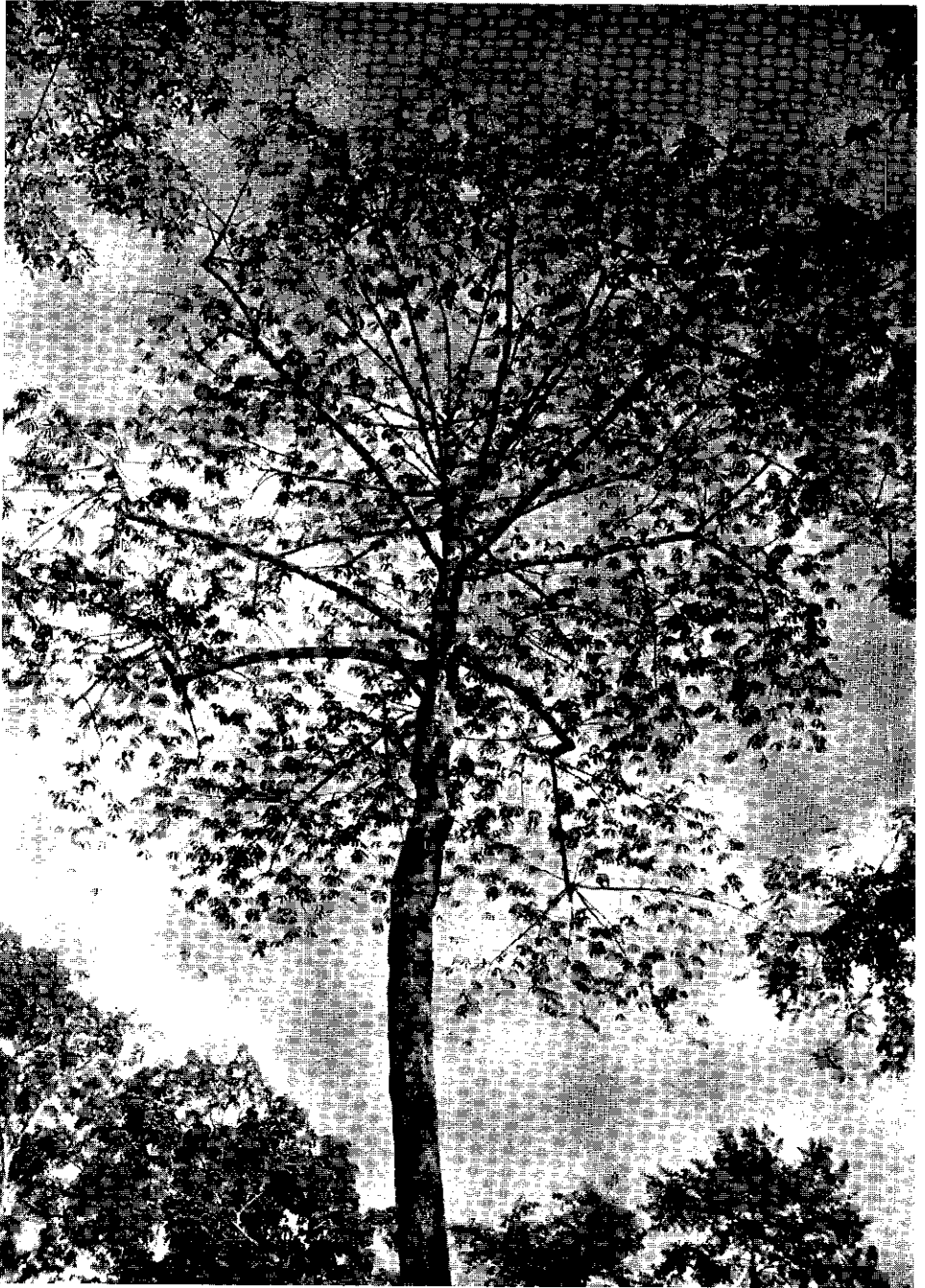
SILVICULTURE. Little is known about the silviculture of *Chlorophora regia*, most efforts being directed towards the culture of *C. excelsa*. The latter species has the drawback of being heavily attacked by a galling insect, *Phytolyma lata* SCOTT, which may severely hamper or even prevent large-scale plantations. I have seen specimens of *Chlorophora regia* in the field which were likewise attacked by a galling insect (I am not sure that it was the same *Phytolyma*), and the cultivation of this tree may suffer from the same difficulties as *C. excelsa*.

USES. The bark of *Chlorophora* is used for several medical purposes (see Harley, Native Afr. Medicin, and Irvine, l.c.).

The wood is moderately heavy, golden brown when dry, sometimes with darker stripes. The sapwood is clearly defined, 5–8 cm ( $\approx 2$ – $3''$ ) wide. The texture is fairly coarse but even, and the grain is interlocked. The wood is slightly oily to the touch. Sawn timber air-seasons well, without trouble from splitting and warping; stickers should be of the same timber to prevent staining. The wood is resistant against fungus and boring insects, though not immune to termites. It works well but cutting edges tend to dull. It is an excellent timber for construction and railway sleepers, parquet, joinery, wagon and coach construction. It renders an attractive sliced veneer. *Chlorophora excelsa* and *C. regia* are traded together.



23. *Chlorophora regia* A. CHEV.. Typical fastigiata crown habit (see page 288).



24. *Pycnanthus angolensis* (WELW.) WARB.. Note the whorled branches and the drooping leaves (see page 290).

## MYRISTICACEAE

A tropical family of trees, rarely climbers, best represented in America and Asia. Leaves entire, pinnately nerved, alternate, estipulate. Flowers unisexual, dioecious, apetalous. Calyx funnel-shaped, 3-lobed, the lobes valvate. Male flower: stamens 1-30, filaments united in a column; anthers 2-celled, free or united in a mass, opening by slits. Female flower: ovary sessile, mounted by a (sub)sessile stigma. Fruit 1-celled, opening with 2 valves, containing an arillate seed. Endosperm often ruminant.

The family is represented in Liberia by two tree species, *Pycnanthus angolensis* (WELW.) WARB. and *Coelocaryon* aff. *oxycarpum* STAPP, and one climber, *Pycnanthus dinklagei* WARB.. The Moluccan nutmeg tree (*Myristica fragrans* HOUTT.) is a member of this family.

*Pycnanthus angolensis* (WELW.) WARB.

[24, 53 F-M/31,32]

'*Pycnanthus*': Gr. puknos: crowded; Gr. anthos: flower; referring to the crowded male flowerheads.  
'*angolensis*': referring to Angola, where Welwitsch collected the type.

Warburg in Notizbl. Bot. Gart. Berl., I, p. 100 (1895);

*Myristica angolensis* WELWITSCH in Syn. Expl. Mad. et Drog. Med., p. 51 (1862), basionym; type: Welwitsch 581 (K, isotype!);

*Myristica kombo* BAILLON in Adansonia, IX, p. 79 (1868); type: Griffon du Bellay s.n., Gabon (P!);

*Pycnanthus kombo* (BAILL.) WARBURG in Nov. Act. Kaiserl. Leop.-Carol. Deutsch Akad. Naturforsch., LXVIII, p. 252 (1897).

1913: F.T.A., VI, II, p. 158 (*P. kombo*, *P. schweinfurthii*, *P. mechowii*)

1927: F.W.T.A., 1st ed., I, p. 64 (*P. kombo*)

1931: Cooper & Record, Evergr. For. Liberia, p. 21 (*P. kombo*)

1936: Aubréville, F.F.C.I., 1st ed., I, p. 124 (*P. kombo*)

1936: Kennedy, F.F.S.N., p. 17 (*P. kombo*)

1937: Dalziel, U.P.W.T.A., p. 11 (*P. kombo*)

1950: Normand, A.B.C.I., I, p. 86; Pl. XVIII (*P. kombo*)

1951: Fl. Congo Belge, II, p. 391

1954: F.W.T.A., 2nd ed., I, p. 61

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 156

1959: Kryn & Fobes, Woods of Liberia, p. 92

1960: Taylor, Syn. Silv. Ghana, p. 258

1960: Keay, Nigerian Trees, I, p. 68

1961: Irvine, Woody Plants of Ghana, p. 29

1961: Centre Techn. For. Trop., Monographie de l'Iloomba, Publ. No. 20

LOCAL NAMES: diehn (Bassa, cf. Cooper); dean (Gio); tidee (Krahn)

TRADE NAME: Iloomba



GEOGRAPHICAL DISTRIBUTION: Guinea – Uganda and Angola

**BOTANY.** A medium-sized or large tree. Young branchlets and leaves covered with a dense, rusty brown indumentum of branched hairs, glabrescent but remaining sparsely pubescent on the lower surface of the blade. Leaves simple, alternate, markedly distichous and drooping, bright green above, paler beneath. Petiole 1–2 cm long, striate. Blade narrowly oblong, 13–30 cm long, 3–8 cm wide, cordate at base, acute – acuminate at the top, nearly always perforated with numerous holes caused by insects. Midrib and nerves slightly impressed above, prominent beneath, the nerves in 20–35 (–40) pairs, parallel, looping near the edge. Reticulation by veins dense, not prominent. Leaves of saplings more narrowly elliptic, rounded at base, with less pairs of nerves.

Inflorescences paniculate, axillary, on older, barren branches. Peduncles flattened, densely puberulous with rusty-coloured, branched hairs; bracts caducous. Male inflorescence 5–15 cm long, slender. Male flower head c. 5 mm across, composed of numerous, crowded, sessile flowers. Each flower formed by a c. 1 mm long, 3-lobed, at the top papillate calyx, surrounding a single stamen. Filament c. 1.5 mm long; anther 0.3 mm long, with 4 (–6) thecae, opening with slits. Female inflorescences up to 30 cm long, stout. Female flowers in few-flowered clusters, minute, c. 1 mm across. Calyx urceolate, shortly 3-dentate. Ovary sessile, globular, 1-locular, containing 1 basal ovule.

Fruits in large bunches, ellipsoid, 2–4 cm long, 2–2.5 cm across, dehiscent with two 3–4 mm thick valves, enclosing one arillate seed; arillus laciniate, red.

Seedling (cf. Taylor): germination epigeal. Cotyledons remain in the testa. Epicotyl about 10 cm long. First 2 leaves opposite, next leaves alternate, obovate. Seedling covered with a dark brown indumentum of stellate hairs.

**TAXONOMICAL NOTES.** In Fl. Congo Belge, II, 1951, p. 391, the synonyms *Pycnanthus schweinfurthii* WARB. and *P. mechowii* WARB. are cited, but I was unable to trace the types (apparently fruits only). Seedlings I saw in the Paris herbarium did not have the first pair of leaves opposite, as recorded by Taylor.

The present description is based on the following specimens: Bomi Hills 139; Kle 454; Totota Range 412; Gbi Nat. For. 657; Kanweake 955; Nimba 906.

**FIELD NOTES.** *Pycnanthus angolensis* is a fairly fast growing, light demanding species. It is rather rare in old high forest and where it occurs in large numbers, it may indicate the secondary character of the forest. The tree sometimes reaches a height of 35 m ( $\approx$  115'), and a diameter of 1.20 m ( $\approx$  4'). The base is straight, but large, old specimens may have narrow, heavy butt flares up to 1.50 m ( $\approx$  5') high. The bole is straight and slender, often somewhat angular, and may reach up to 20 m ( $\approx$  66') to the first branches. The crown is undeep, rather flat. On the whorled branches the ultimate twigs, bearing distichous, nearly always densely perforated leaves, are slightly drooping. The

bark is light brown, somewhat flaky, with long, thin bark scales. The slash is medium thick, granular, pale red to reddish brown, exuding a red or greyish sap, which turns red. The sapwood is almost white and soft.

*Pycnanthus angolensis* is found throughout Liberia, but it might be slightly more common in the moist semi-deciduous zone. It seems little exacting as to site, but does not grow in swamps. The tree is evergreen. The flowering period lasts from November–April; fruits ripen during the next flowering season. Regeneration in secondary formations is common, never gregarious.

*Coelocaryon* aff. *oxycarpum* Stapf, the only other tree of this family in Liberia, has a similar slash type as *Pycnanthus*: it is thick, granular, reddish, and exudes a red sap from the slash wound. This tree, which prefers moist habitats, and which may be up to 30 m ( $\approx 100'$ ) tall and 75 cm ( $\approx 2.5'$ ) in diameter, is locally fairly common in the eastern province. It has narrow root spurs (occasionally stilt-roots), a straight bole with a flaky brown bark. The coriaceous leaves which are slightly folded along the midrib resemble those of *Coula edulis* in shape and nervation, but lack the characteristic venation and stellate hairs of *Coula*. The globose fruit is c. 5 cm across, yellow when ripe, opening with 2 thick, fleshy valves, enclosing a single seed, like *Pycnanthus* surrounded by a red, lacinate aril (see fig. 57 H).

**USES.** The seeds have a very high fat content and can be used as candles. The inner bark when macerated and mixed with salt is applied as a poultice for toothache (cf. Cooper).

The wood is greyish white to pinkish brown when dry, with little distinction between sapwood and heartwood. It has a rather coarse texture, and usually a straight grain. Local houses and dwellings constructed of this wood, show a pallid silvery white sheen on the exterior walls. It is fairly light, and varies from moderately hard to soft. It is not durable and easily attacked by insects and fungi. However, it is easy to treat with a preservative. The timber could be used for core veneer and light carpentry. In Liberia it is marketed as Bassa Whismore, a misleading name, as the wood qualities are not comparable with the true Whismore (*Heritiera utilis*).

## OCHNACEAE

A mostly tropical family of woody plants, rarely herbs, often with a watery juice. Leaves simple, alternate, stipulate, pinnately nerved, often with numerous nerves. Flowers hermaphrodite, actinomorphic, often 5-merous, as a rule white or yellow. Sepals as a rule 4 or 5, rarely 10, free, imbricate, often persistent in fruit. Petals 4–10, as a rule 5, free, imbricate or contorted. Stamens 5, 10 or many, free, sometimes partly staminal; anthers linear, basifixed, opening by slits or by terminal pores. Ovary entire or deeply lobed, 1–10 celled, with an entire or bifid style. Ovules 1 – ∞. Fruiting carpels often becoming quite separate on the enlarged torus and drupaceous, or elongated capsular and septical.

This family is well-represented in Liberia by many species of *Ouratea* AUBL., as a rule shrubs with bright yellow flowers. The only large tree of this family in Liberia is *Lophira alata* BANKS ex GAERTN. f.

*Lophira alata* BANKS ex GAERTN. f.

[25, 55/32,335]

'*Lophira*': Gr. lophos: crest, referring to the wing of the fruit.

'*alata*': L. alatus: winged, also referring to the fruit.

Gaertner f. in De Fructibus et Siminibus Plantarum, 3, p. 52, t. 188 (1805); type: Smeathmann s.n. (BM!); Keay in Kew Bull. 1953, p. 487;

*Lophira africana* BANKS ex G. DON in Loud. Hort. Brit., p. 200 (1830), illegitimate name;

*Lophira simplex* G. DON in Gen. Syst., 1, p. 814 (1831);

*Lophira barteri* (type: Barter 2085, K!), *L. macrophylla* (type: Thollon 9, P!), *L. thollonii* (type: Thollon 739, P!), and *L. spathulata* (partly, for the type: Mann 708, K!), all of van Tieghem in Journ. de Bot., XV, p. 186, 187 (1901);

*Lophira procera* A. CHEVALIER in Vég. Util., 5, p. 154 (1909); type: Chevalier 16120 (P!);

*Lophira alata* var. *procera* (A. CHEV.) BURTT DAVY in Chalk & Burtt Davy, Twenty W. Afr. Timber Trees, p. 78.

1868: F.T.A., I, p. 173, partly (part of the cited material refers to *L. lanceolata* KEAY)

1927: F.W.T.A., 1st ed., I, p. 195, partly

1931: Cooper & Record, Evergr. For. Liberia, p. 30

1933: Chalk & Burtt Davy, Twenty W. Afr. Timber Trees, p. 78 (*L. alata* var. *procera*)

1936: Aubréville, F.F.C.I., 1st ed., II, p. 272 (*L. procera*)

1936: Kennedy, F.F.S.N., p. 39 (*L. alata* var. *procera*)

1937: Dalziel, U.P.W.T.A., p. 64

1946: Kinloch, Silv. Notes Gold Coast Trees, p. 1 (*L. alata* var. *procera*)

1954: F.W.T.A., 2nd ed., I, p. 231

1954: Centre Tech. Trop. For., 'Azobé'

1955: Normand, A.B.C.I., II, p. 121; Pl. CVI

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 314

1959: Kryn & Fobes, Woods of Liberia, p. 63

1961: Irvine, Woody Plants of Ghana, p. 91

1960: Taylor, Syn. Silv. Ghana, p. 260

1963: de Saint Aubin, La Forêt du Gabon, p. 171

1960: Keay, Nigerian Trees, I, p. 126

LOCAL NAMES: malah (Kpelle); k'deng (Gola); plu (Gio); faboy (Krahn)

TRADE NAME: Azobé

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Angola

**BOTANY.** A large, glabrous tree. Leaves in tufts at the end of the branchlets, simple, alternate, stipulate, glossy dark green. Stipules surrounding the terminal bud, triangular, c. 6 mm long, 3 mm wide, caducous. Petiole 0.8–1.8 cm long, slightly swollen at base. Blade (narrowly) obovate, 8–25 cm long, 3–9 cm wide, cuneate at base, rounded to emarginate at the top, with a slightly undulate margin. Midrib prominent above and beneath. Nerves very numerous and fine, slightly raised on both surfaces, 1–2 mm apart, parallel, joining a marginal nerve. Leaves of saplings and young trees much larger, up to 1 m long and over 10 cm wide, acute at the top.

Flowers in lax, terminal, glabrous panicles. Bracts narrowly triangular, c. 4 mm long, caducous. Pedicels c. 2 mm long, markedly articulate at base. Sepals 5, imbricate, 8–12 mm long, 6–10 mm wide, unequal-shaped, the outer 2 ovate, with an acute tip, the inner 3 broadly ovate with an obtuse apex. Petals 5, white, imbricate in bud, spreading at anthesis, up to 1.5 cm long and 2 cm wide, obovate, bilobed at the top. Stamens numerous, in 4 whorls, yellow-orange. Filaments c. 6 mm long; anthers 4–5 mm long, c. 1 mm wide, with 2 thecae, opening by apical pores. Ovary sessile, 1-celled, with numerous ovules, narrowly conical, tapering into a bifid style, the 2 arms pointing in opposite directions.

Fruit a 1-seeded nut, 2.5–3 cm long, c. 1.2 cm thick at base, tapering into the persistent style, at the base with 2 unequal-sized wings, formed by the 2 accrescent outer sepals (rarely one of the inner sepals also accrescent); one wing 5–10 cm long, 1.5–3 cm wide, the other wing 2.5–4 cm long, c. 8 mm wide.

Seedling: germination epigeal; the nut, enclosing the cotyledons, remaining on the ground. Cotyledons c. 1.5 cm long, 5 mm wide, 2–3 mm thick, pointed at the top, with slender, twisted petioles. Epicotyl 8–14 cm long. First 2 leaves opposite, sessile, narrowly elliptic, up to 10 cm long and 3 cm wide. The third leaf develops simultaneously with and directly above the first pair, so forming a pseudo-whorl. Following leaves with distinct internodes.

**TAXONOMICAL NOTES.** The genus *Lophira* GAERTN. f. counts but one more species, *L. lanceolata* v. TIEGH. ex KEAY, a gnarled, fire resistant tree of the savanna regions, not yet recorded from Liberia. The name *Lophira alata* has long been wrongly applied to this species, but Keay (1953, l.c.) demonstrated that the description of *L. alata* by

Gaertner (1805, l.c.), must have been based on a sample of Smeathmann, which is undoubtedly the high forest specimen. The numerous synonyms of van Tieghem were partly based on juvenile forms which are different from the mature leaves.

The description is based on the following samples: Kanweake 977, 1014; Gbi Nat. For. 546, 556; Ganta, Harley s.n.; Nimba 892; Bassa III, Siga 703; Bomi Hills 1301.

FIELD NOTES. *Lophira alata* may be a giant of the rain forest, reaching a height of up to 50 m ( $\approx 160'$ ) and a diameter of over 1.50 m ( $\approx 5'$ ). The base of the tree rarely has any buttresses, but very heavy root swellings, often extending in widespread surface roots and in heavy ridges on the stem. The bole may reach over 30 m ( $\approx 100'$ ) to the first branches; it is rarely perfectly straight, often slightly sinuous, cylindrical except on the lower part, which is angular owing to the root ridges. The crown is dome-shaped with few, heavy, ascending branches. The clustered leaves give the crown a characteristic tufty habit. The bark is sometimes grooved, more commonly very scaly with irregular, longitudinal scales, thick, red-brown to dark brown, but grey when exposed to the sun. Between the dead outer bark and the living inner bark there is a nearly always present, thin, bright yellow layer. The slash is hard and granular, pale pinkish brown near the cambium, red-brown towards the outside, turning darker on exposure; a watery sap may collect in the slash wound.

The tree is deciduous soon after the rainy season, October–November, and part of the crown may still have leaves, while the other part stands bare. New leaves appear in bright red flushes, turning the crown into a bright red spot on the green forest canopy. The tree flowers after the new leaves appear, November–December. Ripe fruits are found from March to June. Regeneration may be abundant near the mother trees; the seeds, though winged, are not widely dispersed. *Lophira alata* is a light demander, and regeneration is most vigorous on open sites, clearings, road sides etc.; in its initial stages it is able to stand some shade, but it needs light for further development. When overhead shade is present, growth rate is reduced and stems tend to become crooked. *Lophira alata* is a very common tree throughout Liberia; stocks of 90–190 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile were recorded.

SILVICULTURE. There are c. 120 seeds to a pound (cf. Taylor). Germination of fresh seeds is good, taking 9–16 days, but viability decreases rapidly. Plant material is suitable for transplanting in the field after 18 months. The saplings form a strong taproot, which must be pruned before transplanting. Both striplings and stumps can be used; plant material is susceptible to drought.

*Lophira alata* has not been planted to any extent, because the growth is comparatively slow, and the prospects for hard, heavy timbers are rather poor.

USES. The seeds of *Lophira* have a fat content of c. 40%. Seeds and leaves are used in native medicine for treating leprosy (cf. Cooper).

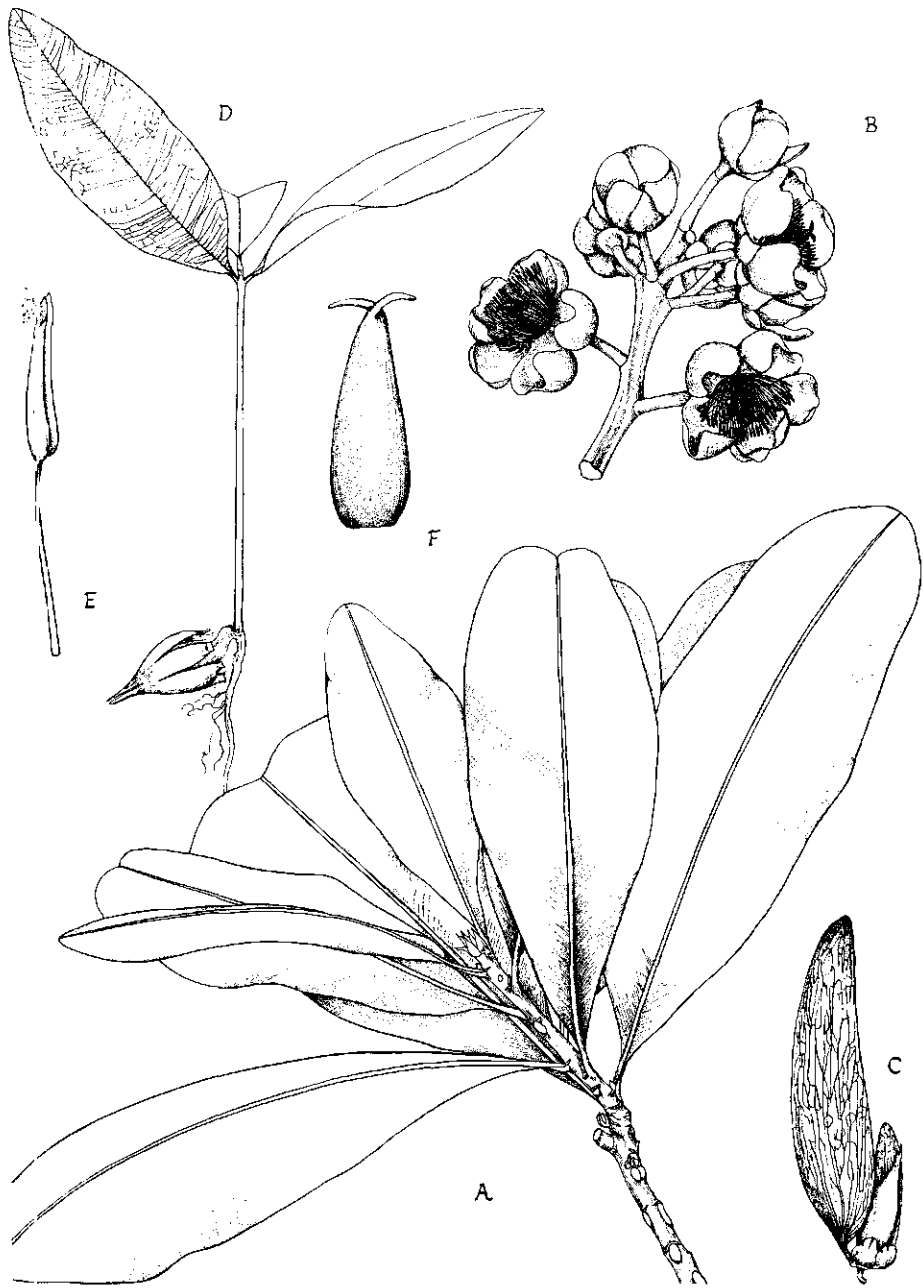


Fig. 55. *Lophira alata* BANKS ex GAERTN. f. A: branch with leaves ( $\times \frac{1}{2}$ ); B: inflorescence ( $\times 1$ ); C: fruit ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ); E: stamen ( $\times 5$ ); F: ovary ( $\times 3$ ).

The chocolate-brown wood is very hard and heavy, strong, and resistant (though not immune) against termites. It seasons very slowly, and severe splitting and some distortion are apt to occur. Once seasoned, it is rather stable in use. It is difficult to work, and the main applications are in maritime structures (it is *Teredo* resistant), piling, dam building, locks, such heavy constructions as bridges and wharves, and railway ties. It is suitable for heavy duty flooring, and for wooden rails of underground railways. For all these purposes it is one of the best heavy timbers produced in the tropics.

## OLACACEAE

A tropical and subtropical family of trees, shrubs, and climbers, with simple, alternate, estipulate, pinnately nerved leaves. Flowers as a rule hermaphrodite, small, actinomorphic. Calyx synsepalous, 4–6 lobed, often accrescent in fruit. Petals 4–6, free or connate, valvate. Disc often present, annular, sometimes accrescent in fruit. Stamens as many as and opposite the petals, or more numerous, free or connate. Ovary superior, partially 2–5 celled or 1-celled; ovules with 0, 1 or 2 teguments. Style 1, with a 2–5 lobed stigma. Fruit drupaceous, 1-seeded. Seeds with copious endosperm.

Trees as a rule with hard and heavy wood.

### *Coula edulis* BAILL.

[56 A-E/32]

'*Coula*': vernacular name from Gabon 'N'coula'.

'*edulis*': Latin for edible.

Baillon, *Adansonia*, III, p. 64, t. 3 (1864); type: Aubry le Comte, Gabon (P!); H. Sleumer, *Nat. Pfl.fam.*, 2nd ed., 16B, p. 12 (1935);

*C. cubrae* DE WILDEMAN & TH. DURAND, *Bull. Soc. Roy. Bot. Belge*, XXXVIII, 2, p. 189 (1899); type: Cab'ra 42, Congo (BR!);

*C. utilis* SP. MOORE, *Journ. of Bot.*, LVIII, p. 226 (1920); type: Gossweiler 6835 (BM!).

1868: F.T.A., I, p. 351

1928: F.W.T.A., 1st ed., I, p. 458

1931: Cooper & Record, *Evergr. For. Liberia*, p. 82

1936: Aubréville, *F.F.C.I.*, 1st ed., I, p. 86

1936: Kennedy, *F.F.S.N.*, p. 144

1937: Dalziel, *U.P.W.T.A.*, p. 293

1948: *Fl. Congo Belge*, I, p. 250

1950: Normand, *A.B.C.I.*, 1, p. 74; Pl. IX

1958: F.W.T.A., 2nd ed., I, p. 645

1959: Aubréville, *F.F.C.I.*, 2nd ed., I, p. 104

1959: Kryn & Fobes, *Woods of Liberia*, p. 36

1960: Taylor, *Syn. Silv. Ghana*, p. 263

1961: Irvine, *Woody Plants of Ghana*, p. 467

1963: de Saint Aubin, *La Forêt du Gabon*, p. 135

LOCAL NAMES: sla, sra (Gio); sratju (Bassa); 'walnut'

TRADE NAME: Coula

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Congo

BOTANY. A medium-sized tree. Young shoots and leaves densely rusty pubescent with very fine stellate hairs, glabrescent. Petiole 1.5–3 cm long, canaliculate above, jointed at the top. Blade (narrowly) elliptic, sometimes slightly obovate, (7–) 10–25 cm long,



(2.5–) 5–8 cm wide. Base (obtusely) cuneate; margin slightly revolute; top long acuminate or caudate. Midrib flat above, prominent beneath. Nerves slightly impressed above, prominent beneath, (3–) 6–12 pairs reaching close to the edge. Reticulation of veins indistinct above, slightly raised beneath, close and parallel, transverse to the nerves.

Inflorescences paniculate, axillary, 4–8 cm long, densely rusty puberulous with stellate and branched hairs. Bracts minute, triangular, 1–2 mm long. Pedicel 2–3 mm long. Calyx cupuliform in bud, rim-shaped, not enclosing the petals, at anthesis disc-shaped, 2 mm across. Petals 4 or 5, 2.5 mm long, acute, pale green, nearly glabrous, free, with a central crest near the top on the inner surface. Stamens 12–20, the outer series alternating with –, the inner series opposite the petals. Filaments free, 1.5–2 mm long, the upper 0.5 mm slightly curved. Anthers with a broad, apiculate connective; thecae opening by lateral slits. Disc annular, nearly glabrous, adnate to the sessile ovary. Ovary conical, 3–4 locular, each locule with 1 ovule. Style very short, terminated by a 3-lobed stigma.

Fruit a nearly globular or somewhat ovoid drupe, 4 cm across and 4.5 cm long. Exocarp smooth, green or reddish when ripe; mesocarp c. 5 mm thick, hard-pulpy. Endocarp forming a hard, rough, c. 5 mm thick scale, on which the 3 or 4 carpels can be recognised. Seed subglobular, slightly angulate, c. 2 cm across, mainly composed of endosperm, with a corky testa.

Seedling: germination epigeal, the hard nut breaking open, but the cotyledons not developing. Epicotyl about 12 cm long, nearly glabrous, distinctly swollen at base. First pair of leaves opposite, caducous. First internode c. 2 cm long, stellate-puberulous; next leaves alternate, progressively larger, densely rusty puberulous when young.

**TAXONOMICAL NOTES.** *Coula* BAILL. is a monotypic genus, only found in Africa, but closely related to *Ochanostachys* MAST. in Asia and *Minquartia* AUBL. in S. America, both also monotypic genera (see H. H. Stauffer, *Santalales Studien VIII*, Viertelj. Nat. Ges. Zürich, 106, p. 412–418, 1961).

The present description and figures are based on the following specimens: Kanweake 798, de Wilde 3647; Zuole area 229, 245; Nimba 909; Ganta, Harley 1151; Bong Range s.n.; Bomi Hills 844.

**FIELD NOTES.** *Coula edulis* rarely reaches up to 75 cm ( $\approx 2.5'$ ) diameter, but may reach a height of 25 m ( $\approx 80'$ ). The base has low root spurs or, rarely, butt flares up to 1.5 m ( $\approx 5'$ ). The bole is early branched, rarely longer than 6 m ( $\approx 20'$ ), often quite angular. The crown is dense, the ultimate branches and the leaves with a drooping habit. The bark is greyish brown, shallowly grooved, slightly scaly and lenticellate, quite shaggy. The slash is medium thick, brittle-fibrous, brown with a saffron tinge; white pinpoints of latex appear in the slash wound.

*Coula edulis* is found all over Liberia, without an outspoken preference for site. It has

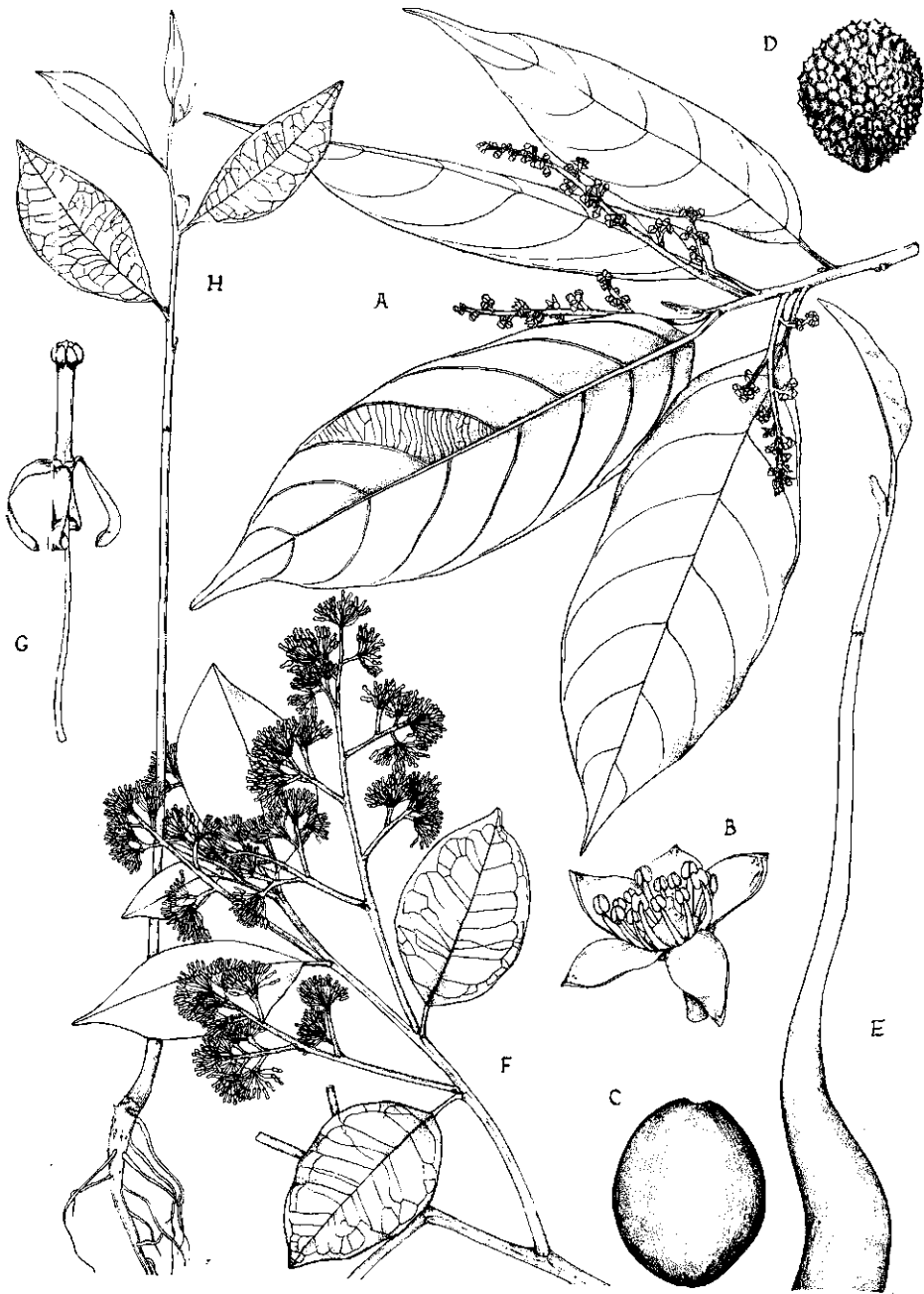


Fig. 56. *Coula edulis* BAILL. A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 5$ ); C: fruit ( $\times \frac{1}{2}$ ); D: nut ( $\times \frac{1}{2}$ ); E: seedling ( $\times \frac{1}{2}$ ).  
*Ongokea gore* (HUA) PIERRE F: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); G: open flower ( $\times 5$ ); H: seedling ( $\times \frac{1}{2}$ ).

a gregarious tendency and locally it may form a substantial part of the middle story of the high forest. Flowering occurs from January–June. The main fruiting season lasts from November–February. Fruit bearing is copious, but regeneration seems to be very scarce. The tree is evergreen.

**USES.** The seeds have a high fat content and are edible. The nuts are collected in the forest and form an important article in the local trade. A decoction of the bark is said to be an effective agent for abortion.

The heartwood is dull reddish brown, extremely hard and heavy, with a fine texture and a straight or interlocked grain. The timber seems to be termite resistant.

***Ongokea gore* (HUA) PIERRE**

[26, 56 F-H, 57 A-B/32]

'*Ongokea*': vernacular name from Gabon, Ongoke.

'*gore*': vernacular name from Gabon.

Pierre in Bull. Soc. Linn. Paris, II, p. 1313 (1897); H. Sleumer, Nat. Pfl.fam., 2nd ed., 16B, p. 30 (1935). *Aptandra gore* HUA, in Bull. Mus. Hist. Natur., I, p. 315 (1895), basionym; type: Dybowski 103, Gabon (P!);

*Ongokea klaineana* PIERRE, l.c., p. 1314; type: Klaine 381, Gabon (K!, P!);

*Ongokea kamerunensis* ENGLER in Bot. Jahrb., 43, p. 163 (1909); type: Zenker 2325 (K!, P!), 2541 (P!), 2874 (K!); Staudt 426 (?), syntypes.

1928: F.W.T.A., 1st ed., I, p. 461

1936: Aubréville, F.F.C.I., 1st ed., I, p. 84

1936: Kennedy, F.F.S.N., p. 146

1937: Dalziel, U.P.W.T.A., p. 294

1948: Fl. Congo Belge, I, p. 276

1950: Normand, A.B.C.I., I, p. 74; Pl. X

1958: F.W.T.A., 2nd ed., I, p. 649

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 100

1959: Kryn & Fobes, Woods of Liberia, p. 79

1960: Taylor, Syn. Silv. Ghana, p. 264

1961: Irvine, Woody Plants of Ghana, p. 471

1963: de Saint Aubin, La Forêt du Gabon, p. 136

**LOCAL NAMES:** kuwi, kwi (Gio); kuoto (Krahn)

**TRADE NAME:** Angeuk

**GEOGRAPHICAL DISTRIBUTION:** Sierra Leone – Angola

**BOTANY.** A large, glabrous tree. Leaf-bearing branchlets distinctly laterally compressed, at the nodes with fine but distinct ridges formed by the decurrent edges of the canaliculate, 6–10 mm long petiole. Leaves simple, alternate, papery, medium green. Blade elliptic or slightly ovate, 4–8 cm long, 2–5 cm wide; base rounded – cuneate, apex shortly and bluntly acuminate. Midrib slightly impressed above, prominent beneath. Nerves slightly raised on both surfaces, 4–10 pairs, rather faint, joining at some distance from the edge. Reticulation of veins lax, indistinct. Leaves of saplings and water shoots somewhat larger.

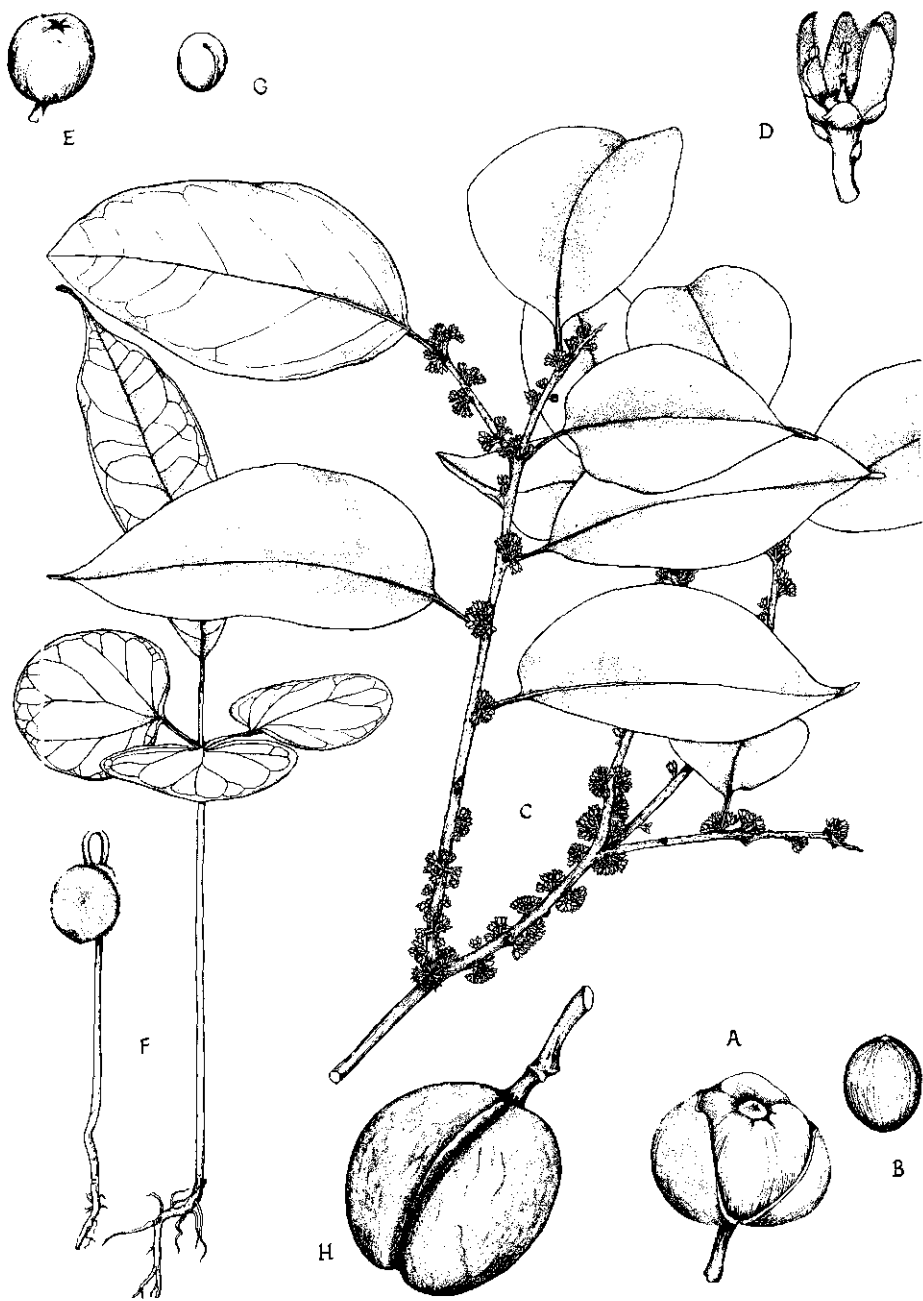


Fig. 57. *Ongokea gore* (HUA) PIERRE A: fruit with accrescent calyx ( $\times \frac{1}{2}$ ); B: nut ( $\times \frac{1}{2}$ ).  
*Strimbosia glaucescens* ENGL. C: branch with leaves and flowers ( $\times \frac{1}{2}$ ); D: open flower ( $\times 5$ ); E:  
 fruit ( $\times \frac{1}{2}$ ); F: seedlings ( $\times \frac{1}{2}$ ); G: nut ( $\times \frac{1}{2}$ ); H: fruit of *Coelocaryon oxycarpum* STAPF ( $\times \frac{1}{2}$ ).

Inflorescence paniculate, axillary, 2–9 cm long, glabrous. Bracts c. 1 mm long, persistent. Flowers pale green, concentrated at the end of short lateral peduncles (dwarf shoots), with caducous bracts leaving rim-shaped scars at the base of the filiform, c. 7 mm long pedicel. Bud 4 mm long, oblong, with a somewhat swollen top. Calyx shallowly cupuliform, 1 mm across, shortly 4-dentate. Petals 4, valvate in bud, recurving at anthesis, strap-shaped, 3–4 mm long, 0.8 mm wide, somewhat narrower in the middle. Disc extrastaminal, 4-lobed, 0.5 mm high, thick. Stamens united in a 3 mm long, slender tube, crowned by 3 or 4 sessile, extrorse anthers, each anther with 2 thecae, opening in the closed flower with basal valves; at anthesis the valves fold back against the staminal tube. Ovary superior, sessile, 1-celled. Style hardly exerting from the staminal tube at anthesis.

Calyx accrescent in fruit, splitting in 2 or 3 very concave, c. 3 cm long, bright green valves, partly enclosing the globose fruit. Disc accrescent in fruit, bright yellow, forming a c. 7 mm thick fleshy layer around the globular, c. 1.8 cm thick nut, but leaving the bluntly pointed top of the nut free. Nut shell striate, rugose at the base, c. 1.5 mm thick. Seed globular, 1.5 cm across, mainly formed by endosperm.

Seedling: germination epigeal, but the hypocotyl does not develop; the seed with the cotyledons is shed before the endosperm is exhausted (cf. Sleumer, l.c.). Epicotyl c. 18 cm long, slightly swollen and with a pair of scales at base, woody. First pair of leaves opposite. Following leaves alternate, similar to the mature leaves.

**TAXONOMICAL NOTES.** *Ongokea* PIERRE is a monotypic, African genus. The present description and figures are based on the following specimens: Duport, Devilbush 1051, 1070; Ganta, Harley 471; Zuole area 153, 763; Chien area 659.

**FIELD NOTES.** *Ongokea gore* may reach a height of 40 m ( $\approx 130'$ ), and a diameter up to 1.20 m ( $\approx 4'$ ). It is a tree of the upper canopy of the forest. The base has low, heavy root swellings, sometimes extending in heavy, spreading surface roots. The bole is generally straight and cylindrical, but somewhat angular near the base, up to 25 m ( $\approx 80'$ ) to the first branches. The crown is fair-sized, rather open, with few, heavy branches. The up to 1.5 cm thick bark may be smooth or finely scaly, slightly fissured or cracked; it is dark brown, grey or black, often with numerous small lenticels scattered or in rows. The slash is faintly scented, yellow or yellowish brown, hard and granular, brittle, with a white cambium layer; it may make a rustling sound and some clear sap may collect in the slash wound. The sapwood is pale yellow.

This evergreen tree is found scattered throughout Liberia, from near the coast (Duport, near Monrovia) to the Nimba mountains, but it seems to be more common in the moist semi-deciduous zone. Inventory results record 6 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile for the evergreen forest, which figure may raise to 35 in the drier forest type. The tree flowers from December–May; the main fruiting season is from April–June. Regeneration is rather scarce. Germination may take over a year, but may be stimulated by

filing through the nut shell near the radicle, on the rugose side of the nut.

The yellow, granular slash character is shared by *Cassipourea nialatou* but the latter species has a characteristically coiled base, and a smoother, ashy grey bark.

USES. The fruits of *Ongokea* are eaten by many animals ('animals like it too much') and hunters search for this tree in the fruiting season. Honey-bees may live in hollow specimens, but this species in particular makes the honey bitter, rendering it unfit for consumption.

The heartwood is yellowish, hard and heavy, Sp. G. 0.75–0.80. It has at present no commercial value. The tree tends to split badly during felling.

*Strombosia glaucescens* ENGL.

[57 C-G/34]

'*Strombosia*': Gr. strombos: top (toy); referring to the shape of the fruit of the genus type: *Strombosia javanica* BLUME.

'*glaucescens*': L. glaucus: bluish green, referring to the tinge of the dried leaves.

Engler, Bot. Jahrb., 43, p. 167 (1909); type: Zenker 2218(K!); J. Léonard in Bull. Jard. Bot. Bruxelles, 18, p. 148 (1947);

*S. pustulata* OLIV. in Hook. Ic. Pl. t. 2299 (1894), partly, quoad Sc. Elliott 4733, on which the description and drawing of the fruit are based.

*S. pustulata* AUCT. non OLIV., in many older works concerning W. Africa.

1928: F.W.T.A., 1st ed., I, p. 460 (*S. pustulata*)

1950: Normand, A.B.C.I., I, p. 74; Pl. X (*S. pustulata*)

1931: Cooper & Record, Evergr. For. Liberia, p. 83 (*S. pustulata*)

1958: F.W.T.A., 2nd ed., I, p. 648

1936: Aubréville, F.F.C.I., 1st ed., I, p. 84 (*S. pustulata*)

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 102

1937: Dalziel, U.P.W.T.A., p. 295 (*S. pustulata*)

1959: Kryn & Fobes, Woods of Liberia, p. 106

1948: Fl. Congo Belge, I, p. 267

1960: Taylor, Syn. Silv. Ghana, p. 265

1961: Irvine, Woody Plants of Ghana, p. 472

LOCAL NAMES: woing-ti (Gio); sô-kpu (Bassa); k'duo (Gola)

TRADE NAME: Afina

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Nigeria; Congo

BOTANY. A medium-sized tree. Branchlets terete, glabrous, lenticellate. Leaves simple, alternate, glabrous. Petiole 0.5–1 cm long, grooved above. Blade ovate – elliptic, 4–10 cm long, 2–6 cm wide, more or less pustulate, the upper surface dull or glossy, sometimes slightly glaucous when dry. Base rounded – truncate; top acute to acuminate. Midrib flat above, prominent beneath, extending to the very tip of the blade. Nerves 4–6 pairs, indistinct above, slightly raised beneath, the lower pair sub-basal. Reticulation of veins indistinct above, distinct or indistinct beneath. Leaves of watershoots larger.

Inflorescences: axillary dwarf shoots, on leaf bearing and barren branchlets. Each individual flower with some minute persistent scales, enclosing the bud. Pedicel 1–2 mm long, glabrous, with 2–3 half-orbicular, 0.3 mm long, ciliate scales. Calyx funnel-shaped, 0.5 mm deep, with 5 suborbicular, 0.8 mm long, imbricate, ciliate lobes. Petals 5, but sometimes 1–3 reduced, free, valvate in bud, slightly spreading at anthesis, pale green, 2–3 mm long, densely pilose on the inner surface above the stamens. Stamens 5, opposite and for 1 mm adnate to the petals. Anthers introrse, basifixed. Ovary subinferior, 1-locular but at the base 5-celled, at the base outside adnate to the calyx tube, the upper part surrounded by a swollen disc. Style 1 mm long, terminated by a 5-lobed stigma.

Fruit a false fruit, formed by the accrescent, fleshy calyx tube, globular, about 2 cm across, purple when ripe, pitted at the top, where the 5 calyx lobes remain visible. The actual fruit a drupe, c. 1.5 cm across, surrounded by the calyx; nut with a thin, coriaceous shell, containing only 1 seed, mainly formed by waxy endosperm.

Seedling: germination epigeal; the hypocotyl lifts up the whole seed at its recurved top, and not until it is full grown and 10–15 cm long the remnant of the endosperm between which the cotyledons are pressed, is shed. Then the hypocotyl straightens and the 2 or 3 cotyledons unfold. Cotyledon: petiole 0.6–1 cm long, grooved above. Blade orbicular, 4–6 cm across, rounded – cordate at base, palmatinerved with 5 basal nerves. Epicotyl (0.8–) 1.5–3 cm long. Leaves alternate, as the mature leaves but larger, and longer acuminate.

**TAXONOMICAL NOTES.** Aubréville (1959, l.c.) reports the seed to be enclosed by a very hard nut, but the pericarp is thin and coriaceous. The occurrence of three cotyledons was found to be a quite normal phenomenon in this species.

*Strombosia glaucescens* and *S. pustulata* seem to be closely related, the latter species having a mucronate leaf tip, and petals of 4–5 mm long. Léonard (1947, l.c.) distinguishes two varieties of *S. glaucescens*: var. *glaucescens* and var. *lucida*, the former variety having pustulate leaves with 7–10 pairs of nerves, a hardly distinct venation, and a petiole of 1–2.5 cm long. The Liberian samples all fall within the variety '*lucida*', but it should be noted that the field description from Congo, given by Léonard: 'a large tree of c. 30 m ( $\approx 100'$ ) high, with buttresses up to 1.80 m ( $\approx 6'$ ) high, and a longitudinally striate bark of c. 6 mm ( $\approx \frac{1}{4}''$ ) thick' does not agree with the Liberian tree (see field notes). A careful revision of the genus might result in some changes in the present nomenclature, as already suggested in F.W.T.A., 1958, l.c.

The present description and figures are based on the following specimens: Bomi Hills 1054; Bong Range 75, 1046; Zuole 1225; Chien area 626.

**FIELD NOTES.** *Strombosia glaucescens* is an understory tree, which may reach a height of 30 m ( $\approx 100'$ ), but rarely attains a diameter of 60 cm ( $\approx 2'$ ). The base is provided with short, sharp root spurs. The bole is straight and slender, and may reach up to 20 m



25. *Lophira alata* BANKS ex GAERTN. f. Typical scaly bark habit (see page 294).





26. *Ongokea gore* (HUA) PIERRE. Note the heavy root swellings (see page 302).

(≈ 56') to the first branches. The crown is small and dense. The bark is grey – black, with numerous small corky lenticels, scaly with an irregular pattern of larger and smaller scales, leaving shallow and walled, yellowish brown scars; this gives the tree a characteristic 'camouflaged' effect. The slash is medium thick, fairly hard, yellowish, interspersed with fine white stripes, granular on the outside, brittle-fibrous on the inside.

This common, evergreen tree is found all over Liberia, but most commonly in the high forest of the evergreen zone. Locally it may form a substantial part of the middle story of the forest, sometimes in a mixture with *Chidlowia sanguinea* and *Scytopetalum tieghemii*. Flowering lasts from July–October. The main fruiting season is December–January. The tree is a shade bearer and regeneration may be abundant near the mother tree. The remark of Taylor (1960, l.c.) that local people tend to confuse *Strombosia* and *Ongokea* does not apply to Liberia; both bark and slash are diagnostic.

**USES.** Pole-sized trees are much used for 'mortar stick' and house-building. Bark and roots are made up into an ointment for treating withered hands or feet (cf. Cooper). The very heavy heartwood, Sp. G. 0.99, is pale-purplish brown, with purplish streaks. The sapwood is thick and sharply defined. The wood is fairly lustrous, the grain straight, the texture fine. It is resistant and durable, tough and strong but difficult to dry. It may be suitable for flooring. After preservative treatment young trees may be used for telegraph poles. The wood makes good fuel.

## RHIZOPHORACEAE

A pantropical family of trees and shrubs, among them characteristic species of periodically inundated silts of the seashore. Branchlets swollen at the nodes. Leaves simple, opposite, rarely in whorls of 3–4 or alternate, with interpetiolar, caducous stipules, rarely estipulate, pinnately nerved, often coriaceous. Flowers hermaphrodite, actinomorphic, in axillary inflorescences. Calyx tube adnate to the ovary or free, with 3–14 valvate lobes. Petals usually small, bifid, laciniate or fimbriate, convolute or inflexed in bud. Stamens about the same number or twice as many as the petals, free, rarely connate, as a rule at the base adnate to an intrastaminal disc. Ovary as a rule inferior, sometimes superior, 1–6 celled. Ovules 2 in each cell, or more in 1-celled ovaries, attached towards the apex on the inner angle of the cell or on the central column in 1-celled ovaries. Fruit as a rule indehiscent and 1-seeded or the cells 1-seeded; rarely the fruit dehiscent and the seeds winged. Cotyledons thick and connate or foliaceous, free.

The *Rhizophoraceae* are named after the genus *Rhizophora* L., represented in Liberia by *Rhizophora racemosa* G. F. W. MEY, *R. harrissonii* LEECHMAN, and *R. mangle* L., trees with slender, arched stilt-roots, gregarious in the brackish swamps along the coast. The fruits germinate on the tree and the hypocotyl may exceed 50 cm before they are shed.

The species treated below excepted, *Anisophyllea meniaudi* AUBRÉV. & PELLEGR. is the only large rhizophoraceous tree at present recorded from Liberia. It is a tree up to 30 m ( $\approx 100'$ ) high and 60 cm ( $\approx 2'$ ) in diameter, slightly fluted at base, with a brown, scaly bark, a fairly thick, yellow-brown, granular slash with narrow, dark brown, vertical zig-zag lines; some clear sap collects in the slash wound. The leaves are alternate, with very characteristic parallel nerves (see fig. 58 G). The wood gives out a bad smell when sawn.

*Anopyxis klaineana* (PIERRE) ENGL.

[58/35,372]

'*Anopyxis*': Gr. ano: above, upwards; Gr. pyxis: box, capsule; referring to the fruit, an erect capsule.  
'*klaineana*': referring to Klaine, the collector of the type specimen (see p. 80).

Engler in Nat. Pfl.fam., Nachtr. II, z. II-IV, p. 49 (1908);

*Macarisia klaineana* PIERRE in Bull. Soc. Linn. Paris, 1898, p. 78, basionym; type: Klaine 1308, Gabon (P!);

*Pynaertia ealaensis* DE WILDEMAN in Ann. Mus. Congo, Ser. V, t. II, p. 262 (1908); type: Pynaert 1024, Eala, Congo (BR!);

*Pynaertia occidentalis* A. CHEVALIER in Vég. Util., 5, p. 211 (1909); type: Chevalier 16209, Ivory Coast (P! K!);

*Anopyxis ealaensis* (DE WILD.) SPRAGUE in Kew Bull. 1909, p. 311;

*Anopyxis occidentalis* (A. CHEV.) A. CHEV. in Mém. Soc. Bot. France, t. II, No. 10, p. 171 (1912).

1927: F.W.T.A., 1st ed., I, p. 229 (*A. ealaensis*)

1958: Aubréville, F.F.C.I., 2nd ed., III, p. 54

1931: Cooper & Record, Evergr. For. Liberia, p. 36 (*A. ealaensis*)

1959: Kryn & Fobes, Woods of Liberia, p. 12

1936: Aubréville, F.F.C.I., 1st ed., III, p. 42 (*A. ealaensis*)

1960: Taylor, Syn. Silv. Ghana, p. 281

1960: Normand, A.B.C.I., III, p. 39; Pl. CXXXII

1960: Keay, Nigerian Trees, I, p. 169

1936: Kennedy, F.F.S.N., p. 50 (*A. ealaensis*)

1961: Irvine, Woody Plants of Ghana, p. 136

1937: Dalziel, U.P.W.T.A., p. 84 (*A. ealaensis*)

1963: de Saint Aubin, La Forêt du Gabon, p. 185

1954: F.W.T.A., 2nd ed., I, p. 286

LOCAL NAMES: (u)weng (Gio); wei-kpo (Mano)

TRADE NAME: Bodioa; Kokoti

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Congo

**BOTANY.** Young branchlets and stipules densely –, young leaves sparsely greenish pubescent, glabrescent. Internodes 1–4 cm long; nodes slightly swollen. Leaves simple, in whorls of 3, rarely of 2 or 4, with acicular, 3–7 mm long, slightly curved, long-persistent interpetiolar stipules. Petiole 4–13 mm long, flat above. Blade coriaceous, dark green and glossy above, often somewhat arched, oblong or (narrowly) elliptic or (–) obovate, (5–) 7–13 cm long, (2–) 3–5.5 cm wide, obtuse – cuneate at base, rounded – obtuse or obtusely acute at the top; margin more or less decurrent. Midrib slightly impressed above, prominent beneath. Nerves 7–12, ascending, not very pronounced pairs; reticulation of veins close.

Inflorescences solitary in the axils of the upper leaf whorls, dichasial, increasingly greenish pubescent from the base to the ultimate ramification, up to 5 cm long. Bracts 1.5–2 mm long, acute. Pedicel at anthesis c. 2 mm long, articulate at base. Calyx greenish tomentose outside and inside. Calyx tube c. 4 mm deep, c. 6 mm wide; calyx lobes 5 (rarely 4 or 6), closed and valvate in bud, the adjacent edges forming 5 crests on the flower bud (reduplicate valvate); lobes spreading at anthesis, c. 6 mm long, acute at the top. Petals 5 (rarely 4 or 6), white, membranous, ciliate, narrowly spatulate, c. 9 mm long, at base strap-shaped, 0.4 mm wide, c. 2 mm wide below the bi- or trifid top, in bud folded over the edge of the staminal tube, at anthesis recurving between the calyx lobes. Stamens united in a glabrous, pale green, 7–10 mm long tube, carrying 10 (rarely 8 or 12) shortly stipitate, basifixed, introrse anthers on the rim. Ovary sessile, densely sericeous, (4–) 5-locular, each locule with 2 ovules. Style sparsely pubescent, slightly exserting the staminal tube at anthesis, crowned by a small, peltate, slightly 5-lobed stigma.

Fruit a subsessile, erect, greenish tomentose, septicidal capsule, obovate, 3–3.5 cm

long, about 2 cm thick, obtuse and emarginate at the top, with the accrescent, persistent calyx at base, dehiscent with 5 valves, containing at most 10 winged seeds, which are attached just above the base of a short central column, the wings pointing towards the top of the capsule. Seed medium brown, flattened, c. 8 mm long, 4 mm wide, concave; wing pale brown, membranous, c. 2 cm long and 8 mm wide. The valves are shed separately from the calyx and the central column.

Seedling: germination epigeal, after about one week. Hypocotyl 2.5–3 cm long. Cotyledons foliaceous, spreading; petiole 2–3 mm long; blade broadly ovate, c. 1.8 cm long, 1.5 cm wide, rounded at base, obtuse at the top. Epicotyl 1–2 cm long. First pair of leaves opposite, following nodes with 2 or 3 leaves. Blade elliptic – obovate, progressively larger, with an undulate – crenate margin. All young parts densely pilose.

TAXONOMICAL NOTES. *Anopyxis* ENGL. has a staminal tube, resembling that of *Meliaceae*, and de Wildeman (1908, l.c.) placed a new genus, *Pynaertia* DE WILD. within this family. However, the aestivation of the flower (sepals reduplicate valvate and petals reflexed in bud), and the whorled, stipulate, simple leaves clearly indicate *Rhizophoraceae*. Sprague (1909, l.c.) demonstrated that *Pynaertia* was synonymous to *Anopyxis*. The differences in leaf characters, as used by Sprague to differentiate *A. klaineana* and *A. ealaensis* do not justify the distinction of two separate species, or even varieties, as proposed by Pellegrin (Not. Syst., 14, p. 300, 1953). The presence of 4- and 6-merous flowers was observed on Voorhoeve 1213 but the ovaries were only 4- or 5-locular.

The present description and figures are based on the following specimens: Duport 504, 1021, 1213; Loma Nat. For. 743; Gio Nat. For. 247; Ganta, Harley 661; Nimba 901; Chien area s.n.; Putu area 807.

FIELD NOTES. *Anopyxis klaineana* may be a very large tree, up to 45 m ( $\approx$  150') high and 1.20 m ( $\approx$  4') in diameter. The base of the tree has thick, rounded root spurs, on large trees developing into very heavy, narrow buttresses up to 1.80 m ( $\approx$  6'), sometimes extending in spreading surface roots. The bole is long and straight or sometimes slightly curved, round and only slightly tapering, up to 27 m ( $\approx$  90') to the first branches. The crown is dome-like, with few, heavy, ascending branches. The dark foliage is massed near the end of the branchlets. In general the bark has a clear, grey, sometimes nearly white colour. It is not grooved or scaly, but fairly smooth, superficially and vertically cracked, very thick, especially on the root swellings; often it has vertical rows of lenticels. The slash is fine granular, fairly hard, pinkish or whitish brown on the root spurs, pale brown on the bole, turning a darker shade on exposure, with paler vertical dilatation stripes under the bark cracks; some clear sap collects in the slash wound.

*Anopyxis* is evergreen, and seems not very exacting as to site, being found in rather wet valleys as well as on steep rocky hill sites. It occurs all over Liberia, often in small open aggregations, perhaps somewhat more commonly in the evergreen forest zone (stocks of 20–42 trees  $>$  60 cm ( $\approx$  24")  $\varnothing$ /sq. mile were recorded).

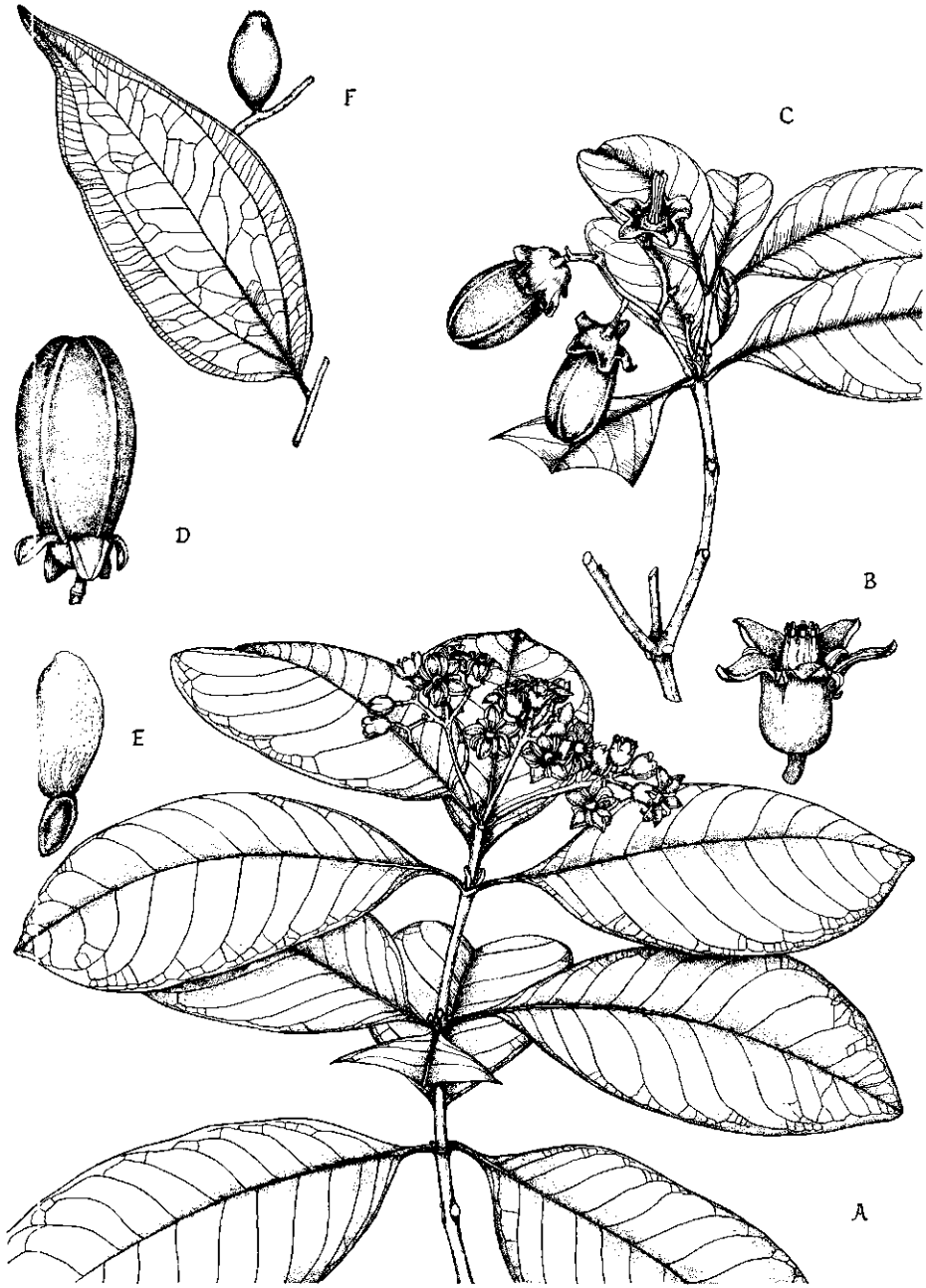


Fig. 58. *Anopyxis klaineana* (PIERRE) ENGL. A: branch with leaves and inflorescences ( $\times \frac{1}{2}$ ); B: open flower ( $\times 2$ ); C: branch with fruits ( $\times \frac{1}{2}$ ); D: fruit ( $\times 1$ ); E: seed ( $\times 1$ ); F: leaf and fruit of *Anisophyllea meniaudi* AUBRÉV. & PELLEGR. ( $\times \frac{1}{2}$ ).

Flowering lasts from August to October. Fruits ripen during February–March. Many fruits drop unopened from the tree and regeneration under the mother tree is scarce. The winged seeds, released from the fruits on the tree, turn fast like a horizontal propeller, sailing far from the mother tree.

USES. The tanniferous bark is used for treating skin infections and ulcers (cf. Cooper).

The wood is hard and heavy, Sp.G. 0.78–0.88, uniformly light yellow-brown, with a coarse texture and an irregular grain. Though used for planks and general building purposes, it is not durable. It is suitable for turning; impregnated it may serve for railway ties.

*Cassipourea nialatou* AUBRÉV. & PELLEGR.

[27, 59/36,303]

'*Cassipourea*': latinized vernacular name from Guiana (S. America).

'*nialatou*': vernacular name from Ivory Coast.

Aubréville & Pellegrin, Bull. Soc. Bot. France, 83, p. 706 (1937); type: Serv. For. 1676, Ivory Coast (Pl, K!); Jaques Felix, Rev. Bot. Appl. 1952, p. 266: *Les Cassipourea* d'Atrique occidentale.

1936: Aubréville, F.F.C.I., 1st ed., III, p. 46

1958: Aubréville, F.F.C.I., 2nd ed., III, p. 60

1954: F.W.T.A., 2nd ed., I, p. 283

1960: Normand, A.B.C.I., III, p. 38; Pl. CXXXIII

LOCAL NAMES: wengèh (Bassa)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Liberia, S.W. Ivory Coast

**BOTANY.** A medium-sized, rarely large tree. Branchlets long and slender, slightly swollen and compressed at the nodes, with internodes of 1–3.5 cm long. Leaves simple, opposite, with c. 2 mm long, triangular, interpetiolar stipules, covering the sticky terminal bud, leaving transverse scars on the nodes when shed. Petiole 5–7 mm long; blade coriaceous, glossy dark green above, pale beneath, elliptic – obovate, (3.5–) 5–13 cm long, (1.5–) 2.5–5 cm wide, cuneate at base, bluntly acute or shortly cuspidate at the top. Midrib flat above, raised beneath. Nerves 5–8 pairs, hardly raised beneath. Reticulation of veins nearly absent, indistinct. Leaves of water shoots larger, often elliptic.

Flowers crowded in axillary dwarf shoots on leaf-bearing branchlets. Flower buds sticky. Pedicel 0.4–1 mm long. Calyx campanulate, glabrous outside; calyx tube c. 2.5 mm long, sparsely puberulous inside; calyx lobes (5–) 6–7, valvate in bud, more or less spreading at anthesis, triangular, c. 1.5 mm long, densely puberulous inside. Petals as many as the calyx lobes, folded in bud, erect, c. 5 mm long at anthesis, the lower 3–3.5 mm strap-shaped, the upper 1.5–2.5 mm fimbriate. Stamens about twice the number of

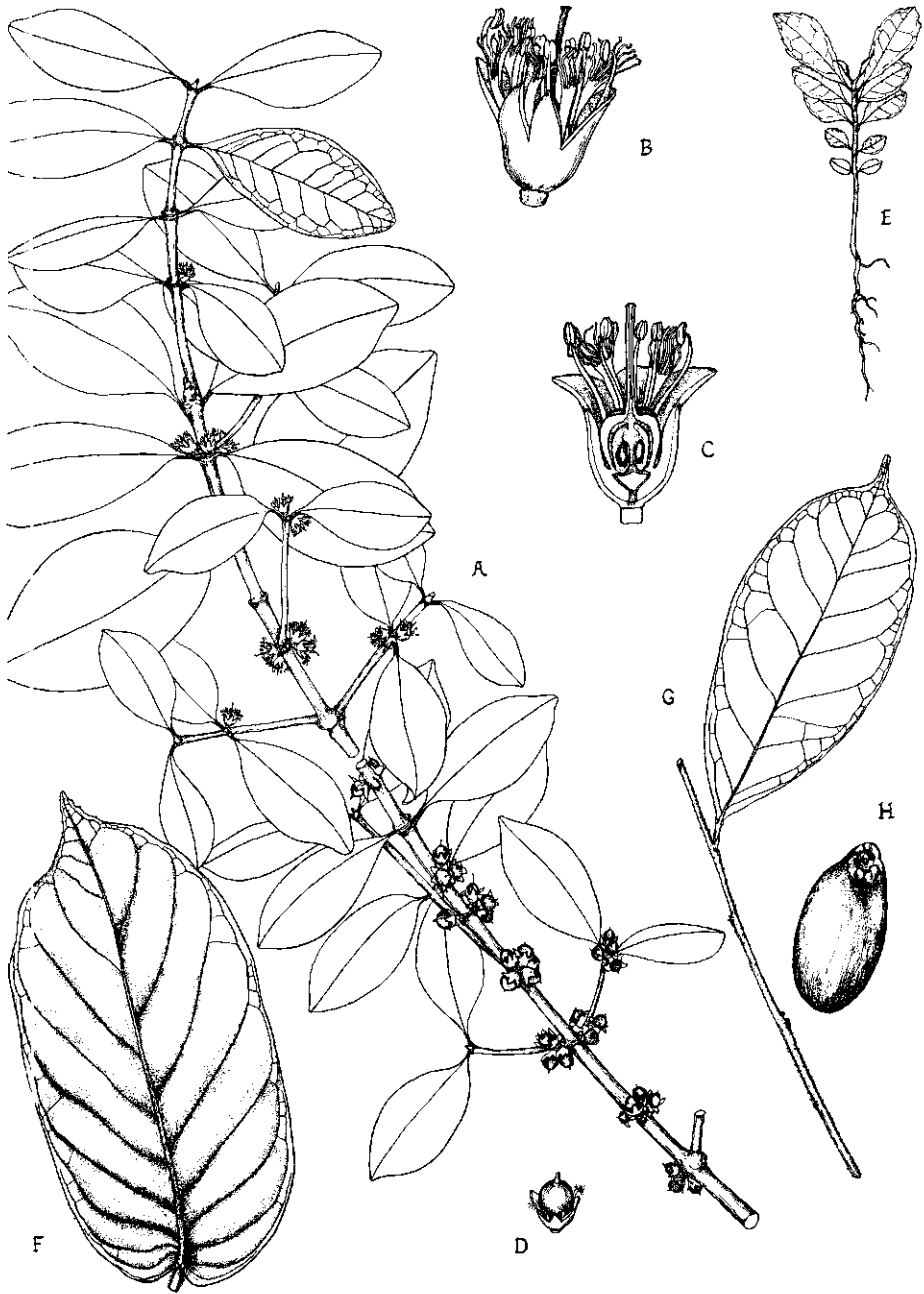


Fig. 59. *Cassipourea nialatou* AUBRÉV. & PELLEGR. A: branch with leaves and flowers ( $\times \frac{1}{2}$ ); B: open flower ( $\times 4$ ); C: length-section of flower ( $\times 4$ ); D: fruit ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ); F: leaf of *Parinari aubrevillei* PELLEGR. ( $\times \frac{1}{2}$ ); G: leaf of *Parinari glabra* OLIV. ( $\times \frac{1}{2}$ ); H: fruit ( $\times \frac{1}{2}$ ).



petals, at base shortly adnate to the membranous, 0.7 mm high, lobed disc; filaments 4–5 mm long, glabrous; anthers oblong, dorsifixed, c. 1 mm long. Ovary sessile, globose, with 3 distinct ridges, puberulous towards the top, 1-celled, with 6 ovules pending from the top of a central column. Style 2.5–3.5 mm long.

Fruit a globose, purplish black berry, 4–5 mm across, containing 3–4 smooth, brown, 2.5 mm long, ellipsoid seeds, enclosed by a lobed and folded white aril.

Seedling: germination epigeal. Hypocotyl c. 1.5 cm long. Cotyledons foliaceous, spreading, ovate, 6 mm long, 4 mm wide. Epicotyl 3–4 mm long. Leaves opposite, progressively larger, the first pair c. 1 cm long, 0.5 cm wide, the 7th pair about 6 cm long, 2 cm wide, with a denticulate margin. Stipules very small. Nerves very faint. Stem sparsely pilose.

**TAXONOMICAL NOTES.** This species seems to be restricted to Ivory Coast, Liberia and possibly Sierra Leone. The original description of Aubréville & Pellegrin (1937, l.c.) cites the measurements of the leaves as 7–17 cm long, but such large leaves are probably from water shoots, which frequently occur on the lower part of the bole (and which do not occur on the type specimen). The one-celled ovary has a distinct central column in the Liberian material, unlike the figures, given by Aubréville & Pellegrin (l.c.).

From Liberia one more endemic *Cassipourea* species has been recorded, which may be a fair sized tree: *Cassipourea firestoneana* COOPER & RECORD, only known by the collections of Cooper in the Firestone Plantation (1928). Cooper in Evergr. For. Liberia, p. 37, 1931: 'forest tree, 75–90 ft tall and 2–2½ ft diameter, with low buttresses, long, clear bole and spreading crown having large, crooked branches; bark greenish grey, slightly plated or scaly; leaves oval, cuneate at the base, abruptly pointed at apex, margin entire, 1–5" long, glabrous above, slightly pubescent underneath; flowers greenish, ½" long, axillary, on pendulous stalks 1" long, the pedicel, bracts and calyx covered with velvety pubescence'. This tree, 'kutwahn' in Bassa, seems to play an important role in native juju. It has never been collected or observed by the author. A smaller tree of the sandy coastal plains is *Cassipourea barteri* (HOOK. f.) N.E. BR..

The present description and figures are based on the following specimens: Bomi Hills 828; Bong Range 1180, 1250; Gbi Nat. For. 540; Chien area 290; Kanweake 972, 993, 1121, 1268.

**FIELD NOTES.** *Cassipourea nialatou* is a medium-sized, rarely large tree, up to 30 m (≈ 100') high and 90 cm (≈ 3') in diameter. The base is swollen or has low root swellings, which are characteristically coiled. The bole is straight and cylindrical, and may reach up to 20 m (≈ 66') to the first branches. The crown is rather dense, rounded. The bark is smooth or finely flaky, ashy grey, sometimes yellowish, striate with horizontal lentils. The slash is about 1 cm thick, hard, granular, ochre-yellow; some clear sap collects in the slash wound. The tree is evergreen and seems to be confined to the evergreen forest zone, where it grows scattered or, locally, slightly gregarious. It seems to

have little preference for site, but does not grow on marshy sites. Flowering lasts from April–June, possibly longer; fruits ripen in November–December. Regeneration may be abundant on open, mineral soils (road sides).

The smooth, grey bark habit is shared by various leguminous trees (*Didelotia*, *Tetra-berlinia* etc.) but the coiled base and the slash are diagnostic.

**USES.** The wood is very hard. No data are available on its use.

## ROSACEAE

A large cosmopolitan family of trees, shrubs, and herbs. Leaves simple and pinnately nerved, or compound, alternate, rarely opposite. Stipules as a rule present. Flowers actinomorphic or subzygomorphic, usually hermaphrodite, often 5-merous. Receptacle often forming a cup or tube, carrying the sepals, petals, and stamens on the rim. Calyx free or adnate to the ovary, the lobes imbricate. Petals as a rule present, imbricate. Stamens usually numerous; filaments free or connate; anthers small, 2-celled. Carpels one or more, free or connate, superior or inferior; styles free or rarely connate, sometimes gynobasic.

The branchlets of *Rosaceae* are often markedly lenticellate, and the leaves often have glands on the petiole or blade. The slash is often granular and fills up with some clear, watery sap.

In Liberia the *Rosaceae* are represented by 5, possibly 6 genera, mostly trees. *Chrysobalanus ellipticus* SOLAND. ex SABINE and *C. orbicularis* SCHUM., shrubby trees, form the first dense, coastal thickets after the beach flora. *Acioa barteri* (HOOK. f. ex OLIV.) ENGL. and *Afrolicania elaeosperma* MILDBR. are understory trees, the latter characterized by its sharply ridged and fluted bole. Most important for the forester are the *Parinari* species, treated below. These genera are all arranged within the sub-family *Chrysobalanoideae*, which is often treated as a distinct family, the *Chrysobalanaceae*.

### *Parinari excelsa* SABINE

[28, 60/19,22,29]

'*Parinari*': vernacular name from Brazil.

'*excelsa*': L. *excelsus*: lofty, high; transf.: eminent, probably referring to the quality of the fruit.

Sabine, Trans. Hort. Soc., V, p. 451 (1824); type: G. Don, s.n., Sierra Leone (K!); Hauman, Bull. Jard. Bot. Bruxelles, 21, p. 191 (1951); R. A. Graham, Kew Bull. 1957, p. 229.

(In older literature the generic name *Parinarium* is used).

1871: F.T.A., II, p. 367

1928: F.W.T.A., 1st ed., I, p. 318

1931: Cooper & Record, Evergr. For. Liberia, p. 59

1936: Aubréville, F.F.C.I., 1st ed., I, p. 146

1937: Dalziel, U.P.W.T.A., p. 168

1950: Normand, A.B.C.I., I, p. 95; Pl. XXII

1958: F.W.T.A., 2nd ed., I, p. 429

1959: Aubréville, F.F.C.I., 2nd ed., I, p. 180

1959: Kryn & Fobes, Woods of Liberia, p. 82

1960: Taylor, Syn. Silv. Ghana, p. 284

1960: Keay, Trees of Nigeria, I, p. 318

1961: Irvine, Woody Plants of Ghana, p. 264



Fig. 60. *Parinari excelsa* SABINE A: branch with leaves and inflorescences ( $\times \frac{1}{2}$ ); B: open flower ( $\times 4$ ); C: fruit ( $\times \frac{1}{2}$ ); D: cross-section of fruit ( $\times \frac{1}{2}$ ); E: seedling ( $\times \frac{1}{2}$ ); F: petiole with glands ( $\times 2$ ); G: leaf of *Parinari excelsa* subsp. *holstii* (Engl.) R. Grah. ( $\times \frac{1}{2}$ ).

LOCAL NAMES: (g)boh (Gio); kotue (Krahn); kpar (Bassa, cf. Cooper)

TRADE NAME: Parinari; rough-skin plum

GEOGRAPHICAL DISTRIBUTION: Senegal – Tanganyika

**BOTANY.** A large tree. Terminal branchlets tomentose-pilose with short appressed hairs and long spreading hairs. Older branchlets glabrescent, with numerous small, white lenticels, especially below the nodes. Stipules c. 1.5 cm long, 3 mm wide at base, acute, pilose outside, early caducous. Leaves simple, alternate, brownish or greyish felty on petiole and lower surface, pilose on petiole and midrib, glabrous and glossy green on the upper surface except for the midrib. Petiole 0.5–1.3 cm long, slightly grooved and with a pair of obscure – distinct glands above, situated near the middle. Blade elliptic, 6–13 cm long, 2.5–5 cm wide, obtusely cuneate at base, acute – acuminate at the top. Blade of leaves on flowering twigs often narrowly elliptic, 4–10 cm long, 1–4 cm wide, cuneate at base, long acuminate at the top, tending towards the leaf type of *P. excelsa* subsp. *holstii*. Midrib and nerves flat above, prominent beneath, the nerves in 15–22 pairs, straight and parallel, reaching till the near edge. Reticulation of veins slightly raised, more or less parallel between the nerves. Leaves of saplings and water shoots oblong, up to 20 cm long and 7 cm wide, with up to 30 pairs of nerves.

Inflorescences paniculate, axillary, 3–10 cm long, often on up to 20 cm long, slender twigs with slightly modified leaves (see above). Peduncles, bracts, pedicels and outside of the sepals densely tomentose – pilose. Bracts concave, acute, up to 5 mm long, caducous, 2 bracts enclosing 2–3 flowers. Pedicel 0.5 mm long. Receptacle cup-shaped, c. 2 mm deep, sericeous inside, the rim with a fringe of long hairs, pointing downwards. Sepals, petals, stamens and staminodes inserted on the rim of the receptacle. Sepals 5, imbricate in bud, spreading at anthesis, triangular, 2–3 mm long, 1–1.5 mm wide, tomentellous inside. Petals 5, white, membranous, narrowly elliptic, acute, glabrous or ciliolate, at anthesis equal to or slightly exceeding the sepals. Fertile stamens as a rule 7, on the side of the receptacle where the ovary is attached. Filaments 2.5–3.5 mm long, glabrous. Anthers dorsifixed, introrse, very small, opening with 2 slits. Staminodes 8, completing the whorl of stamens, free, acicular, 0.8 mm long. Ovary obliquely attached to the side of the receptacle, sericeous, formed by 1 carpel with 2 ovules, separated by a septum. Style 1, gynobasic, pilose. Stigma terminal.

Fruit an ovoid drupe, 2.5–6 cm long, 1.5–4 cm across. Exocarp orange-brown or grey when ripe, coriaceous, rough, covered with numerous small lenticels ('rough-skin plum'); mesocarp fleshy, somewhat mealy, 4–8 mm thick; endocarp very hard, 1–3 cm thick, 2-celled, the cell walls lined with a woolly, golden-brown pubescence, only one cell containing a seed, the other cell sterile.

Seedling: germination epigeal, but the cotyledons remaining enclosed in the hard endocarp. Epicotyl 5–9 cm long, villous, with about 8 scales at regular distances of c. 1

cm. Leaves alternate, similar to the mature leaves but at first somewhat smaller and with less nerves. Germination may take 2–3 months. From a strictly morphological point of view the epicotyl is only c. 1 cm long, and of the first eight leaves only the connate stipules have developed as scales. When the leading shoot is damaged a new shoot develops from the axil of one of the scales.

TAXONOMICAL NOTES. Except for *Parinari excelsa* five more species and one subspecies are recorded from Liberia; they may be distinguished as follows:

- |       |  |   |
|-------|--|---|
| 1. a. | Pair of glands about in the middle of the petiole  | 2                                       |
| b.    | Glands on the base of the blade, on the upper surface  | 4                                       |
| 2. a. | Blade ovate, as a rule slightly cordate at base; glands flat and glossy, adjacent; tree of river borders   | <i>P. congensis</i>                     |
| b.    | Blade elliptic, (obtusely) cuneate at base; glands slightly raised, small  | 3                                       |
| 3. a. | Leaves of vegetative shoots 2.5–5 cm wide; sepals, petals, and stamens at anthesis over 2 mm long; staminodes free, acicular                             | <i>P. excelsa</i>                       |
| b.    | Leaves of vegetative shoots up to 2.5 cm wide; sepals, petals, and stamens at anthesis up to 2 mm long; staminodes partly connate, forming a dentate rim | <i>P. excelsa</i> subsp. <i>holstii</i> |
| 4. a. | Blade glabrous beneath or more or less pubescent, but not felty  | 5                                       |
| b.    | Blade with a felty indumentum beneath  | 6                                       |
| 5. a. | Blade slightly cordate at base, more or less pubescent beneath; apex glandular-denticulate; nerves in 8–13 pairs   | <i>P. aubrevillei</i>                   |
| b.    | Blade cuneate at base, glabrous; apex slightly caudate, not with glands; nerves in 5–7 pairs   | <i>P. glabra</i>                        |
| 6. a. | Felty indumentum reddish brown; high forest tree   | <i>P. chrysophylla</i>                  |
| b.    | Felty indumentum grey – white; gnarled savanna tree  | <i>P. macrophylla</i>                   |

*Parinari aubrevillei* PELLEGR.: a medium-sized, rarely large tree up to 80 cm ( $\approx$  2.5') in diameter and 30 m ( $\approx$  100') high. The base has low root swellings or root spurs. The bole is straight and cylindrical, the crown dark and dense. The bark is dark grey, smooth and horizontally striate or scaly with large, irregular scales, densely lenticellate. The slash is hard and granular, dark red – red-brown, with some clear sap in the slash wound. The nearly glabrous, dark green leaves are (narrowly) elliptic, slightly cordate at base, with c. 10 pairs of steeply ascending, prominent nerves. They are readily recognised by the glandular-denticulate apex (see fig. 59 F).

The inflorescence is corymbose. The flowers, including the pedicel, are c. 2 cm long, greyish brown pubescent; stamens are pale green, c. 2 cm long; the ovary is formed by 3 free, densely sericeous carpels. The smooth fruits resemble those of *P. glabra* (see fig. 59 H). Flowers and fruits were collected during October. *P. aubrevillei* (zu-ti, or 'black zu' in Gio) is fairly common locally; it is a species of the evergreen forest. The wood is extremely hard and unfit for utilisation.

*Parinari chrysophylla* OLIV.: a tree resembling *P. aubrevillei* in habit, but with a very characteristic rusty red-brown foliage, somewhat like *Anthonotha fragrans*, owing to the red-brown indumentum on the lower surface of the leaves. The tree (*Parinarium* sp. in Cooper & Record, l.c., p. 60) is rare. Red monkeys use this tree as a hiding place.

*Parinari congensis* F. DIDR.: This strictly riparian species has only been recorded from Liberia by Karl Mayer as *P. subcordatum*. I did not find it.

*Parinari glabra* OLIV.: a large tree up to 30 m ( $\approx 100'$ ) high and over 1 m ( $\approx 3.5'$ ) in diameter, somewhat resembling *P. excelsa*, but as a rule only with heavy, narrow buttresses up to 1 m ( $\approx 3.5'$ ) high. The bole is often straight and cylindrical, the crown heavily branched and spreading. The yellowish bark is covered by lenticels; it is scaly with large, irregular scales on the lower part, nearly smooth on the upper part of the bole. The slash is hard and granular, pink-red on the buttresses, dark red on the bole, moist. The glabrous, slightly caudate leaves have a pair of usually distinct glands at the base of the blade. The inflorescence is corymbose; flowers, including the pedicel, are c. 1.5 cm long. The fruits are smooth, ovoid, laterally compressed, c. 4 cm long, 2.5 cm wide, hard and smooth, without fleshy mesocarp (see fig. 59 G, H).

*Parinari excelsa* subsp. *holstii* (ENGL.) GRAHAM: a very large tree up to 45 m ( $\approx 150'$ ) high and 1.50 m ( $\approx 5'$ ) in diameter, in Liberia apparently restricted to the moist semi-deciduous forest. The base has narrow, thick, sometimes very high but as a rule low buttresses; there is a long, straight, cylindrical bole, a fairly smooth, shallowly grooved, yellowish grey bark, covered abundantly with brown lenticels; sometimes the bark is scaly with large bark plates. The slash is thick and granular, flesh-red, moist with some clear sap. The crown has a fine texture owing to the small, more or less distichous leaves (see fig. 60 F).

There have been various opinions about the relationship of this taxon and *P. excelsa*. Hauman (1951, l.c.) sorted out the nomenclature of *P. holstii* ENGL., reducing *P. tenuifolium* A. CHEV. and *P. elliotii* ENGL. to synonyms. Hauman observed that *P. excelsa* was restricted to W. Africa, whereas *P. holstii* extended from Ivory Coast to Tanganyika. Graham (1957, l.c.), while acknowledging the obvious differences between the two taxa, did not consider these differences of specific rank and reduced *P. holstii* to *P. excelsa* subsp. *holstii* (ENGL.) GRAHAM. In the F.W.T.A. (1958, l.c.) both taxa were treated as one, *P. excelsa*, and this view has been followed by recent authors (Taylor 1960, Keay 1960, Irvine 1961). Compared with *P. excelsa* (see description above), the differences in subsp. *holstii* can be described as follows: the pubescence of the young twigs is uniformly tomentose; the leaves are rarely larger than 8 cm long and 2.5 cm wide; the panicles are somewhat shorter, with shorter peduncles, and a less pilose pubescence; the flowers are smaller, sepals, petals, and stamens rarely reach more than 2 mm at anthesis; the staminodes are shortly connate, forming a denticulate rim.

In view of these differences, and taking in account the characteristic difference in habit in the field, I prefer to follow Graham. It is possible, however, that in the revision of *Parinari* now being prepared at Oxford (FHO), the status of this taxon will again be

changed and in view of this I have refrained from citing possible synonyms of *P. excelsa*. It should be noted that in the revision mentioned the species *P. aubrevillei*, *P. chrysophylla*, and *P. glabra* will be transferred to a separate genus.

*Parinari macrophylla* SABINE: a gnarled tree or shrub of the coastal savannas, with large, coriaceous leaves and fruits, resembling those of *P. excelsa*, but larger.

The present descriptions and figures are based on the following collections: *P. aubrevillei*: Bomi Hills 77, 1252; Gbi Nat. For. 535; Bong Range s.n.; Putu area 1000. *P. chrysophylla*: Bong Range 1138. *P. congensis*: Ivory Coast, Leeuwenberg 3330. *P. excelsa*: Duport 389, 393, 778; Bomi Hills 1056; Bopolu, Whyte s.n.; Nimba 894; Gio Nat. For. s.n.; Chien area 668. *P. glabra*: Duport 312, 390, 1117, 1188; Ganta, Harley 1223; Zuole 200, 1128; Putu area 861. *P. excelsa* subsp. *holstii*: Nimba 877. Ivory Coast: Leeuwenberg 2623, 2814. *P. macrophylla*: Duport 263, 324.

FIELD NOTES. *Parinari excelsa* may reach a height of 45 m ( $\approx 150'$ ) and a diameter of 1.50 m ( $\approx 5'$ ). The base is very variable. Young trees only have root spurs, older trees thick and narrow buttresses, only on very large specimens reaching up to 4 m ( $\approx 13'$ ). The bole is straight or slightly sinuous, often somewhat angular, up to 20 m ( $\approx 66'$ ) to the first branches. The crown is a vast spreading dome with heavy branches, often with a thick growth of epiphytes. The foliage often has a reddish or brownish glow when seen from below. The yellowish grey or brown bark is densely covered with warty lenticels, scaly with large, irregular scales, leaving shallow impressions. Young trees are not scaly, but also have a very lenticellate bark. The slash is hard and thick, brittle-granular, pale red to pale brown with brighter brown inclusions, moist with some clear, watery sap.

*Parinari excelsa* is found all over Liberia; it has a definite gregarious tendency: values of over 200 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile were recorded. Locally it may form single dominant forests (Bopolu), whereas the highest slopes of the Nimba mountains in Liberia are covered by a nearly pure *Parinari excelsa* forest. Likewise gregarious stands in all stages of development were observed in secondary formations, and the single dominant *Parinari* high forests may well be a relic of an ancient shifting cultivation. This invasive capacity, not to be expected from a tree with such heavy fruits, is to be explained by the fact that the fleshy mesocarp of the fruits is edible, and that the nuts containing the seeds are distributed by birds and mammals.

The tree is evergreen. It seems little exacting as to site, but does not grow in swamps. Flowering takes place from January–June, fruits are found from October–January. Regeneration in the high forest is scarce, but in broken up forest, logging roads and young secondary forest regeneration is common, locally even dominant.

A *Parinari* is easily recognised by its slash type: red, granular, and moist, and by the fruits: the nut, transversely cut, shows two cells, one fertile and one sterile. For the distinction between the separate species see taxonomical notes.



USES. The mealy fruits, 'rough skin plum', are edible and highly esteemed. The wood is hard and heavy, fairly durable. It has a high silica content which has a severe dulling effect on the cutting edges of tools. It should therefore be sawn green, preferably with stellite-tipped saws. Its main economic interest is for railway sleepers, for which it is excellent when pressure-treated with a preservative.



27. *Cassipourea nialatou* AUBRÉV. & PELLEGR., showing the characteristic coiled base (see page 312).



28. *Parinari excelsa* SABINE with a typical dome-shaped crown habit (see page 319).

## RUBIACEAE

A very large, cosmopolitan family, in the tropics mostly represented by trees, shrubs, and climbers, in the temperate zone mostly by herbs. Leaves simple, opposite, entire, pinnately nerved, as a rule with interpetiolar stipules. Flowers usually hermaphrodite, actinomorphic. Calyx adnate to the ovary. Corolla epigynous, sympetalous and more or less tubular, as a rule 4-5 merous with imbricate or valvate lobes. Stamens epipetalous, as many as -, and alternating with the corolla lobes. Anthers mostly separate, 2-celled, opening lengthwise. Ovary as a rule inferior, 2- or more celled. Style often slender. Fruit a capsule, berry or drupe.

In Africa this family counts relatively few large forest species; among smaller trees or shrubs, however, it is one of the dominant families. In addition to the trees treated below, the following species has to be mentioned:

*Pausinystalia lane-poolei* (HUTCH.) HUTCH. ex LANE POOLE; a medium-sized forest tree, up to 60 cm ( $\approx 2'$ ) diameter and 25 m ( $\approx 80'$ ) high. The bole is straight but angular, the bark grey-brown, scaly, the scales leaving deep, rounded pits when shed. The slash is fairly thick, soft and fibrous, pale brown on the outside, pale yellow near the cambium. The tree flowers during the rainy season, and at this time the forest may be densely dotted with the white crowns of the flowering trees. The tree seems most common in the western province, though it is found throughout the evergreen forest zone.

The genus *Canthium* LAM. is also represented in Liberia with a few small and medium sized trees.

### *Mitragyna ciliata* AUBRÉV. & PELLEGR.

[61/37,367]

'*Mitragyna*': Gr. mitra: mitre; Gr. gune: woman; referring to the mitre-shaped stigma.  
'*ciliata*': referring to the ciliate calyx lobes.

Aubréville & Pellegrin, Bull. Soc. Bot. France, 83, p. 36 (1936); type: Mann 1771 (K!, lectotype);  
*Mitragyna macrophylla* HIERN in F.T.A., III, p. 41 (1877) (pro parte, illegitimate name);  
*Mitragyna stipulosa* AUCT. non (DC.) KUNTZE, pro parte, in various older works concerning West Africa.

1931: F.W.T.A., 1st ed., II, p. 98 (partly, as *M. stipulosa*)

1931: Cooper & Record, Evergr. For. Liberia, p. 111 (as *M. stipulosa*)

1933: Chalk, Burt Davy, Twenty W. Afr. Timb.

Trees, p. 84 (partly, as *M. stipulosa*)

1936: Aubréville, F.F.C.I., 1st ed., III, p. 224 (partly, as *M. stipulosa*)

1936: Kennedy, F.F.S.N., p. 214 (partly, as *M. stipulosa*)

- 1937: Dalziel, U.P.W.T.A., p. 402 (partly, as *M. stipulosa*)  
 1941: Harley, Native Afr. Medecine, p. 47, 49, etc. (partly? as *M. stipulosa*)  
 1946: Kinloch, Silvicultural Notes Gold Coast Trees, p. 58  
 1959: Aubréville, F.F.C.I., 2nd ed., III, p. 258, 262  
 1959: Kryn & Fobes, Woods of Liberia, p. 73  
 1960: Normand, A.B.C.I., III, p. 115; Pl. CLXIV  
 1960: Taylor, Syn. Silv. Ghana, p. 288  
 1961: Irvine, Woody Plants of Ghana, p. 683  
 1963: de Saint Aubin, La Forêt du Gabon, p. 154  
 1963: F.W.T.A., 2nd ed., II, p. 161

LOCAL NAMES: bo (Mano); bôh (Gio); floye (Krahn)

TRADE NAME: Abura; Poplar (commonly used in Liberia)

GEOGRAPHICAL DISTRIBUTION: Liberia – Congo

**BOTANY.** A medium-sized or large tree. Branchlets angulate, glabrous but sparsely pubescent at the nodes. Stipules interpetiolar, (2-) 3–10 cm long, (1-) 2–7 cm wide, obovate, rounded at the top, parallel-nerved, glabrous or more or less pubescent at base outside, glabrous inside. Leaves simple, opposite, coriaceous, medium green above, pale green beneath, on the lower surface with tufts of hairs in the axil of the nerves and scattered hairs on midrib and nerves. Petiole 1.5–4 cm long, slightly canalliculate above. Blade suborbicular – obovate, 10–40 (–65) cm long, 8–30 (–44) cm wide, truncate – cuneate at base, rounded – obtuse at the top; margin slightly undulate. Midrib and nerves slightly impressed above, prominent beneath, the nerves in 7–12 pairs, looping near the edge. Reticulation of veins slightly raised, parallel, more or less transverse with the nerves. Leaves of young trees and saplings often more (narrowly) elliptic and slightly more pubescent. Leaves subtending the inflorescences smaller, often only 7 cm long, 3 cm wide.

Inflorescences axillary or terminal, lax cymes of flower heads. Peduncles 2–7 cm long, glabrous. Flower heads at anthesis 1.5–2 cm across, dense, with a pilose flower axis. Each flower surrounded by c. 15 wedge-shaped, c. 4 mm long bracts, truncate and ciliate at the top. Calyx 1 mm high, distinctly or shallowly lobed, densely to sparsely ciliate, not exceeding the bracts at anthesis, persistent and usually curving inwards in fruit. Corolla tube 2.5–3.5 mm long, glabrous, white, with 5–7 valvate, c. 2 mm long, acute, outside densely pubescent lobes. Stamens 5–7; filaments adnate to the corolla tube; anthers at the base of –, and alternating with the corolla lobes, c. 1 mm long, sagittate, acute. Ovary inferior, 2 mm long, 2-locular. Style glabrous, at base enclosed by the urceolate receptacle, at anthesis up to 1 cm long, terminated by a mitre-shaped stigma.

Infructescence 1.3–2.3 cm across, formed by numerous, 5–8 mm long, amphora-shaped capsules, crowned by the persistent, inflexed, as a rule still ciliate calyx. The outer wall of each fruit formed by the accrescent receptacle, free from the bony pericarp, opening with 10–12 slits; the pericarp first septicial, then splitting open at the

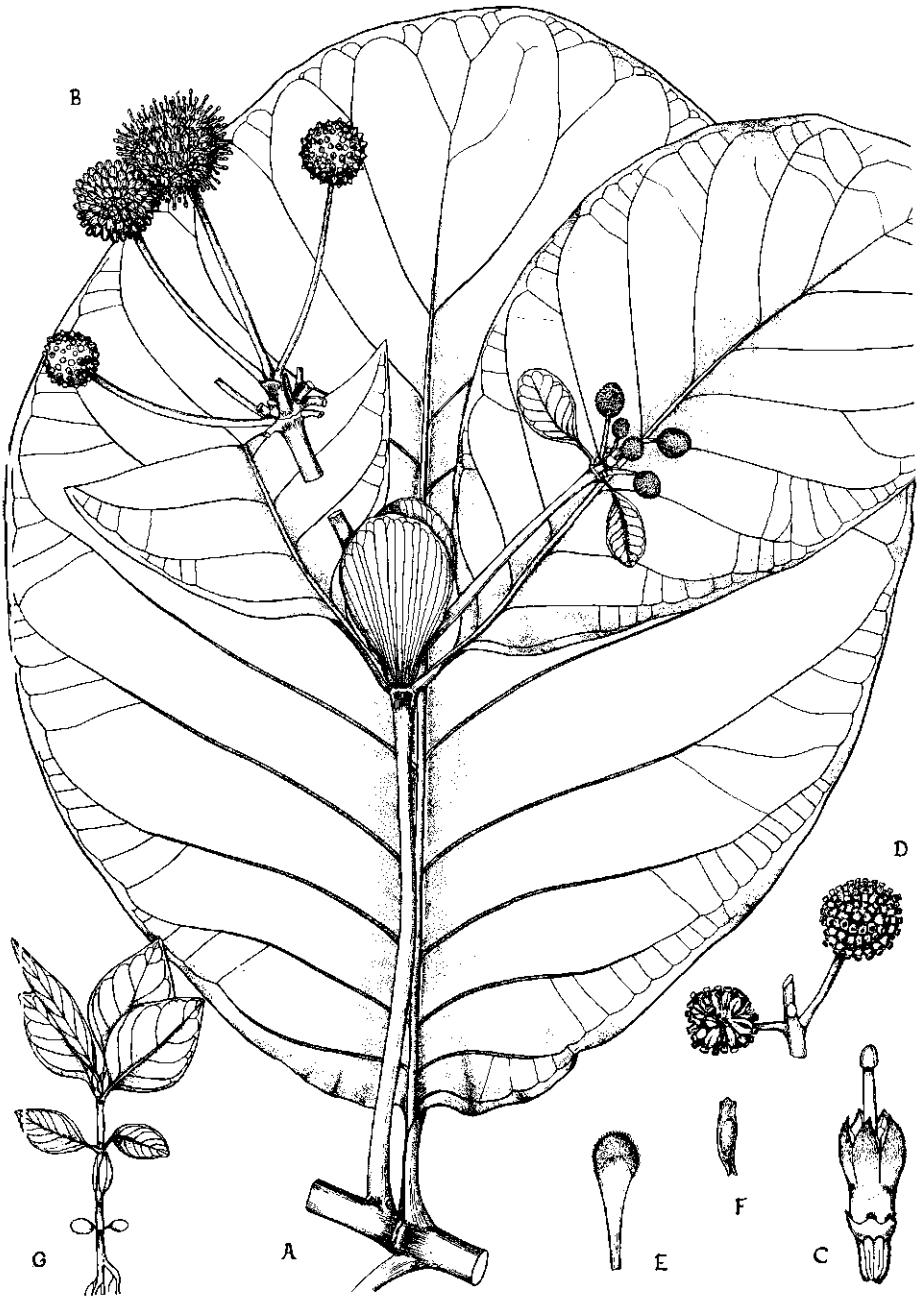


Fig. 1. *Mitragyna ciliata* AUBRÉV. & PELLEGR. A: leaf and young inflorescence ( $\times \frac{1}{2}$ ); B: mature inflorescence ( $\times \frac{1}{2}$ ); C: flower detail ( $\times 3$ ); D: infructescence ( $\times \frac{1}{2}$ ); E: bract ( $\times 5$ ); F: seed ( $\times 5$ ); G: seedling ( $\times 1$ ).

top, freeing the numerous, 1.5 mm long, flat, slightly winged seeds.

Seedling: germination epigeal. Hypocotyl 2–3 mm long. Cotyledons foliaceous, 1.5 mm long. Epicotyl 1.5 mm long. First pair of leaves estipular, only c. 3 mm long; third pair of leaves c. 2 cm long, 1.5 cm wide, with small, triangular, interpetiolar stipules. Young parts puberulous.

TAXONOMICAL NOTES. In 1877 Hiern (F.T.A., l.c.) described *Mitragyna macrophylla*, basing his species on *Nauclea macrophylla* LEPRIEUR. However, the latter name had never been validly published, therefore *Mitragyna macrophylla* Hiern was a new name. As an earlier, validly published basionym was cited (*Nauclea stipulosa* DC.), this name is illegitimate: it should have been *Mitragyna stipulosa* (DC.) HIERN. *M. macrophylla* should not therefore be used for *M. ciliata*, even when the description and part of the material cited clearly belong to the latter species.

*M. stipulosa* (DC.) KUNTZE is distinct from *M. ciliata* in having a truncate, glabrous calyx, exceeding the bracts at anthesis. It is a tree of the drier forest zones. It has been recorded from Liberia in the neighbourhood of Voinjama only. The stipules and the leaves are somewhat more pubescent, but otherwise the trees are nearly identical. The bulk of *Mitragyna* in Liberia has to be referred to as *M. ciliata*. However, the presence has to be noted of forms with a very shallowly lobed, very sparsely ciliate calyx (No. 656, cited below), presenting a possible intermediate form between *M. ciliata* and *M. stipulosa*.

The present description and figures are based on the following specimens: *M. ciliata*: Bomi Hills 817; Firestone Reserve 329; Bong Range 756; Laketa 1187; Ganta, Harley 880; Zuole 765; Gbi Nat. For. 555; Chien area 656; Kanweake, de Wilde 3665. *M. stipulosa*: 10 M. S. of Voinjama 717.

FIELD NOTES. *Mitragyna ciliata* is a medium-sized to large tree, exclusively of swamp forests, reaching a height of 35 m ( $\approx 115'$ ), and a diameter up to 1.15 m ( $\approx 4'$ ). The base is straight or has low, heavy root spurs up to 1 m ( $\approx 3.5'$ ) high, rarely real buttresses; occasionally the tree may form pneumatophores. It has a long, straight, clear and almost cylindrical bole up to 20 m ( $\approx 66'$ ) to the first branches. The crown is fairly small, irregular, with a few heavy, gnarled branches, covered by epiphytes; the foliage is fairly light green. The bark is somewhat untidy, irregularly and thin scaly, shallowly pitted or with longitudinal slits, yellowish or greyish brown. The slash is thick, soft and fibrous, pinkish brown or pale yellowish brown, turning a darker shade on exposure, with narrow vertical stripes of pale yellow dilatation tissue.

*Mitragyna ciliata* is confined to swamps and marshy places where it has subsoil moisture during the whole year, but it does not grow in deep, all-year flooded swamps. It has a gregarious tendency and very rich stands occur, which however are limited in extension; still it averages 40–60 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile. The tree is found all over Liberia, and only in the most northern parts of the western province it is re-

placed by *M. stipulosa*. The tree is evergreen; new flushes of leaves are bronze-coloured. Flowering occurs in November–January; the fruiting season lasts from February–May. According to Aubréville flowering and fruiting is observed nearly the whole year round. The very light, minute, winged seeds are widely dispersed by wind. Natural regeneration in the high forest is rare, but open swamps may be covered by a dense regrowth, when a few mature overstanders are present. Its distribution, locally abundant and elsewhere practically absent, may be influenced by shifting cultivation patterns and habits; some tribes prefer swamps for rice cultures, thus creating the open swamps necessary for regeneration; other tribes avoid swamps for rice culture. Inventory data showed that the class of trees from 40–60 cm  $\varnothing$  ( $\approx$  16–24") is often markedly less represented than the class of trees  $>$  60 cm  $\varnothing$ , which is not a natural uneven-aged distribution, and may indicate that *Mitragyna* stands are fairly even-aged, which is to be expected when regeneration takes place on cleared swamp sites.

The tree is often accompanied by *Heritiera utilis*, *Gilbertiodendron splendidum*, and *Nauclea* aff. *vanderguchtii*. The latter species has a habit, very similar to *Mitragyna*, but the crown is rounded and has a very dark green, glossy foliage. This tree may also reach 90 cm ( $\approx$  3') in diameter and a height of 33 m ( $\approx$  110'). The base is straight or swollen, rarely with widespread surface roots, root spurs or pneumatophores. The bole is straight and cylindrical, up to 20 m ( $\approx$  66') to the first branches. The bark is yellowish brown, thin-scaly, or with longitudinal ridges of lenticels. The slash is the clearest differentiating field character with *Mitragyna*: it is also thick, soft and fibrous, but distinctly pink. During the fruiting season (October–November) large, globose, up to 8 cm ( $\approx$  3") thick, fleshy, pitted, orange-brown fruits are found in abundance under the tree (see also *Nauclea*, taxonomical notes).

**SILVICULTURE.** *Mitragyna ciliata* is a relatively fast-growing species. As it produces a valuable timber, its cultivation is an interesting project, combining direct economic interest (timber production) with such indirect interests as water management, erosion control etc.

Seeds may be dispersed by the wind before the fruit capsules are shed, making seed collection difficult. Taylor (1960, l.c.) describes a method of stump planting: stumps of stem cuttings, c. 12 cm ( $\approx$  5") long and 2 cm ( $\approx$  3/4") thick are planted in beds at the edge of a swamp. Root and shoot development is fast and the plants do well when transplanted in the cleared swamp, provided planting is done at the beginning of the rainy season. Plants may grow 1 m ( $\approx$  3.5') a year.

Kennedy (1936, l.c.) and Kinloch (1946, l.c.) report: care should be taken to sow the pale brown, c. 1.5 mm long seeds, and not the c. 4 mm long, dark brown bracts. Germination is successful in 5–8 days, provided the natural conditions are imitated in the seed beds by using swamp soil, well mixed with vegetable litter, and watered with swamp water. Overhead shade is not necessary. Transplanting is done with stumps or natural seedlings; root suckers also do well. Aubréville (1959, l.c.) reports that even



when the natural regeneration is dominant in the initial stages, the ultimate results rarely form a *Mitragyna* stand of satisfactory quality. The subsequent competition of fast-growing secondary species such as *Macaranga* spp. seriously hamper the trees, many of which die, only the most vigorous surviving, and then often twisted and crooked. Plantations of *Mitragyna* therefore need good care during the first few years.

USES. The wood of *Mitragyna ciliata* is reddish brown to pale brown or tan, usually plain and without figure. It is not very lustrous, has a straight or interlocked grain, and a moderately fine and even texture. On an average it is a light wood. Logs are inclined to split, but lumber can be air-seasoned rapidly with little degrade. Once seasoned it is very stable. The wood is not resistant to decay or termites, but is easy to impregnate. It has medium hardness and strength properties. It is a good general utility timber for interior joinery, furniture, light constructions and, on account of its acid resistant properties, also good for accumulator boxes, laboratory tables etc. It peels easily and veneers well to provide a superior utility plywood. It is unsuitable for external use, but might replace softwood imports when accurately converted, air-dried and treated with a preservative. Exports largely depend on the possibility of preventing the logs from perishing, viz. rapid extraction and conversion, dipping the lumber in a preservative and air-drying it before despatch.

*Nauclea diderrichii* (DE WILD.) MERRILL

[62/37,170]

'*Nauclea*': from L. *navicula*: boat. Some of the species, formerly included in this genus, have fruits, dividing in 2 boat-shaped halves when dry.

'*diderrichii*': referring to Mr. Diderrich, the Belgian explorer, mining engineer, and collector of the holotype (1867–1925).

Merrill in J. Wash. Acad. Sci., 5, p. 530 (1915); Petit in Bull. Jard. Bot. Bruxelles, 28, p. 10 (1958); A. Chevalier, Rev. Bot. Appl., IX, p. 188 (1938);

*Sarcocephalus diderrichii* DE WILDEMAN in Rev. Cult. Colon., IV, p. 7 (1901), basionym; holotype lost; neotype: Louis 2922 (BR!);

*Sarcocephalus trillesii* PIERRE ex DE WILDEMAN, 1901, l.c., nomen;

*Sarcocephalus trillesii* PIERRE ex A. CHEVALIER in Vég. Util., 9, p. 230, t. 24 (1917): invalid name; Trilles 161 (K!, BR!);

*Nauclea trillesii* (PIERRE ex DE WILD.) MERRILL, l.c., invalid name.

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|---|---|
| 1931: F.W.T.A., 1st ed., II, p. 608 ( <i>S. diderrichii</i> ,<br>excl. syn. <i>S. pobeguini</i> ) | 1941: Harley, Native Afr. Medicin, p. 45 etc. ( <i>S.</i><br><i>diderrichii</i> ) |
| 1931: Cooper & Record, Evergr. For. Liberia,<br>p. 114 (partly, as <i>S. esculenta</i> )          | 1946: Kinloch, Silv. Notes Gold Coast Trees, p.<br>60 ( <i>S. diderrichii</i> )   |
| 1936: Aubréville, F.F.C.I., 1st ed., III, p. 232 ( <i>S.</i><br><i>diderrichii</i> )              | 1959: Aubréville, F.F.C.I., 2nd ed., III, p. 266<br>( <i>N. trillesii</i> )       |
| 1936: Kennedy, F.F.S.N., p. 215 ( <i>S. diderrichii</i> )   | 1959: Kryn & Fobes, Woods of Liberia, p. 99<br>( <i>S. diderrichii</i> )          |
| 1937: Dalziel, U.P.W.T.A., p. 411 ( <i>S. diderrichii</i> )                                       |   |

1960: Normand, A.B.C.I., III, p. 114; Pl. CLXV  
 1960: Taylor, Syn. Silv. Ghana, p. 292  
 1961: Irvine, Woody Plants of Ghana, p. 692

1963: F.W.T.A., 2nd ed., II, p. 164  
 1963: de Saint Aubin, La Forêt du Gabon, p. 153  
 (*N. trillesii*)

LOCAL NAMES: gluu (Gio); tebotue (Krahn); wei-yidi (Mano)

TRADE NAME: Bilinga; Brimstone

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Mosambique

**BOTANY.** A large tree. Branches and leaves entirely glabrous. Interpetiolar stipules green, foliaceous, enclosing the terminal bud, caducous, elliptic – obovate, 2–4 cm long, 1.5–2.5 cm wide, rounded at the top, distinctly keeled, with colleters at the base of the inner surface. Stipules of saplings up to 6 cm wide and 8 cm long. Shed stipules leaving transverse scars at the nodes. Petiole 1–2.5 cm long, flat above, the margin of the blade slightly decurrent. Blade (suborbicular) – elliptic – oblong or slightly obovate, (7–) 10–30 cm long, (5–) 8–16 cm wide. Base cuneate (– rounded); top obtusely acute. Midrib and nerves only slightly raised above, prominent beneath, the nerves in (3–) 6–9 pairs. Reticulation of veins lax, slightly raised. Leaves of saplings may be larger, up to 40 cm long and 25 cm wide.

Inflorescence a solitary, terminal, subglobular flower head of 2.5–4 cm across, on a 1–1.5 cm long peduncle with 2 pairs of opposite bracts. Sepals c. 3 mm long, ciliate at the top, fleshy, more or less connate and dorsally connate with surrounding calyces. Corolla tube pale yellow, 6–7 mm long, narrowly funnel-shaped, glabrous, crowned by 4–5 obtuse corolla lobes of 1.5–2.5 mm long, pilose inside. Anthers 4–5, implanted in the throat of the corolla tube, alternate with the lobes, c. 1 mm long, introrse. Ovary inferior, 2-celled, with numerous ovules. Style glabrous, at anthesis exerting from the flower for c. 3 mm, terminated by a club-shaped, 2 mm long stigma.

Fruit a fleshy subglobose syncarp, 2.5–4 cm across, formed by the accrescent receptacles, pitted with pits of 2–4 mm across (honey-comb surface), each with a central navel of c. 1 mm across; surface rough by persistent, slightly lignified calyx lobes. Seeds very numerous, minute, subglobose – ellipsoid, c. 1 mm across, hard and smooth.

Seedling: germination epigeal. Hypocotyl 3–5 mm long. Cotyledons 1–3 mm long, 1–2 mm wide, obtuse. Epicotyl 3 mm long, puberulous. First pair of leaves c. 7 mm long, 4 mm wide, with minute stipules. Following leaves progressively larger, the sixth pair with a blade c. 13 cm long, c. 8 cm wide, herbaceous. Saplings with very large leaves and a sappy stem.

**TAXONOMICAL NOTES.** The genus *Nauclea* L. is represented in Liberia by four species which can be distinguished as follows:

1. a. Interpetiolar stipules broadest at or above the middle, rounded at the top 2
- b. Interpetiolar stipules broadest at base, obtuse – acute 3

2. a. Fruit 6–8 cm across, pitted with 7–10 mm wide, walled pits, each pit with an annular navel of 3–4 mm across. Seeds 1.5–2.5 mm long, c. 1 mm through, slightly carinate. Tree of swampy valleys with a pink, fibrous slash  
*Nauclea* aff. *vanderguchtii*
- b. Fruits 2.5–4 cm across, pitted with 3–4 mm wide pits, each pit with a navel of c. 1 mm across. Surface rough with the persistent calyx lobes. Seeds subglobular, c. 1 mm across, not carinate. Tree of dry land forest, with a yellow slash  
*Nauclea diderrichii*
3. a. Fruits 2–5 cm across, subglobular, smooth but pitted with shallow pits of 2–3 mm across. Seeds 0.6 mm across, ellipsoid. Sarmentose shrub of roadsides, secondary bush, and savannas  
*Nauclea latifolia*
- b. Fruits up to 6 cm across, densely papillose with the long-hairy calyx lobes. Seeds 2–3 mm long, marginate. Tree of riverborders; slash yellow, fibrous  
*Nauclea pobeguini*

*Nauclea diderrichii* (DE WILD.) MERRILL. There has been some argument whether the valid specific epithet of this species should not be *trillesii*, but the name *Sarcocephalus trillesii* PIERRE has never been validly published (see Petit, 1958, l.c.). The description of the fruit in F.W.T.A., 1963, l.c.: 'pits on the surface of the mature fruits 7–9 mm diam.' refers to *N. vanderguchtii*, whereas the corresponding sentence under *N. vanderguchtii* refers to *N. diderrichii* (the sentences having been transposed).

*Nauclea latifolia* Sm.. This very common sarmentose shrub was formerly known as *Nauclea esculenta* (AFZEL. ex SABINE) MERRILL.

*Nauclea pobeguini* (POBEGUIN ex PELLEGR.) PETIT. This rather rare species closely resembles *Nauclea diderrichii* in the field but it is confined to river borders. The slash is pale yellow-brown, turning dark yellow on exposure. The triangular stipules and large, rugose fruits are diagnostic.

*Nauclea* aff. *vanderguchtii* (DE WILD.) PETIT. This species, a large tree, growing in swamps (see *Mitragyna* field notes) is possibly a new species of *Nauclea*. The leaves are (narrowly) elliptic to (–) obovate, 15–25 cm long, 7–11 cm wide, cuneate at base, rounded at the top, and have 4–7 pairs of strong nerves. The midrib may or may not be minutely puberulous on the lower surface. The stipules are similar to those of *N. diderrichii*. Flowers are as yet unknown. Fruits and seeds: see key. The tree is related to *N. vanderguchtii*, a smaller tree, found in S. Nigeria, Cameroon, Gabon and Congo, but the seeds of the latter species are larger and more carinate, the fruits lack the wide annular navel in the centre of the pits, the leaves are generally larger and the branches are myrmecodomous (ants live in the hollow nodes).

*Nauclea xantoxylon* (A. CHEV.) AUBRÉV., a tree species found in Central Africa (but apparently also in Ivory Coast, though not mentioned in the recent F.W.T.A.) is distinct in having a pubescent lower leaf surface and rounded seeds of c. 1 mm across.

The present description is based on the following specimens: *N. diderrichii*: Bomi



Fig. 62. *Nauclea diderrichii* (DE WILD.) MERRILL A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: fruit ( $\times \frac{1}{2}$ ); C: seedling ( $\times \frac{1}{2}$ ); D: fruit of *N. aff. vanderghuchtii* (DE WILD.) PETIT ( $\times \frac{1}{2}$ ); E: node with interpetiolar stipule of *N. pobeguini* (PELLEGR.) PETIT; F: seed of *N. diderrichii* ( $\times 5$ ); G: seed of *N. xantoxylon* (A. CHEV.) AUBRÉV.; H: seed of *N. aff. vanderghuchtii* ( $\times 5$ ); I: seed of *N. vanderghuchtii* ( $\times 5$ ); K: seed of *N. pobeguini* ( $\times 5$ ).

Hills 620; N. Gio Nat. For. 159; Nimba 895; Siga, Bassa III, 1105; Chien area 631, 1004; Kanweake, de Wilde 3690. *N. latifolia*: Gbama, de Wilde 3816. *N. pobeguini*: Bomi Hills 1151. *N. aff. vanderguchtii*: N. Gio Nat. For. 148, 1269.

FIELD NOTES. *Nauclea diderrichii* is a very large tree, reaching a height of up to 50 m ( $\approx 160'$ ) and a diameter of up to 1.50 m ( $\approx 5'$ ). The base has heavily swollen root spurs, sometimes extending in spreading surface roots, and on old trees reaching up to 3 m ( $\approx 10'$ ) high. The bole is straight, at base somewhat angular owing to the root swellings, but otherwise cylindrical, reaching up to 30 m ( $\approx 100'$ ) to the first branches. The crown is fairly small, rounded, open, with bright green leaves, which are shed at the end of the rainy season, but soon replaced by green flushes of new leaves. The bark is yellowish brown, often shallowly fissured, fairly smooth, hardly scaly, but the outer-bark weathering on the tree. The slash is thick, the dead outer layer pale brown, the inner layer pale yellow-yellowish brown, nearly white near the cambium, fairly rough-fibrous, brittle, somewhat bitter when tasted, and has a fresh smell.

*Nauclea diderrichii* is found all over Liberia, preferring light, well-drained soils; values of 20–80 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile have been recorded. The flowering season is from March–June. Ripe fruits are found from September–December. The fleshy fruits are edible and the seeds are spread by small mammals, but probably even more by birds. Regeneration may be very abundant on such open sites as logging roads, recent farmland etc. It often shows a vigorous growth, but in too open conditions it may be hampered by shoot borer attack resulting in bushy heads, after which small black ants occupy the hollow leading shoot.

SILVICULTURE. Fruit production is regular and copious, resulting in a good seed supply. The seeds remain viable for over a year when sun-dried. The very fine seeds are difficult to sow. To free the seeds the fleshy fruits are pounded in a mortar with some water. The resulting pulp is either sun-dried, pulverised and mixed with fine sand before sowing, or mixed with some water and poured out over the seed beds. The seed bed should have a light shade cover. The soil should be fine. Sowing should not be too dense. Germination is effective in two to three weeks; initial growth is slow. When the seedlings are 5–10 cm high, the shade cover should be removed. After one to two months seedlings are 10–15 cm high and can be pricked out and put in transplant beds at 25 cm spacing ( $\approx 10 \times 10''$ ), or in baskets. This should be done very carefully because the seedlings are herbaceous and when pulled out by the stem the cambium may be injured. Transplanting in the field is done with material of about one and a half years old, either as stumps or as basket plants, in full light or with some side shade. Stems should be well cut back to minimise the danger of drying back, because the stem is sappy and has a large pith. Basket plants do not have the disadvantage of the drying stump. Spacing about  $2.50 \times 2.50$  m ( $\approx 8 \times 8'$ ). The crown is dense with spreading branches. Initial growth in the field is slow. Once the plant starts to grow, it needs full

overhead light. Height growth may average nearly 1 m ( $\approx 3'$ ) a year. The tree cleans itself well. This species has been found to do well in taungya schemes and its rate of growth makes it suitable for forming matrix in which mahoganies can be planted in wide spacings.

Uses. For various medical applications of the bark, see Harley, l.c. The wood ('mortar-stick') is preferred for the manufacture of mortars, being easy to work and durable. The sapwood is c. 5 cm ( $\approx 2''$ ) wide, pale yellow. The heartwood is uniformly golden yellow, when fresh with a slightly unpleasant smell. It is heavy, strong and fairly fine-grained. The wood is durable and has a high resistance against termite and fungus attack. It is suitable for railway ties, furniture, flooring, harbour works, bridges and general constructive work.

## RUTACEAE

A cosmopolite, but mostly tropical family of woody plants, rarely herbs. Leaves simple, digitate, trifoliolate or pinnate, mostly gland-dotted; stipules absent. Flowers hermaphrodite or unisexual, actinomorphic, 4–5 merous. Sepals free or connate. Petals mostly free, imbricate. Stamens as a rule once or twice the number of petals. Ovary superior, (1) 4–5 celled, sometimes the carpels free. Ovules often 2 in each cell, superposed. Fruit a berry or drupe, rarely a capsule.

The *Rutaceae* are readily recognised by the gland-dotted, usually compound leaves, the glands often visible as translucent points. Often the leaves are scented when crushed, and also the slash is scented. *Araliopsis* ENGL. and *Fagara* L. are the only genera in Liberia, representing large forest trees. The citrus fruits belong to this family.

*Araliopsis tabouensis* AUBRÉV. & PELLEGR.

[63/38,338]

'*Araliopsis*': Gr. *opsis*: habit; with the habit of *Aralia*. *Aralia* L. is a genus of the *Araliaceae*, likewise with digitate leaves.

'*tabouensis*': referring to the village of Tabou, on the Ivory Coast, near which the type specimen was collected.

Aubréville & Pellegrin in Bull. Soc. Bot. France, 83, p. 488 (1933); type: Aubréville 1304 (P!).

1931: Cooper & Record, Evergr. For. Liberia, p. 98 (as <i>Schefflera</i> sp., Cooper 341, BM!)	1958: F.W.T.A., 2nd ed., I, p. 688
1936: Aubréville, F.F.C.I., 1st ed., II, p. 90	1959: Aubréville, F.F.C.I., 2nd ed., II, p. 114
1955: Normand, A.B.C.I., II, p. 175; Pl. LXXII	1961: Irvine, Woody Plants of Ghana, p. 491

LOCAL NAMES: doo-clean (Gio); hn'tôh (Gola, 'chicken popo')

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Liberia – Nigeria

**BOTANY.** A medium-sized, or large tree. Terminal buds covered with a sticky gum. Leaves digitately compound, alternate, estipulate, glabrous. Petiole 6–18 (–27) cm long, terete, slightly grooved above towards the top. Leaflets (3–) 5–9, as a rule 6 or 7, the central one largest, with petiolules of 0.5–2 cm long. Blade thin-coriaceous, glossy on both sides, dotted with very numerous glandular, translucent points, as a rule (narrowly) obovate, rarely (–) elliptic, 5–28 cm long, 3–11 cm wide, cuneate at base,



Fig. 63. *Araliopsis tabouensis* AUBRÉV. & PELLEGR. A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: male flower ( $\times 4$ ); C: female flower ( $\times 4$ ); D: infructescence ( $\times 1$ ); E: endocarp and seed ( $\times 2$ ); F: seedling ( $\times \frac{1}{2}$ ).



(abruptly) long-acuminate, sometimes acute at the top. Midrib slightly raised above, prominent beneath. Nerves fine, slightly raised on both surfaces, 10–20 main pairs and numerous slightly weaker pairs; reticulation of veins lax.

Flowers unisexual (tree dioecious?). Male inflorescences axillary and terminal, female inflorescences terminal, paniculate, puberulous, slightly gland-dotted, with minute bracts, many-flowered. Calyx pale green, nearly flat, very shortly 4-lobed, ciliate on the lobes, 1.5–2 mm across. Petals (3) 4, slightly imbricate, pale green outside, white inside, elliptic, 3–3.5 mm long, 2–2.5 mm wide, acute, glabrous, slightly gland-dotted. Male flowers: stamens twice the number of petals. Filaments white, c. 4 mm long, the epipetalous filaments only slightly shorter than the others; anthers basifixed, c. 1 mm long, sagittate, opening with lateral slits. Disc absent. Ovary conical, 2.5 mm long, shortly 3-lobed at the top, sterile. Female flower: stamens reduced, 1–1.5 mm long, sterile. Ovary subglobular, 2 mm across, 4-, sometimes 5-locular, crowned by a sessile, disc-shaped stigma, 1.5 mm across.

Fruits subglobular, drupaceous, on a c. 5 mm long stalk, c. 12 mm across, yellow and juicy when ripe, resinous, containing 4 or 5 nuts, formed by the hard endocarp. Each nut open at the top, as a rule containing 2 seeds tightly pressed against each other, seemingly forming one single, slightly curved, finely striate, black seed, c. 7 mm long, 4 mm thick, acute and with a ventral cavity at the top; seed coat hard and brittle.

Seedling: germination epigeal. Hypocotyl 2.5–4 cm long, puberulous. Cotyledons foliaceous, oblong, 10–17 mm long, 2–4 mm wide. Epicotyl 2–4 mm long. First pair of leaves opposite, trifoliolate, petiole 3–5 mm long; leaflets 6–15 mm long, 2–3 mm wide, with a denticulate margin, gland-dotted. Following leaves alternate, progressively larger, trifoliolate, gradually less denticulate; 10th leaf with a petiole of 2 cm long and leaflets of 4 cm long and 1 cm wide. All leaflets gland-dotted; stem puberulous.

**TAXONOMICAL NOTES.** The vicarious species *Araliopsis soyauxii* ENGL., found in Gabon and Cameroon, is remarkably similar to *A. tabouensis*, but the leaves have a distinctly less close nervation. As stated in F.W.T.A., 1958, l.c., the position of the taxa *Vepris* A. JUSS., *Oricia* PIERRE and *Araliopsis* ENGL. needs to be thoroughly revised (but see also: I.C. Verdoorn, Revision of the African *Toddalieceae*, Kew Bull. 1926, p. 389).

The present description is based on the following specimens: Bomi Hills 59, 1298; Bong Range 1005; N. Gio Nat. For. 143; Bassa III, Siga 704; Kanweake 1273.

**FIELD NOTES.** *Araliopsis* may reach a height of up to 40 m ( $\approx 130'$ ), and a diameter of 1.20 m ( $\approx 4'$ ). The base has heavy root swellings, on large trees up to 80 cm ( $\approx 2.5'$ ) high, sometimes extending in heavy, spreading surface roots. The bole is often straight and cylindrical, up to 18 m ( $\approx 60'$ ) to the first branches. Some trees may have a bulgy, angular and twisted bole. The crown is compact, rounded, dark green. The bark is ashy grey to black, sometimes ochre-brown, cracked and rough, sometimes with small scales, always with very characteristic, thick, yellow – ochre cork pustules on the lower

part of the bole and on the surface roots. The slash is fairly thick, soft and fibrous, or slightly brittle on the outside, ochre-yellow or pale brown, near the cambium paler yellow, rapidly turning a dirty brown on exposure; it is strongly scented and very bitter to the taste. The layer between the dead outer bark and the inner bark is often bright yellow. The sapwood is nearly white.

*Araliopsis tabouensis* is predominantly a species of the evergreen forest zone, though it is also found in the moist semi-deciduous forest. It often grows in groups, preferably on plateaux, often in a mixture with *Lophira alata*. The tree is evergreen. Flowering is in December–January, the fruits ripen in September–October.

Old specimens of *Fagara tessmannii* may resemble *Araliopsis tabouensis* in habit: on the lower part of the stem prickles are replaced by yellow corky pustules. However, its long, pinnate, clustered leaves are diagnostic.

*Cussonia bancoensis* AUBRÉV. & PELLEGR. (*Araliaceae*), a tree mostly of secondary forest, also has digitately compound leaves, distinct by the long petiole with a pair of stipules adnate to the base; it lacks translucent points in the blade.

USES. The bark of *Araliopsis tabouensis* is beaten in a mortar; the pulp is rubbed on the skin against crawl-crawl and yaw.

The wood is fairly hard and heavy, yellowish or nearly white, strongly scented. It has a woolly surface when sawn, and when sawn fresh it has a very penetrating smell.

*Fagara tessmannii* ENGL.

[29, 64/41]

'*Fagera*': an ancient name of an aromatic plant, possibly of Arabic origin.

'*tessmannii*': referring to Tessmann, a German botanist, collector of the type specimen.

Engler in Bot. Jahrb., 46, p. 406 (1911); type: Tessmann 637, Sp. Guinea (HBG, isotype); Letouzey, Fl. du Cameroun, I, p. 55 (1963);

*Fagera iturensis* ENGLER in Mildbraed, Deutsch. Zentr. Afr. Exp. 1907–1908, II, p. 423 (1912); type: Mildbraed 3057, 3070 (BR, isosyntypes!);

*Fagara inaequalis* ENGLER in Bot. Jahrb., 54, p. 303 (1917); type: Mildbraed 5189, 6103 (HBG, isosyntypes);

*Fagara rigidifolia* ENGLER non HERZOG, 1917, l.c.; type: Mildbraed 3971, 4543 (HBG, isosyntypes) = *F. obliquefoliolata* ENGLER in Pfl.fam., 2nd ed., 19A, p. 222 (1931);

*Fagara melanorhachis* HOYLE in Kew Bull. 1933, p. 174; type: Kennedy 2297 (K!);

*Fagara macrophylla* AUCT. non ENGL., partly; in various works where *Fagara tessmannii* and *Fagara macrophylla* are not separated.

1936: Aubréville, F.F.C.I., 1st ed., II, p. 88, partly; fig. 159, B4

1958: F.W.T.A., 2nd ed., I, p. 685 (*F. melanorhachis*)

1958: Fl. Congo Belge, VII, p. 88 (*F. inaequalis*)

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 110,

partly; fig. 166, B4

1959: Kryn & Fobes, Woods of Liberia, p. 51, partly, as *F. macrophylla*

1960: Taylor, Syn. Sylv. Ghana, p. 296, partly, as *F. macrophylla*

1963: Letouzey, Fl. du Cameroun, I, p. 55

LOCAL NAME: sagli (Gio)

TRADE NAME: Olon

GEOGRAPHICAL DISTRIBUTION: Liberia – N. Rhodesia

**BOTANY.** A medium-sized, armed tree. Leaves pinnately compound, alternate, clustered at the end of the branches, 50–150 cm long, dark green. Branches and petioles more or less with sharp, 3–10 mm long, often slightly curved prickles. Petiole 10–20 cm long, swollen at base, terete, above with 2 faint ridges, minutely puberulous. Rachis terete or slightly flattened and with a faint groove above, minutely puberulous, especially on the lower part more or less prickly with c. 3 mm long prickles. Leaflets subopposite. Petioles 5–10 mm long, flattened above. Blade coriaceous, glossy above, paler and matt beneath, speckled with glandular, translucent points, (narrowly) oblong, 12–22 cm long, 5–8 cm wide, very unequal-sided at base, the proximal side (narrowly) cuneate, joining the midrib well above the rounded or slightly cordate distal side; a pair of small glands present above, where the slightly revolute margin joins the midrib. Apex acute to acuminate. Midrib prominent beneath, puberulous. Nerves in 10–18 pairs, raised beneath.

Inflorescences terminal, many-flowered, up to 50 cm long. Main floral axis ridged and armed with short prickles. Peduncles densely puberulous. Flowers unisexual (tree dioecious?); male flowers sessile in few-flowered clusters (dwarf shoots) on the tertiary branches, at base with a few minute bracts. Calyx tube c. 0.4 mm long, calyx lobes 5, about 0.6 mm long, acute, with a membranous margin. Petals 5, elliptic, about 2 mm long and 1 mm wide, obtuse at the top, greenish white, imbricate in bud, spreading at anthesis. Stamens 5, alternating with, and slightly exceeding the petals, subulate. Anthers basifixed, bilobed, with a dark gland on the dorsal side of the connective. Disc swollen, about 0.5 mm thick, 5-lobed, crowned by a minute, reduced ovary, which is terminated by a truncate style. Female flowers not seen.

Infructescence up to 30 cm long, much-branched, with dense masses of fruits. Fruit a small, subglobular, dehiscent capsule, 5–6 mm across, opening with 2 coriaceous valves, containing only one bluish black, ovoid and slightly laterally compressed seed, about 5 mm long and 4 mm thick.

Seedling: germination epigeal. Hypocotyl 3–4 cm long. Cotyledons foliaceous, (narrowly) oblong, 10–15 mm long, 4–5 mm wide, rounded at the tip. Leaves alternate, at first simple, distinctly gland-dotted, with a denticulate margin, progressively larger, the 8th leaf about 13 cm long and 5 cm wide, the midrib prickly above and beneath.

**TAXONOMICAL NOTES.** *Fagara macrophylla* (OLIV.) ENGL. is a tree, very similar to *F. tessmannii*, but mainly occurring in the secondary forest, rarely reaching over 50 cm ( $\approx 20''$ ) in diameter, whereas *F. tessmannii* is a high forest species (see field notes). The flowers of both species are nearly identical, but the inflorescence and infructescence of

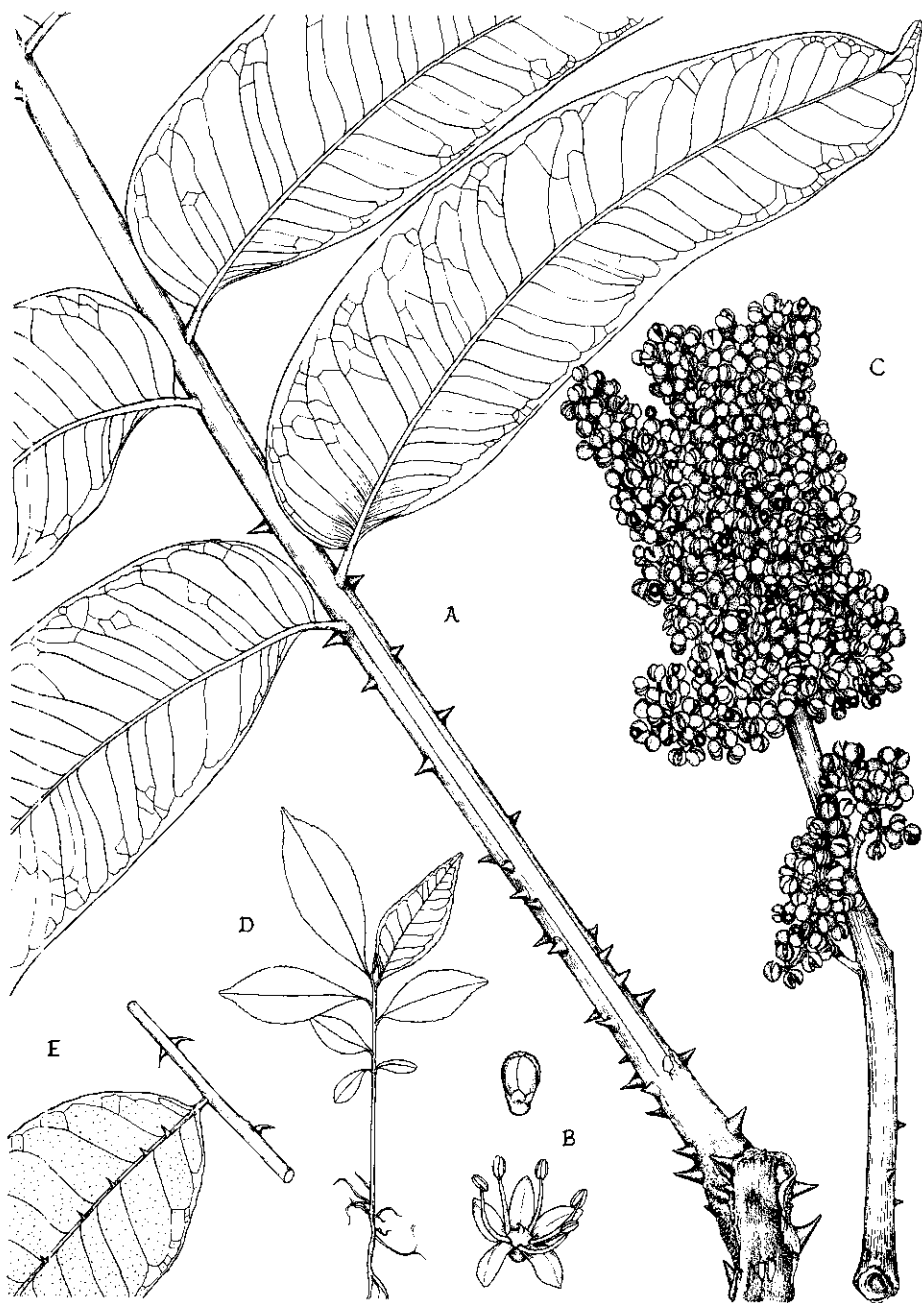


Fig. 64. *Fagara tessmannii* ENGL. A: lower part of a leaf ( $\times \frac{1}{2}$ ); B: male flower, open and in bud ( $\times 4$ ); C: infructescence ( $\times \frac{1}{2}$ ); D: seedling ( $\times \frac{1}{2}$ ); E: base of leaflet of *Fagara macrophylla* (OLIV.) ENGL. ( $\times \frac{1}{2}$ ).

*F. macrophylla* is less branched, narrower than that of *F. tessmannii*. The leaves of *F. macrophylla* are more prickly on the rachis, and the leaflets are shorter petiolate and nearly equal-sided, cordate at base (see fig. 64 E). The taxa allied to *Fagara macrophylla* or *tessmannii* are, however, difficult to segregate because the stated distinctive characters are by no means constant; e.g. leaves of young plants, saplings and seedlings cannot be separated. In fact the type of *F. macrophylla*, Mann 1114 (K!), presents a perfect intermediate form between both taxa. A monographic revision is necessary to verify whether both species ought to be combined (as was done recently in *Flora Zambesiaca*, Vol. 2, I, p. 190, 1963). Here Letouzey (1963, l.c.) is followed, because he apparently made the most thorough study of the types concerned, but I exclude *Fagara kivuensis* LEBRUN ex GILBERT, cited by Letouzey as a synonym, which may well present a character in the fruits which makes it specifically different (persistent style).

The present description is based on specimen 513 and 513 A, from the Zuole area.

**FIELD NOTES.** *Fagara tessmannii* may reach up to 33 m ( $\approx 110'$ ), and attain a diameter up to 90 cm ( $\approx 3'$ ), rarely more. The base has low root swellings or root spurs, rarely narrow, thick butt flares up to 6 m ( $\approx 20'$ ). The bole is generally straight and cylindrical. The crown is open, very characteristic with its long, pinnate leaves in terminal clusters. The lower part of the bole has usually sharp, conical or flattened thorns, up to 5 cm wide at base and 6 cm high; the bark between the thorns is smooth and grey, or rough-textured and covered with pustulate lenticels. Old trees may have heavy cork ridges instead of thorns, somewhat like *Araliopsis tabouensis*. The slash is thick and granular, orange- or ochre-yellow, lighter and darker mottled, more or less scented.

Flowering trees were observed in October–November. The fruiting season is January–March. The seeds, which have a high oil content, are spread by birds. Regeneration in secondary forest and on open places is nearly always present, but never gregarious. Growth is good where favorable light conditions prevail. The sapling is unbranched with a dense terminal cluster of leaves; the stem is densely prickled. As stated before, it is impossible to separate with certainty the young specimens of *F. tessmannii* and *F. macrophylla*. Mature trees of both species have a very similar habit, though *F. macrophylla* does not grow as large as *F. tessmannii*; as a rule the leaflets are diagnostic.

Only the *Erythrina* species have thorns, comparable with those of *Fagara*. *Erythrina vogelii* HOOK. f. has conical spines, terminated by a sharp black point. It is a tree of secondary forest, with brilliant orange-red flowers, flowering when the tree stands bare (July–October). *Erythrina mildbraedii* HARMS, which has pink flowers and flowers in the dry season (October–January), has sharp prickles, which on old trees may form prickly ridges. The *Erythrina* species have trifoliolate leaves.

**USES.** The bark has numerous medical applications in native medicine. The wood is hard and moderately heavy, straw-yellow or yellow-brown, fine-textured, with a straight to interlocked grain. It is locally used for high grade furniture and cabinet work.

## SAPOTACEAE

A large family of woody plants, often with a milky juice; trees, shrubs, rarely climbers, mostly in the tropics and subtropics. Leaves simple, alternate, with or without stipules. Flowers hermaphrodite, actinomorphic, usually small, often in axillary clusters. Calyx 4–8 lobed, or sepals free. Corolla 4–8 lobed, lobes 1–2 seriate, imbricate, sometimes with petaloid dorsal appendices. Stamens epipetalous, opposite and as many as the corolla lobes, or more numerous and 2 – or more seriate. Staminodes often present. Disc present or absent. Ovary superior, several-celled. Style simple. Ovules solitary in each cell. Fruit 1- or several-celled, often a berry, rarely a capsule. Seeds with a bony, often shiny testa and a large, broad hilum.

The family can be recognised by its white latex, simple, alternate leaves, often cauliflorous flowers, and the grooved bark. In number of large high forest tree species this family comes second in Liberia after the *Leguminosae*, with 14 species recorded and several probably present but not yet recorded. Some of the species are extremely rare, and in volume the family is less important. However, field experience shows that the family is at first difficult to recognise, but when once one becomes acquainted with it, it proves to be rather more common than was anticipated. A short summary of the larger tree species not treated in extenso beneath, is therefore provided.

*Afrosorsalisia afzelii* (ENGL.) A. CHEV.. A large tree with a fluted base and often a twisted bole. The bark is grooved and scaly, brown. The slash is pale reddish brown, fibrous, and slowly exudes a white latex. The leaves are (narrowly) elliptic or (-) obovate, rather small up to 13 (-16) cm long and 4 (-6) cm wide, growing in lax tufts. There are 10–15 pairs of slightly raised nerves; reticulation by veins indistinct. The fruits are small, 1-seeded berries, c. 1.8 cm long, 1 cm thick. The tree, though also occurring on dry land, is mostly found on moist bottom lands.

*Afrosorsalisia cerasifera* (WELW.) AUBRÉV., a large tree of the drier forest zone, is also found in Liberia. It has somewhat larger leaves and the fruits are 2–3 cm long and up to 2 cm thick.

*Aningeria robusta* (A. CHEV.) AUBRÉV. & PELLEGR.. A large tree, characteristic for the moist semi-deciduous forest, up to 1.50 m ( $\approx$  5') in diameter and 40 m ( $\approx$  130') high. The base has thick, at the foot branched buttresses up to 3 m ( $\approx$  10') high. The bole is straight and cylindrical, the crown dense and dark green. The bark is grey, vertically grooved, not scaly. The slash is red-brown, medium thick, fairly soft, fibrous inside, more brittle outside, with a reddish dilatation tissue under the grooves; it exudes an abundant white latex. The leaves are variable, ovate – obovate, up to 15 cm long and 6 cm wide, glabrous above, densely pubescent beneath with characteristic reddish or

orange hairs on the nerves of fresh leaves. Nerves in 10–20 pairs, joining a marginal nerve. Fruit subglobose, 1.5–2 cm across, containing only one seed. The tree was observed near Diala and S. of the Putu Range.

*Gluema ivorensis* AUBRÉV. & PELLEGR.. A medium-sized tree with a preference for river borders. The base has low root spurs. The bole is twisted, rarely straight. The crown is characterized by long, tufted leaves. The bark is brown, grooved. The slash is pink-red, fibrous, exuding an abundant white latex (resembling the slash of *Tieghemella heckelii*). The coagulated latex is locally used as a chewing gum. The leaves are narrowly obovate, with a petiole of 2–5 cm long. The blade is up to 30 cm long and 9 cm wide, long-acuminate at the top. There are 12–20 pairs of nerves, prominent beneath. The fruit is a c. 6 cm long, very coriaceous capsule, narrowed at both ends, opening with a lateral slit, containing only one smooth, pale yellow-brown seed of c. 5 cm long and 1.5 cm thick.

*Kantou guereensis* AUBRÉV. & PELLEGR.. A very rare, very large tree up to 50 m ( $\approx$  160') high. The base of the tree is swollen and has heavy butt flares. The bole is straight and cylindrical, clean. The crown is dense, dark green, the long leaves standing in tufts. The dark bark is longitudinally grooved, scaly. The slash is pale yellowish, orange mottled. The leaves are narrowly obovate or (–) oblong, cuneate at base, obtuse – rounded at the top, up to 25 cm long and 7 cm wide, with 10–15 pairs of nerves; reticulation by veins indistinct; petiole 4–5 cm long. Fruit globose, red, c. 8 cm across, 1-seeded. Seed c. 5 cm long, c. 2 cm thick, smooth and brown. The tree was observed in the Gio National Forest and near Zwedru.

*Neolemonniera clitandrifolia* (A. CHEV.) HEINE. A medium-sized or large tree, often found on rocky sites, solitary or in small groups. The base has low root spurs or (cf. Cooper) 'flanged buttresses and huge roots spreading out for many feet along the surface'. Different from the typical, grooved sapotaceous bark, this tree is fairly smooth, with large, thin, irregular bark plates, leaving light brown patches on the dark bole when shed. The slash is reddish and exudes an abundant white latex. The papery leaves are clustered in pseudo-whorls, (narrowly) elliptic or (–) obovate, up to 15 cm long and 2.5 cm wide on fertile shoots, but larger on sterile branches. Nerves c. 10 pairs, very faint; reticulation of veins indistinct. Stipules often present in the terminal leaf clusters. The fruit is 7–8 cm across, containing 5 smooth, brown, c. 3.5 cm long seeds. The tree was observed in the Putu area, the Bong Range, the Firestone Timber Reserve and in the Gola National Forest, S. of Gbai. Oil from the seeds is used for frying food and dressing hair (cf. Cooper).

*Omphalocarpum ahia* A. CHEV. and *O. elatum* MIERS. The *Omphalocarpum* species are remarkable for their large, depressed globose fruits of 15–20 cm diameter, which are borne on the stem. Each fruit contains numerous flat, black seeds. The two species can be distinguished by their leaves (see p. 27). The trees often grow on moist sites and are rather rare.

*Chrysophyllum perpulchrum* MILDBR. ex HUTCH. & DALZ. [65/26,143]

'*Chry:ophyllum*': Gr. chrusos: gold; Gr. phyllon: leaf; 'gold leaf (tree)'.

'*perpulchrum*': L. per: intensive prefix; L. pulcher: beautiful, fine; referring to the beautiful leaves of the type of the genus, *C. cainito* L..

Hutchinson & Dalziel in F.W.T.A., 1st ed., II, p. 9 (1931), and Kew Bull. 1937, p. 57; type: Mildbraed 8882, Cameroon (K!);

*Gambeya perpulchra* (HUTCH. & DALZ.) AUBRÉV. & PELLEGR., Not. Syst., 16, p. 247 (1960).

1936: Aubréville, F.F.C.I., 1st ed., III, p. 118

1960: Taylor, Syn. Silv. Ghana, p. 314

1937: Dalziel, U.P.W.T.A., p. 355

1961: Irvine, Woody Plants of Ghana, p. 590

1951: Eggeling & Dale, Ind. Trees Uganda, p. 395

1963: F.W.T.A., 2nd ed., II, p. 28

1959: Aubréville, F.F.C.I., 2nd ed., III, p. 140

1959: Kryn & Fobes, Woods of Liberia, p.

31 (partly)

LOCAL NAME: bleing (Gio)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Liberia – Uganda and Congo

**BOTANY.** A large tree. Branchlets densely dark brown, villous, ridged. Leaves simple, alternate, densely rusty brown – red-brown, villous, with T-shaped hairs, the upper surface soon glabrous, glossy, medium – dark green. Petiole 1–3 cm long, slightly ridged, canaliculate above. Blade coriaceous, as a rule narrowly elliptic or (–) obovate, (7–) 10–25 cm long, (3–) 4–9 cm wide, acute – obtuse at base, (bluntly) acute at the top. Midrib slightly impressed above, prominent beneath. Nerves flat above, prominent beneath, in (6–) 15–20 pairs, looping near the edge. Reticulation of veins parallel, oblique to the nerves, indistinct above, obscured by the dense pubescence beneath. Leaves of saplings obovate, up to 35 cm long and 12 cm wide, with up to 35 pairs of nerves.

Flowers in dense axillary clusters, (sub)sessile, unisexual (through reduction). Exposed parts of the calyx densely rusty brown villous with T-shaped hairs, the overlapped parts more sparsely pubescent; calyx lobes suborbicular, c. 2.5 mm across, slightly concave, ciliate. Corolla tube c. 2 mm long, glabrous, crowned with 5 (rarely 6), c. 1 mm long, obtuse, towards the base densely ciliate lobes. Stamens 5 (rarely 6), adnate to the lower part of the corolla tube, opposite the lobes. Flowers with fertile stamens not seen. Female flowers with stamens, lacking the anthers. Ovary sessile, densely pilose with erect hairs, 5-celled, each cell with 1 ovule. Style 1–1.5 mm long, truncate, slightly 5-lobed at the top.

Fruit densely brown villous with T-shaped hairs, globose, at both ends slightly depressed, 2–4 cm across, 3–5 angulate, containing 3–5 smooth, shiny brown seeds, which are 1.5–2 cm long, c. 1 cm wide, with a ventral scar of 8–10 mm long.



Seedling: germination epigeal. Hypocotyl 6–7 cm long, glabrous; cotyledons foliaceous, broadly ovate, 2–5 cm long, 2 cm wide, very shortly petiolate, glabrous. Epicotyl 2 mm long (?). Leaves alternate; young parts above the cotyledons all densely villous with T-shaped hairs.

TAXONOMICAL NOTES. Recently Aubréville (Not. Syst., 16, p. 245, 1960) published a study of the genus *Chrysophyllum* L., concluding that the African *Chrysophyllum* species could no longer be maintained within this genus. The S. American species of *Chrysophyllum* have stamens, inserted on the throat of the corolla tube, and 1-seeded fruits (teste Aubréville), unlike the African species, which have stamens, inserted near the base of the corolla tube and 3–5 seeded fruits. Aubréville recognises again the former African sections of *Chrysophyllum*, *Donella* PIERRE ex BAILL. and *Gambeya* PIERRE as distinct genera; the difference between these two genera is that *Donella* has leaves with very numerous, fine, parallel nerves and *Gambeya* relatively few, widely spaced, prominent nerves. This difference seems to be substantiated by wood-anatomical characters, but differences in flowers, fruits or seeds cannot be indicated. The old nomenclature, still used by the F.W.T.A., 1963, is employed at present because it seems preferable to revise the whole African section of the genus, if not the whole genus, before a change in the systematy of the genus s.l. is accepted.

*Chrysophyllum* is represented in Liberia by several large tree species which can be distinguished as follows:

- |  |                       |   |
|--|-----------------------|---|
| 1. a. Leaves with numerous, fine, indistinct parallel nerves (see fig. 65 F) | <i>C. pruniforme</i>  |   |
| b. Leaves with up to 30 pairs of prominent nerves beneath                    |                       | 2 |
| 2. a. Leaves silvery-silky beneath   | <i>C. albidum</i>     |   |
| b. Leaves fulvous or rusty brown or red-brown beneath                        |                       | 3 |
| 3. a. Nerves in 15–20 pairs. Hairs not appressed                             | <i>C. perpulchrum</i> |   |
| b. Nerves in 18–30 pairs. Hairs distinctly appressed                         | <i>C. delevoyi</i>    |   |

*Chrysophyllum pruniforme* PIERRE ex ENGL. (bleing-ti in Gio). A tree attaining up to 90 cm ( $\approx 3'$ ) in diameter and over 36 m ( $\approx 120'$ ) high. The lower part of the trunk is swollen and has low, thick, transversely ridged root spurs or thick butt flares up to 2 m ( $\approx 6.5'$ ). The bole may be straight and cylindrical. The crown is fairly open, medium green. The bark is dark brown – black, not scaly but vertically grooved with numerous, 2–6 cm long, deep cracks (zig-zag pattern, see photograph 30). The slash is thick, yellowish – light brown, brittle-fibrous, exuding a white latex; white or pinkish stripes of dilatation tissue under bark grooves. The fruits are yellowish green, smooth, ovoid, c. 4 cm long, and 3.5 cm across, containing 4–5 smooth, brown, c. 2.5 cm long seeds. Locally the tree is fairly common, both in high forest and in secondary forest. The leaves are nearly identical to those of *Chrysophyllum welwitschii* ENGL., a climber, or *Chrysophyllum pentagonocarpum* ENGL. & KRAUSE, a large tree, not yet recorded from Liberia. The latter species has much larger fruits, up to 11 cm long.

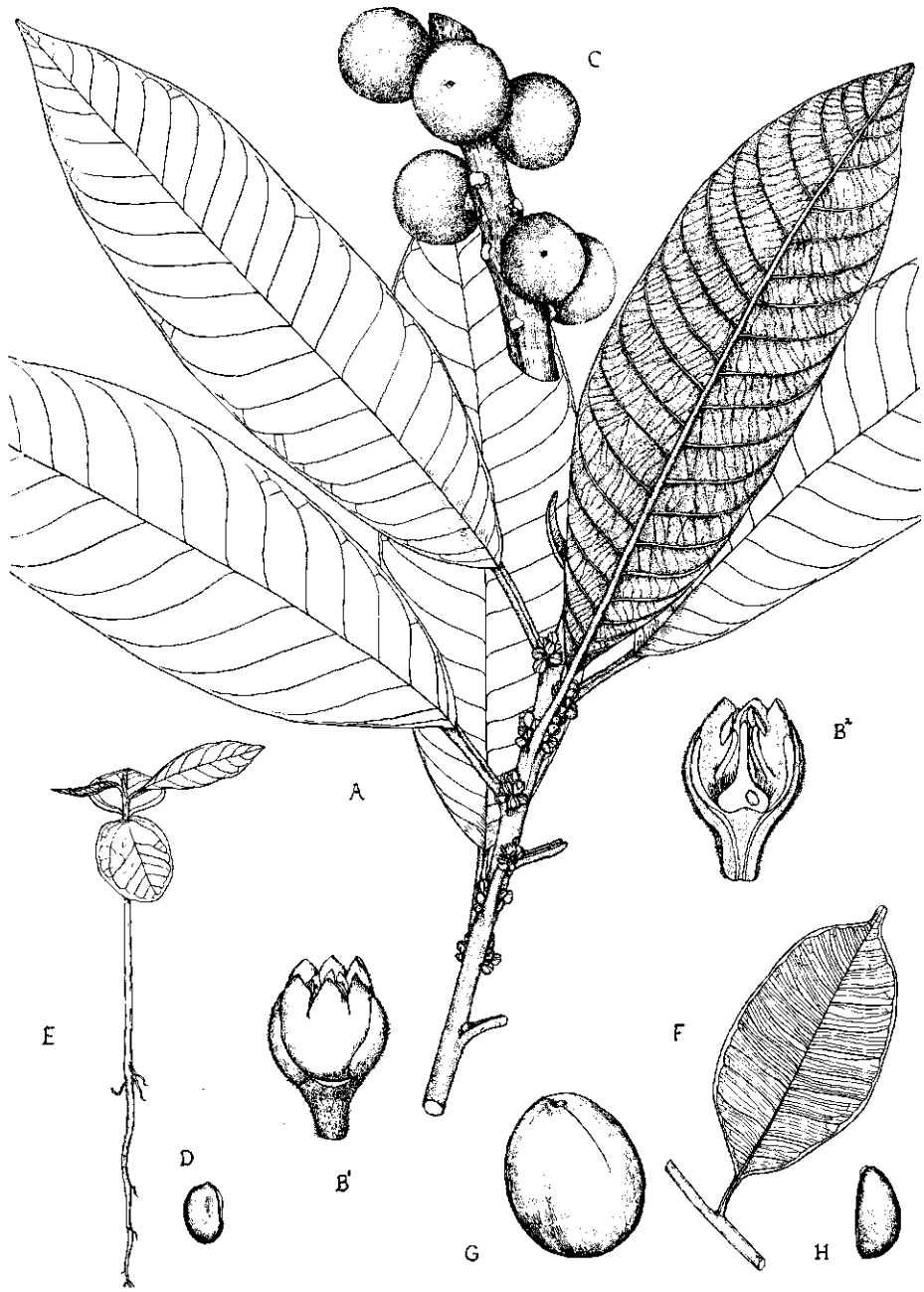


Fig. 65. *Chrysophyllum perpulchrum* MILDBR. ex HUTCH. & DALZ. A: branch with leaves and flowers ( $\times \frac{3}{4}$ ); B<sup>1</sup>: open flower ( $\times 5$ ); B<sup>2</sup>: cross-section of flower ( $\times 5$ ); C: fruits ( $\times \frac{1}{2}$ ); D: seed ( $\times \frac{1}{2}$ ); E: seedling ( $\times \frac{1}{2}$ ).

*Chrysophyllum pruniforme* PIERRE ex ENGL. F: leaf ( $\times \frac{1}{2}$ ); G: fruit ( $\times \frac{1}{2}$ ); H: seed ( $\times \frac{1}{2}$ ).

*Chrysophyllum albidum* G. DON. A large tree up to 90 cm ( $\approx 3'$ ) in diameter and 36 m ( $\approx 120'$ ) high. Base swollen and with rounded butt flares, sometimes with adventitious roots. The bole is straight and cylindrical. The bark is black, shallowly zig-zag grooved. The slash is pale brown, fibrous, exuding some white, gummy latex. The leaves are (narrowly) elliptic, 6–16 cm long, 3–6 cm wide, with 7–15 pairs of prominent nerves on the silvery pubescent lower surface. Petiole 1–2 cm long. Fruit about 3 cm across. This species is only slightly different from *C. subnudum* BAK., which is a smaller tree with glabrescent leaves.

*Chrysophyllum delevoiyi* DE WILD. (= *C. africanum* DC., illegitimate name). This tree resembles *C. perpulchrum*, but is smaller, often growing at river borders, and has larger, when ripe yellowish, pointed, orange fruits.

*Chrysophyllum perpulchrum* MILDBR. ex HUTCH. & DALZ.. This species has not been chosen to be discussed at some length because it would be the most common *Chrysophyllum* species; *C. pruniforme* and *C. albidum* are probably more common. However, *C. perpulchrum* is the most striking *Chrysophyllum* species in Liberia. The flower structure of the various species is very similar.

The present description and figures are based on the following specimens: *C. perpulchrum*: Liberia: Nimba 923, 1016; Ganta Harley s.n. Ivory Coast: de Wilde 612, Leeuwenberg 3115, 3795. *C. pruniforme*: Bong Range 70, Kanweake 1031. *C. albidum*: Bong Range 1139; Tapeta 214; Bassa III, Siga 1111.

FIELD NOTES. *Chrysophyllum perpulchrum* may be a tree up to 30 m ( $\approx 100'$ ) high, and 90 cm ( $\approx 3'$ ) in diameter. Its base is fluted; the bole is slender; the crown is deep and close to the bole, very characteristic red-brown when seen from below. The bark is smooth or slightly fissured, grey or pale brown. The slash is brown, with lighter stripes, granular, slowly exuding a milky white latex.

This species of *Chrysophyllum* is a tree of the drier forest zone; in the Nimba area it is rather common. It seems to be absent in the evergreen zone. The tree is evergreen; it flowers from March–July; fruits are ripe at the end of the year, but often persist on the branches, so that flowers and fruits can be collected at the same time.

The other *Chrysophyllum* species, *C. delevoiyi*, *C. pruniforme*, and *C. albidum* are more common in the evergreen zone.

Tree finders sometimes confuse *Anthonotha fragrans* with *Chrysophyllum delevoiyi* or *C. perpulchrum*.

USES. The fruits of *C. perpulchrum* are edible, though less appreciated than those of *C. albidum*. The wood is soft and light, perishable. The wood of the *Chrysophyllum* species is white or pale brown, rather dull, not very hard. Timber of *Chrysophyllum* has only local application.

*Manilkara obovata* (SABINE) J. H. HEMSLEY

[66/27,352]

'*Manilkara*': vernacular name from Malabar.

'*obovata*': referring to the obovate leaves.

Hemsley in Kew Bull. 17, p. 171 (1963);

*Chrysophyllum obovatum* SABINE in Trans. Hort. Soc. Lond., V, p. 458 (1824), basionym (partly, only for the leaves); type: G. Don s.n. (BM!);

*Mimusops lacera* BAKER in F.T.A., III, p. 507 (1877); type: Mann 489 (K!);

*Manilkara lacera* (BAK.) DUBARD in Ann. Mus. col. Marseille, sér. 3, 3, p. 24 (1915);

*Manilkara sylvestris* AUBRÉVILLE & PELLEGRIN in Bull. Soc. Bot. France, 104, p. 279 (1957); type: Aubréville 1306 (P!).

1931: F.W.T.A., 1st ed., II, p. 14 (*Manilkara lacera*)

1931: Cooper & Record, Evergr. For. Liberia, p. 101 (?*Chrysophyllum obovatum*), p. 102 (*Mimusops* sp.)

1936: Aubréville, F.F.C.I., 1st ed., III, p. 98 (*M. lacera*)

1936: Kennedy, F.F.S.N., p. 199 (*M. lacera*)

1937: Dalziel, U.P.W.T.A., p. 355, 357 (*C. obovatum*, *M. lacera*)

1959: Aubréville, F.F.C.I., 2nd ed., III, p. 120, 122 (*M. lacera*, *M. sylvestris*)

1959: Kryn & Fobes, Woods of Liberia, p. 70 (*M. lacera*)

1960: Normand, A.B.C.I., III, p. 63; Pl. CXL (*M. lacera*)

1961: Irvine, Woody Plants of Ghana, p. 592 (*M. lacera*)

1963: F.W.T.A., 2nd ed., II, p. 20

LOCAL NAMES: kpangkun (Gio)

TRADE NAME: Fou

GEOGRAPHICAL DISTRIBUTION: Not possible to indicate before a revision of the genus has defined the boundaries of the species.

BOTANY. A very variable tree. Leaves of the shrub-like form which grows on rocky river borders on average smaller than those of the large tree form, but the ranges of variation of the forms overlapping each other nearly completely. Young branchlets minutely puberulous, glabrescent.

Leaves simple, alternate, more or less concentrated in tufts, stipulate. Stipules minute, 1–1.5 mm long, acicular, very early caducous. Petiole 0.5–4 cm, on average 1–2 cm long, slightly grooved above. Blade thick-coriaceous, dark green or greyish green, glabrous above, when young bright brown, slightly glossy beneath, densely appressed puberulous (pubescence hardly distinct without a magnifying glass), on older leaves glaucous grey or greyish green beneath; blade rarely (narrowly) elliptic, as a rule obovate, sometimes narrowly obovate, 2.5–19 cm long, 1–8 cm wide, (broadly) cuneate at base, emarginate or rounded, cuspidate, abruptly acute or (bluntly) acuminate at the top. Midrib slightly impressed above, prominent beneath; nerves flat or slightly impressed above, indistinct beneath, 10–20 pairs; reticulation by veins dense, slightly impressed above and beneath, indistinct or absent.

Flowers in 3–4 flowered fascicles left and right of the bud in the leaf axil, on leafy shoots or on the barren twigs beneath fresh leafy shoots. Pedicel 0.7–1.5 cm long, brown puberulous. Sepals in 2 whorls of 3, 4–7 mm long, 3–4 mm wide, acute at the top, spreading or recurving at anthesis; outer whorl rusty puberulous outside, valvate in bud; inner whorl pale brown puberulous, slightly imbricate in bud. A few flowers with 8 sepals were present between the other flowers. Petals 6, glabrous, at base united in a slightly swollen, 1–1.5 mm high corolla tube; corolla lobes pale yellow, 4–6 mm long, erect at anthesis, the margin revolute inwards; each corolla lobe with 2 darker yellow, ovate, long-acute, 4–6 mm long dorsal appendices, spreading or slightly recurving at anthesis. Stamens implanted on the corolla tube, opposite the corolla lobes, glabrous; filaments 1.5–3 mm long; anthers white, extrorse, 2–3 mm long, bilobed at base. Staminodes pale green, alternating with the stamens, bent over the ovary, 2–4 mm long, 1–2 mm wide, more or less deeply lacinate, or bilobed, the lobes 3–4 partite (the bilobed type more common, though not standard, in the large tree form, the lacinate type more common in the shrub-like form). Disc annular, intrastaminal. Ovary sessile, orange-puberulous, 9–12, often 10-celled, each cell with 1 ovule; style pale green, as long as the corolla lobes, terminated by a minute brown stigma.

Fruit a 2-3 seeded orange berry, 1.5–2.5 cm long, 1–1.5 cm across, blunt at the top but terminated by the persistent style. Seeds 1–1.5 cm long, with a smooth brown testa and a hilum covering less than half of the ventral side.

Seedling: germination epigeal. Hypocotyl 6–7 cm long, glabrous, the lower 2–3 cm brown, with a defoliating bark, the upper 3–4 cm green. Cotyledons opposite, coriaceous, ovate, about 3 cm long, 2 cm wide, indistinctly palmati-nerved. Epicotyl about 1 cm long. Leaves alternate, as the mature leaves but papery and sharper acuminate.

**TAXONOMICAL NOTES.** Sabine (1824, l.c.) stated: ‘Obovate-Leaved Star Apple. *Chrysophyllum obovatum*. This species of Star Apple is a small, spreading tree, which does not exceed thirty feet in height; and has moderate sized obovate, entire leaves, silvery white underneath. It grows only in the mountains. The fruit, which was tasted by Mr. Don, is of the size of a moderate apple, with a sharp apex, much inferior to the Star Apple (*Chrysophyllum cainito* L.) of the West-Indies, but yet agreeable’. The description of the fruit does not correspond to that of *Manilkara*, which is smaller and rounded at the top. Sabine probably refers to a real *Chrysophyllum* fruit; the fruit concerned is not preserved. However, the leaves which were used for the description clearly belong to *Manilkara*, and therefore the name *Chrysophyllum obovatum* is the oldest basionym for a W. African *Manilkara* species.

This genus forms an extremely difficult taxon. Many species have been described, but the differences between these species are indistinct. There are doubtless many forms which can be clearly distinguished in the field, but these field differences are not matched by clear-cut morphological differences in leaves, flowers or fruits. The phenomenon of the extreme variability according to site has been pointed out by Aubréville (Flore



Fig. 66. *Manilkara obovata* (SABINE) J. H. HEMSLEY A<sup>1</sup>, A<sup>2</sup>: branch with leaves and flowers ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: fruit ( $\times 1$ ); D: seed ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ); F: staminodia ( $\times 6$ ).

du Gabon, 1, p. 26, 27, 1961). Aubréville tried to give each form a specific rank, arguing that it would be peculiar to give the same botanical name to a large rain forest tree and a shrub of the semi-arid areas. However, these two extreme forms are linked by so many intermediate forms, that I feel more inclined to consider *Manilkara obovata* as an extremely variable species with many ecotypes. A thorough revision of the African species of *Manilkara* is needed before a sound nomenclature can be established (if possible at all). For this reason a complete list of synonyms is not given. Until it can be shown that the large high forest *Manilkara* (*Manilkara sylvestris* of Aubréville, 1957, l.c.) is specifically different from *Manilkara obovata* (= *M. lacera*), the specific epithet *obovata* may be used.

The present description is based on the following specimens: Bomi Hills 1067 = 1245 (small tree in rapids), 1044, 1150, de Wilde 3803 (large forest tree); Bong Range 1137, 1184, 1186 (medium-sized trees); Tapeta area 303 (very large tree). Ivory Coast: de Wilde 3310 (small tree in rapids).

FIELD NOTES. As stated before, *Manilkara obovata* is an extremely variable species, which can grow as a small, gnarled tree on rocky rapids and river borders. It can also grow into a large forest tree up to 40 m ( $\approx 130'$ ) high and over 90 cm ( $\approx 3'$ ) in diameter. The present description refers to the latter form. The base of a younger tree has heavy root swellings or low, sharp buttresses; older trees can have narrow buttresses up to 2 m ( $\approx 7'$ ) high. The bole is straight and cylindrical, up to 25 m ( $\approx 80'$ ) to the first branches. The crown is dense, rounded with steeply ascending branches, dark green when seen from aside, slightly brownish green or greyish green when seen from beneath. Bark of younger trees with deep slits, of older trees longitudinally grooved, often thin-scaly or the bark decaying on the tree; it is pale or dark brown. The slash is thick and fibrous, pale pink or more pinkish red towards the outside, exuding a sometimes abundant white, sticky latex.

This evergreen tree is found scattered throughout the high forest; locally it is fairly abundant (Bong Range). There is some evidence that the tree prefers rocky sites. Flowering and fruit bearing is irregular, both during the rainy and dry season. Flowers open at night or in the very early morning, filling the air with their heavy, sweet fragrance. At noon there is a fine rain of falling petals below the crown; when a tree is felled in the afternoon, only buds and overblown flowers are found. Regeneration can be fairly copious, but most of the seedlings perish.

A typical sapotaceous tree, *Manilkara* is difficult to confuse with other species. The slash type of *Gluema ivorensis* is somewhat similar, but the long, distinctly nerved leaves of *Gluema* are diagnostic. Large specimens of *Manilkara*, however, may look very similar to *Tieghemella heckelii*; *Tieghemella* has somewhat less outspoken buttresses, a darker pinkish red slash and papery, bright green leaves with a distinct reticulation by veins.

USES. The sapwood is yellowish brown, 4–6 cm wide, sharply divided from the dark red heartwood. The wood is very hard, heavy and durable, the cells containing silica granules. Cooper (1931, l.c.) stated: 'The tree is fairly plentiful in the high forest; being difficult to cut, it is generally avoided by the natives. The wood is highly durable and suitable for timbers and flooring. A medical oil is extracted from the seeds.' The wood seems to provide a good fuel.

*Tieghemella heckelii* (A. CHEV.) ROBERTY

[67/27,348]

'*Tieghemella*': named in honour of the French botanist van Tieghem (1839–1914).

'*heckelii*': named in honour of the French botanist Heckel (1843–1911).

Roberty, *Petite Flore de l'ouest-Africain*, p. 79 (1954); A. Chevalier in *Vég. Util.*, 2, p. 172, 1907, nomen nudum;

*Dumoria Heckeli* A. CHEVALIER in *Compt. Rend. Acad. Sci. Paris*, 145, p. 267 (1907), basionym; type: Herbar Pierre No. 6024 (P); *Vég. Util.*, 5, p. 237 (1909); cited specimen: Chevalier 16253 (P!);

*Mimusops heckelii* (A. CHEV.) HUTCH. & DALZ. in *F.W.T.A.*, 1st ed., II, p. 14 (1931).

1936: Aubréville, *F.F.C.I.*, 1st ed., III, p. 102  
(*Mimusops heckelii*)

1936: Kennedy, *F.F.S.N.*, p. 197 (*Mimusops heckelii*)

1937: Dalziel, *U.P.W.T.A.*, p. 358 (*Mimusops heckelii*)

1941: Harley, *Native Afr. Medicin*, p. 101 (*Mimusops heckelii*)

1946: Kinloch, *Silv. Notes Gold Coast Trees*, p. 56 (*Mimusops heckelii*)

1955: Bois et For. Trop., 41, p. 19–22 (*Dumoria heckelii*)

1959: Aubréville, *F.F.C.I.*, 2nd ed., III, p. 126  
(*Dumoria heckelii*)

1959: Kryn & Fobes, *Woods of Liberia*, p. 71  
(*Mimusops heckelii*)

1960: Normand, *A.B.C.I.*, III, p. 65; Pl. CXXX-IX (*Dumoria heckelii*)

1960: Taylor, *Syn. Silv. Ghana*, p. 316 (*Mimusops heckelii*)

1961: Irvine, *Woody Plants of Ghana*, p. 598

1963: *F.W.T.A.*, 2nd ed., II, p. 21

LOCAL NAMES: kpo (Mano); gwah (Gio); dzurutu (Krahn)

TRADE NAME: Makoré

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Nigeria

BOTANY. A large tree. Leaves simple, alternate, more or less in tufts, papery or thin-coriaceous, glossy above, glabrous. Stipules absent. Petiole 1.5–4 cm long, slender. Blade (narrowly) elliptic – (–) obovate, 6–15 cm long, 2–6.5 cm wide, cuneate at base, emarginate, rounded, acute or acuminate at the top; margin slightly undulate. Midrib flat above, prominent beneath; nerves numerous, indistinct or slightly raised beneath; reticulation by veins close, indistinct or slightly raised beneath.

Flowers as a rule paired in the axil of the leaves, sometimes with 4 together. Pedicel



1.5–2.5 cm long, glabrous. Calyx lobes imbricate, in two whorls of 4, 3–5 mm long, the outer whorl glabrous on the exposed parts, like the inner whorl softly tomentelous on the overlapped parts. Corolla creamy white; corolla tube 2–2.5 mm long, 8–10 mm across, thick and fleshy. Corolla lobes 8, c. 2 mm long, shortly clawed, membranous, each lobe with 2 fleshy, 3–3.5 mm long, triangular, imbricate, at anthesis more or less spreading dorsal appendices. Stamens 8, inserted on the corolla tube in front of the corolla lobes; filaments short; anther c. 1 mm long. Staminodes alternating with the stamens, short, ovate. Ovary conical, sessile, softly tomentelous, 8-celled, each cell with 1 ovule. Style short, not exceeding the anthers at anthesis.

Fruit a large, smooth berry, yellow when ripe, ovoid – subglobose, 8–10 cm long, 5–8 cm across, containing 1–3 seeds in a yellowish pulp. Seed (5–) 6–7.5 cm long, 3–4 cm thick, with a very hard seed coat, the dorsal half or two-thirds smooth, yellowish brown, the ventral half or one-thirds rough, bullate.

Seedling: germination epigeal. Hypocotyl stout, 9–14 cm long. Cotyledons dark green, sessile, succulent, c. 4 cm long, 1.5 cm wide and 0.5 cm thick. Epicotyl 9–11 cm long. Leaves alternate, with less nerves than the mature leaves, papery.

**TAXONOMICAL NOTES.** The genus *Tieghemella* was first described by Pierre (Not. bot. *Sapotaceae*, 18, 1890), based on seeds from a tree in Gabon: *Tieghemella africana* PIERRE. Later the specific epithet *heckelii* was used by Pierre for another species, as a manuscript name attached to seeds, communicated to him by Heckel. Chevalier, aware of Pierre's manuscript name, used the name *Tieghemella heckelii* three times (Vég. Util., 2, p. 8, p. 160, p. 172). Only the citation on p. 172 might be considered as a descriptive phrase sufficient for legitimate publication of the name *Tieghemella heckelii* PIERRE ex A. CHEV., and Heine, F.W.T.A., 1963, l.c., actually accepted this name. However, Chevalier wrote, referring to Moabi or Maniki (*Mimusops pierreana* ENGLER): 'Cet arbre diffère du Djave (*Baillonella*) par ces feuilles et ses fruits; mais les fruits présentent, à une petite différence de taille près, les caractères de ceux du *Tieghemella Heckelii* (PIERRE), vulgairement Makérou du Grand Bassam'. Chevalier states that it are the fruits (and not the seeds) of *Tieghemella heckelii* that differ slightly in size from those of *Mimusops pierreana* ENGLER. This is all descriptive material because he continued (not cited here) to describe the seeds of *Mimusops pierreana* ENGLER, and makes no further reference to its fruits. In fact, in the preceding description of *Mimusops pierreana* (l.c., p. 171, bottom) he even stated that its fruits were unknown. From this it follows that not even the semblance of a description can be maintained, so that *Tieghemella heckelii* PIERRE ex A. CHEV. is a nomen nudum.

In the same year Chevalier (Comptes Rendus, l.c.) published *Dumoria Heckeli* with a valid description, basing his new genus and species on seeds present in Herbarium Pierre, No. 6024 (P), and his own field observations. Mistaking the caducous corolla for a calyx, he considered his genus as distinct from *Mimusops* L.; since at that time only seeds of *Tieghemella africana* PIERRE were available, he was unable to place his species

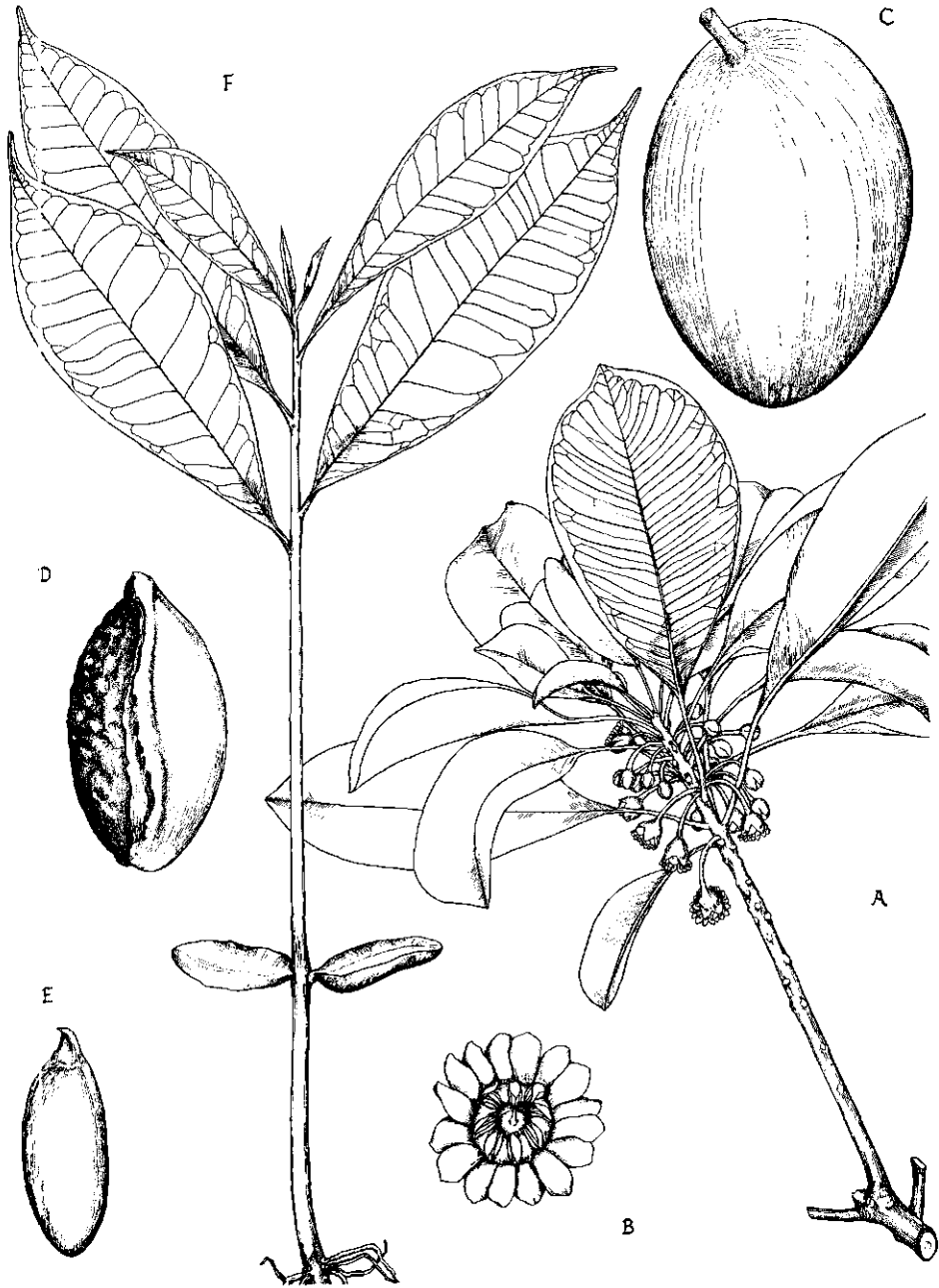


Fig. 57. *Tieghemella heckelii* (A. CHEV.) ROBERTY A: branch with leaves and flowers ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: fruit ( $\times \frac{1}{2}$ ); D: seed ( $\times \frac{1}{2}$ ); E: kernel ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ).

with certainty in *Tieghemella*, as suggested by Pierre and previously so accepted in Vég. Util., 2, l.c. (see above). However, *Dumoria* cannot be upheld against *Tieghemella*. The name *Tieghemella heckelii* based on *Dumoria Heckeli* A. CHEV. as its basionym should therefore be adopted: *Tieghemella heckelii* (A. CHEV.) ROBERTY, as it seems that Roberty (though probably unaware of the problems involved) is the first author to use this combination since 1907.

The description and figures are based on the following specimens: Bopolu 680; Tapeta area 304; N. Gio Nat. For. 260; Chien area 640; Kanweake, de Wilde 3689.

FIELD NOTES. *Tieghemella heckelii* may grow to form one of the largest and most beautiful, often emergent trees of the high forest, reaching a height of over 50 m ( $\approx$  160') and a diameter up to 2 m ( $\approx$  6.5') or more. The base of a large tree has very heavy, narrow buttresses or butt flares, reaching up to 3 m ( $\approx$  10'), and often very heavy spreading surface roots. Younger trees have only heavy root swellings. The bole is straight and cylindrical, but above the butt flares somewhat angular, reaching up to 30 m ( $\approx$  100') to the first branches. The lower part of the bole is often swollen, probably because elephants used to tear off the bark. The crown is heavy, rounded; often the heavy branches abruptly spreading from the top of the bole; the foliage is medium green. Younger trees, not yet reaching into the highest canopy, have a narrow, deep crown. The bark is dark, often nearly black, but grey on exposed sites, deeply furrowed, especially on the lower part with rectangular scales of c. 2 cm wide and c. 10 cm long. The slash is fairly thick, fibrous but brittle, red or somewhat pink near the cambium, exuding a sticky, white latex.

*Tieghemella* is found all over Liberia, except perhaps in the wettest parts of the evergreen forest; it prefers rather heavy soils and avoids swamps. It is rather rare, but often grows in groups of a few individuals. It is suggested that elephants eat the fruits and disperse the heavy seeds. With the elephants being rapidly reduced in number and the high forest areas more and more limited, the distribution of *Tieghemella* will also be halted and the prospects of a natural regeneration are poor. Unless replanted by the Forest Service, the species will probably become extinct.

The tree is evergreen. Flowering lasts from February–May; the tree flowers early in the morning, the corolla is shed in the afternoon. The fruits ripen from October to December; only fairly large-sized trees are mature. Fruit production is fairly abundant. Regeneration adapts itself well to light conditions; under heavy shade the tree grows slow but straight; when light conditions improve it grows rather fast to reach the upper canopy.

The dark, grooved bark may make the tree resemble *Terminalia ivorensis*, *Chlorophora* or *Combretodendron*, but the red slash with white latex is diagnostic. From *Manilkara obovata* the tree is distinct by the darker red slash (pinkish in *Manilkara*), and the green, thin coriaceous leaves (grey or glaucous green or brownish, thick coriaceous in *Manilkara*).



29 *Fagaya tessmannii* ENGL.. Note the differently shaped prickles (see page 338).



30. *Chrysophyllum pruniforme* PIERRE ex ENGL., showing the typical zig-zag pattern of grooves (see page 342).

**SILVICULTURE.** There are approximately 15 seeds to a pound. Collection of the seeds in November–December should not be delayed, as they are sought by rodents. Viability decreases fast and seeds should be planted within two weeks in the nursery, at a spacing of  $40 \times 40$  cm ( $\approx 16 \times 16$ " ), as it is better not to transplant the seedlings until they are ready to be transplanted in the field. Seed beds should be lightly shaded and well-watered, as the time of planting coincides with the dry season. The seeds should be placed in the surface soil. The germination is good and takes about 25 days, but rodents eat the cotyledons and may cause severe damage when not kept out by fences. Seedlings show a fast initial growth, up to 30–40 cm ( $\approx 12$ –16" ), then rest for a fairly long period; a strong taproot is formed. Planting out is done with striplings of 1.0–1.5 m ( $\approx 3$ –5' ), which are about two and a half years old at the beginning of the rainy season. Rate of growth is slow, but as the tree is very tolerant of shade it may be planted in a mixture with a faster growing species and serve as a second crop. The site of plantation should be well selected in connection with the preference for heavy soils. Termites may damage the roots of saplings.

**USES.** The fleshy pulp of the fruits is washed out in water, leaving a very sticky substance which is used as a glue to catch birds and even rats. Young buds are used for treating the bite of a little green snake (cf. Harley). The kernels of the seeds are rich in fat; they are split, sun-dried, pounded to a paste and boiled. The skimmed-off fat is yellowish, semi-fluid, without any bitter or unpleasant flavour. It is edible and preferred to palm oil as a cooking oil.

The tree tends to split badly during felling. The heartwood is pink to red-brown, the sapwood pale yellowish, 5–8 cm ( $\approx 2$ –3" ) wide. The wood is moderately heavy and hard; the grain is generally interlocked, sometimes straight, and of a fine texture. It is very durable, possibly termite resistant; it resists impregnation. Makoré is a valuable and very good timber, used for furniture and cabinet work; first class logs are used for veneers. Sawn timber can be used for joinery, interior fitting, vehicle framing, doors, sills, thresholds, railway sleepers, mine props etc. Sawdust irritates the skin, nose, and throat.

## SIMAROUBACEAE

A fairly large, pantropical family of trees and shrubs. Leaves alternate, rarely opposite, pinnate, rarely simple, as a rule without stipules. Flowers small, unisexual or polygamous, actinomorphic. Calyx lobes 3–5, imbricate. Petals 3–5, imbricate, valvate or contorted in bud, as a rule free. Stamens inserted at the base of the disc, equal or double the number of petals. Ovary 2–5 lobed, 1–5 celled, or carpels quite separate; styles 1–5, ovules solitary, rarely 2 or more in each cell. Fruits variable, drupaceous or dry.

This family has been accepted here in the concept of Engler (Nat. Pfl.fam., 2nd ed., 19A, p. 396, 1931) and Nootboom (Flora Malesiana, Ser. I, vol. 6, 2, p. 195) viz. incorporating the *Irvingiaceae* (F.W.T.A., 2nd ed., p. 692, 1958, and Hutchinson, Fam. Fl. Pl., ed. 2, p. 261, 1959) in this family as the sub-family *Irvingioideae*. The *Irvingioideae* have been treated separately by reason of the large stipules and the wood anatomy (wood of the *Irvingioideae* is extremely hard, that of most other *Simaroubaceae* soft). However, the wood anatomy of the *Simaroubaceae* is not homogenous (teste Nootboom l.c.); stipules are also found in the simaroubaceous genus *Picrasma* BLUME. In addition the *Irvingioideae* (teste Nootboom l.c.) have highly silicified leaves, like the sub-tribe *Simaroubinae*.

*Klainedoxa gabonensis* PIERRE ex ENGL.

[31, 68/33,225]

'*Klainedoxa*': Gr. doxa: glory, fame; in honour of Klaine (see p. 80).

'*gabonensis*': referring to Gabon, where the type was collected.

Engler in Nat. Pfl. fam., III, 4, p. 227 (1896); type: Klaine 188 (P!, K!); Pierre in Bull. Mens. Soc. Linn. Paris, No. 156, p. 1235 (1896); Engler, l.c., 2nd ed., 19A, p. 396 (1931); Aubréville, Flore du Gabon, 3, p. 16 (1962).

-- var. *oblongifolia* ENGL. in Bot. Jahrb., 32, p. 125 (1902); type: Zenker 1932 (K!); Gilbert, Fl. Congo Belge, VII, p. 110 (1958);

*K. oblongifolia* (ENGL.) STAPP, Fl. Sud., p. 228 (1929).

1928: F.W.T.A., 1st ed., I, p. 483

1931: Cooper & Record, Evergr. For. Liberia, p. 88

1936: Aubréville, F.F.C.I., 1st ed., II, p. 95

1936: Kennedy, F.F.S.N., p. 150

1937: Dalziel, U.P.W.T.A., p. 314

1951: Eggeling & Dale, Ind. Trees Uganda, p. 411

1955: Normand, A.B.C.I., II, p. 179; Pl. LXXIV

1958: F.W.T.A., 2nd ed., I, p. 693

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 121

1959: Kryn & Fobes, Woods of Liberia, p. 61

1960: Taylor, Syn. Silv. Ghana, p. 329

1961: Irvine, Woody Plants of Ghana, p. 507

1963: de Saint Aubin, La Forêt du Gabon, p. 111

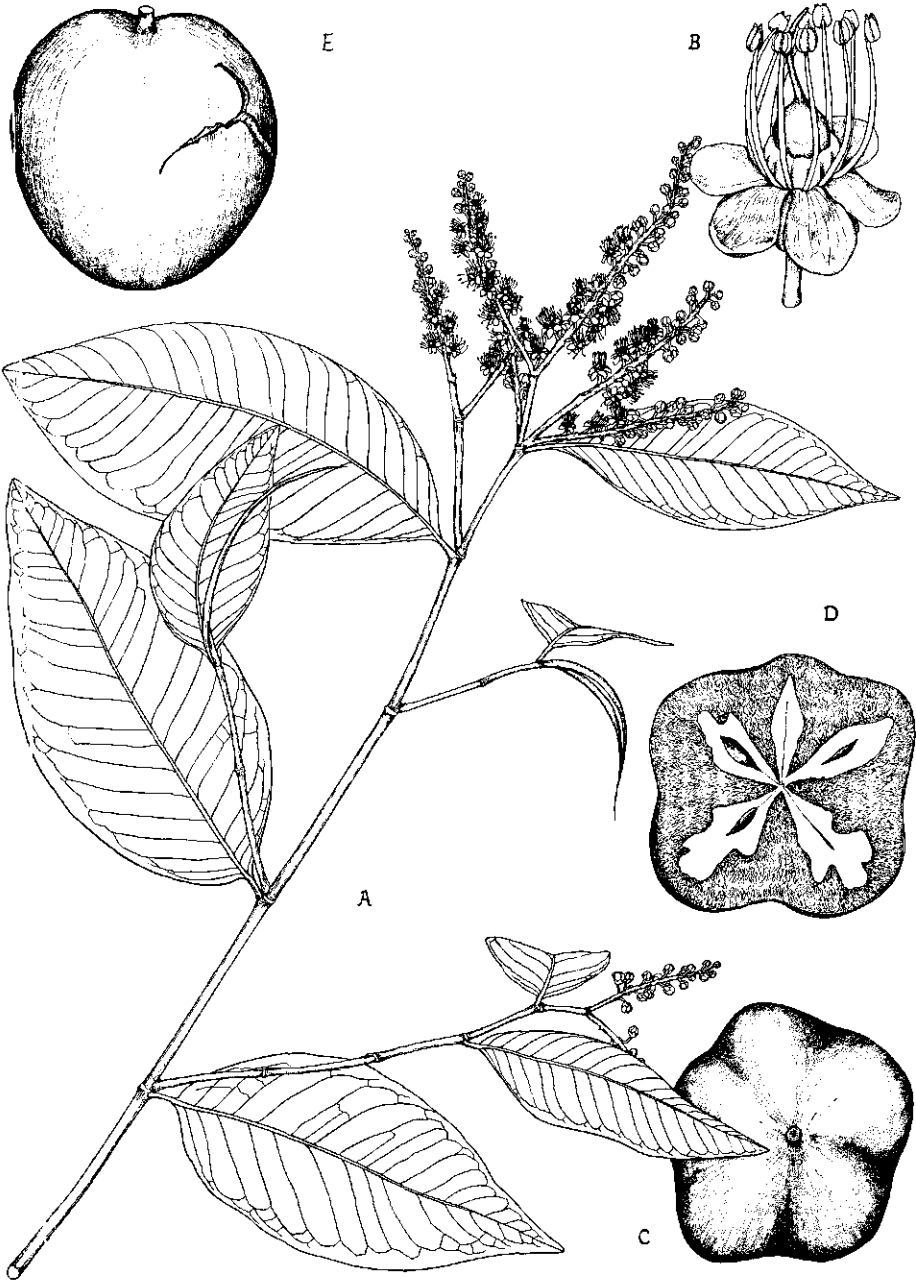


Fig. 68. *Klainedoxa gabonensis* PIERRE ex ENGL. A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 5$ ); C: fruit ( $\times \frac{1}{2}$ ); D: cross-section of fruit ( $\times \frac{1}{2}$ ); E: fruit of *Irvingia gabonensis* (O'RORKE) BAILL. ( $\times \frac{1}{2}$ ).



LOCAL NAMES: gooh (Gio); goe (Bassa, cf. Cooper)

TRADE NAME: EVEUSS

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Uganda and Tanganyika

**BOTANY.** A large tree. Branchlets slender, glabrous. Leaves of mature trees simple, alternate, stipulate, coriaceous, glossy above, glabrous. Stipules 5–10 cm long, linear, enclosing the young bud, caducous, leaving an annular scar at the node. Petiole 4–9 mm long. Blade ovate or elliptic, rarely narrowly elliptic, 6–15 cm long, 2.8–7.5 cm wide, rounded – obtuse or cuneate, sometimes slightly asymmetrical at base, wedge-shaped and acute towards the top; margin slightly undulate. Midrib slightly prominent above and beneath; nerves only slightly raised, fine, in 12–20 pairs, looping; reticulation of veins very close, distinct. Leaves of seedlings, saplings, and young trees very different, narrowly elliptic, – ovate or – oblong, up to 40 cm long and 12 cm wide, often slightly cordate at base, with up to 15 cm long stipules.

Inflorescences paniculate, axillary or terminal, 10–12 cm long, glabrous. Peduncle slightly ridged. Pedicels 3–4 mm long, articulate at base. Sepals and petals 4 or 5, imbricate in bud, spreading at anthesis, broadly elliptic, concave, white, the sepals c. 2 mm across, the petals c. 3 mm long, 2 mm wide, membranous. Stamens 8 or 10, free; filaments folded in bud, white, c. 4 mm long, slender; anthers 0.5 mm long, with 2 thecae, opening with slits, dark purple. Disc swollen, orange, intrastaminal, c. 1 mm thick, with 8–10 grooves on the outside, partly fitting around the filaments. Ovary purple, subglobose, slightly 5-angulate, 5-celled, each cell with 1 ovule. Style simple, folded in bud, c. 2 mm long; stigma indistinct.

Fruit a hard, depressed drupe, 3–5 cm thick, 5–8 cm across, slightly or distinctly 4- or 5-lobed, green when ripe, with a smooth exocarp, a tough, fibrous mesocarp, and containing 4–5 woody nuts, formed by the endocarp; nuts lobed, connate along the ventral side, each containing 1 seed.

Seedling (cf. Taylor): germination epigeal. Hypocotyl c. 10 cm long, slender, woody. Cotyledons strap-like, c. 2.5 cm long, 0.5 cm wide, sessile, slightly fleshy, olive green on the outside, with a purplish hue on the inner side and along the margin. Epicotyl c. 4 cm long. First 2 leaves opposite, following leaves alternate, narrowly elliptic, progressively larger; lower surface of the blade and youngest part of the stem glaucous.

**TAXONOMICAL NOTES.** The leaves of *Klainedoxa gabonensis* PIERRE ex ENGL. are polymorphic; size and shape vary widely with age, and possibly with site. This polymorphic character induced van Tieghem (Ann. Sci. Nat., Sér. IX, 1, p. 300–304, 1905) to publish 14 binomials in *Klainedoxa*, basing his 'species' several times on juvenile specimens. It would seem that most, if not all, v. Tieghem's 'new species' are synonymous with *K. gabonensis*. Engler (1902, l.c.) distinguished the variety *oblongifolia*, a variety still maintained in Fl. Congo Belge, 1958, and F.W.T.A., 1958, but its distinction from var. *gabonensis* is not clear. Engler (Bot. Jahrb., 46, p. 285, 1911) published *K. buesgenii*,

maintained as separate species in Fl. Congo Belge, 1958, and in Fl. du Gabon, 1962; *K. mildbraedii* ENGLER (Pfl. welt Afr., III, 1, p. 769, 1915) from Cameroon seems to have sessile flowers. Vermoesen (Man. Ess. For. Congo Belge, p. 148, 1923) published three bir omials, in Fl. Congo Belge, 1958, reduced to synonyms of *K. gabonensis* var. *oblongifolia*. Aubréville in Fl. du Gabon, 1962, maintains one more variety, *K. gabonensis* var. *microphylla* PELLEGR..

A revision of the whole genus is needed to establish the actual number of species and varieties. Although the type of Pierre has leaves which are more broadly elliptic than those of the type of Engler's variety, it is apparently the only specimen with such leaves ever collected, as I was unable to find a single similar specimen either in the Kew or the Paris herbarium. Considering the variation in leaf shapes which may occur on one tree, I prefer not to distinguish the varieties *gabonensis* and *oblongifolia*. There may be, however, some justification in distinguishing var. *microphylla*.

In Liberia *Irvingia gabonensis* (O'RORKE) BAILL. is the only other species of the small sub-family *Irvingioideae*. It is a large, buttressed tree. The leaves are elliptic or slightly obovate, glossy above, up to 16 cm long and 8 cm wide, with 8–12 pairs of slightly prominent nerves and a lax reticulation of veins; young leaves are covered by a glaucous waxy layer. Petiole c. 1 cm long; stipules 1–1.5 cm long, like in *Klainedoxa* leaving an annular scar on the twigs when shed. The broadly ellipsoid, laterally compressed fruit is 5–6 cm long, 3–4 cm thick, and has a smooth exocarp, a very fibrous mesocarp, and a hard endocarp. The fruit somewhat resembles that of *Detarium senegalense*. The Liberian tree finders distinguish two types of *Irvingia*: a small-leaf type with inedible seeds and a large-leaf type with edible seeds.

The present description and figures are based on the following Liberian specimens: *Klainedoxa gabonensis*: Duport, Devilbush 380, 380A; Chien area 624; Putu area 807. *Irvingia gabonensis*: Chien area 667; Bong Range 1045; Tapeta 527; Bomi Hills, v. Dillewijn 64.

FIELD NOTES. *Klainedoxa gabonensis* is a very large tree, up to 40 m ( $\approx$  130') high and 1.20 m ( $\approx$  4') in diameter. The base has thin, sharp, spreading, often convex buttresses, which may reach as high as 4 m ( $\approx$  13') and often are ridged parallel to the edge. The bole is straight and cylindrical, sometimes reaching a length of 25 m ( $\approx$  80'); sometimes stems grow corkscrew-fashion. The crown is half globular, spreading, fairly open, dark green. The bark is dark red-brown or brown, smooth, with very numerous small lenticels, or finely scaly. The slash is thin, hard, brittle and granular, light brown or yellowish brown, white near the cambium; some clear or honey-coloured sap fills the slash wound. Young trees, (or sometimes trees up to 60 cm ( $\approx$  24") in diameter) have short, 3–5 cm long sharp spines on bole and buttresses. The high-buttressed, long, slender, heavily crowned trees form a characteristic feature in the landscape of cultivated areas, because the wood is so hard, that the farmers often leave the tree standing when clearing land for their farm.

In high forest areas densities of 30–80 trees  $> 60$  cm ( $\approx 24''$ )  $\varnothing$ /sq. mile have been recorded. The tree is evergreen; new, brilliant red leaves flush in October. It flowers from August–November, the flowers covering the crown with a purplish hue. Fruits are ripe in February–March but more or less decayed fruits are found nearly the whole year round, giving an useful clue to identification. Young fruits are purplish. Regeneration is scarce.

*Irvingia gabonensis* has a habit which is often similar to that of *Klainedoxa*, with well-developed buttresses. The slash is brittle-fibrous, orange yellow, striped. The slash wound fills up with a little clear sap.

USES. The wood of both *Klainedoxa* and *Irvingia* is too hard for general use. Special applications (railway ties, heavy construction timbers) may open up a very limited local market for these species.

*Quassia undulata* (GUILL. & PERR.) D. DIETR.

[69/41]

'*Quassia*': named after the negro Quassi who around 1750 was the slave of the mother-in-law of a Swedish amateur botanist, C. G. Dalberg, at that time living in Surinam (S. America); Quassi informed Dalberg of the febrifuge properties of the wood of *Quassia amara* L.. Dalberg passed on this information to Linnaeus, who named the species after Quassi.

'*undulata*': referring to the occasionally undulate margin of the leaflets.

D. Dietrich, Syn. Pl., 2, 1840, p. 1416; H. P. Nootboom, Blumea, vol. IX, No. 2, p. 521–522 (1962); *Simaba? undulata* GUILL. & PERR. in Fl. Sénéq. 1830–1833, I, p. 136, t. 34, basionym; type: Perrottet s.n., Sénégal (P);

*Hannoa undulata* (GUILL. & PERR.) PLANCHON in Hook. Lond. J. Bot., 5, p. 567 (1846);

*Hannoa klaineana* PIERRE ex ENGLER in Bot. Jahrb., 46, p. 282 (1912); type: Klaine 1333, 2306 (P!).

For full synonymy see Nootboom l.c. The name *Hannoa klaineana* is used in nearly all works quoted below.

1928: F.W.T.A., 1st ed., I, p. 485

1931: Cooper & Record, Evergr. For. Liberia, p. 87

1936: Aubréville, F.F.C.I., 1st ed., II, p. 102

1936: Kennedy, F.F.S.N., p. 153

1937: Dalziel, U.P.W.T.A., p. 311

1955: Normand, A.B.C.I., II, p. 185; Pl. LXXV

1958: F.W.T.A., 2nd ed., I, p. 691

1958: Fl. Congo Belge, VII, p. 123

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 134

1959: Kryn & Fobes, Woods of Liberia, p. 57

1960: Taylor, Syn. Silv. Ghana, p. 326

1961: Irvine, Woody Plants of Ghana, p. 503

1963: de Saint Aubin, La Forêt du Gabon, p. 183

LOCAL NAMES: yaglu, yagli (Gio); k'forôh (Gola); zauh (Bassa, cf. Cooper)

TRADE NAME:

GEOGRAPHICAL DISTRIBUTION: Senegal – Uganda and Angola

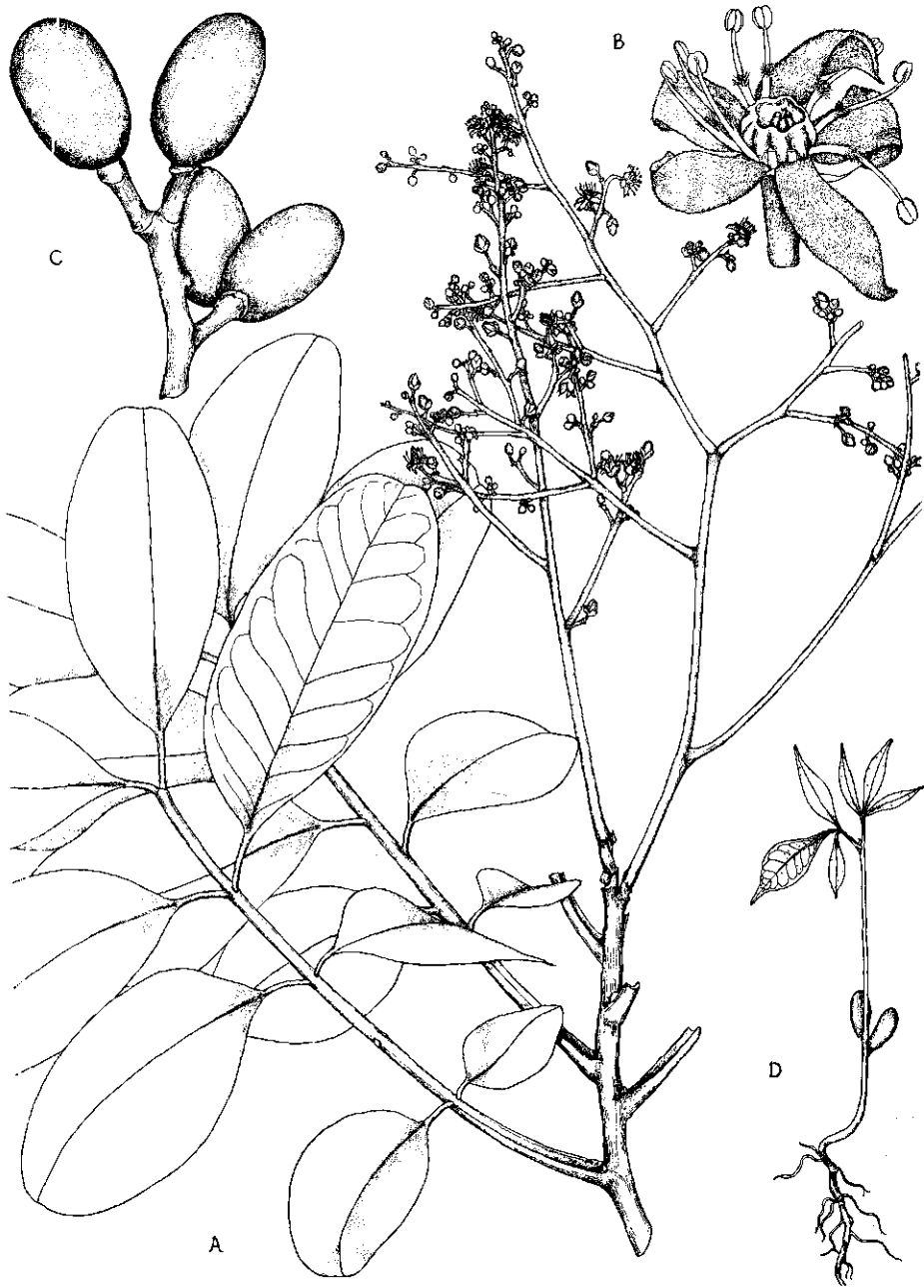


Fig. 69. *Quassia undulata* (GUILL. & PERR.) D. DIETR. forma *silvestris* VOORHOEVE A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 5$ ); C: infructescence (partly) ( $\times 1$ ); D: seedling ( $\times \frac{1}{2}$ ).

**BOTANY.** Leaves more or less clustered, impari-, or, as a result of reduction, paripinnately compound, with 3–8 pairs of (sub)opposite leaflets, with or without an odd leaflet, alternate, estipulate, in very young buds ciliate on the petiole, otherwise completely glabrous. Petiole more or less swollen at base, 3–7 cm long, slightly winged, the wings of very young leaves enclosing the terminal bud. Rachis 4–20 cm long, slightly broadened where the leaflets are attached. Petiolules 0.5–1.2 cm long, slightly grooved above, the margin more or less decurrent until the rachis. Blade thick coriaceous, dark green above, mat beneath, oblong, elliptic, or (narrowly) obovate, (4–) 6–12 cm long, (1.5–) 2.5–7 cm wide, often asymmetrical, especially at the cuneate base. Apex obtuse or rounded, sometimes slightly emarginate or shortly cuspidate, the tip folded; margin sometimes slightly revolute. Midrib and nerves flat or slightly impressed above; midrib very prominent beneath, nerves flat or impressed beneath, in 6–10 rather faint pairs; reticulation of veins indistinct or absent. Leaves of saplings and suckers up to 80 cm long, with over 10 pairs of narrowly oblong leaflets, which can be 20 cm long.

Inflorescences (sub)terminal, lax, puberulous panicles, 15–40 cm long. Bracts triangular, 1–2 mm long, caducous. Pedicel 1–2 mm long, articulate at base. Flowers white. Calyx closed in bud, rupturing in 2–3 unequal segments, c. 2 mm long at anthesis. Petals 5 (–6), free, 4–6 mm long, 1–2 mm wide, elliptic, puberulous outside, tomentelous inside, imbricate in bud, spreading and recurving at anthesis. Stamens twice the number of petals, inserted below the ribbed, intrastaminal disc; filaments with a straight, stout, sparsely villous lower part of c. 2 mm long, towards the top carrying a villous scale on the adaxial side, and a glabrous, slender, slightly curved, subulate upper part, also c. 2 mm long; anthers basifixed, 0.5 mm long, with 2 thecae, opening with slits. Disc urceolate, surrounding the ovary, which is formed by 5 free, sessile, 1-ovulate carpels, of which the styles are connate into one central, c. 1.5 mm long style, terminated by 5 (6) stigma-teeth.

Mericarps 1–5, dark, purplish or black, ellipsoid drupes, about 2 cm long and 1.5 cm across, with a thin, fleshy mesocarp and a c. 2 mm thick, woody endocarp, containing only 1 seed each. Scar of the style excentrically at the top.

Seedling: germination epigeal. Hypocotyl c. 3.5 cm long. Cotyledons subopposite, sessile, fleshy, c. 1 cm long, 0.5 cm wide, thick. Epicotyl c. 5 cm long. First 2 leaves opposite, trifoliolate. Petiole c. 6 mm long; leaflets herbaceous. Next leaves simple, articulate below the blade. Saplings long and slender, unbranched, with a dense terminal tuft of very long leaves.

**TAXONOMICAL NOTES.** Recently Nootboom (1962, l.c., 'Generic delimitation in *Simaroubaceae* tribus *Simaroubeae*') published a critical study of the delimitation of the genera *Eurycoma* JACK (Malaysia), *Samadera* GAERTN. (Indo-Australia), *Hannoa* PLANCH., *Odyendyea* (PIERRE) ENGL., *Pierreodendron* ENGL. (Africa), *Quassia* L., *Simaba* AUBL. and *Simarouba* AUBL. (America). He concluded that, except for *Eurycoma*, all cited genera should be merged in one genus, for which the oldest generic

name available is *Quassia* L.. In reducing the other genera to synonyms he improved on the view of Pierre (Bull. mens. Soc. Linn., Paris, No. 156, 1896, p. 1236), who already considered *Hannoa*, *Quassia*, *Odyendyea*, and *Simaba* as sections of a single genus, *Quassia*. In this wide concept *Quassia* is a pantropical genus with about 35 species, 25 in America, 5–10 in Africa, two in Asia and two in Australia.

Nooteboom's study is of special interest for the taxonomy of West Africa, in relation with the species formerly referred to *Hannoa*. He reduced all three species mentioned in the F.W.T.A., 1958, l.c. (*H. ferruginea* ENGL., *H. klaineana* PIERRE ex ENGL., and *H. undulata* (GUILL. & PERR.) PLANCH.) to one species, *Quassia undulata* (GUILL. & PERR.) D. DIETR., noting: 'After careful examination of the material at hand it appeared that most of the hitherto used characters for discriminating between the species reduced here are not useful. They concerned the length of the lateral petiolules and the number of leaflets. It appeared that the length of the petiolules is constant for the specimen only, but in different specimens which are otherwise similar, some can have short and others long petiolules. The same thing is true for the number of leaflets. Another character, which was sometimes used because of its conspicuousness, is the shape of the leaflets, which is, however, highly variable, and all the intermediate shapes can be found. As to the flowers there is only a gradation in their size, but no essential difference in the proportion of the parts. For all this reasons it appeared to be necessary to reduce a fairly large number of specific names'.

In this wide concept *Quassia undulata* is a very variable species, showing some distinct ecological forms: a low, shrubby, fire-resistant savanna tree (former *Hannoa undulata*), and a tall high forest tree (former *Hannoa klaineana*). On looking through the material of these taxa in Kew and Paris, I found that they are generally easily distinguished by the length of the petiolule (*Hannoa undulata* having long petiolules). However, an intermediate is represented by *Hannoa chlorantha* ENGL., a savanna woodland shrub of Angola, Rhodesia and the Zambesi area, with short petiolules. I therefore follow Nooteboom's concept of *Quassia undulata* s.l., but propose to distinguish a form:

*Quassia undulata* (GUILL. & PERR.) D. DIETR. forma *silvestris* VOORHOEVE n.f.

which is the taxon represented by Engler's *Hannoa klaineana* (Engler, l.c.) and has Klaine No. 1333 (P!) as type; '*silvestris*' indicates that this is the form found in the rain forest. When characters become available in the future that would warrant maintaining this taxon as a distinct species, the name *Quassia klaineana* PIERRE is not available, being a synonym of *Quassia gabonensis* PIERRE, a tree recorded from Cameroon. A choice will have to be made between *Hannoa chlorantha* ENGL. (1903), *Odyendyea zimmermannii* ENGL. (1912), or *Hannoa kitombetombe* GILBERT (1958) for a basionym.

*Quassia grandifolia* (ENGL.) NOOTEBOOM (as *Pierreodendron* ENGL. in F.W.T.A., 1958, *Mannia* HOOK. f. in F.F.C.I., 1959) is a tree, not recorded from Liberia, but found in Sierra Leone and Ivory Coast, predominantly in the secondary forest. The leaves with 5–15 pairs of leaflets slightly resemble those of *Quassia undulata*, but the petiolules are

c. 3 mm long, the nerves slightly raised on the lower surface of the leaflets; the fruits are yellow when ripe, ellipsoid, 5–6 cm long, containing one very fibrous nut.

Another large tree is *Gymnostemon zaizou* AUBRÉV. & PELLEGR., found in the S.W. part of Ivory Coast, its habit somewhat resembling that of *Entandrophragma utile*, with the leaves clustered in terminal tufts. The base has root swellings, no buttresses; the bark is smooth or fissured on old trees; the slash is thick, brittle, yellowish brown. The imparipinnate leaves have 6–12 pairs of opposite, sessile, 8–13.5 cm long, 2–4.5 cm wide, coriaceous leaflets with a revolute margin and small intramarginal glandular pits on the upper surface where the nerves fork. Fruits ovoid, up to 10 cm long and 8 cm across, with a grey, pustulate surface, containing one large seed (teste Aubréville). Leaves of suckers from the stump of a large, felled tree, collected near Kanweake, were with some doubt referred to this species (No. 1272).

A characteristic shrub or small tree, often with paired thorns at the base of the leaf, a winged leaf-rachis and leaflets with a crenulate margin, is *Harrissonia abyssinica* OLIV.. It was observed in Cape Mount and in the marginal forest on the ridge in the Gio National Forest.

The present description and figures are based on the following specimens: Bomi Hills s.n.; Duport, Devilbush 115, 383, 422, 1193; Bassa III, Siga 687; Ganta, Harley s.n.; Gio Nat. For. 246; Kanweake 1030.

FIELD NOTES. *Quassia undulata* is, in Liberia, a tree which can reach a height of 33 m ( $\approx 110'$ ) and a diameter over 1 m ( $\approx 3.5'$ ). The base is straight, with hardly any root swellings. The bole is straight and cylindrical, up to 24 m ( $\approx 80'$ ) to the first branches. The crown is globular, dense. The bark is smooth and grey, but on older trees the lower part of the bole may have a rough, brown bark with a thick layer of dead tissue. The slash is very characteristic, nearly white or somewhat yellowish, soft and fibrous, fairly thick, bitter. The wood is soft and white.

*Quassia undulata* is a light demanding, fast growing species, and mainly a tree of secondary formations, though it may occur in old high forest, where (cf. Taylor) its occurrence is linked with former gaps in the canopy. It seems to be little exacting as to site, but avoids swamps. The tree flowers during the rainy season. The fruit ripens in November–December. The seeds may be distributed by water, the seeds being buoyant, as they do not completely fill the endocarp. Regeneration in secondary forest is quite common. Saplings may show some resemblance with young specimens of *Entandrophragma* or *Khaya*, but the slash, the winged petiole, and the character of the leaflets are diagnostic.

USES. The wood is nearly white or straw-coloured, without distinction between sapwood and heartwood. It is light and soft, but firm. It is very liable to blue stain unless dried promptly. It is used locally for doors and ceilings, also for canoes, but has no established value on the timber market.

## STERCULIACEAE

A large tropical family of trees and shrubs, rarely herbs, mostly with stellate or scaly hairs. Leaves alternate, simple and pinnately or palmately nerved, or digitately compound, as a rule stipulate. Flowers hermaphrodite or unisexual, actinomorphic. Sepals valvate, mostly partially connate, rarely spathaceous. Petals 5 or absent, contorted or imbricate in bud. Stamens free or connate in bundles or in a column; staminodes sometimes present. Ovary superior, on a short (andro) gynophore, syncarpous or apocarpous. Fruits often formed by free mericarps, sometimes winged.

The stellate-pubescent leaves are often characteristic, but also the slash of many *Sterculiaceae* is diagnostic: it is fibrous and tears off easily in thin strips, speckled with numerous small, narrow and long slits or holes, caused by the high wood rays which remain on the tree; dilatation tissue is often distinctly different from the primary bark tissue, spongy.

Most important in forestry management are *Heritiera utilis* (SPRAGUE) SPRAGUE and *Triplochiton scleroxylon* K. SCHUM., but these are by no means the only trees of this family in the Liberian high forests. Discussed below is also *Nesogordonia papaverifera* (A. CHEV.) CAPURON. An important timber tree of the deciduous forest, rarely found in Liberia, is *Mansonia altissima* (A. CHEV.) A. CHEV.. Its softly stellate-pubescent, cordate leaves are palmately nerved with 6-7 basal nerves, which extend slightly beyond the margin. The fruits are winged.

Well-represented as understory trees are species of the genus *Cola* SCHOTT & ENDL.. Best known is *Cola nitida* (VENT.) SCHOTT & ENDL., cultivated near villages; the seeds form an important trade article (Kola). 'Monkey Apple', a small or medium-sized tree with large, globular fruits, containing water and an edible pulp, is *Cola lateritia* K. SCHUM. var. *maclaudi* (A. CHEV.) BRENNAN & KEAY. At least 7 more *Cola* species are recorded from Liberia. The Cocoa or Cacao tree, *Theobroma cacao* L. is locally cultivated; it is native in tropical America.

*Heritiera utilis* (SPRAGUE) SPRAGUE

[32, 70/32,39,236,291]

'*Heritiera*': named after Ch. L. L'Héritier (1746-1800), author of many botanical publications, especially on exotic plants.

'*uti*'/'*is*': Latin for useful.

Sprague in Kew Bull. 1909, p. 348; Kostermans, Reinwardtia, 4, p. 534 (1959) (p. 465-583: 'A monograph of the genus *Heritiera* AITON, *Sterculiaceae*');



*Triplochiton utile* SPRAGUE in Kew Bull. 1908, p. 257, basionym; type: Thompson 1, Ghana (K!);  
*Tarrietia utilis* (SPRAGUE) SPRAGUE in Kew Bull. 1916, p. 85; Aubréville & Pellegrin in Bull. Soc. Bot. France, 104, p. 459 (1958);  
*Tarrietia utilis* var. *laxiflora* PELLEGR. (error for var. *utilis*) in Bull. Soc. Bot. France, 88, p. 381 (1941);  
*Cola proteiformis* A. CHEVALIER in Vég. Util., 5, p. 250 (1909); type: Chevalier 22293 (K!);  
 In all literature, quoted beneath, this species is referred to as *Tarrietia utilis*.

1928: F.W.T.A., 1st ed., I, p. 256	1959: Aubréville, F.F.C.I., 2nd ed., II, p. 298
1931: Cooper & Record, Evergr. For. Liberia, p. 47	1959: Kryn & Fobes, Woods of Liberia, p. 109
1936: Aubréville, F.F.C.I., 1st ed., II, p. 256	1960: Taylor, Syn. Silv. Ghana, p. 353
1937: Dalziel, U.P.W.T.A., p. 110	1961: Bois et For. Trop., 76, p. 45–54; 80, p. 13–26
1946: Kinloch, Silv. Notes Gold Coast Trees, p. 12	1961: Irvine, Woody Plants of Ghana, p. 181
1955: Normand, A.B.C.I., II, p. 242; Pl. CV	1961: Martinot-Lagarde, Serv. des Rech. For., Centre Tech. For. Trop., Abidjan: Le Niangon etc.
1958: F.W.T.A., 2nd ed., I, p. 332	

LOCAL NAMES: dahmlu (Gio); k'nyauw (Gola); sanon (Kpelle); pablie (Krahn); de-ohr (Bassa, cf. Cooper); yawi (Mendi, cf. Cooper)

TRADE NAME: Niangon; Whismore (the latter name only used in Liberia)

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Ghana

**BOTANY.** A medium-sized tree. Branchlets and leaves densely clothed with golden brown scales, but the upper surface of the leaflets soon glabrescent. Leaves digitately compound with 5–7 leaflets, or through reduction unifoliolate, stipulate, but the stipules soon caducous, leaving scars at the nodes; digitate leaves found on saplings, suckers, and as shadow leaves on mature trees; simple leaves in the surface of the crown. Simple leaf: petiole 1–6 cm long, jointed at base and the top, striate. Blade thin – coriaceous, glossy green above, golden brown beneath, 5–25 cm long, 2–10 cm wide, (narrowly) elliptic, less commonly ovate or obovate, cuneate at base, long-acuminate at the top; margin more or less undulate. Midrib and nerves prominent beneath, the nerves in 8–18 pairs. Indumentum on the lower surface formed by very small, scaly hairs with a fimbriate margin. Digitate leaves may have a much longer petiole, over 25 cm long on saplings. The leaflets are very similar to the simple leaf, described above, but the margin is decurrent along the petiolule, the blade is often more obovate; the central leaflet is largest. Flower bearing branchlets always with simple, mostly fairly small leaves.

Inflorescences axillary, paniculate, up to 20 cm long. Peduncles red-brown with scales. Bracts light brown, c. 1 cm long, caducous. Flowers in clusters on dwarf shoots, unisexual, the male flowers lateral, the female terminal. Pedicel 4–12 mm long, slender, densely pubescent with stellate hairs, as is the white calyx. Calyx tube 2–3 mm long, campanulate; calyx lobes 4–5, 2–4 mm long, acute. Petals absent. Disc present, swollen, orange. In the male flower filaments united in a c. 1 mm long androphore, ter-



Fig. 70. *Heritiera utilis* (SPRAGUE) SPRAGUE A: digitate leaf ( $\times \frac{1}{2}$ ); B: branch with simple leaves and inflorescences ( $\times \frac{1}{2}$ ); C: male flower ( $\times 3$ ); D: female flower ( $\times 3$ ); E: fruit ( $\times \frac{1}{2}$ ); F: seedling ( $\times \frac{1}{2}$ ).

minated by 3–5 minute points, carrying the anthers, each anther with 2 thecae, opening by slits; ovary absent. In the female flower stamens absent; pistil formed by 4–6 free, scaly carpels, each c. 1 mm long, carrying a short style, terminated by a reflexed stigma.

Fruits formed by the free carpels, each flower producing 1–6 densely lepidote, sessile, winged mericarps; the body of each mericarp ellipsoid, slightly flattened, c. 2.5 cm long, 1.5 cm wide, 1 cm thick, the wing obliquely attached, membranous, golden brown, up to 8 cm long and 3 cm wide, nervose. Pericarp coriaceous; seed with endosperm, edible.

Seedling: germination epigeal. Hypocotyl 10–15 cm long, increasingly scaly towards the top. Cotyledons foliaceous, spreading, obovate, 6–7 cm long, 4–5 cm wide, rounded at the top, slightly cordate at base, palmati-nerved with 3 distinct basal nerves; petiole c. 5 mm long. Epicotyl 2–3 cm long. Leaves alternate, at first simple, progressively larger, like the mature leaves; about the 10th leaf bifoliolate, the next trifoliolate etc.

**TAXONOMICAL NOTES.** In the absence of flowers, the type specimen (Thompson 1 from Ghana) could not be identified with certainty, but a comparison of the fruits suggested that it might be *Triplochiton*, and it was accordingly described as *Triplochiton utilis* SPRAGUE (1908, l.c.). Examination of additional flowering material showed that the species belonged to *Heritiera* and the new combination *Heritiera utilis* (SPRAGUE) SPRAGUE was established (1909, l.c.). At about the same time Chevalier described his *Cola proteiformis*, based on material from Ivory Coast. This consisted of leaves and (young) fruits, which led Chevalier to believe that a new *Cola* species was at hand.

In 1916 Sprague re-examined the seeds of *Heritiera utilis*, and the presence of albumen induced him to transfer the species to *Tarrietia*, which necessitated the new combination *Tarrietia utilis* (SPRAGUE) SPRAGUE. He noted, however, that the segregation of *Heritiera* and *Tarrietia*, based on the absence or presence of albumen only, was questionable, and that a monograph of the genera concerned (including *Argyrodendron* MÜLLER) was desirable. This revision was carried out by Kostermans (1959, l.c.), who actually reduced *Tarrietia* to *Heritiera*, considering the segregation according to the presence or absence of endosperm untenable. This view has not been followed by recent authors, e.g. Hallé in *Fl. du Gabon*, 2, p. 28 (1961).

*Heritiera* is a genus with about 34 species, of which 32 in India, the Malayan archipel, Australia and the Pacific, and 2 species in Africa: *Heritiera utilis* (SPRAGUE) SPRAGUE from Sierra Leone to Ghana and *H. densiflora* (PELLEGR.) KOSTERMANS in Gabon. The latter is distinct from *H. utilis* in having simple, entire or palmati-lobed leaves, never digitately compound leaves, and denser inflorescences; the indumentum of the leaves is less dense.

The present description and figures are based on the following specimens: Bomi Hills 834, 1023, Leeuwenberg 4825; Bong Range s.n.; Bassa III, Siga 623; Tapeta 525, 1257; Zuole, de Wilde 1510; Gbi Nat. For. 579.

FIELD NOTES. *Heritiera utilis* ('whismore') is a common tree in the high forest throughout Liberia, though perhaps absent from the coastal belt. Mature trees average about 30–35 meter ( $\approx 100$ – $116'$ ); in an exceptional case a tree may reach up to 40 m ( $\approx 130'$ ). The base is very variable; it may have plain, thin, spreading buttresses (mostly on dry land), or stilt-roots, or be very strangely shaped, intermediate between buttresses and stilt-roots (mostly in marshy areas, though by no means not so on dry land). The buttress formations may reach as high as 4 m ( $\approx 13'$ ), even on relatively small trees. The bole above the buttresses rarely measures over 90 cm ( $\approx 3'$ ) in diameter; it is often more or less twisted, only occasionally straight and cylindrical, as a rule branched below 20 m ( $\approx 66'$ ), rarely clear for more than 25 m ( $\approx 80'$ ).

The crown is deep and narrow, often with a golden brown or brownish green hue when seen from beneath. The bark is clear yellowish brown, more or less grooved longitudinally, thin, and peeling by rectangular scales. The slash is thin, with a brown outer layer of dead bark and a pink, fibrous inner layer; ripple marks are often visible. The slash on the buttresses may be nearly white; on the trunk the shade of the slash colour varies with age and site.

Whismore is a species of the middle and upper strata of the closed canopy, but never an emergent tree. It seems little exacting as to site, growing from steep rocky hills to marshy valleys and swamps, where it often associates with *Mitragyna ciliata*. However, it is not found in swamps flooded all the year round. It seems to prefer a loamy soil above sandy soils. Its best growth habit was observed on gently rolling, well-drained slopes, where also the buttress formation may be less extravagant. The tree has a slight gregarious tendency; locally it is very common, elsewhere it only grows scattered. On average a figure of 1.81 tree  $> 40$  cm  $\varnothing$ /ha ( $\approx 0.7$  tree  $> 16'' \varnothing$ /acre) is recorded, but only 0.5 tree  $> 60$  cm  $\varnothing$ /ha ( $\approx 0.2$  tree  $> 24'' \varnothing$ /acre).

*Heritiera utilis* flowers at the end of the rainy season, October–November. Fruits ripen from January–March. In general seed production is copious, but local mast-years may occur. In the high forest regeneration is regular, locally even abundant. Seedlings may grow up to 1 m ( $\approx 3.5'$ ) under high shade, but do not develop well under a low, dense undergrowth. Improved light conditions are necessary for further development. Where the canopy is partially open, growth may be fairly fast but often erratic: regeneration in exploited high forest usually shows a poor habit.

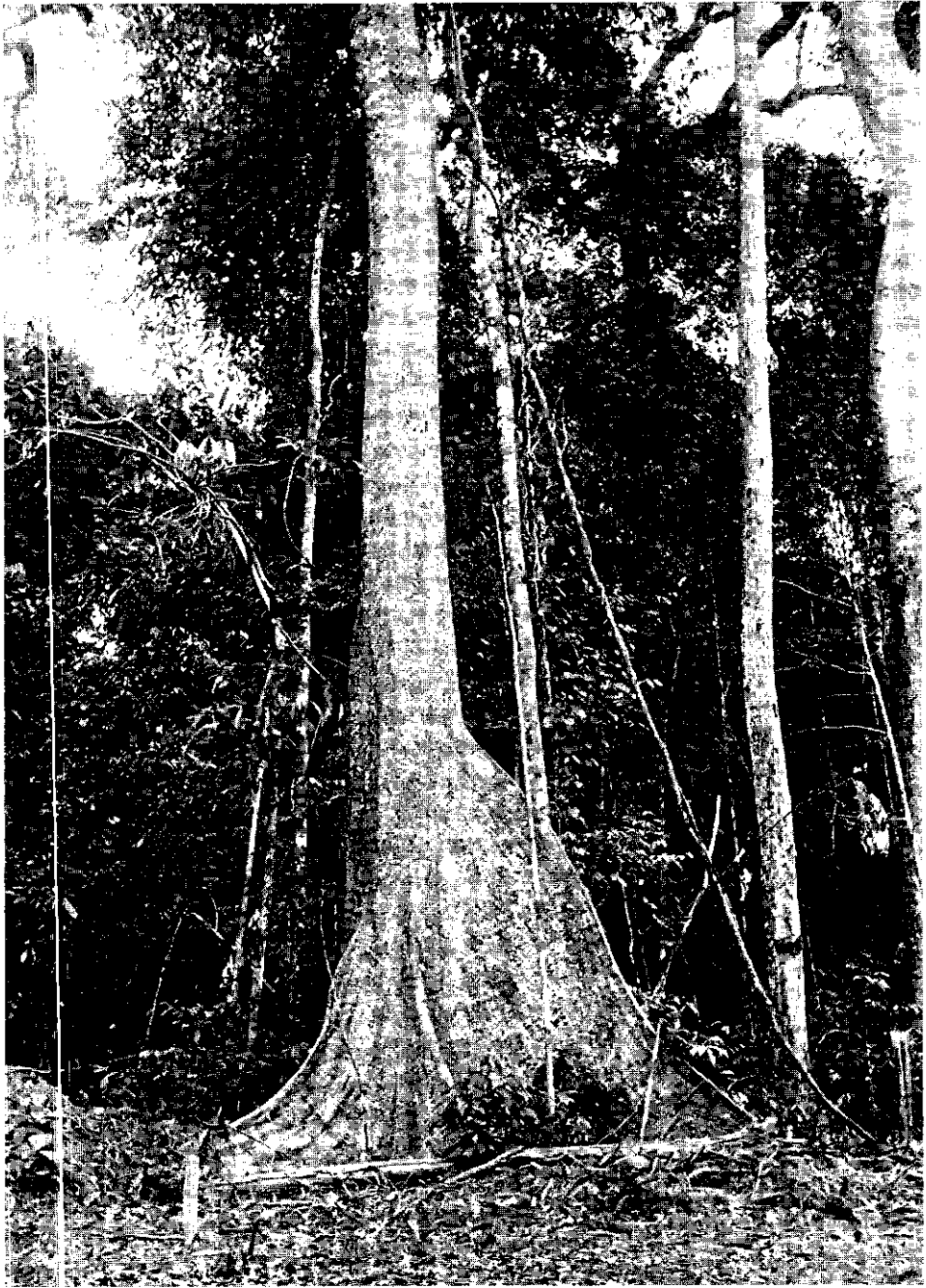
SILVICULTURE. Although whismore shows a relatively poor habit and never reaches such heavy dimensions as e.g. the *Entandrophragma* species, its silviculture may still become one of the major tasks of the forest research and forest service in Liberia. Various considerations point in this direction: (1) Whismore is the only really common tree in Liberia with an established market value; (2) it produces an excellent quality timber, and is exploitable as from 50 cm ( $\approx 20''$ ) in diameter; (3) it is fully adapted to the specific climatic conditions of Liberia; (4) seed supplies or natural seedlings are abundant; (5) the tree grows in a wide variety of soil types and sites.

The following general principles may be stated:

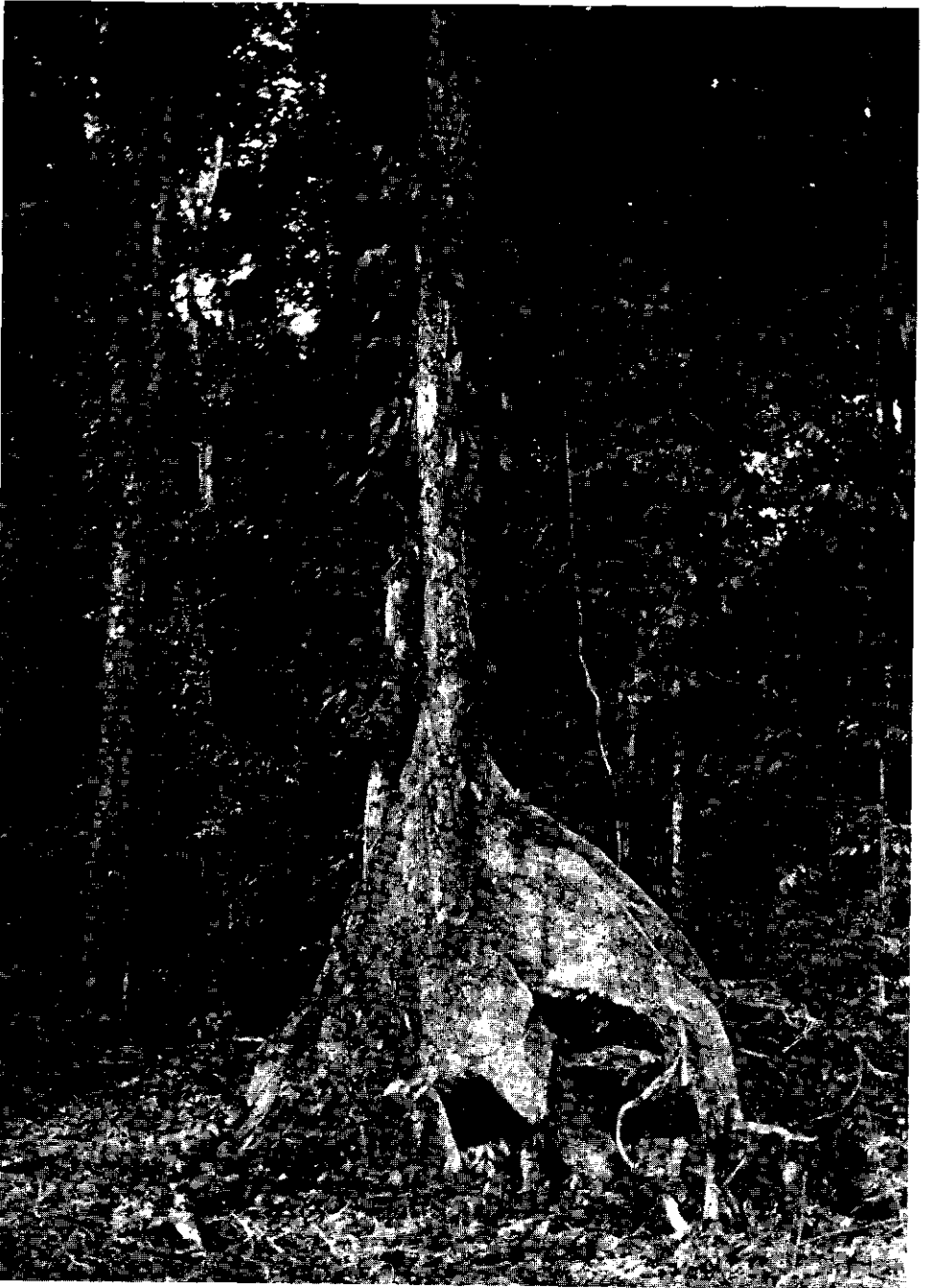
1. Well-shaped whismore trees do occur, and selection of seeds and plant material may improve the habit of cultivated trees. As trees growing in swamps show in general a poorer shape than those of dry land, in dry forest collected seeds are preferable. Research into the relations soil – site – habit is needed.
2. Nurseries can be established under shade or in full light. There are about 35 seeds to an ounce (cf. Taylor). Germination is fast, over 80% within 2 weeks when the seeds are fresh; viability decreases fairly fast. Nursery stock may be attacked by galling insects and top shoot borers.
3. Planting in the field is done at the beginning of the rainy season, May–June, when saplings are 18 to 30 months old, or 1–1.5 m high ( $\approx 3.5$ –5'). One month before transplanting the lateral roots should be pruned by cutting with a shovel around the taproot at about 10 cm ( $\approx 4$ " distance; this will stimulate the formation of a dense system of short lateral roots, which will enhance the chance of successful establishment in the field. The plants are transplanted as striplings. The taproot is very susceptible to damage.
4. The crown of whismore is deep and narrow, which makes a fairly close spacing desirable.
5. Selection of site is important: loamy, well-drained soils are perhaps preferable, but research in this is needed.
6. Height and diameter growth are relatively slow; mixture with other valuable, faster growing species is advisable (in view of the climatic conditions nearly only *Khaya ivorensis* may be considered; this species cannot be planted in monoculture in view of the top shoot boring larva of the moth *Hypsipyla*).

Trials on the Ivory Coast may be summarised as follows:

1. Promoting natural regeneration. Attempts to stimulate present natural regeneration by gradually lifting the existing canopy failed because the upper canopy was partially removed first, resulting in a vigorous growth of the understories, and so repressing the whismore regeneration which is able to stand high, but not low shade. Trials in reverse, viz. first cutting the undergrowth and later the upper canopy, is necessary in order to find out whether natural regeneration offers prospects. Taylor reports successful trials with the tropical shelterwood system for Ghana. A disadvantage is the impossibility of using selected plant material.
2. Dense planting under cover (1930). After the undergrowth had been cleared and girdling of the smaller trees, 15–20 cm high seedlings were planted in a 2 × 2 metre spacing. Seedlings were collected locally. Girdling of the upper canopy was effected during the subsequent 1st, 2nd, and 5th year. Maintenance rounds were regular the first 6–8 years, afterwards irregular. The first thinnings were effected in 1953 (far too late). This resulted in rich whismore stands, with straight, clean boles, 400–550 trees/ha ( $\approx 160$ –220 per acre), an average annual diameter increment of



31. *Ki tinedoxa gabonensis* PIERRE ex ENGL.. Note the high and sharp buttresses (see page 357).



32. *Hevea utilis* (SPRAGUE) SPRAGUE, showing the typical habit of stilted buttresses (see page 367).

0.5 cm, or, for the 50 largest trees, 1.1 cm. Conclusion: a possible method, with good results, but labour-intensive. Thinnings should be carried out at an earlier date, which possibly could improve the diameter increment.

3. Wide line plantings. The canopy is lifted by cutting the undergrowth and poisoning the small and large trees. Lines are cut at 5 metres intervals, and striplings are planted at a spacing of 5 metres; within this matrix of  $5 \times 5$  metres *Khaya ivorensis* is planted in a  $25 \times 25$  metre spacing. The result is a plantation of 384 whismore trees and 16 *Khaya ivorensis* trees per ha. The slowly dying trees of the upper canopy provide an initial light shade, necessary for the establishment of the planted material. Failures are replaced the following year. During the first five years the lines are cleaned, afterwards the plantation is left until thinnings become necessary. Conclusion: a less labour-intensive method, but resulting in a smaller number of trees/ha.

USES. Whismore is an excellent timber, in mechanical properties comparable with *En:androphragma utile*, but somewhat more difficult to work. The sapwood, varying between 3 and 7 cm ( $\approx 1-3''$ ) in width is pale brown coloured and should be removed. The heartwood is first pinkish and takes some time before developing its pleasant reddish-brown colour, which may show a golden lustre. It is a medium hard and medium heavy wood, with a Sp. G. of about 0.60, but there is a considerable variation in density. The grain is interlocked, the texture rather coarse; the timber feels somewhat greasy. It is fairly easy to convert and works well, not dulling instruments. It is a general utility timber for carpentry, cabinet and furniture making, construction work, joinery etc. It has an established value on the timber market.

*Nesogordonia papaverifera* (A. CHEV.) R. CAPURON

[71/31,32]

'*Nesogordonia*': Gr. nesos: island; referring to the island of Madagascar; *Gordonia* ELL.: a mostly Asiatic genus with fruits, slightly resembling those of *Nesogordonia*.

'*papaverifera*': L. ferre to bear: 'bearing (fruits) of *Papaver*' (the fruits resemble those of *Papaver*).

R. Capuron in Not. Syst., 14, p. 259 (1953);

*Cistanthera papaverifera* A. CHEVALIER in Mém. Soc. Bot. France, 8 d, p. 141 (1912), basionym; type: Chevalier 22442, 22459, Ivory Coast (P!, K!).

1928: F.W.T.A., 1st ed., I, p. 240 (*C. papaverifera*)

1933: Chalk & Burt Davy, Twenty W. Afr. Timber Trees, p. 95 (*C. papaverifera*)

1936: Aubréville, F.F.C.I., 1st ed., II, p. 214 (*C. papaverifera*)

1936: Kennedy, F.F.S.N., p. 58 (*C. papaverifera*)

1937: Dalziel, U.P.W.T.A., p. 95 (*C. papaverifera*)

1946: Kinloch, Silv. Notes Gold Coast Trees, p. 8 (*C. papaverifera*)

1955: Normand, A.B.C.I., II, p. 230; Pl. XCVI

1958: F.W.T.A., 2nd ed., I, p. 313

1959: Aubréville, F.F.C.I., 2nd ed., II, p. 252

1960: Taylor, Syn. Silv. Ghana, p. 343

1960: Keay, Nigerian Trees, I, p. 206

1961: Irvine, Woody Plants of Ghana, p. 175

1961: Hallé in Flore du Gabon, 2, p. 135



LOCAL NAME: baa (Gio)

TRADE NAME: Kotibé

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Gabon

**BOTANY.** A medium-sized to large tree. Branchlets brownish puberulous with minute stellate hairs. Leaves simple, alternate, stipulate, with an indumentum of minute, brownish stellate hairs. Stipules c. 6 mm long, acute, surrounding the terminal bud, caducous. Petiole slender, 1–4.5 cm long, densely puberulous. Blade thin-coriaceous, glossy, medium green, glabrous above except for the slightly impressed midrib, slightly paler and sparsely puberulous beneath but densely puberulous on the prominent midrib, elliptic to obovate, rarely ovate, 5–13 cm long, 2.5–6 cm wide, obtuse – rounded at base (rarely cuneate or slightly cordate), acuminate at the top, the very tip mucronulate. Nerves in 5–8 pairs, often with little tufts of long hairs in the axil, the lowest pair (sub) basal and often more steeply ascending than the other nerves; reticulation of veins slightly raised, lax.

Flowers in few-flowered, slender, axillary cymes; peduncle a little longer than the petiole, densely stellate-puberulous. Bracts soon caducous. Pedicel up to 20 mm long, articulate 6–10 mm below the flower. Sepals 5, slightly imbricate in bud, spreading at anthesis, densely stellate-puberulous outside, sparsely puberulous with simple hairs inside, 8–10 mm long, 3–4 mm wide, acute. Petals 5, glabrous, yellowish white, obovate, slightly longer than the sepals. Stamens 15 (–20) in 5 bundles, alternating with the petals, with 0.5 mm long, hardly connate filaments, and linear, c. 4 mm long, extrorse anthers; staminodes opposite the petals, somewhat longer than the fertile stamens, strap-shaped, slightly undulate. Ovary sessile, minutely puberulous, obconical, c. 3 mm long, 5-angulate, ribbed and grooved, depressed above, crowned by 5 acute, c. 3 mm long styles (stigmas?), 5-locular, each locule with 2 ovules.

Fruit a densely puberulous, woody, loculicide capsule, bell-shaped, c. 3 cm long, tapering at base, c. 2 cm wide, truncate and lobed at the top, distinctly 5-ridged (the grooved ridges corresponding with the midribs of the carpels), containing at most 10 winged seeds; seed ellipsoid, c. 6 mm long, flat on one side, with a very thin, papery, c. 15 mm long, 7 mm wide wing, pointing towards the base of the fruit.

Seedling: germination epigeal. Hypocotyl 3–5 cm long, green, puberulous with simple hairs. Cotyledons remain in the seed coat until lifted up by the hypocotyl, then spreading, foliaceous, reniform, 7–10 mm long, 16–24 mm wide, palmati-nerved with 5 faint, at the base sparsely pubescent nerves; petiole 1–2 mm, pubescent with simple hairs. Leaves alternate. First leaf elliptic, c. 16 mm long, 7 mm wide, with a dentate margin; petiole c. 4 mm long, pubescent, as is the midrib, with simple and scattered stellate hairs. Following leaves progressively larger, with more and more stellate hairs. Stipules present, acicular, c. 2 mm long.



Fig. 71. *Nesogordonia papaverifera* (A. CHEV.) CAPURON A: branch with leaves and inflorescence ( $\times \frac{1}{2}$ ); B: open flower ( $\times 3$ ); C: fruit ( $\times 1$ ); D: seed ( $\times 1$ ); E: seedling ( $\times \frac{1}{2}$ ); F: lower leaf surface (d:tail), showing tufts of hairs in axil of the nerves ( $\times 3$ ).

TAXONOMICAL NOTES. Chevalier, when describing *Cistanthera papaverifera* (1912, l.c.) noted already that the African species are closely related, and he suggested a possible synonymy with *C. kabingaensis* K. SCHUM., the type of the genus, and *C. dewevrei* DE WILD. & DUR.. In 1953 (l.c.) Capuron published his findings that *Cistanthera* K. SCHUM. should be merged in *Nesogordonia* BAILL., a genus previously believed to be endemic in Madagascar. However, he contented himself in making new combinations in *Nesogordonia*. Normand (1955, l.c.) stated that the wood anatomy of all species is very similar. A future critical revision of the African species (but preferably the whole genus) might show the need for some changes in nomenclature, perhaps involving the present species.

The present description is based on the following specimens: Liberia: Zuole 768, 1035, 1126. Ivory Coast: Leeuwenberg 2530, 2890.

FIELD NOTES. *Nesogordonia papaverifera* is a tall, slender tree, reaching a height of 45 m ( $\approx 150'$ ), and a diameter of up to 1.20 m ( $\approx 4'$ ), though usually not exceeding 90 cm ( $\approx 3'$ ). Immature trees have small-, full grown trees well-developed, narrow and thin, often steep buttresses up to 3 m ( $\approx 10'$ ) high. The bole is long and straight, slender, often slightly angular, up to 20 (–25) m ( $\approx 66$ –80') to the first branches.

The crown is fairly small, irregular; the leaves are slightly tufted. The bark on the buttresses is slightly striate parallel to the edge; on the bole it is yellowish brown or grey, scaly, the scales leaving bright brown scars; sometimes the bark is pitted. The slash is 4–6 mm thick, soft, long-fibrous (the bark easily stripped off in long strips), pink or pinkish red, turning brown, with a few white stripes of dilatation tissue. Ripple marks are very regular, close and straight; the high wood rays are characteristic, leaving narrow, longitudinal holes in the bark tissue when this is stripped off in thin layers (a character, besides in other *Sterculiaceae*, also found in *Annonaceae*).

*Nesogordonia papaverifera* is a typical tree of the deciduous forest; it avoids swampy localities and favours hills, often growing in groups. In Liberia it is only found in the moist semi-deciduous forest zone. It is an associate of *Triplochiton scleroxylon* but is not such a markedly light demanding secondary forest species. Flowers were collected during May, fruits in May, July and December, seedlings in May. Regeneration may be fairly abundant near the mother tree. Taylor reports that the seeds of shed, unopened fruits are immature. Germination (cf. Kinloch) takes 7–25 days; seed beds should be shaded; initial growth is slow. The tree is a good shade bearer. It does not clean itself well, which is possibly the cause of the pin knots usually found in the wood. Small branches tend to persist, and this tendency grows with increased light conditions. This species has not been used much in plantations, and its silviculture in Liberia would probably be uninteresting in the absence of the optimal climatic conditions.

Leaves, fruits and habit of *Nesogordonia* are very characteristic; its seeds should not be confused with those of *Anopyxis klaineana*.

USES. The sapwood is pale pinkish brown, 2–3 cm wide in the mature tree, distinct from the heartwood, which is rose-brown when freshly cut, maturing to a pleasant red-brown. The wood is slightly greasy and lustrous, the texture fine, the grain interlocked, producing a ribbon figure on the quarter cut. It is a medium heavy wood, Sp.G. 0.65–0.80, fairly hard, but with good working properties. Tough and elastic, with good strength properties, it is considered as good for tool handles, construction timber, wagon and carriage building, flooring etc.

*Triplochiton scleroxylon* K. SCHUM.

[72/31,372]

'*Triplochiton*': Gr. triplous: triple; Gr. chiton: shirt. Referring to the three coverings (shirts) in the flower: calyx, corolla and whorl of petaloid staminodes.

'*scleroxylon*': Gr. xylon: wood; Gr. skleros: hard; Schumann, when describing this species, erroneously assumed the wood to be hard.

K. Schumann in Bot. Jahrb., 28, p. 331 (1900); type: Zenker & Staudt 595 (BM!, K!); Zenker 298 (?); Pilger in Nat. Pfl.fam., Nachtr. III zu III, 6, p. 215–216 (1908); *T. johnsonii* C. H. WRIGHT in Hook. Ic. Pl., t. 2752 (1903); type: Johnson 813 (K!); *T. nigericum* SPRAGUE in Kew Bull. 1909, p. 212; type: Foster 370, Punch 125 (K!); *Samba scleroxylon* (K. SCHUM.) ROBERTY, Bull. IFAN., 15, p. 1403 (1953).

1928: F.W.T.A., 1st ed., I, p. 248 (+ <i>T. nigericum</i> )	1957: Bois et For. Trop., 53, p. 21–24
1936: Aubréville, F.F.C.I., 1st ed., II, p. 260	1958: F.W.T.A., 2nd ed., I, p. 313
1936: Kennedy, F.F.S.N., p. 59	1959: Aubréville, F.F.C.I., 2nd ed., II, p. 302
1937: Dalziel, U.P.W.T.A., p. 111 (+ <i>T. nigericum</i> )	1959: Kryn & Fobes, Woods of Liberia, p. 119
1946: Kinloch, Silv. Notes Gold Coast Trees, p. 14	1960: Taylor, Syn. Silv. Ghana, p. 355
1955: Normand, A.B.C.I., II, p. 241; Pl. CV	1960: Keay, Nigerian Trees, I, p. 202
	1961: Irvine, Woody Plants of Ghana, p. 184
	1961: Hallé in Fl. du Gabon, 2, p. 111
	1963: de Saint Aubin, La Forêt du Gabon, p. 145

LOCAL NAMES: du, (d)lou (Gio); wotue (Krahn)

TRADE NAME: Obeche; (Samba, Wawa)

GEOGRAPHICAL DISTRIBUTION: Sierra Leone – Gabon

BOTANY. A large tree. Leaves simple, palmately-lobed, alternate, stipulate, when young covered with a brown indumentum of fine stellate hairs but glabrescent, or glabrous. Stipules linear, 2–4 cm long, 3–4 mm wide, enclosing the terminal bud, soon caducous and leaving annular scars at the nodes. Petiole (1.5–) 3–7 cm long, somewhat flattened above. Blade with 5–7 basal nerves, slightly cordate at base, 5–7 lobed for about 1/3–1/2 of the length, the lobes broadly ovate or triangular, obtuse – acute; central nerve longest (3–) 7–15 cm long; lateral nerves shorter. Reticulation of veins slightly raised. Leaves of saplings and suckers often larger and deeper incised.

Inflorescences axillary or terminal, up to 10 cm long panicles, densely covered with stellate hairs. Young flower buds enclosed by 3 early caducous, broadly elliptic, c. 5 mm long, 4 mm wide, concave bracts. Pedicel articulate at base, at anthesis 3–4 mm long, brown stellate-puberulous, as is the outside of the calyx. Sepals 5, valvate in bud, spreading at anthesis, triangular, c. 7 mm long, 4 mm wide, densely sericeous inside. Petals 5, imbricate in bud, spreading at anthesis, pinkish white but purple at base, densely sericeous inside and outside, broadly or depressed obovate, c. 1 cm long, 1–1.5 cm wide, palmati-nerved. Androgynophore c. 3 mm long, 5-ridged, pilose. Stamens 30–40, with filaments 2–3 mm long, connate at base in pairs; each anther with 1 theca only. Ovary surrounded by 5 imbricate, petaloid, glabrous, c. 3 mm long and wide staminodes. Ovary formed by 5 free, papillate carpels, c. 2 mm long, the styles connate, c. 1.5 mm long; each carpel with 6–10 ovules.

Fruits formed by 1–5 free, winged mericarps, each mericarp 1-seeded, more or less rhombic, the diagonals c. 2 and c. 1 cm long, with a membranous, nervose, at the back thickened, obliquely attached wing of c. 4 cm long.

Seedling: germination epigeal. Hypocotyl about 7 cm long, minutely stellate-puberulous. Cotyledons foliaceous, suborbicular, 2.5–3 cm across, slightly cordate at base, palmati-nerved with 3–5 faint nerves. Petiole 1.5 cm long, stellate puberulous, as is the 1.5–2 cm long epicotyl. Leaves alternate; first leaf 3-lobed, with scattered hairs on the nerves and lower surface. Stipules minute.

TAXONOMICAL NOTES. Schumann (1900, l.c.) originally placed *Triplochiton* in a separate family, *Triplochitonaceae*, but Pilger (1908, l.c.) transferred it to the sub-family *Mansonieae* in *Sterculiaceae*, together with the genus *Mansonia* PRAIN. *Mansonia* is represented in Liberia by *M. altissima* (A. CHEV.) A. CHEV., a forest tree typical of the deciduous forest. The tree is very rare in Liberia and was only observed on the eastern slopes of the ridge in the Gio National Forest (see fig. 72 E).

The present description and figures are based on the following specimens: Loma Nat. For., near Basiweng 731; Diala 271, 1009, 1308, Harley s.n. Ivory Coast: Leeuwenberg 2877, de Wilde 851.

FIELD NOTES. *Triplochiton scleroxylon* is often an emergent tree reaching a height of up to 50 m ( $\approx 160'$ ) and a diameter of over 1.20 m ( $\approx 4'$ ); the largest specimen observed in Liberia measured 2.10 m ( $\approx 7'$ ) across above the buttresses. The base is fairly irregular, on younger trees with low, fairly thick buttresses, on older trees with low or very high developed buttresses, and butt flares up to 7 m ( $\approx 23'$ ). The bole is straight, but rarely cylindrical, often angular and heavily ridged; it may be up to 30 m ( $\approx 100'$ ) to the first branches. The crown is dense, rounded, with heavy, not far-spreading branches. The foliage is often massed at the end of the heavy branches. The bark is ashy grey or yellowish brown, more or less scaly, sometimes rather smooth, often with vertical lines of lenticels. The slash is characteristic, pale yellowish brown, in interlocked

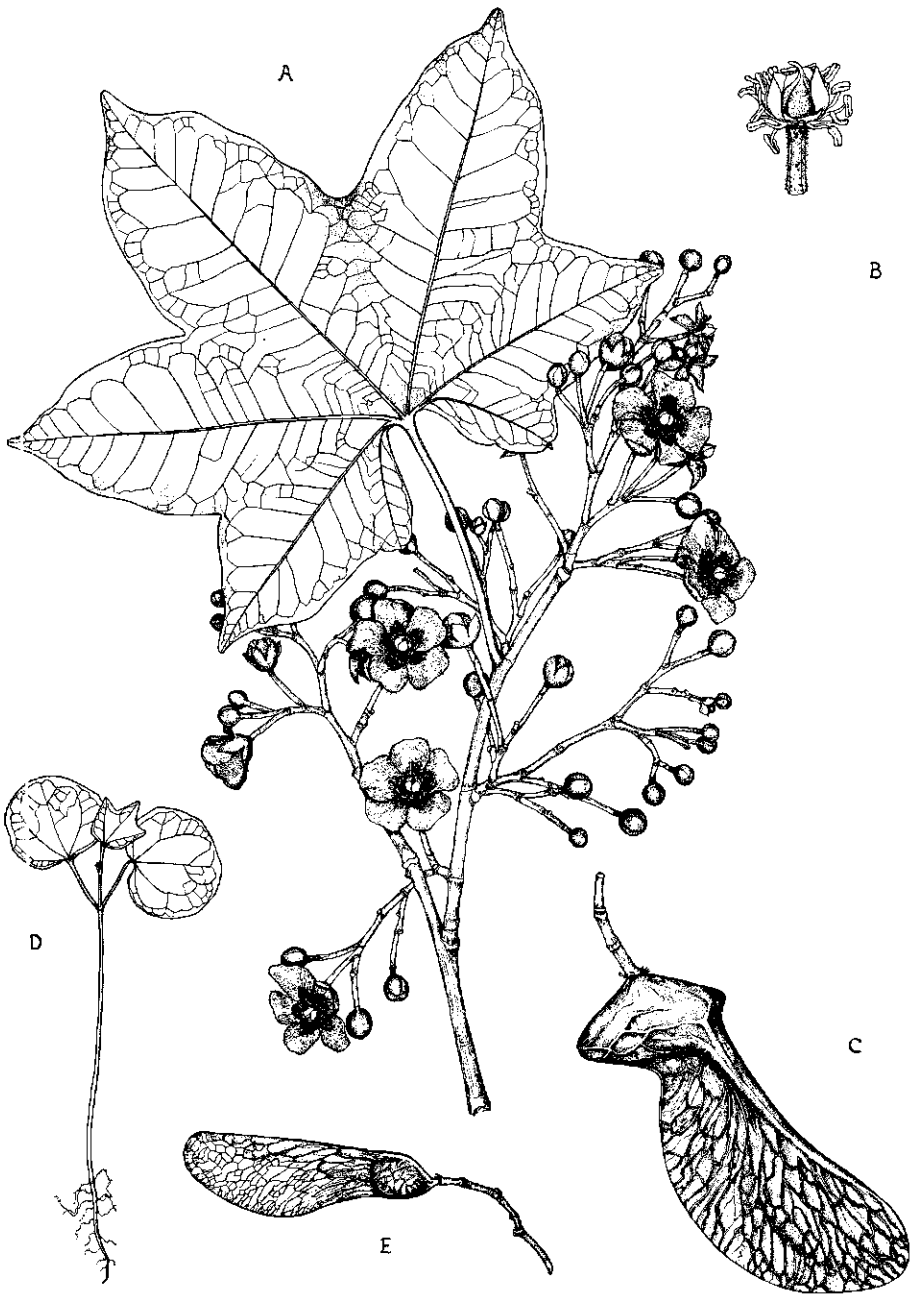


Fig. 72. *Triplochiton scleroxylon* K. SCHUM. A: branch with leaf and inflorescence ( $\times \frac{1}{2}$ ); B: androgynophore with petaloid staminodes ( $\times 2$ ); C: fruit ( $\times 1$ ); D: seedling ( $\times \frac{1}{2}$ ); E: fruit of *Mansonia altissima* (A. CHEV.) A. CHEV. ( $\times \frac{1}{2}$ ).

tangential layers, fibrous; a fine ripple mark structure is often distinct. Young trees have broad stripes of dilatation tissue.

The distribution area of *Triplochiton* in Liberia can be roughly estimated to be north of an imaginary boundary from Gi-creek and Putu Range (Penoken) over Tapeta to Gbarnga and Kolahun. The tree is essentially a secondary forest species, little exacting as to site but avoiding swamps. Mature high forest with a high percentage of *Triplochiton* is rare and restricted to special ecological formations (eastern slopes of the ridge in the Gio National Forest). It has a gregarious tendency, due to its pioneer habit; natural regeneration may be abundant, even dominant when circumstances are favourable, e.g. recent farmlands or otherwise disturbed forests in the neighbourhood of seed-bearing mother trees. Owing to its colonising capacity the tree gradually penetrates into the moister forest types, although it was originally a species of the deciduous forest.

The tree flowers in December–January, usually when the leaves are shed (col. No. 731 still had leaves on the flowering twigs). Fruiting is from January–March. Seed production is irregular; even when flowering has been profuse seeding may be very limited. Many fruits are shed immature. Good seeding years may occur at intervals of 7–10 years.

**SILVICULTURE.** There are about 84 winged fruits to an ounce (teste Taylor). Germination is fast, one to two weeks, but with a fairly low germination percentage. Growth is fast and nursery stock is ready for planting after one year. Planting with stumps is successful when the soil is moist, e.g. at the beginning of the rainy season. Seedlings may stand shade in the initial stage, but soon require full overhead light for healthy development. Its fast growth makes a mixture with other species, except perhaps *Terminalia*, less desirable. When planted in a  $3 \times 3$  m ( $\approx 10 \times 10'$ ) spacing, the canopy can be closed after three years, which makes it possible to dispense with cleaning operations, but necessitates subsequent thinnings.

*Triplochiton* is a much sought after species on the timber market, and its silviculture may be of considerable interest. However, the very irregular seed production makes the required regular seed supply unreliable.

**USES.** A very light, nearly white wood, *Triplochiton* has found a wide application in Europe for rotary cut veneer for plywood, and as a replacement for softwood. The timber is not durable, but highly susceptible to fungus attack (especially blue stain), and borer attack; it is resistant to impregnation. Stocks in Liberia are limited.

## LIST OF SPECIMENS USED FOR THE FIGURES

*Numbers without the name of a collector refer to the Voorhoeve collection.*

- Fig. 1: A: 891; B, C, D, E: 1176; F, G: 754 (alc. coll.); H: van Harten s.n.  
Fig. 2: A<sup>1</sup>, B: 530; A<sup>2</sup>, F, G, K: 819; A<sup>3</sup>: 234; H: 1040; C, D, E: Leeuwenberg 2472  
Fig. 3: A: 757; B, C: 747; D, E, F: 1316 (alc. coll.); G: 940  
Fig. 4: A: 251; B: 681; C, D: Harley s.n.; E: 1054  
Fig. 5: A, E, F: 1069; B, G, H: 1181; C, D: de Wilde 3708 (alc. coll.); K: 939A  
Fig. 6: A, B, C: 511; D: 136A; E, F: 836 (alc. coll.); G: 1018  
Fig. 7: A: Harley s.n.; B, C, D: 1125; E, F: Leeuwenberg 3956; G, H, K: 1306  
Fig. 8: A, D: 1191; B: 1120A; E: 1011; F: 1003; G: 301A  
Fig. 9: A: 1177; B: de Wilde 3820; C, D: 294; E: 1017; F: 980  
Fig. 10: A, B: 787; C: 141; D, E: 1197; F, G: 1196; H: 1008  
Fig. 11: A, B: de Wilde 3822; C, D, F: s.n.; E: de Wilde 3753  
Fig. 12: A: 470; B: 432; C: s.n.; D: 1206  
Fig. 13: A, B, C, D: 775; E: 1055  
Fig. 14: A, B: 839; C, D: 644; E, F: 759; G: 1278  
Fig. 15: A, B: de Wilde 3751; C: 586; D: 137A  
Fig. 16: A: 152; B, C, D, E: 598; F: 337; G, H: 197; K: s.n.  
Fig. 17: A: 639; B: 603 (alc. coll.); C: 146 (fr. coll.); D: 1179  
Fig. 18: A: 146 (fr. coll.); B: 60A (fr. coll.); C: 1299; D: 1299A (fr. coll.)  
Fig. 19: A<sup>1</sup>: 783; A<sup>2</sup>: slide coll. No. 23, 611 (WAG); B: 1317; C: 868  
Fig. 20: A, B: de Wilde 3674; C: s.n. (fr. coll.); D: 937; E: 755 (alc. coll.)  
Fig. 21: A<sup>1</sup>: 925; A<sup>2</sup>: 7; A<sup>3</sup>: 1149; B, C: 719; D: 1033  
Fig. 22: A, B: 1172; C, D: 1003; E: 885; F: s.n.  
Fig. 23: A, D, E, F: 1152; B, C: v. Dillewijn 51; G: 151  
Fig. 24: A: 255; B: 1061 (alc. coll.); C, D, E, F: 74; G: 848  
Fig. 25: A, B: 1280; C, D: 167; E: 713  
Fig. 26: A<sup>1</sup>, B: 1303; A<sup>2</sup>: 943, 1303; C: Whyte s.n.; D: 1275; E, F: Dinklage 2033 (K, type)  
Fig. 27: A, B, C: 735; D, E: s.n. (fr. coll.); F: 1020  
Fig. 28: A, B: 524; C, D: de Wilde 3663; E: 142; F: 1095; G, H: 144; J: 692  
Fig. 29: A, B, C: 1060 (type); D: 585; E, F: 531; G: 938; H, I: 411  
Fig. 30: A, B: 907; C: Leeuwenberg 4681; D: 531A; E: 403  
Fig. 31: A, B, C, D, E: 1210; F: 897; G: s.n. (alc. coll.)  
Fig. 32: A, C, D: 674; B: s.n. (alc. coll.); E: 1047  
Fig. 33: A, B, C: 1277; D, E: 893; F: 1024; G, H: 675C; I: Dinklage 1695(K)  
Fig. 34: A, B, C: de Wilde 3659; D: 939; E: 548; F: Leeuwenberg 4927; G: 1194; H: 416; I: Aubréville 4053 (P)



- Fig. 35: A, B, C: 231; D: Wright 15; E, F: 830  
 Fig. 36: A: 310; B, C: 1115; D, E: 446; F: 1043; G: 1300; H: 961  
 Fig. 37: A, B: 924; C: King 148 (K); D: s.n.; E: 1138; F: 1297; G: 1139  
 Fig. 38: A, B, C, D: 785; E: 920; F: 1029; G, H: s.n.  
 Fig. 39: A, B, C, D, E: 311; F: 686; G: 1028  
 Fig. 40: A, B: 468; C: 691; D: de Wilde 3877; E: s.n.; F: 686  
 Fig. 41: A–G, K: de Wit 9032; H, I, J: Leeuwenberg 2783; L: 1019  
 Fig. 42: A: 976; B, C, D: 233; E: s.n.; F: 1050  
 Fig. 43: A, B, C, D, E: 215; F, G, H: de Wit 9040  
 Fig. 44: A, B, C: de Wilde 3626; D, E: de Wilde 3848; F: 1041; G: Leeuwenberg 4817  
 Fig. 45: A, B, C, D: Leeuwenberg 2493; E: s.n.  
 Fig. 46: A: Leeuwenberg 2483; B, C, D, E, F: 194; G, H: Chipp 106 (K)  
 Fig. 47: A: 903; Leeuwenberg 2510; B: 196; C: Leeuwenberg 2510; D: 881; E: FHI 25596 (K)  
 Fig. 48: A: Brenan 8822 (K); B: de Wilde 3912; C, D: 196  
 Fig. 49: A, B, C: 1160; D, E: 300; F: Harley s.n.  
 Fig. 50: A: 1129; B: Leeuwenberg 3744; C, D, E: 202; F: Leeuwenberg 3955  
 Fig. 51: A, B: 766; C, D, F: s.n.; E: 1022  
 Fig. 52: A, D, F: de Wilde 3133; B, C: Leeuwenberg 3751; E: culta (WAG)  
 Fig. 53: A: 708; B, C: v. Harten 112; D: Toka 26; E, H, K: 955; F, G: 139; L, M: s.n.  
 Fig. 54: A, D, H: 947; B, C: 926; E: 248; F: 1057; G, I: 874  
 Fig. 55: A, B: 1301; C: s.n.; D: de Wilde 3668; E, F: 1301  
 Fig. 56: A, B: 798; C, D: s.n.; E: slide no. 24, 227 (WAG); F, G: 763; H: 1051  
 Fig. 57: A, B, E, G: s.n.; C, D: 75; F: 1054; H: de Wilde 3707  
 Fig. 58: A, B, D, E: 504; C: 743; F: v. Dillewijn 60  
 Fig. 59: A, B: 290; C, D: 1250; E: 1268; F: 77; G: 200; H: 861  
 Fig. 60: A, B, F: 778; C, D: s.n.; E: 1056; G: 877  
 Fig. 61: A: 756; B, C: 765; D, E, F: de Wilde 3665; G: 1187  
 Fig. 62: A: de Wilde 3690; B, F: 1105; C: 1004; D, H: 1269; E, K: 1151; G: Deville 172 (BR); I: Kennedy 2363 (K)  
 Fig. 63: A, B: 1298; C: 143; D, E: 59; F: 1005  
 Fig. 64: A, B: 513; C: 513 A; D: 1055; E: s.n.  
 Fig. 65: A, B: Leeuwenberg 3795; C, D: 923; E: 1016; F, G, H: 70  
 Fig. 66: A, B, F: 1150; C, D: de Wilde 3803; E: 1044  
 Fig. 67: A, B: de Wilde 3689; C: 590; D, E: 680; F: s.n.  
 Fig. 68: A, B: 380; C, D: 380 A; E: s.n.  
 Fig. 69: A, B: 1193; C: 115; D: 1030  
 Fig. 70: A: Leeuwenberg 3797; B, C, D: 525; F: Leeuwenberg 4825  
 Fig. 71: A, B, F: 1126; C, D: 768; E: 1035  
 Fig. 72: A, B: 731; C: Harley s.n.; D: 1009; E: Breteler 2155

## ABBREVIATIONS AND SYMBOLS

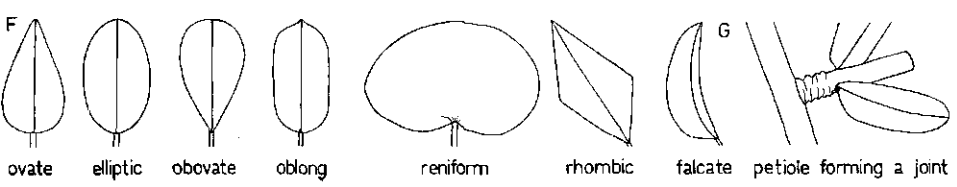
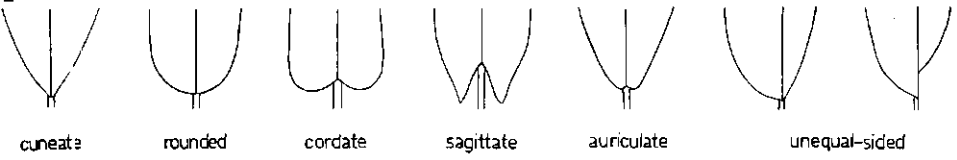
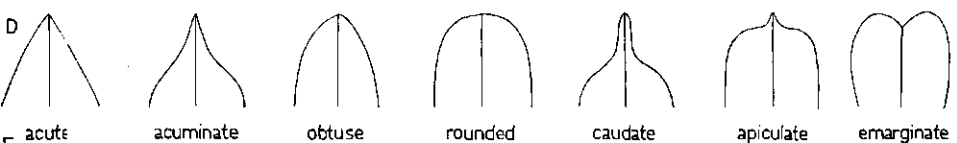
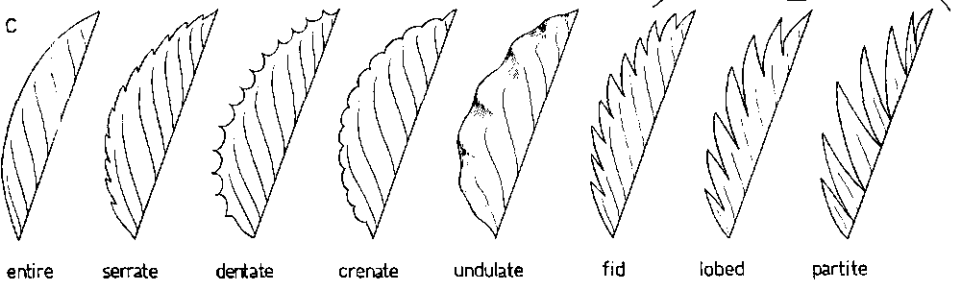
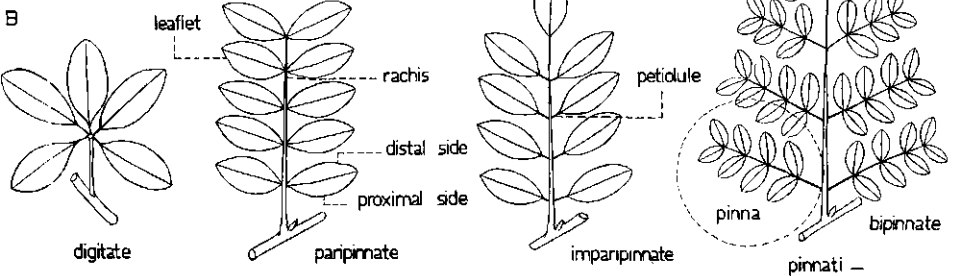
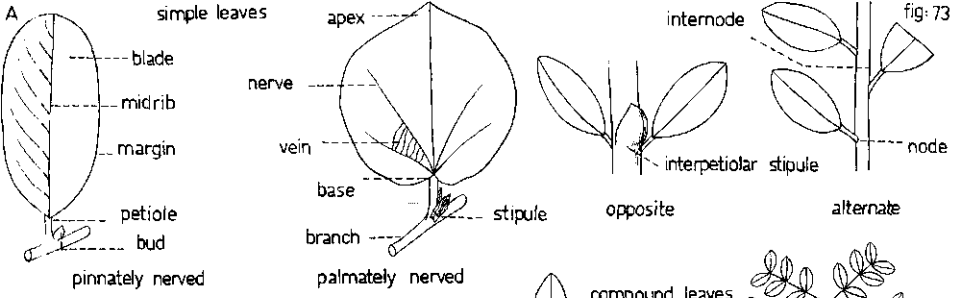
(A)	= Arnold Arboretum, Cambridge, Mass., U.S.A.
A.B.C.I.	= Atlas des Bois de la Côte d'Ivoire; D. Normand
aff.	= affine, near to, closely related to
Afr.	= African
Afz.	= Afzelius
Aubrév.	= A. Aubréville
auct.	= auctorum (of authors)
Baill.	= Baillon
Benth.	= Bentham
Bot.	= Botanic(al), Botanique, Botanische
Bot. Jahrb.	= Botanische Jahrbücher
(BM)	= British Museum (Natural History); London, Great Britain
(BR)	= Jardin Botanique de l'Etat; Brussels, Belgium
Bull.	= Bulletin
Bull. Jard. Bot.	= Bulletin du Jardin Botanique de l'Etat à Bruxelles Bruxelles
Bull. Soc. Bot.	= Bulletin de la Société Botanique de France France
c.	= circa, about
cf.	= compare
A. Chev.	= Auguste Chevalier
cm	= centimetre ( $\approx 2/5''$ )
(COI)	= Botanical Institute of the University of Coimbra; Portugal
DC.	= De Candolle
de Wi. d.	= de Wildeman
diam.	= diameter
E.	= East
ed.	= edition
Engl.	= Engler
excl.	= excluding
Evergr. For.	= Evergreen Forest of Liberia; G. P. Cooper & S. J. Record Liberia
f.	= filius, son (e.g. Hook. f. = Hooker filius)
fasc.	= fascicle
F.F.C.I.	= La Flore Forestière de la Côte d'Ivoire; A. Aubréville

- F.F.S.N. = Forest Flora of Southern Nigeria; J. D. Kennedy  
 (FHO) = Forest Herbarium, Dept. of Forestry, Commonwealth Forestry Institute, University of Oxford, Great Britain
- fig. = figure  
 fr. = fruit  
 ft. = foot, feet
- F.T.A. = Flora of Tropical Africa  
 F.W.T.A. = Flora of West Tropical Africa  
 G.C.A.a. = Genera des Cynometreae et des Amherstieae africaines; J. Léonard, Acad. roy. de Belgique, Classe des Sciences, Mém., Tome XXX, Fasc. 2, 1957
- (GH) = Gray Herbarium of Harvard University, Cambridge, Mass., U.S.A.
- Gr. = Greek  
 ha. = hectare (= 10,000 m<sup>2</sup> ≈ 2.47 acre)  
 (HBG) = Staatsinstitut für allgemeine Botanik und Botanischer Garten; Hamburg, Germany
- Hook. = Hooker  
 ibid. = ibidem, the same (author)  
 Ic. Pl. = Icones Plantarum  
 ind. = indigenous  
 Journ. = Journal  
 (K) = Royal Botanic Gardens, The Herbarium and Library; Kew, Great Britain
- Kew Bull. = Kew Bulletin (formerly Bulletin of Miscellaneous Information)  
 km = kilometre (1000 metres)  
 L. = Latin; Linnaeus or Linné when placed after a botanical name  
 (L) = Rijksherbarium; Leiden, the Netherlands  
 lbs. = pounds  
 l.c. = loco citato, in the place mentioned (previously)
- Leg. Gab. = Les Legumineuses du Gabon; Pellegrin  
 (LIB) = Harley Herbarium; University of Liberia, Monrovia, Liberia  
 Lib. = Liberia  
 lit. = literature  
 M. = Mile (1609 metres)  
 m. = metre (international standard unit of length ≈ 39.37")  
 Mildbr. = Mildbraed  
 mm = millimetre (1/1000 of a metre)  
 Mt., Mtn. = Mountain  
 N. = North  
 Nat. For. = National Forest

- Nat. Pfl. fam. = Die Natürliche Pflanzenfamilien; A. Engler und K. Prantl  
 N.E. = North-east  
 N.W. = North-west  
 (P) = Muséum National d'Histoire Naturelle, Laboratoire de Phané-  
 rogamie; Paris V, France  
 Pellegr. = Pellegrin  
 pl. = plural  
 S. = South  
 S.E. = South-east  
 s.l. = sensu lato, in a wide sense  
 s.n. = sine numero, without a number  
 Soc. = Society, Société  
 sp., spp. = species (singular and plural)  
 Sp. G. = Specific Gravity  
 sq. = square  
 subsp. = subspecies  
 S.W. = South-west  
 syn. = synonym  
 Syn. Silv. = Synecology and Silviculture in Ghana; C. J. Taylor  
 Ghana  
 t. = tabula, plate or illustration; tome (French for volume)  
 U.P.W.T.A. = Useful Plants of West Tropical Africa; J. M. Dalziel  
 (US) = U.S. National Museum (Department of Botany), Smithsonian In-  
 stitution; Washington D.C., U.S.A.  
 var. = variety  
 Vég. Util. = Les végétaux utiles de l'Afrique tropicale Française; A. Chevalier  
 vol. = volume  
 W. = West  
 (WAG) = Laboratory for Plant Taxonomy and Plant Geography; Wage-  
 ningen, the Netherlands  
 Welw. = Welwitsch
- SYMBOLS**  
 > = more than  
 ∅ = in diameter  
 (K!) = specimen seen in the Kew Herbarium  
 ≈ = equals about

## GLOSSARY OF TERMS

- abaxial*, the side or face away from the axis.
- abortion*, suppression of parts usually present.
- abrupt*, suddenly ending, as though broken off.
- acrescent*, increasing in size with age, as the calyx of some plants after flowering.
- achene*, a small, hard, dry, indehiscent fruit, strictly of one free carpel.
- acicular*, very narrow, stiff and pointed, needle-shaped.
- actinomorphic*, regular, applied to flowers which may be bisected in more than one, vertical plane.
- acuminate*, having a gradually diminishing point, drawn out (fig. 73 D).
- acute*, distinctly and sharply pointed, but not drawn out (fig. 73 D).
- adaxial*, the side or face next to the axis, ventral.
- adherent*, the union of parts usually separate.
- adnate*, united with a member of another body or series (see also *connate*).
- adventitious buds*, those produced elsewhere than in the axils of the leaves or the extremities of the branch; – *roots*, those produced not from the radicle or its subdivisions but from another part.
- aestivation*, the manner in which the sepals and petals are arranged in bud.
- afforestation*, bringing land under the conditions of forest.
- albumen*, the nutritive material stored in the seeds and surrounding the embryo.
- alternate*, applied to leaves, inserted at different levels along the branch as distinct from opposite (fig. 73 A).
- altitude*, used to specify the height above sea level.
- amorphous*, shapeless, the form not regular or definite.
- anastomosis*, union of one vein with another, the connection forming a reticulation.
- ander*, -*dra*, -*dro*, in Greek compounds = the male sex.
- androgynophore*, a stalk supporting the stamens and the gynaecium, formed by an elongation of the receptacle.
- androphore*, a stalk supporting the stamens, and formed by an elongation of the receptacle.
- angular*, used when an organ shows a determinate number of angles.
- anisophyllous*, the two leaves of a pair of different size or shape.
- annular*, in the form of a ring, or used of any organs arranged in a circle.
- anterior*, position in front, or turned away from the axis.
- anther*, the part of the stamen which contains the pollen, usually divided into two pouches or cells (thecae).



- anthesis*, the time when the flower is expanded, or when fertilisation takes place.
- anthropogenous*, influenced or caused by man.
- apetalous*, without petals or with a single perianth.
- apex*, the tip of an organ.
- apicula*, a sharp and short, but not stiff point, in which a leaf may end.
- apiculate*, ending abruptly in a short point (fig. 73 D).
- apocarpous*, carpels free and separate from each other.
- appendage*, *appendix*, a part added to another (as leaves are appendages to the stem).
- appressed*, lying close and flat.
- arboretum*, a place assigned for the culture of trees, usually in systematic order.
- arching*, see *arcuate*.
- arcuate*, curved like a bow.
- aril*, *arillus*, an appendage covering or partly enclosing the seed and arising from the funicle (or stalk) of the seed.
- armed*, bearing thorns or similar defences.
- ascending*, directed upwards; the ascending axis is oblique at first, then erect.
- articulate*, jointed or separating at a certain point, leaving a clean scar.
- attenuate*, narrowed, tapered.
- auriculate*, having an ear-like lobe or appendage at base of the leaf-blade (fig. 73 E).
- autochthon*, a native plant, not an introduction.
- axial*, relating to the morphological axis, as distinct from its appendages.
- axil*, the angle between the leaf and the branch, or the nerve and the midrib.
- axillary*, arising from the axil, placed in the axil.
- axis* (of the inflorescence), that part of the stem or branch on which the individual flowers are borne.
- baccate*, berry-like.
- back*, that side which is turned from the part to which an organ is attached; the dorsal surface.
- bark*, all tissues outside the cambium.
- basal*, at the base of an organ or part.
- base*, the extremity of attachment by which nutrition takes place.
- basifixed*, of an anther attached by its base.
- basionym*, when a species is transferred to another genus, its binomial in the original description is the basionym.
- beaked*, used of fruits which end in a long point.
- bell-shaped*, tubular and inflated.
- berry*, a juicy fruit with seeds immersed in the pulp.
- bi-*, *bis-*, in Latin compounds = twice or double.
- bifid*, cleft in two parts at the tip.
- bifoliolate*, having two leaflets.
- bilobed*, divided into two lobes.

*bilocular*, with two compartments or cells.

*binomial*, in botanic nomenclature, the use of a generic and specific name to connote a given organism.

*bipartite*, divided nearly to the base into two portions.

*bipinnate*, when the primary divisions (pinnae) of a pinnate leaf are themselves pinnate (fig. 73 B).

*bisexual*, having both sexes in the same flower or inflorescence.

*blade*, the limb or expanded portion of a leaf or a leaflet (fig. 73 A).

*blunt*, ending in a rounded form, neither tapering to a point, nor abruptly cut off.

*bole*, the main trunk of a tree.

*bone*, of a close and hard texture.

*bordered*, having a margin distinct in colour or texture from the rest.

*brachy-*, short, used in Greek compounds.

*bract*, a small leaf subtending a flower or flower stalk.

*bracteoles*, small bracts on the pedicel or close under the flower.

*branch*, a division of the stem or axis of growth.

*bristle*, a stiff hair.

*broadly-*, expressing that the length: width ratio of a flat form varies between 3:2 and 1:1.

*bud*, the nascent stage of a flower or branch; *bud scales*, the coverings of a bud.

*bullate*, surface of leaves prominently raised between the veins.

*butt flares*, very narrow, steep, often high-reaching buttresses.

*buttress*, the knee-like or plank-like outgrowth of the roots at the base of the trunk of a tree (photograph 2, 22).

*caducous*, falling off early.

*calyx*, the outer envelope of the flower, consisting of free or united sepals.

*calyx tube*, when the sepals are partly united, the lower portion is the tube, the upper free part is the limb usually divided into calyx teeth, or lobes.

*cambium*, the layer of nascent tissue between the wood and the bark, adding elements to both.

*campanulate*, bell-shaped.

*canaliculate*, with a longitudinal groove.

*canopy*, the high, leafy covering in woodlands, the uppermost layer in the forest.

*capitate*, (1) like the head of a pin, as the stigma of some flowers; (2) collected into compact head-like clusters (flowers of *Parkia*, *Nauclea*).

*capsule*, a dry fruit composed of two or more united carpels, and either splitting when ripe into pieces called valves, or opening by slits or pores.

*carinate*, keeled, with a distinct median ridge.

*carpel*, fruit-leaf (modified leaf carrying the ovules), forming a simple pistil when folded and united by its edges, or a syncarpous ovary when united with one or more other carpels.



*catkin*, a close, bracteate, often pendulous spike.

*caudate*, abruptly ending in a long tail-like tip or appendage (fig. 73 D).

*cauliflorous*, producing flowers from the old wood separate from the leaves.

*cell*, (1) the cavity or cavities of an ovary or fruit containing the ovules or seeds; (2) the pollen-sac of an anther, an anther lobe (= theca).

*central*, relating to the centre of a body.

*ceracious*, waxy in appearance or colour.

*choripetalous*, a flower having the petals separate.

*cicatrice*, the mark left by the separation of one part from another, as by the leaf from the stem.

*ciliate*, with a fringe of hairs along the edge.

*ciliolate*, minutely ciliate.

*circa*, c., in Latin compounds = round about.

*clavate*, club-shaped, or thickened towards the end.

*claw*, the narrowed, drawn-out base of a petal.

*cleft*, cut halfway down.

*club-shaped*, gradually thickened upward from a slender base.

*clustered*, compactly gathered together.

*collar*, the neck of a plant; the imaginary boundary between the above- and underground portion of the axis.

*colleters*, slimy, gum secreting hairs.

*compact*, closely joined or pressed together.

*compound*, the opposite of simple; composed of several similar parts, as a leaf of several leaflets; – fruit, when the fruits of separate flowers become united in a mass, as in *Nauclea*.

*compressed*, flattened lengthwise from side to side (laterally), or from front to back (dorsally).

*concave*, hollow, as the inside of a saucer.

*concentric*, having a common centre.

*conical*, having the figure of a cone.

*connate*, when parts of the same series are united so closely that they cannot be separated without tearing.

*connective*, the part of an anther which connects its two lobes or cells.

*contorted*, of sepals or petals in bud when each overlaps an adjoining one on one side, and is overlapped by the other adjoining one on the other side.

*contra-*, in Latin compounds = against.

*convex*, having a more or less rounded surface.

*copious*, abundant.

*coppice*, a small wood which is regularly cut at stated intervals, the new growth arising from the stools; *coppicing*, in forestry, cropping the plantation by cutting the under-wood every few years.

*cordate*, applied to the base of a leaf-blade when it is more or less deeply notched (fig. 73 E).

*coriaceous*, firm, tough, of the consistence of leather.

*corolla*, the inner envelope of a flower, consisting of free or united petals.

*cosmopolite*, of a plant of well-nigh universal distribution.

*costa*, a rib, when single a midrib or middle nerve.

*cotyledons*, seed-lobes, the first leaves of an embryo.

*cream-coloured*, white with a slight inclination to yellow.

*crenate*, the margin notched with regular blunt or rounded teeth (fig. 73 C).

*crenulate*, crenate with very small teeth.

*crest*, an elevation or ridge upon the summit of an organ.

*crowded*, closely pressed together, thickly set.

*cuneate*, wedge-shaped, the base of a leaf-blade when tapering gradually (fig. 73 E).

*cupuliform*, nearly hemispherically cup-shaped.

*cuspidate*, abruptly tipped with a sharp point (as caudate but the tip sharp and rigid).

*cylindrical*, elongated with a circular cross-section.

*cyme*, an inflorescence in which the central flower opens first, and the first branches at least are usually forked or opposite.

***deciduous***, falling off eventually; not evergreen.

*decurrent*, when the edges of the leaf-blade are continued down the petiole as raised lines or narrow wings.

*decussate*, in pairs alternately at right angles.

*deflected*, bent or turned abruptly downwards.

*dehiscent*, opening spontaneously when ripe, as capsules, pods, and anthers.

*deltoid*, shaped like an equal-sided triangle.

*dendrology*, the study of trees.

*dentate*, the margin prominently toothed, the teeth directed outwards (fig. 73 C).

*denticulate*, finely toothed.

*depressed*, more or less flattened from above downwards or at least at the top.

*descending*, tending gradually downwards.

*di-*, *dis-*, in Greek compounds = two or double.

*dichasium*, a false dichotomy in which two lateral shoots of nearly equal strength arise from the primary axis below the flower which terminates the apex, the process being repeated by each set of branches.

*dichotomous*, forking regularly into two.

*dicotyledon*, plants of the class denoted by the possession of two cotyledons.

*digitate*, a compound leaf whose leaflets diverge from the same point (the top of the petiole), like the fingers of a hand as in the Cotton tree, *Ceiba* (fig. 73 B).

*dilatation tissue*, of the bark, tissue formed by cell-division of the parenchyma of the medullary rays, causing cleavage of the original bark tissue (phloem) and often giving rise to the formation of different-coloured and -textured vertical bands and

stripes; dilatation tissue makes the bark keep up with the circumference growth of the tree.

*dimorphic*, of two forms.

*dioecious*, with unisexual flowers, the male and female flowers on separate individual plants, as distinct from monoecious.

*diphyllous*, having two leaves.

*disc*, an enlargement of the receptacle within the calyx or within the corolla or stamens, usually in the form of a ring or cup, often lobed.

*dispersal*, *dispersion*, the various ways by which seeds are scattered, by wind, birds, adhesion to animals etc.

*dissected*, deeply divided, or cut into many segments.

*distal*, remote from the place of attachment; the converse of proximal (fig. 73 B).

*distichous*, regularly arranged one above another in two opposite rows, one on each side of the branch.

*divided*, used where lobing or segmentation extends to the base.

*dominant*, chief constituent of a plant-association.

*dormant*, applied to parts which are not in active life, as – buds.

*dorsal*, the back, or the face turned away from the axis (of a carpel); *dorsal suture*, see *suture*.

*dorsifixed*, of an anther attached by its back to the filament.

*drawn*, applied to attenuated shoots, diminished and etiolated, often increased in length.

*drip-point*, *drip-tip*, the acuminate apex of a leaf, from whose point water soon drips (German: Träufelspitze).

*drooping*, inclining downwards but not quite pendent.

*drought*, want of rain, hindring plant growth.

*drupaceous*, resembling a drupe, producing similar fruit.

*drupe*, a stone-fruit such as plum; the pericarp fleshy or leathery, containing a stone with a kernel.

*e*, *ex*, in Latin compounds = without.

*echinate*, covered with prickles.

*ecology*, the study of plant life in relation to environment.

*edaphic*, influence of the soil on the plant growing upon it.

*edge*, the margin or outline, as of a leaf.

*ellipsoid*, an elliptic solid.

*elliptic*, shaped like an ellipse, with a length : width ratio of 5 : 2 to 3 : 2, with the widest part in the middle (fig. 73 F).

*elongated*, drawn out in length.

*emarginate*, notched at the top (fig. 73 D).

*embryo*, the rudimentary plant still enclosed in the seed, consisting of the radicle, from the end of which the root will develop, the cotyledons, which become the earliest leaves, and the plumule, the bud from which the stem and more leaves develop.

- endemic*, confined to a region or country and not native anywhere else.
- endocarp*, the innermost layer of the pericarp.
- endosperm*, the nutritive material stored within the seed and often surrounding the embryo.
- entire*, with an even margin without teeth, lobes etc. (fig. 73 C).
- envelope*, a surrounding part.
- epicotyl*, the young stem of a seedling between the cotyledons and the first leaf.
- epiderm*, the true cellular skin or covering of a plant; *epidermal*, relating to the outer covering.
- epigeal*, of cotyledons which spread above the surface.
- epigynous*, when the sepals, petals, and stamens are apparently above the ovary.
- epipetalous*, on the petals.
- epiphyte*, a plant which grows on another plant but without deriving nourishment from it, i.e. not parasitic, as many *Ficus* species.
- epithet*, the specific name, which in combination with a genus name forms the binomial scientific name of a species.
- equal-sided*, equal, when applied to the two sides of an organ.
- erect*, upright.
- esculent*, suitable for human food.
- estipuiate*, without stipules.
- evergreen*, bearing green foliage all the year.
- exasperate*, rough with hard projecting points.
- eccentric*, one-sided, out of the centre.
- excrescence*, an outgrowth or wart on the stem of a tree.
- exocarp*, the outer layer of the pericarp (of fruit).
- exotic*, not native, introduced from abroad.
- exserted*, projecting beyond.
- exterior*, outer.
- external*, outward.
- extrorse*, of an anther which opens outwardly towards the circumference of the flower.
- falcate**, curved like a scythe or sickle (fig. 73 F).
- family*, a group of genera.
- fascicle*, a cluster of flowers, leaves etc., arising from about the same point.
- fastigiatae*, parallel, clustered and erect (photograph 23).
- febrifuse*, suppressing fever.
- ferruginous*, rust-coloured.
- fertile*, capable of producing fruit.
- fibrous*, having much woody fibre, as the rind of a coconut.
- filament*, the stalk of the stamen supporting the anther.
- filiform*, slender, thread-like.
- fimbriate*, with the margin bordered by long slender processes.

*flaky*, of a bark with numerous very thin bark scales.

*flower*, an assemblage of the organs essential for fertilisation, as stamens and pistils, with some protecting envelope.

*folded*, when the two halves of a leaf are applied to one another.

*foliaceous*, leaf-like.

*follicle*, a fruit of one carpel, opening by a ventral suture.

*foot*, as a measure, 12 inches or 30.5 cm; sign '.

*free*, neither adhering nor united.

*fruit*, the fertilised and developed ovary; the matured pericarp and its contents.

*funicle*, the little cord which attaches the ovule or, in fruit, the seed to the placenta.

*fusiform*, spindle-shaped, thick but tapering towards each end.

*gall*, a monstrous growth caused by an insect puncture.

*gamopetalous*, when the petals are united either entirely or at the base in a tube, cup or ring.

*gamosepalous*, when the sepals are united (= synsepalous).

*geniculate*, bent like a knee.

*genus*, the largest natural group containing distinct species which all carry the same generic name.

*germination*, the first act of growth in a seed.

*glabrescent*, becoming glabrous or nearly so.

*glabrous*, devoid of hairs.

*gland*, (1) a secreting structure on the surface or imbedded in the substance of a leaf, flower etc., or raised on a small stalk (glandular hairs or stipitate glands); (2) a warty protuberance or fleshy excrescence.

*glaucouscent*, becoming sea-green or bluish green.

*glaucous*, a pale bluish green.

*globose*, nearly spherical.

*globular*, spherical in shape.

*glomerate*, compactly clustered.

*glossy*, shining.

*granular*, composed of grains.

*gregarious*, growing in company.

*gum*, a viscid secretion frequently extruded from stems and hardening in the air.

*gynaecium* (pistil), the female part of the flower, when complete consisting of ovary, style, and stigma.

*gynobasic*, applied to a style which adheres by its base to a prolongation upwards of the receptacle between the carpels.

*gynophore*, a stalk supporting the gynaecium and formed by an elongation of the receptacle.

*habit*, the general appearance of a plant.

*habitat*, the kind of environment where a plant grows, as swamps, savanna etc.

- hair*, an outgrowth of the epidermis, a single elongated cell or a row of cells.
- heartwood*, the innermost, oldest, and dead wood in a tree, often different in colour from the younger, living sapwood under the bark.
- herb*, a plant with no persistent stem above the ground.
- hermaphrodite*, having stamens and pistil in the same flower.
- hilum*, the scar left on the seed where it was attached to the funicle or placenta.
- hirsute*, pubescent with rather coarse, stiff hairs.
- hypocotyl*, the young stem of a seedling below the cotyledons.
- hypogynous*, petals and stamens inserted on the receptacle below the ovary, and free from it, the ovary being thus superior.
- imbricate*, (1) overlapping like tiles; (2) in a flower bud when one sepal or petal is wholly internal and one wholly external and the others overlapping at the edge only.
- imparipinnate*, pinnate with an odd terminal leaflet (fig. 73 B).
- imperfect*, where certain parts, usually present, are not developed.
- inch*, an English measure, equalling 2.54 cm; 12 inch make one foot; sign".
- incised*, cut rather deeply.
- inconspicuous*, not readily seen from small size or lack of colour.
- indefinite*, numerous.
- indehiscent*, not opening when ripe.
- indigenous*, original to the country, not introduced.
- indumentum*, any covering such as hairs, wool, scales.
- induplicate*, with the margins bent inwards.
- indusium*, a ring of collecting hairs below the stigma.
- inermous*, without spines or prickles.
- inferior*, of an ovary which appears to be below the calyx, the latter being adherent to the ovary and superior.
- inflexed*, turned abruptly or bent inwards, incurved.
- inflorescence*, the arrangement of the flowers on a plant.
- infructescence*, the inflorescence in the fruiting stage.
- inserted*, joined to or placed on.
- insolation*, exposure to direct rays of the sun.
- intermediate*, half-way or between.
- internode*, the portion of the stem between the nodes (fig. 73 A).
- interpeltolar*, of (often connate) stipules placed between the petioles of opposite leaves (fig. 73 A).
- intra-*, within; *intramarginal*, placed within the margin near the edge; *intrapetiolar*, between the petiole and the stem.
- introrse*, of an anther when it opens by a slit facing the centre of the flower.
- involute*, when the edges of the blade are rolled inwards.
- irregular* flowers, those in which the parts of the calyx or corolla are dissimilar in size or shape, including (1) asymmetric flowers, which cannot be divided into two equal

halves in any vertical plane, and (2) zygomorphic flowers, which are bilaterally symmetric and may be bisected in only one vertical plane.

*isohyetal*, and imaginary line connecting stations with equal rainfall.

**joint**, the often swollen and rugose place on a petiole or petiolule which enables the leaf or the leaflet to make such movements as the sleeping movements of *Albizia* species at night (= pulvinus).

*jointed*, see *articulate*.

*jugate*, having one jugum, or more juga.

*jugum*, a pair of leaflets.

**kapok**, the woolly fiber-tissue surrounding the seeds in the fruits of many bombacaceous species.

*keel*, the two partially united lowest (or adaxial) petals of a papilionaceous flower.

*keeled*, ridged along the middle of a flat or convex surface.

*lacinate*, cut into slender lobes.

*lamina*, the blade of a leaf.

*latex*, the milky juice of such plants as the rubber tree.

*lax*, loose, distant.

**leaf**, the principal appendage or lateral organ borne by the stem; *leaf bud*, a bud which develops into a leafy branch.

*leaflet*, the blade or separate division of a compound leaf (fig. 73 B).

**legume**, the fruit-pod of the family *Leguminosae*, consisting of a single carpel, usually opening round the margin along both sutures into two halves.

*lenticellate*, having lenticels.

*lenticels*, corky spots on the bark, corresponding to the epidermal stomata.

*lepidote*, clothed with scales.

*lignified*, converted into wood.

**limb**, the upper usually expanded part of the calyx, or cololla, which is united in a cup or tube below.

*linear*, long and narrow with parallel edges.

*locular*, having cavities or compartments; *unilocular*, one-celled, *bilocular*, two-celled.

*loculicidal*, the cavities of a fruit dehiscent along the dorsal suture, thus each valve formed by the halves of two carpels (*Oldfieldia*, *Nesogordonia*).

*longitudinal*, in the direction of the length.

*looping*, of the nerves when they connect near the margin with distinct arches.

**margin**, the edge or boundary of a body (fig. 73 A).

*marginal*, placed upon or attached to the edge.

*marginate*, broad-rimmed, furnished with a margin of distinct character.

*medial*, *median*, belonging to the middle.

*membranous*, thin and semi-transparent.

**mericarp**, a portion of the fruit which splits away as a perfect fruit, as a rule formed by a single, (free) carpel as in *Pachypodanthium*, *Heritiera*.

– *nerous*, as suffixes, indicating numbers.

*mesocarp*, when the walls of a pericarp consist of three different layers, the middle one is the mesocarp; it is often fleshy or succulent.

*midrib*, the principal nerve in the blade (fig. 73 A).

*monadelphous*, the anthers united by their filaments into a single brotherhood.

*monocotyledon*, a plant having a single cotyledon or seed-leaf.

*monoecious*, when the male and female flowers are separate, but borne on the same individual plants, the converse of dioecious.

*monograph*, a systematic account of a particular taxon (a species, a genus, a family).

*mucous*, slimy.

*muco*, a sharp terminal point.

*mucronate*, ending abruptly in a short stiff point.

*multiovulate*, with numerous ovules.

*muricate*, rough, with short and hard tubercles or pointed protuberances.

*myrmecodomous*, affording shelter to ants.

*naked*, wanting its usual cover.

*narrowly* –, expressing that the length : width ratio of a flat body varies between 6 : 1 and 3 : 1; narrowly elliptic, narrowly ovate etc.

*nascent*, in the act of being formed.

*nectar*, a sweet fluid extruded from various parts of the plant; in the flower it is called honey.

*nervation*, the manner in which the foliar nerves are arranged.

*nerves*, the principal or more conspicuous ribs of a leaf which start from the midrib and diverge or branch throughout the blade; the smaller branches are veins (fig. 73 A).

*net-veined*, when the smaller veins are connected like the meshes of a net.

*node*, the point on the stem or branch at which a branch or leaf is borne (fig. 73 A).

*nomenclature*, the correct use of scientific names in taxonomy.

*nomen nudum*, a bare name without description.

*numerous*, in botany indefinite, not readily counted; the sign is ∞.

*nut*, a one-seeded indehiscent fruit, with a hard dry pericarp (the shell).

*ob*, as a prefix, means inversely or oppositely.

*obconical*, conical, but attached at the narrower end.

*oblique*, of a leaf when the two sides of the blade are unequal at base; slanting.

*oblong*, much longer than broad, the sides nearly parallel; length : width ratio = 5 : 2 to 3 : 2 (fig. 73 F).

*obovate*, ovate with the broadest part above the middle; length : width ratio = 5 : 2 to 3 : 2 (fig. 73 F).

*obtuse*, blunt or rounded at the end (fig. 73 D).

*oddly pinnate*, with a terminal leaflet, imparipinnate.

*opaque*, not transparent, dull, not shining.



*opposite*, of leaves or branches when two are borne at the same node on opposite sides of the stem (fig. 73 A).

*optimal*, the most advantageous for an organism or function.

*orbicular*, flat with a more or less circular outline.

*ovary*, the part of the pistil which contains the ovules and eventually becomes the fruit.

*ovate*, egg-shaped but flat, with the broadest part below the middle; length : width ratio = 5 : 2 to 3 : 2 (fig. 73 F).

*ovoid*, an egg-shaped solid.

*ovule*, the immature seed in the ovary before fertilization.

***palaeotropical***, (the tropical flora) of the old world, e.g. Africa and Asia.

*palmate*, lobed or divided into segments like the palm of a hand.

*palmati-nerved*, the nerves spreading from the top of the petiole in a palmate manner (fig. 73 A).

*panicle*, an inflorescence in which the axis is divided into branches bearing several flowers.

*paniculate*, having a panicle as inflorescence.

*papilionaceous*, applied to flowers with a butterfly-shaped corolla as in the sub-family *Papilionoideae*.

*papillate*, *papillose*, covered with minute, nipple-like protuberances.

*parietal*, borne on or belonging to a wall.

*paripinnate*, a pinnate leaf without an odd terminal leaflet (fig. 73 B).

*partite*, cleft nearly but not quite to the base.

*pectinate*, pinnatifid with narrow segments set close like the teeth of a comb.

*pedicel*, the stalk of each individual flower of an inflorescence.

*peduncle*, the general name for a flower-stalk bearing either a solitary flower or cluster, or the common stalk of several pedicellate or sessile flowers.

*pellucid*, translucent.

*peltate*, of a leaf of which the stalk is attached to its under-surface instead of to its edge.

*pendulous*, hanging down.

*pentamerous*, with parts in fives, as a corolla with five petals.

*perianth*, the floral envelopes, consisting of calyx or corolla or both.

*pericarp*, the wall of a ripened ovary; it may be formed by one layer, or more or less divisible into three layers: exocarp (outer layer), mesocarp (middle layer), and endocarp (inner layer).

*perigynous*, when the sepals, petals, and stamens are carried up around the ovary, but not attached with it (see also superior).

*perpendicular*, used of an organ with its direction vertical, either to the horizon, or to its attachment.

*persistent*, remaining till the part which bears it is fully matured, as the calyx on the fruit of *Ongokea*.

*petal*, one of the leafy, often coloured expansions in the floral whorl styled the corolla.

*petaloid*, resembling a petal.

*petiolate* having a petiole.

*petiole*, the stalk of a leaf (fig. 73 A).

*petioleule*, the stalk of a leaflet (fig. 73 B).

*phanerogams*, plant with flowers in which stamens and pistils are distinctly developed.

*pilose*, hairy with rather long, simple hairs.

*pinna*, a primary division of a pinnate or bipinnate leaf; in a pinnate leaf a pinna equals a leaflet, in a bipinnate leaf it equals a secondary rachis with the leaflets attached to it (fig. 73 B).

*pinnate*, of a compound leaf with the leaflets arranged along each side of the common rachis (fig. 73 B).

*pinnatifid*, with the margin pinnately cleft (fig. 73 C).

*pinnatilobed*, pinnately divided to about half-way the midrib (fig. 73 C).

*pinnatipartite*, pinnately divided almost to the midrib (fig. 73 C).

*pinnule*, a secondary division of a leaf which is twice pinnate (bipinnate), e.g. the leaflets of a bipinnate leaf.

*pistil*, the female part of the flower, formed by one or more free or connate carpels, consisting when complete of ovaries, styles and stigmas.

*pistillode*, a rudimentary ovary, present in some unisexual, male flowers.

*pith*, the spongy centre of a stem, chiefly consisting of parenchyma.

*pitted*, marked with small depressions.

*placenta*, the part of the ovary, sometimes but not always thickened or raised, to which the ovules are attached.

*plicate*, folded into plaits, usually lengthwise.

*pneumatophore*, breathing-root.

*pod*, a dry, dehiscent fruit, including (1) a legume, formed of a single carpel, and (2) a siliqua, which is two-celled, divided by a thin partition.

*pollen*, the fertilising dust-like powder produced by the anthers, more or less globular in shape.

*pollination*, the placing of the pollen on the stigma.

*poly-*, in Greek compounds = many.

*polygamous*, when a species has male, female and hermaphrodite flowers on the same or different individual plants.

*pore*, any small aperture, as in some anthers for the emission of the pollen.

*posterior*, next or towards the main axis; the reverse of anterior.

*prickle*, a sharp outgrowth from the bark, detachable without tearing the wood.

*primary*, (1) used of the part first developed, (2) the main division of a leaf.

*prominent*, standing out beyond some other part.

*proximal*, nearer to the place of attachment, the converse of distal (fig. 73 B).

*pseudo-*, in Greek compounds = false.

*puberulous*, shortly pubescent.

*pubescence*, the hairiness of plants.

*pubescent*, covered with short, soft hairs.

*pulp*, the juicy or fleshy tissue of a fruit.

*punctate*, marked with dots or translucent glands.

*pungent*, ending in a sharp, rigid point.

*pustulate*, having slight elevations like pimples or blisters.

***quadrangular***, with four corners.

***raceme***, an inflorescence in which the flowers are borne on pedicels along an individual axis or peduncle.

*racemose*, having racemes, or raceme-like.

*rachis*, a common axis on which the pinnae of a compound leaf are inserted (fig. 73 B).

*radial*, radiating as from a centre.

*radicle*, the rudimentary root of the embryo.

*receptacle*, the extremity of the peduncle or pedicel on which the parts of the flower, sepals, petals, stamens, and pistil are inserted.

*reduplicate valvate*, of aestivation when the edges are valvate and reflexed.

*regular*, actinomorphic, applied to flowers which may be bisected in more than one vertical plane.

*reniform*, kidney-shaped (fig. 73 F).

*reticulate*, net-veined, when the smallest veins of a leaf are connected like the meshes of a net.

*retuse*, notched.

*revolute*, of a blade having the margins rolled backwards towards the midrib.

*rhombic*, shaped like a rhomb, an equilateral oblique-angled figure (fig. 73 F).

*riparian*, pertaining to the banks of a river.

*ripple marks*, the effect of fine, parallel, horizontal lines in the tangential section of wood or bark, caused by the storied structure of all the wood and bark elements, or by the distribution in horizontal layers of the medullary rays (wood rays and bark rays) only.

*rudimental*, arrested in an early stage of development.

*rufous*, reddish, of all shades.

*rugose*, wrinkled.

*ruminate*, of endosperm marked by transverse lines or divisions owing to infolding of the inner layer of the seed-coat into the paler endosperm causing a marbled or mottled appearance (*Annonaceae*, *Myristicaceae*).

***sagittate***, of the base of a leaf with two acute straight lobes directed downwards (fig. 73 E).

*samara*, an indehiscent, one-seeded fruit provided with a wing (*Heritiera*).

*sapling*, a young tree, the stage next to a seedling.

*sapwood*, the new wood of a tree, so long as it is pervious to the flow of water, often distinct in colour from the (see) *heartwood*.

*sarmentose*, with long, slender branches.

*savanna*, xerophilous grassland containing isolated trees.

*scabrid*, rough to the touch, usually from the presence of very short, harsh hairs.

*scales*, (1) reduced leaves, usually sessile and scarious; (2) a kind of indumentum in the form of small, flat disks attached by the centre; (3) thin pieces of bark.

*scaly*, having an indumentum formed by scales, or with numerous scales.

*scar*, a mark left on a stem by the separation of a leaf.

*scarious*, thin and dry, not green.

*scattered*, without apparent order.

*secondary formation*, those formations which have arisen through human interference.

*section*, an important division of a genus.

*seedling*, the young plant which develops from a seed.

*segment*, a part or division of an organ.

*semi-*, in Latin compounds = half or nearly.

*semi-deciduous*, between evergreen and truly deciduous.

*sepal*, one of the, often green coloured, expansions of the floral whorl styled the calyx.

*septate*, divided by one or more partitions.

*septicidal*, when a ripe capsule splits along the lines of junction of the carpels, thus each valve formed by one carpel; each carpel then itself usually splitting down its ventral suture.

*sericeous*, silky, with closely appressed, soft straight hairs.

*series*, a row.

*serrate*, toothed like a saw, with regular, pointed teeth (fig. 73 C).

*serrulate*, serrate with minute teeth.

*sessile*, without a stalk.

*shell*, the hard envelope of a nut.

*shoot*, a young growing branch or twig.

*simple*, the opposite of compound; *simple leaf*, of one blade, not divided into leaflets;

*simple fruit*, one which results from the ripening of a single carpel or ovary.

*sinuate*, when the margin is uneven, with rather deep undulations.

*sinuous*, see *sinuate*; of a tree which is not straight but curved in various directions.

*slash*, the wound in the bark of a tree when cut with a cutlass.

*smooth*, not rough, the reverse of scabrous, free from hairs, glabrous.

*soli:ary*, single, only one from the same place.

*spatulate*, spoon-shaped, broadly rounded above and long and narrow beneath.

*species*, the unit in classification, the aggregate of all those individuals which have the same constant and distinctive characters.

*specimen*, a plant, or portion of one, prepared for botanic study.

*spherical*, relating to a sphere.

*spicate*, arranged in a spike.

*spicigerous*, bearing flower spikes.

- spike*, an inflorescence with the flowers sessile along a simple, undivided axis.
- spine*, a sharp, pointed, hardened structure, an outgrowth of the wood, the converse of a prickle.
- spinose, spinescent*, having spines.
- squamiform*, scale-like.
- stamens*, the male envelope in the flower, each stamen consisting of a filament and an anther.
- staminode*, an abortive or rudimentary stamen without a perfect anther.
- standard*, the large posterial petal (outside in bud) of a papilionaceous flower.
- stellate hairs*, hairs with several arms radiating horizontally.
- stigma*, the point or surface of the pistil which receives the pollen, either sessile (when there is no style), or on the top or surface of the style or its branches.
- stilt-roots*, the oblique or arched adventitious roots on the lower part of the bole above the ground (as in *Uapaca*, photograph 6).
- stipe*, the stalk supporting a carpel or gynaeceum.
- stipellae*, two small secondary stipules at the base of a leaflet (*Haplormosia*), or a pair of leaflets (*Amphimas*).
- stipitate*, supported on a special stalk.
- stipulate*, having stipules.
- stipules*, leaf-like, scale-like, or needle-like appendages of a leaf, usually at the base of the petiole.
- stoma* (pl. stomata), breathing pores in the epidermis.
- stratum* (pl. strata), layer; stratification, the differences in vegetation at different vertical levels.
- striate*, marked with parallel, longitudinal lines, grooves or ridges.
- style*, the narrow upper part of the pistil supporting the stigma.
- sub-*, a prefix implying somewhat, or slightly, e.g. subacute, somewhat acute, subopposite, of leaflets which are not exactly opposite.
- sub-family*, a group of genera within a family.
- subulate*, ending in a thin, sharp point; awl-shaped.
- sulcate*, grooved.
- superior*, of an ovary when the sepals, petals, and stamens are inserted below it (hypogynous); also when the receptacle bearing the calyx, corolla, and stamens is prolonged so as to be separate from the ovary, but forms a cup surrounding it (*perygynous*, as in many *Caesalpinioideae*).
- superposed*, vertically over some other part.
- suture*, the line of junction, or seam of union, commonly used of the line of opening of a carpel; dorsal suture (outer or anterior) of a carpel represents the midrib of the fruit-leaf; ventral suture represents the united margins of the fruit-leaf, on which the ovules and placenta are borne.
- symmetrical*, see *actinomorphic*.

*syn-*, adhesion or growing together; *syncarpous*, composed of two or more united carpels; *synpetalous*, the petals connate; *synsepalous*, the sepals connate.

*synonym*, a superseded or superfluous name.

**taxon** (pl. taxa), a natural group of plants, e.g. a family, a genus, a species etc.

*taxonomy*, classification.

*tepal*, a division of the perianth, sepal or petal, when these are not differentiated.

*terete*, cylindrical, circular in transverse section.

*terminal*, proceeding from or belonging to the end or apex.

*testa*, the outer coat of the seed.

*thecae*, anther-cells.

*throat*, the orifice of a synpetalous corolla.

*tomentellous*, shortly tomentose.

*tomentose*, densely covered with short and soft hairs.

*translucent points*, glandular cells in the blade which when held against a source of light shine through.

*transversely* -, expressing that the length : width ratio of a flat surface varies between 2 : 3 and 2 : 5.

*tri-*, in compounds meaning three or triple.

*tribe*, group superior to a genus but less than a family.

*trifoliate*, having three leaflets.

*trimerous*, of flowers with three sepals three, petals etc.

*truncate*, cut off more or less squarely at the end.

*tube*, any hollow elongated body or part of an organ.

*type specimen*, the original specimen from which a description was drawn up; *holotype*, the single gathering upon which alone a taxonomic group has been based, and indicated as such by the author; *isotype*, a duplicate of a holotype; *paratype*, other specimens used for the original description; *syntype*, when several specimens are cited with the original description, but the holotype is not indicated; *lectotype*, a type selected from the syntypes by a later author, the balance becoming automatically paratypes; duplicates of the lectotypes are isotypes.

**umbel**, an inflorescence in which a cluster of pedicels spring from the same point, like the ribs of an umbrella.

*unarmed*, destitute of prickles or other armature.

*undulate*, wavy on the margin (fig. 73 C).

*unilocular*, with one locule (cell).

*unisexual*, of a flower having stamens only or a pistil only.

*urceolate*, urn-shaped, with a short swollen tube, contracted near the top and then slightly expanded in a narrow rim.

*valvate*, when the edges of sepals or petals meet without overlapping.

*valve*, one of the parts produced by the splitting of a ripe fruit.

*vein*, a strand of vascular tissue in a leaf; the fine branches of the nerves (fig. 73 A).

*velutinous*, velvety.

*venation*, arrangement of the veins on the blade.

*venose*, having veins.

*ventral*, the inner face, or the surface towards the axis; *ventral suture*, see suture.

*ventricose*, swollen or bulging on one side.

*verrucose*, warty.

*versatile*, of an anther attached by its back to the very tip of the filament so as to swing loosely.

*verticillate*, of leaves in a whorl, or several arising from the same node arranged regularly around the stem.

*vicarious species*, closely related species found under similar ecological conditions but in separated geographical areas.

*villous*, beset with long, weak hairs.

*wart*, a hard or firm excrescence.

*water shoot*, an often sappy shoot, mostly from the base of a tree.

*waxy*, resembling beeswax in consistence or appearance.

*whorl*, see *verticillate*.

*wing*, (1) any flat membranous expansion; (2) one of the two lateral petals of a papilionaceous flower.

*wood ray*, the rays in the wood passing radially outwards, derived from the cambium.

*zig-zag*, flexuous, or bent alternately in opposite directions.

*zygomorphic*, see *irregular*.

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