REIN WARD TIA
Published by Herbarium Bogoriense, Kebun Raya Indonesia
Volume 2, Part 1, pp. 1 - 68 (1952)

SERTULUM DIPTEROCARPACEARUM MALAYENSIUM—V*

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The Dipterocarpaceae of eastern Malaysia (Celebes, the Moluccas, and New Guinea)

Some 70 years ago Thiselton Dyer showed Dipterocarpaceae from New Guinea to the Linnean Society of London. This event is referred to in the "Journal of Botany"[1] as follows:—

"Mr Tbiselton Dyer exhibited the *Dipterocarpaceae* collected by Beccari on his visit to New Guinea in 1872. These were only three in number, an extremely poor result compared with the extraordinary abundance and variety in the forms belonging to this family previously collected by the same botanist in the adjacent island of Borneo, . . . The Dipterocarpaceae being, perhaps, the most characteristic family of the Indo-Malayan Flora, the poverty of its representation in New Guinea was a conclusive proof that its vegetation was not a markedly Malayan type."

In addition to the data relating" to the Dipterocarpaceae of New Guinea to be found in literature in scattered references, surveys were given by Diels[2] in 1922 and by Van Slooten[3] in 1926.

Starting from the geographical distribution of the Dipterocarpaceae, E. D. Merrill in a comprehensive publication[4] traced the former land routes along which an exchange of floral elements might have taken place from western to eastern Malaysia.'" As to the Dipterocarpaceae he reached the conclusion that this exchange had not taken place directly *via* Celebes, but *via* the Philippines, i.e. from and to Borneo across the Sulu and Palawan bridges, from and to Celebes *via* the Sangi (Sangihe) Islands, and from and to Halmahera and New Guinea *via* Celebes or Talaud Island.*[1]

*The following parts already appeared in this series: I, *in* Bull. Jard. hot. Buitenzorg III 16: 430-454. 1940; II, *in* Bull. bot. Gdns Buitenzorg III 17: 96-138. 1941; III, *ibid.* 17: 220-255. 1942; IV, *ibid.* 18: 229-269. 1949.

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1.J. of Bot. 16: 93-94. 1878.

2.Die Dipterocarpaceen von Papuasien. *In* Bot. Jb. 57: 460-463. 1922.

3. Dipterocarpaceae. *In* Nova Guinea 14 (2): 222-228 *pi. 19.* 1926.

4. E. D. MERRILL: Distribution of the Dipterocarpaceae. Origin and relationships of the Philippine flora and causes of the differences between the floras of eastern and western Malaysia. *In* Philipp. J. Sci. 23: 1-32. 1923.

[5]In the present paper 'eastern Malaysia' does not cover more than the eastern' part of the" former Netherlands East Indies, exclusive of the Philippines and the Lesser Sunda Islands.

°In my opinion the distribution of the recent species does not point to the possibility that "a few came from Java through Bali, Lombok, and what are now the Postilion and Paternoster islets to southwestern Celebes." (Merrill, *op.cit.* p. 21).

Merrill gives a detailed account of how the Dipterocarpaceae have developed as a family in South-East Asia and in western Malaysia at a time when the Sunda Islands still formed part of the Asiatic continent. At that period they could easily spread across this continent. Starting from this extensive central area, the Sunda Land, they spread eastwards, where they are far less numerous than in the west, in spite of the fact that conditions in eastern Malaysia on the whole meet the requirements of the Dipterocarpaceae. Merrill now concludes that geological history shows that the Dipterocarpaceae were unable to cross the sea east of Borneo, and could only make use of the bridges referred to above.

Since Merrill's publication, Herbarium Bogoriense has been supplied with new material from eastern Malaysia. Though scanty and in many cases incomplete and not to be determined as to species, it nevertheless clearly demonstrates that—with the exception of *Anisoptera costata {q.v.)* •—Merrill's view still holds good; the ratio of the number of species from western Malaysia to that from eastern Malaysia has remained the same, those from western Malaysia having continued to be in the great majority. With the exception of *Anisoptera costata* and *Vatica papuana*, all of the species treated below are restricted to eastern Malaysia. The Philippines show an endemism of approximately 70%. This phenomenon, too, points to an immigration from the west and to conditions favouring 'regeneration.'

I do not intend, however, to elaborate this theoretical problem in the present publication, the primary aim of which is to define the species From eastern Malaysia taxonomically. For this reason I precede the main subject only by the mention of a number of facts and conclusions which have emerged from my studies. In the accompanying table the genera were arranged alphabetically, the species geographically, according to Their occurrence from west to east. The well-known species were numbered and so were those which, owing to insufficient material could not yet be described , but could nevertheless with a high degree of certainty be recognized as independent species. In order to give as complete as possible a survey of the Dipterocarpaceae of eastern Malaysia, an enumeration of the material which is too incomplete for identification and description ("specimina inquirenda") was also added, but not numbered.

In eastern malaysia ,the Dipterocarpaceae appear to be represented by four genera,viz *Anisoptera, Hopea, Shored*, and *Vatica*. The number of species considered adequately founded is 26, although 7 of them could not yet be described owing to incompleteness of the material and hence

TABEL 1

The Dipterocarpaceae of Eastern Malaysia

Celebes	Moluccas	New Guinea
1. *Anisoptera costata*	1. *Anieoptera costata* 2. *Anisopttra polyandra*	
	3. *Anisoptera?spec.nov.*: Kostermans 1337	
		Anisoptera sp,: Beccari s.n. *Anisoptera sp.*: bb.22351 *?Anisoptera sp.*: bb.31344
4. *Hopea celebica* 5. *Hopea dolosa* 6. *Hopea gregaria*		
	7. *Hopea ?spec. nov.*: bb.24903	
	8. *Hopea ?spec. nov.*: bb.25259 and 25320	
		9. *Hopea nodosa* *Hopea parvifolia* *Hopea sp.*: Beccari a.n. 10. *Hopea nabirensis* 11. *Hopea iriana* *Hopea sp.*: bb.30359 12. *Hopea similis* 13. *Hopea novoguineensis* 14. *Hopea papuana* *Hopea celebica sensti* JDiels *Hopea papuana seyisu* White & Francis 15. *Hopea ?spec. nov.*: NGF 1251 *Hopea sp.*: NGF 1307 16. *Hopea glabrifolia*
	Hopea or *Shorea sp.*: Kostermans 828	*Hopea* or *Shorea sp.*: NGF 1333
17. *Shorea koordersii*	18. *Shorea selanica* 10. *Shorea montigena* 20. *Shorea fspec. nov.*: bb.228O8 and 31349	
		21. *Shorea fspec. nov.*: bb.22567 *Shorea sp.*: bb.31092 22. *Shorea forbesii*
	23. *Vatica papuana*	
Vatiea sp.: bb.32438 24. *Vatica celebensis* 25. *Vatiea flavovirens* *Vatica sp.*: bb.1860, 1888, 1904, 1913, and 1920 *Vatica* sp.: bb.30172 28. *Vatica fspec. nov.*: Pella 62 *Vatica* sp.: bb.14540		

are provisionally listed as " *?spec. nov."* They are distributed over the genera as follows:

Anisoptpya	2 + 1 *?spec. nov.*	*Skorea*	4+2 *?spec. nov.*
Hopea	10 + 3 *?spec. nov.*	*Vatica*	3 + 1 *fspec. nov.*

There are also bound to be new species among the remainder of the *msteria).*

In the following, the accompanying table is further elucidated.

CELEBES .—*A nisopte ra.*—Represented solely by *A. costata,* which is restricted to the Malili District in the southernmost part.

Hopea.—Also occurring exclusively in the southern part, but on the western *(H. celebica)* as well as on the eastern peninsula *(H. dolosa* and *H. gregaria).*

Shore a.—Shorea koordersii is known from five localities, from all parts of the island.

Vatic a.—Most probably represented by some seven species, occurring in North, Central, and South Celebes.

MOLUCCAS.—*Anisoptera.—Anisoptera costata* and *A.polyandra* are restricted to Halmahera and Batjan, and Obira and the Aru Islands, respectively. On Morotai a third species appears to occur.

Hope a.—This genua is also represented by only two, as yet not further to be described, species, also in Halmahera and on the Aru Islands. A third species (or *Shorea?)* seems to be restricted to Morotai.

Shore a.—Shorea koordersii and *S. selanica* are very common in the central part of the western Moluccas. *Shorea montigena* is restricted to Buru and western Ceram, a sterile collection showing a fourth species to occur, also on Buru.

Vatic a.—Only *V. papuana,* in the northern half and on the Aru Islands.

NEW GUINEA.—*Anisoptera.*—Only *A.polyandra* is here widely distributed and is found to extend as far as the easternmost point. *Anisoptera costata* is known only from the Bomberai Peninsula in the western part, together with a third species of *Anisoptera,* a fourth species probably occurring in the Arfak Mountains and a fifth in the'surroundings of Hollandia.

Hopea.—Of the four genera the one most widely represented, by at least eight species , possibly by more. The species are scattered throughout the island and are found even in the Louisiade Archipelago. The majority of them, however , are (so far) known from only one locality.

Shore a.—Unlike *Hopea,* represented by only three species: a probably new species in West New Guinea, an as yet not to be described species in Central New Guinea, and *S. forbesii* in East New Guinea.

Vatic a.—*Vatica papuana* is found from the extreme west to the extreme east, including the Louisiade Archipelago.

From these surveys a few general conclusions may be drawn:

(i) Celebes, and to a lesser degree also the Moluccas, are poor in Dipterocarpaceae.

(ii) From Celebes only some eight localities are known. In this island there would seem to be distinct centres of distribution.

(iii) As far as the Moluccas are concerned, it is in the northern Moluccas that relatively the greatest number of Dipterocarpaceae are found. In the Sula Archipelago, on the islands south of Halmahera, and on Buru, *Shorea koordersii* and S. *selanica,* are (together with *Vatica papuana)* the predominant Dipterocarpaceae. Dipterocarpaceae are also found in the Aru Islands.

(iv) In contradistinction to Celebes, Dipterocarpaceae are in New Guinea found throughout the island. Here they extend from west to east, be it that one single species is widely distributed *(Anisoptera polyandra, Vatica papuanu),* or that one genus is represented by several species *(Hopea).*

(v) Together with *Anisoptera costata,* the two species mentioned sub (iv) are the only Dipterocarpaceae with an extensive area of distribution. *Anisoptera costata* extends farthest west, where it has its main distribution: Siam, Malay Peninsula, Sumatra, Borneo, and eastern Malaysia; *Vatica papuana* has its principal distribution *within* eastern Malaysia, but is, *with the exception of Celebes,* also met with in North and North-East Borneo, inclusive of Tawitawi. These are the only species found also outside eastern Malaysia. *Anisoptera polyandra* is limited to the Moluccas and New Guinea. These three are followed by *Shorea koordersii* from Celebes, the Sula Archipelago, Batjan and Obira, and the islands in between.

(vi) The remaining species are known from only one or two, or at most three localities.

(vii) *Anisoptera costata* excepted, the Dipterocarpaceae from eastern Malaysia are undoubtedly purely eastern species. The presence of *Vatica papuana* in North-East Borneo and on the adjacent island of Tawitawi (belonging to the Philippine Archipelago) may be assumed to be due to the fact that its fruits (which are often found floating in the sea) are distributed by currents. Even so the question remains why Celebes was 'skipped.'

(viii) None of the Dipterocarpaceae from eastern Malaysia, not excepting those which, owing to insufficient material can not yet be described, are to be identified with species from the Philippine Archipelago, if *Vatica papuana* is left out of consideration. The species from eastern Malaysia relatively most closely related to one from the Philippines, is *Anisoptera polyandra,* which is nearest to *A. thurifera.* Leaving *A. eostata (q.v.)* out, it appears safe to share Merrill's view that the Dipterocarpaceae of eastern Malaysia have indeed found their way there *via* the Philippines. This applies, however, only to the *genera* which in eastern Malaysia—and also at an earlier date in the Philippines themselves, for that matter—found a basis for 'regeneration.' Judging by the *number* of species, in particular as far as *Hopea* is concerned, conditions have evidently been more favourable in the direction of New Guinea than further west in the Moluccas and in Celebes.

(ix) In the Philippine Archipelago the Dipterocarpaceae are represented by some 50 species, 35 of which are endemic. All of the non-endemic species have their area of distribution in western Malaysia, *Vatica papuana* excepted. It may hence be readily assumed that the Dipterocarpaceae element in the Philippine flora has been introduced from the west, and has in the Philippines found the opportunity of developing in a definite direction. Compared with the main area of distribution of the Dipterocarpaceae around the Chinese Sea, where hundreds of species occur, the Philippine flora is poor in species. The number of Dipterocarpaceae decreases even further towards the east. Since in New Guinea three out of the four genera are found scattered throughout the island, it is to be expected that further exploration and reclamation will result in substantial additions as to the localities as well as the number of species, particularly of the genus *Hopea.*

(x) Although the number of their species is far below that of the western part of Malaysia, the Dipterocarpaceae are nevertheless often locally very numerous in eastern Malaysia. Occasionally they even grow gregariously or serm'gregariously: *Anisoptera eostata* in the Malili District of South Celebes and in the Weda District of Halmahera, *A. polyandra* in South and East New Guinea, *Hopea gregaria* in the Kendari District of South Celebes, *Shorea selanica* on Buru and the Sula Islands, *Shorea ?spec. nov.* (bb.22808 and 31349) on Buru, and *Vatica papuana* on Morotai, Batjan, and in New Guinea.

(xi) The great majority of the localities are situated at 500 m at most, and often much lower. There are relatively few exceptions, viz.

1100 m : *Anisoptera polyandra* (Schlechter 19859) in eastern New Guinea.
400–1000 m : *Shorea monitigena* on Bum and Ceram.
300–1000 m : *Vatica spec,* (bb.1860, etc.) in the Malili District (Celebes).
900 m : *Shorea forbesii* (Forbes 861) in eastern New Guinea.
850 m : *Hopea celebica sensu* Diels (Lederman 9586 and 9846) in -eastern New Guinea.
800 m : *Hopea spec,* (bb.30359) on Japen Island.
750 m : *Shorea tspec. nov.* (bb.22567) in western New Guinea.
600 m : *Anisoptera polyandra* (Forbes 373 and Lane-Poole 223)
Hopea spec. (Lane-Poole 113)
} in eastern New Guinea.

(xii) As is to be expected those genera are represented in New Guinea which most easily spread eastwards. As was already stated *Hopea* is the unrivalled first in this respect. In the easternmost corner and/or still further east in the Louisiade Archipelago are found *Anisoptera polyandra, Hopea glabrifolia, H. papuana, Hopea spp., Shorea forbesii,* and *Vatica papuana.*

In a few instances *(cf. Hopea dolosa, Shorea koordersii,* and *S. selanica)* references are found below to two publications, cited as "Harsonderzoek" by Dr. F. H. Endert and "Herkomst Damar." The first appeared as "Korte Mededeeling van het Boschbouwproefstation No. 51" in 1935 and simultaneously in "Tectona," volume 28, in the same year, under the title: "Het harsonderzoek in Nederlandsch Indie, meer in het bijzonder der damarsoorten"; the second contribution was published under the title: "De botanische herkomst van damar," in the form of a "Voorloopig Rapport van het Boschbouwproefstation No. 5" ("Voorloopig Rapport No. 2 van de Afd. Bosehexploratie") in September 1937. See further the "Bulletin of the Botanic Gardens, Buitenzorg," series III, volume 18 (1949), pages 229 and 230.

NGF-numbers refer to the Queensland Herbarium of the Botanic Gardens, Brisbane.

After my return to The Netherlands from Indonesia I had the opportunity to make some corrections and additions in the manuscript of the present paper on the basis of the collections of the "Rijksherbarium" at Leyden and not in the least of those of Beccari. Specimens collected by that explorer were sent on loan by the Botanical Institute at Florence through the kind intermediance of Prof. Dr. C. G. G. J. van Steenis. I am very much indebted to the Directors of these institutes for their co-operation.

ANISOPTERA Korth.

1. ANISOPTERA COSTATA Korth.

Anisoptera costata Korth. (1839-42); Van Slooten *in* Bull. Jard. hot. Buitenz. Ill 8: 7-11 *fig. 1.* 1926. — *Adde:* Thorenaar in Meded. Proefst. Boschw. Buitenz. 16: 106 *fig. 15.* 1926; Heyne, Nutt. PL Ned. Ind., 2nd Ed., 1098. 1927; Foxworthy in Mai. For. Eee. 10: 97. 1932; Symington *in* Gdns' Bull., Str. Settl. 8: 9 *pi. 3A.* 1934; Van Slooten *apiid* Holthuis & Lam *in* Blumea 5: 214. 1942; Symington *in* Mai. For. Rec. 16: 204 *fig. 101.* 1943.

In 1926 only one collection of *A. costata* from eastern Malaysia could be mentioned by me, viz. Lam 3533 (Morotai). Now the species is known from South-East Celebes, the Moluccas (Morotai, Halmahera, and Batjan) and western New Guinea.

SPECIMENS EXAMINED (intra limital).—CELEBES. South-eastern peninsula: Malili District *{bb.20045, 23910, 32468,* and *32611,* baoti; *bb24493* tolu).

MOLUCCAS. Morotai: G. Sabatai *(Lam 3533,* bolam); G. Baru *(bb£i552,* kora; *bb.246Ol,* hate besi). — Halmahera: Tobelo District *(23748,23754,, 23756,* and *23758,* kora or hirus); Weda District *(bb.2iS65,* kokodaka; *bb.24913,* owiru; *bb.24938,* kako). — Batjan: Saoran Domut *(bb.23163,* damar utan or asomban; *bb23171* gawi; *bb23175,* wewe perempuan); Masurung *{bb23123,* bohe; *bb23140,* damar hiru).

NEW GUINEA. Western part: Bomberai Peninsula, Babo *(bb.32692,* tairi).

The vertical distribution in eastern Malaysia shows the same altitudinal range as in the western part, it being usually between sea level and 200 m, and also exceptionally reaching 500 m, as is the case on Pulau Batjan (bb.23123 and 23140). Locally the species is rather or very common, usually growing in scattered specimens, and even semigregariously (bb. 24493), which is also in agreement with western Malaysia.

The only two Dipterocarpaceae also to be found outside eastern Malaysia are *Anisoptera costata* and *Vatica papuana. Anisoptera costata has,* in fact, contrary to *Vatica papuanci, its principal distribution outside this region wild can be counted among the Dipterocarpaceae which have the widest distribution altogether.* In order to show this conclusively I append a map (fig. 1) of the complete distribution of *A. costata.* This map shows that it may be found from the Burmese border in Siam, in the Malay Peninsula, in western Malaysia, up to the Moluccas and western New Guinea. (The identifications of the only specimen known from West Java and of that from Sarawak are rather doubtful. For the latter, see p. 10).

There are other Dipterocarpaceae in South-East Asia which have their principal region of distribution in western Malaysia, none of them however extending as far eastwards as *A. costata.* The species of Diptero-

carpaceae meant here are three in number, viz. *Dipterocarpus gracilis* Bl., *D. hasseltii* BL, and *D. grandiflorus* Blanco. They do extend fairly far eastwards, even to the Philippines, but within the Malay Archipelago they do not reach beyond Java and Borneo.

FIG. 1. Distribution of *Auisoptera costnta* Korth.

I have purposely added this outline of the distribution of *A. costata*. because it requires an explanation on a few points. As this can be given more fully only within an all-over review of the distribution of Dipterocarpaceae in Malaysia as a whole, I want for the present to stress only the following facts.

Above all I should like to point out the rather peculiar distribution of *A. costata* in Borneo. Had this species been restricted to this island, there would have, been nothing puzzling in the fact it occurs there only in the whole of the eastern and in the central part of the extreme South of Borneo. In connection, however, with the further distribution in Malaysia the fact that the species occurs 'locally' on Borneo should considerably help to explain how the distribution of *A. costata* came about and consequently to establish the place of origin of this species.

In view of several facts it can be assumed that the locality of origin of the Dipterocarpaceae lies in the region which is now occupied by the South China Sea. In connection with *A. costata* one may assume that of this region only the southernmost part is to be taken into consideration, viz. that part which is surrounded by the Malay Peninsula and the Greater Sunda Islands, i.e. Sumatra, Java, and Borneo. The occurrence of the species in Siam might then be explained by immigration from the south.

Even if along these lines an acceptable explanation of the distribution of *A. costata* in western Malaysia can be found, the occurrences in eastern Malaysia may be much harder to explain. There are neither northern nor southern links which could be considered, as *A. costata* is absent in those regions through which it could have passed, unless *A. mindanensis* Foxw. from the Philippines should prove to be identical with *A. costata.* Synonymy in this case does not seem impossible to me, as the description does not show any important differences. I do not have sufficient material for comparison, however, to be able to make any definite statement. In addition, in *A. costata* the leaves seem to be rather variable in form, size, and *(in sicco)* colour, which is not surprising considering its wide distribution. However, *A, costata* could in this case, in the form of *A. mindanensis,* have used the Philippines and one of the northern routes for its distribution eastward. Otherwise we must assume that *A. costata* has somewhow emigrated to the east without using the Philippine Archipelago as a link. 1 should like to refer here to Dr. Van Steenis' monograph on the Styracaceae[7] in which in connection with the genera *Styrax* and *Bruinsmia* he also has to assume them to have somehow crossed the Macassar Strait directly on their way east.

In 1926 (Van Slooten, *op. cit.* p. 10) I suggested that *A. grandiflora* Brandis *(in* J. Linn. Soc, Bot. 31: 43 *pi. 2 fig. 29.* 1895) might prove to be synonymous with *A. costata* korth., but Symington *(op. cit.* p. 13) was of the opinion that it is based merely on a large-leaved collection of *A. marginata* Korth. "This is, however," he wrote (p. 14), "difficult to prove because these two species are essentially similar in flower structure, the best diagnostic character being the more numerous veined and more pubescent leaves of *A. costata."* After having studied in the Herbarium at Leyden the duplicate specimen of Haviland 959, collected near Kuching, Sarawak, I am still not convinced that in this case we are really dealing with *A. marginata,* although the latter species is also known from West Borneo, and *A. costata* is not. In view of the distribution areas Symington

'C. G. G. J.VAN STEENIS: The Styraeaeeae of Netherlands India. *In* Bull. Jard. bot Buitenz. Il1 12: 254-265. 1932.

might be correct. However, in my opinion, the kind of hairiness on the lowep surface of the leaves reminds one rather of *A. costata.* Together with Haviland *s.n.* in the Sarawak Museum (fruiting Feb. 26, 1893), Haviland 959 is the only material of *Anisoptera* I know from Sarawak. Additional collections are highly desirable. As long as these are not available the correct position of *A. grandiflora* remains uncertain.

The specimen from New Guinea (bb.32692), lacking flowers and fruits, has extraordinarily large leaves (up to 25 by 16 cm). It is from a young tree, but the determination seems to me nevertheless to be sufficiently reliable.

"When treating *Anisopte-ra* Korth. on a former occasion (Van Slooten, *op.cit.* p. 8), I stated: "The manuscript-names *Dipterocarpus parallehis* Korth., *D. tampurau* Korth. and *Dryobalanops Hallii* Korth., recorded by Burck as synonyms of *A. costata,* I was not able to find either in the specimens of Herb. Bog., nor in those of H.L.B. or of H.A.R.T." Apparently I had at that time not received on loan all the Leyden material; last year I came across three sheets, numbered 902,146-40 and -43 and 925,250-338. On the two first mentioned Korthals wrote the name *Dipterocarpus tampoerau* Korth., while on the third sheet the names *Dipterocarpus parallelus* Korth. and *Dryobalanops Hallii* Korth. are written, also in his handwriting. Numbers 902,146-43 and 925,250-338 are fruiting specimens of *A. costata.* We are dealing here with three herbarium names. — It follows from the denomination *Dipterocarpus tampoerau,* that Korthals himself—doubtlessly because of the incompleteness of the material—had no clear conception of the true *D. tampurau* Korth. (cf Van Slooten, *op.cit.* 8: 290 *fig. 1.* 1927), with which this herbarium name should not be confused.

2. ANISOPTERA POLYANDRA Bl.

Anisoptera pol-yavdra El. (18521; Van Slooten *in* Bull. Jard. bot. Buitenz. Ill 8: 15. 1926, excl. syn. *Avisoptera spec.nov.* Dyer. — *Adde:* Lane-Poole, Report For. Resources Terr. Papua and New Guinea 22, 33, 119, & 167. 1925; White & Francis in Proc. roy. Soc. Queensl. 38: 247. 1927.

The following addition might be made to my previous description:

The leaves may be as large as 20.0—25.0 by 10.0—11.0 cm; in saplings the main nerves may be 20 pairs and the petioles may reach a length of 5.5 cm; the subspherical fruiting calyces exceptionally attain 1.8 cm in diameter and the enlarged lobes 12.0 by 2.5 cm in size.

Anisoptera polyandra is a large tree up to 50 m high, with a clear *bole* up to 20—30 m, with good form and even taper (large trees almost

cylindrical), at the base channelled or with root swellings. The *bark* is grey or grey-brown, longitudinally fissured and tending to form scales; the inner bark is reddish, exuding a gum when cut. The *sap wood* is (pale) straw-coloured, the *heartwoord* (very) pale brown with narrow, concentric, pinkish bands. The wood has a resinous odour and a pale watery-white coloured gum exudes slowly from it and is also present in old wounds in the bark. The species "yields copious supplies of a very inferior gum" (Lane-Poole, *op. dt.* p. 167). *Leaves* bright green above, the younger ones (almost) golden beneath, the older ones a duller shade of brown or merely greyish. — Flowering specimens are known from the months of April, July, and August, fruiting ones, from March and from June to September.

Anisoptera polyandra occurs throughout New Guinea, even in the Eastern Division of Papua (Milne Bay) and so *belongs to the most eastwards extending Dipterocarpaceae* (fig. 2). We find it in primary forests

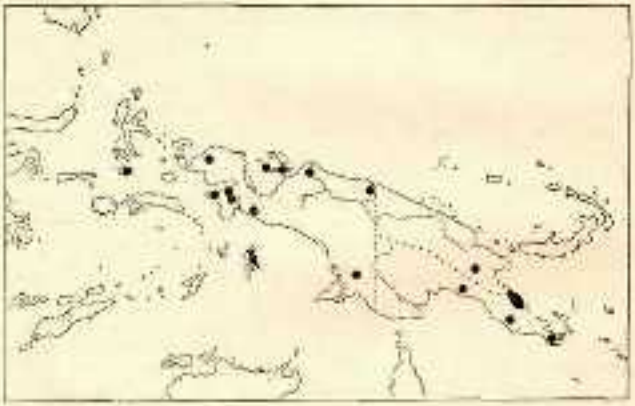

FIG. 2. Distribution of *Anisoptera polyandra* Bl.

where it can be the largest tree in its locality. It grows on clayey, sandy, or calcareous, even stony soil on level, never inundated ground as well as on tops and slopes of ridges and mainly on the spurs. Only a few times it is recorded as having its habitat on a bank. It has been found at a maximum altitude of 600 m, with one exception, as Schlechter (19859)

collected it also at an elevation of 1100 m; the tree, however, mainly occurs between 10 and 200 m above sea level. Generally it is (very) common in its habitat, but it usually grows in scattered specimens or with few specimens together. Lane-Poole records *(op. cit.* pp. 33, 167) that the karawa is very common in the Northern Division of Papua and especially in the Bunda District: it forms *(op. cit.* p. 119) "a social-two-species-forest with *Afzelia bijuga* in the foot-hills of the Hydrographer's up to 1,000 feet; above that it is more scattered, and *Afzelia.* does not occur." According to Schlechter 19859 they are "maehtige Baume, stellenweise massenhaft," according to Zippelius they are "in Massa vorhanden" near the Triton Bay. Brass (no. 9000) calls it a "common canopy tree in rainforest of ridges."

SPECIMENS EXAMMtD.—MOLUCCAS. Obi Is.: P. Obira, Kasina *(bb.23804,,* kora). — Am Is.: P. Kobroor *(bb.253t9,* jamar); P. Wokam *(bb.25280,* doka).

NEW GUINEA. Western part: "Vogelkop," Amaroe Lake *(bb.22148,* avan marei) ; Onin Peninsula, Pikpik *(bb.22244,* wuhu), Bomberai Peninsula, Agonda *(bb. 22328* and *223i8,* taire and damar papan respectively), Argoeni Bay, Rauna *{bb.22558,* damar papan), Triton Bay, Mt. Lihminsir *(Zippelius s.n.* in Herb. Lugd. Bat. sub nos. 902, 146-52 and -59 to -64 incl., *type);* Mios Noem (island) *(bb.30931, 30932,* and *30970,* taai); Japen I. *(bb.30388,* baurai; *bb.30i02,* maniuri; *bb.30472,* armaniuri; *bb.30644* and *30652,* kansiopi; *bb.30675,* ansiopi); Mamberamo R. basin, "Pionier-bivouac" *(bb.31067,* merait); Hollandia *(bb.14568,* kandau; *bb.2501,6, 25063,* and *25652; Brass 9000);* Digoel, 20 km NNE *(Witkamp s.n.),* — Eastern part: Jaduna *(Schkchter 19311; fide* Diels *in* Bot. Jb. 57: 461. 1922); Maboro, 1100 m *(SMechter 198S9; fide* Diels, *I.e.):* Morobe *(NGF 8SS,* "in alluvial silt on flat"; *NGF 133* and *1250)* ; Vailala R. (Lane-Poole, *op. cit.* pp. 32, 33, 119, karalaka); Buna on the Ambogi R. *(Lane-Poole 136,* garawa); forests between Pernambata and Embi in tbe Hydrographer's Range to 600 m *(Lane-Poole 228,* karawa or warawa); Embi Lakes, inland from Buna *(NGF 1266,* balia) ; Sogeri region, 600 m *(Forbes 373, type* of *A. forbesii; Forbes 730,* Mt. Wori-wori) ; Milne Bay area, on "an ironstone-gravel capped ridge in comparatively open forest" *(NGF 1296,* porluma or baridfl; *NGF 1297,* ord'-ma or barida; *NGF 1301,* barida).

3. ANISOPTEEA ?SPEC. NOV.

SPECIMEN EXAMINED.—MOLUCCAS. Morotai: Songowo R., 50m *(Kostermavs 1387;* common, growing in scattered small groups; tree 35 m high with a greyish coloured bole). — Leaves only.

The brownish leaves are densely covered with coarse, stellate tufts of rather long hairs on the midrib, nerves, and veins on the lower surface. The young parts of the branches bear a dense tomentum of the same kind. The pairs of main nerves are about 15—18 in number. The petioles are 2.5—3.0 cm long and densely stellate-tomentose. On account of this pubescence I am rather sure that this collection represents a new species, distinguishable from the four species from the Philippines. — Fig. 3.

Specimina inquirenda

ANISOPTERA SPEC.

SPECIMENS EXAMINED.—NEW GUINEA. Western part: Arfak Mts. *{Beccari s.n.*, 'type' of *Anisoptera spec.nov.* Dyer; in Herb. Univ. Florent., no. 1517 of Beccari's herbarium). — Broken fruits only.

Previously (Van Slooten *in* Bull. Jard. bot. Buitenz. Ill 8: 15. 1926) I regarded this specimen as belonging to *A. polyandra* Bl. After having received it from Florence, I find that some caution seems to be called for. The accrescent calyx-segments, the longest of which reaches 10 cm in length and which are at most 1.3 cm wide, are characterised on both sides by a dense indumentum of faintly shining, brown gland- or scale-like emergences which make a different impression from the scale-like indumentum characteristic of the lower leaf-surfaces of *Anisoptera.* These elements of the covering, by their density and their colour, render the sparse star-shaped hairs hardly detectable.

I incline to believe that, when more material will become available, the indumentum as just described may furnish more important differences with *A. polyandra* than the length of the calyx segments emphasized by Dyer *(in* J. of Bot. 16: 99. 1878).

For these reasons I prefer to keep this material apart again from *A. polyandra* for the time being. — Fig. 3.

ANISOPTERA SPEC.

SPECIMEN EXAMINED.—NEW GUINEA. Western part: Bomberai Peninsula, Tovui, in primary forest on dry, hilly ground on clay *(bb.22351,* taire; rather common, although growing scattered). — Leaves only.

Not to be identified with one of the two species of *Anisoptera* known from New Guinea. Slightly resembles *A, marginata* Korth. but differs in the larger leaves which are greenish or yellowish brown below when dry. Perhaps to be compared with *A. aurea* Foxw. from the Philippines, though the main nerves are less in number and the petioles shorter. — Fig. 3.

?ANISOPTERA SPEC.

SPECIMEN EXAMINED.—NEW GUINEA. Western part: Hollandia, "Pionier-bivouac" in the Mamberamo R. basin, along rivulet in primary forest on dry, level land on stony soil, 30 m *{bb.31344,* wapei; young tree 15 m high). — Leaves only.

This sterile collection impresses me as a species of *Shorea,* but may be an *Anisopteru* although the minute scales on the underside of the

leaves, which are typical of this genus, are not so pronounced as is usually the case in *Anisoptera.* — Fig. 3.

FIG. 3. Distribution of *Anisoptera ?spec. nov.* (Kostermans 1337) (1), *Anisoptera spec.* (bb. 22351) {21, *Anisoptera spec.* (Becean *s.n.)* (3), and *I Anisoptera spec.* (bb. 31S44) (4).

Excluded species

Anisoptera parvifolia Warburg (in Bot. Jb. 13: 382. 1891; Van Slooten *in* Bull. Jard. bot. Buitenz. Ill 8: 5. 1926, sphalm. *"parviflora")* = *Hopea parvifolia* (Warb.) Van Slooten (see p. 37).

HOPEA Roxb.

For distribution map, *see* figure 4

4. HOFEA CELEBICA Burck—Fig. 5

Hopea celebica Burek in Ann. Jard. bot. Buitenz. 6: 237. 1887; Brandis *in* J. Linn. Soc, Bot. 31: 64. 1895; *non sensu* Diels *in* Bot. Jb. 57: 462. 1922.

TYPE.—Teysmann 12779HB. — Illustrative specimen.—bb.25554.

Branches greyish brown puberulous, glabrescent, slightly angular by short elevated ribs decurrent from the insertion of the leaves. *Stipules* not seen. *Leaves* drying yellow-brown or greenish yellow, flat, lanceolate or oblong-lanceolate, attenuate, acuminate, the acumen subacute and up to 1.5 cm long, obtuse or rounded at the hardly asymmetrical base, the margins slightly revolute, especially at the base, 13.0—18.0 cm long, 5.0—

FIG. 4. Distribution of the species of *Hopca* in eastern Malaysia. The numbers and species correspond as follows:

H. celebica Burck	1
H. celebica sensu Diels	17
H. dolosa Van Slooten	2
H. glabrifolia C. T. White	21
H. gregaria Van Slooten	3
H. iriltna Van Slooten	12 and 10
H. nabirensis Van Slooten	11
H. nodosa Van Slooten	6, 7, and ?12
H. navoguineensis Van Slooten	14
H. papuana Diels	15, 16, 17 and ?20
H. papuana sensu White & Francis	18 and 720
H. parvifolia (Warb.) Van Slooten	8
H. similis Van Slooten	13
Hopea 'spec. nov. (bb. 24903)	4
Hopea fspec. nov. (bb. 26259 and 25320)	10
Hopea 'spec. nov. (NGP 1251)	19
Hopea spec. (Beccari *s.ti.)*	9
Hopea spec. (bb. 30359)	12
Hopea spec. (NGF 1307)	20
Hopea or Shorea spec. (NGF 1333)	20
Hopea or Shorea spec. (Kostermans 828)	5

It will be l-eadily noticed that all species of *Hopea,* whether definitely or tentatively recognized, except for at most four, are known each from one locality. (A note of interrogation indicates a doubtful identification.) The numbers 12, 16, 17, and 20 show that only in those regions two or more specifes were collected. The genus *Hopea* is, therefore, a fine example to demonstrate that our knowledge of the dipterocarps of New Guinea may be expected to increase considerably in the future by an intensive exploration.

6.0 cm wide, glabrous and somewhat shining on both sides; midrib hardly elevated above, prominent beneath; main nerves 7—8 pairs, conspicuous above, elevated beneath, forming sharp angles to the midrib, curved upwards near the margin; domatia conspicuous, canaliculate, glabrous as is the ostium, present in most of the axils of the main nerves but always absent at the very base; nervules numerous, visible on both sides; *petioles* robust, Ruberulous, soon **glabrous, 1.2—2.0 cm long.** *Inflorescences* **axillary and**

terminal, usually several together, rarely solitary, the rachis and branches flattened, very fine and slender, densely greyish puberulous, up to about 12.0 cm long; branches solitary or in pairs; ultimate branchlets about up to 9-flowered. *Flowers* (only flower buds present) obviously sessile. *Sepals* different in length, fleshy, densely greyish pubescent outside, the

FIG. 5. *Hopea celebica* Burck: *a*, inflorescence with flower buds (× 0.5); *b*, part of leaf showing domatia (nat. size); *c*, branchlet of panicle (× 1.5); *d* and *e*, flower buds (× 5); *f*, stamens (× 10); *g*, ovary (× 8). — Drawing after bb. 25554.

2 outer ones oblong, blunt at the top, pubescent on the upper half inside, the third sepal one-sided membranous, the 2 inner ones ovate, attenuate, acute, partly membranous, glabrous inside. *Petals* oblique-oblong, tomentose on the portion exposed in the bud, smooth inside, many-nerved.

Stamens 15, in 2 rows, of 2 different lengths; anthers ovate-oblong; filaments 1 to 2 times as long as the anthers, broad at the base, narrowing towards the top, the filiform portion as long as the broadened base or absent; appendage to connective linear, up to one and a half times as long as the anther. *Ovary* ovoid, broad at the base, tapering into the stylopodium, glabrous; stylopodium obviously subpapillose; style very short, as long as the stylopodium, glabrous. *Fruit* unknown to me (see below).

The only Dipterocarpacea from Smith-West Celebes, Hopea celebicu, has only been found twice, exclusively in the neighbourhood of Maros. — The specimens from the Sepik region of the Territory of New Guinea collected by Ledermann, which were identified by Diels *(I.e.)* as belonging to this species, must represent a different species (see *Hopea, celebica se-nsu* Diels). — L. G. den Berger & F. H. Endert *(in* Meded. Proefst. Boschw., Buitenz. 11; 108 *pi. 13 fig. 51.* 1925) deal with the principal timber-species of the Malay Archipelago. Among these is pooti from Kendari (SE Celebes). This name must pertain to *Hopea gregaria* Van Slooten, and not to *H. celebica* Burck as mentioned there.

The description above is entirely taken from specimen bb.25554. It is incomplete, as was Burck's, since open flowers and fruits are lacking. The specimens in the herbaria of Bogor and Leyden do not include fruits; yet very young ones were described by Burck, merely as follows: "Fructus immaturi breviter pedunculati. Calycis fructiferi laciniae majores 7-nerviae."

Backer (no. 36886) collected material with flower-buds, very likely representing *H. celebica,* in the park of Tjiomas Estate near Buitenzorg (Bogor), now the site of the Forest Research Institute. The tree must have been planted there in Teysmann's time. If attention will be paid to full-grown flowers and ripe fruits, it will be possible some day to describe these completely.

SPECIMENS EXAMINED.—CELEBES. South-western peninsula: Maros *(Teysmann 12779HB,* immediately after blossoming Sept. 1877) ; near Kappang, in old forest on steepy, stony ground (matrix: limestone), 500 m *(bb.2555&,* fl. buds Sept. 1938, hulodere or këri; common, a few trees growing together; tree 25 m high; bark •with a small quantity of clear resin).

5. **Hopea dolosa** Van Slooten, *spec. nov.*—Fig. 6

TYPE.—Kjellberg 2065.

Hopeae celebicae *Burck valde affinis et foliorum habitu subsimilis, sed ramulis petiolis inflorescentiisque glaberrimis, nervis secondariis pVwribus, domatiis paucioribus, sepalis glaberrimis valde inequalibus facile distinguenda.*

Branches glabrous, finally lenticellate, dark when dry, without decurrent ribs.Stipules not seen. *Leaves* coriaceous, drying (pale) brown on The flower surface,flat, oblong, ovate-oblong or oblong-lanceolate, attenuate

FIG. 6. *Hopea dolosa* Van Slooten: *a,* flowering branch (X 0.5); *b,* flower bud (x 3); *c,* expanded flower (X 3); *d,* petal (X 5); *e,* stamens (X 10); f, ovary (x 5) *g;* immature fruit (X 2). — Drawing after Kjellberg 2065; *g,* after Cel./II-377.

from the lower half, whether or not acuminate, the acumen blunt and 1.0—1.5 cm long, rounded at the base which is symmetrical or very nearly so, the margins conspicuously revolute, (12.0—)15.0—20.0 cm, sometimes even up to 25.0 cm long, usually 6.0—8.0 cm wide, glabrous and hardly shining or dull on both sides; midrib hardly elevated above, prominent beneath; main nerves 8—12 pairs, conspicuous above, elevated beneath, forming wide angles to the midrib, curved upwards near the margin; domatia often absent, but conspicuous and usually in the axils of the higher main nerves only if present, not canaliculate, glabrous; nervules numerous, visible on both sides; *petioles* robust, rugose, glabrous, (1.0—) 1.5—2.0 cm long. *Inflorescences* axillary and terminal, solitary or 2—3 together, the rhaehis and branches grooved, flattened, very fine and slender, entirely glabrous, drying black, up to 12.0 cm long; branches solitary; ultimate branchlets up to 3.0 cm long, each bearing 5—6 secund flowers; bracts and bracteoles not seen. *Flowers* 4.0—6.0mm apart, oblong in bud; *pedicels* glabrous, about 2 mm long. *Sepals* very unequal in size, fleshy, glabrous, the 2 outer ones linear, broad at the base, blunt or subacute at the top, 3.0—4.0 mm long, 1.0 mm wide, the 3 inner ones ovate, attenuate, acute, membranous at the margins, slightly fringed, about 1.5 mm in diameter. *Petals* oblique-oblong, attenuate, sericeous on the portion exposed in bud, smooth inside, fringed along one margin, about 6.0 mm long, 2.0 mm wide, many-nerved. *Stamens* 15, in 2 rows, pairs alternating with single stamens, of 3 different lengths, 0.75—1.25 mm long; anthers ovate-oblong, about 0.5mm long; filaments broad and flattened at the base and as wide as the anther, filamentous in the upper portion, about 0.50—0.75 mm long; appendage to connective linear, up to 1.5mm long. *Ovary* ovoid-oblong, broad at the base, about 2.0 mm long, glabrous; stylopodium glabrous or very slightly pubescent; style glabrous, very short, as long as the stylopodium, together about 0.75 mm long. *Fruiting calyx segments* (of immature fruit) glabrous on both sides, the 2 long wings linear or spathulate, obtuse at the top, at the very base narrowed and flat, about 7-nerved (the rest too immature for description).

Tree up to 40 m high. *Bark* black-grey, producing a small quantity of white or pale yellow[7] clear resin, which in the Malili District is commonly known as damar mata kuching, in the surroundings of Lengkobale also as damar dere. In his "Harsonderzoek" (p. 286) Endert mentions this resin as being produced by *H. celebica*, and ranges it under the beautiful mata kuching resins. He says (p. 283) that this tree is tapped, which, however, is annuled in "Herkomst Damar" (pp. 1-2). An experiment in 1935 showed that tapping did not stimulate the production of resin. "It is said that only trees in bad condition produce the resin spontaneously in considerable quantities." The flowers are whitish yellow and have been collected in August; very young fruits are known from September and January.

From bb.8569 the following data have been derived. Tree with small buttresses. *Bark* coffee-brown, shallowly longitudinally fissured, flaking off in small patches; inner bark yellowish white. *Sapivood* pale brown. *Heartwood* brown, sharply demarcated from the sapwood. The wood is in great demand (for instance for doorposts), as it is said to be very durable if used together with the bark. Though it is difficult to fell, it is easy to split, to saw, and to plane; it is resistant to attacks of sea- and river-pileworms, white ants, *Cryptotermes sp,,* powderpost beetles, *Xylocopa,* and rotting; it splits, shrinks, and warps only little.

Hopea dolosa is a tree of the primary forest in the Malili District from steepy ground on rocky or clayey soil, whether or not growing along liver or lake; only twice (bb.8569 and 32526) it is recorded from soil which is temporarily inundated by fresh water (during the rainy season). it has been found at an altitude of 500 m (bb.23839), but the localities of the majority of the trees (Usu and Lengkobale) are between 150 and 300 m above the sea. Kjellberg collected his specimen at sea level. Locally it is (very) common near Malili, though it always grows scattered or with a few trees together.

The material, consisting merely of leaves, looks deceptively ('dolosus') like *H. celebica* Burck: the leaves differ only slightly and are but little thicker . The lateral nerves, however, are at much wider angles to the midrib, which angles are clearly acute in *H. celebica.* In *H. dolosa* the domatia are found generally in the leaf axils of the higher nerves. They are fewer in number and less clear than in *H. celebica* and are often lacking altogether. The inflorescences and their ramifications are completely glabrous and black when dry, in *H. celebica,* however, they are greyish pubescent; the terminal ramifications are sparsely flowered, and the stalk and calyx of the flowers are also completely glabrous.

SPECIMENS EXAMINED.—CELEBES. South-eastern peninsula. Malili District: Lampea, along the coast *(Kjellberg 2065),* Usu *(Cd.III-206* to *-209,* hulo dere; *Cti. II-S77,* damar dere item; *bb.£1654* to *21658; bb.82526,* damar dere lotong), Dopi **4api** *ibb.23839),* La Rona *(bb.1826,* bisik bisilt; *bb.1832,* damar dere; *bb1897,* rinni rani; *bb.1905,* sare pare; *bb.X91i,* torinni; *bb.1868),* Lengkobale, along lake *(bb.20522* to20534 and *bb.23918),* Warau (66.25535), Timampu, along lake *(bb.8569,* damar «r« item).

6. **Hopea gregaria** Van Slooten, *spec. nov.*—**Fig.** 7

TYPE.—Kjellberg 615.

Species nova nuce globosa rostellata segmentis maioribus patentibus et ncurratis nucem non superantibus facile distinguenda.*

Branches slightly puberulous, glabrescent, drying blackish, with very elevated ribs below the insertion of the petioles. *Stipules* not seen.

Leaves coriaceous, brown or brownish green when dry, flat, ovate-oblong or oblong, from the lower half gradually tapering into the apex, whether or not acuminate, blunt at the top, base (sub) equal and rounded or obtuse, the margins usually slightly revolute, especially at the base, 10.0—14.0 cm long, 4.0—6.0 cm wide (in the flowering specimen, bb.21750, most of the leaves much smaller), glabrous on both sides, shining above, dull beneath; midrib visible above, slightly elevated beneath; main nerves about 8 pairs, not elevated above, slightly so beneath; domatia usually absent, very few in number in the lower axils, hardly developed and glabrous if present; nervules visible on both sides; *petioles* robust, rugose, glabrous, 1.0 cm long. *Inflorescences* axillary and terminal, solitary or sometimes in pairs, the rhachis and branches densely brownish tomentose, 5.0—7.0 cm long; branchlets solitary, up to 2.0 cm long, 5—8-flowered; bracts and bracteoles not seen. *Flowers* (bb.21750) with very short pedicels. *Sepals* subequal in length, broadly ovate, about 2.0 mm in diameter, the portions exposed in bud densely puberulous, blunt or rounded at the top; the 2 outer ones puberulous on the upper half inside, the 3 other ones glabrous inside, the third sepal one-sided, the 2 inner ones two-sided, membranous. *Petals* oblique-oblong, attenuate, puberulous on the portion exposed in bud, smooth inside, erose at the top and along one margin, about 4.5 mm long and 2.0 mm wide, many-nerved. *Stamens* 15, of 3 different lengths, pairs alternating with single stamens, about 0.75 mm long; anthers suboblong, about 0.25mm long; filaments broad and flattened at the base and as wide as the anther (about 0.25 mm), filamentous in the upper half, about 0.5 mm long; appendage to connective linear, about twice as long as the anther. *Ovary* with stylopodium oblong, slightly con-

PIG. 7. *Hopea gmgaria* Van Slooten: *a,* fruiting blanch (X 0.5); 6 and *c,* immature fruits (X 2) : *d,* mature fruit (X 2). — Drawing after Kjellberg 618.

stricted in the middle, together about 1.0 mm long, the ovary glabrous, the stylopodium subpapillose and rounded at the top; style very short, about 0.25 mm long. *Fruiting calyx segments* coriaceous, not overtopping the nut, puberulous at the very base outside, glabrous inside, the 2 outer wings spreading and reflexed, oblong, rounded at the top, about 10.0 mm long and 4.0 mm wide, the 3 inner wings enveloping the base of the nut, ovate , rounded at the top, about 4.0—5.0 mm long and 4.0 mm wide. *Nut woody,* (sub) globular, pointed, glabrous, about 7.5 mm in diameter.

The field notes of bb.3885 give the following data. Tree with a very straight *bole,* said to be hollow when adult; buttresses small. *Bark* brownish black, shallowly longitudinally fissured; inner..bark white. *Sapwood hardly* present, somewhat paler coloured than the pale brown *heartwood. The* wood is said to be very good for interior constructions and is used for roofs, doorposts, handles of axes, etc.; it is easy to fell, though difficult to split, to saw, and to plane and it is resistant to sea-pileworms, white ants , and powderpost beetles; it splits, shrinks, and warps only little.

Hopea gregaria is a tree up to 35 m high, producing usually a small quantity of clear candle-white or yellowish resin. It occurs in the Kendari District only, where it is commonly called poo'ti. There is a rather pure pooti stand at the Staring Bay near the coast on hills steeply rising up from the sea. Such a complex is said to be known from this place only through the species is growing gregariously also on Pulau Wawosunggu. The species occurs in primary forest on dry, hilly or steepy ground on stony or clayey soil. The complex at the Staring Bay lies at an elevation of about 60 m, but the altitudinal limit of *H. gregaria* is apparently 200 m (kampong Langgowala).

Hopea gregaria appears to be a very conspicuous species by its peculiar fruits, the two large calyx-segments at best being as long as the nut . These segments are spreading and reflexed and quite free from the lower portion of the fruit, which is globular and enveloped in its lower half only by the three smaller wings. As a result the nut is nearly completely visible.

L. G. den Berger & F. H. Endert cite pooti from Kendari under tho most important timbers of the Malaysian Archipelago. The name refers to hopea *gregaria* Van Slooten and not to *H. celebica* Burck as was supposed.

SPECIMENS EXAMINED.—CELEBES. South-eastern peninsula: Kendari District: Kendari *{Kjellberg 615,* fr. March 1929; *Brainier* 50), Wawunggu *(bb.3885),* P. Wawosunggu *(bb.5001,* fl. Nov. 1922; *bb.9350,* fl. Aug. 1924; *bb.24071; bb.24072* ind *24073,* fr. April 1938), Langgowala *(bb.21750,* fl. Dec. 1939).

7. HOPEA ?SPEC. NOV.

SPECIMEN EXAMINED.—MOLUCCAS. Halmahera: Weda District, Tiloppe, in primary forest on hilly ground on stony soil (matrix: coral), at sea level *(bb.2i903).* — Leaves only.

A large-leaved species of *Hopea* which is said to be rather rare though growing gregariously, obviously occurring locally only.

In type of leaf actually closely related with H. *novoguineensis* and *H. sirnilis,* the leaves being similar in size and shape, but readily distinguishable by the hairy undersurface and the barbate domatia in the lower half or third part below. These domatia it has in common with *H. philippinensis* Dyer which species, however, is quite distinct in the glabrous, differently shaped leaves.

The vernacular name reported for it is tandjung, which, however, is untrustworthy.

This collection represents the only species of Hopea known from the northern Moluccas up till now, the following collection originating more eastwards, viz. from the Aru Islands.

8. HOPEA ?SPEC. NOV.

SPECIMENS EXAMINED.—MOLUCCAS. Aru Is.: P. Wokam, in primary forest on dry, hilly ground on sandy clay (matrix: limestone), 25 m *ibb.25259,* kamura; tree 31 m high); P. Kobrobr, in primary forest on dry, level ground on sandy clay, 10 m *(bb.25320,* kamura; tree 23 m high), — Leaves and a few remnants of inflorescences only.

In appearance this species of *Hopea,* which is said to be rather common on the islands mentioned, though it grows in scattered specimens, comes nearest to the Celebesian species of this genus. From *H. celebica* Burck it differs by its leaves, which have a conspicuous asymmetrical base, 10—12 pairs of main nerves forming far less sharp angles to the midrib, and no or hardly differentiated domatia. The rhachis and branches of the inflorescences are densely greyish tomentose in contradistinction to the glabrous ones in *H. dolosa.* Of *H. gregaria* it is distinguishable, for instance, by the number of main nerves and the colour of the pubescence of the inflorescences.

The underside of the leaves, which is soft to the touch, is covered with minute, scale-like, stellate hairs only visible under high magnification and vanishing in the older leaves. They are absent in the Celebesian species mentioned above. Only remnants of inflorescences are present.

9. **Hopea nodosa** Van Slooten, *spec. nov.*—Fig. 8

TYPE.—Pleyte 689.

Species nova ramis nodosis, foliis latissime acuminatis, paginis superioribus pilis minutissimis stellatim fasciculatis munitis itaque quasi squamulosis facile cognoscenda.

Branches glabrous, drying brownish or dark in colour, with long decurrent ribs making the branchlets subangular. *Stipules* not seen.

FIG. 8. *Hopea nodosa* Van Slooten: *a,* flowering twig (x 0.5); *b,* flower bud (X 4); *c,* mature flower (x 4); *d,* mature flower, sepals partly and petals all removed (X 4); *e,* stamens (X 10); f, ovary (x 5); *g,* mature fruit (nat. size). — Drawing after Pleyte G89; *g,* after bb. 21884.

Leaves coriaceous, the younger drying yellowish green on both sides, the older ones brownish, flat, ovate-oblong or ovate, rarely oblong, attenuate

from the lower half, acuminate, the acumen broad and plump, blunt, 0.5—1.0 cm long, rounded at the symmetrical base, margins not revolute, 12.0—16.0(—20.0) cm long, 6.0—8.0 cm wide; shining on both sides when young, dull or nearly so when adult, seemingly glabrous, but sprinkled with minute pits only visible under high magnification and perhaps due to very minute, scale-like, stellate hairs above, to a lesser extent so beneath; midrib hardly elevated above, strongly prominent beneath: main nerves 9 pairs, visible and slightly sunken above, elevated beneath, strongly curved upwards near the margin and whether or not confluent in the upper half; domatia absent or hardly differentiated in the very base of the axils, not canaliculate; nervules and venation hardly visible on both sides; *petioles* robust, rugose, glabrous, 1.0—1.5cm long. *Inflorescences* axillary, solitary or 2—4 together, the rhachis grooved, slender, glabrous, drying brown, 4.0—6.0cm long; ultimate branchlets solitary, 1.0 cm long at the utmost, 4—5-flowered; bracts and bracteoles not seen. *Flowers* 1.0—1.5mm apart, ovoid in bud; *pedicels* glabrous, 1.0 mm long. *Sepals* equal in length, glabrous, 1.5 mm in diameter, the 2 outer ones fleshy, broadly ovate, attenuate, acute, the 3 inner ones suborbicular, the third sepal one-sided, the 2 inner ones two-sided, membranous. *Petals* linear-oblong, the top oblique, blunt and erose, sericeous on the portion exposed in bud, smooth inside, 5.0 mm long, 1.0 mm wide, many-nerved. *Stamens* 15, in 2 rows, pairs alternating with single stamens, of 3 different lengths, 0.75—1.0 mm long; anthers subovate, about 0.25 mm long; filaments broad and flattened at the base and as wide as the anther, filamentous in the upper portion, 0.5—0.75 mm long; appendage to connective linear, about 0.75 mm long. *Ovary* and stylopodium subconical, hardly constricted halfway, glabrous, the upper (stylopodial) portion subpapillose, less than 1.5 mm long; style short, less than 0.5 mm long.

Hopea nodosa is very easily distinguished by the swollen nodes of the branches and by the broad and plump acumen of the leaves; there seems to be little difficulty in identifying the species by these vegetative characters alone. By the very fine, scale-like, stellate hairs, too, which high magnification reveals the upper surface of the leaves to be punctate, *H. nodusa* is easily distinguishable from other species as *H. celebica*, *H. dolosa*, and *H. gregaria*, with which it undoubtedly is closely related. Moreover, the named species are quite distinct in details of inflorescential and floral morphology.

SPECIMEN EXAMINED.—NEW GUINEA. Western part: "Vogelkop," Kelamono near Sorong, in primary forest on ridge of hill, 30 m *(Pleyte 689*, fl. Aug. 1948; common; tree 40 m high; flower pale brown).

Though the minute pits on the upper surface are less conspicuous in the two following collections, I consider them also to belong here. If I am right *Hopea nodosa* is a wingless member of the genus. The description of the fruit then would be, as drawn up from bb. 21884, as follows.

Fruiting calyx segments closely embracing the lower portion of the nut but quite free from it, unequal in size, none of them reaching the top of the nut, woody, the margins thin, brownish, glabrous, the 2 outer sepals smaller than the 3 inner ones, oval, about half as high as the mature nut, unequal in size, 0.5 and 0.6 cm long, 0.4 and 0.5 cm wide, the 3 inner sepals suborbicular to transversely oval, concave, two-thirds of the length of the nut, about 0.7 cm long and 0.8 cm wide. *Nut* ovoid, somewhat flattened, attenuate, pointed, glabrous, 1.0 cm long, about 0.5—0.6 cm wide.

The material of bb.21878 belonging to the Forest Research Institute at Bogor was lost during the war and there is no duplicate in Herbarium Bogoriense. The data on the label are detailed enough to conclude that the same species as bb.21884 is involved.

NEW GUINEA. Western part: "Vogelkop," Kariri at Kamundan R., in primary forest on dry, level ground on sandy soil, 3 m *bb.21878* and *21SSi*, biamo(ro); very common locally; tree up to 25 m high; bark with a small quantity of resin].

I doubt if the following specimen belongs here as the leaves are thin and the petioles slender, perhaps because they were taken from a young tree (15m high). However, the branches are somewhat nodose and the upper surface of the leaves are punctate as in *H. nodosa*. Domatia are lacking.

NEW GUINEA. Western part; Japen I.: Seroei, in primary forest on hilly ground on stony soil, 50 m *(bb.30589*, kure; common; young tree of 15 m high). — Leaves only.

10. **Hopea nabirensis** Van Slooten, spec. *nov*.—Fig. 9

TYPE.-Kanehira & Hatusima 12544.

Species nova foliis ovatis glabris, domatiorum canaliculatorum ostio distinctissimo munitorum magnitudine inusitata facile distinguenda.

Branchlets glabrous, drying dark. *Leaves* subcoriaceous, ovate or oval, acutely acuminate-caudate at the asymmetrical apex, conspicuously unequal and usually cuneate at the base, the margins there revolute, 7.5—10.0 cm long, 4.0—4.5 cm wide; entirely glabrous on both surfaces, dull and drying greyish green above, slightly shining and brownish green beneath; midrib elevated on both surfaces, particularly on the lower, pale; main nerves 8—9 pairs, hardly raised above, prominent beneath, in the axils of 4—6 pairs furnished with very conspicuous, glabrous, canaliculate domatia with very large, glabrous ostia, the impression of the domatia being visible on the upper surface; tertiary nerves not elevated but clearly defined and visible on both surfaces; *petioles* rather slender, not thickened in the upper half, glabrous, drying black, up to 1.0 cm long. *Inflorescences* obviously solitary in the axils of the leaves and unbranched, greyish pubescent. *Flowers* unknown. *Fruit* very shortly

stalked; *calyx-segments* woody at the base, closely embracing the lower portion of the nut, glabrous or with hardly any remnants of a very fine pubescence, the 2 long wings obovate-oblong, rounded or subretuse at the apex, narrowed downward up to the base, 6.0—7.5 cm long (including the very base), 1.5—2.0 cm wide, about 12-nerved, the 3 short wings obtuse at the apex and only half height of the nut, about 0.5 cm long. *Nut* ovoid, pointed by the style remnant, glabrous, about 1.0 cm long, the upper half free.

FIG. 9. *Hopea nabirensis* Van Slooten: «, leafy twig (x 0.5); &, part of leaf showing domatia (nat. size); *c*, mature fruit (X 0.5) — Drawing after Kanehira & Hatusima 12544.

This is a distinct species by its large domatia though for the rest they are typical of many species of the genus. They are very conspicuous, canaliculate, not barbate, with a distinct, glabrous ostium, situated a few millimeters outside the axil of the main nerves, while the bases of these nerves are pressed downwards. The species is also characterised by its ovate leaves, which are entirely glabrous.

SPECIMEN EXAMINED.—NEW GUINEA. Western part: Geelvink Bay, Sennen (40 km inwards of Nabire), in *Agathis* forest, 500 m *(Kanehira & Hatusima 125^4,* fr. March 1940; tree 30m high).

11. Hopea iriana Van Slooten, spec. *nov.*—Fig. 10

TYPE.—bb.25644.

Species nova foliis levibus utrinque pilis minutissimis squamiformibus stellate-fasdculatis vestitis, venatione reticuiata, distributionis domatiorum modo alanimque maiorum forma distinguenda.

Young parts of branches very slightly puberulous, soon glabrescent, drying dark in colour, with long, elevated ribs decurrent along the greater part of the internodium. *Stipules* not seen. *Leaves* coriaceous, drying greyish on the upper, brown on the lower, surface, flat, oblong or obovate-oblong (in bb.30645 lanceolate), attenuate, acuminate, the acumen acute and up to 1.0 cm long, usually conspicuously unequal at the base, rounded on one side, cuneate on the other, the margins hardly revolute, 8.0—11.0 cm long, 3.0—4.5 cm wide; dull on both sides or hardly shining above, both

surfaces very densely covered with an extremely minute, scale-like, stellate pubescence (only visible under high magnification); midrib hardly elevated above in the lower half, prominent beneath; main nerves 7—9 pairs, visible above, slightly elevated beneath; domatia conspicuous and in the axils of the lower main nerves only if present, canaliculate, glabrous, their impression **being** visible on the upper surface, obviously always

FIG. 10. *Hopea iriana* Van Slooten; *a*, fruiting twig (X 0.5); *b*, part of leaf showing domatia (nat. size). — Drawing after bb. 25644.

absent in the axils of the lowest pair of nerves at the very base, a number of leaves without domatia; nervules- numerous, faint but visible to the naked eye on both sides, connected by a reticulate venation; *petioles* slender, hardly pubescent, soon glabrous, 0.75—1.0 cm long. *Flowers* and ripe *fruits* unknown. *Infructescences* axillary and terminal, obviously mainly solitary and hardly branched, the rhachis and branchlets fine and

slender, densely pale brown or greyish stellate-tomentose, (as far as present) up to 6.0 cm long. *Fruiting calyx segments* (of immature fruit) minutely puberulous on both sides, the 2 long wings oblong or subobovate-oblong, more than twice as long as wide, rounded at the top, at the very base narrowed and flat, 10—11-nerved, the 3 short wings about as long as the (unripe) nut (the rest too immature for description).

The field notes of bb.25060 are as follows. Tree with a very straight *bole* and black branches. *Leaves* somewhat yellowish green-. *Bark* black, with many deep, longitudinal fissures, shedding in long,' thick patches; inner bark in transverse section pale brown. *Heartwood* yellowish brown.

Hopea iriana has been found in primary, rather heavy forest on hilly ground on clay or sand, rich in mould. Near Hollandia it seems to be rather common, though growing in small groups, at an elevation of about 50 m.

SPECIMENS EXAMINED.—NEW GUINEA. Western part: Japen I.: Seroei, 250m *(bb.30645,* sam; tree 25m high). Hollandia, on hill, 50m *(bb.25060* and *256H,* the second with very young fruits July 1938; tree 22m high).

12. Hopea similis Van Slooten, *spec. nov.*

TYPE.—Docters van Leeuwen 10247.

Hopeae novoguineensi *Van Slooten valde similis sed foliis basi non inaequilateralibus, in iuventute tomento minutissimo sublatericiis, marginibus in sicco valde revolutis, domatiis absentibus, inflorescentiis longioribus dense brunneo-stellato-tomentosis recedit.*

Branchlets densely rusty stellate-tomentose, glabreseent and drying dark in colour and becoming Ientieellate, flattened and slightly angular by long elevated ribs decurrent along the whole of the internodium. *Stipules* not seen. *Leaves* drying brown, the younger ones somewhat brick-coloured below by a very dense and extremely minute, tomentose, finally vanishing pubescence, thickly chartaceous, oblong, 16.0—20.0 cm long, 6.0—8.0 cm wide, rather abruptly acuminate, the acumen blunt and 0.5—1.0 cm long, equal at the rounded base or nearly so, the margins strongly revolute at the very base; glabrous and hardly shining above, dull and with remnants of a stellate pubescence on the midrib and main nerves beneath, without domatia; midrib not prominent on the upper, strongly elevated on the lower, surface; main nerves 12—16 pairs, visible above, elevated beneath; nervules joining the principal nerves in very numerous subparallel lines, visible on both sides; *petioles* thick, rusty tomentose, soon glabrous or nearly so, drying black, 1.25—1.5 cm long. *Panicles* axillary (partly in axils of recently fallen leaves) and terminal, solitary or in pairs, shorter than the leaves, lax, up to 13.0 cm long; ultimate branehlets bearing 4—6 biseriate, secund flowers, up to 2.0cm long; pedicels very short; axes of inflorescences and pedicels covered by a dense, rusty or brownish coloured tomentum of stellate hairs. *Flowers* ovate in bud. *Sepals* unequal in shape, equal in length, about 2.5 mm long, 2 ovate, attenuate towards

the obtuse apex, fleshy, densely stellate-tomentose outside, puberulous on the upper portion inside, minutely fimbriate, 1.5—2.0 mm wide at the base,the 3 inner ones broadly ovate, about 2.5 mm wide, rounded at the top, the centre rather thick, the dorsal part minutely pubescent, glabrous inside, slightly fimbriate towards the apex, the third sepal one-sided, the 2 inner ones two-sided, membranous. *Petals* of mature flowers and *stamens* not seen; stamens possibly 15, remnants of 2 opposite filaments being present. *Ovary* in the very young fruit subconical, constricted in the middle, glabrous, the upper (stylopodial) portion subpapillose, style 1.0 mm long. *Fruits* unknown.

In outward appearance herbarium specimens of *H. similis* are rather like those of *H. novoguineensis*, with which it belongs to the largest-leaved species from New Guinea. The differences between them are partly perhaps of degree rather than kind, but nevertheless, by the sum of them I feel confident in separating the collections specifically. The differences are the following: in *H. similis* the undersurface of the leaf in a young stage is brick coloured when dry owing to a very fine tomentum of minute, stellate hairs; the leaf is equal at the base and strongly involute, the margins being inflexed over their length up till the very top in diminishing degree; domatia are entirely absent; the petioles are 1.25—1.50cm long; the inflorescences may be 13.0 cm in length, the texture of their branches and flowers is distinct, forming a close rusty or brownish coloured tomentum; the stamens may be 15 in number. Since the two collections are quite distinct in these respects I consider them worthy of specific rank until additional material may possibly prove them to be conspeeific. As to the absence of domatia, it is known to me that in a number of species their presence in the axils of the nerves is variable. However, as not the slightest indication exists that they may be present by way of exception, I am inclined provisionally to attach some value to this character when seer, in combination with the other differences mentioned above.

SPECIMEN EXAMINED.—NEW GUINEA. Western part: Rouffaer R., 250 m (Dorters *van Leemuen 10217*, fl. buds Sept. 1928).

According to a list of plants collected by Docters van Leeuwen, his no. 10468 also represents a species of *Hopea.* Probably it belongs here, originating from the same locality and having been collected in the same month though at an altitude of 350 m. Specimen as well as label have been lost.

13. HOPEA NOVOGUINEENSIS Van Slooten

Hopea novoguineenKis Van Slooten in Nova Guinea 14: 224 *pi. la.* 1926.

TYPE.—Feuilletau de Bruyn 74.

Branches glabrous, dark, lenticellate, with rather distinct, elevated ribs decurrent along the internodium. *Leaves* thickly chartaceous, oblong

or oblong-ovate, 14.0—23.0 cm long, 6.5—9.5 cm wide, rather abruptly acuminate, the acumen blunt and 0.75—1.0 cm long, mostly markedly unequal at the base, rounded or subcordate on one side, cuneate or angulate-cuneate on the other, shining" and glabrous on both surfaces, with domatia in the axils of the main nerves of the lower half beneath, the domatia in pairs in the lowest axils, glabrous and with distinct ostia, their impressions faintly visible on the upper surface; midrib strongly elevated beneath, slightly prominent above; main nerves 14—16 pairs, visible above, elevated beneath; nervules joining the principal nerves in very numerous subparallel lines, inconspicuous above, visible beneath; *petioles* thick, glabrous, 0.7—1.0 em long, blackish when dry. *Panicles* axillary .(sometimes in axils of recently fallen leaves), obviously solitary and branched from the very base or with 2 or 3 main branches, much shorter than the leaves, lax, up to 9.0 cm long; ultimate branches subtended by caducous bracts, bearing few biseriate flowers, about 4.0 cm long; pedicels 1.0 mm long; axes of inflorescences and pedicels densely greyish or greyish brown stellate-pubescent. *Flowers* 8.0 mm long, 9.0 mm in diameter. *Sepals* unequal in size and shape: 2 oblong, attenuate towards the obtuse apex, fleshy, densely stellate-pubescent outside and on the upper portion inside, on the lower portion glabrous, minutely fimbriate, 2.75—3.25 mm long, 1.5—1.75 mm wide at the base, the inner 3 broadly ovate, the centre rather thick, the dorsal part minutely pubescent, otherwise glabrous, slightly fimbriate towards the apex, about 2.0 mm in diameter. *Petals* lanceolate, rotundate at the base, rather abruptly attenuate towards the unequal-sided apex, the margins very finely and shortly fimbriate, 7.5 mm long, 2.0 mm wide, stellate-pubescent on the portion exposed in bud, otherwise glabrous, many-nerved. *Stamens* 10, in 1 row, of 2 sizes, longer ones (1.75—2.0 mm) alternating with shorter ones (1.75—1.5 mm); filaments flattened, 0.5 mm long or snorter, as long as or longer than the anthers; appendage to connective as long as the anthers. *Ovary* and stylopodium very minutely pubescent, 1.0 mm in diameter; stylopodium attenuate, surmounted by the very short style, nearly as long as the smaller sepals. *Fruit* unknown.

As no complementary data are available I give here my original description in translation since it has not been published in a periodical of Herbarium Bogoriense. The description of the flowers is taken from the single one present, which I had to dissect; the unripe fruits are much too young for description.

In 1926 *H. novoguineensis* was compared by me with three other species from eastern Malaysia and the Philippines, as follows: *"H. papuana* Diels . . „ a" species of N. E. New-Guinea, is discernible, i.a. by the 'pilis stellatis majoribus minoribusque dispersis' on the lower sides of the leaves, which measure 15—717 by 41.4—8 cm., and by the absence of domatia in the axils of the lateral nerves, the number of the latter amounting to 18—22 pairs. In *H. philippinensis* Dyer . . . these domatia are barbate, while the axes of the inflorescence are glabrous and the branchlets, petioles,

midribs and lateral nerves of the narrowly oblong leaves are usually finely and more or less densely fusco-canescent. *H. celebicu-* Burck comes nearest to *H. novoguineensis,* La. by the glabrous domatia, but it possesses much smaller leaves (10—15 by 4 1/2—6cm.) and a much smaller number of lateral nerves (7—9)."

SPECIMEN EXAMINED.—NEW GUINEA. Western part: Idenburg R., in forest on riverclay, 40 m *{Feuilletau da Bruyu 74,* fl. and very young fr. Sept. 1914; tree 25 m high; wood said to belong to the softwoods; flowers yellowish).

14. HOPEA PAPUANA Diels—**Fig.** 11

Hopea imimhui Dieis *in* Bot. Jb. 57: 461. 1922.

TYPE.—Ledermann 10432.

Young branches densely t'erruginous-tomentose. *Leaves* coriaceous, obovate-oblong or obovate-elliptic, 15.0—17.0 cm long, 4.5—8.0 cm wide, acuminate, the acumen acute and up to 1.5 cm long, unequal at the emarginate or subcordate base, the upper surface shining and glabrous, the lower surface dull and scabrous by larger and smaller stellate hairs, without domatia; midrib slightly prominent above, strongly elevated and furnished with coarse, tufted, stellate hairs beneath; main nerves (12—) 16—22 pairs, visible above, conspicuously elevated and coarsely stellate-hairy beneath; nervules conspicuous, parallel, and with occasional stellate hairs on the lower surface; *petioles* thick, densely covered with coarse, stellate hairs, 0.7—0.8 cm long. *Inflorescences* axillary, solitary, simple or branched from the very base, much shorter than the leaves, up to 5.0 cm long. *Flowers:* "Stamens 15, connectives subulate-elongate, stylopodium conspicuous" (Schlechter 17480). *Fruiting*

fig.11 Hopea papuana Diels: *a,* leafy alyx segments at their base closely embracing the nut,the branch (x0.5); b base of leaf (nat.siz); 2 long wings oblanceolate, (sub) c,mature fruits(x 0.5).-Drawing after Ledermann 10432

obtuse at the top, strongly angustate towards the base, up to 10.0 cm long, 1.5—2.0 cm wide, above the very base only a few mm wide, glabrous, 7—9-nerved.

Tree up to 25 m high (Ledermann 10432) ; *crown* round and dense; *wood* brown (Brass & Versteegh 14001) ; *bark* greyish brown, *Leaves* shining dark green with whitish midrib. *Fruit* green; calyx-lobes white (immature?!).

Hopea papuana was recorded for the first time from the Territory of New Guinea, where it has been found in the Sepik region on hills in dense forest with scanty undergrowth of *Pandanus,* slender palms, and lianes, between an altitude of 50—120 m.

The above description has been completed and emendated as far as the inadequate material permits: new fertile collections are not available. Diels did not describe the flowers and I have not seen them; the brief diagnosis given above is taken from an annotation accompanying Schlechter 17480.

For comparison with other large-leaved species of *Hopea* from eastern Malaysia and the Philippines, see *H. novoguineensis.*

SPECIMENS EXAMINED.—NEW GUINEA. Western part: Idenburg R., Bernhard Camp, in primary rain-forest on ridge, 150m *(Brass & Versteegh 14001;* common; leaves only April 1939). — Eastern part: Sepik region, Malu, "in dichtem Urwald der Hfigelkette," 50—100 m *(Ledermann 101,32,* fr. Jan. 1913), Jatuna, in forests, 120m *(Schlechter 1748o,* fl. buds March 1908).

There are two sterile collections from Hollandia which resemble *H. papuana.* The first, bb.25089, is a small-leaved specimen, but the leaves have about the same shape, the same coarse pubescence, and the same colour when dry, while the petioles are as short as in Diels' species. The leaves of bb.28010 are of about the same size as those of Ledermann 10432, but they differ in number of the main nerves (24—28 pairs).

NEW GUINEA. Western part: Hollandia, in primary forest on hill north of the town, 50 m *(bb.25089;* tree 37 m high; buttresses 1.0 m high; bole dark, the bark scaling off in large patches; heartwood brown; *bb£8010,* without data).

A third collection cited below also resembles *H. papuana,* by the dense young parts of its branches. However, the leaves are elliptic, smaller, and much less scabrous, their base is nearly equal and the petioles are slightly longer. The flower buds are too young for description.

NEW GUINEA. Eastern part: Milne Bay area, near Mapo, in rather mixed oak forest, about 450 m *(NGF 1842,* fl. March 1945, emisopua; tree about 30 m over all; bole 15 m, no buttresses; outer bark brown with pale lenticels arranged in

longitudinal lines, scaly in a few patches; sapwoud pals straw; heart brown; wood fairly hard).

15. HOPEA ?SPEC. NOV.—Fig. 12

SPECIMEN EXAMINED.—NEW GUINEA. Eastern part: Morobe District, Ooinsis Creek at the foot of the Labu-Wau Road, on the slopes of a ridgy, mainly in the. gulleys, 215 m *(NGF 1251;* tret about 50 m over-all with rather sparse, narrow crown; bole about 30m, spur rootsd to about 0.75 m; outer bark dark brown, prominently longitudinally fissured; sapwood pale straw; heartwood brown; wood harder, heavier and darker in colour than that of *Aniscptem polyandra;* "fovaeolae present in axils of main nerves"). — Leaves only.

FIG. 12. *Ho pea ?spec. vov.:* a, leafy branch (x 0.5); *b,* base of leaf showing the domatia (nat. size). — Drawing after NGF 1251,

The last character is a very striking one because of the conspicuous domatia which are canaliculate with a glabrous ostium and which can be found all over the undersurface of the leaves: they are present in the axils of the very base and in those of the main nerves as well as in the axils of the nervules. They resemble those of *H. nabirensis* though they are smaller and more numerous; moreover, the named species is quite distinct in the shape of its leaves.

16. HOPEA GLABKIFOLIA C. T. White.—Fig. 13

Hopeu glabrifotia C. T. White in Proc. roy. Soc. Queensl. 43: 40. 1932.

TYPE.—Staniforth Smith *s.n.* from Misima I.

Topmosts parts of *young branchlets* puberulous; branchlets soon glabrous, drying blackish. *Stipules* caducous, lanceolate, puberulous on both sides. *Leaves* coriaceous, oblong or oblong-elliptic, attenuate, whether or not acuminate, the acumen about 0.5—] .0 cm long, base unequal, rounded on one side and subcordate on the other, in young leaves equal or nearly so and subcordate, the margin not revolute, 10.0—14.0 cm long, 3.5—4.5 cm wide, hardly shining or dull on the upper, dull on the lower, surface; midrib not or slightly elevated above, prominent beneath; midrib and main nerves initially hardly sprinkled with minute, stellate hairs beneath, very soon glabrous; main nerves 9—11 pairs, visible above,

elevated beneath, forming sharp angles to the midrib; domatia absent; petioles nearly immediately glabrous, 0.5—0.75 cm long. *Inflorescences* axillary and terminal, obviously always solitary, the rhachis and branches slender, greyish puberulous, up to 5.0 cm long; ultimate branchlets solitary, at most 1.5cm long, 3—4-flowered; pedicels very short; bracts minute, ovate, puberulous. *Sepals* unequal in length and in shape, the 2 outer ones fleshy, ovate, densely lepidote-tomentose outside, glabrous inside the upper half excepted, blunt or rounded at the top, very broad at the base and there 1.5 mm wide, about 2.0 mm long, in the upper half 0.75 mm wide, the 3 inner ones broadly ovate to orbicular, lepidote-tomentose on the portion exposed in bud, smooth inside, 1.5 mm long, 2.0 mm wide, the third one-sided, the 2 other ones two-sided, membranous. *Petals* oblique-oblong or subfalcate, attenuate at the very base, puberulous on the portion exposed in bud, fringed along one margin, about 6.0 mm long, 2.0 mm wide, many-nerved. *Stamens* 15, of different lengths, minute, 0.75—1.0mm long; anthers elliptic, about 0.25 mm in diameter; filaments flattened and about as wide as the anther, the longest filiform in the upper portion and nearly 0.75cm long; appendage to connective linear, four times as long as the anther. *Ovary* and stylopodium subcylindrical, narrowed above the ovary, together 2.0mm long, glabrous; stylopodium about 1.0 mm long, tapering in the style; style very short, 0.5 mm long. *Fruit* unknown.

FIG. 13. *Hopea glabrifcliu* C. T. White: *a*, flowering twig ()4P.5); *b*, flower bud (X3); c, mature flower (x3), d, ovary (X 7). — Drawing after Smith *s.n.*

With Vatica papuana Dyer, which also occurs in the Louisiade Archipelago, *H. glabrifolia is the most eastwards extending Dipterocarpacea.*

I have prepared the foregoing description, which is an extension and correction of that by White, from the type of *H. glabrifolia.* He erroneously mentions 10 stamens, the correct number being 15, whereas the petals are about 6.0 mm, not 3.0 mm, in length. Of *H. glabrifolia*, the genus is not to

be fixed with certainty, mature fruits being unknown. Obviously the third sepal undergoes a change in shape after blossoming as is the case in *Shorea forbesii* (see there). Hence it is possible that it may also grow out into a large segment. In shape the ovary with the stylopodium and the very short style resembles that of *Shorea forbesii*. However, the number of IB stamens points to a species of *Hopea*, in which genus it may by way of precaution be maintained for the time being.

SFECIMEN EXAMINED.—NEW GUINEA. Eastern part: Louisiade Archipelago, Misima I. *(SUtvifnrth Smith* s.n., rul; "a very useful mining timber").

Species inquirenda

Hopea parvifolia (Warb.) Van Slooten, *comb. nov.*

Anmoptera pfirvifolia Warb. *in* Bot. Jb. 13: 382. 1891; Brandis *in* J. Linn. Soc, Bot. 31: 45. 1895; Diels *in* Bot. Jb. 57: 461. 1922; Van Slooten *in* Bull. Jard. bot. Bwtenz. Ill 8: 5. 1926, *sphalm. "parviflora"; in* Nova Guinea 14: 225. 1926.

TYPE.—Warburg 20034.

Branches glabrous, fuscous, finely lenticellate. *Leaves* coriaceous, broadly lanceolate, attenuate and rather bluntly acuminate at the apex, attenuate at the base, 7.0—9.0 cm long, 2.5—3.5 cm wide, the margin subrevolute; upper surface glabrous and dull, lower surface glabrous and shining; main nerves 9—12 pairs, originating rather close (about 0.6 cm) to each other, widely spreading, elevated beneath, reddish yellow when fresh; tertian.- nerves joining the main nerves in fine parallel lines; *petioles* robust, transversely sulcate, black, 0.6 cm long. *Inflorescence* axillary, 1.1 cm long: peduncle slightly pubescent. *Flower buds* "von sparrig stehenden. lang lanzettlichen Schuppen eingehiillt." *Fruiting calyx segments* closely embracing the nut; the 2 long wings oblong-elliptic, glabrous, 7—9-nerved. *Nut* coriaceous, connate with the calyx-tube which is slightly pilose, nearly entirely hidden by the bases of the calyx-segments.

As I have not seen material of Warburg 20034 I have given here the original description in translation, though it is not very satisfactory. It is too incomplete for deciding whether it is a well-founded species and whether some of the unidentified collections may belong to it. For the time being it has to remain represented by the type only.

In 1922 Diels *(I.e.)* doubted the correctness of taking the specimen of Warburg for a species of *Anisoptera*. As early as 1926 *(II. ce.)* I suspected it to be a species of *Hopea*, the two large segments of the fruiting calyx being said to have seven to nine nerves.

NEW GUINEA. Western part: Onin Peninsula, Sekar Bay (McCluer Gulf), "an trocknem Abhang im Buschwald" near the coast *(Warburg 20034, type* of *Amsoptera parvifolia* Warb.).

Warburg (l.c., p. 70) says he also has this small tree—a sterile one—from "Kele Kay," which is geographically possible. This information, however, is not reliable, as species of Hopea with leaves only can not be identified from fragmentary specimens with any degree of certainty.

HOPEA SPEC.

Hopm, sp.imv. Dyer in *3.* of Eot. lfi: 100. 1878; Brandis *in 3.* Linn. Soc, Bot. 31: 05. 1895; Diels in Bot. Jb. 57: 402. 1922; Van Siooten *in* Nova Guinea 14: 225- 1928.

SPECIMEN EXAMINED.—NEW GUINEA. Western part: "Vogelkop," Arfak Mts. *{Beccari s.n.,* anno 1872).

The 'original' description by Dyer follows, since the material itself, consisting of fruits only, is not known to me:—

"Calyee fructifero obscure puberulo, lobis majonbus basi elliptieo, limbo onlongo-spathulato, apiee obtuso, infra plus minusvc abrupte coaretato, nervis erebis (ad 10) percurso. . . . Calycis fructiferi lobi aueti 1 1/2—2 poll, longi, 1/2—3/4 poll. lati. Capsula 1/4 poll, longa."

No essential, characteristics are mentioned here. Though Dyer may "have considerable confidence in its being otherwise unknown," the fragmentary fruits and their description are too unsatisfactory to be used for identification of further collections. In 1926 *(I.e.)* I could only state that according to Dyer the fruits agree in general facies perhaps more closely with his *H. pkilippinenRix* than with those of any other species. I did not see these fruits. Diels *(I.e.)* remarks: "Vielleicht mit einer der beiden vorigen [viz. *H. papuana* Diels and *H. celebica* Burck] identisch." For the time being I can only add that such fragmentary material will continue to be worthless to science, even if more complete collections become available.

HOPEA SPEC.

SPECIMEN EXAMINED.—NEW GUINEA. Western part. Japcn I.: Seroei, in primary forest on hilly ground on stony soil, 800m *(bb.30359* ajandorie; common; tree 27 m high; bark with a small quantity of clear resin). — Leaves only.

The leaf-bases are remarkably asymmetrical, being rounded on one side and cuneate on the other. Hence one would be inclined to look upon this number as representing *H. iriana* Van Siooten which also occurs on japen Island, though at lower altitude. Comparison shows that it is distinct in the following vegetative characters: the leaves are broader, less attenuate, and more suddenly acuminate, drying dark brown, the venation is more conspicuous, domatia are entirely absent.

HOFEA CELEBICA *sensu* Diels *(non* Burcfc)

Hopea celebica (non Burekl *scusn* Diels *iv* Bot. Jb. 57: 4G2. 1922.

Diels includes two specimens under Burck's species and merely states as follows:

'"Nordöstlieh.es Neu-Guinea: Sepik-Gebiet: Etappenberg, im Hohenwald, 850 m ii. M. '15—20 m hoher Baum, Blatter glanzendgriin mit weissem Mittelnerv[1] (Ledermann n, 9536. — Mit Bliitenknospen 31. Okt. 1912!); Aprilflusa (Ledermann n. 9846, — Verbliiht 25. Nov. 1912!).

"Ich habe von dieser Pflanze weder gut entwickelte Bliiten noch Friichte. Sie -zeigt aber in den Elattern so genaue Ubereinstimmung mit dem Original Burcks, daas ich an der Identitat nicht zweifle."

Although no description of the specimens exists, I doubted the correctness of this identification from the first, also because the New Guinea species of *Hopea* are as yet very insufficiently known, owing-to the material available of many species. In 1950 I could study a duplicate of Ledermann 9586, with very juvenile flower buds *(cf.* Diels, *I.e.),* in the Leyden Herbarium. It certainly reminds one of *Hopea celebica* Burck, but differs, for instance, in the total lack of domatia. In my opinion it represents a large-leaved species comparable to *H. similis* Van Slooten, *H.novoguineensis* Van Slooten, *H. glabrifolia* C. T. White, and *Hopea sp.* (Lane-Poole 113), although distinguishable from each of these by different characters. Ledermann's collection perhaps agrees best with *H. sìmilis* and *may* indeed belong to that species, although—judging from the material available at present—it does not fully agree with it. Intensive collecting in New Guinea will have to be done before it will be possible to assign the numerous doubtful dipterocarps of this region to their proper taxa; this applies more in particular to the numerous *specimina inquirenda* of *Hopea.*

Ledermann 9846 *(cf.* Diels, *I.e.)* I nave not seen, *ut* in the Leyden Herbarium there is a duplicate of Ledermann 9462, presumably belonging to the same species as Ledermann 9586. An error in the number seems hardly likely and yet number 9462 was not mentioned by Diels in spite of the fact that it was collected on the same expedition in the same region.

HOPEA PAPUANA *sensu* White & Francis *{non* Diels)

Hopea paptiqva (wow Diels) *sensu* White & Francis *in* Lane-Poole, Report For. Resources Terr. Papua and New Guinea 119. 1925[1]-; *in* Proc. roy. Soe. Queenal. 38: 247. 1927.

[1]In this publication one will find the specimen cited below referred to as *"H. papuana* Diels (Affin.)?"; in a "Corrigendum et addendum," "(Affin.)?" is indicated as to be deleted according to White. Lane-Poole no. 113 is considered to belong to Diels[1] species without further comment by White & Fi'ancis.

SPECIMEN EXAMINED.—NEW GUINEA. Eastern part: Vanapa *R.*, towards Suku (about 12 miles above Doura), up the foothills, to about 600 m [Lane-Poole 113, fr. June 1922, koka(ka)-p'lo-pilo.—""The winged seeds are a plaything for the native children."].

Describing the foothill forests, which lie between the lowland mixed rain forests and the mid-mountain forests *(op. cit.* p. 33), Lane-Poole *(op. cit.* p. 34) mentions that "two dipterocarps occur of which no. 113 is perhaps the commonest." I suppose that with the second dipterocarp Lane-Poole 112 is meant, cited by him *(op. cit.* p. 119) as "Indt, No. 112" and also from the surroundings of Suku with the native name demo. This num-, ber, of which only leaves were collected, I have not seen.

From the annotations made by Lane-Poole *(I.e.)* and from those accompanying the material in the Herbarium of Brisbane I have drawn up the following description comprising also some additions of mine.

Young shoots, branchlets, and *petioles* covered with a grey, stellate pubescence. *Leaves* chartaceous, elliptic-oblong or lanceolate, shortly and obtusely acuminate, obtuse or slightly rounded at the base, which is equal-sided, the margins slightly though conspicuously recurved up to the top when dry. 16.0—19.0 cm long, 5.0—6.5 cm wide; hardly shining and glabrous on the uoper surface, dull and with occasional stellate hairs along midrib and main nerves on the lower, the pubescent base of the costa excepted; midrib slightly elevated above, strongly beneath; main nerves 15—17 pairs, depressed above, elevated beneath, without domatia; tertiary nerves visible but not conspicuous on the lower surface; *petioles* 1.2—1.5 cm long. *Flowers* unknown. *Fruit* immature. *Fruiting calm-segments* concave at the very base, closely embracing the nut, the 2 long wings oblanceolate to spathulate, obtuse at the top, strongly narrowed downwards up to the base, glabrous or with remnants of a fine pubescence in the lower part, up to 9.0 cm long, 1.25—1.50 cm wide, 6—7-nerved.

Medium tree with an unbuttressed stem about 2 m in circumference . and a *bole* of about 18 m high. *Bark* dark brown, somewhat scaly; inner bark white. *Wood* slightly resinous; sap cream-coloured.

The above description in my opinion clearly proves this specimen not to belong to *Hopea papuana.* An annotation on the sheet says that "it differs in the non-cordate base of the leaf blade, the longer petioles and the fewer lateral nerves of the leaves." I would add that it also differs in the shape of the leaves, in the kind of pubescence of the branchlets and petioles which is not at all ferruginous-tomentose and does not cause the leaves to be scabrous beneath, and in the nervation which is not elevated.

By the shape and the size of its leaves this species comes nearest to H. *novoguineensia* and *H. similis,* the material being too fragmentary for further conclusions.

It is not impossible that the following; collections represent the same species as Lane-Poole 113.

NEW GUINEA. Eastern part: Vanapa area, Koitaki, forest, 450m *(Carr 12739;* very young fruits June 1935); Milne Bay area, north of Waigani plantation on the slopes of an ironstone-gravel capped ridge, 25 m *(NGF 1280,* lomas or koperitoma; tree about 30 m over-all; hole 18m, swollen slightly at the butt; outer bark purplish brown, pustular lenticela numerous and forming longitudinal lines, shedding here and there in thin flakes; sapwood pale straw; heart very pale brown). — Leaves only,

HOPEA SPEC.

SPECIMEN EXAMINED.—NEW GUINEA. Eastern part: Milne Bay area, north of Waigani plantation, on ridge in rain forest, 80 m *(NGF 1307,* kopilatoma; tree about 43 m, bole 30 m high, buttressed to about 1.8 m; outer bark fairly dark brown, reticulately marked from the shedding of irregularly shaped flakes; sapwood pale straw: heartwood brown, fairly hard; leaves yellowish green beneath). — Leaves only.

A small-leaved species of *Hopea* without domatia, resembling *H. glabrifolia* but differing by the topmost parts of the young branchlets and by the petioles which are glabrous almost from the start; the leaves are different in shape and the veinlets of this unnamed species are not visible to the naked eye.

HOPEA SPEC.

NEW GUINEA.(BB..*32698.)*

Of this collection no duplicate from the Forest Research Institute at Bogor was received by Herbarium Bogoriense. This material as well as the data were lost during the war.

HOPEA or SHOREA SPEC.

Of the two following collections the genus could not be fixed with certainty; they may belong either to *Hopea* or, perhaps, to *Shorea.*

MOLUCCAS. Morotai: Tjao, 30m *(Kostermans 828;* tree 12m high; hole grey). — Leaves only.

NEW GUINEA. Eastern part: Milne Bay area, about 2 miles up the Dawa Dawa R., on slopes, 25 m *[NGF 1333,* malehai or mala(a)i, and matapo; very common on the slopes; tree about 30m over-all; bole 18 m, unbuttressed; bark grey or brown, deeply fissured, shedding in longitudinal strips; sapwood straw coloured and hard; heart brown; leaves small].'— Leaves only.

SHOREA Roxb.

17. SHOREA KOORDERSII Brandis apud Koorders—Fig. 14

Shoira koordcrsii Brandis *upud* Koorders, Flora N. O. Celebes *iv* Meded. 's Lands Plantentuin 19: 355. 1898; Koorders, Flora N. O. Celebes, Suppl. 2: 8 *pi.HI.* 1922; ibid., Suppl. S; 44. 1922; Boerlage *in* Icon. bog. 1: *pi. 80.* 1901; Koorders Schumacher, Syst. Verz., Abt. 3: 88. 1914; Heyne, Nutt. PI. Ned. Ind. 3: 303. 1917; 2nd Ed., 1120. 1927.

Shorca ass<tmicit Dyer forma *koordcrsn* (Brandis) Symington in Gtlns' Bull., Str. Settl. 9: 331. 1938.

Vatica celebica Koorders in sched. in Herb. Bog. (1895) : Symington *in* Gdns' Bull., Str. Settl. 9: 331. 1938, pro synon.

TYPE.—Koorders 16736 β((according to the annotations on the sheets). — Illustrative specimen: Van Hulstijn 362.

Branches covered by a greyish brown tomentum of simple hairs of different lengths (reduced tufts of stellate hairs), glabrescent, with slight ly elevated ribs decurrent along; the internodium from the insertion of the leaves. *Stipules* of young branches of adult trees or of young trees con spicuous, subpersistent, oblong elliptic, attenuate, 7—9 nerved, finely pubescent on both sides, 1.0—2.0cm long, 0.5—1.0cm wide; stipules of adult branches caducous. *Leaves* flat, ovate, subattenuate, acuminate, the acumen blunt and 1.0 cm long, rounded or even subcordate at the base, 5.0—12.0 cm long, 2.5—7.0 cm wide (or even larger, the leaves of trees which represent immature stages such as seedlings and those of young trees reaching a size of 22.0 by 10.0 cm; the acumen may be 1.5 cm long) ; sublucid and glabrous on the upper surface the midrib excepted, dull and with a hardly visible pale brownish tomentum which is papillose to *the* touch beneath, giabrescant; midrib elevated beneath; main nerves 10—15 pairs, visible above, hardly elevated beneath, slightly pubescent on the lower surface; domatia barbate, only few in number and hardly developed, although usually absent; nervules joining the main nerves in parallel lines; *petioles* tomentose, up to 0.75, in young leaves up to 1.5 cm long. *Panicles* axillary and terminal, widely spreading, lax, the rhachis and branches greyish or pale brownish tomentose, up to 15.0 cm long; bracts, caducous, oval oblong, 7 nerved, finely pubescent on either side, 0.7—1.0 cm long, 0.3—0.5 cm wide; bracteoles caducous, linear, pubescent on either side, 3.0 mm long, 0.5—0.75 mm wide; pedicels 1.0 mm or shorter. *Sepals* different in length, fleshy or partly membranous, many nerved, greyish brown pubescent outside and on the upper half inside, the 3 outer ones oblong, broad and blunt at the top, 4.0—5.0 mm long, 1.5 mm wide, the very base 2 mm wide, the third sepal one sided mem branous, the 2 inner ones triangular oblong, attenuate, acute, 3.5—4.0 mm long, membranously dilated downwards, 1.5 mm wide. *Petals* membranous, oblong, 0.8—1.0 cm long, 0.4 cm wide at the base, truncate or subretuse at the top, densely sericeous tomentose on the portion exposed in bud, smooth inside, about 10 nerved. *Stamens* 15, in 2 rows, of 2 different lengths, the 5 inner ones 3.5—3.75 mm long, the 10 outer ones 3.25 mm

long, all 0.3 mm wide at the flattened base; filaments linear in the upper half; anthers 0.75 mm long; appendage to connective 1.5—1.75 mm long. *Ovary* tapering into the style, pubescent, 1.0—1.5 mm long; style pubescent at the base, for the rest glabrous, 3.5—5.0 mm long. *Fruiting eabjx segments* (after Heyne *s.n.* from Obira I.) chartaceous, on both sides stellate-

FIG. 14. *Shorca koordersii* Brandis: *a,* shoot with stipules (X 0.5); *b,* flowering branch (x 0.5); *c,* flower' bud (X 2); d, expanded flower (X 2) ; *e,* petal (X 2) ; f, stamens (X 51 ; *(g,ovary* (X 3) ; *h,* mature fruit (X 0.5). — Drawing after Van Hulstijn S62.

puberiilous, concave at the very base and there 0.7—0.8 cm long, 0.6—0.8 cm wide; the 3 Ions wings linear-(ob)lanceolate, gradually widened towards the obtuse or rounded top, 8.0—10.0 cm long, near the top 1.2—1.8 cm wide, the base flat, slightly narrowed and 0.4—0.5 cm wide, 9—11-nerved, nervules conspicuous, the 2 short wings linear, abruptly narrowed above the very base, acute or subobtuse at the top, 3.0—4.5 cm long, 0.4—0.7 cm wide, 3—5-nerved. *Nut* ovoid, attenuate, crowned by the remnant of the style which is up to 1.0 cm long, finely pubescent the base excepted, about 1.0 cm long and 0.8 cm wide at the base.

Concerning *S. koordersii*, the producer of the valuable damar tenang, which as to appearance, clearness, purity, and colourlessness so strongly resembles the damar mata kuching^that Heyne calls it *"the damar mata kuching of the Moluccas."* Ham, who in 1900 investigated the forest products and their exploitability on Pulau Obira, and a few other authors cited below" furnished some data which were made use of in the following.

Of this forest giant, which has an average height of from 45 to 50 m, Ham *{op. cit.* p. 318) on Pulau Bisa measured a specimen which was 60 m high and heavily *buttressed.* Koorders records that in one instance he found these buttresses to measure 2.5 m in diameter (at breast height). However, even very heavy trees do not always have buttresses: they were absent in three trees, the respective heights of which were 30, 45, and 53 m. The *bole* is very straight and hence suitable for the building of lcpa-lepa (prahus) ; the diameter may be as much as 1.5 m (circumference approximately 4.7 m). The crown starts high: the height from the ground to the first branch may be 30, occasionally even 38 m. The *bark* is superficially and longitudinally fissured and hardly scaling off (bb.23121 and 28878) ; along the branchlets the bark is dark brown-red to blackish, along the bole dark grey. Judging by herbarium specimens it usually contains a small quantity of white or hyalin resin; according to literature on the subject, however, only the pith contains resiniferous tubes. Endert ("Hars-onderzoek," p. 288) ranges the resin among the "beautiful mata kuching species." Spontaneously exuded resin is quantitatively insignificant. Bloembergen[10] only found lumps the size of a marble on the trees on the Sula

[ft]J. STORMER: Schets del- Obi-eilanden. *In* Tijdschr. Ind. Taal-, Land- en Volkenk. 32: 620-636. 1883.

J. STORMER *apnd* Encyclopaedisch Bureau: Het Sultanaat Batjan. *In* Meded. Bureau Beatuursz. Buitenbez. Afl. 1: 39-42. 1911.

S. P. HAM: Over de damarwinning in Obi (III. Damar tenang). *In* Tectona 4: 317-334. 1911.

V. E. KORN: Het damarbedrjjf in het Sultanaat van Batjan. *In* Tydschr. binnenl Bestuur 51: 277-294. 1917.

[1fh]S. BLOEM.BERGEN: Verslag van een exploratie-tocbt naar de Soela-eilanden {Juli—Oct. 1939). — This report which as yet exists only as a manuscript, was kindly put at my disposal by the author.

Islands , where the resin was never collected on a large scale. According to Korn *(op. cit,* p. 281) this spontaneously exuded resin is a solid, translucent pale yellow substance which is slightly sticky to the feel. It may , however, also be practically colourless, green, or brownish. According to Ham *(op. cit.* pp. 326-331) S. *koordersii* does not react on wounds by increased exudation, this exudation setting in and increasing strongly as a result of a kind of disease due to infection. This phenomenon is to be observed mainly in the crowns of the trees, where each wound caused by fracture is liable to become infected." Ham sets out in detail a number ofarguments which he thinks conclusive proof of this theory. Korn *(op.* cit. p. 280), on the other hand, prefers to subscribe to the view of the collectors of damar, who are of the opinion that strong winds contort the branches, as a result of which the resin is squeezed out. He states that the branches show distinct indications of strain at the places where resin oozes out. In any case the resin is not found in all trees: as a rule the resiniferous tenang trees are among the tallest and heaviest of their kind, so that climbing may be considered out of the question. For the sake of the resin production—and because of the fact that they are supposed to produce resin only once during their lifetime and to die afterwards (Stormer, *op. cit.* p. 41)—, the trees are simply cut down, which on Pulau Obira and later on also on Pulau Bisa resulted in a marked decrease in the number of resiniferous trees. As to Batjan, where according to Korn (op. *cit.* p. 280) the resin is called damar mata kuching or damar tenang, but also salo tena (language of Ternate) he found *(op. cit,* p. 293) that on this island not the slightest attention is given to young damar plants112 owing to the fact that the damar collecting population stays on Batjan only temporarily and ultimately returns to Halmahera, so that they are not interested in what happens to those who will' come after them. "As a result the damar trees have in the course of a few years' time disappeared from a several miles' wide strip of mountains along the beach and are at present to be found only on ever higher and more inaccessible places . ..." Heringa[1.1] calls *S. koordersii* on Obilatu the producer of the damar buwah or mata kuching. He reports that this *Shorea* does not produce any resin on tapping, not even after months and years, so that in order to collect the damar the tree is always felled. This statement is confirmed by Korn *(op. cit.* p. 293), according to whom the damar tenang trees are cut

[11]See for the controversity between J. G. B. Beumee and K. Heyne as to whether or not the resin is exuded solely as a result of wounds, Tectona 10: 299, 701, 702. 1917.
[12]This applies not only to damar tenang, but also to damar radja *(Aguthis)* and damar hiru *(Vatica papvana)* and the damar producing Burseraceae.
[1.1]*In.* Tectona 14: 809. 1921.

('own, whether they sire old or young, big or small. As late a^ 1935 Endert ("Harsonderzoek," p. 288) admits that the data concerning the possibilities of tapping are rather vague and that further investigation is badly needed, nhereas in "Herkomst Damar" (p. 3) it is, moreover, stated that tentative tapping experiments in Celebes were disappointing. Concerning the resin itself'is recorded that the product which was finally obtained by a certain tapping method proved after one year already brittle and full of air-bubbles: it turned out to be so-called damar mati. — The *wood* is said to be very durable. and useful and to be suitable for house-building, inside work, and furniture, as well as for prahus. During the flowering season from February till July the trees may be loaded with flowers, making the crowns appear white. *Flowers* whitish or cream-coloured with pink.

Shorea koordersii is the only Dipterocarpacea which is found on Celebes as well as in the northern Moluccas, i.e. the Sula, Batjan, and Obi Islands (fig. 15). In C e 1 e b e s it is the only representative of the genus. In South Celebes it occurs in the Malili District[14] of the south-eastern peninsula, where it is common and grows even gregariously (bb.33086, 33087, and 33088; see also a few lines farther down). From Central Celebes, it is known from two localities, viz. from the Parigi District (bb.17510) where Steup found it to be fairly common, and from Poso. In the Minahasa (North Celebes) from where it was first known, S. *koordersii* is also locally fairly common and ranks among the tallest and biggest trees of the forest. In one part of the Minahasa, the Moreah Mountains, *S, koordersii* is—according to Steup15—so numerous in association with *Albizzia minahassae,* that here one may speak of a *Shorea-Albizzia* forest. The upper stratum at any rate consists of these two

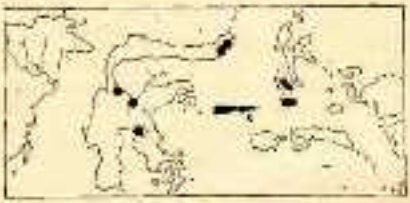

FIG. 15. Distribution of *Shorea koordersii* Brandis.

[14] It is not known to me {from material) that S. *koordersii* also occurs in South Kendari, though Steup—*cf.* next footnote—states that he was told that 5. *koordersii* forests are to found there.

15 F . K. M. STEUP: Over vegetatietypen op Celebes. *In* Natuurk. Tijdsehr. Ned. Ind. 98: 283-293. 193S.

Species, which also occur in combination along the main road from Masamba to Malili *(op. cit.* p. 291).

The following data concerning the Sula Islands have been derived from communications by Dr. S. Bloembergen *(I.e.).* He calls the dipterocarp forest the most common forest type on these islands. It comprises *S. koordersii, S. selanica,* and *Vatica papuana* and grows mainly on older rocky soils with the exception of lime. On Sula Sanana, kaju pien is very common and grows there in great numbers of gigantic specimens (60 m and upward) on soils which are rich in humus; the dipterocarp forest may locally be cut down to a very considerable degree. On Sula Mangole, S. *koordersii* is less predominant than it is on Sula Sanana; the 60 m giants are also absent, probably owing to their being used for the building of prahus. Near Lampaii the intact primary forest reaches down to the coast ridge; in this hilly country, situated at from 5 to 10 m above sea bvel, all three dipterocarps mentioned above are common. On Sula Taliabu, kaju pini is also found.

In the Batj an Archipelago S. *koordersii* is very common in the Sibela Mountains, according to a statement by Korn *(op. cit.* p. 231). These mountains take up the greater part of the southern peninsula of lulau Batjan. On Pulau Mandioli it is also common.

As regards the Obi Archipelago, Stormer *(op. cit.* p. 630) states that the damar tenang is found on all of the islands. He mentions the hilly Pulau Bisa (= Pulau Selili) as the principal locality. According to Ham *(op. cit.* p. 319) the tree grows on Pulau Obi(ra) on the northern, western, and eastern coasts: along ths west coast dense forests of these trees are by Stormer *(op. cit.* p. 630) reported to grow. It is also found on Pulau Tapat and on Pulau Ombilatu. Since the damar tenang is found neither in pure forests, nor as predominant timber species, it is permitted, Ham *(op. cit.* p. 319) says, to speak of damar tenang *areas,* but not of damar tenang *forests.*

Shorea koordersii is a forest giant of the primary forest and occurs, according to Ham's own observation as well as according to information supplied by the native population, preferably near the sea and in the lowlands and coastal plains. In the lowland plains it is commonly found, but it is not rare on ths lower hills either. It grows on dry soils, whether or not along rivers or rivulets; only once it has been reported (bb.32363) to grow on soil which is periodically, during the rainy season, inundated by peaty water. It is apparently found as a rule on fertile ,soil: on clay as well as on (volcanic) sand; on Pulau Bisa (bb.23885) the matrix consists of coral. Usually it is (very) common locally, though growing in scattered

specimens, sometimes also gregariously, however (Malili, Parigi). Its range of vertical distribution lies between 15 and 500 m.

Taking the migration of the Dipterocarpaceae from the west to the east as an established fact, it may be assumed that *S. koordersii* has come from 'the Philippines either *via* the Sangi (Sangihe) Islands or by way of the Talaud Islands, or *via*, both bridges, in view of the fact that it occurs in Celebes as well as in the western Moluccas. This hypothesis gains in probability if this species and 5. *philippinensis* are looked upon as being two forms of one and the same, in the west widely distributed, species (S. *assamica)* as is done by Symington *(I.e.).*

Concerning *S. assamica* Dyer and *S. philippinensis* Brandis we find the following remarks by Symington *(op. dt.,* 1938, pp. 332, 333) about *S. koordersii* Brandis (and S. *globifera* Ridl. from the Malay Peninsula and Sumatra) :

"I have here united under one specific head four 'species'—*S. assamica* Dyer (from Assam), *S. philippinensis* Brandia (from the Philippines), *S. Koordersii* Brandis (from Celebes), and *S. globifera* Ridl. (from the Malay Peninsula). Having examined a considerable amount of material of each I do not think that specific differentiation of these forms is justified, but there are certain fairly constant definable minor differences such as one would expect in distinct geographical races of a widely distributed species. I have, therefore, recognized four forms—forma *assamica* (from Assam and Burma), forma *philippinensis* (from the Philippines), forma *koordersii* (from Celebes and the Moluccas), and forma *globifera* (from the Malay Peninsula and Sumatra).. . .

"The various forms have been fairly adequately described under the names of iS\ *assamica, S. philippinensis, S. Koordersii,* and *S. globifera,* but concerning Foxworthy's description of the flowers of the last-named, I would remark that I have been unable to verify the presence of more than 15 stamens, the species being typical of the section *Anthoshorea* Brandis.

"In the following Key the main differences between the forms are enumerated.

"(1) Branchlets of raceme usually simple, solitary, and alternate; stigma distinctly 3-partite; fruit wings up to about 10.0 cm long; appendage to connective about l 1/2 times as long as the anther. . . . . forma *assamica*

"(1) Branchlets of raceme frequently bi-furcate or fascicled

"(2| Stigma usually distinctly 3-partite; fruit wings up to about 10.0 cm long; appendage to connective as long as the anther , , . forma *globifera*

"(2) Stigma simple, flattened, or obscurely lobed; fruit wings up to about 7,0 cm long; appendage to connective about twice as long as the anther . . (3)

"(3) Leaves usually closely peltate and smooth beneath . . forma *koordersii*

"(3) Leaves usually sparsely soft-stellate-hairy beneath

forma *philippinensis."*

So the species which we in Indonesia have been accustomed to call *S. koordersii* and *S. globifera* are looked upon by Symington as geograph-

ical races "of a remarkably widely-distributed species occurring from assamto the Moluccas. This species has been described separately in several different localities .... These are here united under the oldest spesific name S. *assamica* but the various geographical races, which do exhibit slight differences, are recognized as formae . . .." *(op. cit.* p. 334).

It may be admitted that the differences have possibly no specific valueand that Symington is right in reducing the four species to one only, viz. *S. assamica,* the first name to be published. Yet, I shrink from following him; personally I am inclined to persist in considering the four named fhoreas as distinct species, although I hardly consider the cited differences as satisfying. this , however, is a matter of opinion. The main point in This question is the resultant extensiveness of the area of distribution of S. *assamica.* Such a vast area would be a very great exception in the distribution of the Dipterocarpaceae (as for instance in *Anisoptera costata;* see this paper, p. 8).

All species of *Shorea* mentioned here belong, according to Symington (in Mal.. For. Rec. 16: 27, 1943), to the meranti pa'ang group, which forms "a natural, homogeneous group, which corresponds botanically with section *Anthoshorea-* of the genus *Shorea* as defined by Brandis" *(in* J. Linn. Soc, Bot. 31: 84. 1895). To the same group belong, for instance, *S. javanica* K. & V., S. *lamellata* Foxw., *S. virescens* Parijs, *S. retinodes* Van Slooten, and *S. soroHa* Van Slooten (see Bull. bot. Gdns Buitenz. Ill 18: 230-251. 1949) and also several undescribed species from Sumatra aa well as from Borneo, which have been collected fragmentarily. All these show a distinct agreement in their many-nerved leaves, rich- and relatively large-flowered inflorescences, and in the form of their fruits. It does not, in connection with the above, seem right to me to lump species of such diverse regions before more is known about the elements constituting section *Anthoshorea.*

I have no sufficiently founded opinion about S. *assamica* itself. The scantly material I saw cannot induce me to share Symington's view.

I should not be surprised if it would appeal[1] that *Aporoaa? minahassae* Koorders (Fl. N. 0. Celebes *in* Meded. 's Lands Plantentuin 19: 588, 625. 1898; Koorders 18743/0, described as a Euphorbiacea, is a Dipterocarpaceous plant and more in particular synonymous with S. *koordersii,* simultaneously published, because the latter is the only *Shorea* species known in the region of S. *koordersii.* — The specimen in question is apparently juvenile and gall-bearing. I am not prepared to give a definite opinion in this matter.

SPECIMENS EXAMINED AND CITED FROM LITERATURE.—CELEBES. Manado, Minahasa: Tondano *(Koorders 16742β[2882],* malue) ; Pinamorongan Mts., Kakas *(Koorders 16739β[1321]* and *1679β[899*,* haro or waro(h); Kajuwatu *(Koorders 16737[1453]** and *16738β[1574*,* haro or waro); Bivouac Pingsan near Kajuwatu *{Koorders 16741β [1293], 16736β[1222], 16735β[1794],* and *15982β[1086],* waro or rama willing); Bivouac Totok near Ratatotok *(Koorders 16740βi[2577],* induk or waro; *16734β[2527],* asi asin). — Central Celebes: Parigi near Pebengko *(bb.17510),* Poso *(bb.19i.29,* tambija). — South eastern peninsula: Malili District, Angkona *(bb.32363),* Usu *(bb32605),* Lauwo *(bbJi3086, 33087,* and *330S8),* Toletole and surroundings *(bb.21664* to *21668, bb.2384d,* and *28920)*—all of these Malili specimens, (damar) lari larie; Kawata near Toletole *(Cet.fV 260,* wara wara or tamungku, and *Cel /V 378* to *381,* lari larie).

MOLUCCAS. Sula Is.: P. Taliabu, Tg, Niu *(van Hulstijn 362,* honi), Samuja *(bb.29925,* pini fatau or honi); P. Mangole: Mangole *(bb.29769* and *29799,* pini or pini botti) ; P. Sanana (Sulabesi) *(van Hulstijn All,* pien; *bb.28878,* pien or tenang). — Batjan Is.: P. Batjan *(Warburg 18180™),* Kaputusan *(bb.164 61* and *16AS2* damar tenang putih and damar tenang merah resp.), Masurung *(bb.2S121, 23132, 23145,* and *2314 7,* damar tenang putih), Saoran Domut *(bb.2S184,* damar tenang putih or tenang bobudo), southern peninsula on Mt. Sibela *(vide* Ham and Korn, *It. cc.) ;* P. Mandioli *(vide* Stormer, 1911, and Korn, tf.ee.). — Obi Is.: P. Bisa, Tsouthcoast near Gafela *(Atasrip 54* and *55,* damar tenang; *cf.* Ham, *op.cit.* p. 318), NW point near Galala *(Atasrip 97* and *98,* damar tenang: also *fide* Stormer, 1889, *I.e.),* Wadapolo *(bb.23885,* tenang putih); P. Tapat and P. Obilatu *(fide* Stormer, 1889, *I.e.);* P. Obira *(fide* Ham, *op.cit.* p. 319; Stormer, 1889, *I.e.),* Laiwui *(Obi Co mpanie, e coll. Heyne s.n.,* damar tenang).

18. SHOREA SELANICA (Bl.) BL—Fig. 16

Dammam selanica [Bu.mpk.] Lam., Encyc. 2: 259. 1786.

Unona? selanica (Lam.) DC, Prodr. 1: 92. 1824.

Engelhardtia, selanica BL, Flora Javae 1 (Juglandeae) : 8. 1828,

Hopea selanica Hasskarl, Cat. Hort. bogor. alter 209. 1844 (sub *"Hoppea"* ut *"H. Selanica* Rxb. . . ."); Miquel, Fl. Ind. bat. 1 (2) : 504. 1859.

Shorea selanica (Bl.) Bl., Mus. bot. 2: 33. 1852; De Candolle, Prodr. 16: 629. 1868; Hance *in* J. of Bot. 14: 242. 1876; Burck *in* Ann. Jard. bot. Buitenz. 6: 21G. 1887; Brandis *in* J. Linn. Soe., Bot. 31: 86. 1895; Merrill, Interpr. Rumph. Herb. amb. 375. 1917; Heyne, Nutt. PI. Ned. Ind. 3: 306. 1917; 2nd Ed., 2: 1124. 1927.

Shorea aelaniea Bl. var. *latifolia* Bl., Mus. bot. 2: 33. 1852; Burck *in* Ann. Jard. bot. Buitenz. 6: 216. 1887; Merrill, Interpr. Rumph. Herb. amb. 375. 1917.

Shorea selanica (Bl.) Bl. var. *obtusa* Burck *in* Ann, Jard. bot. Buitenz. 6: 216. 1887.

[Dantmara selanica Rumphius, Herb. amb. 2: 168 *pi. 56.* 1750.]

16 E. Gilg mentions in his "Bemerkungen zu den ‚Botanischen Notizen' des Herrn Dr. Moszkowski" *(in* Notizbl. bot. Gart. Mus. Berlin D. 43: 83. 1908), that he possessed a sterile branch of a tree which supplies damar mata kuching. "den Warburg (n. 18180) von Batjan mitbrachte." This must have been *S.koordersii* as *S. selanica* is not known from Batjan,

TYPE.—Rumphius, Herb. amb. 2: *pi. 56.* 1750.

Buds, young shoots, branchlets, and *branches* densely rusty or greyish stellate-tomentoae; branchlets flattened, with distinct and long elevated ribs decurrent along the internodium. *Stipules* caducous, oval, oblique, one-sided attenuate, broad at the base, stellate-tomentose outside, pubescent

FIG. 16. *Shorea nelavica* (Bl.) Bl.: *a,* flowering' twig with flowers in two stages {x 0-5); 6, shoot with stipules (nat. size); *c,* branchlet of panicle {nat. size); *d,* flower bud (x2.5); *e,* mature flower (X 2.5); f, petal (x 2.5); *g,* stamens (X 5); *h,* ovary (X 5); *i,* mature fruit (nat. size). — Drawing after Hort. Bog. VII. B. 25.

inside, 1.5 cm long, 0.7—0.9 cm wide, 6—8-nerved. *Leaves* drying brown on both sides, oblong, abruptly attenuate and acuminate, the acumen acute, up to 1.5 cm long, rounded or subcordate at the slightly asymmetrical base, usually 10.0—20.0 cm long, 4.5—7.5(—9.0) cm wide; upper surface dull or slightly shining, minutely stellate-pubescent, glabrous when adult the midrib excepted; lower surface dull (or slightly shining when young), sprinkled with scale-like tufts of brownish stellate hairs on midrib, nerves, and nervules; midrib prominent beneath; main nerves 16—20 pairs, elevated beneath; domatia hardly developed, nearly invisible by the indumentum of the leaves, may best be observed by the small depressions in the upper surface; nervules visible on both sides; *petioles* rusty or greyish stellate-tomentose, 0.8—1.4 mm long. *Inflorescences* terminal and axillary, the rhachis and branches flattened, densely greyish tomentose, up to 20.0 cm long; the upmost floral leaves lanceolate, only present in anthesis, 9.0—12.0 em long, 2.5—3.0 cm wide, the lower ones equalling the normal leaves, persistent; branches alternating, unbranched, up to 2.5cm long, about 12-flowered; bracts transversely oval, bilobed, pubescent on both sides, 3.0—4.0 mm long, 4.0 mm wide, about 14-nerved. *Flowers* unilateral, approximate, biseriate; pedicels at best 0.5 mm long. *Sepals* distinctly unequal, ovate to subtriangular, (sub) acute, 3.0—2.0 mm long, at the base 2.0 mm wide, the portions exposed in bud minutely greyish tomentose, smooth inside except on the upper half, many-nerved, the 2 outer ones fleshy, the third one-sided, the 2 other ones two-sided, membranous. *Petals* oblong, gradually attenuate, truncate, minutely puberulous on the portion exposed in bud, glabrous inside, 6.0—7.0 mm long, at the base 3.5 mm wide, about 10-nerved. *Stamens* 15, in 3 rows, of 3 different lengths, from the outside to the inside 2.3—3.0 mm long; dilated portion of filaments 0.5—1.0 mm, filiform portion about 0.3 mm, anthers 0.5 mm, and appendage to connective 1.0 mm long. *Ovary* gradually tapering to the style, distinct stylopodium absent, minutely pubescent, 2.0 mm long; style glabrous, 1.5 mm long". *Fruiting calyx segments* chartaceous, minutely puberulous on both sides, concave at the very base and there about 0.7 cm long and 0.5—0.8 cm wide, closely embracing the nut; the 3 long wings linear-lanceolate to spathulate, the base narrowed, flat and 0.4 cm wide, blunt at the top, 8.0—10.0 cm long, near the apex about 1.5 cm wide, 7—9-nerved, the 2 short wings linear, abruptly narrowed above the very base, acute at the top, 3.0—4.5 cm long, 0.4—0.6 cm wide near the apex, 3—5-nerved. *Nut-ovoid*, acutely apiculate by the style remnant, minutely greyish brown tomentose, 1.2—1.5 cm long, at the base 0.8 cm wide.

Gigantic trees reaching a height of 50, even 58 m, being 34—42 m to the first branch and 1 m in diameter on breast height. *Bark* dark in colour, deeply fissured and flaking off in longitudinal pieces; strips of bark are said to be used for the walls of small houses (Martin, *op. cit.* p. 302; *see* footnote 17). According to Ham *(op. cit.* p. 336) not all bau Iamo trees produce resin in large quantities, which is found only in the pith. For these reasons he thinks the production of a large amount

to be a result of injury and infection as in *S. koordersii.* Usually the quantity produced spontaneously is inconsiderable; the resin itself is of inferior quality and has no commercial value. It is solid, not translucent, and whitish yellow if young and found on the bole and the branches; it is blackish, porous, and rough if found in lumps at the base of the tree. It is used by the natives for torches and other lighting purposes. In "Herkomst Damar" (p. 17) its author thinks it possible that the damar sêlan does not originate from a single species of *Shorea,* at the present time four species being known from the Moluccas, viz. S. *selanica, S. koordersii, &. montigena,* and *Shorea sp.* (bb.22808 and 31349). The *wood* is said to be hard and suitable for house-building and prahus and also for masts as the trees have beautifully straight boles, which have a considerable diameter according to their age. Branches and ultimate parts pale green or pale brown when fresh and young, ultimately greyish coloured. *Leaves* dark green and shining above, with a pale or pale brownish indumentum beneath. Pedunculus and branches of *inflorescences* pale green. *Sepals* cream-coloured. *Petals* pale yellow.

For the distribution area of this species, *see* map (fig. 17).

In literature the statement repeatedly occurs that the kaju bapa, found particularly on the island of B u r u, is very common on this island.

FIG. 17. Distribution of *Shorea selanica* (Bl.) Bl.

It is growing distinctly gregariously, dominating the lowland forests from 15—120 m above sea level. In spite of this there is little and only incomplete material of *S. selanica* available in Herbarium Bogoriense and since the literature cited above is based solely on the remark Rumphius made about his *Dammara selanica,* without describing it accurately, the above-mentioned description is exclusively founded on no. VII.B.25 cultivated in the Gardens at Bogor, a tree which has developed from the material sent from Buru by Teysmann in 1860 (see below).

Various data, e.g. about habitats on Buru of the kaju bapa, which belongs to the valuable wood species and produces the damar sêlan, could

be derived from records of travel.[17] The statements about the large quantities of damar found everywhere on Bum, and the conclusions that might possibly be drawn from such statements regarding the area of distribution of these damar-producing trees, had to be put aside since they refer not to the damar selan of the kaju bapa, but to the damar radja of *Agathis (Damara) alba* Foxw., which is one of the highest and largest trees of the Moluccas and is also common on Buru. This may appear, *inter alia*, from the following statement by Teysmann *(op. cit.* pp. 319-320): "The best damar (Damar toenei)[18] is here [viz. near Oki on the south coast] mainly obtained from the *Damara alba*, but an inferior quality (Damar seelan) from the Kajoe bapa, *(Hopea selanica)* which are both very common in the interior." For this reason the following statement concerning the *Dammara selanica* of Rumphius *(op. cit.* p. 170), who repeatedly mixed up damar producing Dipterocarpaceae, is cited with some reserve: "... [eopiose vero est] in Boero circa Lucielam veterem [i.e. Lisela] & Kelangam [i.e. P. Kelang, situated between Buru and Ceram] .... Invenitur autem aeque in litore, ac in altis montibus, nullibi autem in planis silvis, sed semper ad pedes montium declivos, qui juxta oras fluminum ac maris sunt siti. Hinc in Boero haec *Dammara* fluctuans reperitur aeque ad litus, ac in majoribus fluviis, qui in sinum Cayli [i.e. Kajeli] excurrent. In hujus sinus parte Orientali quaedam arbores in montium adscensu ita alte eriguntur, ut coma sua in mare declinent." This floating damar[19] Teysmann did apparently not see near Kajeli; he does not mention it at all, anyway, no more than J. H. W. van der Miesen does.

About the environment of Kajeli on the north-east coast of Buru, Wilier *(op. eit.* p. 559) says: ". . . After that, the kaju bapas and other trees with tall boles are in the majority and soon form a dense forest of the very high and most beautiful trees. The height of an average kaju bapa is more than 100 feet from the ground to the main branches and is very suitable for the making of masts; the bole is as a rule perpendicular," whereas he remarks about the habitat (op. *cit.* pp. 561-562): ". . . the

"J. E. TEYSMANN *in* Natuurk. Tijdschr. Ned. Ind. 23: 290-309. 1861.

J. H. W. VAN DER MIESEN: Een tocht langs de noord-oostkust van Boeroc, 6—29 **Jan.** 1908. *In* Tijdschr. Nederl. aardrjjksk. Gen. 25: 833-871. 1908.

J. H. W. VAN DEE MIESEN: Tochten op het eiland Boeroc, 7 Febr.—16 Juli 1908. *Ibid.* 26: 214-263. 1909.

T. J. WILLEH: Beschrijving van het eiland Boeroe. *In* Indisch Archief 1 (1). 1849; 1 (2). 1850.

K. MARTIN: Ueber seine Reise in den Molukken durch Buru, Seran und benaehbarte kleinere Inseln. *In.* Verh. Ges. Erdk. 1894.

S. P. HAM: Over de damarwinning op Obi. *In* Tectona 4: 336-337. 1911.

[18] This damar is usually called damar radja.

[19] This points to damar selan, because damar- radja sinks in water.

country from the right bank of the Wai Apu to the eastern chain of Batu lua, consists, but for the open plains, of uninterrupted forests on even soil, marshy in the sagu-dussons, dry in the forests of kaju bapas and similar heavy kinds of wood." Teysmann, who visited Buru in 1860, states (*op. cit.* p. 317) that in the hills of the Wai Apu above Kajeli "the so highly renowned kaju bapa . . . indicated the transition between poor and fertile grounds."

About the occurrence of the kaju bapa on the east coast of Buru we find a few remarks by Van der Miesen (*op. cit.* p. 217, 1909), who says that "the entire mountainous country [from Ilat to Namalea and Sablewa] is covered with dense forest, in which the straight, powerful *kaju-bapa* predominates." In the passage already referred to, Teysmann further says about the surroundings of Oki: "The entire country looks much more fertile than at Kajeli, as here neither kusu-kusu, nor kaju putih are to be found; on the hills many kaju bapa trees grow . . . ." Van der Miesen (*op. cit.* p. 220), too, came across the kaju bapa near Oki: "Near the coast there is the not very high, but extremely steep headland, covered with dense forest, consisting for the greater part of kaju bapa."

Near Masarete on the south coast "the forest, which surrounds Wasamut, consists of kaju bapa and other heavy trees."—Willer (*op. cit.*, 1850, p. 3).

In the interior, south of Lisela on the north coast, the kaju bapa was bearing fruit when in July 1908 Van der Miesen (*op. cit.* p. 250) visited those parts. More to the east Martin (*op. cit.* p. 302) saw in 1892 the kaju bapa on the north coast: "Der Cuscus und das Schwein . . . fressen gerne die Früchte eines kaju bapa genannten Baumes (*Shorea selanica* Bl.), dessen Rinde auch zum Häuserbau benutzt wird, und welcher auf diesen Höhen [viz. at about 725 m above sea level on one of the summits of the Gunung Pitigawa in the regency of Tagalisa] zahlreich wächst."

Finally Van der Miesen (*op. cit.* p. 241) has also come across kaju bapa in Central Buru and evidently also at a fairly great height above sea level: "Across the crest of the mountain Pangwaiha (south of Lake Rano or Wakolo) we marched through dense forest. Kaju bapas of more than 40 m tall with perpendicular boles tower like real forest giants above the surrounding trees."

About the occurrence on Amboina Teysmann says (*op. cit.* pp. 323-324): "The kaju bapa which is reported as not occurring on Amboina, had been planted here in former days and has at present spread in all directions by means of its fruit. Heavy trees had already been felled there, one of which was sold for 100 guilders. Kaju bapa with red and white

wood is said to occur, but is reported to be of inferior quality." Rumphius does not mention the possibility of its having been introduced into Amboma in former days, but *Dammara selanica* is not credited to Amboina by him. The specimens of the kaju bapa, collected by Reinwardt during his tour through the Moluccas in 1821 and present in the Herbarium at Leyden (no. 902.146-650, -653, -656, and 909.56-417) probably originate from Amboina, as Reinwardt did not visit Buru on that occasion.

Shorea selanica occurs also on Pulau Obira. Ham *(op. cit.* p. 336) found it, for instance, in the Borniu regions at about 150 m above sea-level. The tree, which there too belongs to the forest giants, has hard wood and dark brown bark. The yield of the damar, known on Obira as damar bau lamo, is inconsiderable, so that exploitation is of no importance. Not all trees produce resin, no more than all damar tenang trees do.

Bloembergen 20 reports that on the Sula Islands (on Sula Sanana near Molbufa) S. *selanica* is strongly dominant in the old dipterocarp forests with enormous trees, 50—60 m in height; it is distinctly gregarious. On Sula Mangole, kaju bapa is much less in evidence than on Sula Sanana, the gigantic specimens are lacking there. At Lampau the untouched primary dipterocarp forest reaches down to the shore. In this hilly country, at 5—10 m above sea level, kaju bapa is common. On Sula Taliabu S. *selanica* can be found too.

As far as I know *S. selanica* is found neither on Ternate nor on Ceram. The vernacular names solo garo or solo garu (Ternate) and umar (West Ceram) which I met with in "Harsonderzoek" (p. 299) and "Herkomst Damar" (p. 17) are not corroborated by herbarium material.

Rumphius' plate 56 *(Dammara selanica)* was twice used as the base of a 'new' species, first by Lamarck as *Dammara selanica*, secondly as *Engelhardtia selanica* by Blume who does not refer to Lamarck's earlier name. The combination under *Shorea* of the epithet 'selanica Lam.' would be preoccupied by that of *Shorea selanica* (Bl.) Bl. and hence cannot be restored.

The "Index kewensis" (1: 714, 1895) incorrectly suggests the identity of *Dammara selanica* Lam., which is wholly based on Rumphius' account, with *"Diospyros Embryopteris?"*

SPECIMENS EXAMINED AND CITED FROM LITERATURE.—MOLUCCAS. Sula Is.: P. Taliabu, Samuja *(bb.29947*, sehu or boba) ; P. Mangole, Kimehol—Lampau *(bb.29802*, bapa); P. Sanana, Kabauw *(bb.28879*, kaju bapa). — Obi Is.: P. Obira, northcoast near Sepepe *(Atasrip 117*, bau lamo). — Buru: *(de Vriese* in Herb. Lugd. Bat. sub nos. 902.146-648 and -651); Wai Ula *[bb.22800*, luma or b(i)ahut]; Batuboi (Namlea)

[illegible] footnote 10.

(bb.28298 to *28307,* kaju bapa); Balobalo *{bb.313i8,* biahgawa); Wai Apu near Kajeli *Teysmann 1875HB,* kaju bapa); southcoast near Oki *{Teysmann, cf.* Natuurk. Tydsch. Ned. Ind. 23: 319. 1861). — Amboina *(Reinwardt,* see above; *de Vriese in* Herb. Lugd. Bat. sub nos. 902.146-652 and -655; *Teysmann 5146HB,* kaju bapa: originally introduced, see above).

Cultivated in the Botanic Gardens, Bogor: no. VII.B.25 and 25a.

In the "Catalogus Plantarum quae in Horto Botanico Bogoriensi coluntur" by Teysmann & Binnendijk (1866)—which by the way was ready for the press as early as 1863, according- to Treub—as well as in a "Plantenlijst" by Binnendijk, which must have been compiled between 1869 and 1870, only "Moluccas" is given as locality of origin. The "Tuinboek" (1902) however mentions "Ambon" which may possibly be taken from Boerlage (Cat. PI. Phan. Hort. bot. bogor. col. 2: 107. 1901). Only from 1865 onwards plants and seeds received were recorded and registered, therefore it is impossible to consult the Garden files on whence, from whom, and when the plants before 1865 were received and where they were planted. The Garden cannot find any clue as to how Teysmann set up his internal administration, how he recorded plants, received and numbered them. Concerning VII.B.25 one can only assume that it was probably received from Teysmann himself, who in 1860 for the first time made a journey to the Moluccas and in his itinerary (see above) records the kaju bapa from Buru as well as from Amboina, but fails to mention any consignments to the Hortus at Buitenzorg. *Shorea selanica* cannot have been received from Binnendijk, who visited Buru in 1866, in the first place because there was only one Dipterocarpacea *(S. montigena* Van Slooten, *q.v.)* among the plants received on August 24, 1866, and secondly because, as was stated above, the kaju bapa was present in the Garden as early as 1863. — At present both VII.B.25 and 25a are about 47 m tall and have a diameter at breast height of about 1 m. The buttresses are up to 3 m long and 1.15 m high. Flowering material was collected in April 1896, November 1919 and 1923, July 1925 and March 1926, fructiferous material in April 1896, January 1920, July 1925, and March 1926.

19. **Shorea montigena** Van Slooten, *spec. nov.*—**Fig.** 18

Sharea balungeran Burck var. *binnendykii* Boerl., Cat. PI. Pban. Hort. bot. bogor. col. 2: 108. 1901.

TYPE.—Tree VIII.D.25, cultivated in the Botanic Gardens, Bogor.

Species nova sectionis "Eushoreae" *foliis glaberrimis levibus, petiolis foliorum magnitudine comparatis satis longis, alabastris ovatis, floribus magnis staminibusque numerosissimis (65—72) facile cognoscenda.*

Branchlets strongly flattened, densely covered by a brownish, later on greyish tomentum of minute, scale-like tufts of stellate hairs, ultimately glabrescent, with slightly elevated ribs decurrent along the internodium. *Stipules* caducous, lanceolate, falcate, blunt at the top, stellate-tomentose outside, puberulous inside, up to 3.0 cm long, 0.5 cm wide. *Leaves* coriaceous, flat, drying brown or reddish brown, oblong-elliptic attenuate, oblique at the top, whether or not acuminate, the acumen blunt and at best 0.5 or 1.0 cm long, rounded or blunt at the base, the very base usually symmetrical, the margin not revolute, (8.0—) 10.0—11.0 cm long, 4.5—5.0 cm wide; upper surface hardly shining, glabrous, lower surface dull, glabrous when adult; midrib sunken above, elevated and with remnants of minute stellate hairs or glabrous beneath; main nerves 10—12 pairs, hardly elevated beneath; domatia absent; *petioles* greyish tomentose, glabrescent, thickened in the upper half, often genieulate, 2.5—3.0 cm, long. *Inflorescences* axillary and terminal, solitary, the rhachis and branches flattened, densely brownish or greyish stellate-tomentose, 9.0—12.0 cm long, together forming a large panicle of about 17.0 cm long; the floral leaves smaller than the normal leaves, 5.0—6.0 cm long, 3.0—4.0 cm wide; branchlets alternating, unbranched, up to 4.0 cm long, 7—9-flowered; bracts minute, very early deciduous. *Flowers* unilateral, biseriate, about 5.0 mm apart. *Sepals* fleshy,

FIG. 18. *Shorea montigena* Van Slooten: a, flowering twig with flowers in two stages (X0.5); 6, flower bud (X 2); c, expanding flower (X 2); *d*, mature flower with sepals and petals removed (X 3); *e*, petal from mature flower (X 2}; f, stamens (X 4); *g*, ovary (x 3); *h*, fruiting twig (X 0.5). — Drawing after Hort. Bog. VIII. D. 25.

subequal, broadly ovate to ovate-rotundate, densely silvery tomentose outside on the portions exposed in bud, smooth inside, fringed along the margins, many-nerved, the 3 outer wings subacute, about 4.0 mm in diameter, the third sepal one-sided membranous, the 2 inner ones two-sided membranous, about 3.0 mm in diameter. *Corolla* falling in one piece. *Petals* large, oblong, truncate at the top, ovate at the base, silvery puberulous on the portion exposed in bud, smooth inside, about 10.0 mm long, 5.0 mm wide, 12—15-nerved. *Stamens* 65—72, of 4—5 different lengths, the inner ones 5.0—5.5 mm, the outer ones about 4.0 mm long; filaments flattened, tapering to the linear upper portion, up to 4.5 mm long; anthers oblong, about 1.0mm long; appendage to connective 1.5—2.0 mm long. *Ovary* ovoid, broad at the base, tapering into the style, glabrous in its lower half, puberulous at the top, 2.0 mm high, 1.5 mm wide; style puberulous at the base, 2.5 mm long. *Fruiting calyx segments* chartaceous, minutely stellate-puberulous on both sides, the very base concave, very closely embracing the nut, about 1.0 cm long and wide, above the very base narrowed and with revolute margins, the 3 long wings linear-lanceolate to subspathulate, rounded at the top, 8.0—10.0 cm long, 1.0—1.5 cm wide near the apex, about 0.5 cm wide at the base, 9—10-nerved, the 2 short wings linear, (sub) acute at the top, abruptly narrowed above the very base, 2.5—3.5 cm long, about 0.3 cm wide, 3-nerved. *Nut* ovoid, acutely acuminate by the style-remnant, minutely puberulous glabrescent, about 2.0 cm long, at the base up to 1.5 cm wide.

Leaves dark green above, light green beneath, glaucescent. *Peduncle*, branches of inflorescence and calyx-segments light green. *Petals* spreading, yellowish white outside, yellow inside tinged reddish rose at the top, silvery tomentose. *Stamens* conspicuous during anthesis; anthers straw-coloured. *Ovary* and style pale green.

Shorea montigena is a gigantic tree up to 45 m high of the primary forest of Buru, where it occurs on dry, steep, and stony ground with sand or clay; The altitudinal range is from about 400 to 1000 m: it is an inhabitant of the hill as well as of the upper dipterocarp forests, the altitudinal range of the last according to Symington being approximately from 2500 to 4000 feet. Bahut is of common occurrence on Buru, growing even gregariously locally, thus being in the Moluccas a representative of hills or mountains occupying and gregariously growing species of *Shorea*. Also ir, West Ceram this species is rather common; the field notes show that bb.23033 originates from a young secundary forest where it was not cultivated. — The tree contains a rather large quantity of colourless resin; the resin of the specimen of Ceram, however, is said to be dark.

Boerlage did not have fertile material at his disposal; the sterile collection was wrongly identified by him as a variety of *S. balangeran*, which Bornean species in my opinion does not show near relationship

to this *Shorea* from the Moluccas, since, for instance it has only 15 stamens. Though the stamens vary slightly in number, S. *montigena* belongs to the species with the highest number of stamens of the genus. By this character it clearly belongs to section "*Eushorea*" as distinguished by Brandis. Other polyandrous species are S. *glauca* King (60— ?90), *S. ovalis* (Korth.) Bl. (55—67), and S. *collina* Ridl. (55). Of the Philippine species of *Shorea* not a single one is as rich in stamens as is S. *montigena*, the number of stamens in *S. negrosensis* Foxw. {*in* Philip. J. Sci. Bot. 6: 274. *1911; ibid.* 67: 315. 1938) being about 30 and sometimes as many as 50. *Shorea, montigena* is readily recognizable by its flat, glabrous leaves, comparatively long petioles, large flowers, and its remarkable number of stamens.

FIG. 19. Distribution of *Shorea montigena* Van Slooten (V), *Shorea tepee, nov.* (bb. 22808 and 31S49) (A), *Shorea ?spec. nov.* (bb. 22567) (X), *Shorea spec.* (bb. 31092) (▬), and *S. forbesii Brandis* (•).

SPECIMENS EXAMINED.—MOLUCCAS. Buru. Walada, 1000 m *(bb.21499,* bahut or kaju bapa) ; Walpangat, 900 m *(bb.22816,* bahut or gawa); Mngesa Ingan, 800 m *(bb.22837,* bahut or babat); Waldefat, 400 m *(bb31914,* babat). — Ceram. Honitetu, 600 m *(bb.23033,* umale).

Cultivated in the Botanic Gardens, Bogor, no. VIII.D.25, from Buru, type of *Shorea balangeran* Burck var. *binnendijkii* Boerl. Sent by Binnendijk from the surroundings of Kajeli and received in the Gardens on August 24, 1866. At present the tree is 43 m high. Flowering material was collected in December 1923 and February 1948, fructiferous material in February and July 1948. — Fig. 19.

20. SHOEEA ?SFEC. NOV.

SPECIMENS EXAMINED.—MOLUCCAS. Buru: Walur-wau, 150—200 m (*bb.22808,* kultelu or bahut); Balobalo, 100m *(bb31349,* luma). — Leaves only.

This *Shorea,* which occurs on hills or steep slopes, is said to be very common in Buru, growing there even gregariously. It is a tree of up to 40 m high; its bark contains a fairly large quantity of resin. — Fig. 19.

It may easily be mixed up with S. *selanica,* the well-known kaju bapa from Buru and the Sula Islands. Confusion is all the more possible since

S. *selanica* has been collected in the same place (Balobalo) and is known locally by the same name of luma or b(i)ahut. Therefore, one should be cautious as to the data given for these two numbers, both species being very likely to be confused in the field by the collectors.

Comparison of the leaves of this *Shorea* with those of S. *selaniea* gives the following essential differences:

Leaves reddish beneath when dry, rounded at the base and not cuneate-rounded or subcordate, 15.0—17.5 cm long, 6.7—7.5 cm wide, oblong or ovate-oblong; *petioles* slender, 2.0—3.0 cm.

These slender, rather long petioles are the most conspicuous character of this vegetative material, which in my opinion represents a new species.

21. SHOREA ?SPEC. NOV.

SPECIMEN EXAMINED.—NEW GUINEA. Western part: Bomberai Peninsula, Mt. Genofa (Argoeni Bay), in primary forest on steep, stony ground, 750 m *{bb.22567;* very common, a few trees growing together; tree about 35 m high; bark with a small quantity of resin). — Leaves only.

Conspicuous by its entirely flat leaves, only the midrib being elevated beneath, and by the undersurface being lepidote by minute, scale-like, black dots over the whole of the leaf-blade. — Fig. 19.

22. SHOREA FORBESII Brandis—Fig. 20

Shorea forbesii Brandis *in* J. Linn. Soc, Bot. 31: 92. 1895; *in* Forbes's New Guinea Plants tn J. of Bot. 61 (Suppl : 5. 1923.

TYPE.—Forbes 861.

Branehlets densely clothed with scale-like tufts of short, pale brown, stellate hairs, glabrescent, and drying" blackish. *Stipules* caducous, lanceolate, the outside densely stellate-pubescent. *Leaves* coriaceous, flat, (ovate- or oblong-) lanceolate, gradually attenuate towards the obtuse top or slightly acuminate, the acumen about 1.0 cm long, rounded at the hardly asymmetrical base, the margins revolute at the very base, 9.0—12.0 cm long, 2.5—3.5 cm wide; midrib puberulous though glabrescent above, elevated and thinly sprinkled with minute, stellate hairs beneath; main nerves 10—15 pairs, visible above, elevated beneath, forming sharp angles to the midrib, hardly stellate-pubescent; domatia absent; nervules like the main nerves hardly pubescent on both sides, glabrescent; *petioles* densely minutely stellate-pubescent, glabrescent, about 0.75 cm long. *Inflorescences* axillary and terminal, solitary or 2—3 together, the rhachis and branches slender, densely brownish or greyish stellate-pubescent, up to 4.0 cm long; ultimate branchlets solitary, at best 1.0 cm long, 3—4-flowered; pedicels very short. *Sepals* unqual in shape, nearly equal in length, the 2 outer ones fleshy, ovate, lepidote-tomentose outside, glabrous inside, blunt at the top, very broad at the base, about 2.0 mm long, in the upper half 0.75

mm, in the lower half 1.5 mm, wide, the 3 inner ones broadly ovate to orbicular, lepidote-tomentose on the portion exposed in bud, smooth inside, shortly acuminate, acute, 1.5—2.0 mm in diameter, the third one-sided, the 2 other ones two-sided, broadly membranous. *Petals* oblique-oblong or subfalcate, slightly attenuate at the very top, lepidote-tomentose on the portion exposed in bud, smooth inside, fringed along one margin in the upper half and sub-erose as is the top, about 4.0 mm long and 2.0 mm wide, many-nerved. *Stamens* 20 (counted in 1 flower), of 3 different lengths, minute, 0.75—1.0 mm long; anthers oval to elliptic, about 0.5 mm long and 0.25 mm wide; filaments flattened and as wide as the anther, the longest filiform in the upper portion and about 1.0mm long; appendage to connective linear, 1.0 and 1.5 mm long. *Ovary* glabrous, 1 mm long, about 0.75 mm wide, narrowed at the top; ovary and stylopodium subconical, hardly constricted halfway; stylopodium oblong, papillose, 1 mm long, 0.5 mm wide, gradually tapering into the very short style. *Fruits* unknown.

FIG. 20. *Sltorca forbesii* Brandis: *a.* flowering branch (X 0.5); 6, flower bud (X 5); c, expanded flower (x 4); *d—h*, sepals (X 5); *i*, third sepal after blossoming (X 5); *j*, petal from mature flower (X 5) ; *k*, stamens (X 10); *1*, ovary (x 5). — Drawing after Forbes 861.

Large tree up to 35 m high. *Bole* slender and straight, unbuttressed (NGF 1315). *Bark* dark grey (appearing black from a distance) or dark brown, here and there slightly flaky. *Sapwood* straw-coloured to pale brown. *Heurtwood* brown with darker bands. *Flowers* pink-cream.

This Shorea belongs to the Dipterocarpaceae with the most eastern distribution (fig. 19). In the Milne Bay area (NGF 1315) it is "the dominant tree in many parts of the local rain forest."

Symington (in Gdns' Bull. Str. Settl. 9: 341. 1938) suspected "that *Shorea forbesii* is a *Hopea.*" Before examining the flower, I felt inclined to share his opinion. In bud the sepals are nearly equal in length though unequal in shape, the three inner ones being suborbicular in contradistinction to the two outer ones which are ovate, broad at the base and abruptly narrowed towards the top. Moreover the style is very short as is usual in *Hopea,* while the stamens are minute. Further examination, however, showed that the third sepal immediately after blossoming" attains the shape of the two outer ones; apparently it will grow out to a third large segment. Brandis himself already says of the sepals: "... 3 exteriora longiora in acumen lineare . . . prolongata." The number of stamens is 20, which points also to a *Shorea,* for *Hopea* having 15 or less; as to the style, a short one occurs also exceptionally in the genus *Shorea.* For all these reasons I am of the opinion that *S. forbesii* should not be referred to the genus *Hopea* before this change is made imperative by mature fruits. — See also under *Hopea glabrifolia* C. T. White.

SPECIMENS EXAMINED.—NEW GUINEA. Eastern part: Vanapa area, Koitaki, forest, 450 m *(Carr 12072, 12132, 1220S,* and *12551,* fl. April and May 1935); Port Moresby area, in brownish grey loam on medium northerly slope, 460 m *(NGF 26,* fl. April 1944, tatami); Sogeri region, 900 m *(Forbes 861,* fl. April 1886); Milne Bay area, Dawa Dawa R., forest, 50 m *(NGF 1315,* yala yala and emisapu).

Specimen inquirendum

SHOREA SPEC.

SPECIMEN EXAMINED.—NEW GUINEA. Western part: Hollandia, "Pionier-bivouac" in the Mamberamo R. basin, along rivulet in primary forest on dry level land on stony soil, 30m *(bb.31092,* marao; tree 25m high). — Leaves only. — Fig. 19.

Leaves large, up to 28.0 cm long and 10.0 cm wide, cordate at the base, with about 25 pairs of main nerves; *petioles* 1.5cm long.

VATICAL.

For distribution maps, *see* figures 21 and 22

23. VATICA PAPUANA Dyer

Vatioa papuana Dyer (1878); Van Slooten *in* Bull. Jard. bot. Buitenz. Ill 9: 112-114. 1927; *in* Bull. bot. Gdns Buitenz. Ill 17: 233-237 *fig. 27.* 1942. — *Adde:* Van Slooten *apud* Holthuis & Lam *in* Elumea 5: 214. 1942.

The proof that V. *papuana* does indeed occur in Borneo could be given in my second cited publication by two collections only, viz. by Ramos 1903 from the surroundings of Sandakan in British North Borneo, and by bb.17215 from the Beraii District of Indonesian North Borneo. In

1950, however, Mr. H. G. Keith, Conservator of Forests, Sandakan, kindly sent to Bogor for study some collections of Dipterocarpaceae in which *V. papuana* was represented by a number of specimens. On the other hand *this Vatica species remains as yet unknown from Celebes, but is moreover the most eastwards extending Dipterocarpacea known up to now* (see the map of distribution, fig. 21).

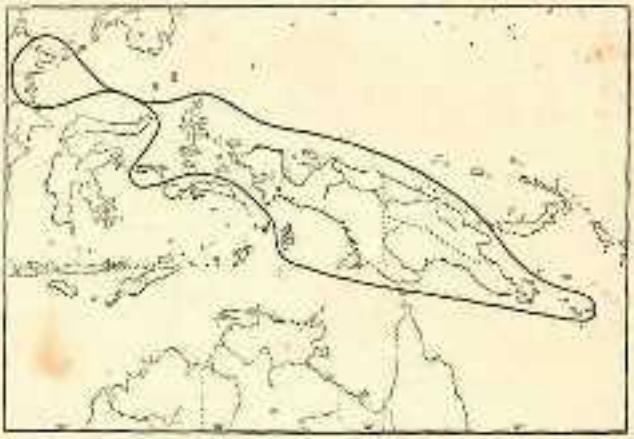

FIG. 21. Distribution of *Vatica papuana* Dyer.

In British North Borneo the wood has been suggested as a good material for the manufacturing of bobbins and shuttles on account of its fine texture and hardness.

Brass calls *V. papuana* a very common canopy tree for Papua, clear boled or slightly spurred at the base , attaining a large size on flood-plains and being fairly common on riverbanks and in fringing rain-forest.

SPECIMENS EXAMINED additional to those cited by Van Slooten ((.&, 1942) :

BORNEO. British North Borneo: Sandakan *(Damit 3848);* Elopura Distr. (Kahili For. Res.: *S.H.-A.S9,* resak batu; Sepilok For. Res.: *S.H.-A.523, -A.S69,* and *-A.2523,* and *-A.S502,* resak bunga; Sapagaya E.: *S.H.-A3261,* resak bunga).

MOLUCCAS. Morotai: Hutan Tjao *(Kostermans 782;* rare); Sg. Sambiki *(Kostennans 892;* very common) ; Totodoku *{bb.33907,* hiru, and *bb.33765).* — Misool: Fakal *(Pleyte Ills).* — Aru Is.: P. Trangan, Ngaibor, savannah in hilly country, a few metres above sea level *(Buwalda 5340,* fr. June 1938, ul); P. Kobroor, Dosina-

malau, in primary forest, a few metres above sea level *(Buwalda 5097*, fr. May 1938, ulai).

NEW GUINEA. Western part: "Vogelkop": Momi near Manokwari (66. *33454* and *33559*, keska); Bomberai Peninsula, Agonda near Babo *(bb.32975 [= Lundquist 256]*, arawe; *Aet 726 [Exp. Lundquist])*. Japen I.: Kamioraro near Seroei *(Aet & Idjan 660 [Exp. Van* ZJp]), — Eastern part: without locality *(Ewart s.n.)*; Oriomo R., Wuroi *(Brass 5884)*; Fly R., 528 mile Camp *(Brass 6826)* ; Palmer R., 2 miles below junction Black R. *(Brass 7367)*; Lower Fly R., east bank opp. Sturt I. *(Brass 8009) ;* Milne Bay area, about 6 miles up to Dawa Dawa R. *(NGF 1316* and *1332*, laguna and mutani).

Fie. 22. Distribution of the species of *Vatica* in Celebes. The numbers and species correspond as follows:

V. celebemis Brandis	2 and 5
V. flavovirens Van Slooten	2 and 4
Vatica 'spec, nov, **(Pella** 62)	**4**
Vatica spec. (bb. 32438)	1
Vatiea spec. (bb. 1860, etc.)	2
Vatica spec. (bb. 30172)	3
Vatica, *spec.* (bb. 14540)	6

Of this genus only *V. papuana* Dyer (q.v.) is known to occur in the Moluccas and New Guinea. It may be assumed that future exploration will reveal a more profuse occurence of this genus also in the case of *Vatica* in eastern Malaysia than is known for the present.

24. VATICA CELEBENSIS Brandis

Vatica celebensis Brandis *in* J. Linn. Soc, Bot. 81: 126. 1895; Van Slooten *in* Bull. bot. Gdns Buitenz. Ill 17: 254. 1942.

Vatica cehbica Van Slooten *in* Bull. bot. Gdns Buitenz. Ill 17: 237 *fig. 28*, £9. 1942.

TYPE.—Beccari *s.n.* (Herb. Beccari 1529C). — Illustrative specimen: Cel./111-12, type of *V. celebica* Van Slooten.

When describing *V. flavovirens* Van Slooten *(in* Bull. bot. Gdns Buitenz. Ill 17: 252. 1942) I devoted some remarks to *V. celebensis*—at that time unknown to me. The latter species was collected in a district close to one of the regions where *V. flavovirens* is known to occur. The description is rather fragmentary and no characters are mentioned which would render the species clearly recognizable. There remained a possibility that the two might prove to be conspecific, although Brandis did not allude to the striking colour of the dried leaves, one of the most notable characters of *V. flavovirens* and one that can hardly be overlooked.

When the type of Brandis' species, preserved at Florence, was put at my disposal, it became at once clear that there is no question of identity: the fruits—not seen by Brandis according to his annotation, "Fruit unknown"—prove that it represents a species belonging to subgenus *Isauxis* (Arn.) Brandis and not to subgenus *Synaptea* (Griff.) Brandis, to which *V. flavovirens* belongs.

agrees fully with the species I described and depicted as *V. celebica* and which is known from the Malili District north of the Kendari District where *V. celebensis* was collected. The latter name has priority; the most ample description of Brandis' species will be found under the name of V. *celebica.*

SPECIMENS EXAMINED.—CELEBES. South-eastern peninsula: Malili District *[cf. V. celebica* Van Slooten, *op.cii.* p. 239; usually (rather) common locally and occuring up to 400m above sea level]; Kendari District: Lepolepo *(Beccari 3tv.;* in Herb. Beccari nos. 1529, 1529C, 1530, 1530A; fl. and fr. July 1874).

25. VATICA FLAVOVIRENS Van Slooten

Vatica flavovirens Van Slooten in Bull. hot. Gdns Buitenz. Ill 17: 252 *fig. 36.* 1942.

Of this Celebesian species, too, a complete treatment was given in the "Bulletin" cited above. Since 1942 no additional data or material have been received.

Known from the eastern peninsula of South Celebes, where it was collected in the north in the Malili District, and in the south-east near Kendari. It usually occurs on slopes up to 400 m above the sea, and it is (rather) common locally.

26. VATICA ?SPEC. NOV.

SPECIMEN EXAMINED.—CELEBES. South-eastern peninsula: Staring Bay, near the coast on limestone hills steeply rising up from the sea *(Pella 62,* longori).

This specimen, obviously originating from the same habitat as *Hopea gregaria,* in all probability represents a new species, for instance, in view of its leaves and the dense yellowish brown tomentum of its inflorescences. In examining the collection I was fortunate in finding one perfect flower which has enabled me to ascertain without doubt that the specimen is a true *Vatica.* However, all other flowers seem to be mis-shapen, being developed into thick fleshy sepals and petals, closely pressed together, the margins induplicate and densely tomentose on both sides. I did not dissect the sole flower and as the subgenus can not be fixed, owing to the absence of mature fruits an adequate description has to be postponed.

Specimina inquirenda

VATICA SPEC.

SPECIMEN EXAMINED.—CELEBES. Manado: Pulias in Toli district, along bank of rivulet on hilly, stony ground, 40 m *(bb.32438,* arsad; very common, a few trees growing together; tree of 25 m). — Leaves only.

A Vatiea, conspicuous by its narrow lanceolate leaves. — It is said to be easily recognizable by its stems which are ash-coloured.

VATICA SPEC.

SPECIMENS EXAMINED.—CELEBES. South-eastern peninsula: Malili District, La Rona, 300—1000m *(bb.1860,* kareto batu; *bb.1888,* palopo; *bb1904,* sangrok; *bb.1913,* tallu lolona; *bb.1820,* talongan). — Leaves only.

About this material nothing definite can be said. It was collected in 1923 and new collections have not been received. Data other than those cited above are not available.

VATICA SPEC.

SPECIMEN EXAMINED.—CELEBES. Central Celebes: Bay of Kolonedale *(bb.* 301712., pooti). — Leaves only

A fragmentary collection showing some similarity to the leaves of *Vatica papuana* Dyer. However, one has to be careful in view of the fact that the latter species *(q.v.)* is not known from Celebes up to now.

VATICA SPEC.

SPECIMEN EXAMINED.—CELEBES. Manado: Lumpias, in primary forest on steep ground, 200m *(bb.14540,* fl. Nov. 1930; tree 32m high, flowers whitish yellow).

Flowering specimens of *Vatica* when not recognizable by the shape of the leaves are mostly indeterminable on account of the uniformity of the flowers. The collection bb.14540 possibly represents a new species but owing to the fact that even the subgenus can not be fixed, it seems desirable to await further collections before describing a new species.

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The names of the speeies fully treated are printed either spaced or, in case of new species or new combinations, in bold face type. Synonyms are in italics. Pages on which analytical drawings occur are marked with an asterisk.