

MATERIALS TOWARDS A STUDY OF THE FLORA OF THE
ISLAND OF NEW GUINEA

by

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Quoique les données ne soient pas encore suffisantes pour pouvoir dresser une statistique de la flore de cette île et pour la comparer à celles des îles voisines, on verra ---- que l'affinité avec la flore de l'Australie n'est pas aussi grande qu'on croyait autrefois.

(R. H. C. C. SCHIEFFER — Ann. d. Jard. bot. de Buitenzorg I,
1876, 1).

Introduction.

It has so often been emphasized that the flora of large tropical islands like New Guinea is still very imperfect, that the impression has been established that the data available should be in a state unapt to produce a conspectus or to procure valuable conclusions. Though it is certainly true that there are still immense plots of land entirely unknown from a botanical (or any other) point of view, and that we know but a part (but most probably more than one half) of the Papuan species of *Pteridophytes* and *Spermatophytes*, I am inclined to think that it is more than anything else the scattered nature of those data, that prevented us from realizing their intrinsic value. The time has come, I think, to pause and to realize what has been done in the past years; to arrange the many uncoordinated data in such an order that, on one hand a comprehensive view may be obtained of what has come to our knowledge and on the other hand the gaps may become apparent. In this way it may be expected beforehand, that our present knowledge, however scanty it may be, may enable us to form some provisional conclusions of not too slight an importance and of not too mean reliability. Especially as far as floristics are concerned it is obvious that, for instance, consideration of one half of a flora will lead to practically the same conclusions as the whole flora would.

In this investigation that is meant to be amplified by more detailed studies later on, I have, first of all, compiled an enumeration of the

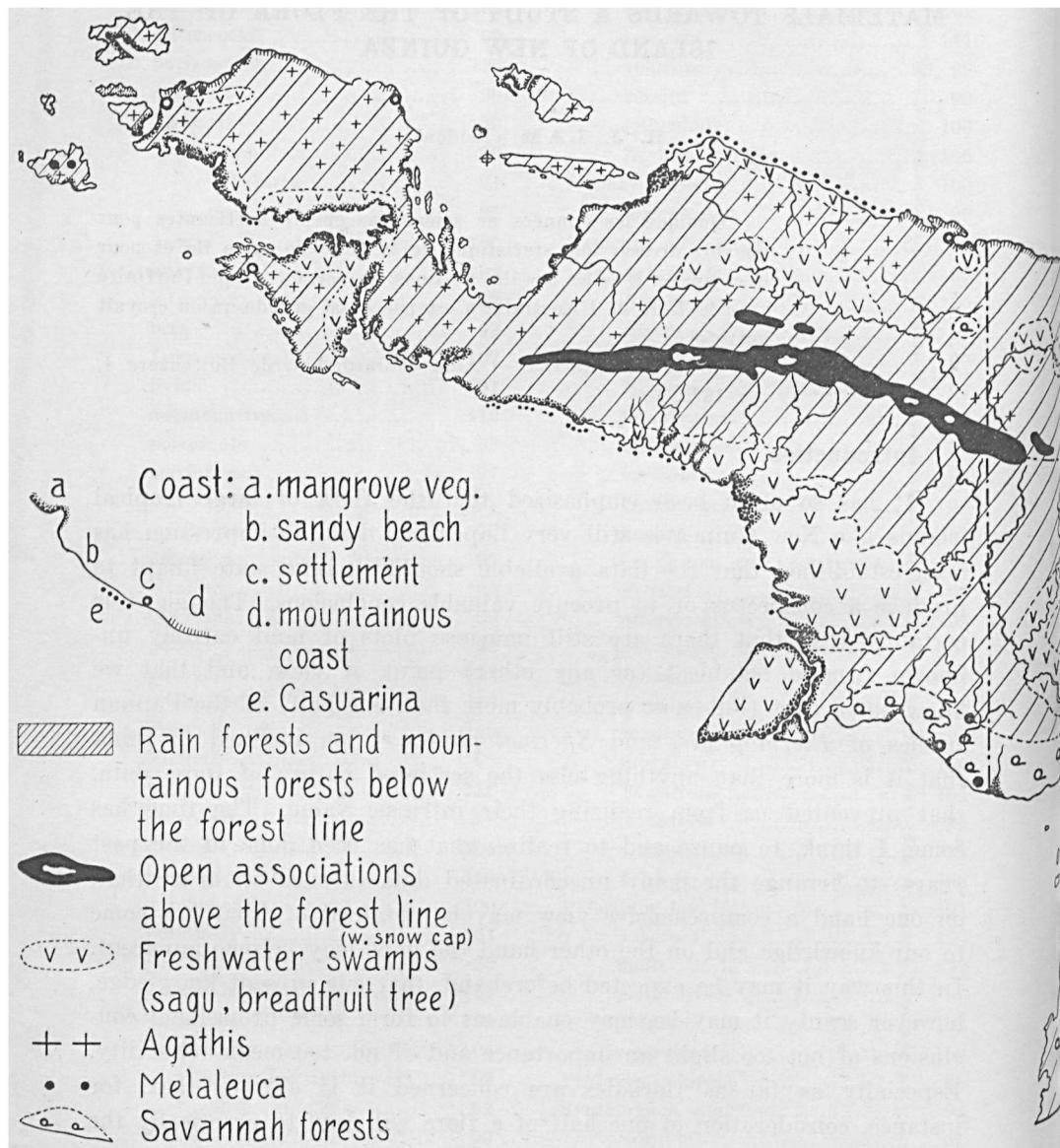
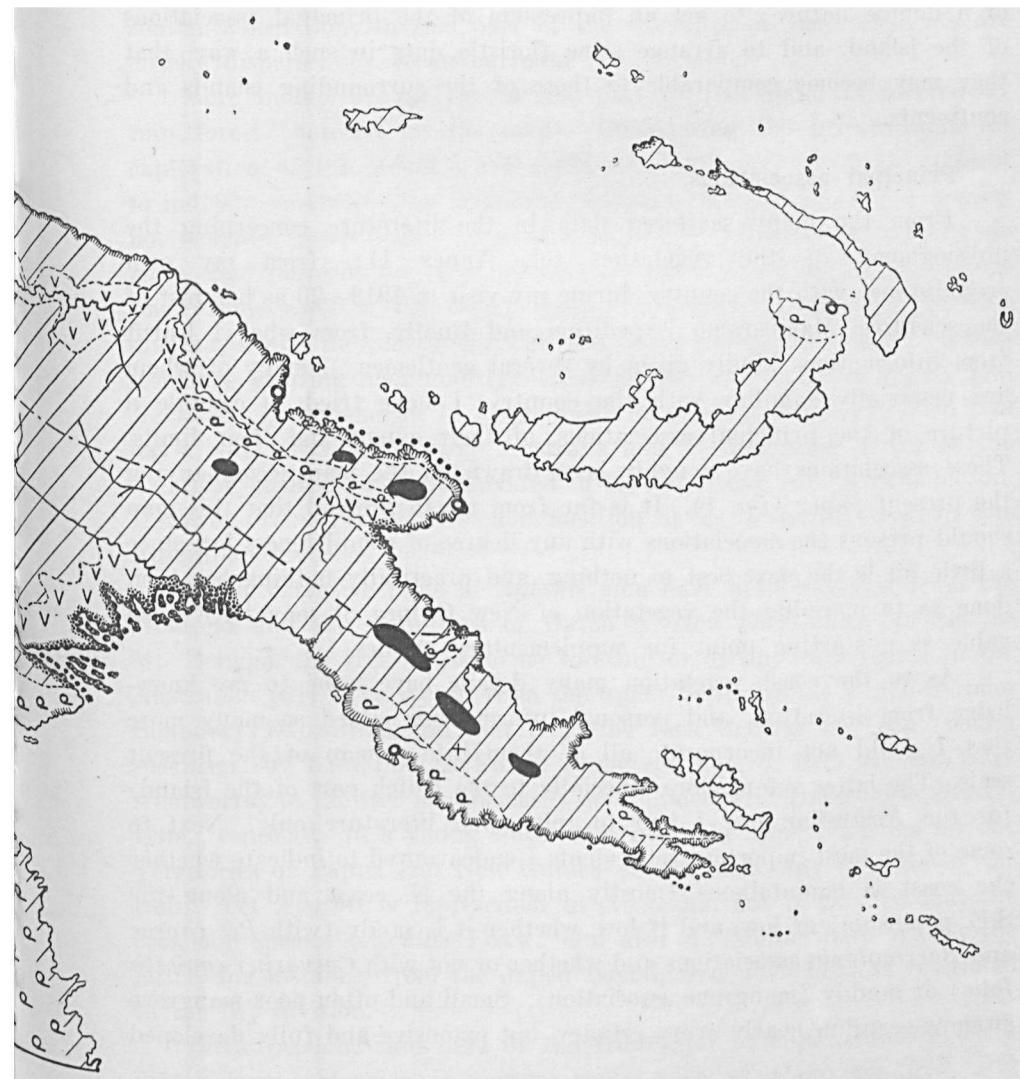
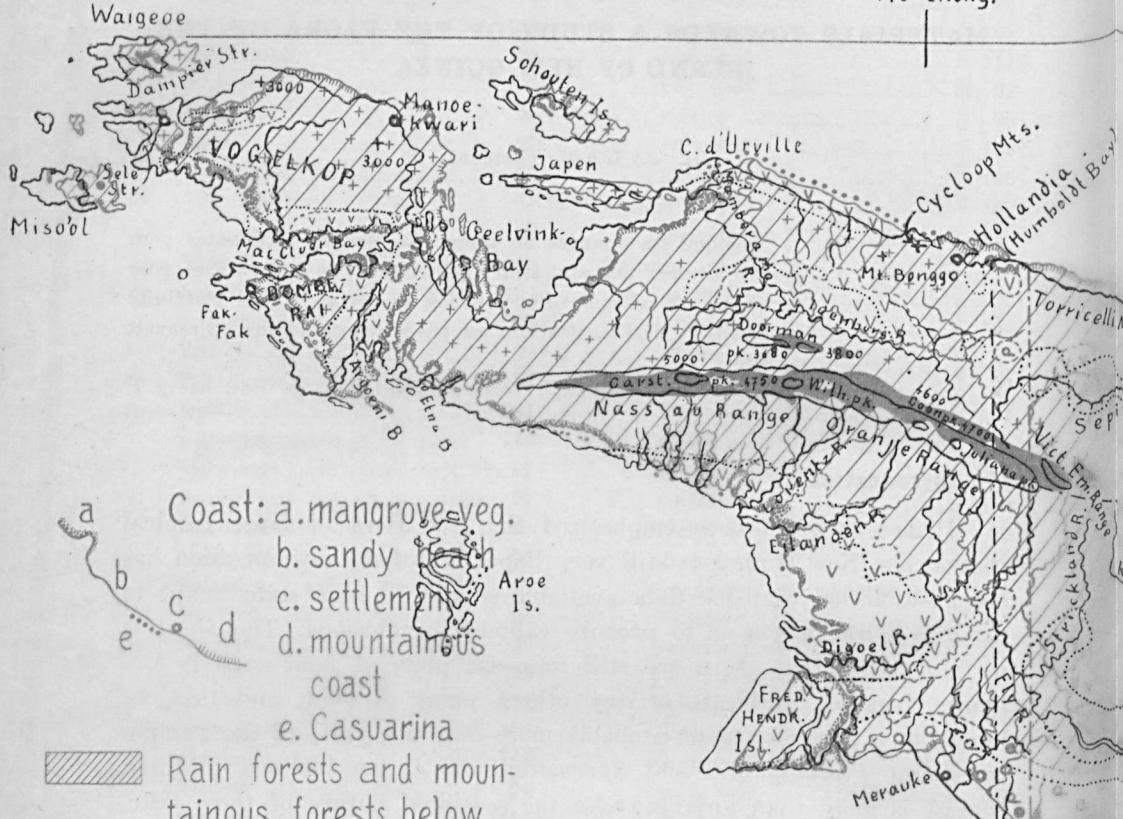


Fig. 1. Principal plant as



Floristic regions of New Guinea.

140° E.long.



Open associations above the forest line

Scale c. 1: 10.000.000.

Freshwater swamps

(says, breadfruit tree)

500 600 700 800 900 1000 km

++ Agathis

• • Melaleuca

Savannah forests

Cap
YORK
PENIN

Fig. 1. Principal plant

150° E. long.

0°



of New Guinea.

more important collectors and also of books and papers (cf. Annexes at the end of the present publication) which, together with the literature cited in some of them, may be considered as a basis to any student of the New Guinea flora, who desires to undertake a special investigation in this matter. As far as the facts are concerned my aims have been of a double nature; to get an impression of the principal associations of the island, and to arrange some floristic data in such a way, that they may become comparable to those of the surrounding islands and continents.

Principal associations.

From the many scattered data in the literature concerning the physiognomy of the vegetation (cf. Annex II), from my own acquaintance with the country during my visit in 1919—20 as botanist of the scientific Mamberamo Expedition and finally, from what I learnt from informations kindly given by several gentlemen¹⁾, many of whom are personally familiar with the country, I have tried to compile a picture of the principal associations, of their extent and their limits. These associations have roughly been drawn on the map accompanying the present paper (fig. 1). It is far from me to pretend that this map should present the associations with any degree of completeness but since a little bit is the next best to nothing, and practically nothing has been done as to mapping the vegetation of New Guinea, it may have some value as a starting point for supplementary studies.

As to the coast vegetation many details have come to my knowledge from literature, and personal informations added so many more that I could not incorporate all of them into a map of the present scale. The latter refers more especially to the Dutch part of the Island; for the Australian one I had to rely upon literature only. Next to some of the most important settlements I endeavoured to indicate whether the coast is mountainous (mostly along the N. coast and along the S.E. peninsula) or low, and if low, whether it is sandy (with *Pes caprae* and *Barringtonia*-associations and whether or not with *Casuarina equisetifolia*) or muddy (mangrove association). Small and often poor mangrove swamps occur in nearly every estuary, but extensive and fully developed

1) I have to thank the following gentlemen for their kind help: Dr C. BRAAK, H. GEURTJENS, N. HALIE, F. J. F. VAN HASSELT, Ir J. E. LOTHE, Col. J. L. H. LUYMES, Prof. Dr G. L. SMIT SIBINGA, Dr J. J. SMITH, Dr C. G. G. J. VAN STEENIS and A. L. VINK.

swamps are found along the N. and NW. coast of the Gulf of Papua (Fly-river delta), from the Frederik Hendrik Island northward, along the S.E. and N. coasts of the Bomberai peninsula, the S. coast of the "Vogelkop", and the shores of the Straits of Sele. The flora of these coastal vegetations is, of course, not or hardly different from that of similar associations in this part of the world, since their elements are largely dispersed by ocean currents.

More inland by far the largest part of the island is covered by rain forest (hatched on the map). Considering the present state of exploration of the mountains I could not think of making an attempt to indicate separately the mountain forests, which, moreover, are usually not sharply distinguished from the true rain forests. I could not do more than indicate the open associations above the forest line and the small snow caps in the Dutch part, the freshwater swamps and the savannahs, and the places where two of the economically more important trees are growing abundantly: *Agathis alba* Foxw. (gum copal) and *Melaleuca Leucadendron* L. (*kaju putih* or *gelam*). The last-named tree has a wide distribution from Australia and W. Polynesia as far as the Asiatic Continent and is cultivated in several places for its valuable oil. However, LANE-POOLE does not mention it as a useful tree in the Australian division.

While extensive plots of *Agathis alba* have been recorded from the Moluccas and the mountains of Dutch N. New Guinea as far east as Mt. Bonggo, the tree seems to be wanting or at any rate scarce in the Australian part. The record from the upper Sepik by the Dutch-German Boundary Expedition and that from the East Central Division (young specimen) by LANE-POOLE (Forest Resources, l. c., p. 167) are not fully trustworthy as the tree may be easily confounded with *Podocarpus Blumei* ENDL., especially in a young state. Moreover, the export figures for the Territories of Papua and New Guinea do not make any mention of the resin. Yet *Agathis* is represented in Australia, but it may be that the economic species (*A. alba* Foxw., and also *A. Labillardieri* WARB., the latter, for instance, from the Japen Island, Geelvinck bay) is restricted to the W. division.

Little need be said here of the freshwater swamps, which reach a pretty large extension in several spots, such as along the Fly- and Strickland rivers, in Frederik Hendrik Island, between the Central Range and the S.W. Coast, in the eastern half of the Bomberai Peninsula, around the Mac-Cluer-Gulf and Bintoeni Bay and in some inland basins

along rivers in the northern divisions (War Samsom [= Wasami], Idenburg river [Mamberamo; "Meervlakte"], Sepik and Ramu). In these parts all transitions occur between swampy forest to open water; sagu (*Metroxylon* spec.) and breadfruit tree (*Artocarpus communis* FORST. [= *incisa* L.]) are locally frequent here.

Though New Guinea is an entirely tropical island, situated but for a small part between the equator and the 10° S. parallel, there are some places where the rain forest has been replaced by associations that have often been called savannahs. It is, however, more than doubtful whether these associations are true savannahs in the sense of naturally open associations like those in N. Australia. The largest of these more or less open associations or "savannahs" are situated at the south coast, viz. between Prinses Marianne Strait and the Fly-River estuary and in the region of Port Moresby. Other places of a similar nature are found along the Goodenough Bay, near the Waria-River, the slopes S. and N. of the Finisterre Range and N. of the Bismarck Range etc., but these are either fully of anthropogenous nature or at least determined by steepness or limestone rocks.

The handbooks on ecology and plant-geography yield no or very scanty information as to the conditions of climate and soil that naturally correspond to those associations but it cannot be far from true to accept that the rainfall and particularly the distribution of the rainfall throughout the year are the main limiting factors here. It is generally accepted, that the rain forest for its full development requires a rainfall of at least 2000 (or under certain circumstances perhaps 1500) mm pro year with the condition that this amount is equally distributed over the year or nearly so. We further know, that as soon as the factor "water-supply" becomes a limiting factor the rain forest reacts by more domination of certain (tree)species of an often deciduous nature. The next phase is a deciduous monsoon-forest with only a small number of more or less dominating tree species and the next steps are the still more open savannah-forest, the "park landscape", the savannah, the steppe and the desert. As, in general, the duration of any external ecological factor is often of more importance for the determination of the vegetation and for the limitation of specific areas, than its momentary severity, it is, in the present case, more particularly the duration of the dry season (monsoon) that affects both of the features mentioned.

Unfortunately, in many parts of the Malay Archipelago the

original vegetation has been largely destroyed, and in many places the population has, moreover, the custom of annually burning the grasslands and "ladangs" (fields). Thus, it often cannot be definitely stated whether a grassland association in a region with a long dry season is natural or not.

I have therefore attempted to gather data as to the severity and duration of the dry season on one hand and the distribution of undoubtedly natural vegetations on the other. For that purpose I have accepted a method first applied, if I am well informed, by the Sugar Experiment Station at Pasoceroean, Java, which consists of mapping the areas where there are 0—5, 5—10, 10—20 or more than 20 rainy days in the driest 4 months of the year. It has been supposed that more than 20 rainy days eventually approaches the conditions under which full rain forest is possible. It needs no special mention that a low annual rainfall does not necessarily correspond to a long dry season. Thus Paloe (Mid-west Celebes at 1° S. lat.) has an annual rainfall of only 546 mm, distributed over 81.6 rainy days. Yet the driest four months of the year still have about 23 rainy days. This is probably the place with the lowest rainfall in the Malay Archipelago¹⁾.

On looking at the accompanying map (fig. 2) the reader may see that the regions with the best developed dry season (less than 5 rainy days in the driest 4 months) comprises, first of all, by far the greater part of N. and N.W. Australia, and further islands or N. parts of islands belonging to the group known as the Lesser Sunda Islands, including a small coastal strip of East Java and Madoera. The place with an extreme dry season in this region is, beside the desert interior of Australia, the island of Solor, E. of Flores, which has a rainfall of 891 mm pro annum with 42 rainy days. Of these

none occur the driest 4 months

| | | | | | |
|-----|---|---|---|---|---|
| 0.9 | " | " | " | 6 | " |
| 3.6 | " | " | " | 7 | " |
| 7.6 | " | " | " | 8 | " |

The part of Australia, shown on the map is less dry, as far as is known, having 2—4 rainy days in the driest 4 months (minimum for E. Java: 3.4).

1) Meteorological data from the publications of the „Koninkl. Magnetisch en Meteorologisch Observatorium” at Batavia (Verhandel. 18, 1924, and 23 and 24, 1931) and from informations, kindly given by Dr C. BRAAK.

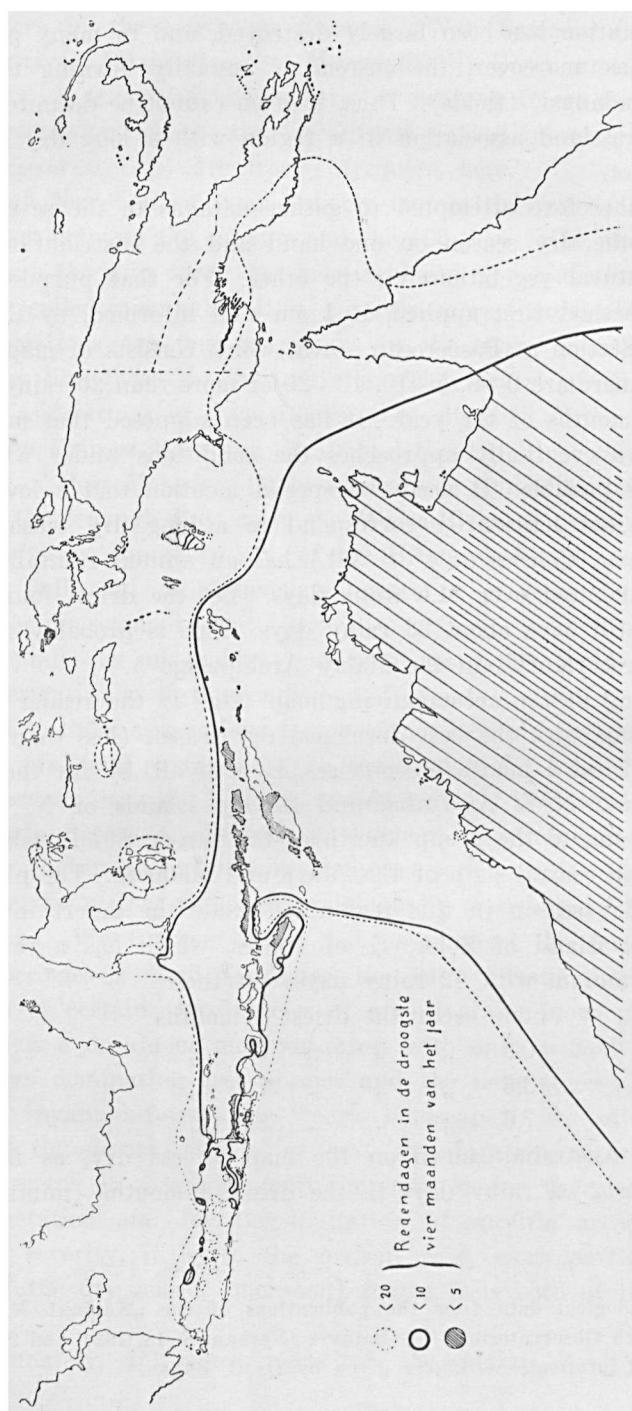


Fig. 2. Severity of the dry season in the Malay Archipelago and N. Australia,
as indicated by the number of rainy days ($0-5$, $5-10$, $10-20$ or more
than 20) in the driest four months of the year.

The 5—10 days line comprises the other parts of the Lesser Sunda Islands, except a small part of S.W. Flores, S.W. Soemba, S.W. Soembawa, W. Lombok and nearly the whole of Bali. The 10—20 days line includes large parts of East Java and smaller ones of W. Java (especially in the N.), further small coastal districts of S.W., S.E. and E. Celebes and N. Boeroe and finally the two larger dry areas in New Guinea, mentioned above.

The number of rainy days in the driest four months in Merauke and Port Moresby and their annual rainfall figures are:

| | annual rainfall | rainy days i.t. dr. 4. m. |
|--------------------|-----------------|---------------------------|
| Merauke | 1528 mm | 16 |
| Port Moresby | \pm 800 mm | 17 |

Both regions perfectly agree as to this point with the western part of N. Queensland, the eastern being considerably wetter and possessing some true rain forests. This region, with 15—20 rainy days in the driest 4 months, is covered by savannah-forests as is apparent from the splendid pictures recently published by L. DIELS and E. PRITZEL (KARSTEN & WALTER, Vegetationsbilder, 24. Reihe, Heft 3, 1934, Taf. 17—18), whilst the more western parts (hatched on the map) possess a savannah or steppe vegetation.

I am inclined to conclude from these data that the Lesser Sunda Islands or at least their drier parts originally have a steppe-like vegetation, which has only little been altered by man. The more or less open associations in New Guinea, however, are of a purely anthropogenous nature as far as they are situated in the rain forest area; but those parts, lying within the 20 rainy days line originally must have had a *Eucalyptus* savannah-forest that has now partly been destroyed by the activities of the population. This conclusion is supported by their present flora, which consists of three distinctly distinguishable categories of elements, viz.:

1. purely Australian elements (trees such as *Eucalyptus*, *Melaleuca*, *Cycas*, some *Proteaceae*, *Acacia*, etc.).
2. trees that are common to other open associations whether natural or anthropogenous, mostly with wide distribution also in the western part of the Archipelago (*Alstonia scholaris* R.Br., *Albizia procera* BENTH., *Gossampinus heptaphylla* [HOUTT.] BAKH., *Garuga floribunda* DECNE., etc.).
3. herbs and other plants, which endure or survive the annual

burning, especially grasses (many species, among which the deep-rooting *alang-alang*, *Imperata cylindrica* BEAUV., var. *Koenigii* BENTH., or *Apluda*-species prevail), *Liliaceae* (with subterraneous bulbs), in wet places also *Drosera* (Australian!).

Floristics.

While the vegetation is mainly a function of the external factors and only in the second place of time, the last-named factor plays a prominent part regarding the flora. In general, one may say that the flora of a country consists of three categories of elements, that meanwhile are not sharply distinguishable:

1. relic-endemisms, being the progeny of unknown elements or of plants that have immigrated a long time ago;
2. neo-endemisms, being the offspring of plants which have immigrated in more recent times;
3. recent immigrants, which have not or not yet had the opportunity or the time to raise new species and for which the country thus forms a part of their area.

Time and immigration possibilities are therefore the main factors that determine a flora; ecological conditions, however important and selective they may be, are second in rank.

With appropriate observance of specific modes of dispersion and of relative differentiation, important conclusions may be drawn as to whether land connections with certain other lands, if any, are of old date or not. As regards New Guinea, conclusions of this nature may be of extreme importance since they may, in connection with data yielded by zoogeography and geology, procure indications as to which conception should be accepted for this part of the world: the old theory of the permanency of oceans and continents, or WEGENER's hypothesis of continental shift. In order to get a provisional idea of whether the New Guinea flora even when only partially investigated, may procure any data for conclusions of this kind, I have compiled some floristic data, that may follow here; these data have been laid down in six lists, viz.:

- I Relation of families, genera and species;
- II Endemism of genera and species;
- III Endemic genera;
- IV Some subendemic genera;
- V Groups with strong differentiation;
- VI Geographic relations.

TABLE I.
RELATION OF FAMILIES, GENERA AND SPECIES.

Data mostly taken from LAUTERBACI's Beiträge zur Flora von Papuasien; cases in which „Nova Guinea“ has been consulted, have been indicated with an asterisk; if other publications have been used, they have been quoted. Only the families have been mentioned, that are in some way pertinent to our purpose.

| | Number of | | | | Number of | | |
|---|-----------|---------|---|--------------------------|-----------|---------|--|
| Fam. | Genera | Species | - | Fam. | Genera | Species | |
| Acanthaceae | 21 | 55 | - | Flagellariaceae | 2 | 3 | |
| Amaryllidaceae | 4 | 8 | | Gentianaceae | 4 | 11 | |
| Anacardiaceae | 12 | 47 | | Gesneraceae | 12 | 180 | |
| Anonaceae | 18 | 84 | | Gnetaceae | 1 | 5 | |
| 5 Apocynaceae | 29 | 88 | | 30 Guttiferae | 9 | 67 | |
| Aquifoliaceae | 1 | 5 | | Halorrhagaceae | 2 | 9 | |
| (Journ. of Bot. 61, 1923, Suppl. 10) | | | | *Icacinaceae | 14 | 47 | |
| Araliaceae | 13 | 85 | | Labiatae | 10 | 19 | |
| Aristolochiaceae | 1 | 15 | | Lauraceae | 10 | 91 | |
| Balsaminaceae | 1 | 8 | | 35 Leeythidaceae | 3 | 21 | |
| 10 Bignoniaceae | 4 | 26 | | Leguminosae | 16 | 73 | |
| Burseraceae | 5 | 30 | | (Mimos. and Caesalp.) | | | |
| (Bull. J. bot. Btzg 1932) | | | | Lentibulariaceae | 1 | 4 | |
| Campanulaceae | 5 | 6 | | Liliaceae | 12 | 53 | |
| Capparidaceae | 4 | 10 | | Linaceae | 1 | 3 | |
| Clethraceae | 1 | 1 | | 40 Loganiaceae | 7 | 44 | |
| (Kew Bull. 1899, 126) | | | | Lythraceae | 3 | 7 | |
| 15 Commelinaceae | 6 | 20 | | Melastomaceae | 21 | 118 | |
| Compositae | 48 | 69 | | Menispermaceae | 7 | 56 | |
| Connaraceae | 2 | 4 | | Monimiaceae | 10 | 60 | |
| Cornaceae | 2 | 3 | | 45 Myricaceae | 1 | 1 | |
| (Blumea, 1934) | | | | *Myrtaceae | 20 | 172 | |
| Cruciferae | 2 | 5 | | Olaceae | 4 | 24 | |
| 20 Cucurbitaceae | 16 | 37 | | Oleaceae | 4 | 24 | |
| Cunoniaceae | 11 | 30 | | Opiliaceae | 3 | 3 | |
| Dichapetalaceae | 1 | 11 | | 50 Orchidaceae | 116 | 2546 | |
| Dilleniaceae | 3 | 61 | | (Rogers 1932) | | | |
| Elaeocarpaceae | 6 | 92 | | Palmae | 33 | 125 | |
| 25*Ericaceae | 7 | 179 | | Pinaceae | 3 | 7 | |

| | Number of Genera Species | | | Number of Genera Species | | |
|-------------------|-----------------------------|---------|------|-----------------------------|---------|------|
| Fam. | Genera | Species | Fam. | Genera | Species | |
| Pittosporaceae | 1 | 3 | 65 | Stemonaceae | 1 | 2 |
| Pteridophyta | 87 | 970 | | Stereuliaceae | 11 | 31 |
| 55 Quereus (s.a.) | 4 | 17 | | *Symplocaceae | 1 | 30 |
| Rhamnaceae | 8 | 14 | | Taxaceae | 3 | 11 |
| Rubiaceae | 47 | 378 | | Ternstroemiaciae | 4 | 8 |
| Rutaceae | 18 | 82 | 70 | Ulmaceae | 4 | 12 |
| Santalaceae | 3 | 14 | | *Urticaceae | 13 | 128 |
| 60 Sapindaceae | 25 | 117 | | Violaceae | 3 | 8 |
| *Sapotaceae | 11 | 47 | | Vitaceae | 4 | 56 |
| Saxifragaceae | 7 | 30 | 74 | Zingiberaceae | 13 | 150 |
| Serophulariaceae | 10 | 28 | | | — | — |
| Simarubaceae | 5 | 5 | | | 834 | 6872 |

From these figures may be concluded that there are, in average:

92.7 species pro family — (80.8)
11.35 genera pro family — (10.23) without Pteridophyta)

8.16 species pro genus: (without Pteridophyta: 7.9; without
Pteridophyta and Orchidaceae: 5.32)

TABLE II.
ENDEMISM OF GENERA AND SPECIES.

Mostly taken from LAUTERBACH's Beiträge zur Flora von Papuasien, sometimes amplified with data from „Nova Guinea“ or other newer publications.

Area: Mainland of New Guinea with the Louisiades, the Bismarck Archipelago, the Admiralty Islands and the islands in the Geelvink bay, however, without the Aru and Kai Islands.

Subendemic means: with the bulk of the species in New Guinea and only one or very few outside the area.

| | Number of genera total | Number of genera endemic | Number of species | |
|----------------------|---------------------------|-----------------------------|-------------------|---------|
| | | | total | endemic |
| | | (subendemic) | | |
| Acanthaceae | 21 | 4 | 55 | 32 |
| Amaryllidaceae | 4 | — | 8 | 2 |
| Anacardiaceae | 12 | 2 | 47 | 30 |
| Anónaceae | 18 | 4(1) | | |
| 5 Apocynaceae | 29 | 6(2) | 88 | 55 |
| Aquifoliaceae | 1 | — | 4 | 2 |

| | | Number of genera | | Number of species | |
|----|------------------------|------------------|-------------------------|-------------------|---------|
| | | total | endemic (subendemic) | total | endemic |
| | Araliaceae | 13 | 1 | 85 | 78 |
| | Aristolochiaceae | 1 | — | 15 | 10 |
| | Burseraceae | 5 | —(1) | 30 | 22 |
| 10 | Campanulaceae | 5 | 1 | 6 | 4 |
| | Capparidaceae | 4 | — | 10 | 2 |
| | Commelinaceae | 6 | — | 20 | 5 |
| | Compositae | 48 | 3 | 69 | 43 |
| | Connaraceae | 2 | — | 4 | 3 |
| 15 | Cornaceae | 2 | 1 | 3 | 1 |
| | Cucurbitaceae | 16 | — | 37 | 10 |
| | Dichapetalaceae | 1 | — | 11 | 11 |
| | Elaeocarpaccae | 6 | 2 | | |
| | Ericaceae | 7 | 1 | | |
| 20 | Flagellariaceae | 2 | — | 3 | — |
| | Gentianaceae | 4 | — | 11 | 9 |
| | Gesneraceae | 12 | 4(2) | 180 | 179 |
| | Gnetaceae | 1 | — | 5 | — |
| | Guttiferae | 9 | 4 | 67 | 62 |
| 25 | Halorrhagaceae | 2 | — | 9 | 6 |
| | Iacinaeae | 14 | 3(1) | | |
| | Lauraceae | 10 | 1 | | |
| | Leeythidaceae | 3 | — | 21 | 15 |
| | Leguminosae | | | | |
| | Mimosaceae | 8 | 1(2) | 35 | 22 |
| | Caesalpiniaceae | 8 | 1 | 28 | 18 |
| 30 | Liliaceae | 12 | — | 53 | 29 |
| | Linaceae | 1 | — | 3 | 3 |
| | Lythraceae | 3 | — | 6 | 2 |
| | Melastomaceae | 21 | 5 | 118 | 110 |
| | Menispermaceae | 7 | 1 | | |
| 35 | Monimiaceae | 10 | 3 | | |
| | Myricaceae | 1 | — | 1 | — |
| | Myrtaceae | 20 | 2 | | |
| | Olacaceae | 3 | — | 3 | 1 |
| | Oleaceae | 4 | — | 24 | 19 |
| 40 | Opiliaceae | 3 | 1 | 3 | 1 |

| | | <i>Number of genera</i> | | <i>Number of species</i> | |
|----|---|-------------------------|----------------|--------------------------|----------------|
| | | <i>total</i> | <i>endemic</i> | <i>total</i> | <i>endemic</i> |
| | | <i>(subendemic)</i> | | | |
| | Orchidaceae (1934) ... | 116 | 8(10) | 2546 | 2534 |
| | Palmae | 33 | 2(2) | 125 | 115 |
| | Pittosporaceae | 1 | — | 3 | 1 |
| | Pteridophyta | | | 970 | 597 |
| 45 | Quercus (s.a.) | 4 | — | 17 | 12 |
| | Rhamnaceae | 8 | — | 14 | 7 |
| | Rubiaceae | 47 | 5 | | |
| | Rubus | 1 | — | 9 | 5 |
| | Rutaceae | 18 | 4 | 82 | 68 |
| 50 | Santalaceae | 3 | — | 14 | 13 |
| | Sapindaceae | 25 | 1 | 117 | 91 |
| | Sapotaceae | 11 | 1 | 47 | 35 |
| | Saxifragaceae | 7 | 2(1) | 30 | 30 |
| | Serophulariaceae | 10 | 1 | 28 | 8 |
| 55 | Stemonaceae | 1 | — | 2 | 2 |
| | Symplocaceae | 1 | — | 21 | 21 |
| | Taxaceae | 3 | — | 11 | 4 |
| | Ulmaceae | 4 | — | 12 | 7 |
| | Urticaceae | 13 | 1 | 121 | 95 |
| 60 | Violaceae | 3 | — | 8 | 7 |
| | Vitaceae | 4 | — | 56 | 34 |
| | Zingiberaceae | 13 | 2(2) | 150 | 140 |
| | Fam. uncertain (Gertrudia, Marumia Warburgii) | 2 | 2 | 2 | 2 |
| | | — | — | — | — |
| | | 687 | 81(25) | 5446 | 4614 |
| | | <u>61 fam.</u> | | <u>53 fam.</u> | |

Therefore the generic endemism is 11.6 (15.3¹) %

the specific endemism: 84.7 %.

1) Subendemics calculated as one half.

TABLE III.

ENDEMIC GENERA ARE (those [16] names, marked with a W, have survived from WARBURG's list of 1891):

- Acanthaceae — *Aneylacanthus* LINDAU; *Calycacanthus* K. SCHUMANN (W);
Gymnophragma LINDAU; *Jadunia* LINDAU.
- Anacardiaceae — *Nothopegiopsis* LAUTERBACH; *Skoliostigma* LAUTERBACH.
- Anonaceae — *Oncodostigma* DIELS; *Oreomitra* DIELS; *Petalo(lo)phus*
K. SCHUMANN; *Schefferomitra* DIELS.
- Apocynaceae — *Delphyodon* K. SCHUMANN; *Discalyxia* MARKGRAF; *Ken-*
trochosia LAUTERBACH & SCHUMANN; *Lamechites* MARKGRAF; *Papu-*
echites MARKGRAF; *Pseudowillughbeia* MARKGRAF.
- Araceae — *Diandriella* ENGLER; *Holochlamys* ENGLER (W); *Xenophya*
SCHOTT (W).
- Araliaceae — *Palmervandenbroekia* GIBBS; *Peekeliopanax* HARMS (N.
Brit.).
- Asclepiadaceae — *Astelma* SCHLECHTER; *Spathidolepis* SCHLECHTER.
- Bignoniaceae — *Neosepicea* DIELS.
- Boraginaceae — *Crueicaryum* BRAND.
- Campanulaceae — *Phyllocharis* DIELS.
- Compositae — *Branchionostylum* MATTFIELD; *Heeatactis* F. v. MUELLER;
Ischnea F. v. MUELLER (W).
- Cornaceae — *Mastixiodendron* MELCHIOR.
- Corsiaceae — *Corsia* BECCARI (W).
- Cruciferae — *Papuzilla* RIDLEY.
- Cunoniaceae — *Aistopetalum* SCHLECHTER; *Kaernbachia* SCHLECHTER;
Opocunonia SCHLECHTER; *Stollaea* SCHLECHTER.
- Cyperaceae — *Capitularia* SURINGAR.
- Elaeocarpaceae — *Anoniodes* SCHLECHTER; *Sericolea* SCHLECHTER.
- Epaeridaceae — *Decatoca* F. v. MUELLER (W)
- Eriaceae — *Disiphon* SCHLECHTER.
- Euphorbiaceae — *Syndyophyllum* LAUTERBACH & SCHUMANN; *Tetraglo-*
chidion SCHUMANN.
- Gesneraceae — *Cyrtandropsis* LAUTERBACH; *Euthamnis* SCHLECHTER;
Oxychlamys SCHLECHTER; *Sepikea* SCHLECHTER.
- Gramineae — *Buergeriachloa* PILGER.
- Guttiferae — *Cyclandra* LAUTERBACH; *Nouhuysia* LAUTERBACH; *Tetra-*
thalamus LAUTERBACH; *Tripetalum* SCHUMANN (W).
- Ieacinaceae — *Leucocorema* RIDLEY; *Pentastira* RIDLEY; *Pocillaria*
RIDLEY.

Lauraceae — *Pseudocryptocarya* TRESCHNER.

Leguminosae — *Schleinitzia* WARBURG (W); *Schizoscyphus* SCHUMANN (W).

Loganiaceae — *Dolianthus* C. H. WRIGHT.

Loranthaceae — *Dactyliophora* van TIEGHEM; *Distrianthes* DANSER; *Papuanthes* DANSER; *Rhizomonanthes* DANSER; *Sogerianthe* DANSER; *Tetradyas* DANSER.

Malvaceae — *Wilhelminia* HOCHREUTINER.

Melastomaceae — *Bammlera* LAUTERBACH & SCHUMANN; *Catanthera* F. v. MUELLER; *Phyllapophysis* MANSFELD; *Poikilogyne* GIBBS; *Serobicularia* MANSFELD.

Menispermaceae — *Macrocoeculus* BECCARI (W).

Monimiaceae — *Anthobembix* PERKINS; *Idenburgia* GIBBS; *Lauterbachia* PERKINS.

Moraceae — *Antiaropsis* SCHUMANN (W); *Dammaropsis* WARBURG (W).

Myrtaceae — *Octamyrtus* DIELS; *Xenodendron* LAUTERBACH & SCHUMANN.

Opiliaceae — *Gjellerupia* LAUTERBACH.

Orchidaceae — *Chitonanthera* SCHLECHTER; *Dryadorchis* SCHLECHTER; *Eurycentrum* SCHLECHTER; *Ischnocentrum* SCHLECHTER; *Papuaea* SCHLECHTER; *Porphyrodesme* SCHLECHTER; *Ridleyella* SCHLECHTER; *Sepalosiphon* SCHLECHTER.

Palmae — *Leptophoenix* BECCARI; *Sommieria* BECCARI (W).

Passifloraceae — *Hollrungia* SCHUMANN (W).

Proteaceae — *Finschia* WARBURG (W).

Rubiaceae — *Airosperma* LAUTERBACH & SCHUMANN; *Maschalodesme* LAUTERBACH & SCHUMANN; *Myrmedoma* BECCARI (W); *Siphonandrium* SCHUMANN; *Versteegia* VALETON.

Rutaceae — *Hormopetalum* LAUTERBACH; *Hunsteinia* LAUTERBACH; *Lamiofrutex* LAUTERBACH; *Terminthodia* RIDLEY.

Sapindaceae — *Mischocodon* RADLKOFER.

Sapotaceae — *Krausella* H. J. LAM.

Saxifragaceae — *Discogyne* SCHLECHTER; *Kania* SCHLECHTER.

Serophulariaceae — *Detzneria* SCHLECHTER.

Urticaceae — *Gibbsia* RENDLE.

Zingiberaceae — *Eriolopha* RIDLEY; *Thylacophora* RIDLEY.

Fam. uncertain — *Gertrudia* SCHUMANN.

Total number: 110.

Doubtful:

?Geitroa BECCARI (W) cf. WARBURG, ENGL. BOT. JAHRB. 13, 1891, 231.
 ?Marumia Warburgii COGN., cf. ENGL. BOT. JAHRB. 60, 1926, 114.

Endemic Sections:

Dendrobium SCHWARTZ Sect. Amblyanthus.
 " Herpetophytum.
 Glomera SCHLECHTER " Giulianettia.

TABLE IV.

SOME SUBENDEMIC GENERA ARE:

- Anonaceae — Papualthia DIELS (also in the Philippine Isl.).
 Apocynaceae — Excavatia MARKGRAF (also 1 species in Kai); Lepiniopsis VALETON (also some species in the Phil., Mol., Polyn.).
 Araliaceae — Anomopanax HARMS (also in the Phil.).
 Burseraceae — Haplolobus H. J. LAM (10 species in N. G., 1 in Amboina, 1 in N. Borneo).
 Cunoniaceae — Betehea SCHLECHTER (also in Australia).
 Ericaceae — Dimorphanthera F. v. MUELLER (30 sp. in N. G., 1 in Amboina, 2 in the Phil., also in Fiji); Paphia SEEM. (also in Fiji).
 Euphorbiaceae — Endospermum BENTHAM (E. formicarum BECCARI; also in Mol.).
 Fungi — Echinophallus HENNINGS (E. Lauterbachii HENNINGS; also in Morotai).
 Gesneraceae — Boca COMMERSON (some sp. in the W. part of the Archipelago); Dichrotrichum REINWARDT (30 sp. out of 33 [western]).
 Himantandraceae — Himantandra F. v. MUELL. (also in Batjan and N.E. Australia).
 Icacinaceae — Rhiti(de)caryum BECCARI (18 sp. N. G., 1 sp. Kai).
 Leguminosae — Archidendron (Hansemannia incl.) F. v. MUELLER (also some sp. in Austr. and Polyn.); Maniltoa SCHEFFER (also sp. in Polyn.).
 Menispermaceae — Albertisia BECCARI (monotypic, also in Boeroe).
 Monimiaceae — Levieria BECCARI (also in Queensl. and Mol.); Steganthera PERKINS (18 spec. N. G., 1 sp. Celebes).
 Moraceae — Pseudotrophis WARBURG (also 1 spec. in the Phil.).
 Myrtaceae — Xanthomyrtus DIELS (also N. Caled., N.E. Austr. and N. Borneo).

- Ochnaceae — *Schuurmansia* BLUME (also in the Mol. and Borneo).
- Orchidaceae — *Aglossorhyncha* SCHLECHTER (also 1 sp. in Seran); *Calymmanthera* SCHLECHTER (also 1 sp. in Morotai); *Corysanthes* R. BROWN (*Corybas* SALISBURY) (also in Austr., some sp. in W. part of Mal. Archip.); *Epiblastus* SCHLECHTER (also in Samoa, Cel. and Mol.); *Hymenorchis* SCHLECHTER (also 1 spec. in Java); *Mediocleara* J. J. SMITH (also some sp. in Celeb.); *Microtatorchis* SCHLECHTER (also some sp. out of N. G.); *Pedilochilus* SCHLECHTER (also 1 sp. in Celeb.).
- Rubiaceae — *Amaracarpus* BLUME? (also in Western parts of Mal. Arch. and in the Phil.).
- Sapotaceae — *Burckella* PIERRE (also some sp. in Mol. and Polyn.).
- Saxifragaceae — *Carpodetus* FORSTER (also 1 sp. N. Zealand).
- Umbelliferae — *Didiscus* DE CANDOLLE (also in Austr. and N. Borneo).
- Verbenaceae — *Faradaya* F. v. MUELLER (1 spec. also in Queensl. and Borneo and 1 also in Seran).
- Zingiberaceae — *Riedelia* OLIVER? (also in Western parts of Mal. Arch.); *Tapeinochilus* MIQUEL (also in Mol. and Austr.).
- Sections:*
- Orchidaceae — *Bulbophyllum* THOUARS Sect. *Coelochilus*; Sect. *Dialeipanthe*; Sect. *Hyalosema*; Sect. *Macrouris*; Sect. *Pelma*; Sect. *Polyblepharon*.
- Dendrobium* SCHWARTZ Sect. *Calyptrochilus*; Sect. *Ceratolobium*; Sect. *Latouria*; Sect. *Oxyglossum*.
- Urticaceae — *Conocephalus* BLUME Sect. *Poikilospermum*.

TABLE V.

GROUPS WITH STRONG DIFFERENTIATION.

- Ericaceae — *Rhododendron* (\pm 80 spec.), *Vaccinium* (\pm 60 spec.).
- Myrtaceae — *Xanthomyrtus*; *Decaspermum*; *Syzygium*.
- Orchidaceae — abt. 2550 spec. in 116 genera.
- Pteridophyta — abt. 1000 spec. in 87 genera.
- Rubiaceae — abt. 380 spec. in 47 genera (especially: *Ophiorrhiza*, *Argostemma*, *Urophyllum*, *Randia*, *Hydnophytum*, *Psychotria*, *Timonius*).
- Araliaceae — *Boerlagiodendron*.
- Asclepiadaceae — *Hoya* (> 50 spec.).
- Bignoniaceae — *Deplanchea*; *Pandorea*; *Tecomanthe*.
- Burseraceae — *Canarium*.

Coniferae — Libocedrus.
 Corsiaceae — 1 genus in N. G. (Corsia), 1 in Chile.
 Cunoniaceae — Gilbea; Pullea (also in Australia).
 Dilleniaceae — Saurauia.
 Elaeocarpaceae — Elaeocarpus.
 Epaeridaceae — Styphelia.
 Gesneraceae — Aeschynanthus (= Trichosporum) (33 spec. out of ± 100); Cyrtandra (95 spec.).
 Magnoliaceae — Drimys.
 Melastomaceae — Medinilla (56 spec.).
 Monimiaceae — Trimenia.
 Myrtaceae — Backhousia (also in Australia).
 Orchidaceae — Bulbophyllum (± 550 spec. in N. G.); Caladenia (74 spec. in N. G.); Dendrobium (± 575 spec. in N. G.); Liparis (> 100 spec. in N. G.); Microstylis (> 100 spec. in N. G.); Oberonia (> 100 spec. in N. G.); Phreatia (± 123 spec. in N. G.); Prasophyllum (72 spec. in N. G.); Pterostylis (64 spec. in N. G.); Taeniophyllum (> 100 sp. in N. G.); Thelymitra (49 sp. in N. G.).
 Palmae — Drymophloeus.
 Pandanaceae — Freycinetia; Pandanus.
 Pteridophyta — Alsophila; Asplenium; Cyathea; Dryopteris, Polypodium; Selaginella; Trichomanes.
 Sapotaceae — Planchonella.
 Sterculiaceae — Sterculia.
 Triuridaceae — Sciaphila.
 Urticaceae — Cypholophus; Elatostema; Pilea.
 Zingiberaceae — Alpinia.

Sections:

Orchidaceae — Dendrobium Sect. Diplocaulobium; Sect. Grostidium.

TABLE VI.

GEOGRAPHIC RELATIONS.

1. Asiatic and Malayan Elements (those provided with an asterisk reach the eastern limit of their area in New Guinea).

Families:

*Ericaceae, abundant in New Guinea, practically wanting in Australia and Polynesia.

*Balsaminaceae

Gesneraceae

Lauraceae

*Myricaceae

Oleaceae

Ulmaceae, etc.

Genera:

Aquifoliaceae — *Ilex*.

Begoniaceae — **Begonia*.

Bombacaceae — *Gossampinus*.

Borraginaceae — *Cynoglossum* (the New Guinea species, however, more related to Australian types?).

Burseraceae — *Canarium*; *Garuga*, **Santiria*.

Campanulaceae — **Pentaphragma*.

Combretaceae — *Combretum*; *Terminalia*.

Compositae — **Lactuca*.

Dipterocarpaceae — **Anisoptera*; *Hopea*; **Vatica*.

Elaeocarpaceae — *Elaeocarpus*.

Ericaceae — *Rhododendron*; **Vaccinium*.

Euphorbiaceae — *Homalanthus*.

Fagaceae — **Castanopsis*; **Quercus* s.a. (not in Australia, extant in Polynesia).

Gentianaceae — **Gentiana*.

Gesneraceae — **Aeschynanthus* (= *Trichosporum*); **Dichrotrichum*.

Gonystylaceae — **Gonostylus*.

Lauraceae — *Litsea*.

Lentibulariaceae — *Utricularia*.

Loranthaceae — **Macrosolen*.

Monimiaceae — **Kibara*.

Myrsinaceae — **Labisia*.

Myrtaceae — *Decaspermum*; *Syzygium*.

Nepenthaceae — *Nepenthes*.

Orchidaceae — *Bulbophyllum*; *Dendrobium*; *Habenaria*; *Peristylus*; *Phreatia*; *Spathoglottis*.

Ranunculaceae — *Ranunculus*; **Thalictrum*.

Rosaceae — **Potentilla*; *Rubus*.

Rubiaceae — **Amaracarpus*; *Argostemma*; *Timonius*.

Rutaceae — *Acronychia*; *Atalantia*; *Evodia*; *Lunasia*; *Luvunga*.

Santalaceae — *Henslowia*.

Saxifragaceae — *Astilbe; *Dichroa; Polyosma.
 Sterculiaceae — Firmiana; *Pterocymbium; Sterculia.
 Styracaceae — *Bruinsmia; *Styrax.
 Symplocaceae — *Cordyloblaste; Symplocos.
 Taxaceae — Podocarpus.
 Ternstroemiacaceae — *Adinandra; Eurya; Ternstroemia.
 Urticaceae — Elatostema; Pilea.
 Valerianaceae — *Triplostegia.
 Verbenaceae — *Teysmanniodendron.
 Violaceae — Viola.

2. Polynesian Elements (an asterisk indicates that the western limit of the area is reached in New Guinea):

Araliaceae — Meryta (also New Caledonia); Plerandra; Tetraplasandra.
 Apocynaceae — Clitandropsis.
 Many Compositae.
 Corynocarpaceae — *Corynocarpus.
 Cunoniaceae — Spiraeanthemum.
 Elaeocarpaceae — Antholoma (also New Caledonia).
 Guttiferae — Penthaphalangium.
 Myrtaceae — Mearnsia (also 1 species Philippines); *Xanthomyrtus (also New Caledonia).
 Nepenthaceae — Nepenthes Vieillardii (also New Caledonia).
 Pandanaceae — *Sararanga.
 Santalaceae — Santalum.
 Sapindaceae — Euphorianthus; Harpullia; Jagera; Tristiroopsis.
 Sapotaceae — Achradotypus.
 Violaceae — *Agatea (also New Caledonia).

3. Antarctic Elements (an asterisk indicates that the western limit of the area is reached in New Guinea; in general Southern Hemisphere, S. America inclusive):

*Corsiaceae (1 genus in New Guinea, 1 genus in S. America).
 Cochlospermaceae — *Cochlospermum.
 Compositae — Abrotanella.
 Cruciferae — Papuzilla (endemic, but related with types of the Southern Hemisphere).
 Cyperaceae — *Carpha.
 Cupressaceae — Libocedrus (circumpacific; in the Malay Archipelago in Batjan only).

Droseraceae — *Drosera* (many in Australia).
 Epacridaceae — *Styphelia* (as far West as Java).
 Halorrhagaceae — *Gunnera*; *Halorrhagis*.
 Iridaceae — **Libertia*.
 Liliaceae — **Astelia alpina*; some *Luzuriagoideae*.
 Magnoliaceae — *Drimys* (1 species in Borneo and Philipp.).
 Orchidaceae — *Glomera* (circumpacific).
 Oxalidaceae — *Oxalis*.
 Pinaceae — **Araucaria*.
 Pittosporaceae — *Pittosporum*.
 Polygonaceae — **Muchlenbeckia*.
 Rosaceae — **Acaena*.
 Sapotaceae — *Lucuma* (circumpacific).
 Saxifragaceae — **Carpodetus* (New Zealand).
 Scrophulariaceae — *Hebe* (N. Zealand, S. America).
 Thymelaeaceae — *Kelleria* (= *Drapetes*) 3 species in New Zealand, 2 in New Guinea, 1 in N. Borneo, 1 in S. Australia and Tasmania.

4. Australian Elements (an asterisk indicates that the northern limit of the area is reached in New Guinea):

Proteaceae.
 Araliaceae — *Boerlagiodendron*; *Kissodendron*; *Mackinleya*.
 Casuarinaceae — *Casuarina*.
 Centrolepidaceae — *Centrolepsis*.
 Compositae — *Brachycome*; **Olearia*; **Tetramolopium*; *Vittadinia*.
 Cunoniaceae — **Betchea*; **Gilbea*; **Pullea*.
 Cyperaceae — *Cladium* (as far West as the Philipp.); *Gahnia*; *Schoenus* (as far West as the Philipp.).
 Dilleniaceae — **Hibbertia* (also in New Caledonia)
 Epacridaceae — *Styphelia* (240 species in Australia and S. America, some as far as the W. Archipelago).
 Eupomatiaceae — **Eupomatia*.
 Goodeniaceae — *Scaevola*.
 Gramineae — *Danthonia*; **Ectrosia leporina*; *Monostachya*.
 Haemodoraceae — **Haemodorum*.
 Iridaceae — *Patersonia* (also N. Borneo).
 Liliaceae — *Arthropodium*; **Lomandra*; *Schelhammera* and other genera.
 Menispermaceae — *Carronia*.
 Monimiaceae — *Daphnandra*; **Palmeria*; **Piptocalyx*.

Myrtaceae — *Backhousia; Eucalyptus (as far West as Timor and Celebes); Melaleuca.

Orchidaceae — Caladenia; Corysanthes (=Corybas); Microtis; *Pterostylus; Thelymitra (as far West as Java).

Palmae — *Bacularia; *Hydriastele; *Kentia; *Linospadix.

Philydraceae — Helmholzia.

Pinaceae — Callitris s.s.

Proteaceae — *Banksia; *Grevillea; *Stenocarpus (also in New Caledonia and N. Australia).

Rubiaceae — Coprosma (some species as far West as the W. Archipelago).

Santalaceae — Exocarpus (14 species in Australia; some as far West as the W. Archipelago and the Philipp.).

Sapindaceae — Dodonaea.

Saxifragaceae — Quintinia (1 species in the Philipp.).

Serophulariaceae — Euphrasia.

Stereuliaceae — *Brachychiton.

Stackhousiaceae — Stackhousia.

Stylidiaceae — Stylium.

Taxaceae — Daerydium (as far as the W. Archipelago); Phyllocladus (as far as N. Borneo, the Philipp. and Celebes).

Umbelliferae — Didicus (also N. Borneo); Oreomyrrhis.

Orchidaceae — Dendrobium Sect. Rhizobium.

From these statements we may notice the following points:

1. The *strong differentiation* appearing from the high figure for species pro genus and pro family and genera pro family (Table I). If we compare them with the corresponding figures for Borneo¹⁾, an island of a quite diametrically different geological history but of almost the same area, we get the following statement (*Spermatophytes* only):

| | New Guinea | Borneo |
|-------------------------------|------------|-----------|
| area in km ² | ± 800.000 | ± 750.000 |
| nr. of spec. pro fam. | 80.80 | 32.00 |
| " " gen. " " | 10.23 | 7.32 |
| " " spec. " genus | 7.90 | 4.34 |

1) E. D. MERRILL, Enum. Born. Pl. — Journ. Str. Br., Roy. As. Soc., Spec. Numb. Sept. 1921.

This means that the development of what we have to consider as the younger elements (species) has been much stronger in New Guinea than in Borneo (proportion concerning species pro family 80.80:32.00 = 2.52; concerning species pro genus 7.90:4.34 = 1.82). The difference on the development of older units (genera) is less (proportion concerning genera pro family 10.23:7.32 = 1.4), though it is obvious that also the genera have taken part in the differentiation. The flora of Borneo, that has to be considered as a part of the Asiatic Continent (cf. LAM, l. c., 1929 and 1930) thus appears to be less differentiated than that of New Guinea and the difference is greatest in the younger (2.52:1), smallest concerning the older units (1.4:1). It must therefore be concluded that the flora of Borneo is older than that of New Guinea, since we may suppose that the differentiation affects the youngest units only, while the older ones get their differentiation indirectly, viz. by natural elimination of individuals, forms, etc. between the concentration points of individuals that form the species. Thus the discontinuity between groups of individuals become more distinct as these groups grow older and a flora which for a great deal consists of young and strongly differentiated units with close mutual relations must therefore, as a whole, be younger than a flora with less differentiation and more evident discontinuity between the groups.

2. This point leads us to the *endemism* factor. It is generally believed that as the discontinuity between endemic units and their nearest relations is greater, the flora as a whole is older. Now the New Guinea flora (Tables II, III, IV) possesses not a single endemic family, while Australia, with which the island forms a geological unit, has several endemic families (*Cephalotaceae*, *Tremandraceae*, *Brunoniaceae*, etc.) and many subendemic ones. The number of younger endemic elements, however, is great. Compared with Borneo these figures are:

| | New Guinea | Borneo |
|-------------------------|------------|--------|
| Generic endemism | 11.6 % | 4.1 % |
| Specific endemism | 84.7 % | 49.0 % |

Moreover it appeared to me that of the New Guinea endemic genera none (as far as I know) is very much different from its relations and many are pretty closely allied to their nearest relations. Though there are some 110 genera known at present to be endemic in New Guinea, this endemism must therefore be relatively young. This conclusion is supported by the high specific endemism figure. Conclusions

concerning this have, however, to be treated with the utmost care and criticism, because the endemism figure is also dependent upon land connections and emigration possibilities. This is also the reason why the endemisms of New Guinea and Borneo cannot be compared like the relations of families, genera and species, since the land connections may have been (and possibly actually have been) entirely different both in time and in age. At any rate, we may state that there are no old relic-endemics (as far as I know) and that, therefore, the endemic elements must have originated in relatively recent times (neo-endemics). It is my impression that the process of differentiation is still going on vigorously after the island has been severed from surrounding landmasses. Apparently New Guinea has, in a relatively recent time, become a centre of dispersion as has been remarked before by several authors (COPELAND, SCHLECHTER, etc.). Yet some units have got the opportunity of spreading and settling in regions outside the island. I have enumerated some of these in Table IV. As far as relations to Australia are concerned, it may in some cases be difficult to discriminate whether a genus has originated in New Guinea or in the Australian Continent, but in most other cases it may be readily accepted that New Guinea has been the birthplace, also of many species or genera that are now found in New Guinea and in Australia only. Such units could be called "secondarily Australian".

It hardly needs to be mentioned that the endemism figure increases at higher altitudes. This is a phenomenon of general validity, probably due to the presence of more pronounced barriers and the strong variation of external factors in relatively small areas. As in many other mountain ranges some plant families have separate species on almost every peak (*Orchidaceae*, *Ericaceae*, *Gesneraceae*, etc.) and it cannot be explained by a general rule why other mountain species have so wide a distribution (cf. GIBBS, l. c.). Thus the endemism figure for the flora of the "Sattelberg"¹⁾ was between

$$\begin{aligned}100-700 \text{ m: } & 41\% \\700-1000 \text{ m: } & 70\%\end{aligned}$$

On examining the *Compositae*, it is striking that of the 25 lowland species there is only one endemic, while there are 42 among the 44 mountain species. In general the endemism of Papuan subalpine species must be something like 90%; in Java it is only 30%¹⁾.

1) TIR. SCHMUCKER, Beiträge z. Kenntn. der Hochgebirgsflora Javas und zur Theorie der Pflanzenausbreitung. — Beih. Bot. Centralbl. XLIII, 1927, 34-68, 5 figs.

3. The third point concerns the *relations* of *neo-endemics* and *recent immigrants*. It has, since the times of WALLACE's book (The Malay Archipelago, etc. 1864), often been said that the Australian element in the Papuan flora should be very considerable; in more recent times, however, a closer investigation has distinctly shown that the Australian element is relatively poor; apparently the former conception has been induced by the phytogeographical interest raised by Australian types in an Asiatic flora. It now is obvious that the Papuan flora is mainly Asiatic in character, particularly in the lower regions.

WARBURG (1891, p. 237) mentioned a collection from the lower regions of the former German Division containing 547 non-endemic species. Of these 273 (50 %) were in common with the Malay Archipelago only, 9 with Polynesia only and 6 in Australia only. These 288 species therefore had their area boundary in New Guinea.

Of the 970 species of *Pteridophytes* known to occur in New Guinea in 1920¹⁾ the island had in common with

| | | | |
|-----------------------------|-----|---|-----|
| the Malay Archipelago | 249 |) | 428 |
| „ Philippines | 179 |) | |
| Polynesia | 165 | | |
| Australia | 78 | | |

Of the 25 Sapindaceous genera, known in 1920²⁾, 9 belong to the Asiatic, 12 to the Polynesian and 4 to the Australian group, while of the 26 non-endemic species 24 were Asiatic and 2 cosmopolitic.

It seems that, as far as Western elements are concerned, the relations are particularly strong with the Moluccas (*Excavatia*, *Haplolobus*, *Dimorphanthera*, *Endospermum formicarum*, *Echinophallus Lauterbachii*, *Himantandra*, *Rhitidocaryum*, *Levieria*, *Schuurmansi*, *Aglossorhyncha*, *Calymmanthera*, *Tapeinochilus*, etc.), the Philippines (cf. MERRILL 1926), as is, for instance, evidenced by such genera as *Alyxia*, *Rauwolfia*, *Osbornia*, *Macropsychanthus*, *Papualthia*, *Parsonsia*, *Andruris*, *Anomopanax*, *Dimorphanthera*, *Pseudotrophis* and *Epiblastus* and also with Celebes (*Mediocalcar*, *Steganthera*, *Pedilochilus*, etc.) and Borneo, particularly Mt. Kinabalu (*Haplolobus*, *Schuurmansi*, *Faradaya*, *Euphrasia*, *Didiscus*, *Drimys*, *Xanthomyrtus*, etc.).

Generally speaking, the Asiatic element decreases in percentage in

1) Engl. Bot. Jahrb. 56, p. 31.

2) Engl. Bot. Jahrb. 56, p. 251.

the mountains. But even there it is prevailing. A small collection of plants made by me above the forest line on Doorman peak (3580 m) consisted of 155 species (among which representatives of 10 endemic genera). Of these 60 % was of Asiatic origin (19 % boreal, 37 % with relations in S.E. Asia and 4 % belonging to endemic genera with Asiatic relations) and 40 % non-Asiatic (16 % Australian, 9 % Antarctic-Polynesian and 15 % belonging to endemic genera with Australian relations). If we compare these figures with those of the mountain flora of Java (TH. SCHMUCKER, l.c.) we must state that at least 88 % of the last-named flora is of Asiatic origin and about 3.5 % non-Asiatic (the rest comprises anthropochores and similar elements).

These few examples, that can easily be amplified, may suffice to show that the Papuan flora is mainly Asiatic and that Polynesian elements are second in rank.

Resuming we may state that:

- a. there are no relic-endemisms known at present;
- b. there is a strong neo-endemism, especially at higher altitudes;
- c. Asiatic floral elements prevail, even in the mountains, Polynesian ones come next and Australian-Antarctic ones apparently last, Australian ones being best represented in the mountains (and in the savannahs);
- d. western relations are particularly strong with the Moluccas, the Philippines and Celebes (beside relations with high peaks).

The questions which now arise are:

Do these facts agree with one of the above mentioned theories concerning the geological history of this part of the world, and if so, with which? Can they be explained by one of them, and if so by which?

Let me give a concise review of both.

The theory of the permanency of continents and oceans considers the Malay Archipelago as the remainders of an ancient continental mass that once connected what is now the Continent of Asia (Sunda-shelf) and that of Australia (with New Guinea; Sahul-shelf).

Should New Guinea be a part of such an intercontinental land connection that must have been severed a long time ago, then we must find some trace of it in the flora, viz. in old Asiatic types or relic-endemic units. As long as these are not known we have to deny the possibility that New Guinea has formed a part of a former land connection between Asia and Australia, and we have to see whether the other conception may explain the facts enumerated.

I think that, provisionally, there is no reason why we should not

accept WEGENER's views as applying to this part of the world.

According to this remarkable hypothesis, that is of the utmost importance for biogeography, the Australian shelf has disjoined itself from the Antarctic Continent in the Eocene. Drifting northward or northwestward (with New Guinea in front), the shelf came into contact with the most south-eastern parts of Asia, where two or possibly three island arches were lying off the coast of the continent. SMIT SIBINGA has newly made extensive studies of the geological conditions of these arches (orogens) and, accepting WEGENER's hypothesis, has investigated the epeirophoresis (continental shifting) and orogenesis in these parts since the first contact was established. I avail myself of this opportunity to tender him my best thanks for his kind interest in my work and for the valuable informations concerning the subject he was kind enough to provide me with at my request. It is the opinion of Prof. SMIT SIBINGA that of the three arches mentioned the outer one (Pelew-orogen) was almost entirely destroyed (cf. fig. 3); it is only to be traced now by its northernmost remainders. The second one (the Molucca-orogen) was heavily disturbed and partly broken into sections, but can still be followed; the inner arch, finally (the Sunda orogen), has only partly endured a strong deformation but is still intact for long stretches. SMIT SIBINGA further suggests, that the epeirophoresis has not been a process of constant pressure, but that periods of a powerful shifting, during which mountain ranges were raised — the Central Range has originated in this way, and the smaller ranges north of it equally — alternated with periods of relative rest, during which erosive forces undid, partially or wholly, what orogenesis had created. It goes without saying that biogeographical contact by means of land connections can only be expected to be established a long time after the geological contact commenced. Now there have been, in SMIT SIBINGA's opinion, three main epeiphoreses:

1. one rather powerful push in the Old Tertiary that can be traced in the Molucca orogen;
2. a second, very powerful one in the Upper Miocene (Central Range of New Guinea raised?), which can equally be traced in the Molucca orogen and which possibly raised surface contacts (land connections) and
3. a weak shifting of Plio-plistocene age (Northern Ranges of New Guinea raised?) that affected both the Molucca orogen and the Sunda orogen.

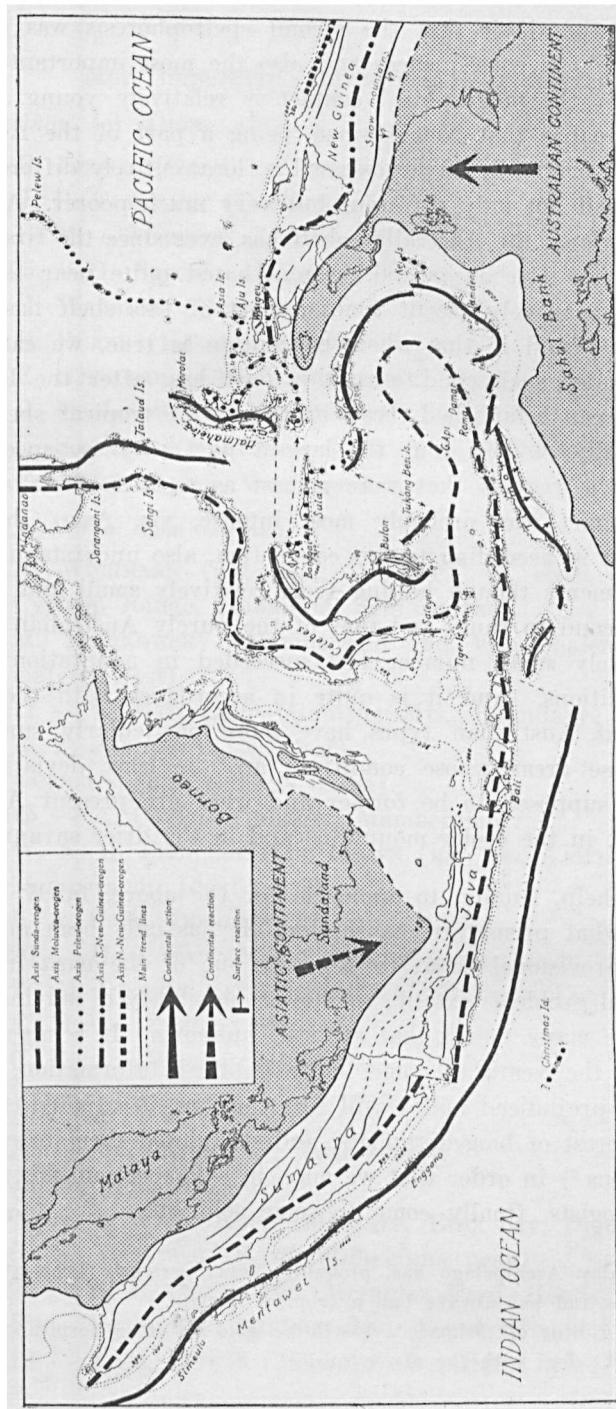


Fig. 3. The Malay orogens, as deformed by the Australian shelf, after SMIT SUBINGA. Courtesy of Dr G. L. SMIT SUBINGA.

Accepting the thesis that the second epeirophoresis was the first with biogeographical consequences and also the most important one, we must state that the biological contact is relatively young. But we must equally realize that New Guinea, being a part of the Australian continent, must originally have possessed a flora, entirely different from that of Asia and not only different but very much poorer. According to WEGENER's views, the Australian shelf has, ever since the first crustal movements in the Carbon period, been situated quite near the South pole. Only in relatively recent times a part of this shelf has arrived in the tropics¹⁾ and if this whole conception is true, we cannot but expect that under such conditions, this part has, after the land connections had been established, been overrun with tropical species.

It is equally obvious that the largest part of these species were hailing from the regions that were richest as to their flora and with which the contact was probably most intense, viz. Asia (the Malay Arches); but it is, according to this conception, also understandable that Polynesian elements though hailing from relatively small and scattered islands, are second in rank, and that of the purely Australian elements only a relatively small number has succeeded in adaptation to such different conditions. And it is quite in accordance with the present conception that Australian types have more particularly survived or settled in those areas whose conditions are the least deviating from what may be supposed to be former and what are present Australian conditions, viz. in the cooler mountains and in the drier savannahs.

I cannot help, finally, to apologize for the above, fairly bold and perhaps somewhat premature, conception. It has only been my aim to gather some provisional data; to stipulate one of the most interesting biogeographical problems extant; to show a possibility of solving it; and to indicate the many points that are still unknown. It is my intention to gather, in the years to come, more detailed information, without, I hope, being prejudiced and I will feel very much satisfied, if I have raised the interest of biogeographers, and stimulated them to contribute data or opinions²⁾ in order that we may, in collaboration, mutually and with the geologists, finally come to some solution.

1) The Malay Archipelago has, probably, never seriously been affected by polar movements and has always had a tropical climate.

2) As the Editor of „Blumea” I will be glad to offer hospitality to such papers that might deal with the above subject. H. J. L.

Annex I.**More important collectors in New Guinea.****1. Vogelkop (cf. GIBBS, 1917).**

- 1824 — P. LESSON (Dorei; on board "Coquille").
 1871 — J. E. TEYSMANN (Dorei, etc.).
 1872 — L. M. d'ALBERTIS (Hatam, 1500 m).
 1872, 1875 — O. BECCARI (Hatam, 1500—2000 m).
 1889 — O. WARBURG (Manoekwari).
 1891 — D. BURKE (Hatam, orchids).
 1912 — K. GJELLERUP (Angi-lakes); much material lost).
 1912 — R. F. JANOWSKY (Manoekwari).
 1913 — L. S. GIBBS (Angi-lakes, etc.).
 1928 — E. MAYR (Arfak, Wandammen).

2. Dutch North New Guinea.

- 1903 — A. WICHMAN (nat. ass.: ATASRIP; W. coast Geelvinck bay,
 Cycloop Range, Hollandia, Sentani-lake).
 1910 — M. MOSZKOWSKY (Mamberamo and Van Daalen Riv.; much
 material lost).
 1910—1911 — K. GJELLERUP (Gauttier Mts., Boundary; partly lost).
 1912 — R. F. JANOWSKY (N. coast).
 1913 — KORNASSI (nat. coll.; N. coast).
 1913—1915 — A. C. TH. THOMSEN (Mamberamo).
 1914 — W. K. H. FEUILLEAU DE BRUYN (nat. ass. AJOEB; Schouten Is.,
 Mamberamo, Idenburg Riv.).
 1914 — L. A. C. M. DOORMAN (Doorman peak).
 1919—1920 — H. J. LAM (Mamberamo, Doorman peak, Central Range).
 1926 — W. M. DOCTERS VAN LEEUWEN (Mamberamo, Central Range).
 1928 — E. MAYR (Cycloop Mts.).
 1931 — G. STEIN (Weyland Mts., Japen, Waigeoe).

3. Dutch South New Guinea.

- 1828 — A. ZIPPEL (Etna bay, Triton bay).
 1901 — JAHERI (nat. coll.).
 1904—1905 — J. W. R. KOCH (Merauke, Etna bay, Digoel Riv.).
 1907 — G. M. VERSTEEG (S. of Wilhelmina peak).
 1907—1908 — B. BRANDERHORST (Merauke, Fred. Hendr. Isl., Eilandenv.
 Riv., Digoel Riv., Otakwa Riv., Noord Riv.).
 1908—1912 — J. M. DUMAS (Merauke c.a., Digoel Riv. etc.).

- 1909 — L. S. A. M. VON RÖMER (S. of Wilhelmina peak).
 1909 — J. H. J. LE COCQ D'ARMANDVILLE (Kents Mts.).
 1911 — C. BODEN KLOSS (S. of Carstensz peak).
 1911 — A. C. DE COCK (Eilanden Riv.).
 1912—1913 — A. A. PULLE (S. of Wilhelmina peak).

4. *Territory of New Guinea* (cf. SCHUMANN & LAUTERBACH, 1905).

- 1875 — C. NAUMANN.
 1886—1888 — M. HOLLRUNG.
 1887—1889 — L. KÄRNABACH.
 1888 — F. C. HELLWIG.
 1889 — O. WARBURG.
 1889—1891 — C. A. F. WEINLAND.
 1890—1891, 1896, 1899—1900 — C. LAUTERBACH.
 1899 — E. O. A. NYMAN.
 1901—1902, 1907—1909 — R. SCHLECHTER.
 1910 — PEEKEL (N. Brit.).
 1910 — SCHULTZE.
 1912—1914 — C. LEDERMANN.
 1912, 1916 — CHR. KEYSER.
 1922—1923 — C. E. LANE-POOLE.
 1929 — E. MAYR (Saruwaged = Salawaket).
 1933 — L. J. BRASS.

5. *Territory of Papua* (cf. WHITE, 1922).

- 1875 — Sir WM. MACLEAY (Isl. Torres Str., Mainland).
 1875 — Rev. S. MACFARLANE (Baxter and Fly River).
 1875 — L. M. D'ALBERTIS (Yule Isl. and Mekeo).
 1875—1877 — L. M. D'ALBERTIS (Fly River).
 1876—1877 — A. GOLDIE.
 1884—1887 — Rev. JAS. CHALMERS.
 1885 — H. O. FORBES (Sogeri).
 1886 — W. BAUERLEN.
 1888—1898 — Sir WILLIAM MACGREGOR (Fly Riv., Astrolabe Range,
 Mt. Victoria).
 1889 — Sir WILLIAM MACGREGOR (Owen Stanley Range).
 1897 — Sir WILLIAM MACGREGOR (Mt. Seratchley).
 ± 1896 — GIULIANETTI and A. C. ENGLISH (Mt. Seratchley, Wharton
 Range, Vanaipa Valley).
 1898 — F. M. BAILEY.

- 1899—1903 — Sir G. R. LE HUNTE.
 1904—1907 — F. R. BARTON.
 \pm 1907—1910 — Rev. C. KING (Ambasi).
 1908 — Mrs. H. T. SCHLENCKER (Boku).
 1918 — C. T. WHITE (Dilava-Mafula, Yule Isl. distr.).
 1922—1923 — C. E. LANE-POOLE.
 \pm 1925 — Rev. L. TURNER (Rigo distr.).
 1925—1926, 1933 — L. J. BRASS.
 1929 — E. MAYR.

Annex II.

More important literature on the Botany of New Guinea.¹⁾

General information:

Annales du Jardin Botanique de Buitenzorg.

Bibliotheca Botanica.

Bulletin du Jardin Botanique de Buitenzorg.

Bulletin Dépt. Agric. Ind. Néerland.

Journal of Botany.

*Mededeelingen van het Encyclopaedisch Bureau: XXI. Schouten en Paidaido-Eilanden. (W. K. H. Feillettat de Bruyn) 1920.

*Mededeelingen Afd. Bestuurszaken van de Buitengewesten, Serie A No. 2. Het Gouvernement der Molukken. (A. J. BEVERSLUIS en A. H. G. GIEBEN) 1929.

Verslag Militaire Expl. Ned. Nieuw-Guinea 1907—1915. — Welt. 1920.

Z. W. Nieuw-Guinea expeditie van 1904—1905. — E. J. Brill, Leiden 1908.

Verslag der commissie (Uittreksel uit het —) ter voorbereiding van de aanwijzing eener natuurlijke grens tussehen het Nederlandsche en het Duitsche gebied op Nieuw-Guinea (1910—1911).

C. Lauterbach e. o., Beiträge zur Flora von Papuasien. — Engl. Bot. Jahrb., 1912 - hodie.

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|----------------------|------|------|------|-------------|-----|
| Acanthaceae | 50 | 1913 | 164 | II | 18 |
| " | 55 | 1918 | 135 | VI | 54 |
| Alangiaceae | 60 | 1926 | 162 | XIII | 109 |
| Amaryllidaceae | 50 | 1913 | 301 | III | 21 |
| Anueardiaceae | 56 | 1920 | 345 | VII | 66 |
| " | 59 | 1925 | 535 | XII | 99 |
| Anonaceae | 49 | 1912 | 113 | I | 8 |
| " | 52 | 1915 | 177 | IV | 35 |
| Apocynaceae | 61 | 1927 | 164 | XIV | 117 |

1) An asterisk denotes that special mention has been made of the literature concerning the subject.

| | Vol. | Year | Page | Beitr. Part. | Nr. |
|------------------------|------|------|------|--------------|-----|
| Aquifoliaceae | 59 | 1925 | 80 | XI | 93 |
| Araceae | 49 | 1912 | 90 | I | 5 |
| " | 54 | 1917 | 74 | V | 39 |
| Araliaceae | 56 | 1920 | 374 | VII | 67 |
| Aristolochiaceae | 52 | 1915 | 104 | IV | 29 |
| " | 58 | 1923 | 488 | X | 89 |
| Asclepiadaceae | 50 | 1913 | 81 | II | 17 |
| Balanophoraceae | 50 | 1913 | 68 | II | 14 |
| Balsaminaceae | 55 | 1918 | 114 | VI | 51 |
| Begoniaceae | 50 | 1913 | 335 | III | 25 |
| Bignoniaceae | 57 | 1922 | 496 | VIII | 78 |
| Burmanniaceae | 49 | 1912 | 100 | I | 6 |
| " | 55 | 1918 | 202 | VI | 57 |
| Burseraceae | 56 | 1920 | 317 | VII | 64 |
| Caesalpiniaceae | 55 | 1918 | 19 | VI | 49 |
| Campanulaceae | 55 | 1918 | 121 | VI | 52 |
| Capparidaceae | 52 | 1915 | 108 | IV | 30 |
| " | 61 | 1927 | 30 | XIV | 115 |
| Caryophyllaceae | 61 | 1927 | 164 | XIV | 117 |
| Cinnamomum | 58 | 1923 | 492 | X | 90 |
| Combretaceae | 57 | 1922 | 427 | VIII | 73 |
| Commelinaceae | 50 | 1913 | 54 | II | 12 |
| Connaraceae | 58 | 1923 | 178 | IX | 83 |
| Compositae | 62 | 1929 | 386 | XVI | 124 |
| Convolvulaceae | 59 | 1925 | 84 | XI | 94 |
| Cornaceae | 60 | 1926 | 167 | XIII | 110 |
| Corsiaceae | 49 | 1912 | 109 | I | 7 |
| Cruciferae | 55 | 1918 | 265 | VI | 60 |
| Cucurbitaceae | 60 | 1926 | 150 | XIII | 108 |
| Cunoniaceae | 52 | 1915 | 138 | IV | 33 |
| Cyperaceae | 59 | 1925 | 41 | XI | 91 |
| Dichapetalaceae | 49 | 1912 | 168 | I | 9 |
| " | 62 | 1929 | 341 | XVI | 119 |
| Dilleniaceae | 57 | 1922 | 436 | VIII | 75 |
| Dipterocarpaceae | 57 | 1922 | 460 | VIII | 76 |
| Elaeocarpaceae | 54 | 1917 | 92 | V | 40 |
| Ericaceae | 55 | 1918 | 137 | VI | 55 |
| Erythroxylaceae | 58 | 1923 | 249 | X | 83 |
| Flacourtiaceae | 55 | 1918 | 273 | VI | 61 |
| Flagellariaceae | 50 | 1913 | 288 | III | 19 |
| " | 59 | 1925 | 544 | XII | 103 |
| Fungi | 54 | 1917 | 246 | V | 47 |
| " | 57 | 1922 | 321 | VIII | 68 |
| Gentianaceae | 61 | 1927 | 28 | XIV | 114 |
| Gesneraceae | 58 | 1923 | 255 | X | 85 |

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| Gnetaceae | 60 | 1926 | 144 | XIII | 107 |
| Gramineae | 52 | 1915 | 167 | IV | 34 |
| Guttiferae | 58 | 1923 | 1 | IX | 80 |
| " | 61 | 1927 | 30 | XIV | 115 |
| Halorrhagaceae | 61 | 1927 | 26 | XIV | 113 |
| Himantandra | 55 | 1918 | 126 | VI | 53 |
| Hydrocharitaceae | 49 | 1912 | 68 | I | 3 |
| Icacinaceae | 58 | 1923 | 155 | IX | 82 |
| Juglandaceae | 50 | 1913 | 66 | II | 13 |
| Labiatae | 62 | 1929 | 376 | XVI | 122 |
| Lauraceae (cf. also sub Cinnamomum) | 58 | 1923 | 380 | X | 86 |
| Lichenes | 58 | 1923 | 250 | X | 84 |
| Lecythidaceae | 57 | 1922 | 341 | VIII | 70 |
| Lentibulariaceae | 62 | 1929 | 382 | XVI | 123 |
| Liliaceae | 59 | 1925 | 547 | XII | 104 |
| " | 50 | 1913 | 290 | III | 20 |
| Linaceae | 52 | 1915 | 115 | IV | 31 |
| Loganiaceae | 54 | 1917 | 156 | V | 41 |
| Loranthaceae | 57 | 1922 | 464 | VIII | 77 |
| Lycopodiaceae | 54 | 1917 | 226 | V | 45 |
| Lythraceae | 61 | 1927 | 23 | XIV | 112 |
| Magnoliaceae | 50 | 1913 | 70 | II | 15 |
| " | 54 | 1917 | 239 | V | 46 |
| Melastomaceae | 60 | 1926 | 105 | XIII | 106 |
| Menispermaceae | 52 | 1915 | 187 | IV | 36 |
| Mimosaceae | 55 | 1918 | 19 | VI | 49 |
| Monimiaceae | 52 | 1915 | 191 | IV | 37 |
| " | 55 | 1918 | 195 | VI | 56 |
| " | 58 | 1923 | 244 | X | 82 |
| Musaceae | 50 | 1913 | 306 | III | 22 |
| Musci | 55 | 1918 | 19 | VI | 48 |
| Myricaceae | 59 | 1925 | 540 | XII | 101 |
| Myrtaceae | 57 | 1922 | 356 | VIII | 72 |
| Nyctaginaceae | 52 | 1915 | 101 | IV | 28 |
| Oleaceae | 61 | 1927 | 1 | XIV | 111 |
| Olacaceae | 58 | 1923 | 155 | IX | 82 |
| Opiliaceae | 58 | 1923 | 155 | IX | 82 |
| Orchidaceae | 58 | 1923 | 50 | IX | 81 |
| " | 66 | 1934 | 161 | XX | 126 |
| Palmae | 52 | 1915 | 19 | IV | 26 |
| " | 28 | 1923 | 441 | X | 87 |
| Pandanaceae | 49 | 1912 | 60 | I | 2 |
| Pinaceae | 50 | 1913 | 46 | II | 11 |
| Piperaceae | 55 | 1918 | 204 | VI | 58 |

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| Piperaceae | 57 | 1922 | 354 | VIII | 71 |
| Pittosporaceae | 62 | 1929 | 338 | XVI | 118 |
| Proteaceae | 50 | 1913 | 328 | III | 24 |
| " | 54 | 1917 | 198 | V | 42 |
| Pteridophyta | 49 | 1912 | 1 | I | 1 |
| " | 56 | 1920 | 31 | VII | 62 |
| Quercus s. a. | 59 | 1925 | 41 | XI | 92 |
| " | 59 | 1925 | 538 | XII | 100 |
| Rhamnaceae | 57 | 1922 | 326 | VIII | 69 |
| " | 59 | 1925 | 535 | XII | 99 |
| Rubiaceae I Cinchoneae | 60 | 1926 | 1 | XIII | 105 |
| Rubiaceae II Coffcoideac | 61 | 1927 | 32 | XIV | 116 |
| Rubus | 54 | 1917 | 69 | V | 38 |
| Rutaceae | 55 | 1918 | 221 | VI | 59 |
| " | 59 | 1925 | 535 | XII | 99 |
| " | 61 | 1927 | 30 | XIV | 115 |
| Santalaceae | 59 | 1925 | 118 | XI | 97 |
| Sapindaceae | 50 | 1913 | 73 | II | 16 |
| " | 56 | 1920 | 251 | VII | 63 |
| Sapotaceae | 58 | 1923 | 463 | X | 88 |
| Saxifragaceae | 52 | 1915 | 118 | IV | 32 |
| Scrophulariaceae | 59 | 1925 | 99 | XI | 96 |
| Selaginella | 50 | 1913 | 1 | II | 10 |
| Simarubaceae | 56 | 1920 | 341 | VII | 65 |
| Solanum | 55 | 1918 | 58 | VI | 50 |
| Stemonaceae | 59 | 1925 | 541 | XII | 102 |
| Sterculiaceae | 62 | 1929 | 347 | XVI | 120 |
| Symplocaceae | 54 | 1917 | 212 | V | 44 |
| Taxaceae | 54 | 1917 | 207 | V | 43 |
| Theaceae | 57 | 1922 | 431 | VIII | 74 |
| Triuridaceac | 49 | 1912 | 70 | I | 4 |
| Ulmaceae | 50 | 1913 | 308 | III | 23 |
| Urticaceae | 57 | 1922 | 501 | VIII | 79 |
| Verbenaccac | 59 | 1925 | 87 | XI | 95 |
| Violaceae | 62 | 1929 | 368 | XVI | 121 |
| Vitaceae | 59 | 1925 | 505 | XII | 98 |
| Zingiberaceae | 52 | 1915 | 40 | IV | 27 |

Nova Guinea.

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| Acanthaceae | VIII | 2 | 1910 | 333 |
| Aizonaceae | " | " | " | 335 |

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| Algae | " | " | " | 253 |
| Amarantaceae | " | 2 | 1910 | 351 |
| " | " | 4 | 1912 | 627 |
| Amaryllidaceae | " | 5 | 1913 | 899 |
| Anacardiaceae | " | 2 | 1910 | 297 |
| " | " | 4 | 1912 | 829 |
| " | XIV | 1 | 1924 | 97 |
| Anonaceae | VIII | 3 | 1911 | 427 |
| " | " | 4 | 1912 | 871 |
| Apocynaceae | XIV | 2 | 1927 | 278 |
| Araceae | VIII | " | 1910 | 247 |
| " | " | 4 | 1912 | 805 |
| " | XIV | 2 | 1927 | 210 |
| Araliaceae | VIII | " | 1910 | 271 |
| Balanophoraceae | " | 4 | 1912 | 777 |
| " | " | 5 | 1913 | 919 |
| Bignoniaceae | XIV | 2 | 1927 | 293 |
| Boraginaceae | VIII | " | 1910 | 399 |
| " | " | 4 | 1912 | 683 |
| Burmanniaceae | " | 1 | 1909 | 193 |
| " | " | 4 | 1912 | 895 |
| Burseraceae | " | 2 | 1910 | 295 |
| " | " | 4 | 1912 | 827 |
| " | XIV | 1 | 1924 | 135 |
| Campanulaceae | VIII | 2 | 1910 | 407 |
| " | " | 4 | 1912 | 691 |
| Casuarinaceae | " | 2 | 1910 | 347 |
| " | " | 4 | 1912 | 621 |
| Celastraceae | " | 2 | 1910 | 279 |
| Chenopodiaceae | " | " | " | 349 |
| Chloranthaceae | " | 4 | 1912 | 623 |
| Clethraceae | XII | 2 | 1914 | 169 |
| Combretaceae | VIII | " | 1910 | 317 |
| " | " | 4 | 1912 | 847 |
| " | XIV | 2 | 1927 | 196 |
| Commelinaceae | VIII | 5 | 1913 | 905 |
| Corsiaceae | " | 1 | 1909 | 197 |
| " | " | 4 | 1912 | 893 |
| " | XII | 2 | 1914 | 171 |
| Cruciferae | VIII | " | 1910 | 363 |
| " | " | 4 | 1912 | 641 |
| Cucurbitaceae | " | 2 | 1910 | 405 |
| " | " | 4 | 1912 | 689 |
| Cunoniaceae | " | " | " | 645 |
| " | XII | 5 | 1917 | 491 |

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|------------------------|------|------|------|------|
| Cunoniaceae | XIV | 1 | 1924 | 150 |
| Cycadaceae | VIII | 2 | 1910 | 343 |
| Cyperaceae | " | 4 | 1912 | 695 |
| Dichapetalaceae | XIV | " | 1932 | 533 |
| Dilleniaceae | VIII | 2 | 1910 | 307 |
| " | | 4 | 1912 | 835 |
| " | XIV | 1 | 1924 | 81 |
| Dipterocarpaceae | " | 2 | 1927 | 222 |
| Ebenaceae | VIII | 1 | 1909 | 199 |
| Elaeocarpaceae | " | " | " | 173 |
| " | " | 4 | 1912 | 661 |
| " | XIV | 1 | 1924 | 151 |
| " | | 2 | 1927 | 304 |
| Epacridaceae | VIII | 4 | 1912 | 797 |
| " | XII | 5 | 1917 | 539 |
| Equisetaceae | VIII | 4 | 1912 | 619 |
| Ericaceae | " | 1 | 1919 | 183 |
| " | " | 4 | 1912 | 875 |
| " | XII | 2 | 1914 | 129 |
| " | | 5 | 1917 | 495 |
| Euphorbiaceae | VIII | 2 | 1910 | 221 |
| " | " | 4 | 1912 | 779 |
| " | XII | 5 | 1917 | 479 |
| Fagaceae | VIII | 2 | 1910 | 413 |
| " | XIV | 1 | 1924 | 73 |
| Filices | VIII | " | 1909 | 149 |
| " | " | 4 | 1912 | 715 |
| Flacourtiaceae | " | " | " | 671 |
| " | XIV | 2 | 1927 | 190 |
| Flagellariaceae | " | " | " | 180 |
| Gentianaceae | VIII | 1 | 1909 | 175 |
| " | " | 4 | 1912 | 889 |
| Gesneraceae | " | 2 | 1910 | 327 |
| " | " | 4 | 1912 | 859 |
| " | XIV | 2 | 1927 | 308 |
| Gnetaceae | VIII | " | 1910 | 345 |
| " | XIV | " | 1927 | 221 |
| Gonystylaceae | " | " | " | 306 |
| Goodeniaceae | VIII | 4 | 1912 | 693 |
| Guttiferae | " | 2 | 1910 | 309 |
| " | " | 4 | 1912 | 843 |
| Haemodoraceae | " | 5 | 1913 | 901 |
| Halorrhagaceae | XIV | 1 | 1924 | 105 |
| Hernandiaceae | VIII | 4 | 1912 | 639 |
| Hippocrateaceae | " | 2 | 1910 | 281 |

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| Hydrocharitaceae | VIII | 5 | 1913 | 915 |
| Icacinaceae | " | 4 | 1912 | 657 |
| " | XIV | 2 | 1927 | 275 |
| Iridaceae | " | 1 | 1924 | 114 |
| Lauraceae | VIII | 4 | 1912 | 819 |
| Lecythidaceae | " | 2 | 1910 | 315 |
| " | " | 4 | 1912 | 845 |
| Leguminosae I Mimos. | " | 2 | 1910 | 369 |
| Leguminosae II Caesalp. | " | " | " | 373 |
| Leguminosae III Papil. | " | " | " | 375 |
| Leguminosae | " | 4 | 1912 | 649 |
| Liliaceae | " | " | " | 663 |
| " | " | 6 | 1914 | 989 |
| " | XIV | 2 | 1927 | 173 |
| Linaceae | VIII | " | 1910 | 391 |
| " | XIV | 1 | 1924 | 112 |
| Loganiaceae | VIII | 1 | 1909 | 201 |
| " | XIV | 1 | 1924 | 115 |
| Loranthaceae | VIII | 2 | 1910 | 289 |
| " | " | 4 | 1912 | 815 |
| " | XIV | 1 | 1924 | 100 |
| Lythraceae | VIII | 4 | 1912 | 675 |
| Magnoliaceae | " | " | " | 633 |
| " | XIV | 1 | 1924 | 75 |
| Malvaceae | " | " | " | 159 |
| Melastomaceae | " | 2 | 1927 | 199 |
| Meliaceae | VIII | " | 1910 | 423 |
| Menispermaceae | " | " | " | 283 |
| " | " | 4 | 1912 | 869 |
| " | XIV | 1 | 1924 | 80 |
| Monimiaceae | VIII | 4 | 1912 | 876 |
| Musci | " | " | " | 735 |
| " | XII | 2 | 1914 | 109 |
| Myristicaceae | VIII | 4 | 1912 | 635 |
| Myrtaceae | " | 2 | 1910 | 319 |
| " | " | 4 | 1912 | 849 |
| " | XIV | 1 | 1924 | 85 |
| Nepenthaceae | VIII | 2 | 1910 | 339 |
| Nyctaginaceae | " | " | " | 353 |
| " | " | 4 | 1912 | 629 |
| Nymphacaceae | " | 2 | 1910 | 361 |
| Ochnaceae | " | 4 | 1912 | 667 |
| Oenotheraceae | " | 2 | 1910 | 395 |
| " | " | 4 | 1912 | 681 |
| Oleaceae | " | 2 | 1910 | 409 |

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| Oleaceae | XIV | " | 1927 | 329 |
| Opiliaceae | VIII | 4 | 1912 | 817 |
| Orehidaceae | " | 1 | 1909 | 1 |
| " | " | 3 | 1911 | 521 |
| " | XII | 1 | 1913 | 1 |
| " | " | 3 | 1915 | 173 |
| " | " | 4 | 1916 | 273 |
| " | XIV | 3 | 1929 | 337 |
| Oxalidaceae | VIII | 2 | 1910 | 389 |
| " | " | 4 | 1912 | 655 |
| Palmae | " | 1 | 1909 | 203 |
| Passifloraceae | " | 4 | 1912 | 673 |
| Pinaceae | " | " | " | 613 |
| Piperaceae | " | 2 | 1910 | 415 |
| " | " | 6 | 1914 | 1005 |
| Pittosporaceae | " | 2 | 1910 | 365 |
| " | " | 4 | 1912 | 643 |
| Plumbaginaceae | " | 2 | 1910 | 397 |
| Polygalaceae | " | 1 | 1909 | 169 |
| " | " | 4 | 1912 | 897 |
| Polygonaceae | " | 2 | 1910 | 359 |
| " | " | 4 | 1912 | 625 |
| " | XIV | 2 | 1927 | 333 |
| Pontederiaceae | VIII | 5 | 1913 | 909 |
| Portulaceae | " | 2 | 1910 | 357 |
| Primulaceae | XIV | 1 | 1924 | 113 |
| Proteaceae | VIII | 2 | 1910 | 285 |
| " | " | 4 | 1912 | 811 |
| " | XIV | 1 | 1924 | 74 |
| Pteridophyta | " | " | " | 1 |
| Ranunculaceae | VIII | 4 | 1912 | 631 |
| Rhamnaceae | XIV | 1 | 1924 | 110 |
| " | VIII | 2 | 1910 | 393 |
| Rhizophoraceae | " | 2 | 1910 | 679 |
| " | " | 4 | 1912 | 393 |
| Rosaceae | " | 4 | 1912 | 647 |
| " | " | 2 | 1910 | 367 |
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| " | " | 4 | 1912 | 755 |
| " | XIV | 2 | 1927 | 229 |
| Rutaceae | VIII | " | 1910 | 291 |
| " | " | 4 | 1912 | 823 |
| " | XIV | 1 | 1924 | 139 |
| Santalaceae | VIII | 2 | 1910 | 287 |
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Books and Papers.

- D'ALBERTIS, L. M., Vegetation Fly River. — Petermann's Geogr. Mitt. 1878.
- BAILEY, F. M., Additions to the New Guinea flora. — Bot. Bull. 13—14, 1896.
(Queensl. Dept. Agric.), 14—16.
- , Names of easily recognised plants. N. G. Expedition Lord Lannington. — Report of visit to Br. N. G. 1896, Appendix 27—28.
- , Contributions to the flora of British New Guinea. — Some papers in the Queensl. Agric. Journ., 1897—1914.

- BAILEY, F. M., Notes on the vegetation of New Guinea. — Proc. Roy. Soc. Queensl. 14, 1898, 14—20.
- , Some papers in annual reports, Br. N. G. (reprinted from Queensl. Agric. Journ.) 1899—1901.
- , Contributions to the flora of Queensl. and New Guinea. — Queensl. Agric. Journ. 16, 1906, 410—412.
- BECCARI, O., Malesia I—III. 1877—1890.
- , Notes on plants collected by d'Albertis. — Nova Guinea 1880, 391—400.
- BURKILL, J. H., On an collection of plants from New Britain. — Proc. Cambridge Phil. Soc. IX, 1896, II, 91—98.
- BURNETT, G., Timber Trees of the territory of Papua, Melbourne 1908. Ed. Dept. External Affairs.
- COPELAND, E. D., Papuan ferns, collected by Rev. Copland King. — Phil. Journ. Sci. Bot. 6, 1911, 65—92.
- DIELIS, L., Die Pflanzengeographische Stellung der Gebirgsflora von Neu-Guinea. — Bericht der freien Vereinigung für Pflanzengeographie und systematische Botanik für das Jahr 1919, Berlin 1921, 15—59.
- , Beitr. zur Flora des Saruwaged Gebirges. — Engl. Bot. Jahrb. 62, 1929, 452—501.
- , Ein Beitr. zur Analyse der Hochgeb. Flora von Neu-Guinea. — Engl. Bot. Jahrb. 63, 1929, 324.
- DIXON, H. N., The mosses of the Wollaston Exp. to Dutch New Guinea 1912—1913, with some additional mosses from British New-Guinea. — Journ. Linn. Soc. Bot. 45, 1922, 477—510.
- DOCTERS VAN LEEUWEN, W. M., Schets van de flora en de fauna van het Van Reesgebergte rondom het Albatros bivak, Noord-Nieuw-Guinea. — De Trop. Nat. XV, 1926, 177.
- *GLBBS, L. S., Dutch N. W. New Guinea. A contr. to the phytogeogr. and flora of the Arfak mountains. — London 1917.
- HEMSLEY, W. B., Report on botanical collections. — Annual Report British New Guinea. 1897—1899, 147—150.
- , Kew Bull. 1899, 95—126.
- HEYNE, K., De nuttige planten van Ned. Ind., 2nd Ed. I—III, 1927.
- HOLLEUNG, M., Die Vegetation von Deutsch-Neu-Guinea. — Globus 54, 1888.
- HUBRECHT, A. A. W., Nederlandsche Natuuronderzoekers in Nieuw-Guinea. — Gids 1909, I, 310.
- KING, Sir G., Some new species of Ficus of New Guinea. — Calcutta Roy. Bot. Gard. I, Append. 51 pp., 5 plates, Calc. 1887.
- KOOLMAAS, D. R., Resin of Agathis Labillardieri, Japen Isl. — Rec. Trav. Chim. Pays Bas. 51, 1932, 389—395.
- LAM, H. J., Vegetationsbilder aus dem Innern von Neu-Guinea. — Schenck und Karsten, Vegetationsbilder XV. Reihe, Heft 5—7, 1924.
- *—, Some remarks on the genet. phytography of the Mal. Archip. — Annales du Jardin Botanique de Buitenzorg. 37, 1929, 33—48, pl. V—XX.
- *—, Fragmenta Papuana I—VII. — Nat. Tijdschrift Ned. Ind. 87, 1927, 110; 88, 1928, 187, 252; 89, 1929, 67, 291.

- *LAM, H. J., Het genetisch-plantengeografisch onderzoek van den Indischen Archipel en Wegener's verschuivingstheorie (with English summary). — Tijdschr. Kon. Ned. Aardr. Gen. 2, 47, 1930, 553—581.
- LANE-POOLE, C. E., Forests of Papua and New Guinea. — Imp. For. Journ. V, 1925, 206—234.
- *—, The forest resources of the territories of Papua and New Guinea. — Parliam. Commonw. Austr. 1925.
- , Papua and New Guinea: The forest resources of the territories of —; Austr. For. Journ. V, 10, 1927, 59, 61.
- LEDERMANN, C., Einiges von der Kaiserin Augusta Fluss Expedition. — Engl. Bot. Jahrb. 55, Beibl. 4, 1919, 33—44.
- LAUTERBACH, C., Die geographischen Ergebnisse der Kaiser Wilhelmsland Expedition. — Zeitschr. d. Ges. f. Erdk. 33, 1898.
- , cf. list above (Engl. Bot. Jahrb.).
- , Die Pflanzenformationen einiger Gebiete Nordost-Neu-Guineas und des Bismarck Archipels I—IV. — Engl. Bot. Jahrb. 62, 1928, 284—304, 452—501, 550—569; 63, 1929, 1—28, 419—476.
- MACKLOT, H., Verslag van het land, bewoners, voortbrengselen van Nieuw Guinea (Z. M. korvet „Triton“). — Bijdr. tot de Natuurk. Wetenschapp., V, 1830, 142.
- MARTELLI, U., The Pandanaceae collected for the Arn. Arboretum by L. J. Brass in New Guinea. — Journal Arnold Arboretum 10, 1929, 137—142.
- *MERRILL, E. D., Enumeration of Philippine Flowering Plants IV, 1926, 97—105.
- MOSZKOWSKI, M., Expedition zur Erforschung des Mamberamo in Holländisch Neu-Guinea. — Zeitschr. Ges. f. Erdkunde 1912, 271, 365.
- MUELLER, F. von, Several small papers in Victorian Naturalist I—XIII, 1844—1896.
- , Several small papers in Melbourne Chemist and Druggist, 1884—1885.
- , Several small papers in Wing's Southern Science Record I, II (New series) 1885—1886.
- , Several small papers in Garten Flora 33, 1886.
- , Several small papers in Australasian Journal of Pharmacy 1886—1887.
- , Several small papers in Transact. Roy. Soc. Vict. 1887 and Roy. Soc. N. S. Wales 1890.
- , A Gesneriaceous plant discovered in New Guinea. — Wing's Southern Science Record II, 1882, 229.
- , Descriptive notes on Papuan plants. — I—V, 1875—1877, Append., VI—VIII, 1885—1886.
- , Highland plants from New-Guinea. — Nature 42, 382—383.
- , Report on a small collection of plants from the Aird River. — Proc. Linn. Soc. N. S. W. New series II 1887, 419—422.
- , Some Papers in Annual Reports, British New Guinea, 1888—1896.
- , Record of observations on Sir William Mac Gregor's highland plants from New Guinea. — Transact. Roy. Soc. Vict. I, 2, 1889, 145.
- , Notes on Papuan plants, 3 Papers in Journal of Bot. 29—31, 1891—1893.
- MUELLER, SAL., in: C. J. Teniminek, Natuurk. Geschiedenis der Ned. Overzeesche Bezittingen, 1839—1844, 1—80.

- NAUMANN, C., Ueber den Vegetationscharakter der Inseln des Neu-Brittannischen Archipels und der Insel Bougainville. — Engl. Bot. Jahrb. 6, 1885, 422—426.
- PHAFF, J. M., Kustbeschrijving van den Ind. Archip., in: de Zeeën van Ned. O. Ind., Ed. Kon. Ned. Aard. Gen. 1922, 358—506.
- PULLE, A., Naar het sneeuwgebergte van Nieuw-Guinea. — Ed.: Ned. Wereld Bibliotheek, undated.
- , Botanische indrukken van Nieuw-Guinea. — Natuur en Mensch 1933, 184.
- RECHINGER, K., Vegetationsbilder Neu-Guinea. — Karsten und Schenck, Vegetationsbilder, VI. Reihe, Heft 2.
- , Bot. u. Zoöl. Ergebnisse einer Wissenschaftl. Erforschungsreise nach den Samoa Inseln, den Neu-Guinea Archip. und den Salomon's Inseln. — Denkschr. Mathem. Naturwissenschaftl. Klasse der Kaiserlichen Ak. der Wissenschaften Wien LXXXI—LXXXIX, 1907—1913.
- , L. u. K. Streifzüge in Deutsch-Neu-Guinea und auf den Salomon Inseln, Berlin 1908.
- REINER, A., A supplement to C. T. WHITE: Ligneous plants collected in the Territory of Papua in 1925—1926 by L. J. Brass. — Journ. Arn. Arb. 14, 1933, 62—67.
- RENDLE, A. B., Dr. H. O. Forbes's New Guinea Plants. — Journ. of Bot. 61, 1923, Suppl. 1—64.
- RIDLEY, H. N., On the Monoc. plants of New Guinea collected by Dr. H. O. Forbes. — Journ. of Bot. 24, 1886, 321—327, 353—360.
- , Report on the Botany of the Wollaston Expedition to Dutch New Guinea. — Transact. Linn. Soc. London, 2nd. ser., Bot. IX, 1916, 1—269.
- ROGERS, R. S., Contributions to the Orchidology of Papua and New Guinea. — S. Austr. Roy. Soc. XLIX, 254—265, 1925.
- *—, Some developments in Orchidology. — Presid. Addr. Rept. Austr. and New Zealand. Assoc. Adv. Science XXI 1932.
- RUMPHIUS, G. E., Het Amboinsche Kruidboek I—VI, 1741—1750.
- SCHIFFER, R. H., Plantes de la Nouvelle Guinée. — Annales du Jardin Bot. de Buitenzorg I, 1876, 1—60.
- SCHLECHTER, R., Die Gutta-percha und Kautschuk Expedition nach Kaiser Wilhelmsland, 1907—1909, 1911, 151—171.
- , Die Orchidaceae von Deutsch Neu-Guinea, 1911—1914.
- SCHUMANN, K., Die Flora des Deutschen Ostasiatischen Schutzgebietes. — Engl. Bot. Jahrb. 9, 1887, 186—223.
- , Plantae Bammelerianaæ. — Notizbl. Bot. Gart. u. Museum Berlin I, 1895, 44—57.
- , Die Flora von Neu-Pommern. — Notizblatt Bot. Garten u. Museum Berlin II, 1898, 59—185.
- , u. HOLLRUNG, M., Die Flora von Kaiser Wilhelmsland. 1889.
- , u. LAUTERBACH, C., Die Flora der Deutschen Schutzgeb. i. d. Südsee, 1901; Nachtr. 1905.
- SMIT SIBINGA, G. L., The Malay double (triple) orogen. I, II, III. — Proc. Kon. A. K. Wet., Amsterdam 36, 1933, 202, 323, 447 (cf. also LAM, 1930).
- SUMMERHAYES, V. S., Ficus species. — Journ. Arn. Arb. 10, 1929, 142—154.

- TEYSMANN, J. E., Extrait d'un récit d'un voyage à la Nouvelle Guinée. — Ann. d. Jard. Bot. de Buitenzorg, I, 1876, 61—95.
- , Reis naar Nieuw Guinea. — Nat. Tijdschr. Ned. Ind. 40, 1881, 193.
- THOMSON, J. P., British New-Guinea. — Appendix II 1892, 218—221.
- VALETON, TH., Plantae Papuanae. — Bullet. Dept. Agric. Ind. Néerland. 10, 1907, 1—70.
- WARBURG, O., Beiträge zur Kenntnis der papuanischen Flora. — Engl. Bot. Jahrb. 13, 1891, 230—455.
- , Die Vegetationsverhältnisse von Neu-Guinea. — Verh. d. Ges. f. Erdk. 1892, 130—147.
- , Bergpflanzen aus Kaiser Wilhelmsland. — Engl. Bot. Jahrb. 16, 1893, 1—32.
- , Plantae Hellwigianae. — Engl. Bot. Jahrb. 18, 1893, 184—212.
- , Monsunia I, 1900.
- , Das Pflanzenkleid und die Nutzpflanzen Neu-Guineas, undated (\pm 1901).
- WERNHAM, H. F., Dr. H. O. Forbes' New-Guinea Rubiaceae. — Journ. of Bot. 56, 1918, 68—77, 129—135.
- WHITE, C. T., A contribution to our knowledge of the flora of Papua (British New Guinea). — Proc. Roy. Soc. Queensl. 34, 1922, 5—65.
- , On a small collection of plants from the Rigo district, Papua. — Proc. Linn. Soc. N. S. W. LI, 3, 1926, 296—298.
- , Plants collected in the mandated Territory of New Guinea by C. E. Lane-Poole. — Proc. Queensl. Roy. Soc. 39, 61—70, 1928.
- , Lignous plants collected in the interior of Papua. (Br. New Guinea) in 1925—1926 by L. J. Brass. — Journ. Arn. Arb. 10, 1929, 197—274.
- , & W. D. FRANCIS, Plants collected in Papua by C. E. Lane-Poole. — Proc. Queensl. Roy. Soc. 38, 225—261, 1927.
- WOLLASTON, A. R., An expedition to Dutch New Guinea. — Geogr. Journ. 43, 1914, 248.
- ZIPPEL, A., Letter from ---- to C. L. Blume also in Alg. Konst- en Letterbode I, 1829, 294.
- , Letter from ---- on the flora of New Guinea. — Flora oder Bot. Zeit. 12, 1892, 281 sq.