ORIGIN OF THE FLORA OF THE MALAY PENINSULA

by

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(Kew).

In my work on the Malay Peninsula, I included such plants as were known from the districts of North Kedah, Perlis and Setul. Botanically however, the Malayan flora ceases at a line running from a little north of Kedah peak Lat. 6.5, to Kota Bahru in North Kelantan Lat. 6.10. It is in fact approximately the termination of the Granitic Mountains as shown in SCRIVENOR's Map of the Geology of Malaya. North of this line there is a remarkable sudden change in the flora (with also a change of climate and soil) from the Malayan to Indo-Chinese. More than 60 genera of typical Malay plants entirely disappear, and many more are represented by a single species which has crossed the line, and disappears in Tenasserim. Among these plants are the *Durioneae, Lowiaceae, Schismatoglottis, Homalomena, Cyrtandra, Neuwiedia, Plocoglottis, Leptaspis* and most of Palms. A few plants from southern Siam and Cambodia have invaded the north of the Peninsula chiefly on the East side where the soil is most suitable. It is quite clear that the Peninsula was separated from the Tenasserim—Siam region through the Isthmus of Kra at no very distant period of time and was thus an island.

The whole of the Peninsula (Malaya) contains about 52.000 square miles, and is about 485 miles long and 200 miles wide in its widest part. It consists of a mass of mountains usually rising to 5.000 feet alt., with two, Gunong Tahan and Gunong Kerbau 7.000 feet alt., and is fringed on the west coast by lowlands with mangrove bordering the sea, and on the East coast with sandy plains. Except on the latter the whole country is covered by dense forest, the tallest trees being 180 feet tall so that on looking over it from an elevated point, nothing can be seen but the tops of the trees.

The trees ascend to the summits of the mountains in most places, but are shorter after 4.000 feet, where the nature of the forest also alters. Hence the greater part of the vegetation is woody, either trees, big lianes or shrubs, but beneath these grow a number of herbaceous plants — small *Rubiaceae, Melastomaceae, Gesneraceae, Zingiberaceae,* Aroids, terrestrial orchids, *Begonias* and many others. All over the forest region, *Compositae* and *Gramineae,* as well as *Cyperaceae* are very scarce; a few Bamboos and representatives of *Mapaniae* and *Hypolytrum,* and the *Leptaspis* are seen. In the lowlands a number of indigenous grasses occur along river-edges and seashores, and some in sandy spots on the East coast. Of 157 species of grasses a large proportion have certainly been introduced. As in the *Cypereae* section of *Cyperaceae,* here the greater number seem to have been introduced from India. Of *Compositae* 45 recorded, about 8 are indigenous, the rest widely distributed weeds.

The main flora is Sundaic, i.e. common to the Sunda islands, Java, Sumatra and Bali, to this have been added an influx of species from Borneo and other Eastern regions, and a large series from the north; India, Indochina and Burmah. Of the Maritime or Sea-dispersed plants I have given a full account in "Plant Dispersal", and there need be no more said but that with a few exceptions such as *Dolichandrone, Heritiera, Sarcolobus, Finlaysonia* and a few others apparently originating in India or Africa, all are derived from the far East. Plants of human introduction also need not be dealt with. Many have been introduced in Rice or other cultivations, or by various accidents and are still being introduced but except one or two, such as *Bidens* and *Adenostemma* carried about by wild tribes, they are only to be found in cultivated ground or by roadsides.

The Sundaic flora.

This flora extended over Sumatra, Java and Bali (Sunda) at a time when all were connected together, and with the Malay Peninsula (Malaya). A very large percentage of the Malayan plants are common to the flora and to Borneo as well, but I am inclined to think that in the latter case the presence of these plants is due to the undoubted connection of Borneo and Malaya rather than the connection of Java with Borneo.

We know that Borneo was connected with the East coast of Malaya directly at an early date, not only from the flora, but from the mammal distribution. A molar of the extinct *Elephas namadicus* (Lower Pleistocene) was found in Perak, and portion of one of another extinct Elephant — possibly the same species, was found in Borneo, and some

of the existing mammals are common to both countries. In the Sundaic region we find a number of animals which are missing from Borneo and must have come down from India and Indochina after the separation of Sunda from Borneo, and while Malaya was in land-connection with Sumatra; such are the tiger, panther, elephant, the wild dog (*Cuon javanicus*), *Herpestes urva, Rhinoceros sondaicus* and *Capricornus.*

In the Java and Sumatra mountains we find an extensive series of North Temperate plants from the Himalayas and Yunnan entirely absent from Borneo where the alpine plants are mainly derived from the Eastern Archipelago, and are of Australian origin. Some of these occur also on the Malayan mountains. Of the Himalayan plants occurring in the Sumatran mountains some are found in the Malay Peninsula chiefly on the west side, and these as will be shown are derived from the East coast of Sumatra.

WALLACE'S Line between Bali and Lombok forms the boundary between the Sundaic flora and that of the Moluccas region, though a good many plants of Sundaic origin have passed the boundary and are found in Celebes and other islands to the East.

The flora of Malaya differs however, to a large extent from the Sundaic one, partly from the invaders from India and Cochinchina and from Borneo, and contains a very large number of endemic genera and species of various orders. The following are the endemic genera: *Scaphocalyx (Flacourtiaceae), Leptonychiopsis* and *Peniculifera (Sterculiaceae), Icicaster (Burseraceae), Oreorhamnus (Rhamnaceae), Curtisina, Phoenocimon, Napaeodendron (Sapindaceae), Burkillia (Leguminoseae), Calycopteris (Combretaceae), Perilimnastes, Oritrephes (Melastomaceae), Wardenia, Hederopsis, Scheffleropsis (Araliaceae), Aleisanthia, Becheria, Klossia, Pomazota, Aulacodiscus, Mesoptera, Perakanthus (Rubiaceae), Codonoboea, Orchadocarpa, Micraeschynanthus (Gesneraceae), Acrymia (Labiatae), Actephilopsis, Sphaerostylis (Euphorbiaceae), Renantherella (Orchidaceae), Odontychium, Carenophila, Conamomum, Geostachys (Scitamineae), Tricalistra (Liliaceae), Ranalisma (Alismaceae), Spatholirion (Commelinaceae), Calospatha (Palmae).*

The number of endemic species is very large; thus out of 40 species of *Sonerila,* 35 are endemic, of 122 species of *Eugenia* 100, of *Argostemma* out of 41 species 36, of *Didissandra* 16 all, and of 53 species of *Didymocarpus* 46 are endemic.

However, the neighbouring islands — Sumatra and Borneo have still not been thoroughly explored, and some of these local plants may yet be obtained there, but Malaya also includes a very large area of

mountain forest in which no botanist has ever been. The mountain valleys of the interior almost all contained one or more species of *Didymocarpus* peculiar to that spot, and I considered it was a poor expedition when I did not get on an average two new species of plants a day. Again Sumatra and Java have been for many centuries so heavily populated, that much of the flora, especially of the lowlands, has been quite destroyed by cultivation and timber-felling, while Malaya till the last few years was inhabited only by the Sakai, wild tribes who cultivated nothing and caused no alteration in the flora, and the Malays who confined their settlements to the seashore and river banks. Malacca province alone was heavily cultivated till the beginning of the 19th century. The Malayan forests were thus quite free from introduced plants, and consist of a flora of vast antiquity quite unchanged.

Date of the Sundaic Flora.

The researches of Mrs Clement Reid, Miss Chandler and others into the Eocene flora of Europe, and especially of southern England, show that in the Sundaic flora, especially that of Malaya, there are very many relics of this early period, more indeed here than in any other country.

Some of the Eocene genera e.g. *Magnolia, Lonicera, Nyssa, Altingia (Protaltingia)*, natives of a cooler climate than the Malay lowlands, and confined to the mountains, have probably come down from temperate India, but a large number of genera are not now represented there. Some are not only found in India and Malaya, but in Africa and South America, such are *Tetracera, Vitis, Symplocos, Diospyros*, which doubtless passed over when West Africa and Guiana were connected.

We have in the Eocene period the following genera or closely allied forms of Malay plants: *Anonaceae* allied to *Polyalthia* and *Uvaria, Proto-Barclaya, Tinomiscoides, Tinospora, Euhypserpa, Erythropalum, Olax, Iodes, Palaeo-allophylus, Zizyphus, Echinocarpus, Dalbergia, Palaeo-rhodomyrtus, Mastixia, Ardisia, Acanthus* allied to *ilicifolius* and *volubilis, Radermachera, Tylophora, Phyllanthera* (a very rare plant only found now in the Perak mountains, Java and Sumatra), *Leucopogon, Endiandra, Cinnamomum, Beilschmiedea, Litsea, Neolitsea, Artocarpus, Myrica, Engelhardtia, Terminalia, Ficus, Epipremnum, Nipa, Acrostichum. Nipa* in Eocene days was abundant on the coasts of England and along the Mediterranean to Egypt, now it grows only from the Sundribuns along Malaya and the islands to Australia and the Solomon islands. The Eocene tidal rivers in Southern Europe with *Nipa* and *Acrostichum* and

Acanthus, with *Tylophora* climbing over the shrubs and the forests of *Cinnamomum* and other *Lauraceae, Artocarpus, Ficus, Palaeo-allophylus* and *Dracontomelum* behind, and the river turtles, *Trionyx* and crocodiles in the water must have closely resembled the Malayan tidal rivers of today.

The Himalayan element.

In the high mountains of Java and Sumatra is found a very considerable flora of north temperate Himalayan and Yunnan plants. These are quite absent from Borneo, showing that the ridge of high mountains which formerly stretched from India to Java along which these plants descended did not touch Borneo, nor did it reach Malaya, but we have there a number of these plants scattered about chiefly on the west of the Peninsula, derived evidently from Sumatra when it was joined to Malaya.

The largest number I found together was at Cameron's Highlands in Perak, and later I found a similar but more extensive flora on the opposite mountains at Berastagi in Sumatra at approximately the same altitude. The plants were *Viola serpens, Desmodium scalpe, Sarcopyramis, Sanicula europaea, Ophiopogon intermedius* and *Disporum pullum.* It was remarkable that at both localities there grew the white-flowered *Didymocarpus albinus,* for this group of plants is rare in Sumatra, and this was the only one I found at Berastagi.

Other Himalayan types found in other mountains in Malaya are *Anemone sumatrana, Gaultheria punctata,* allied closely to *G. fragrantissima, Psychotria fulva, Nyssa javanica, Speirema montana, Ainsliea, Pistacia* and *Sycopsis. Pentapterygium malayanum* from the Perak mountains is remarkable as no species of that Himalayan genus is yet known from Sumatra, and even more unexpected was the discovery of *Stichoneuron* in Pahang. This genus is only known from one species in the Himalayas, where fruit has never been seen, and it was equally sterile in Pahang. It is found also in Kelantan, and it is possible that it came directly through Burmah or Siam as it is not always a mountain plant in India, and is certainly not one in Malaya.

Invasions from the East.

A number of plants have arrived from the Australian region, either through the islands to Borneo and into Malaya when that island was connected with it, or having reached South China via the Philippines have travelled through Cambodia to the north of the Peninsula and then gone south from there.

Examples of the latter invasion are *Melaleuca* and *Leptocarpus disjunctus (Restionaceae).*

Melaleuca leucadendron (Myrtaceae) occurs in a wild state in Amboina, Cochinchina, and southern Siam to the north of the Peninsula, as far south as Kedah, and with it in Southern Siam is found *Thysanotus (Liliaceae),* also a typical Australian plant and several other Australian types. It is probable that *Melaleuca* also invaded the south of the Malay Peninsula via Borneo. A large extent of this plant occurred near Malacca, where tradition said it had been introduced by the Dutch, and I found the same form, var. *minor,* in Singapore. It also occurs in Borneo. It is the only species of the genus known outside Australia, and has certainly been cultivated in many parts of the East.

Leptocarpus disjunctus is the only plant of its order in Asia, and occurs in Cambodia and Southern Siam to Tringanu in Malaya. The genus is Australian.

The other route from Australasia to Malaya is clearly through the islands and all the other Australasian plants have been found in Borneo, chiefly on the high mountain Kinabalu, and are mostly found on quartzite ridges or on the seashore, though there are some lowland forest Australian types. They are missing from the Sunda islands and from the Indian and Burmese regions.

Among the *Myrtaceae,* are *Baeckia frutescens,* a bush abundant on the sandy mountains, and even on the small quartzite ridges at Klang gates in Selangor, surrounded for many miles by the granite hills covered with Malayan forest. It grows also sometimes on sandy shores. *Leptospermum flavescens* grows as far north as Moulmein. This bush occurs also in Java and Sumatra, perhaps a migrant from Malaya; *Rhodamnia, Nelitris* and *Rhodomyrtus* are all of Australian origin. Their baccate fruits are freely dispersed by birds, so that these have a wider distribution to Java and Sumatra, and in the case of *Rhodomyrtus* to South India. *Tristania,* lowland forest trees, is also an Australian type, but except for the seashore *T. Whiteana* Griff., which has reached Sumatra from Malaya, none are Sundaic, but get to Siam and Cambodia, Mergui etc. *Weinmannia (Saxifragaceae)* of Australia and New Zealand has spread through the Philippines to Malaya, and to Madagascar. It also occurs in Sumatra.

Nertera depressa (Rubiaceae) is another migrant from the Antarctic region. A little herb with orange berries, popular with birds of the thrush tribe (*Turdidae*), it has spread through the islands to Gunong Tahan in Pahang, its most Western locality. *Dianella (Liliaceae),* a large

Australian genus, is represented by the widely dispersed *D. ensifolia* from the Philippines to Formosa, China and North India and along the islands from Papua to Madras, and the Mascarene islands; dispersed perhaps by sea, but also by birds. Two or three other species are found on the Malay mountains. *Joinvillea (Flagellariaceae)* is a Polynesian genus which is found in Borneo and Malaya. The lowland forest *Cyrtandra (Gesneraceae)*, abundant in Polynesia, Papua, the Sunda isles and Borneo, appears in diminished number in Malaya and disappears at the north of the Peninsula altogether. The *Cyperaceae* of the high mountains are mainly of Australian origin, and those of Gunong Tahan were nearly all identical with those of Mount Kinabalu in Borneo, most are quite absent from the Sunda islands; *Gahnia tristis* is found near the sea and on the mountains, *G. javanica* on wet mountains, in the Sunda isles as well as Borneo; *G. castanea* in China, *Cladium undulatum* and *glomeratum, Vincentia Maingayi, Lepidospermum chinense*, the only species of this large genus outside Australia, and *Schoenus calostachys* are all Australian types. *Lepironia* inhabits the lowland swamps and goes as far as Ceylon and Madagascar. Most remarkable of all is *Oreobolus distichus* on Gunong Kerbau in Perak on the west side of the Peninsula. The genus is only known from single species in Australia and New Zealand, in the Sandwich isles, in Chili and quite recently from Mount Kinabalu in Borneo, five species in all at great distances apart. On Gunong Tahan too, I found *Eriocaulon Hookerianum*, otherwise only known from Mount Kinabalu and *Gentiana malayana* closely allied to a species from the latter mountain. All these plants show a strong connection between Malaya and Borneo.

Leucopogon malayanus (Epacrideae) is also an Australian type which occurs both on the seashores and mountains of Malaya, Borneo and Sumatra. This plant is specially interesting, as though it goes further north of any of the genus, to Kedah peak, in the north of Malaya, it is found fossil in the Eocene period, in the London clay. That the island of Borneo was connected with Malaya by land is clear from the two floras, and Professor BROUWER thinks that a continuous land mass connected part of Borneo with the Malay Peninsula in upper tertiary times Miocene or Pliocene (SCRIVENOR, Geology of Malaya p. 119) and this may have been the date at which this Australasian element passed over. Unfortunately such fossils as we have throw very little light on the period. Portion of the tooth of an extinct elephant was found in Borneo in a cave at Bau, and a tooth of *Elephas namadicus* of the lower Pleistocene was found in Perak, but it is not certain that

the Borneo elephant belonged to the same species. A small number of fossil leaves sent me from Rantau Panjang, Selangor by Mr SCRIVENOR were insufficiently fossilized. They included a pinnule of *Angiopteris evecta*, and leaves resembling those of *Vaccinium Scortechinii*, a *Litsea* or *Lindera*, a *Polyalthia* and *Eugenia*.

All were small coriaceous leaves suggesting a dryer climate such as on the Gunong Tahan quartzite. The date is doubtful and they may have been deposited in Post-Pleistocene days, but the compactness of the shales in which they were embedded is against this and they may have been deposited much earlier.

Invasion from the North.

It seems to me probable that Malaya was separated from the Siamese mainland and connected again on more than one occasion. It appears that the sea overflowed what is now the Isthmus of Kra, at a comparatively recent date, and the silting up of this portion and reconnection of the two countries later accounts for the Siamese plants which have travelled as yet a short distance down the Peninsula. Many have reached no further than Penang and Northern Perak, such are the tidal swamp — *Phoenix paludosa*, as far south only as the Dindings, *Prunus martabanica*, *Thunbergia laurifolia*, *Wikstroemia viridiflora*, *W. Ridleyi*, *Leptocarpus* and many others. But as the soil and climate north of Kedah are so unlike those of the wet rain-forests of the south, the migration has been slow.

There are however, a number of plants of Indo-Chinese origin on the now broken up ridge of limestone rocks in Malaya, which must have arrived when the limestone was a continuous mass from Tenasserim southwards. I treat these separately. They must have arrived at a much earlier date. There is also a very large element of Indian, and Indochinese plants which are widely diffused all over the Peninsula, and which therefore must be much earlier arrivals. A complete list of these would be too long to write here, but I give some illustrations: *Pieris ovalifolia*, absent from the Sundaic and Bornean region, a native of the Himalayas and Siam as far south as Gunong Tahan, *Pentasacme*, *Hymenocardia*, *Chlorophytum*, *Tupistra*. Most of the indigenous grasses: *Sclerostachyum*, *Garnotia*, *Eriachne*, *Thysanolaena*, *Coix gigantea*, *Dimeria*, *Myriostachya*, *Leptochloa polystachya* and others are undoubtedly of Indian origin.

Some large genera like *Sonerila* and *Didymocarpus*, abundant in India and becoming rarer as we travel farther east, and the forest

Liliaceae, Tupistra, Peliosanthes, Ophiopogon, Dilleniaceae and *Magnoliaceae,* most at last of the *Carices, Arisaema, Lepionurus oblongifolius,* occur or have affinities with the Indian and Indo-Chinese region. This wave of immigration from the north is correlated with the invasion of the big Indian mammals; the tiger, panther, elephant, *Bos Gaurus,* the Seladang and Wild dog, already mentioned, most of which reached the Sunda region before Malaya was separated from Sumatra and Java and after the separation from Borneo, where they are entirely absent.

The limestone flora.

In the Lankawi islands and Perlis and Setul are considerable masses of limestone rocks which bear a very extensive and peculiar flora. This limestone is continued down the Peninsula on both sides of the main central mountain ranges in the form of broken masses, about 1.000 feet alt., as far south as Kwala Lumpur Batu Caves, and on these masses, usually at the summit, we find a series of plants otherwise only occurring in Lankawi and Perlis. The rock masses are surrounded by dense lowland wet forest of the ordinary Malayan flora. It is interesting to note that two large species of *Boea (Gesneraceae)* which grow on the upper precipices of the Batu Caves: *B. verticillata* and *B. paniculata,* allied to species occurring in Lankawi have retained their habit of drying up completely after January, and flowering again in October, just as if they still inhabited the dry climate of Lankawi at that season, regardless of the fact that there is no dry season in Malaya, and the rain falls continuously over the forest surrounding the rocks.

The following plants are common to Malaya and the southern Siam limestone rocks, and are absent elsewhere; *Polygala cardiocarpa, Columbia integrifolia, Orophea cuneiformis, Miliusa amplexicaulis, Impatiens Scortechinii, Leea saxatilis, Helicteres angustifolia, Begonia phoeniogramma, Tarenna Curtisii, Canthium aciculatum, Canscora pentanthera, Boea* and *Chirita,* species allied to Lankawi ones; *Justicia uber, Callicarpa angustifolia, Cleistanthus gracilis, C. minutiflorus, Andrachne calcarea, Calanthe vestita, Livistona rupicola, Typhonium fultum, Colocasia gigantea, Arisaema fimbriatum, Amonum testaceum.*

It is obvious that this series of plants must have reached their present position when the limestone ridges were continuous from north to south and before they were broken up into isolated blocks by denudation as they are at the present day.

I have now outlined as briefly as possible the origin of the constituents of the flora of Malaya. A great deal remains to be done both

in further botanical exploration and in geological research, before we can definitely settle the history of the origin of this extensive flora.

It is clear that the flora is a mixture of plants which have arrived or evolved at different periods from the Eocene period to the present day, and it is probable that the invasions from the East and North took place in the early or later pleistocene period. It is possible that Borneo was connected with Malay earlier i.e. in the Pliocene period as suggested by BROUWER, and also by the occurrence of the *Mastodon* in Brunei, Borneo and in Burmah, but of this we have at present insufficient data to decide.