PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

The Vegetation of the Solomon Islands

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Phil. Trans. R. Soc. Lond. B 1969 **255**, 259-270
doi: 10.1098/rstb.1969.0010

Phil. Trans. Roy. Soc. B **255**, 259–270 (1969)
Printed in Great Britain

The vegetation of the Solomon Islands

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CONTENTS

The Solomon Islands are entirely clothed in tropical rain forest except for small areas of probably anthropogenous grasslands and heaths which occur in regions with a seasonal climate. The main features of the vegetation are described and related to the exceptionally wet climate of the archipelago. The extensive areas which carry thickets of small trees and climber tangles instead of high forest are thought due to the combined influence of man, earthquake, landslip and cyclone. Many species are shown to have wide ecological amplitudes.

Introduction

The Solomon Islands are almost entirely clothed in tropical rain forest and this with the ubiquitous cloud cap gives them a sombre appearance to the seaborne traveller, a possible derivation of the term Melanesia, the dark islands.

The vegetation is strongly influenced by the young, unstable landscape, the very wet climate, and many centuries of disturbance by man and natural catastrophes.

Geology and Geomorphology

The archipelago in its present form is geologically recent, dating from the Pliocene at the latest (Coleman 1965). The land surfaces are all young. Only Guadalcanal and Bougainville have extensive coastal plains. Elsewhere the mountains rise directly from the sea and the rivers run swift and cold. The interior of all the islands is a jumble of steep, unstable ridges and peaks. Earthquakes are frequent. Rainfall is everywhere heavy and frequent. Landslips are common.

Rainfall

The rainfall of New Guinea and the whole of Melanesia has recently been studied by Brookfield & Hart (1966) and Fitzpatrick, Hart & Brookfield (1966) who have made harmonic analyses of data from 235 rainfall stations of which eight lie in the Solomon Islands. The following is a summary of their findings.

In the Solomons the most marked season begins fairly abruptly between mid-April and

mid-May when the South-East Trade winds move north. In the Solomons (lat. 5 to 10° S.) this is a season of regular rain-bearing winds and distinct windward-leeward belts develop throughout the archipelago. The Trade Winds are manifested by a cumulus cloud cap developing daily over every island more than a few miles square in area, trailing away to the north-west. The weather coasts of the big eastern islands, Guadalcanal, Malaita and San Cristobal, and of Bougainville, exposed to the south-east and backed by high mountains, have a mid-year rainfall peak during these months, and the lee sides of the mountains experience a dry season. Some years have exceptionally wet spells, such as 13 days of July 1965 when the Royal Society Expedition had the misfortune to be in the field, and during which Avu Avu on the south coast of Guadalcanal received 314 cm of rain; Honiara in the rain-shadow on the north coast received 17·8 cm in the same period.

About August–September the season gradually changes. The S.E. Trades are slowly replaced by equatorial air masses (the so-called 'perturbation belt') moving southwards with the sun. For the rest of the annual cycle the winds are irregular, blowing from various directions. No rain shadows develop.*

All parts of the Solomons have an early year rainfall maximum in this season, mostly in January or February, except for the 'weather coasts' already described. And everywhere in the New Georgia Islands which have two peaks. Wetness and dryness are however relative terms. In fact the whole of the Solomons except the south-east rain-shadow areas has a continuously wet climate (defined as $\geqslant$ 40 weeks with $\geqslant$ 5 cm rain/week). It is not surprising that no regular seasonality has been observed in changing of leaves or flowering of plants. Mean annual rainfall varies from 312 to 625 cm except in the rain-shadow areas which receive 125 to 312 cm. These analyses are based on rainfall stations at or near the coasts. There are no inland stations in the Solomons. Rainfall certainly increases inland, possibly by 10 cm for every 30 m elevation up to a critical level at *ca.* 1500 m. On this calculation the crater rim of Kolombangara, for instance, receives 825 cm of rain perannum.

The Solomons are amongst the wettest places in the humid tropics, and the climate may be described as tropical maritime. This has a profound effect on the vegetation as will be described.

Very occasionally cyclones reach as far north as the Solomons in the early months of the year and cause huge damage. The two most recent were on 23–24 January 1952 which *inter alia* swept away the wartime jetties at Kukum on Guadalcanal; and on 28–29 March 1967. This latter cyclone caused damage throughout the Solomons except in the far north-west, the worst hit areas being in a broad belt covering part of Santa Isabel, north Malaita, parts of south-east New Georgia, West Guadalcanal and west San Cristobal (G. F. C. Dennis, *in litt.*).

Vegetation

Grasslands and heaths

The only breaks in the rain forest mantle are areas of grasslands and heaths, probably anthropogenous. The biggest of these areas lies along the part of the north coast of Guadalcanal which is in the rain shadow of the high Kavo range during the S.E. Trade wind

* This time of year used to be called the North-West Monsoon. Close inspection of the data now available suggests this is a misnomer.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

season, and has a markedly seasonal annual rainfall of only 125 to 187 cm. It is a region of Pleistocene sediments with, at the western end, a series of raised beaches, grass covered and deeply dissected by forested gullies. Eastwards lies the Guadalcanal Plain. This carries grassland with riverine gallery forest and a narrow coastal strand forest as far as the Berande River. Farther east outside the rain shadow the grass is broken by forest patches and by Taivo Point the forest is continuous.

The grassland is an almost pure consociation of *Themeda australis* with small areas of *Imperata cylindrica*, and in moist places *Saccharum spontaneum*, replaced in very wet places by the reed *Phragmites karka* (Pendleton 1949; B. L. Leach *in litt.*) In disturbed places, for instance in a narrow strip along roadsides, is the introduced grass *Pennisetum polystachyum*. Typical secondary forest tree species and bushes stand in the grassland especially along the forest fringes, principally these are *Alstonia scholaris* (Apocyn.), *Colona scabra* (Tili.), *Commersonia bartramia* (Sterculi.), *Desmodium umbellatum* (Legum.), *Hibiscus tiliaceus* (Malv.), *Kleinhovia hospita* (Sterculi.), *Leucaena leucocephala* (Legum.), *Maaranga aleuritoides* (Euphorbi.) *M. tanarius* (e.g. a big stand north of Henderson Field), *Melastoma polyanthum*, *Morinda citrifolia* (Rubi.), *Premna corymbosa* (Verben.), *Timonius timon* (Rubi.) and *Trichospermum* spp. (Tili.). In the grassland stand isolated plants of *Pandanus* sp. and *Sararanga sinuosa*. It seems likely that the grasslands are a fire-climax maintained at their present extent by burning after long dry spells. For instance within Honiara town the whole of Lengakiki Ridge caught fire after 6 to 8 rainless weeks in July to August 1964 and the invading woody plants were killed. This suggestion is supported by evidence from the Santa Isabel ultrabasics described below.

Parts of the Florida Islands also carry grasslands; the climate is similar to north Guadalcanal. Heyligers (in Scott, Heyligers, McAlpine, Saunders & Speight 1967) reports small areas of grasslands burnt annually by hunters on north-west Bougainville.

The dry part of Guadalcanal has a group of tree species characteristic of the seasonal climates and savannah woodlands of E. Java, the Lesser Sunda Islands and parts of Queensland and New Guinea. These are *Garuga floribunda* (Burser.) *Gyrocarpus americanus* (Hernandi.), *Melia dubia*, *Prosopis insularis*, *Piptadenia novoguineense* (Legum.). In contrast to New Guinea and Queensland neither of the distinctive Australian genera *Banksia* (Prote.) and *Eucalyptus* (Myrt.) are found. Nor is there in the Solomons any rain forest eucalypt, unlike New Britain and New Guinea which have *E. deglupta*. In fact the Australian element is very poorly represented in the Solomons flora.

Flora

Lowland forests

The lowland rain forest of the Solomons is floristically like Malesia but with fewer families, genera and species. This impoverishment is to a limited extent compensated by distinctive Melanesian and Pacific elements which are of considerable interest as discussed later in this volume (pp. 549–563). The flora is monotonously uniform from island to island, no regional differences have been detected.

There are about twelve very common tree species which reach and form the top of the forest canopy, namely: *Calophyllum kajewskii*, *C. vitiense* (Guttif.), *Campnosperma brevipetiolatum** (Anarcardi.), *Dillenia salomonensis*, *Elaeocarpus sphaericus*, *Endospermum medullosum*

* Not yet found on Guadalcanal or San Cristobal.

(Euphorbi.), *Gmelina moluccana* (Verben.), *Maranthes corymbosa*, *Parinari salomonensis* (Ros.), *Pometia pinnata* (Sapind.), *Schizomeria serrata* (Cunoni.) and *Terminalia calamansanai* (Combret.). Only about 60 big tree species are at all common (see Whitmore 1966).

Despite the floristic paucity it is not possible to characterize forest types by naming one or a few big tree species, except in the special cases described below, and in this respect the descriptions and maps by Heyligers (in Scott *et al.* 1967) of Bougainville and Buka forests are misleading simplifications, of doubtful utility. A first attempt at objective detection of forest types in mixed-species lowland forest is given for Kolombangara in Greig-Smith, Austin & Whitmore (1967).

Structure

The high forest canopy is 30 to 45 m tall, and is locally very broken by climber-filled clearings and dense thickets of small trees only about 6 m tall. The only emergents from the high forest canopy are *Terminalia calamansanai*, an elegant slender tree with the habit of a Malayan *Shorea* (Dipterocarp.) and the strangling and banyan figs (*Ficus virgata*, *F. glandulosa*, *F. obliqua*, *F. xylosycia*, *F. benjamina*, and *F. subcordarta* respectively). These big trees are very abundant, in places one grows every two or three hectares. Several of the Admiralty charts adjure mariners to take their sight for a passage on a 'conspicuous banyan'. The high forest canopy is lower than in western Malesia where trees 45 to 60 m tall are common, often as emergents. There are also fewer big trees per acre in the Solomons, as can be seen in table 7 where the results of wide-ranging timber surveys in low undulating country of Santa Isabel and in south-east Malaya are compared. The Malayan forest has 1·5 times as many trees $\geqslant$ 180 cm girth and their trunks are 1·2 times the volume, that is to say they are on average about a third longer than the Solomons' trees.

TABLE 7. COMPARISON OF BIG TREE NUMBERS IN LOWLAND RAIN FOREST, MALAYA AND SOLOMONS

	Malaya, Johore, Kluang District low undulating < 150 m alt.	Solomons, Santa Isabel, Allardyce Hbr. undulating < 300 m alt.
survey area (ha)	47 400	15 800
area samples	47	216
area sampled (as %)	0·16	1·4
stems/ha $\geqslant$ 180 cm g.b.h.	4·8	3·3
ratio Malaya/Solomons	1·5	
vol/ha stems $\geqslant$ 180 cm g.b.h. (m^3)	62·0*	33·8†
ratio Malaya/Solomons	1·9	

* Using Forest Department volume tables.

† Using a form factor of 0·65 and allowing a mean timber length per tree of 13·5 m, not the 9 m of the original survey (B.S.I.P. Forestry Department, unpublished).

All figures have been converted to metric from the original imperial measure.

Another comparison, table 8, shows that the smaller number of big trees in the Solomons is not compensated for by more smaller trees. The Malayan sample had an excess of 1·3 times as many trees over 30 cm girth over the Solomons in a comparable lowland forest.

TABLE 8. COMPARISON OF NUMBERS OF TREES ⩾ 30 cm GIRTH ON SMALL PLOTS, MALAYA AND SOLOMONS

	Malaya Negri Sembilan Pasoh Forest Reserve (Wong & Whitmore 1970)	Solomons New Georgia Isl. Kolombangara (Whitmore, obs.)
plot area (ha)	4	132
no. stems ⩾ 30 cm g.b.h.	2280	5838
stems/ha	91	71
Malaya/Solomons	1·5	

These figures support the subjective observation of the botanist newly arrived in the Solomons from western Malesia that the total biomass of trees is less in the Solomons lowland rain forest.

The undergrowth of Solomons' forests contain an abundance of pachycaul treelets, a conspicuous and distinctive life-form which is possibly to be considered primitive (Corner 1964, etc.) and now swamped and almost overtaken by intensive competition with leptocaul trees in the Malesian heartland. Examples are *Barringtonia papeh* (Lecythid.), *Boerlagiodendron* spp. (Arali.), certain *Ficus* of sect. *Sycocarpus*, *Leea indica*, *Piper wichmanii*, *Tapeinosperma cristobalense*, *T. pachycaulum* (Myrsin.) and an undescribed *Cyrtandra* (Gesneri, RSS 6162).

Climbers and epiphytes

These are much more abundant than in West Malesia. Tree trunks are commonly partially or completely obscured by bole climbers and epiphytes, very abundant in the lowlands especially along rivers, and increasing inland with increasing altitude. In the lowlands aroids are conspicuous and in places reach almost South American abundance. The principal species are *Epipremnum amplissimum*, *E. dahlii*, *E. nobile*, *Pothos hellwigii*, *P. rumphii*, *Rhaphidophora korthalsii*, *R. novo-guineensis*, *Scindapsus altissimus*, *S. salomoniensis*, *Spathiphyllum commutatum*, and *S. salomonense*. The fern genus *Staenochlaena* is also abundant. *Freycinetia* spp. (Pandan.) are frequent in the lowlands and increase with elevation to dominate the climbers. Amongst the big epiphytes *Asplenium*, *Hydnophytum* (Rubi.) and *Myrmecodia* (Rubi.) are conspicuous.

At Sandfly Harbour on Kolombangara, a typical site, bryophytes and filmy ferns form a discontinuous film on tree trunks at 57 and 81 m altitude, this has become more continuous by 153 m and by 246 m has become a continuous sheath several centimetres thick on all trunks.

Natural catastrophes

These break up the high forest canopy. Earthquakes and the young immature landscape, which easily slips after heavy rain, contribute to big and frequent landslips. Earthquakes can also cause direct damage. J. F. Chapman (personal communication) visited western Vella Lavella near Paramatta after the major earthquake of 18 August 1959 (see Grover

1965) and found that over many hectares all the trees had been snapped off from the shock waves. Small gaps up to *ca.* 0·1 ha resulting from lightning strike are common. A central big tree is totally killed plus the adjacent sides of all surrounding trees, with signs of burning. Cyclone force winds, although infrequent, destroy forest, usually along a narrow path.

The high forest takes many decades to recover after these natural hazards.

Man's influence

Besides these natural hazards man has made a strong mark on forests in the Solomons. It seems likely that the archipelago formerly had far more people than the present population of about 192000.* The Spanish discoverers in 1568 reported towns of 1000 persons upwards in regions now virtually uninhabited (Guppy 1887). After the islands were rediscovered by Europeans in 1767 the introduction of steel, powder and European diseases is known to have greatly diminished the population. Nowadays, under the influence exerted for 50 years or more by government and Christian missions, the population is stable in numbers, and people have begun to move away from the interior to the coast.

Coconuts were introduced as a cash crop in the nineteenth century. Much of the beach and coastal forests on the Quaternary coral fringe have been felled for plantations. These seldom stretch more than one kilometre; small lagoon coral islets have sometimes been completely planted. Many square miles of European coconut plantations were abandoned in 1942 and have never been rehabilitated, especially in the New Georgia Islands, for instance round the Wanna Wanna lagoon and the Diamond Narrows. In these places *Rhus taitensis* (Anacardi.) has now formed a dense closed forest over and obscuring the coconuts.

Small outlying islands with dense population have very disturbed forest, e.g. Rennell, or no natural vegetation left at all, e.g. Sikaiana.

In the New Georgia Islands the interior is now quite uninhabited. There and elsewhere many signs remain in high forest of earlier habitation. Examples are stone house foundations (Choiseul, Kolombangara, Rendova, Vella Lavella), roadways (Wairaha River, north-central San Cristobal), sago palms on high inland ridges (northern Choiseul), charcoal in twenty-two soil pits spread over west and north Kolombangara up to 8 km inland and 420 m altitude. Big clumps of the cultivated bamboo *Bambusa vulgaris*, still to be seen in central Are Are (southern Malaita) on ridge crests, were planted to supply cooking pots for adjacent cannibal shrines, and the pretty palmlet *Areca guppyi* was brought 640 km from the north-west Solomons to decorate the shrines.

Shifting cultivation is now universally practised throughout the Solomons, and has probably always been the dominant mode of agriculture. Even a small population thus destroys much forest. There are signs of terracing on the Beacon Hills in south-west Kolombangara, which indicate a different earlier practice there. The staple crop is nowadays nearly everywhere the sweet potato (*Ipomoea batatas*); formerly taro (principally *Colocasia esculenta*) was the staple but it was largely wiped out by a *Phytophthora* epidemic in the late 1940s.

* Western Pacific High Commission Circular 20/65 (1965) gives the total population of B.S.I.P. as 570 Chinese, 1120 Europeans and 137 000 Melanesians, Micronesians and Polynesians of whom *ca.* 8500 live in the Santa Cruz Islands. Scott *et al.* (1967) give the 1963–4 population of Bougainville and Buka as 62 500.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Signs of cultivation extend high into the mountains, for instance to within a few hundred metres of the 1300 m summit of the Kubinitu-Sasari massif on Santa Isabel and Jonapau, 1400 m, on Guadalcanal. In fact Vangunu and Kolombangara in the New Georgia Islands are exceptional in bearing high forest from sea level to their crater rims, and are thus of great scientific importance and interest. It is to be hoped that a national park can be created on part of one of these islands before the newly established lumber industry destroys the virgin forest.

Extensive areas of forest are found throughout the Solomons dominated by one or a few species of big trees such as *Campnosperma brevipetiolatum*, *Endospermum medullosum* and *Gmelina moluccana*. Recent studies in timber felling areas and in natural high forest have revealed that seedlings of these species cannot grow up in shade but come up gregariously and vigorously in clearings. It is highly probable that these forest stands have grown up following the destruction of the forest over big areas by man, cyclone or earthquake.

Thus, for example, there are many square kilometres on north-west Santa Isabel around Allardyce Harbour with *Campnosperma brevipetiolatum* forming about 45 % of the stems $\geqslant$ 180 cm girth (Forest Dept. B.S.I.P. unpublished survey report). This particular area may well date from the abandonment of cultivations following the decimation of the local people by raiding parties from New Georgia across the Sound which is known to have occurred just within living memory late last century. The few Isabel survivors fled to the Tatamba area at the other end of the Island where they and their descendants still live, though they still remember and claim land in the north. I saw an old village site abandoned, according to my guide, about 1910, on the slopes of Mt Komboro on south-east Choiseul; now the area is covered by a pure stand of *Campnosperma* all 60 to 120 cm girth. A timber company is currently exploiting the northern Santa Isabel forests, and exporting the logs for peeled veneer. The present-day timber industry has much to thank former inhabitants for.

In other places former areas of habitation can be detected from an abundance of fruit trees in the forest, e.g. in north-east San Cristobal near the confluence of the Wairahito and Pagato rivers *Artocarpus altilis* (Mor., breadfruit), *Canarium indicum*, *C. salomonense* (Burser., nut trees), *Mangifera* spp. (Anacardi. mango) and *Spondias dulcis* (Anacardi., hog plum) were all noted growing in high forest in some places with trees of clearings such as *Albizia falcata* and *A. minahassae* (Legum.).

Many of the big wars and population movements took place after European weapons were introduced and before the British Protectorate (declared 1893) became efficient. There are still a very few old men who remember some of what happened. I should like to make a plea that this completely neglected field of anthropology be chronicled now before it is lost for ever. For, sad though it is to relate, these 'things belong me feller time before' are nowadays thought shameful, and die with those who took part in them.

Depleted forest

Solomon Island houses are entirely made from plant products, nails and corrugated metal are virtually unknown, even for the difficult-to-weatherproof ridge crests. The thatch itself is made from the sago palm *Metroxylon salomonense*, cultivated nowadays mainly for this. The houseposts (principally *Securinega flexuosa*, Euphorbi.), floors and walls

(the arecoid palms *Actinorhytis*, *Cyrtostachys*, *Gulubia*, *Rehderophoenix* and the bamboo *Bambusa vulgaris*), rafters, all beams, and the twine (*Calamus* spp. and *Rhaphidophora* spp.*) to tie them together are culled from the rain forest. Fishnets (*Gnetum*), fishing lines (*Anodendron* Apocyn.), canoe planks (*Gmelina moluccana*) caulked with putty made from the fruit of *Parinari glaberrima* (Ros.) and spears (*Strongylocaryum*, a palm) are also made from forest products. Scitamineae leaves are used extensively to wrap foods for cooking. The consequences to the vegetation are very conspicuous and for the result I propose the name *depleted forest*. For several miles around a village palms, small trees and climbers have been selectively removed and the forest takes on a rather open appearance, with big trees standing over the herb layer (often gregarious *Selaginella*), the lower part of the canopy largely gone. Where the top canopy is opened trees of open places and secondary forest invade.

Valley forests

High forest is sometimes found along alluvial valley bottoms and some big tree species grow only there, namely *Albizia salomonensis*, *Archidendron oblongum* (Legum.) and *Planchonella thyrsoidea* (Sapot.). In many places, however, valley floors carry a dense low scrub only 3 to 9 m tall. This presumably results from former cultivation or destructive floods. Here *Hibiscus tiliaceus*, *Kleinhovia hospita* and *Macaranga* spp. are common trees. This is the habitat *par excellence* of palms and other giant monocotyledonous plants. *Areca macrocalyx*, *Heterospathe* spp. and *Rhopaloblaste elegans* are the principal palms and the giant herbs principally comprise *Heliconia indica*; the gingers *Catimbium novae-pommeraniae*, *Costus speciosus*, *Guillainia purpurata* and *Tapeinochilus* sp. (e.g. RSS 6173); and the Marantaceae *Cominsia gigantea*, *C. guppyi* and *Donax cannaeformis*.

Freshwater swamp forests

These are developed near the coast in places as small pockets up to about 1 km^2 in area, and characteristically carry nearly pure stands of *Terminalia brassii* (Combret.), a big tree of commercial interest to 40 m tall, which develops large platform-like masses of interlocking fine aerial roots at and above the water table. This *Terminalia* also grows along river valleys near the sea as a narrow consociation often only one or two trees wide. Its flattish pale green crown is very easily spotted from the air and on aerial photographs.

Mangrove forests

These are well developed round the Solomons. The flora is Malesian. *Nypa*, *Bruguiera parviflora*, *B. sexangula*, *Rhizophora apiculata* and *Ceriops tagal* here reach their eastern limit, and a few eastern Malesian species do not occur (*Bruguiera cyclindrica*, *Ceriops decandra*). *Lumnitzera littorea* in many places forms extensive pure stands. The Solomons' mangrove forests have never been exploited and the canopy is commonly 24 m tall.

Beach forests

These have the typical composition of this vegetation formation throughout Indo-Malesia. Besides fringing the main islands it grows on raised reefs and coral atolls

* Personal communication, Susui of Kwara'ae Malaita.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

throughout the archipelago. The principal woody species in the Solomons are *Barringtonia asiatica* (Lecythid.), *Calophyllum inophyllum* (Guttif.), *Casuarina equisetifolia*, *Cerbera* spp. (Apocyn.), *Cordia subcordata* (Boragin.), *Cynometra ramiflora* (Legum.), *Desmodium umbellatum*, *Heritiera littoralis* (Sterculi.), *Hernandia sonora*, *Hibiscus tiliaceus* (Malv.), *Inocarpus fagiferus* (Legum.), *Intsia bijuga* (Legum.), *Messerschmidia argentea* (Boragin.), *Planchonella obovata* (Sapot.), *Premna corymbosa* (Verben.), *Scaevola* spp. (Goodeni.). Beach forest still persists in the Solomons in its full primaeval glory, except where felled for coconut plantations and vegetable gardens, or where there have been recent crustal movements which have drowned it, such as are currently visible on the south-east coast of Malaita in Are Are, south-east Shortland Island and western Vella Lavella (the last resulting from the big earthquake of 1959, see Grover 1965).

Forest on ultrabasics

The most distinctive variant of lowland rain forest is found on the areas of ultrabasic rocks which outcrop principally on southern Santa Isabel and adjacent San Jorge, and southern Choiseul, with additional smaller areas on Guadalcanal (Marau Sound and Wanderer Bay), San Cristobal and Florida (several small outcrops each), see figure 15.

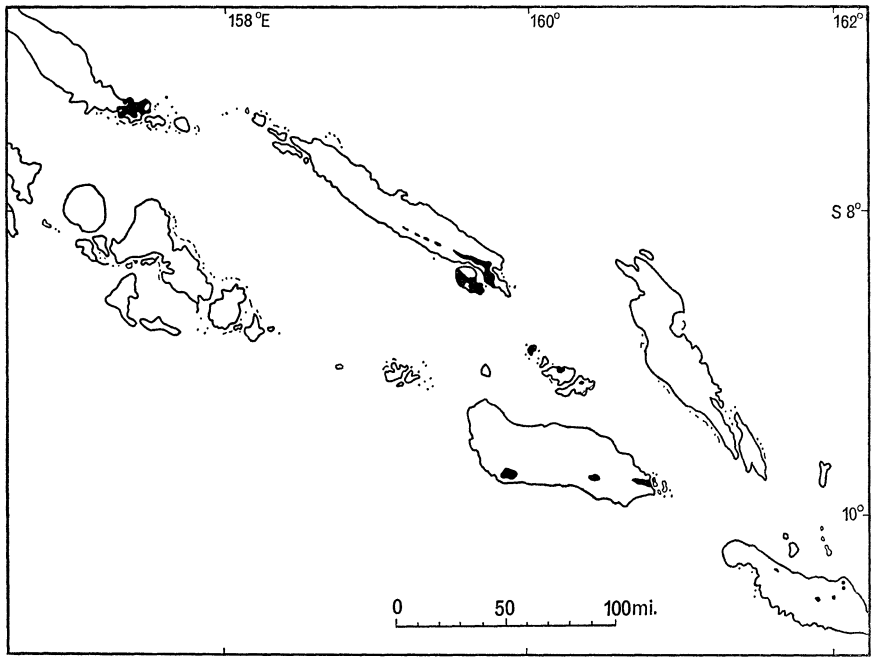

FIGURE 15. Map showing outcrops of ultrabasic rocks in the British Solomon Islands (after Thompson 1965).

The forest is poor in species and dominated over large areas by *Casuarina papuana* or *Dillenia crenata* (not Choiseul), and a few other species all of which grow scattered through the other forests. Only four species are so far known which are restricted to the ultrabasics, *Gulubia hombronii* (a palm), *Myrtella beccarii* (a myrtaceous shrub, Santa Isabel only and also on New Guinea ultrabasic heaths), *Pandanus lamprocephalus* with laterally borne fruits (north-east San Cristobal only) and an undescribed species of *Xanthostemon* (BSIP 4010, Myrt.).

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Burning by hunting parties has destroyed much of the forest on the Santa Isabel and San Jorge ultrabasics; open heath has resulted with a ground cover of *Gleichenia* spp. (s.l.) and *Lycopodium cernuum*, which is invaded by *Commersonia bartramia*, and later by other trees, when fire is excluded. It is undoubtedly significant that southern Santa Isabel has a low annual rainfall similar to parts of northern Guadalcanal and Florida which carry grassland (Fitzpatrick *et al.* 1966, map VA) and is the only area of ultrabasics where the forest has been extensively destroyed by fire.

Ecological ranges of tree species

Many tree species in the Solomons have wide ecological ranges. The ultrabasics appear to act mainly as a kind of sieve which lets part of the flora through, that part then proliferates.

Pometia pinnata is common on Quaternary coastal coral terraces, sometimes comes up gregariously after felling of the forest, and grows along river valleys, often high into the mountains. Yet morphologically it is uniform, all trees examined belonging to the single *forma pinnata* (Jacobs 1962; Whitmore 1967), except a single individual of *forma repanda* (BSIP 2694).

The extensive areas of calcium-rich soils in the Solomons derived from coral limestone or reef detritus do not carry a distinctive forest type and no obligate calcicoles are known. *Celtis* (Ulm.) and *Pimeleodendron amboinicum* (Euphorbi.) are commonest on calcareous soils but are occasionally found elsewhere, e.g. on basic andesite in north-west Guadalcanal. *Pometia pinnata*, as already described, may be gregarious on calcareous soils, but has a number of other habitats. These species may be basicoles rather than calcicoles.

The most extreme instance of ecological catholicity known is found in some *Calophyllum* species. For instance, *C. kajewskii* is one of the commonest big trees in well-drained lowland forest, and is the main timber tree on Gizo Island for instance, yet pure stands are also known from Gatukai, Wanna Wanna, Rendova and Buma growing on massive coastal coral limestone, the trees standing in a few inches of brackish water. The trees from these contrasting sites cannot be told apart in forest or herbarium. *C. cerasiferum*, *C. paludosum* and *C. soulattri* grow in well-drained inland forest from the lowlands to the mountains and sometimes also in lowland freshwater swamp forest. In *Calophyllum* apparently physiological evolution has not been accompanied by morphological evolution.

Montane forests

Inland the rain forest in the Solomons change rapidly with increasing elevation. There is a strong compression of vegetation zones compared to the big mountain blocks of Malesia, as is usual on isolated ranges, the so-called *masserherhebung effect*. I have seen the stunted elfin woodland facies of upper montane rain forest* as low as 690 m on the crater rim of Vangunu, and at similar elevation on Mt Gallego, and north-east San Cristobal in the Pagato area.

A few species which elsewhere occur only in montane forest are found in the lowlands

* For full descriptions of these vegetation belts and how they are defined see Grubb, Lloyd, Pennington & Whitmore (1963).

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

in the Solomons, e.g. *Weinmannia blumei* (Cunoni.) and (on Vanikoro, Santa Cruz Islands) *Metrosideros* (Myrt.).

It has already been noted that the flora of the Solomon Islands is in main a poor relation to the Malesian. The diminution in flora is more strongly marked in montane than lowland groups. Thus in New Guinea the lower montane rain forest* (1200 to 2300 m) is characterized by abundance or dominance over large areas by *Nothofagus* spp., *Castanopsis* spp. (especially *C. acuminatissima*), both Fagaceae, or *Engelhardia* spp. (Jugland.) or *Araucaria* spp. The upper montane rain forest (2200 to 2500 m) and the subalpine forest (2500 to 3500 m) have, in different parts, much small-leafed *Podocarpus* spp. and *Papuocedrus* spp. often replaced upwards by Ericaceae and *Olearia* (Compos.) (Brass 1941; Womersley 1958; van Royen 1963).

All these groups are absent from the Solomons except Ericaceae which has four endemic epiphytic rhododendrons and a single shrubby *Vaccinium*.

The mid-mountain fagaceous and *Araucaria* forests are thus quite absent. In the mountains of the Solomons montane species of Myrtaceae (*Acmena*, *Eugenia*, *Mearnsia*, *Metrosideros*, *Rhodamnia*) are the most prominent group; this family is apparently less prominent in New Guinea mountains.

The combined result of compression of vegetation zones and absence of certain floristic groups is that no clear lower montane rain forest zone can be distinguished in the Solomons.† The only sharp boundary with increasing elevation is to upper montane rain forest. In the Solomons this formation type is very 'mossy' with the ground and tree trunks and limbs usually swathed in bryophytes up to 30 cm thick. A thick layer of peat lies over a shallow mineral soil.

No mountain in the Solomons reaches above the tree line. The two highest ranges, the Emperor range on Bougainville and the Kavo range on Guadalcanal, are forested to the summits, with the exception of bare volcanic ash slopes around the crater of Mt Balbi, 2835 m, the highest mountain in the archipelago and an active volcano, and patches of *Sphagnum* bog on the summit plateau of Popomanaseu (2670 m) in the Kavo range. Balbi, Popomanaseu and Kolombangara all have zones with abundant scrambling bamboo (probably *Nastus productus*) near the summit. The 1965 Royal Society Expedition made the very difficult ascent of Popomanaseu and collected extensively above 1300 m. The flora was found to be much the same as on smaller mountains, e.g. the crater rim of Kolombangara at *ca.* 1500 m. In fact the vegetation and flora of Popomanaseu over 1500 m was found to be similar to mountains half its height.

Conclusions

The strong compression of vegetation zones, occurrence of a few montane species in the lowland rain forest, and the strong development of climbers and epiphytes throughout the lowlands and mountains, are prominent features of Solomon Islands' rain forest. I consider that it is likely that all these features have as their single common and most important cause the climate which is very wet even by the standards of other tropical rain forest regions.

* See footnote on p. 268.

† Except perhaps on the two biggest ranges, Kavo and Emperor, whose ecology remains unstudied.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

The over-all poor flora of the archipelago is a result of regional geological history, and the replacement of high rain forest over extensive areas by thickets of small trees and climber tangles is due to the combined influences principally of man, cyclone, earthquake and landslip. The vegetation of the Solomons thus has to be described and interpreted in terms of a spectrum of strong disruptive influences operating on a species-poor flora.

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PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES