CONTRIBUTION TO THE KNOWLEDGE OF THE SOIL-FAUNA OF NEW GUINEA

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With 5 text-figures and 19 plates

ABSTRACT

A broad survey is given of the occurrence and distribution of microarthropods (and some other animals) in the soil of the following vegetation types in New Guinea: algal communities in the intertidal zone, beach forest, mangrove swamp forest, sago palm swamp, lowland swamp forest, forests on limestone and other sedimentary rocks, pioneer vegetation on barren coral limestone, forests on serpentine and cristalline schists, and montane vegetations.

I. INTRODUCTION

In the period October 1953–May 1954 I made extensive field studies in New Guinea with a double purpose. On behalf of the Royal Netherlands Navy I made a study of scrub typhus and scrub itch, on which subject an account was published elsewhere (Van der Hammen, 1956). At the same time I collected a series of samples (mainly microarthropods, among which more than 20.000 mites, thousands of Collembola, and nearly 300 Pseudoscorpionida) from the soil in a wide variety of vegetation types. The results of the last-mentioned field studies are briefly summarized in the present paper. Earlier publications pertaining to my material include a first report (Van der Hammen, 1955b), descriptions of some species of mites (Van der Hammen, 1955, 1955a, 1956a, 1960; Womersley, 1961), and studies of the Pseudoscorpionida (Beier, 1965), Tetrablemmid Araneida (Deeleman-Reinhold, 1980), terrestrial Isopoda (Vandel, 1973), Collembola Poduromorpha (Massoud, 1965), and Mollusca (Van Benthem Jutting, 1963). The present paper constitutes the base for further studies of the material.

My journey to New Guinea was made possible by the cooperation of the Royal Netherlands Navy, and a grant from the Netherlands Organization for

Pure Research (ZWO). During my travels I have received much help from many persons in New Guinea, among which the C. in C. Naval Forces Netherlands New Guinea, the late vice-admiral G. B. Fortuyn; the staff of the Forestry and Mining Divisions; and my friends and companions during many field-trips, surgeon commander A. Veldhuyzen R. Neth. N., lieutenant-commander J. Zwart R. Neth. N., and naval chaplain the Reverend Father G. van Hout R. Neth. N. Mr. J. G. G. C. J. van Bellen sorted the samples and reproduced the photographs. I owe them all a deep debt of gratitude.

II. Methods

I collected 82 samples of litter and moss from a wide variety of vegetation types, and extracted the microfauna of nearly all samples with the help of the modified Tullgren apparatus described by Haarløv (1947); one of the first samples from Biak Island (K3) was simply placed on wire-gauze above a Petri dish. Some working knowledge of the vegetation was obtained by a study of the introduction to the flora of the Malay archipelago by Merrill (1949), some working knowledge of geology by a study of a report by Zwierzijcki (1924). Much general information about New Guinea can now be found in the ecological and biogeographical studies collected by Gressitt (1982), in which collective work a study of the soil-fauna is, however, lacking. The measures of capacity of my samples were variable, but on the average I took samples of about 500 cm^3 of soil material. The fauna was extracted at my temporary base, and the use of a bulb for desiccation depended on the presence of electricity; the period of extraction depended on my itinerary. Evidently, the results of my sampling are qualitative and not quantitative. My samples sometimes contained many Diptera and other flying insects. Because these could have been attracted by the light of the bulb, they are not included in the following surveys of the contents.

III. Geographical data

Field studies were made in four areas in former Netherlands New Guinea[1], viz., (a) islands north of the Geelvinkbaai (Soepiori Island, Biak Island, Padaido Islands), (b) scattered localities in the western part of New Guinea (Fak

[1] To avoid errors and misunderstanding, geographical names are those which were in use at the time of my field work.

Fak, Ajamaroe), (c) the Wissel lakes area (Edarotali plain), and (d) the Hollandia area (Hollandia, the surroundings of Lake Sentani, the Cycloop Mountains, the surroundings of Genjem). Geographical particulars pertaining to these areas are mentioned below.

(a) Islands north of the Geelvinkbaai

The islands investigated by me include the Schouten Islands (Soepiori Island and Biak Island) and the Padaido Islands.

Soepiori Island (fig. 1)

Soepiori Island, the westernmost of the Schouten Islands, is separated from Biak Island by a narrow channel. It is mountainous, and the interior of the island is difficult of access. I visited it in the period 7-10 April 1954, and investigated the surroundings of Korido (0° 49′ S 135° 37′ E), situated on the south coast of the island. At the localities of my samples (M9-10) the rocks consisted of cristalline schists.

Biak Island (fig. 2)

Biak Island constitutes the easternmost of the Schouten Islands. It consists for the greater part of coral limestone ridges and table-lands. According to Feuilletau de Bruyn (1920), the north-west part consists of sandstone, and the central eastern part of sandstone and serpentine. I stayed on the Base of the Royal Netherlands Navy in the periods 26 October-14 November 1953, 16 November-15 December 1953, 16-20 December 1953, 13-16 February 1954, 22-24 February 1954, 26 February-1 March 1954, 4 March-7 April 1954, 10-24 April 1954, 3-4 May 1954, and 7-11 May 1954. In these periods I took samples (K1-20) at localities in the southern and eastern part of the island, viz., near the Base of the Royal Netherlands Navy and the village of Sorido (1° 10′ S 136° 3′ E), west of the Base (1° 10′ S 136° 1′ E), near the Boroekoe aerodrome (1° 10′ S 136° 6′ E), near the Hospital Cave (1° 10′ S 136° 7′ E), and in the region of the Arfak villages, north of Bosnik, in the central eastern part of the island (1° 9′ S 136° 14′ E).

Padaido Islands (fig. 3)

The Padaido Islands are situated south of Biak Island. I investigated those

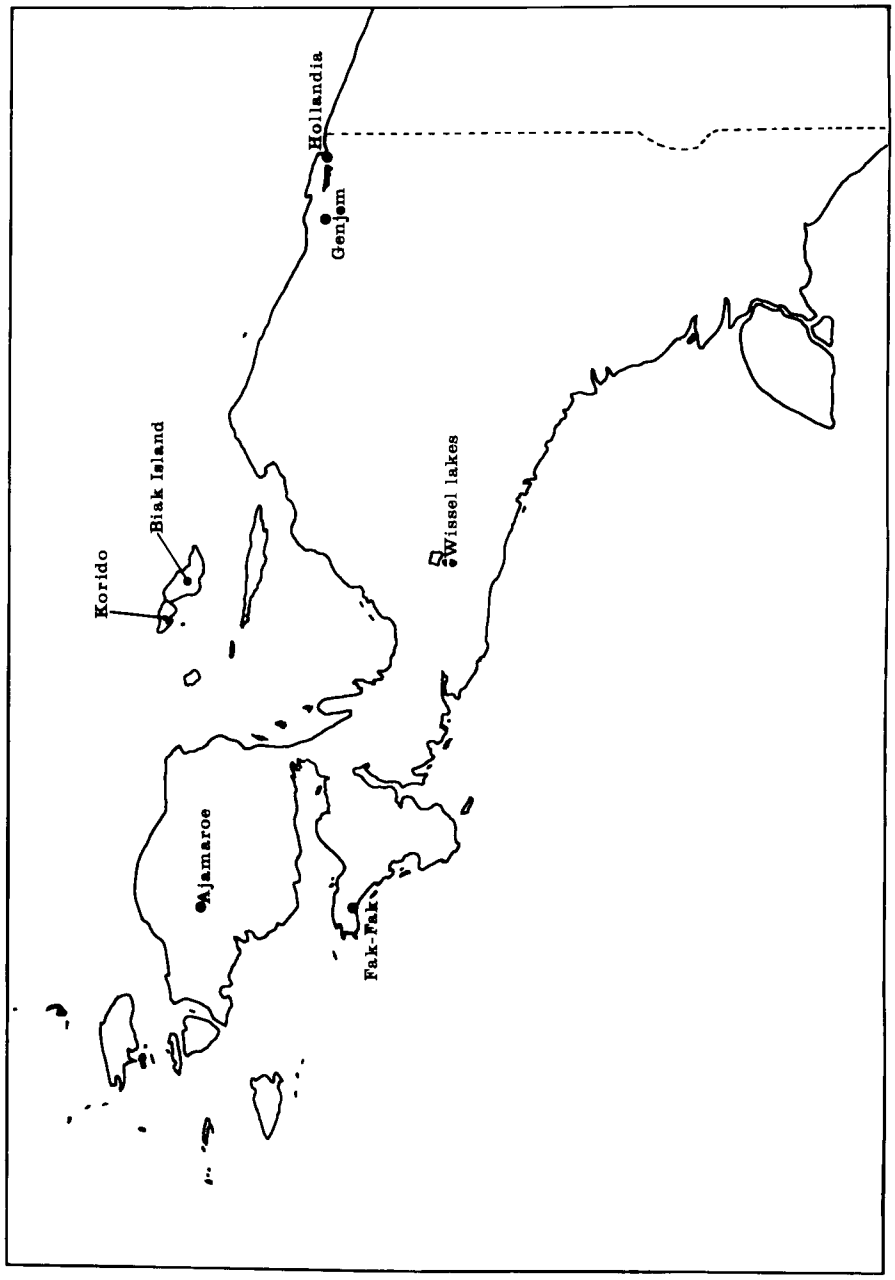

Fig. 1. Map of former Netherlands New Guinea. Scale approximately 1:10.000.000.

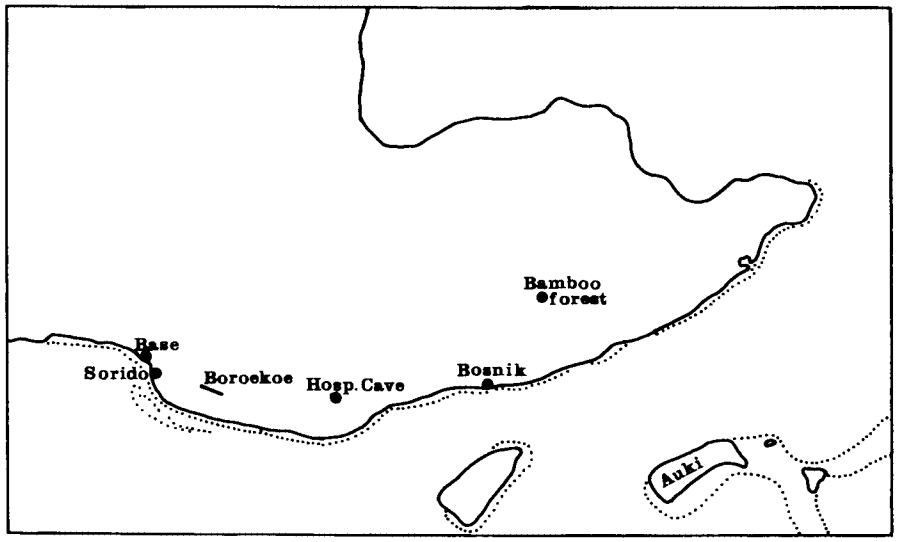

Fig. 2. Map of the southeastern part of Biak Island (with some of the Padaido Islands). "Base" pertains to the former Base of the Royal Netherlands Navy, "Boroekoe" to the Boroekoe aerodrome. The *Agathis* forest borders on the bamboo-forest. The dotted lines represent the borders of the coral reefs. Scale approximately 1:420.000.

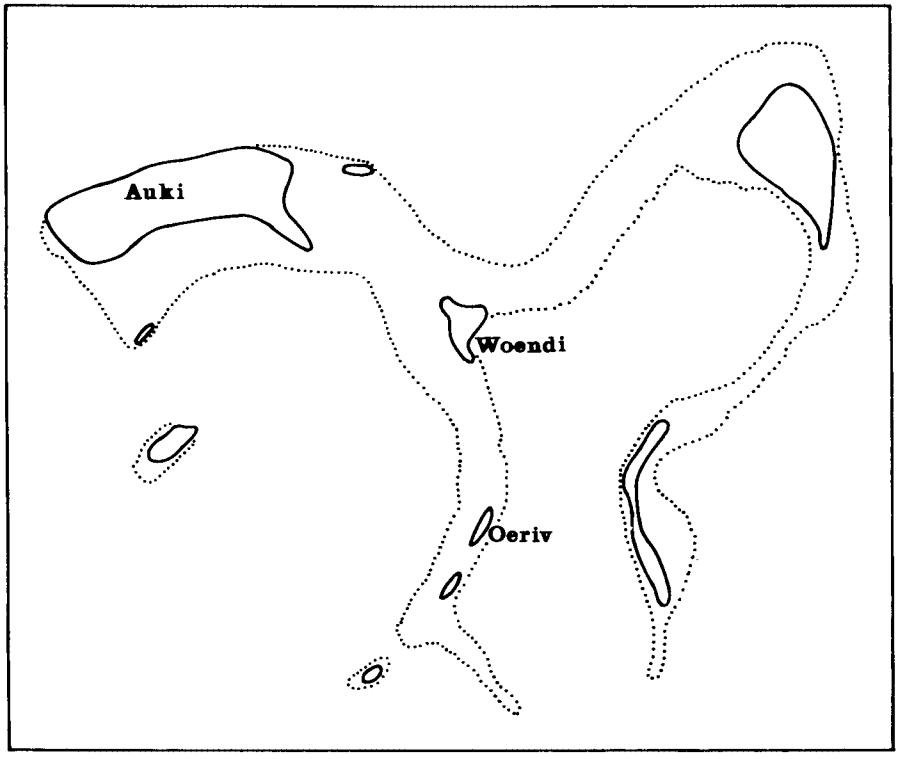

Fig. 3. Map of Woendi atoll (Padaido Islands). The dotted lines represent the borders of the coral reefs. Scale approximately 1: 162.500.

islands that form part of the Woendi atoll (in the periods 17-22 February and 1-4 March 1954). Samples (M4-8) were collected on Auki Island (1° 15′ S 136° 20′ E), Woendi Island (1° 15′ S 136° 23′ E) and Oeriv Island (1° 18′ S 136° 23′ E); the last-mentioned is the smallest, the first-mentioned the largest. The vegetation of the islands consists of beach forests (along the sandy coasts; the vegetation of Oeriv Island, which was uninhabited, consists entirely of a beach forest), coconut trees, and forest on coral limestone and sandstone (the interior and the northern part of Auki Island).

(b) Scattered localities in the western part (including the Birdshead)(fig. 1)

I paid short visits to scattered localities in the western part in the period 24-26 February 1954, and collected at Fak Fak (2° 56′ S 132° 17′ E) and Ajamaroe (1° 17′ S 132° 11′ E; altitude about 250 m). At Fak Fak, I took a sample in a forest on the coastal limestone hills (M1). At Ajamaroe, I took samples (M2-3) in a forest in an area of limestone karst, south of the lake.

(c) The Wissel lakes area (fig. 4)

I paid short visits to the Wissel lakes area in the periods 14-16 November 1953 (when I stayed in Enarotali), and 24 April-3 May 1954 (when I stayed in Enarotali, and made a trip to the Edarotali plain). Samples were taken during my stay in the Edarotali plain (4° 0.5′ S 136° 19′ E). This plain is situated at an altitude of about 1800 m. The soil consists of white material (probably disintegrated sandstone) and yellowish clay. The vegetation of this plain (which is the result of disforestation by the natives) has the aspect of a heathland; it was described by Rappard & Van Royen (1959), and consists, among others, of *Dacrydium*, *Rhododendron*, *Vaccinium*, *Nepenthes* and *Lycopodium* species, and of mosses and lichens. The plain is bordered by a *Nothofagus* forest.

(d) The Hollandia area (fig. 5)

The Hollandia area is situated in the north-eastern part of former Netherlands New Guinea. I visited the area on three occasions, viz., in the periods 15-16 December 1953, 22 December 1953-11 February 1954, and 4-7 May 1954. I collected 47 samples (L1-47), most of which were taken during the second period. Localities include: Hollandia (2° 32′ S 140° 42′ E), Dock V or

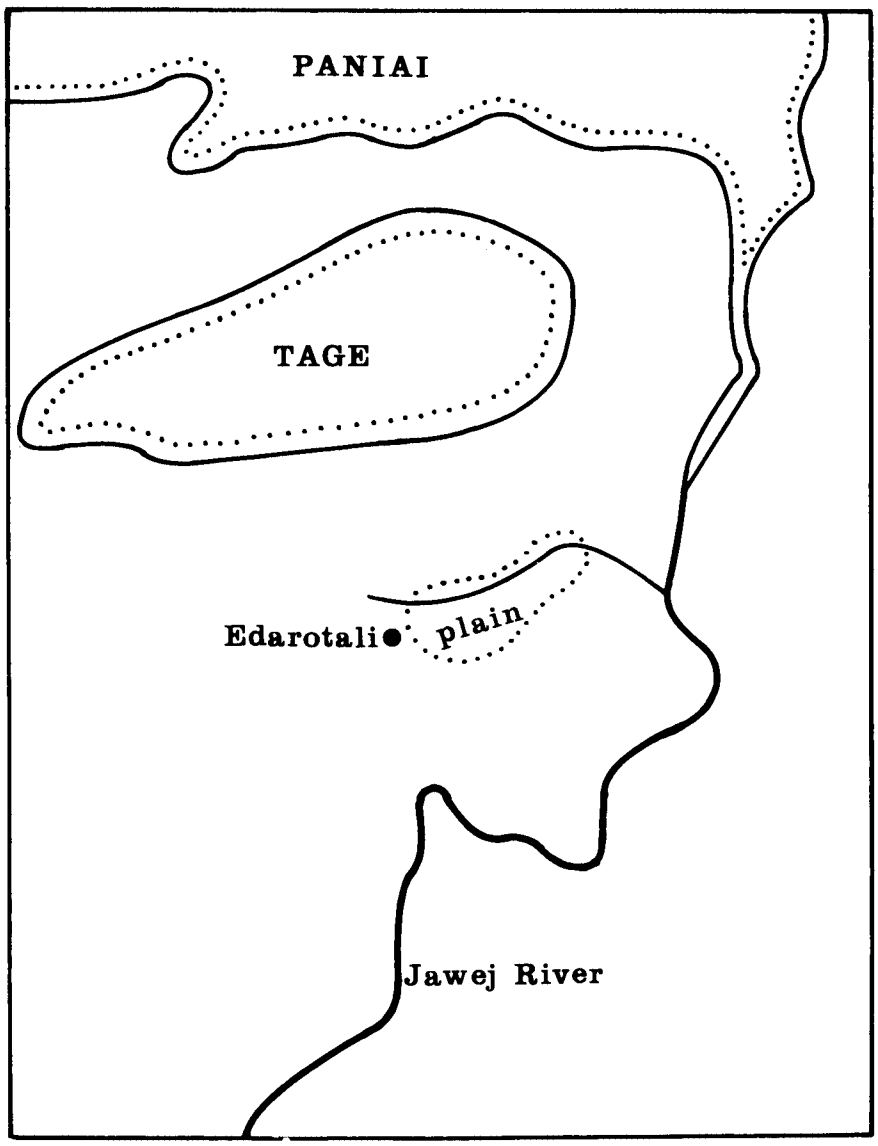

Fig. 4. Map of part of the Wissel lakes area, with the Edarotali plain. Scale approximately 1:100.000 (redrawn after Rappard & Van Royen, 1959).

Noordwijk (2° 32′ S 140° 43′ E), Base G and Soeadja hill (2° 32′ S 140° 45′ E), Jarremoh hill (2° 33′ S 140° 43′ E), Invasion beach and Cape Pie (2° 35′ S 140° 43′ E), Pim (2° 36′ S 140° 42′ E), the narrow peninsula near the entrance

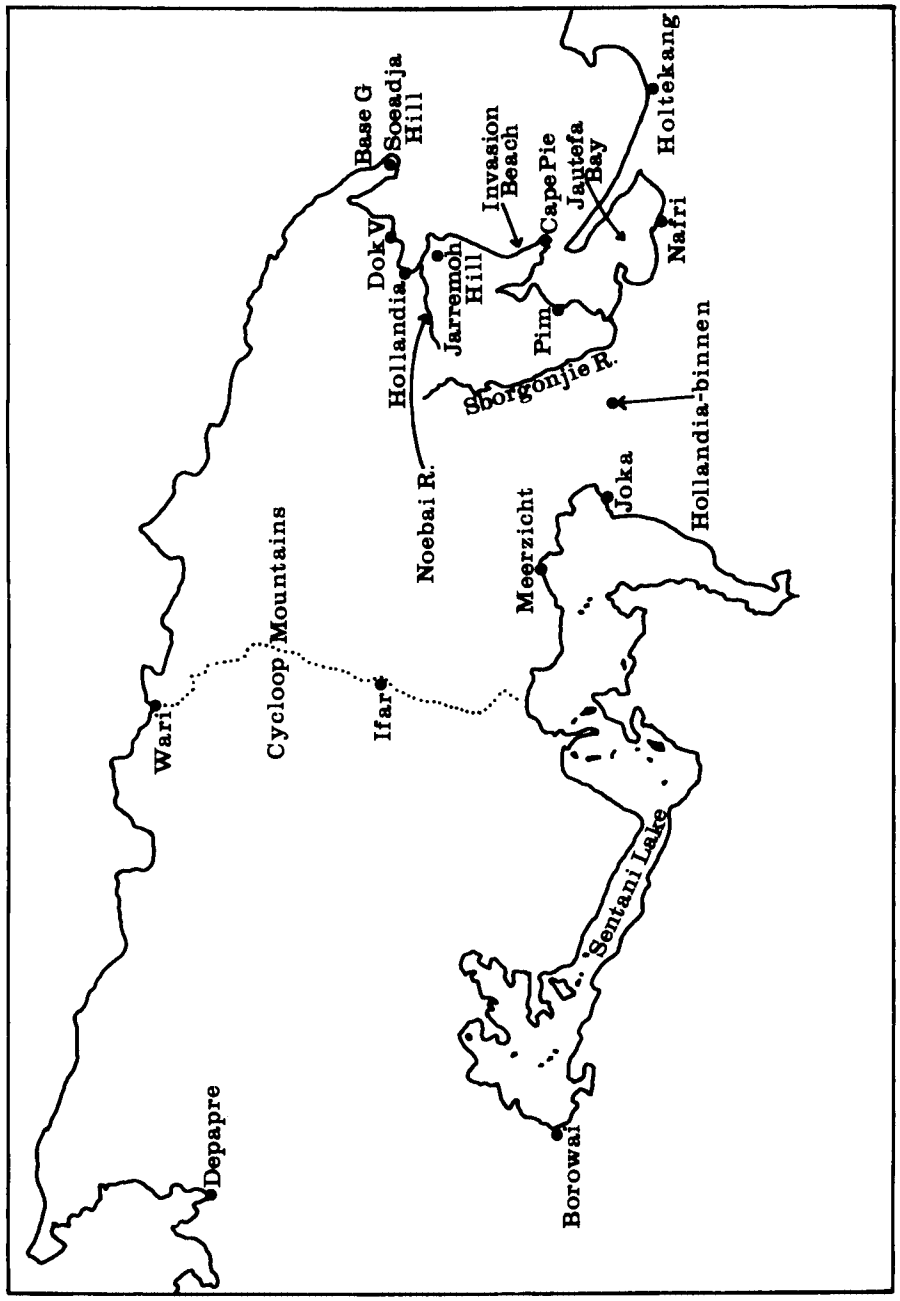

Fig. 5. Map of the Hollandia area, with Cycloop Mountains and Lake Sentani. Scale approximately 1: 312.500.

to the Jautefa bay (2° 36′ S 140° 43′ E), Sborgonjie river (2° 35′ S 140° 40′ E), the coast of the Jautefa bay near Pantai and Nafri (2° 38′ S 140° 44′ E), Holtekang (2° 38′ S 140° 47′ E), Hollandia-binnen (Kota Baroe) (2° 36′ S 140° 39′ E), Joka (2° 36′ S 140° 37′ E), Lake Sentani (2° 35′ S 140° 35′ E), Cycloop mountains north of Ifar (2° 30/33′ S 140° 33′ E), Depapre (2° 28′ S 140° 22′ E), Borowai (2° 36′ S 140° 23′ E), Genjem (2° 30′ S 140° 15′ E). The geology of the region was described by Zwierzijcki (1924). The area is characterized by a great variety of vegetation types.

IV. The soil-fauna of various vegetation types

The occurrence and distribution of microarthropods and other elements of the soil-fauna was investigated by me in the following vegetation types: algal communities in the intertidal zone, beach forest, mangrove swamp forest, sago palm swamp, lowland swamp forest, forests on limestone and other sedimentary rocks, pioneer vegetation on barren coral limestone, forests on serpentine and cristalline schists, and montane vegetations[1].

(a) Algal communities in the intertidal zone

The fauna of the intertidal zone was studied at one locality only, viz., the south coast of Biak Island, near the village of Sorido, in the neighbourhood of the Base of the Royal Netherlands Navy. The coast in that area is constituted by a steep ridge of coral limestone, whilst the intertidal zone is characterized by the presence of isolated rocks of coral limestone (pl. 1). These stones, which fall dry at low tide, were overgrown with green *Cladophora socialis* and several species of red algae. At the locality, the sea-water was mixed with fresh water from a small source in the coastal rocks. Several species of Mollusca can be found in the lower parts of the stones. A species of Scincid lizard, viz., *Emoia atrocostata* (Lesson), is regularly found on the stones during low tide. Males, females and nymphs of a species of Trombidiid mite (*Platytrombidium maritimum* Womersley) are also regularly found at low tide, creeping on the stones; these specimens are submerged during high tide. A sample of algae (K14), collected on 10 December 1953, contained the following animals:

[1]In the surveys of animal groups, the heading "Insects" refers to Pterygotous insects. Latin group names are generally mentioned in the plural form, even when only a single specimen was found.

1 Oribatid mite (*Fortuynia marina* Van der Hammen), 1 Actinedid mite (*Platytrombidium maritimum* Womersley), 2 Acaridida (*Hyadesia vietsi* Womersley), 57 Gamasida (43 *Cyrtolaelaps hammeni* Womersley, 7 *Leioseius littorale* Womersley, 7 *Periseius littorale* Womersley), 45 Crustacea (27 Talitrid Amphipoda, 4 young Grapsoid crabs, 14 Isopoda (among which Sphaeromidae and the Styloniscid *Clavigeroniscus mussaui* Vandel), 5 Collembola, numerous Insect larvae, and 3 Polychaeta.

Although several of the species mentioned above are known from New Guinea only, several of the genera are more or less cosmopolitan or pantropical. Species of *Fortuynia* and *Platytrombidium* are also known from the Pacific coast of Panama.

Material from the sample was studied by Fain (1979: 127-130, figs. 1-7), Van der Hammen (1960; cf. also Van der Hammen, 1963), Vandel (1973: 20-22, figs. 7-8, and Womersley (1961).

(b) BEACH FOREST

Beach forests usually occupy consolidated sand ridges, and are characteristically only 5-10 m wide; they consist of trees, shrubs and undergrowth (cf. pls. 2-3). Among the typical representatives, mention must be made of *Barringtonia asiatica*, *Pandanus tectorius*, *Hibiscus tiliaceus*, *Casuarina* spec., *Scaevola frutescens*, *Terminalia catappa* (trees and shrubs), *Crinum asiaticum* (a species of Amaryllidaceae) and the parasitic *Cassytha filiformis* (Lauraceae). In some places, the beach forest consists nearly exclusively of *Casuarina*.

The soil fauna of this vegetation type was investigated in five localities: three in the Hollandia area, two on the Padaido Islands. The localities in the Hollandia area are: Base G, on the Pacific coast near Hollandia (samples L3-4, taken on 23-24 December 1953; samples L27-28, taken on 18 January 1954; sample L34 taken on 28 January 1954); the Invasion beach, along the Humboldt bay near Hollandia (sample L9, taken on 29 December 1953); and the narrow peninsula between the Jautefa bay and the Humboldt bay near Hollandia (samples L32-33, taken on 24 January 1954, L32 consisted of *Casuarina* litter). The localities on the Padaido Islands are: Woendi Island (samples M4-5, taken on 1 March 1954); and Oeriv Island (sample M8, taken on 3 March 1954). The contents of the samples are the following.

Sample L3: 45 Gamasida, 8 Actinedida (among which 1 Cryptognathidae), 125 Oribatida (among which 2 Oribotritiidae, 8 *Archegozetes*, 17 Hermanniellidae, 20 Neoliodidae, 12 Zetorchestidae, 19 Carabodidae), 7 Pseudoscorpio-

nida (among which *Xenolpium novaguineense* Beier), numerous Collembola, and 11 Insects (among which 1 Coleoptera).

Sample L4: 186 Gamasida, 80 Actinedida (among which 1 Cryptognathidae), 223 Oribatida (among which 22 *Allonothrus*, 32 Neoliodidae, 3 Zetorchestidae, 7 Carabodidae, 2 *Eremaeozetes*), 5 Acaridida, 7 Pseudoscorpionida (among which *Xenolpium novaguineense* Beier), 3 Araneida, 4 Collembola, 12 Insects (among which 1 Coleoptera, 4 Formicidae).

Sample L27: 98 Gamasida, 3 Actinedida, 110 Oribatida (among which 6 Oribotritiidae, 6 *Allonothrus*, 6 *Archegozetes*, 5 *Cyrthermannia*, 15 Neoliodidae, 11 Zetorchestidae), 3 Acaridida, 2 Pseudoscorpionida (*Xenolpium novaguineense* Beier), 4 Araneida, 1 Myriapoda, 10 Collembola, 6 Insects (among which 2 Coleoptera, 3 Formicidae).

Sample L28: 298 Gamasida, 36 Actinedida, 598 Oribatida (among which 9 Oribotritiidae, 2 Neoliodidae, 33 Zetorchestidae, many Carabodidae), 1 Acaridida, 3 Araneida, 3 Myriapoda, some 35 Collembola, 10 Insects (among which 6 Formicidae).

Sample L34: 252 Gamasida, 17 Actinedida, 338 Oribatida (among which 1 Lohmaniidae, 10 Oribotritiidae, 7 *Allonothrus*, 26 Neoliodidae, 43 Zetorchestidae, 2 Acaridida, 3 Pseudoscorpionida (among which *Morikawia wlassicsi* (Daday), several Amphipoda, 4 Collembola.

Sample L9: 28 Gamasida, 26 Actinedida (among which 1 Cryptognathidae), 27 Oribatida, 2 Pseudoscorpionida (*Geogarypus* (*G.*) *javanus javanus* (Tullgren)), 2 Araneida, 1 Collembola, 3 Insects (among which 1 Formicidae).

Sample L32 (*Casuarina* litter): 1 skeleton of an Oribatid mite (Neoliodidae).

Sample L33: 57 Gamasida, 28 Actinedida (among which 5 Cryptognathidae), 66 Oribatida (among which 1 Lohmanniidae, 2 Oribotritiidae, 10 *Archegozetes*, 7 Neoliodidae, 10 Carabodidae, 1 *Eremaeozetes*), 1 Tarsonemida, 1 Araneida, 2 Myriapoda, 4 Insects (among which 2 Formicidae).

Sample M4: 17 Gamasida, 17 Actinedida (among which 9 Cryptognathidae), 92 Oribatida, 1 Collembola.

Sample M5: 206 Gamasida, 30 Actinedida, 370 Oribatida (among which 30 *Eohypochthonius*, 91 Lohmanniidae, 29 Carabodidae), 3 Acaridida, 5 Pseudoscorpionida (among which *Xenolpium novaguineense* Beier), 1 Araneida, 2 Isopoda (*Nagurus* (*N.*) *nanus* (Budde-Lund)), numerous Collembola, 1 Insect.

Sample M8: 28 Gamasida, 6 Actinedida, 331 Oribatida (among which 5 Lohmanniidae, 1 Hermanniidae, 310 *Archegozetes*), 3 Pseudoscorpionida (*Xenolpium novaguineense* Beier), 1 Araneida, 4 Collembola, 9 Insects (among which 4 Coleoptera).

The soil-fauna of the beach forest is characterized, among others, by the

occurrence of particular species of Uropodina (Gamasida), Cryptognathidae (Actinedida), Oribotritiidae, Neoliodidae, Zetorchestidae, Carabodidae and Scheloribatidae (Oribatida). In places where the beach forest consists of *Casuarina* only, the soil fauna is apparently very poor. The Pseudoscorpion *Xenolpium novaguineense* Beier, although not restricted to beach forests, was regularly collected in this vegetation type.

Material from the samples taken in beach forests was studied by Beier (1965: 760-764), Van der Hammen (1955, 1955a), and Vandel (1973: 148).

(c) MANGROVE SWAMP FOREST

I investigated a mangrove swamp forest in the Hollandia area, west of the Invasion beach, where I took three samples. One sample (L10) was taken on 29 December 1953 in the tidal part of the forest, with *Rhizophora* spec., near open water, where the soil is very soft and muddy, and very few litter is present (cf. pl. 4). Two samples (L41-42) were taken on 6 February 1954 in the northern and innermost part of the forest (near the road from Hollandia to Hollandia-binnen), which part is only occasionally flooded, and where the tree *Bruguiera* spec. is found; in this part much more litter is present (particularly between the roots, and outside the reach of creeks). The contents of the three samples are the following.

Sample L10 (tidal part of the forest): 1 Gamasida, 1 Oribatida, 1 Acaridida, 3 Isopoda (Styloniscidae), 4 Collembola.

Sample L41: 84 Gamasida, 50 Oribatida, 1 Isopoda (Styloniscidae), 9 Collembola.

Sample L42: 21 Gamasida, 84 Oribatida, 1 Isopoda (Styloniscidae), 20 Amphipoda (Talitridae), 13 Mollusca (*Assiminea lentula* Van Benthem Jutting).

The Oribatida from samples L41-42 belong, for the greater part, to three species. Species of the Gastropod genus *Assiminea* are often found in brackish and nearly terrestrial environments.

The differences, in species as well as in numbers of specimens, between the tidal and extratidal parts of the forest are evident. No Pseudoscorpionida, no Araneida, no Myriapoda and no Insects (except Collembola) were found in the samples from the mangrove swamp forest.

Material from the above-mentioned samples was studied by Van Benthem Jutting (1963: 456).

(d) SAGO PALM SWAMP

I investigated two sago palm swamps near Lake Sentani, in the Hollandia area: one near the eastern part of the lake, north of Joka (sample L8, consisting of mud and some litter, collected on 28 December 1953), and one along the north-eastern part of the lake, west of "Meerzicht" (sample L47, consisting of litter, collected on 10 February 1954) (cf. pl. 5). The contents of the samples are the following.

Sample L8: 4 Gamasida, 1 Actinedida, 28 Oribatida, 2 Araneida (among which 1 Oonopidae), 5 Collembola.

Sample L47: 3 Gamasida, 31 Oribatida (among which 1 Lohmanniidae, 2 Hermanniidae), 2 Collembola.

No Pseudoscorpionida, no Myriapoda, no Isopoda and no Insects (except Collembola) were found in the samples from sago palm swamps.

(e) LOWLAND SWAMP FOREST

Two lowland swamp forests were investigated: one near Holtekang, on the eastern shore of the Humboldt bay (sample L20, taken on 7 January 1954), and one near Genjem, in the Nimboran plain, south-west of Hollandia and Lake Sentani (samples L23-24, taken on 13 January 1954). These swamp forests grow on quaternary clay, and are subject to seasonal inundation (cf. pls. 6-8); the muddy soil presents numerous deep holes, dug by crabs. The contents of the samples are the following.

Sample L20: 49 Gamasida, 6 Actinedida, 112 Oribatida (among which 1 Lohmanniidae en 1 Zetorchestidae), 1 Araneida (Oonopidae), 2 Isopoda (*Clavigeroniscus mussaui* Vandel), 9 Collembola, 2 Insects (Coleoptera).

Sample L23: 2 Gamasida, 2 Actinedida, 31 Oribatida (among which 2 Phthiracaridae and 13 Malaconothridae), 1 Acaridida, 2 Araneida, 5 Insects (among which 2 Coleoptera).

Sample L24: 53 Gamasida, 50 Actinedida, 186 Oribatida (among which 3 Lohmanniidae, 2 Mesoplophoridae, 2 Phthiracaridae, 37 *Archegozetes*, 9 Hermanniidae, 30 Zetorchestidae), 2 Tarsonemida, 9 Pseudoscorpionida (among which *Morikawia wlassicsi* (Daday), 2 Araneida, 1 Myriapoda, numerous Collembola, 21 Insects (among which 2 Coleoptera, 7 Formicidae).

Species from the samples taken in lowland swamp forests were studied by Beier (1965: 760-761) and Vandel (1973: 20-22).

(f) Forests on limestone and other sedimentary rocks

I investigated forests on sedimentary rocks (mainly coral limestone) in the following regions: Biak Island, Auki Island, Fak Fak, Ajamaroe, and the Hollandia area. The forests belong to different types, and in the following discussion they are arranged according to locality and type.

Dry primary bush on coral limestone near the south coast of Biak Island

This vegetation type consists of rather low trees; the soil is dry, and in the day-time the temperature in the bush is usually very high. I investigated the bush west of the Base of the Royal Netherlands Navy, situated between the south coast and the high ridge of coral limestone north of it (samples K4-5, taken on 23 November 1953). The contents of the samples are the following.

Sample K4: 48 Gamasida, 51 Actinedida, 153 Oribatida (among which 3 Lohmanniidae, 6 Neoliodidae, 7 Zetorchestidae, 4 Otocepheidae, 5 *Eremaeozetes*), 9 Pseudoscorpionida (*Morikawia wlassicsi* (Daday) and *Ideobisium bipectinatum* Daday), 3 Myriapoda, numerous Collembola (among which *Brachystomella christianseni* Massoud and *Pseudachorutes* (*Pseudachorutella*) *stachi* Massoud), 10 Insects.

Sample K5: 51 Gamasida, 26 Actinedida, 226 Oribatida (among which 7 Lohmanniidae, 3 Neoliodidae), 21 Acaridida, 7 Pseudoscorpionida (*Morikawia wlassicsi* (Daday)), 1 Araneida, 2 Isopoda, 2 Myriapoda, 38 Collembola, 30 Insects.

Material from the above-mentioned samples was studied by Beier (1965: 760-762) and Massoud (1965: 379, 388).

Primary forests on ridges in the southern part of Biak Island

At varying distances from the south coast, and more or less parallel to it, steep ridges of coral limestone are found, 60-100 m high, with a table-land (the breadth of about 1000 m) on top of it (cf. pls. 9-10). These ridges are covered with a dense primary forest with much higher trees than in the coastal bush. I investigated this vegetation type at the following localities (from west to east): the ridge west of Sorido (samples K8-10, taken on 3 December 1953), the ridge north of the Boroekoe aerodrome (sample K6, taken on 26 November 1953; sample K18, taken on 14 December 1953), and the ridge near the Hospital Cave (sample K15, taken on 11 December 1953). The contents of these samples are the following.

Sample K8: 87 Gamasida, 7 Actinedida, 250 Oribatida (among which 4

Lohmanniidae, 3 Hermanniidae, 3 Neoliodidae, 4 Otocepheidae), 3 Acaridida, 8 Pseudoscorpionida (among which *Smeringochernes novaeguineae* Beier), 1 Myriapoda, 13 Collembola (among which *Xenylla thibaudi* Massoud), 21 Insects (among which 9 Coleoptera).

Sample K9: 89 Gamasida, 4 Actinedida, 265 Oribatida (among which 1 Lohmanniidae, 2 Hermanniidae, 10 *Archegozetes*, 1 Neoliodidae, 4 Zetorchestidae, 10 Otocepheidae, 78 *Eremaeozetes*), 1 Acaridida, 3 Pseudoscorpionida (*Morikawia wlassicsi* (Daday)), 3 Isopoda, 15 Collembola (among which 2 *Pseudachorudina delamarei* Massoud), 1 Insect (Coleoptera).

Sample K10: 74 Gamasida, 44 Actinedida, 420 Oribatida (among which 18 Lohmanniidae, 10 *Archegozetes*, 2 *Eremaeozetes*), 3 Acaridida, 3 Pseudoscorpionida (among which *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier), 6 Isopoda (*Clavigeroniscus mussaui* Vandel), 5 Myriapoda, numerous Collembola (among which 1 *Pseudachorudina delamarei* Massoud, 6 *Pseudachorutes murphyi* Massoud), 127 Insects (among which 116 Coleoptera and 3 Formicidae).

Sample K6: 103 Gamasida, 41 Actinedida, 1163 Oribatida (among which 1 Lohmanniidae, 170 Trhypochthoniidae, 4 Neoliodidae, 29 Zetorchestidae, 7 Otocepheidae, 57 *Eremaeozetes*), 19 Tarsonemida, 3 Acaridida, 3 Pseudoscorpionida (among which *Morikawia wlassicsi* (Daday)), 1 Araneida (Oonopidae), 15 Insects (among which 8 Coleoptera).

Sample K18: 25 Gamasida, 99 Oribatida (among which 2 Hermanniidae, 5 Neoliodidae, 4 Zetorchestidae, 1 Otocepheidae), 1 Acaridida, 5 Pseudoscorpionida (2 *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier, 1 *Ideobisium bipectinatum* Daday, 1 *Haplochernes warburgi* (Tullgren), 1 *Morikawia wlassicsi* (Daday)), 1 Araneida, 5 Isopoda (*Paraphiloscia hammeni* Vandel), 12 Collembola, 28 Insects (2 Coleoptera, 26 Formicidae).

Sample K15: 10 Gamasida, 41 Actinedida, 76 Oribatida (among which 1 Neoliodidae), 27 Tarsonemida, 10 Acaridida, 6 Pseudoscorpionida (2 *Morikawia wlassicsi* (Daday), 2 *Ideobisium bipectinatum* Daday, 2 *Paratemnus salomonis* Beier), 1 Araneida, 20 Collembola, 1 Insect (Coleoptera).

Material from these samples was studied by Beier (1965: 758-762, 767, 774-775, 782), Massoud (1965: 374-376, 384-388) and Vandel (1973: 20, 97).

Secondary forests on coral limestone in the southern part of Biak Island

The forest types arranged under this heading are all influenced by man (either by complete disforestation and subsequent regeneration, or by cutting down trees in smaller areas). They are often characterized by the presence of a particular species of *Ficus*. The forests occupy the space between the coast

and the ridges, the area originally occupied by dry and rather low bush (which becomes higher in the neighbourhood of the ridges). I investigated the forest near Sorido (sample K1 taken on 13 November 1953; sample K3, taken on 18 November 1953), and the forest near the Boroekoe aerodrome (sample K2, taken on 13 November 1953; sample K17, taken on 14 December 1953). The results of these samples are the following.

Sample K1: 9 Actinedida, 60 Oribatida (among which 1 Otocepheidae), 1 Acaridida, 3 Collembola (among which *Odontella salmoni* Massoud), 1 Insect (Coleoptera).

Sample K3: 2 Oribatida (among which 1 *Archegozetes*), 2 Isopoda (*Nagurus* (*Nagurus*) *cristatus* (Dollfus)).

Sample K2: 2 Gamasida, 15 Actinedida, 108 Oribatida, 4 Acaridida, 6 Collembola, 10 Insects (among which 1 Coleoptera).

Sample K17: 186 Gamasida, 28 Actinedida, 575 Oribatida (among which 3 Lohmanniidae, 1 Oribotritiidae, 17 *Archegozetes*, 92 *Allonothrus*, 5 Neoliodidae, 2 Otocepheidae), 34 Tarsonemida, 30 Pseudoscorpionida (among which *Morikawia wlassicsi* (Daday)), 5 Araneida, 4 Myriapoda, numerous Collembola, numerous Insects (among which 8 Coleoptera).

Material from these samples was studied by Beier (1965: 760-761), Massoud (1965: 380-382) and Vandel (1973: 109).

Bamboo-forest in the central eastern part of Biak Island

In the central eastern part of Biak Island, in the region of the Arfak villages, which area according to Feuilletau de Bruyn (1920: 17) consists of serpentine, sandstone and limestone, various types of forest are found side by side. The bamboo-forest (pl. 11) occurs on sandstone and continues, near the outer border, on a layer of disintegrated limestone, which covers the sandstone. I investigated the area on several occasions, and took two samples (K11-12) in the bamboo-forest on 6 December 1953. The contents of these samples are the following.

Sample K11: 102 Gamasida, 24 Actinedida, 130 Oribatida (among which 10 Lohmanniidae, 4 Oribotritiidae, 7 Phthiracaridae, 3 *Cyrthermannia*, 1 Neoliodidae, 17 Otocepheidae), 11 Acaridida, 4 Pseudoscorpionida (*Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier), 5 Araneida (among which 1 Ochyroceratidae), 3 Isopoda, 3 Myriapoda, numerous Collembola (among which 40 *Friesea hammeni* Massoud), 46 Insects (among which 11 Coleoptera and 32 Formicidae).

Sample K12: 196 Gamasida, 41 Actinedida, 385 Oribatida (among which 4 Lohmanniidae, 1 Oribotritiidae, 2 Phthiracaridae, 3 Hermanniidae, 2 Neolio-

didae, 8 Otocepheidae, 18 *Eremaeozetes*, 15 Eupelopsidae), 11 Tarsonemida, 12 Acaridida, 15 Pseudoscorpionida (among which *Morikawia wlassicsi* (Daday) and *Ideobisium bipectinatum* Daday), 1 Araneida, 3 Isopoda, 2 Myriapoda, numerous Collembola (among which 4 *Pseudachorudina delamarei* Massoud and 3 *Friesea hammeni* Massoud), 9 Insects.

Material from these samples was studied by Beier (1965: 758-762) and Massoud (1965: 377-379, 386-388).

Forest on coral limestone in the central and northern part of Auki Island

According to Feuilletau de Bruyn (1920: 7, map 2), a small part in the centre of Auki Island consists of sandstone, the remaining part of coral limestone. I investigated the island on 2 March 1954 and took two samples in the limestone area: M6 in the northern part of the island, M7 in the central part. The contents of these samples are the following.

Sample M6: 36 Gamasida, 4 Actinedida, 186 Oribatida, 32 Acaridida, 4 Isopoda (*Lobodillo hebridarum* Verhoeff), 20 Collembola, 22 Insects.

Sample M7: 304 Gamasida, 20 Actinedida, 676 Oribatida (among which 1 Zetorchestidae, 1 Otocepheidae, 72 *Eremaeozetes*), 9 Acaridida, 7 Pseudoscorpionida (among which *Morikawia wlassicsi* (Daday)), 12 Araneida (among which 2 Ochyroceratidae), 1 Schizomida, 3 Isopoda (*Clavigeroniscus mussaui* Vandel), 1 Myriapoda, numerous Collembola, 7 Insects (among which 1 Formicidae).

Material from these samples was studied by Vandel (1973: 20-22, 134-135).

Forest on coral limestone near Fak Fak

I investigated a forest on a coastal limestone hill near Fak Fak, and took one sample on 24 February 1954. The contents of this sample are the following.

Sample M1: 30 Gamasida, 1 Actinedida, 144 Oribatida (among which 2 Otocepheidae), 1 Pseudoscorpionida (*Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier), 14 Collembola, 3 Insects (2 Coleoptera, 1 Formicidae).

Material from this sample was studied by Beier (1965: 758-760).

Forest in the area of limestone karst near Ajamaroe

I investigated a forest in the area of limestone karst near Ajamaroe (Birdshead), and took two samples (M2-3) on 25 February 1954. Sample M2 was taken on a hill, sample M3 lower down, in a more humid area (cf. pl. 12). The

contents of the samples are the following.

Sample M2: 38 Gamasida, 12 Actinedida, 195 Oribatida (among which 1 Lohmanniidae, 1 Epilohmanniidae, 1 Hermanniidae, 68 *Archegozetes*, 5 Zetorchestidae, 5 Otocepheidae), 5 Pseudoscorpionida (among which *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier), 2 Araneida, 9 Isopoda (among which *Clavigeroniscus mussaui* Vandel), 3 Myriapoda, some 20 Collembola, 30 Insects (among which 8 Coleoptera, 16 Formicidae).

Sample M3: 22 Gamasida, 48 Oribatida (among which 8 Lohmanniidae, 4 Epilohmanniidae, 5 Hermanniidae), 3 Pseudoscorpionida (2 *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier, 1 *Smeringochernes aequatorialis* (Daday)), 1 Myriapoda, 4 Collembola, 8 Insects (Coleoptera).

Material from these samples was studied by Beier (1965: 758-760) and Vandel (1973: 20).

Dry bush on coastal sedimentary rocks along Jautefa bay

Some of the coastal hills along Jautefa bay (in the Hollandia area) are covered with a dry primary bush. I took two samples (L5-6) near the southern shore of the bay, between the villages of Pantai and Nafri, on 26 December 1953. According to Zwierzijcki (1924), the soil of this region consists of sedimentary rocks (marl and limestone). The contents of the samples are the following.

Sample L5: 142 Gamasida, 37 Actinedida, 75 Oribatida (among which 4 Phthiracaridae, 11 *Archegozetes*, 3 Zetorchestidae), 5 Pseudoscorpionida (among which *Euryolpium salomonis* (Beier)), 11 Araneida, 10 Isopoda (*Papuasoniscus holthuisi* Vandel), 4 Collembola, 16 Insects (among which 7 Coleoptera and 4 Formicidae).

Sample L6: 161 Gamasida, 43 Actinedida, 92 Oribatida (among which 3 Phthiracaridae, 19 *Archegozetes*, 6 Otocepheidae), some 15 Pseudoscorpionida (among which *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier, *Morikawia wlassicsi* (Daday), *Euryolpium salomonis* (Beier)), 1 Opilionida, some 7 Araneida (among which several Ochyroceratidae), 1 Myriapoda, some 30 Collembola (among which *Pseudachorudina delamarei* Massoud), 18 Insects (among which 15 Formicidae).

Material from the samples was studied by Beier (1965: 758-762), Massoud (1965: 386-388) and Vandel (1973: 25).

Pandanus forest on coastal hill of coral limestone along the Humboldt bay

The forest on the seaward slope of Cape Pie (young coral limestone), situa-

ted on the west coast of the Humboldt bay, consists of a *Pandanus* species (probably *Pandanus dubius*). I investigated this forest on 9 January 1954, and took one sample (L21). The contents of this sample are the following.

Sample L21: 94 Gamasida, 71 Actinedida, 114 Oribatida (among which 4 Lohmanniidae, 1 Oribotritiidae, 25 *Basilobelba*, 1 Zetorchestidae), 1 Tarsonemida, 1 Acaridida, 1 Araneida, 1 Isopoda (*Paraphiloscia hammeni* Vandel), numerous Collembola (among which more than 500 *Xenylla similata* Denis), some 23 Insects (among which 2 Coleoptera and 6 Formicidae).

Material from this sample was studied by Massoud (1965: 374) and Vandel (1973: 97-99).

Various forests on limestone in the Hollandia area

The forests discussed under this heading are often characterized by the presence of heavily buttressed trees, among which *Pometia pinnata* (cf. pl. 13). I investigated the following forests: forest on Soeadja Hill, near the entrance of the Humboldt bay (samples L15-16, taken on 5 January 1954; L15 near the top, at an altitude of about 150 m, L16 lower down); the forest on top of Cape Pie (sample L22, taken on 9 January 1954; cf. sample L21 from the *Pandanus* forest on the seaward slope of Cape Pie, mentioned above); forest in the limestone area near Jarremoh hill (samples L1, L11-12; the first sample was taken on 15 December 1953, the second and the third on 31 December 1953; L1 was taken near the road, L11 at an altitude of about 100 m, L12 near the top of the hill, at an altitude of about 300 m); forest near Holtekang, at the east coast of the Humboldt bay (sample L19, taken on 7 January 1954); forest near Borowai, on the western shore of Lake Sentani (sample L26, taken on 14 January 1954). The contents of the samples are the following.

Sample L15: 53 Gamasida, 22 Actinedida, 164 Oribatida (among which 1 Mesoplophoridae, 3 Oribotritiidae, 1 *Cyrthermannia*, 1 *Archegozetes*, 4 Hermanniidae, 1 Neoliodidae, 19 Zetorchestidae, 15 Otocepheidae, 20 *Eremaeozetes*), 2 Acaridida, 6 Pseudoscorpionida (among which *Morikawia wlassicsi* (Daday)), 2 Araneida, 3 Isopoda (*Papuasoniscus holthuisi* Vandel), some 30 Collembola (among which *Xenylla thibaudi* Massoud, *Pseudachorutes* (*Pseudachorutella*) *stachi* Massoud), some 30 Insects (among which 2 Coleoptera and 20 Formicidae).

Sample L16: 15 Gamasida, 2 Actinedida, 25 Oribatida (among which 4 Otocepheidae), 12 Insects (among which 1 Coleoptera).

Sample L22: 15 Gamasida, 23 Actinedida, 105 Oribatida (among which 4 *Archegozetes*, 4 Zetorchestidae, 2 *Basilobelda*, 6 Otocepheidae, 1 *Eremaeozetes*), 2 Tarsonemida, 1 Acaridida, 5 Pseudoscorpionida (*Morikawia wlassicsi*

(Daday)), 2 Araneida (Oonopidae), 3 Isopoda (*Paraphiloscia hammeni* Vandel), 1 Myriapoda, some 15 Collembola (among which 6 *Xenylla similata* Denis), 17 Insects (3 Coleoptera, 14 Formicidae).

Sample L1: 335 Gamasida, 312 Actinedida, 941 Oribatida (among which 2 Oribotritiidae, 2 Hermanniidae, 6 Neoliodidae, 4 Zetorchestidae, 1 *Basilobelba*, 6 Otocepheidae, 1 *Eremaeozetes*), 9 Pseudoscorpionida (among which 1 *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier, 1 *Morikawia wlassicsi* (Daday)), 6 Araneida (among which 2 Oonopidae), 1 Isopoda, 3 Myriapoda, numerous Collembola, 5 Insects (among which 1 Coleoptera, 2 Formicidae).

Sample L11: 51 Gamasida, 9 Actinedida, 101 Oribatida (among which 3 Neoliodidae, 10 Zetorchestidae, 3 Otocepheidae), 22 Pseudoscorpionida (among which 10 *Morikawia wlassicsi* (Daday), 6 *Smeringochernes aequatorialis* (Daday)), 1 Araneida, numerous Isopoda (*Papuasoniscus holthuisi* Vandel), numerous Collembola (among which 2 *Pseudachorudina delamarei* Massoud), 18 Insects (among which 3 Coleoptera, 11 Formicidae).

Sample L12: 246 Gamasida, 187 Actinedida, 555 Oribatida (among which 2 Mesoplophoridae, 3 Lohmanniidae, 7 *Eremaeozetes*), 6 Tarsonemida, 16 Acaridida, 18 Pseudoscorpionida (3 *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier, 13 *Morikawia wlassicsi* (Daday), 2 *Smeringochernes aequatorialis* (Daday)), some 7 Araneida (among which 2 Ochyroceratidae, 1 Oonopidae), 5 Isopoda, 1 Myriapoda, numerous Collembola, 51 Insects (among which 4 Coleoptera, 45 Formicidae).

Sample L19: 67 Gamasida, 27 Actinedida, 147 Oribatida (among which 1 Oribotritiidae, 1 Hermanniidae, 2 Otocepheidae, 2 *Eremaeozetes*), 1 Opilionida, 3 Pseudoscorpionida (*Morikawia wlassicsi* (Daday)), 3 Araneida (among which 1 Ochyroceratidae), 2 Isopoda, 2 Myriapoda, some 6 Collembola, some 22 Insects (among which 2 Coleoptera).

Sample L26: 30 Gamasida, 79 Actinedida, 128 Oribatida (among which 2 Mesoplophoridae, 26 *Archegozetes*, 1 *Basilobelba*), 1 Pseudoscorpionida (*Morikawia wlassicsi* (Daday)), 2 Araneida, numerous Collembola, 19 Insects (among which 9 Coleoptera, 8 Formicidae).

Material from these samples was studied by Beier (1965: 758-761, 783-784, Massoud (1965: 374-376, 386-390) and Vandel (1973: 25, 97).

Forest on hill of sedimentary rocks near Genjem

The hills south of Genjem consist of sedimentary rocks (brown coals, clayish sediments, sandstone). Forests on these hills are influenced by man,

because trees were regularly cut down by the local population. I took one sample (L25) on 13 January 1954, the contents of which are the following.

Sample L25: 32 Gamasida, 10 Actinedida, 34 Oribatida (among which 1 Lohmanniidae, 2 *Archegozetes*, 1 Zetorchestidae, 6 Otocepheidae), 1 Tarsonemida, 1 Acaridida, 5 Pseudoscorpionida (*Morikawia wlassicsi* (Daday)), 1 Araneida, 6 Isopoda (*Paraphiloscia hammeni* Vandel, *Clavigeroniscus mussaui* Vandel), 2 Myriapoda, 7 Collembola, 62 Insects (among which 9 Coleoptera, 50 Formicidae).

Material from this sample was studied by Beier (1965: 760-761) and Vandel (1973: 20, 97).

(g) Pioneer vegetation on barren coral limestone

An extensive area in the southern part of Biak Island was completely disafforested for military purposes during World War II. The leveled surface of barren coral limestone was subsequently colonized by a pioneer vegetation, mainly consisting of mosses, colonies of algae (*Nostoc commune*) and a species of Cyperaceae. This vegetation type was investigated at a locality near the Boroekoe aerodrome (sample K7, taken on 28 November 1953) and at localities on the Base of the Royal Netherlands Navy (sample K16, taken on 12 December 1953; sample K13, taken on 10 December 1953 in the same area, got lost). The contents of the samples are the following.

Sample K16: 2 Gamasida, 5 Actinedida, 117 Oribatida (among which 40 *Allonothrus schuilingi* Van der Hammen), 1 Acaridida, numerous Collembola, 5 Insects (2 Coleoptera, 3 Formicidae).

Sample K7: 22 Gamasida, 4 Actinedida, 1610 Oribatida (among which 78 *Eohypochthonius*, 1025 *Allonothrus schuilingi* Van der Hammen), 3 Insects (2 Coleoptera, 1 Formicidae).

Material from the sample was studied by Van der Hammen (1955a; cf. also Van der Hammen, 1953). The species of *Allonothrus* was originally described by me from epiphytic vegetation.

(h) Forests on serpentine and cristalline schists

I investigated forests on serpentine and cristalline schists in the following regions: Soepiori Island, Biak Island and the Hollandia area. The present section includes the lower-montane forests in the Cycloop mountains (in the Hollandia area). The forests belong to different types; in the following survey,

they are arranged according to locality and type.

Forest on cristalline schists in the southern part of Soepiori Island

On 9 April 1954, I took two samples (M9-10) in the forest near Korido, about 10, respectively 20 m above the level of the river Ramgardori (cf. pl. 14). The contents of these samples are the following.

Sample M9: 20 Gamasida, 9 Actinedida, 74 Oribatida (among which 1 Oribotritiidae, 1 Lohmanniidae, 1 Neoliodidae, 12 Otocepheidae), 1 Tarsonemida, 3 Acaridida, 1 Schizomida, 1 Araneida, some 12 Collembola (among which 4 *Odontella gladiolifer* Massoud), 10 Insects (5 Coleoptera, 5 Formicidae).

Sample M10: 45 Gamasida, 1 Actinedida, 192 Oribatida (among which 1 Oribotritiidae, 4 Lohmanniidae, 1 *Cyrthermannia*, 1 Otocepheidae), 1 Tarsonemida, 3 Pseudoscorpionida (among which 2 *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier), 1 Araneida (Ochyroceratidae), 5 Isopoda (*Clavigeroniscus mussaui* Vandel), 17 Collembola, 21 Insects (among which 16 Coleoptera).

Material from this sample was studied by Beier (1965: 758-760), Massoud (1965: 382-383) and Vandel (1973: 20).

Agathis forest in the central eastern part of Biak Island

According to Feuilletau de Bruyn (1920), the rocks in this part of Biak Island consist of serpentine. The forest (which borders on the bamboo forest)[1] consists of tall *Agathis* trees (a species of Coniferous tree which yields dammar resin), with scanty undergrowth. On 18 April 1954, I took two samples (K19-20) in this area. The second sample (K20) consisted of *Agathis* litter. The contents of the samples are the following.

Sample K19: 58 Gamasida, 2 Actinedida, 187 Oribatida (among which 1 Lohmanniidae, 1 Neoliodidae, 28 Otocepheidae, 31 *Eremaeozetes*, 1 Eupelopsidae), 10 Pseudoscorpionida (among which 4 *Morikawia wlassicsi* (Daday), 5 *Smeringochernes aequatorialis* (Daday)), 3 Araneida (among which 1 Oonopidae), 1 Myriapoda, 8 Collembola, 13 Insects (among which 9 Coleoptera).

Sample K20: 46 Gamasida, 3 Actinedida, 414 Oribatida (among which 5 *Tropacarus*, 8 Hermanniidae, 3 *Cyrthermannia*, 2 Neoliodidae, 1 Otocepheidae, 25 *Eremaeozetes*), 1 Myriapoda, numerous Collembola (among which *Odontella salmoni* Massoud), 1 Insect.

[1] Cf. note 2 on p. 32.

Material from the samples was studied by Beier (1965: 760-761, 783-784), and Massoud (1965: 380-382). The occurrence of a *Tropacarus* species in *Agathis* litter is interesting (a European *Tropacarus* species is also found in Coniferous litter).

Dry bush on coastal hills (cristalline schists) along Jautefa bay

On 2 January 1954, I took two samples (L13-14) in this hot and dry bush, situated on the western shore of the Jautefa bay, near the native village of Pim (in the Hollandia area). (This type of bush could be compared with the bush on sedimentary rocks, on the southern shore of the Jautefa bay.) The contents of the samples are the following.

Sample L13: 186 Gamasida, 240 Oribatida (among which 7 Zetorchestidae, 2 Otocepheidae), 3 Pseudoscorpionida (2 *Xenolpium novaguineense* Beier, 1 *Smeringochernes aequatorialis* (Daday)), some 5 Araneida, some 5 Collembola, some 8 Insects (among which 1 Coleoptera).

Sample L14: 45 Gamasida, 24 Actinedida, 142 Oribatida (among which 16 *Archegozetes* and 2 Zetorchestidae), 3 Tarsonemida, 6 Acaridida, 2 Pseudoscorpionida (1 *Morikawia wlassicsi* (Daday), 1 *Xenolpium novaguineense* Beier), 8 Insects (among which 1 Coleoptera, 4 Formicidae).

Material from these samples was studied by Beier (1965: 760-763, 783-784).

Various forests on serpentine and cristalline schists in the Hollandia area

With the exception of the dry bush (mentioned above) and the lower-montane forests (which are dealt with in the next paragraph), I investigated the following forests on serpentine and cristalline schists in the Hollandia area: forest on laterite (disintegrated serpentine) near Dock V (Noordwijk) (sample L2, taken on 15 December 1953; samples L17-18, taken on 6 January 1954); forest on serpentine along the river Noebai near Kloofkamp (samples L39-40, taken on 2 February 1954); forest on cristalline schists along Sborgonjie river near Hollandia-binnen (sample L29, taken on 19 January 1954); dry bush on serpentine near Hollandia-binnen (samples L30-31, taken on 22 January 1954); dry bush on serpentine near Joka (sample L7, taken on 27 December 1953); forest on serpentine above Depapre, near the Tanah Merah bay (samples L37-38, taken on 31 January 1954). The contents of these samples are the following.

Sample L2: 30 Gamasida, 2 Actinedida, 150 Oribatida (among which 46 *Archegozetes*), 13 Pseudoscorpionida (4 *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier, 9 *Morikawia wlassicsi* (Daday)), 1 Araneida (*Brignoliella*

delphina Deeleman-Reinhold), 2 Myriapoda, some 50 Collembola (among which 1 *Brachystomella christianseni* Massoud, 1 *Pseudachorutes* (*Pseudachorutella*) *stachi* Massoud), 6 Insects (among which 5 Formicidae).

Sample L17: 54 Gamasida, 31 Actinedida, 171 Oribatida (among which 2 Mesoplophoridae, 3 Hermanniidae, 2 *Cyrthermannia*, 3 Neoliodidae, 9 Otocepheidae), 8 Pseudoscorpionida (among which 4 *Morikawia wlassicsi* (Daday), 1 *Xenolpium novaguineense* Beier), 4 Araneida (*Brignoliella delphina* Deeleman-Reinhold), 2 Isopoda, some 25 Collembola (among which *Xenylla thibaudi* Massoud), 12 Insects (among which 1 Coleoptera, 5 Formicidae).

Sample L18: 2 Gamasida, 7 Oribatida (among which 2 Hermannidae, 1 Neoliodidae, 1 Otocepheidae), 1 Acaridida, 3 Insects (among which 1 Coleoptera).

Sample L39: 9 Gamasida, 1 Actinedida, 73 Oribatida (among which 3 Mesoplophoridae, 3 Lohmanniidae, 1 Oribotritiidae, 2 Hermanniidae, 9 *Archegozetes*, 1 *Cyrthermannia*, 2 Zetorchestidae, 1 Otocepheidae), 2 Opilionida, 5 Pseudoscorpionida (among which 3 *Morikawia wlassicsi* (Daday), 1 *Smeringochernes aequatorialis* (Daday)), 6 Araneida (among which 2 *Brignoliella delphina* Deeleman-Reinhold), 2 Myriapoda, 10 Collembola (among which *Xenylla thibaudi* Massoud), 10 Insects (among which 4 Coleoptera, 4 Formicidae).

Sample L40: 154 Gamasida, 35 Actinedida, 267 Oribatida (among which 2 Mesoplophoridae, 2 Lohmanniidae, 1 Oribotritiidae, 17 Hermanniidae, 2 Neoliodidae, 8 Zetorchestidae, 12 Otocepheidae, 28 *Eremaeozetes*, 6 Eupelopsidae), 6 Pseudoscorpionida (among which 1 *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier), some 6 Araneida (among which 1 *Brignoliella delphina* Deeleman-Reinhold, 1 Ochyroceratidae), 1 Myriapoda, some 15 Collembola (among which 6 *Xenylla thibaudi* Massoud), 10 Insects (among which 5 Coleoptera, 2 Formicidae).

Sample L29: 23 Gamasida, 5 Actinedida, 110 Oribatida (among which 3 Mesoplophoridae, 2 Lohmanniidae, 6 Hermanniidae, 5 *Archegozetes*, 4 Neoliodidae, 12 Zetorchestidae, 4 Otocepheidae, 3 *Basilobelba*), 1 Opilionida, 4 Pseudoscorpionida (among which 3 *Morikawia wlassicsi* (Daday)), 2 Araneida, 1 Isopoda, 1 Collembola, 1 Insect (Coleoptera).

Sample L30: 11 Gamasida, 11 Actinedida, 84 Oribatida (among which 1 Lohmanniidae, 1 Oribotritiidae, 5 *Archegozetes*, 5 Neoliodidae), 5 Acaridida, 6 Pseudoscorpionida (*Morikawia wlassicsi* (Daday), *Euryolpium salomonis* (Beier)), 1 Araneida, 2 Isopoda (*Papuasoniscus holthuisi* Vandel), some 10 Collembola, some 10 Insects (among which 4 Coleoptera, 2 Formicidae).

Sample L31: 47 Gamasida, 50 Actinedida, 157 Oribatida (among which 3 Hermanniidae, 2 Neoliodidae, 11 Zetorchestidae, 4 Otocepheidae), some 8

Pseudoscorpionida (among which 5 *Morikawia wlassicsi* (Daday), 1 *Xenolpium novaguineense* Beier), 1 Araneida, 8 Insects (among which 3 Coleoptera, 2 Formicidae).

Sample L7: 27 Gamasida, 4 Actinedida, 59 Oribatida (among which 1 Otocepheidae), 1 Acaridida, some 8 Pseudoscorpionida (among which 6 *Xenolpium novaguineense* Beier), 1 Araneida, some 5 Collembola (among which *Xenylla thibaudi* Massoud), some 5 Insects (among which 1 Formicidae).

Sample L37: 41 Gamasida, 2 Actinedida, 36 Oribatida (among which 4 Mesoplophoridae, 5 Lohmanniidae, 1 Zetorchestidae, 2 Otocepheidae), 2 Isopoda (*Paraphiloscia hammeni* Vandel), 1 Collembola, 6 Insects (among which 3 Coleoptera).

Sample L38: 26 Gamasida, 7 Actinedida, 49 Oribatida (among which 2 Mesoplophoridae, 1 Lohmanniidae, 1 Hermanniidae, 5 Neoliodidae, 8 Otocepheidae), 1 Araneida, 1 Isopoda (*Rennelloscia cycloopi* Vandel), 4 Collembola, 16 Insects (among which 6 Coleoptera, 4 Formicidae).

Material from these samples was studied by Beier (1965: 758-763, 783-784), Deeleman-Reinhold (1980: 79-80), Van der Hammen (1955), Massoud (1965: 374-376, 379-380, 388-390), and Vandel (1973: 25-28, 39-41, 97-99).

Lower-montane forests on the Cycloop Mountains (pl. 15)

The forests dealt with in the present paragraph are all on cristalline schists; they consist, among others, of oaks (probably *Lithocarpus*) and *Araucaria*. The altitude of the area investigated ranges from 500-1200 m. Samples were taken along the footpath from Ifar to Wari and Ormoe, south of the watershed. Samples L35-36 were taken on 29 January 1954, at an altitide of about 500 m. Samples L43-46 were taken on 7 February 1954, L46 at an altitude of about 700-800 m, L45 at an altitude of about 900 m, L43-44 at an altitude of about 1200 m. All samples consisted of litter, with the exception of L44, which consisted of moss from trees and decaying wood. The contents of the samples are the following.

Sample L35: 36 Gamasida, 19 Actinedida, 154 Oribatida (among which 4 Hermanniidae, 97 *Archegozetes*, 2 Neoliodidae, 1 Otocepheidae, 6 *Basilobelba*), 1 Acaridida, 4 Pseudoscorpionida (*Morikawia wlassicsi* (Daday)), 3 Araneida, some 5 Isopoda (*Clavigeroniscus mussaui* Vandel), some 60 Collembola (among which 2 *Brachystomella christianseni* Massoud), 10 Insects (4 Coleoptera, 6 Formicidae).

Sample L36: 32 Gamasida, 17 Actinedida, 193 Oribatida (among which 1 Mesoplophoridae, 3 Lohmanniidae, 1 Otocepheidae, 1 *Basilobelba*), 2 Tarsonemida, 7 Pseudoscorpionida (*Smeringochernes aequatorialis* (Daday)), 1 Iso-

poda (*Clavigeroniscus mussaui* Vandel), some 20 Collembola, 36 Insects (among which 23 Coleoptera, 11 Formicidae).

Sample L46: 41 Gamasida, 14 Actinedida, 157 Oribatida (among which 3 Mesoplophoridae, 2 Lohmanniidae, 4 Hermanniidae, 2 *Cyrthermannia*, 3 Neoliodidae, 3 Zetorchestidae, 4 *Basilobelba*, 1 *Eremaeozetes*), 2 Tarsonemida, 1 Pseudoscorpionida (*Morikawia wlassicsi* (Daday)), 6 Isopoda (*Rennelloscia cycloopi* Vandel) numerous Collembola (among which *Odontella salmoni* Massoud), 16 Insects (among which 5 Coleoptera, 2 Formicidae).

Sample L45: 9 Gamasida, 1 Actinedida, 17 Oribatida (among which 1 Hermanniidae), 2 Collembola (among which 1 *Pseudachorutes* (*Pseudachorutella*) *stachi* Massoud), 29 Insects (among which 13 Coleoptera, 14 Formicidae).

Sample L43: 33 Gamasida, 106 Oribatida (among which 13 *Nanhermannia*, 1 Neoliodidae), 1 Araneida (Oonopidae), 4 Collembola, 9 Insects (among which 2 Coleoptera).

Sample L44: 10 Gamasida, 1 Actinedida, 54 Oribatida (among which 1 Hermanniidae), 1 Insect (Coleoptera).

Material from these samples was studied by Beier (1965: 760-761, 783-784), Massoud (1965: 379-382, 388-390), Vandel (1973: 20, 39).

(i) MID-MONTANE VEGETATIONS

I investigated two types of mid-montane vegetations, in and near the Edarotali plain, in the Wissel lakes area, at an altitude of about 1800 m: a vegetation in the plain, with the general aspect of a heathland (with *Vaccinium, Rhododendron*, scattered *Dacrydium, Nepenthes*, mosses and lichens, cf. pls. 16-19); and a mid-montane Fagaceae-forest (dominated by *Nothofagus*) on a hill. On 26 April 1954, I took three samples from the "heathland" (M11, consisting of *Cladonia*; M12, consisting of *Sphagnum*; and M13, consisting of epiphytes from shrubs), and two samples from the *Nothofagus*-forest (M14, consisting of epiphytic mosses from the trunk of a tree; M15, consisting of litter and moss from roots at the base of tree-trunks). The contents of the samples are the following.

Sample M11: 35 Gamasida, 22 Actinedida, 150 Oribatida (among which 15 *Trhypochthonius montanus* Van der Hammen), 2 Acaridida, 14 Collembola, 1 Insect.

Sample M12: 1 Gamasida, 16 Oribatida (among which 1 *Trhypochthonius montanus* Van der Hammen), 1 Araneida, 2 Collembola, 7 Insects.

Sample M13: 8 Gamasida, 4 Actinedida, 35 Oribatida.

Sample M14: 2 Gamasida, 8 Actinedida, 18 Oribatida (among which 4

Mesoplophora, 1 *Nanhermannia*), 2 Acaridida, 2 Araneida, 1 Pseudoscorpionida, some 10 Collembola, 3 Insects.

Sample M15: 2 Gamasida, 2 Actinedida, 35 Oribatida (among which 3 *Mesoplophora*, 2 Otocepheidae), 1 Araneida, 2 Myriapoda, 6 Collembola, 1 Insect.

The fauna of the mid-montane samples is characterized, among others, by the absence of typical tropical or subtropical families of Oribatid mites (such as Lohmanniidae and Zetorchestidae), and the presence, in the "heathland" of a *Trhypochthonius* species (related species are found, in the temporate regions, in similar environments).

Material from the samples was studied by Van der Hammen (1956a).

V. The distribution of the soil-fauna

Some vegetation types apparently have a characteristic fauna, such as the algal communities in the intertidal zone, the beach forest, the zones of the mangrove swamp forest, and the pioneer vegetation on barren coral limestone. Most of the larger and more complex forests are, however, more difficult to characterize. Some indications can be found by a comparative study of the distribution of some animal taxa. The Oribatid families Lohmanniidae and Zetorchestidae, e.g., have not been collected in the intertidal zone, in mangrove swamp forests, in pioneer vegetations on barren coral limestone, and above 700-800 m; Zetorchestidae, moreover, have not been collected by me in sago palm swamps.

Pseudoscorpionida have not been collected in the intertidal zone, in mangrove swamp forests, in sago palm swamps, in pioneer vegetation on barren coral limestone, and in mid-montane "heathland". *Tyrannochthonius* (*Lagynochthonius*) *novaeguineae* Beier was found in twelve samples collected in forests on sedimentary rocks, serpentine and cristalline schists; these were often rather dry, but never swampy. *Morikawia wlassicsi* (Daday), the commonest Pseudoscorpion, found in thirty samples, was collected in dry as well as swampy forests on sedimentary rocks, serpentine and cristalline schists. *Ideobisium bipectinatum* Daday was found in four samples, taken in various types of forest (mostly rather dry) in Biak Island. *Euryolpium salomonis* (Beier) was found in three samples, collected in dry bush on sedimentary rocks and serpentine in the Hollandia area. *Xenolpium novaguineense* Beier was found in ten samples collected in beach forests and dry bushes on serpentine. *Geogarypus* (*Geogarypus*) *javanus javanus* (Tullgren), widely distributed in the Pacific area, was found by me in one sample taken in a beach forest. *Paratemnus salomonis*

Beier was collected in one sample from a forest on limestone in Biak Island; the same applies to *Haplochernes warburgi* (Tullgren). *Smeringochernes novaeguineae* Beier was found in one sample from dry bush in Biak Island. *Smeringochernes aequatorialis* (Daday) was found in seven samples collected in forests on limestone, serpentine and cristalline schists. It appears that, generally, the occurrence of the above-mentioned species is not correlated with the geological characteristics of the soil, but that there is a certain preference for dry and rather hot forests and bushes.

The Tetrablemmid Spider *Brignolia delphina* Deeleman-Reinhold was found in four samples from forests on serpentine in the Hollandia area.

Isopoda have not been collected in samples taken from sago palm swamps, pioneer vegetations on barren coral limestone, and in mid-montane vegetations. *Clavigeroniscus mussaui* Vandel was found in nine samples, taken from a wide variety of vegetation types (algal communities in the intertidal zone, lowland swamp forest, forests on limestone and cristalline schists up to 500 m); the species probably also occurred in the extra-tidal part of mangrove swamp forests (unidentified Styloniscid Isopoda were present in my samples). *Papuasoniscus holthuisi* Vandel was found in four samples, collected in forests and dry bushes on sedimentary rocks and serpentine. *Rennelloscia cycloopi* Vandel was found in two samples from forests on serpentine and cristalline schists, up to 800 m[1]. *Paraphiloscia hammeni* Vandel was found in five samples, taken in forests on sedimentary rocks and serpentine. *Nagurus* (*Nagurus*) *nanus* (Budde-Lund) was found in one sample taken in a beach forest, *Nagurus* (*Nagurus*) *cristatus* (Dollfus) in one sample taken in a secondary forest on limestone, and *Lobodillo hebridarum* (Verhoeff) in one sample taken in a forest on limestone.

Collembola were present in samples from all vegetation types investigated by me. The distribution of the Poduromorph Collembola is the following. *Xenylla similata* Denis was found in two samples from coastal forest on limestone. *Xenylla thibaudi* Massoud was found in six samples from forests and bushes on serpentine and limestone. *Friesea hammeni* Massoud was found in two samples taken in a bamboo-forest on sedimentary rocks. *Brachystomella christianseni* Massoud was found in three samples from forest and dry bush on cristalline schists, serpentine and limestone. *Odontella salmoni* Massoud was found in three samples taken in forests on cristalline schists and limestone. *Odontella gladiolifer* Massoud was found in one sample from a forest on cristalline schists. *Pseudachorutes murphyi* was found in two samples taken in

[1] A third locality (Ajamaroe), mentioned by Vandel (1973: 39), is probably attributable to a mistake; the material is not present in the collection.

a sago palm swamp and in a forest on limestone. *Pseudachorudina delamarei* Massoud was collected in five samples collected in forests and dry bushes on sedimentary rocks. *Pseudachorutes* (*Pseudachorutella*) *stachi* Massoud was found in four samples taken in forests and dry bushes on cristalline schists and limestone. Generally, there appears to be little correlation between the distribution of Poduromorph Collembola and vegetation type and geological properties of the soil.

Assiminea lentula Van Benthem Jutting, a species of Gastropod Mollusca, was collected in the extra-tidal part of a mangrove swamp forest. Species of the genus *Assiminea* are generally found in brackish and nearly terrestrial environments.

VI. List of samples[1]

K1. Secondary forest near Sorido, Biak Island, 13 November 1953, litter (X1782).

K2. Secondary forest near Boroekoe aerodrome, Biak Island, 13 November 1953, litter (X1781).

K3. Secondary forest near Sorido, Biak Island, 18 November 1953, litter (X1718).

K4. Dry primary bush between coast and ridge, west of the Base of the Royal Netherlands Navy, Biak Island, 23 November 1953, litter (X1780).

K5. As K4 (X1709).

K6. Forest on ridge, north of Boroekoe aerodrome, Biak Island, 26 November 1953, litter (X1805).

K7. Pioneer vegetation on barren coral limestone, near Boroekoe aerodrome, Biak Island, 28 November 1953, moss (X1799).

K8. Forest on ridge, west of the Base of the Royal Netherlands Navy, Biak Island, 3 December 1953, litter (X1813).

K9. Forest on ridge near the Base of the Royal Netherlands Navy, Biak Island, 3 December 1953, litter from the lower part of the forest (X1717).

K10. As K9, litter from a higher part of the forest (X1784).

K11. Bamboo-forest in the central eastern part of Biak Island, 6 December 1953, litter of isolated tree (X1779)[2].

K12. As K11, litter (X1793).

K13. Pioneer vegetation on barren coral limestone, on the Base of the Royal Netherlands Navy, Biak Island, 10 December 1953, moss.

K14. Algal communities in the intertidal zone near the Base of the Royal Netherlands Navy, Biak Island, 10 December 1953, sample *Cladophora socialis* and red algae.

K15. Forest on ridge near Hospital Cave, Biak Island, 11 December 1953, litter (X1771).

K16. Pioneer vegetation on barren coral limestone, on the Base of the Royal Netherlands Navy, Biak Island, 12 December 1953, sample moss and *Nostoc commune* (X1783).

[1] The collection numbers of the mite samples are added between brackets. When no collection number is given, the sample has either completely been studies, or (in a few cases) got lost.

[2] The bamboo-forest in the central eastern part of Biak Island (samples K11-12) borders on the *Agathis* forest (samples K19-20). The greater part of the bamboo-forest is found on sandstone, but continues, near the outer border, on a thin layer of disintegrated limestone covering the sandstone. The *Agathis* forest is found on serpentine. The areas are not always clearly separated; for this reason, samples K11-12 and K19-20 should also be compared with each other.

K17. Secondary forest (with some high trees) near Boroekoe aerodrome, Biak Island, 14 December 1953, litter (X1711).
K18. Forest on ridge, north of the Boroekoe aerodrome, Biak Island, 14 December 1953, litter (X1774).
K19. *Agathis* forest in the central eastern part of Biak Island, 18 April 1954, litter (X1774).
K20. As K19, *Agathis* litter (X1796).
L1. Forest on limestone, along the road near Jarremoh hill, Hollandia, 15 December 1953, litter (X1773).
L2. Remains of a forest on laterite (disintegrated serpentine) near Dock V (Noordwijk), Hollandia area, 15 December 1953, litter (X1719).
L3. Beach forest near Base G (Pacific coast near Hollandia), 23 December 1953, litter (X1795).
L4. As L3, 24 December 1953 (X1807).
L5. Dry primary bush on coastal hills of sedimentary rocks, along the Jautefa bay, near Pantai and Nafri (Hollandia area), 26 December 1953, litter from the lower part (X1775).
L6. As L5, litter from a higher part (X1710).
L7. Dry bush on serpentine hill near Joka (Hollandia area), 27 December 1953, litter (X1723).
L8. Sago palm swamp, in the eastern part of Lake Sentani, north of Joka (Hollandia area), 28 December 1953, sample mud and litter (X1791).
L9. Beach forest on the Invasion beach, along the Humboldt bay (Hollandia area), 29 December 1953, litter (X1769).
L10. Mangrove swamp forest, near the Invasion beach (Hollandia area), 29 December 1953, sample mud and litter.
L11. Forest on limestone, on Jarremoh hill near Hollandia, 31 December 1953, litter from an altitude of about 100m (X1772).
L12. As L11, litter from an altitude of about 300 m (X1721, X1727).
L13. Dry bush on coastal hills of cristalline schists, along Jautefa bay, near Pim (Hollandia area), 2 January 1954, litter (X1725).
L14. As L13 (X1776).
L15. Forest on Soeadja Hill (limestone), in the Hollandia area, 5 January 1954, litter from the part of the forest near the top (X1722).
L16. As L15, litter from a part of the forest lower down (X1794).
L17. Forest on serpentine hills, north of Dock V (Noordwijk), in the Hollandia area, 6 January 1954, litter (X1728).
L18. As L17, sample moss from decaying wood (X1811).
L19. Forest on limestone near Holtekang (on the east coast of the Humboldt bay), 7 January 1954, litter (X1770).

L20. Lowland swamp forest on quaternary clay near Holtekang (on the east coast of the Humboldt bay), 7 January 1954, litter (X1786).
L21. *Pandanus* forest on coral limestone, on the seaward slope of Cape Pie (west coast of the Humboldt bay), 9 January 1954, litter (X1802).
L22. Forest on coral limestone, on the top of Cape Pie (west coast of the Humboldt bay), 9 January 1954, litter (X1803).
L23. Lowland swamp forest near Genjem (Nimboran plain), 13 January 1954, litter (X1801).
L24. As L23, litter from less swampy part of the forest (X1715).
L25. Forest on hill of sedimentary rocks, south-west of Genjem, 13 January 1954, litter (X1777).
L26. Forest on limestone near Borowai (on the western shore of Lake Sentani), 14 January 1954, litter (X1778).
L27. Beach forest near Base G (Pacific coast near Hollandia), 18 January 1954, litter (X1724).
L28. As L27 (X1729).
L29. Forest on cristalline schists, along Sborgonjie river, near Hollandia-binnen, 19 January 1954, litter (X1787).
L30. Dry bush on serpentine hills near Hollandia-binnen, 22 January 1954, litter from lower part of bush (X1726).
L31. As L30, litter from higher part of bush (X1730).
L32. Beach forest on narrow peninsula north of Jautefa bay, 24 January 1954, litter of *Casuarina* (X1792).
L33. As L32, litter of mixed forest (X1800).
L34. Beach forest near Base G (Pacific coast near Hollandia), 28 January 1954, litter (X1785).
L35. Forest on cristalline schists, Cycloop Mountains near Ifar, altitude about 500 m, 29 January 1954, litter (X1731).
L36. As L35 (X1720).
L37. Forest on serpentine above Depapre (near Tanah Merah bay), 31 January 1954, litter from part of forest near brooklet (X1716).
L38. As L37, litter in part of forest with many tree-ferns (X1788).
L39. Forest on serpentine along the river Noebai, near Kloofkamp (Hollandia), 2 February 1954, litter from part of the forest near the river (X1789).
L40. As L39, litter from higher part of the forest (X1804).
L41. Mangrove swamp forest near the road from Hollandia to Hollandia-binnen, 6 February 1954, litter from the extra-tidal part of the forest (X1713).
L42. As L41 (X1790).

L43. Lower-montane forest on cristalline schists, along footpath from Ifar to Wari and Ormoe, Cycloop Mountains, south of the watershed, altitude about 1200 m, 7 February 1954, litter (X1810).
L44. As L43, moss from tree-trunks and decaying wood (X1705).
L45. As L43, altitude about 900 m, litter (X1812).
L46. As L43, altitude about 700-800 m, litter (X1808).
L47. Sago palm swamp along the north-eastern part of Lake Sentani, west of "Meerzicht" (Hollandia area), 10 February 1954, litter (X1714).
M1. Forest on coastal limestone hill near Fak Fak, 24 February 1954, litter (X1704).
M2. Forest in an area of limestone karst near Ajamaroe (Birdshead), 25 February 1954, litter from part of forest on hill (X1768).
M3. As M2, litter from more humid area, lower down (X1708).
M4. Beach forest on Woendi Island (Padaido Islands), 1 March 1954, litter of part of forest with *Casuarina* (X1767).
M5. As M4, litter of mixed forest (X1815).
M6. Forest on limestone, on Auki Island (Padaido Islands), 2 March 1954, litter from northern part (X1814).
M7. As M6, litter from central part (X1816).
M8. Beach forest on Oeriv Island (Padaido Islands), 3 March 1954, litter (X1703).
M9. Forest on cristalline schists near Korido, Soepiori Island, 9 April 1954, litter from part of forest 10 m above the river Ramgardori (X1806).
M10. As M9, litter from part of forest 20 m above the river Ramgardori (X1706).
M11. Mid-montane "heathland" in the Edarotali plain, Wissel lakes area, altitude about 1800 m, 26 April 1954, sample *Cladonia* (X1798).
M12. As M11, sample *Sphagnum* (X1797).
M13. As M11, sample epiphytes from shrubs (X1732).
M14. Mid-montane *Nothofagus* forest on hill near Edarotali plain, Wissel lakes area, altitude about 1800 m, 26 April 1954, sample epiphytes from the trunk of a tree (X1712).
M15. As M14, litter and moss from roots at the base of tree-trunks (X1707).

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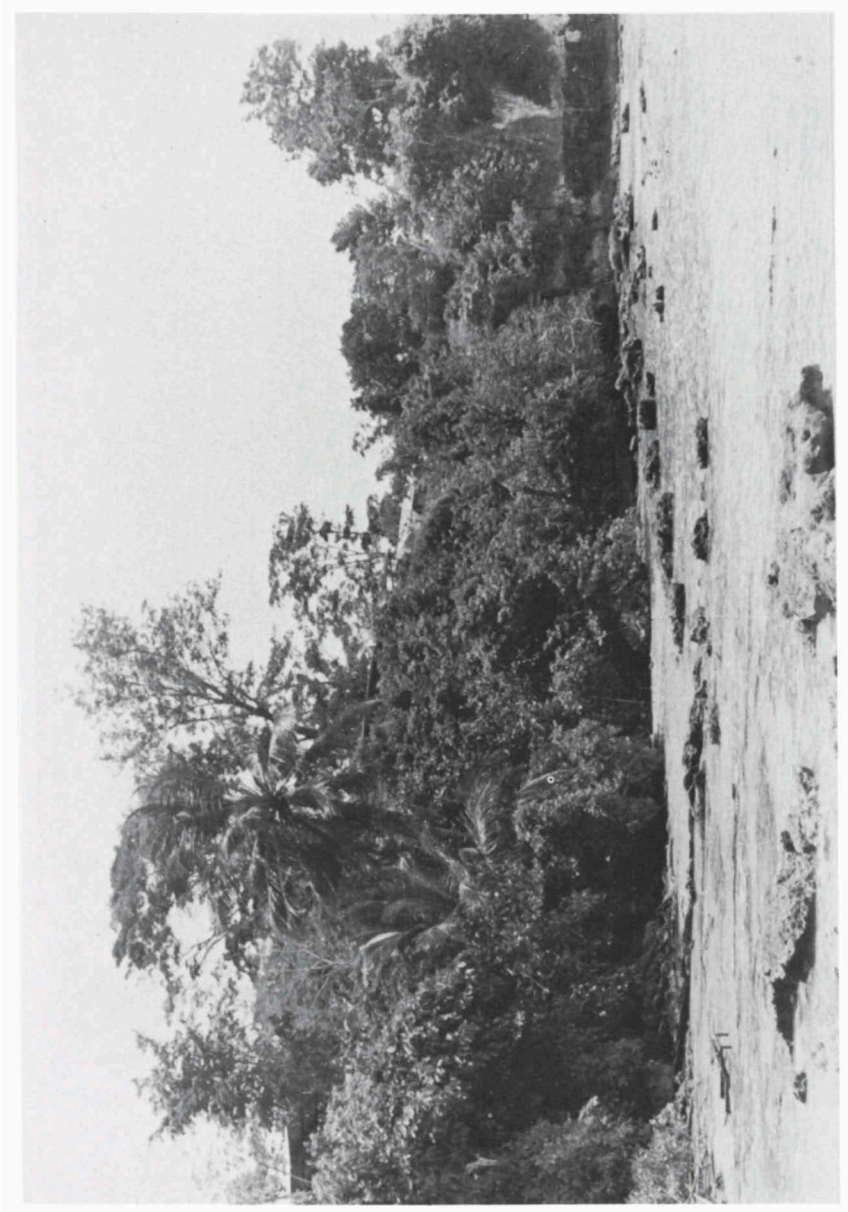
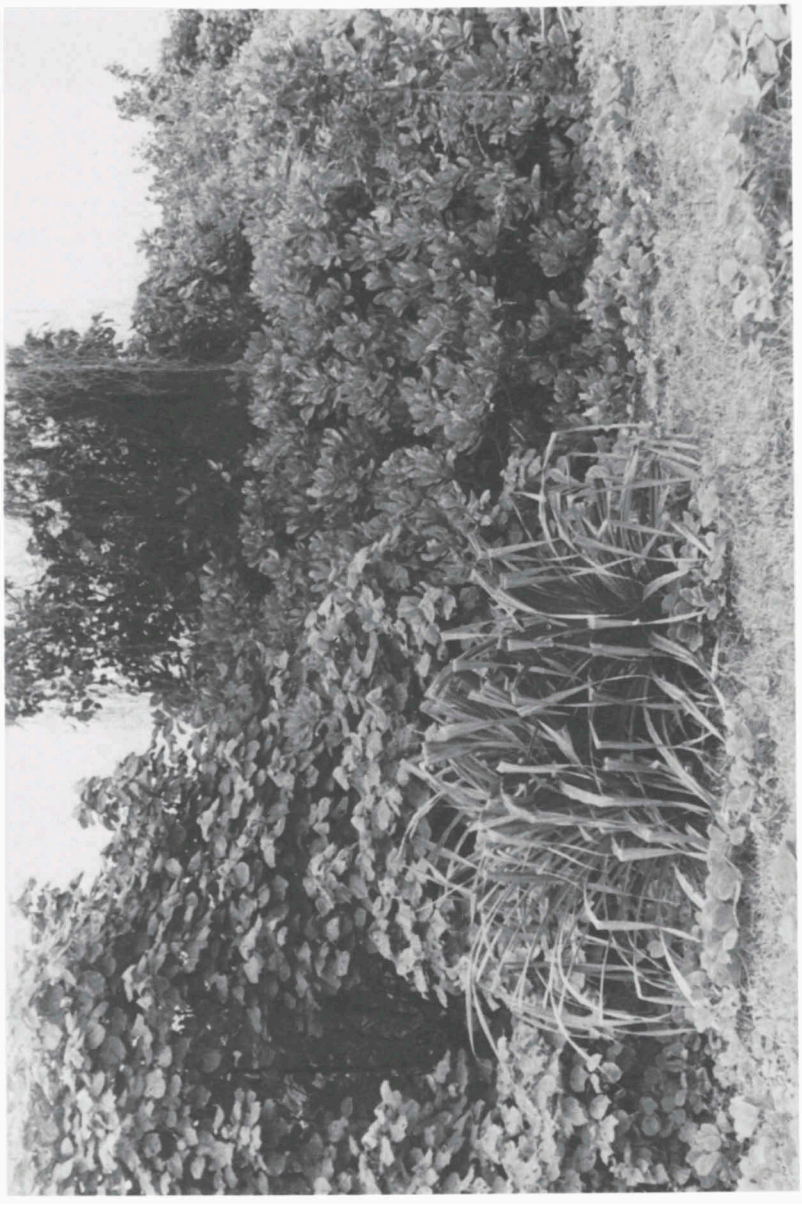


Pl. 1. South coast of Biak Island, near the Base of the Royal Netherlands Navy. The scattered rocks in the foreground are in the intertidal zone. Photograph: about November 1953.



Pl. 2. Beach forest on the Invasion beach near Hollandia. From left to right: *Hibiscus tiliaceus*, young *Pandanus tectorius* and *Scaevola frutescens*. In the background the tree *Terminalia catappa* with the parasitic *Cassytha filiformis* hanging down. In the foreground *Canavalia maritima*, a characteristic plant of the beach outside the forest. Photograph: 17 January 1954.

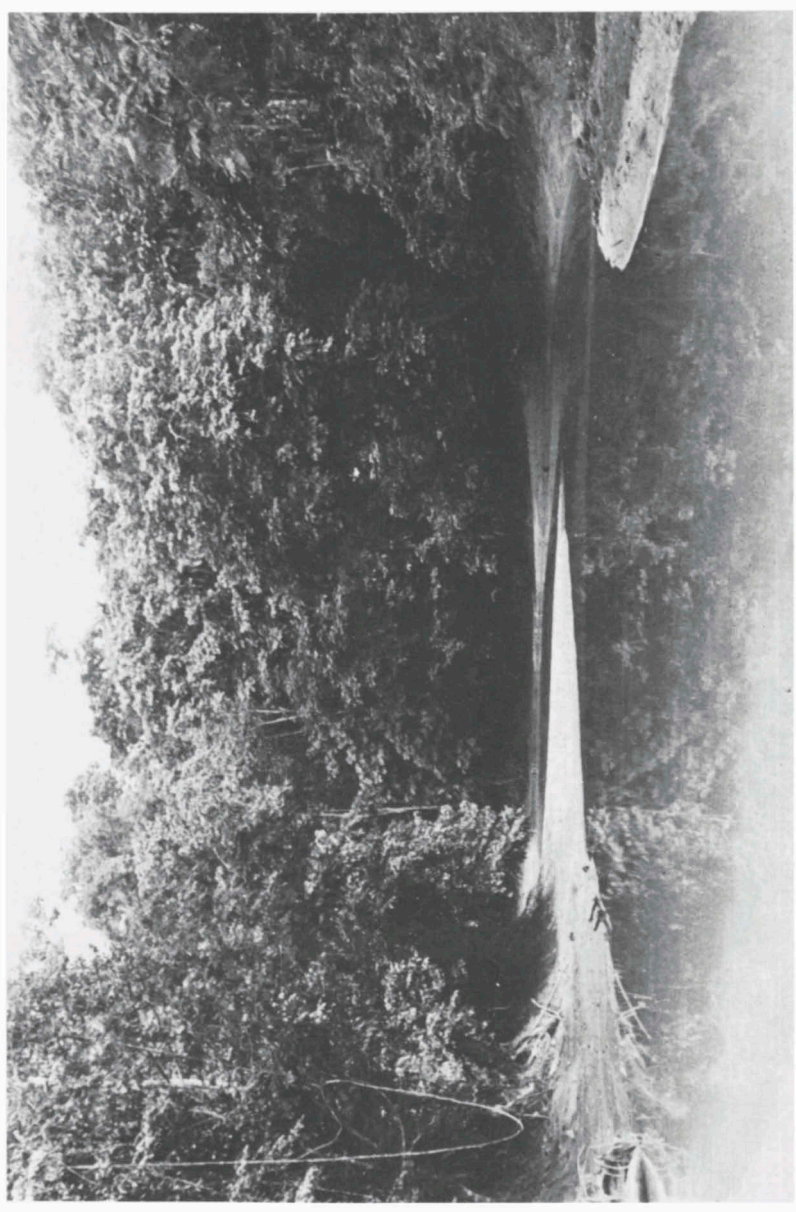
Pl. 3. Undergrowth of the beach forest at Oeriv Island, with flowering *Crinum asiaticum*. Photograph: 3 March 1954.

Pl. 4. Mangrove swamp forest behind the Invasion beach near Hollandia. Tidal part of the forest, near open water, with *Rhizophora* spec. (note the young plant in the foreground). Photograph: 17 January 1954.

Pl. 5. Sago palm swamp along Lake Sentani, in the Hollandia area. In the foreground grassland; the smoke on the right is caused by native grassland burning. Photograph: January 1954.

Pl. 6. Lowland swamp forest on quaternary clay near Genjem. The forest and the road are subject to seasonal inundation. Photograph: 13 January 1954.

Pl. 7. Lowland swamp forest on quaternary clay near Genjem. Photograph: 13 January 1954.

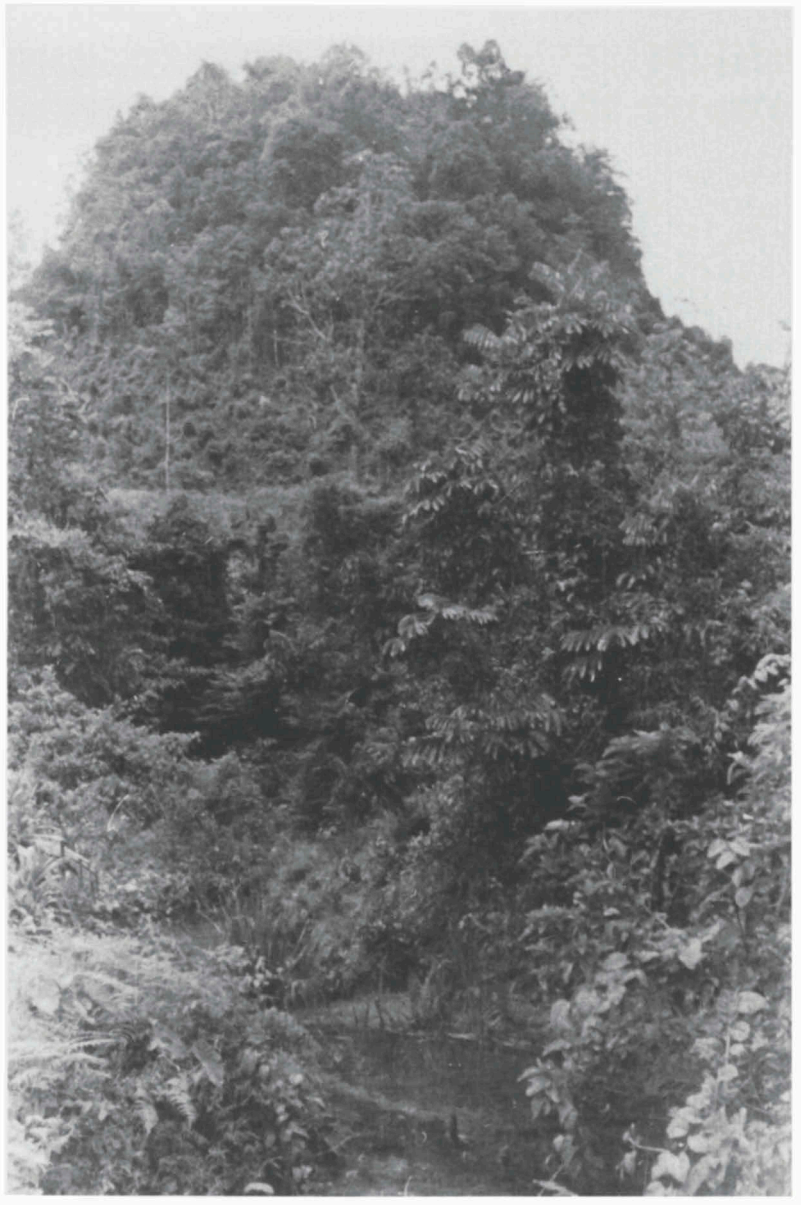


Pl. 8. Grimé river and lowland swamp forest in the Nimboran plain, north of Genjem. Photograph: 12 January 1954.

Pl. 9. Forest on coral limestone in Biak Island. In the foreground dry bush, in the background forest on elevated ridge. Photograph: 1953/54.

Pl. 10. Forest on elevated ridge of coral limestone, in the southern part of Biak Island. The path is at the foot of the steep ridge; dry bush is found at the level of the path. Photograph: 1954.

Pl. 11. Bamboo-forest and brooklet in the central eastern part of Biak Island.
Photograph: 1953/54.

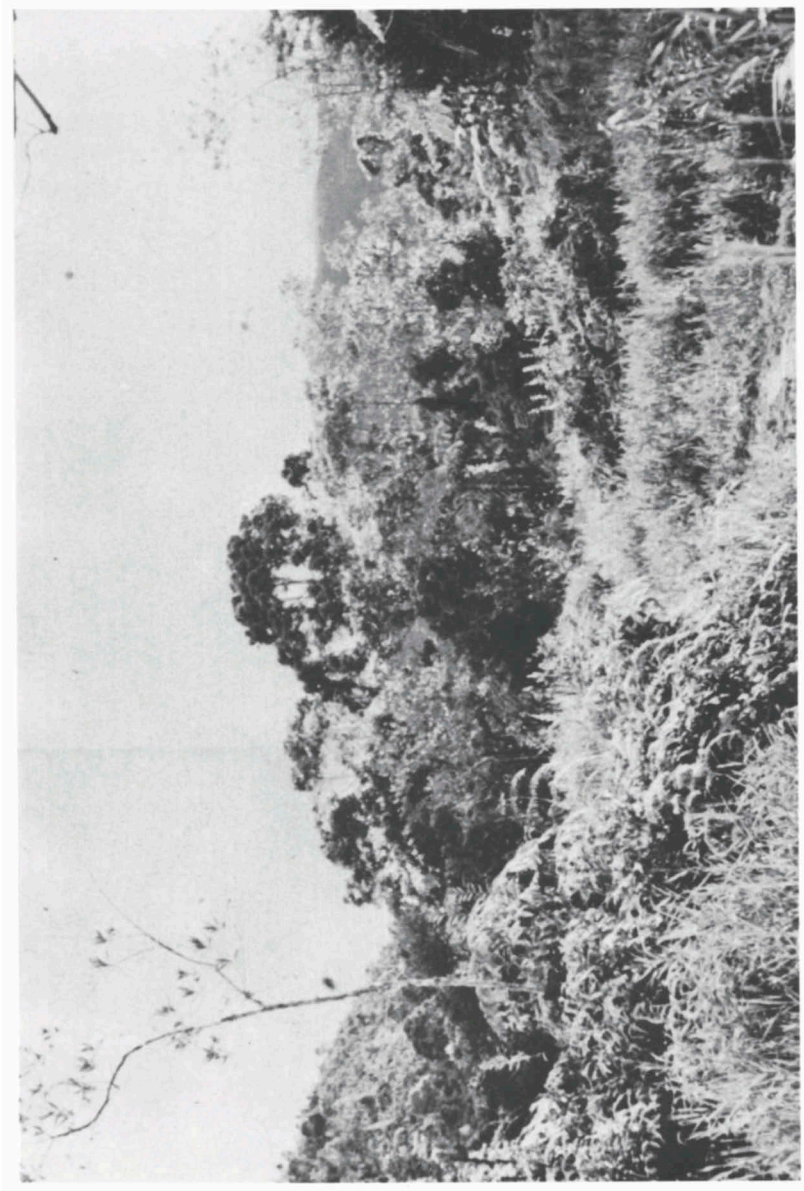


Pl. 12. Forest in area of limestone karst near Ajamaroe (Birdshead). Photograph: 25 February 1954.

Pl. 13. Forest on coral limestone near Hollandia (note the heavily buttressed trees). Photograph: February 1954.

Pl. 14. Forest on cristalline schists, along the river Ramgardori, north of Korido, Soepiori Island. Photograph: April 1954.

Pl. 15. Cycloop Mountains, viewed from the South (from MacArthur Hill).
Photograph: January 1954.



Pl. 16. Mid-montane "heathland" in the Edarotali plain, Wissel lakes area; altitude about 1800 m. Photograph: April 1954.

Pl. 17. *Rhododendron* species in the Edarotali plain. Photograph: April 1954.

Pl. 18. *Dacrydium* species with climbing-plant (probably *Psychotria* species, Rubiaceae) in the Edarotali plain. Photograph: April 1954.

Pl. 19. *Nepenthes* species in the Edarotali plain. Photograph: April 1954.