

Entomological Investigations in New Guinea Mountains¹

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This is a preliminary report on my first trip to New Guinea. Since it is made before study of any of the material collected, and before identification of most of the host-plants, it consists mainly of notes on the environment and collecting in the areas visited. The trip was made possible by a John Simon Guggenheim Memorial Foundation Fellowship. I spent from June 5 to September 25, 1955, in New Guinea and New Britain. The objectives of the trip were (1) to collect insects primarily in new or relatively uncollected mountain areas in the interior of New Guinea in order to gather more data towards an understanding of the zoogeography of New Guinea insects, (2) to obtain material to be used in comparative studies in aiding the collaborators of the INSECTS OF MICRONESIA series to identify Micronesian genera and to help them to work out the zoogeography of the Micronesian insect groups they are studying, and (3) to help develop a representative collection from the Papuan area at Bishop Museum towards an understanding of the source-areas of the oceanic Pacific insect fauna.

It is assumed that much of the oceanic Pacific insect fauna originated from the major islands stretching between the Solomons and southeast Asia, perhaps in the main from New Guinea, eastern Indonesia and the southern Philippines.

Since rather little insect collecting has been done in the high mountain areas of most parts of New Guinea, I spent most of my time in the mountains. The principal insect collecting in New Guinea has been in the coastal areas or mountains along the north coast, as well as in the extreme west end (Vogelkop) and in scattered parts of Papua. The most extensive entomological survey in the interior was made by L. J. Toxopeus (PROC. EIGHTH INT. CONGR. ENT. 508-522, 1950) and his staff on the Third Archbold Expedition (Netherlands Indian-American Expedition) during 1938-39, when collecting was done systematically at all altitudes from just above sea level to nearly the highest altitudes in westcentral New Guinea (eastcentral Netherlands New Guinea), from the Mamberamo River where it reaches the lowlands, southwest to the Mt. Wilhelmina area in the Snow Mountains. Other ex-

¹ Partial results of a John Simon Guggenheim Memorial Foundation Fellowship, 1955-56. Revision of Presidential Address, December, 1955.

tensive mountain collections were made by Miss Evelyn Cheesman at Kokoda on the Owen Stanley Range in 1933, and in other mountains such as the Cyclops Mountains (1936) near the north coast of the central portion, and Waigeo (1938); by C. T. McNamara on Mt. Lamington (near Kokoda) in 1929; by the Second Archbold Expedition in the Upper Fly River area of western Papua in 1936-37; by P. J. Darlington in the northeast in 1944-45; by E. O. Wilson in eastern New Guinea in 1955, and others. Most other collecting has been in lowland areas, except some done recently by J. J. H. Szent-Ivany.

With the expectation of further trips to the New Guinea area (now assured by invitations from the Departments of Agriculture of the Territory of Papua and New Guinea and of the British Solomon Islands Protectorate, and a grant from the National Science Foundation), I decided on this first trip to visit several widely separated areas at different altitudes, in order to obtain as broad a sampling as possible, at the same time collecting in new or little-collected areas.

The planning and arranging of my trip was very materially aided by the suggestions of Drs. J. J. H. Szent-Ivany, H. Boschma, M. A. Lieftinck, and L. B. Holthius. Extensive assistance in the field was rendered by the departments of agriculture of the Territory of Papua and New Guinea, and of Netherlands New Guinea, and especially by Dr. J. J. H. Szent-Ivany, Mr. J. S. Womersley, Mr. L. A. Bridgeland, Dr. F. C. van Loenen, Mr. R. T. Simon Thomas, and Mr. R. den Haan. Further help was given by Ian Downs, G. P. Keleny, R. S. Carne, J. Sharp, Fr. M. E. Bodnar, Fr. J. Labor, F. Pemble-Smith, F. Shaw Meyer, Dr. and Mrs. A. Handsoo, A. J. Slatter, K. R. Gorringer, the South Pacific Lumber Co., W. J. Hughes, Mr. Wyttevaall, Mr. Veldkamp, L. E. Laurens, Rev. and Mrs. Troutman, L. Pospisil, and many others. Assistance in collecting was obtained locally in each area. Dr. Szent-Ivany accompanied me during my first 12 days, and loaned me his assistant, Edmund, for the following week. Mr. Simon Thomas accompanied me during my month in Netherlands New Guinea.

In order to supply material to all collaborators on the INSECTS OF MICRONESIA project, all groups of insects and other terrestrial arthropods were collected. Emphasis was placed on the insect groups better represented in Micronesia: Coleoptera, Homoptera, Heteroptera, small moths, and other small insects. Since many of these are nocturnal, special emphasis was placed on light-trapping. Much general sweeping and beating was done, and also considerable Berlese-funneling. The light trap and Berlese-funnel were of the same types as used in Micronesia (INSECTS OF MICRONESIA 1:202, 1954). Nets used were primarily heavy sweeping nets, a collapsible-frame beating sheet, improvised beating sheets (fig. 9c), butterfly net, water net, and organdie net. Little emphasis was placed on butterflies, since they have been better collected than other groups and are poorly represented in Micronesia.

The general areas visited during the trip were the Port Moresby area in Papua, the "Eastern" and "Western Highlands" of northeast New Guinea, the Lae area of the Huon Gulf, Hollandia, Biak Island, the Wisselmeren (Wissel Lakes) area of westcentral Netherlands New Guinea, and the Gazelle Peninsula of Northeastern New Britain. Collecting was done at all altitudes from sea level to 4,600 meters, although no insects were taken above 4,200 meters.

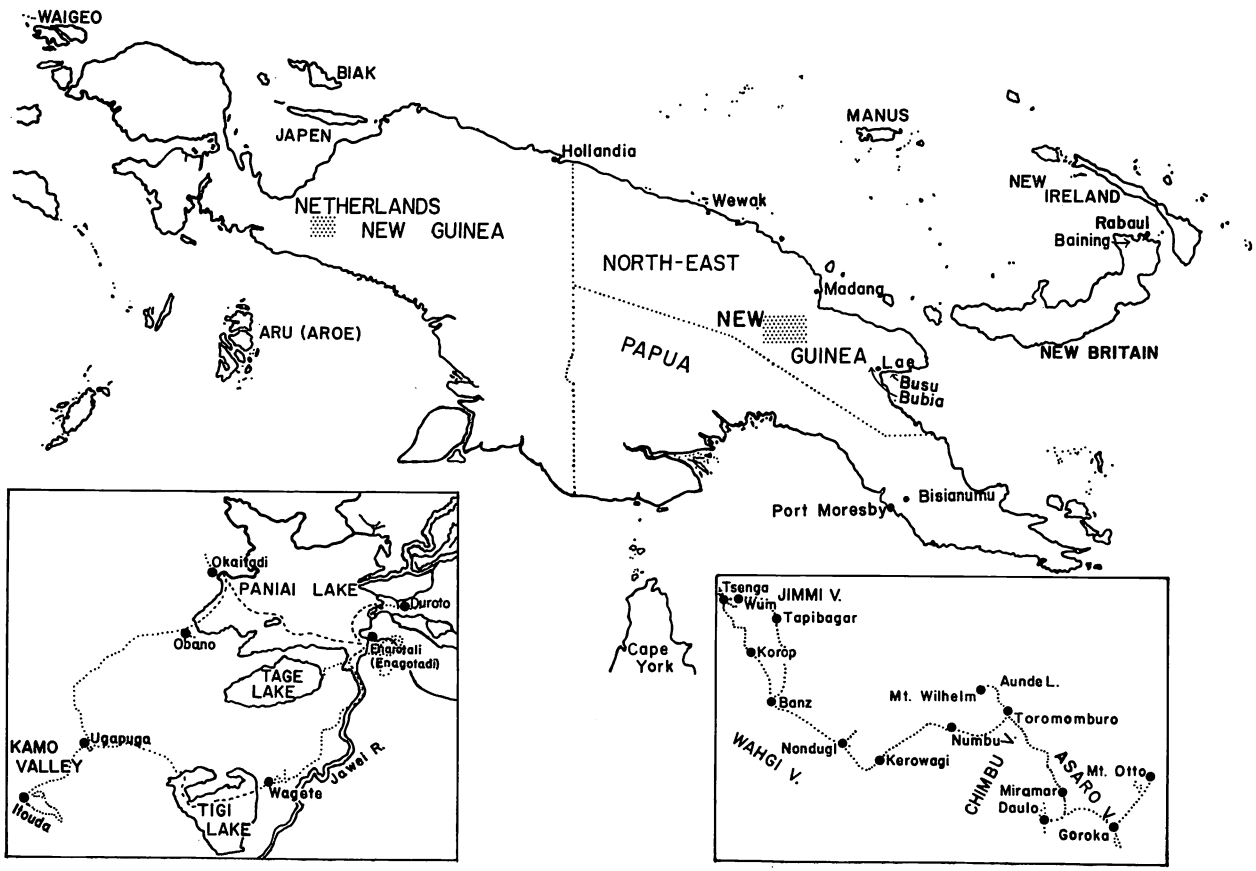
PAPUA

My trip commenced at Port Moresby, Papua, June 5, 1955. Here the climate is quite dry for New Guinea, with only 1,000 mm. of rain per year, and average humidity of 60–95 per cent. In this dry area *Eucalyptus* trees are dominant, and the fauna is atypical for New Guinea, with Australian types predominating. The widespread *Oecophylla* ants are numerous among the *Eucalyptus* trees. Two days were spent with arrangements and procuring equipment, and two days were spent collecting at Bisianumu, alt. 500 meters, at edge of foothill rainforest in a rubber-growing region. Here rainfall is about 2,500 mm. per year and vegetation is lush jungle. At the Rubber Experiment Station, many kinds of insects were collected on flowering *Crotalaria*, grown as a cover crop. Several kinds of cerambycids and weevils were found ovipositing on *Hevea* rubber bud stock. A *Pantorhytes* (a genus which includes serious pests of cacao) weevil was found in jungle. Bisianumu was again visited September 23–24. A short stop was made at the Brown River, also near Port Moresby.

NORTHEAST NEW GUINEA HIGHLANDS

The second destination was Goroka, in the Eastern Highlands of Northeast New Guinea, by air via Wau. Goroka is in the Asaro Valley, at 1,550 meters, southeast of Mt. Wilhelm, and east of the Wahgi and Chimbu valleys. The Asaro is wide, flat, and grassy, with forested ranges over 3,000 meters high on each side. It drains into the Purari River, to the Gulf of Papua. At Goroka interesting telephorids, weevils, and chrysomelids were found on introduced ornamental plants, vegetables, sugar cane, *Pipturus*, and others. A *Coptorrhynchus* weevil had just become a pest of coffee, and a melolonthid and ants were causing injury to airstrips. *Casuarina*, bamboos, *Eucalyptus deglupta* Blume, and other plants present were possibly introduced by the natives. *Poinciana* was found crowded with elephant beetles, and *Papuana* dynastids were taken in the light trap.

The next locality (June 11–16) was Daulo Pass, northwest of Goroka, on the Chimbu-Asaro Divide, at 2,450 meters, with the ridge going higher in both directions. Collecting was done up to 3,000 meters. Moss forest included small *Pandanus*, *Freycinetia*, small bamboos, *Nothofagus*, lianas, and *Rhododendron*, among a very rich variety of vegetation. A tall apparently

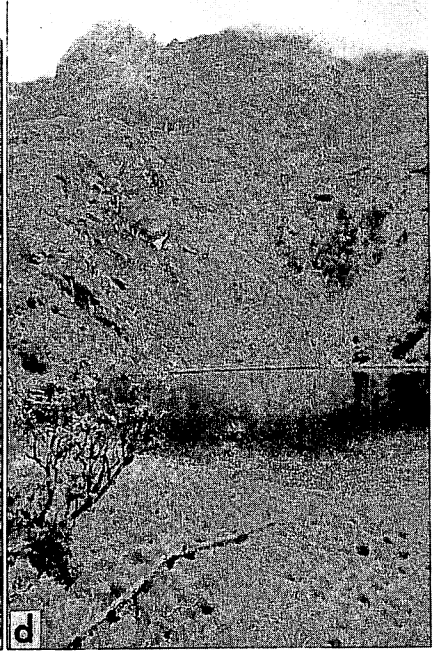
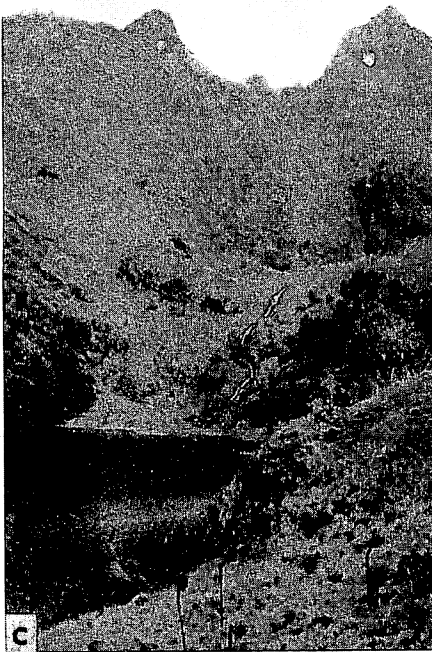
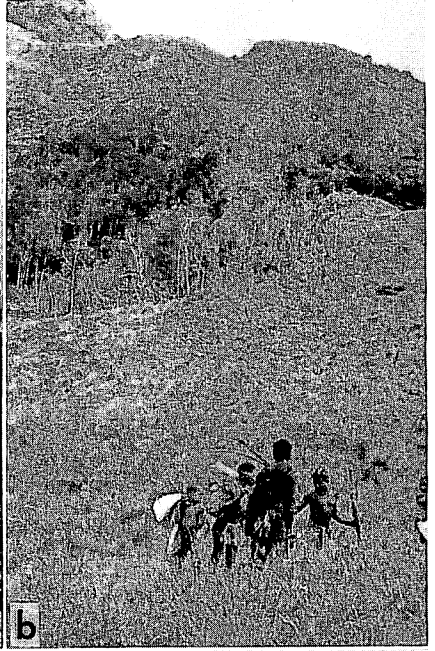


semi-cultivated *Pandanus* with long red fruit grows near the villages. Though the weather was cool, insects were abundant. Many moths flew at night as it generally rained in afternoon and evening. Two male hercules moths were taken by Dr. Szent-Ivany. Rainfall is probably over 3,000 mm. per year.

After returning to Goroka, I went to Mr. Otto (June 20–24) on the east side of the Asaro Valley. The east rim at this point is higher, overlooking much of the ridge on the west side of the valley. The upper portions of the ridge are largely covered with moss forest. Parts of the highest peaks (3,300 m.) are grassy, the result mainly of fires kindled by native hunters to warm themselves, or to provide hunting places. Tree kangaroos and other marsupials and some rodents occur in these situations. I camped on the lower side of the mountain, at Kabebe village, at 2,100 meters. Collecting was done on the main ridge, and also lesser ridges to the west, just north of the village. The area was largely forested, with some new or old clearings, mostly for sweet potato, with *Pandanus* near the village. *Cordyline* was a very common plant, particularly bordering the sweet potato patches. Here the chrysalis of a *Troides* (*Ornithoptera*) was found on the underside of the large leaf of a shrub, at 2,200 meters. The butterfly emerged some days later and was thought to be a species described from the Owen Stanley Range to the east.

Leaving Goroka again, June 27, I rode north up the Asaro Valley to Miramar, through grassy country with *Casuarina*, *Cordyline*, *Ficus*, and other familiar plants. Miramar, 1,800 meters, is north of the road leading to Daulo Pass, and is at the foot of the west wall of the valley. Next day, with porters, I walked further north, past Gobayabe, and part way up the ridge to two round huts, at Nenguag, on a side ridge near the main ridge. June 29 we climbed up over the main ridge at Bogonege, 3,000 meters, where the view included both the upper Asaro Valley, with various mountains, including Mt. Monisa and Mt. Otto to the east, and westward across the Upper Chimbu Valley to the slopes of Mt. Wilhelm, its peaks hidden in clouds. On the ridge, again, was moss forest, with small bogs here and there. A short distance west from the ridge we came to a large shallow grassy valley. Repeated burning kept this in grass, with tree ferns surviving in spots. Passing through some natural forest we reached an upper branch of the Chimbu Valley with signs of dense population. Sweet potato fields extended from 2,500 meters altitude down to the river. Crossing the stream, we visited a village where the people were coming in for a "sing-sing". We had to cross another steep ridge, then descend to the west fork of the Upper Chimbu, and proceed up it, and then a short distance up a branch to the west, to reach Toromomburo, 2,350 meters (or Denglagu as it is often called—the name of the local tribe).

FIG. 1. Map of New Guinea and New Britain, showing collecting areas. Inset of Wisselmeren area (stippled on large map) on lower left; inset of route in Asaro, Chimbu, Wahgi, and Jimmi valleys (stippled on large map) on lower right.

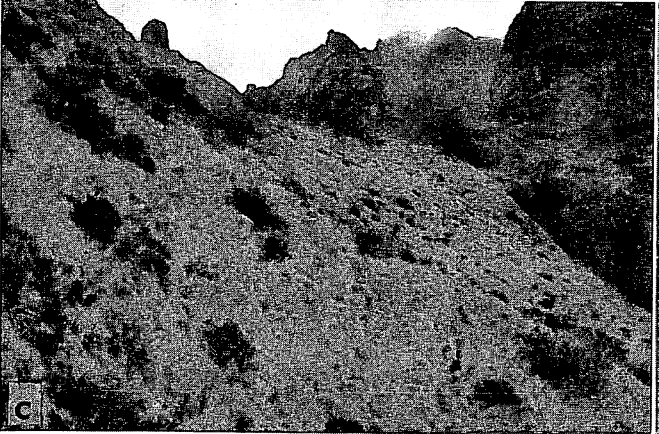
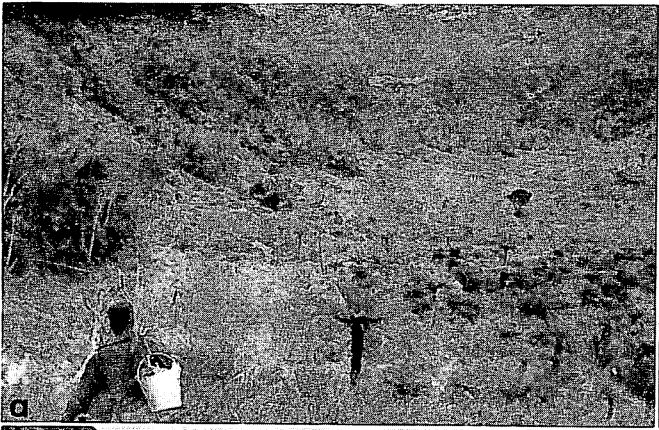
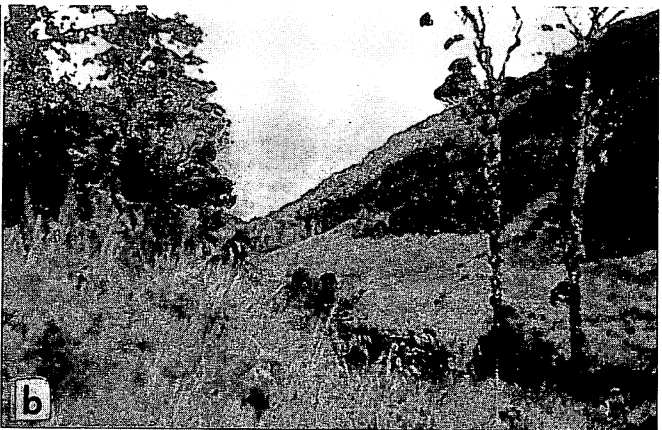


The next morning, June 30, with new porters, I started up Mt. Wilhelm, first passing the airstrip, Keglsugl, 2,500 meters, and then entering wet moss forest. At about 3,200 meters the deep moss forest gave way to open grassy areas with scattered tree ferns, and shrubbery or small groves on the slopes. After five hours we reached Lake Aunde, lowest of three lakes below the higher peaks. Here, at 3,600 meters, we camped for two nights in what seemed like near freezing weather at night. The surroundings were grassy with dense thickets of shrubbery or stunted trees, with trees up to 12 meters or more tall in protected situations. There were still many kinds of plants, and a type of moss forest, but with obvious differences reflecting low temperatures and strong wind. On the more exposed slopes the dense growth could hardly be penetrated, and in the open the grass was deep and thick, making progress difficult.

On July 1 the ascent was made on up the mountain, passing Lake Piunde and then two small ponds. From the ridge just below the main peaks, at 4,200 meters, Lake Guraruraga was seen below in the valley to the west. This was the highest point at which insects were taken. Several flies and spiders were obtained in low shrubs on the ridge. Because of clouds higher up, this was also the highest point at which scenery was seen: the Sarowaged Mountains well to the northeast, the Owen Stanleys far to the eastsoutheast, and many nearer ranges. Keeping near to the tops of the rock slides from the granite peaks, we worked around to the north, and finally two of us climbed to the summit of a peak which I later learned was the second-highest, some 4,600 meters, on the basis of data in the record left there the previous year by the official Wilhelm patrol. A single small woody plant was found growing a few meters below the summit of the peak, considerably higher than the highest bunch-grass seen. Cold rain hampered collecting on the descent to Lake Aunde. With parts of three afternoons, one morning's collecting, and two nights' light-trapping, around Lake Aunde, we took about 200 species of insects and other arthropods, at 3,600 meters. Dominant insects were caddis flies, small moths, homopterans, beetles, and flies. Many of the plants at this altitude and above belonged to the Ericaceae.

No conifers were seen at these high altitudes, but mostly below 2,000 meters, and hardly ever in solid stands. This correlates with Toxopeus' (1950) statement that New Guinea has no true alpine insect fauna, but rather that the lowland insects have recently been adapting themselves to the higher altitudes, as the young high mountains of New Guinea have been elevated just to the south of remnants of a lower ancient Melanesian continent. No pines, for instance, occur, but mostly *Araucaria*, *Podocarpus*, and cupressine trees.

FIG. 2. *a*, Brown River lowland rain forest, near Port Moresby, Papua; *b-d*, Mt. Wilhelm, Northeast New Guinea; *b*, just below Lake Aunde, 3,550 meters; *c*, Lake Aunde, 3,600 meters, looking northwest; *d*, Lake Aunde, looking east.



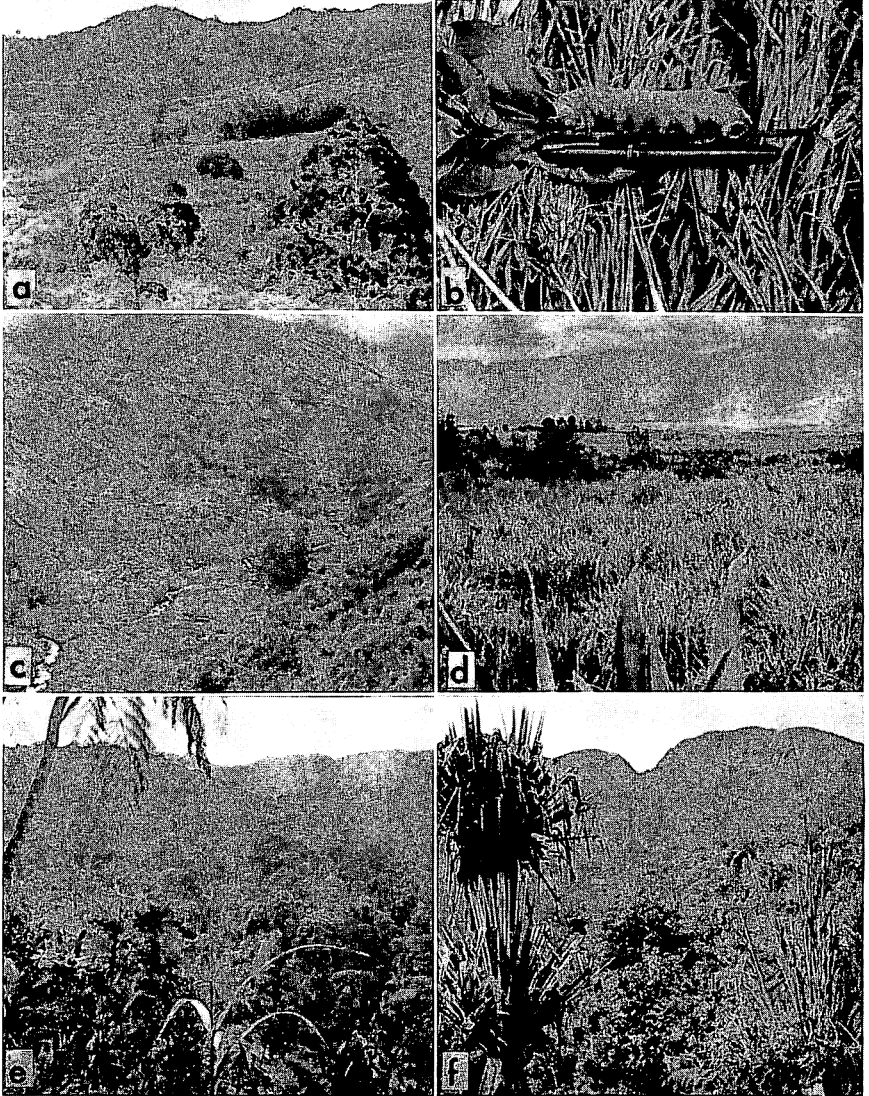
Returning to Toromomburo, more collecting was done in that valley (fig. 4c) which drains from Lake Guraruraga, which was seen from above, and also in the rain forest above Keglsugl. Caterpillars of the hercules moth (fig. 4b) were brought in on *Homalanthus populneus* (Geiseler) Pax. Leaving Mt. Wilhelm on July 5, I started south down the upper Chimbu Valley, which leads into the east end of the Wahgi Valley. In the lower part of the Chimbu some limestone cliffs may be seen from a distance, and there are also limestone caves. Along these streams, and on the cultivated slopes and by villages, *Casuarina* is dominant. However, it was never seen in unpopulated areas, suggesting that it has been planted by the natives, as has the kamerere (*Eucalyptus deglupta*). *Casuarina* is of wide distribution, but the kamerere is rare or lacking in natural stands in the lowlands, except in New Britain and on the summits of some low extinct volcanoes on the mainland of New Guinea.

After passing Gembol and Womukamu, I turned up another tributary, to the northwest, near Gogme, in order to collect on another ridge, by entering the Wahgi Valley farther to the west. Spending the night at Numbu, at nearly 2,000 meters, the next morning the pass, Kukumbagl, was crossed at 2,700 meters. Descending the west side of the ridge to Bogo, there was more natural forest and many butterflies, particularly *Delias*, along the small streams where the trail, and a little lumbering, allowed sunshine to penetrate the forest. Coming out of the narrow valley, we reached Kerowagi, on the north side of the wide Wahgi Valley. Thus I had walked from the center of the "Eastern Highlands" to the border of the "Western Highlands," by a devious route. From Kerowagi south across the valley, an excellent view is had of the great Kubor Range, forming the south wall of the valley. Several of its peaks are over 4,000 meters high.

I spent from July 7 to 11 at Nondugl, location of the Hallstrom Trust animal farm and zoological garden. The latter includes large aviaries housing many of the birds of paradise, cassowaries, parrots, and marsupials of the neighboring regions. Collecting was done in remnants of forest on local hills, and on the slopes of the Ahl Valley descending from the Sepik-Wahgi Divide to the north. A common tree in cultivated areas here, as well as in the Asaro and Chimbu Valleys, is *Dammaropsis kingiana* Warburg which has very large leaves and fruit, and is sometimes called breadfruit.

From Nondugl I was driven to Banz, farther west, and 11 "boys" I employed to accompany me to the Jimmi Valley went ahead by foot. On the 11th after a drive west to "Wadda Kar" we started climbing the Sepik-Wahgi

FIG. 3. Mt. Wilhelm, Northeast New Guinea: *a*, tree ferns in grassy valley at 3,000 meters; *b*, edge of scrub by Lake Aunde, 3,600 meters; *c*, above lakes, approaching main peaks, showing bunch grass, small shrubs, and 4,200 meter pass in upper center, above Lake Guraruraga; *d*, looking down on two small ponds (left foreground), Lake Piunde, and Lake Aunde from 4,000 meters.



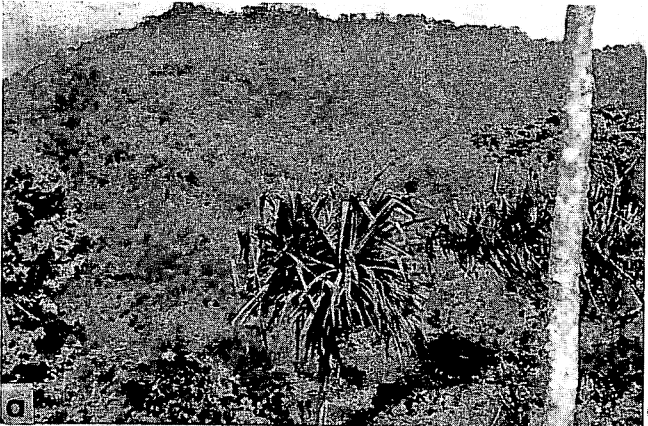
Divide. First we passed swampy kunai grass country on the valley-floor, partly being eliminated for coffee cultivation; then cultivated areas mixed with shrubby slopes, *Casuarina*, and *Pandanus*, and higher up, natural forest, still with *Pandanus*. Crossing the divide at 2,200 meters, we started down the north side, into the Jimmi Valley in the southeastern Sepik drainage. On this side, the slopes and the valley bottoms were much more wooded. The human population was much sparser, and mostly limited to medium high slopes. In the higher Wahgi, Asaro, and particularly the Chimbu Valley, the human populations are probably the densest in New Guinea, and the correlation of absence of malaria at the higher altitudes seems quite clear.

The village of Dori, at 1,650 meters, was passed in the afternoon, and the night spent at Wana, 1,500 meters, the same level as the floor of the Wahgi Valley. The next day we descended the ridge to a low stream, at 900 meters, went up a branch stream, then up to a ridge again. The night of July 12 was spent at Korop, 1,300 meters, on a ridge like Dori. The light trap here produced an estimated 5,000 specimens, in great variety of species.

The next day, proceeding mainly westward and a little north, we descended through largely natural forest to a river at 760 meters, then over a pass at 1,030 meters, then along a ridge, past Kumur village, at 1,170 meters, down to another tributary of the Jimmi at 750 meters, and up a partly cultivated slope with some second growth to Tsenga, at 1,230 meters. Here we stayed in the "house kiap" for three nights. Along the ridge there were *Casuarina* trees, some banana plants, *Pandanus*, and overgrown fields. We collected on forested ridges up to 1,500 meters or more, and down to the river at 700 meters. Near the river was jungle, but a little higher were groves of the cultivated *Pandanus*, called "mareda."

On July 16 we moved down a low ridge towards the Jimmi River, through fields, grass, bamboo, and forest, to Wum (Um), at 840 meters. This was the lowest village in this part of the valley, and was rather new. Clearings were being made in the jungle which provided very good collecting on dead branches, stumps, and logs. Very tall *Araucaria* trees towered high above the jungle in a rather even sprinkling, over a large area. On the 17th some of us went down to the Jimmi River, at 460 meters, all the way through virgin jungle, quite damp and warm, and with not many insects in evidence. Though I had assumed I might find considerable endemicity in the Jimmi Valley, some of the larger beetles taken around Wum were of familiar north coastal species. However, the rest have not yet been studied.

FIG. 4. Northeast New Guinea highlands: *a*, branch of Asaro Valley leading to Kabebe, Mt. Otto, with *Papuacedrus* in foreground; *b*, larva of hercules moth, Toromomburo, Mt. Wilhelm; *c*, valley just above Toromomburo; *d*, floor of Wahgi Valley, from just north of Banz, looking south; *e*, above Kabebe, 2,250 meters, Mt. Otto at right; *f*, near pass, 2,700 meters, between Numbu and Kerowagi (between Chimbu and Wahgi valleys).



From Wum we returned to the Wahgi Valley by another route, farther east and nearer Mt. Wilhelm, again a three-day walk. On the 19th we retraced the route to the Jimmi, crossed it, and proceeded through jungle, across a low ridge, then up to the crest of the main ridge between the two main branches of the Jimmi, in line with the main river to the west and half way between the Bismarck Range and the Sepik-Wahgi Divide. From the village at the crest, we proceeded east along the ridge, in part at 1,600 meters. There were bamboos, *Cordyline*, some quite tall betel-like palms, and native forest on the slopes, with a bit of moss forest at the highest point. Reaching Tapibagar, 1,400 meters, where the ridge meets another from the south, it was grassy, with a few large *Araucaria* trees. The next day we walked south along the ridge, going up and down between 1,300 and 2,000 meters. At one spot, north of Koronodu, at 1,475 meters, there were two kinds of *Araucaria*, a cupressine tree, perhaps *Papuacedrus papuanus* (F. v. Mueller) Li, and *Casuarina*, betel-like palms, two or three species of bamboos, and a tall straight *Pandanus* with large leaves. The night of the 20th was spent at Karap, on the same ridge, at 1,550 meters. The next day the route continued south on the ridge, up and down, until the Sepik-Wahgi Divide was reached at Tumbul, near Memiz, at 2,500 meters, in boggy moss forest, above the *Nothofagus* forest. We traversed the ridge west for some distance before turning south down into the Wahgi, still to the east of the point at which we had entered the Jimmi. On the upper slopes, the large black broad-nosed weevils, as found at Daulo Pass, were common on the tops of shrubs, but disappeared lower down. We reached the road on the east side of Banz.

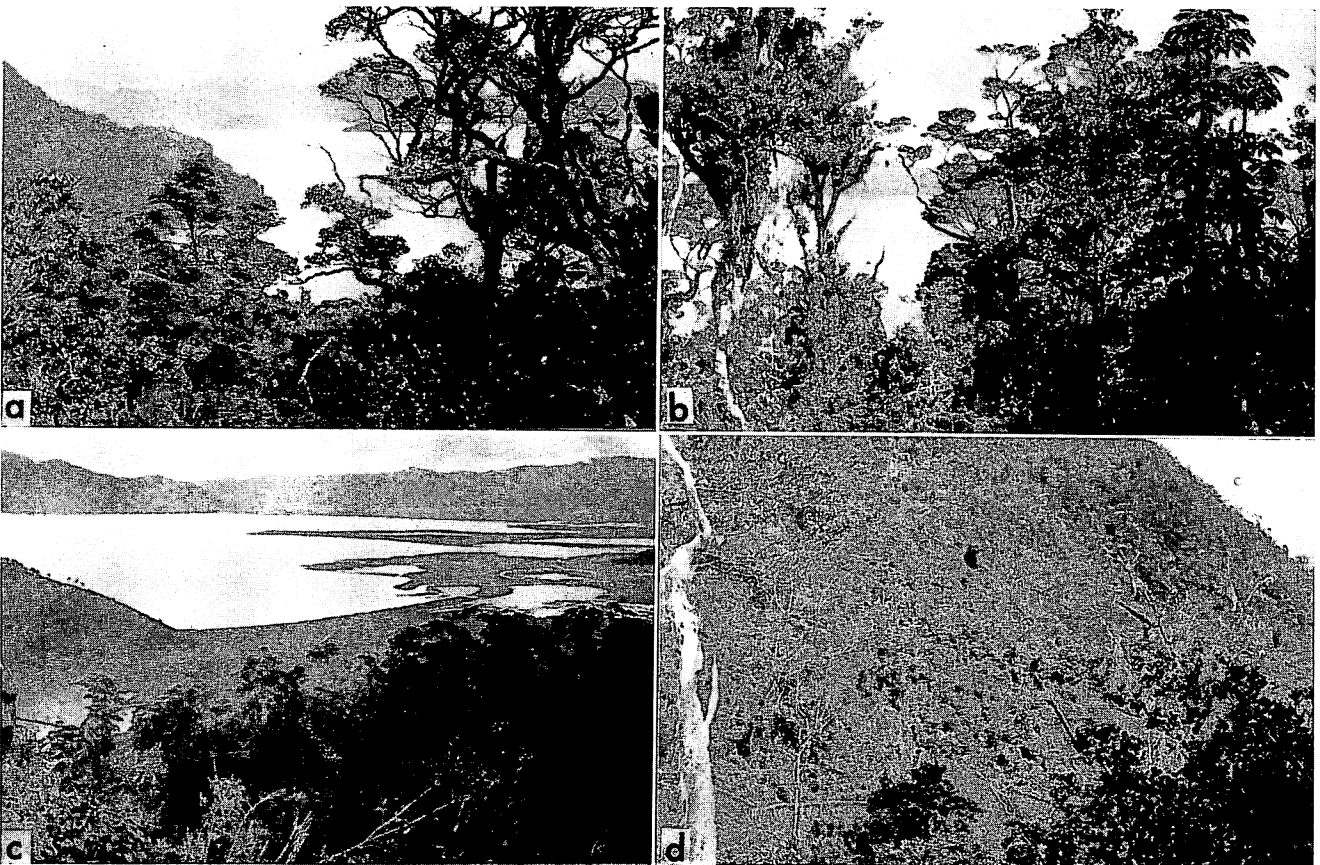
On July 23 I left Banz, flying to Goroka, and then Lae. Because of a storm between the Wahgi and Asaro valleys, we flew west, then north, up the Wahgi Valley, over the lower Jimmi, around the Bismarcks, over the middle Ramu, then over Bundi and past the north side of Mt. Wilhelm, which had received a snow fall during the storm, before entering the Asaro from the east.

Three days were spent at Lae, shipping specimens and collecting in jungle clearings and in second growth, at close to sea level. Both plants and insects, of course, were largely different from those in the highlands.

NETHERLANDS NEW GUINEA

On July 27 I flew from Lae to Hollandia, via Madang and Wewak, and the next day, with Mr. Simon Thomas, from Hollandia to Biak in the Schouten Islands. On Biak I ran the light trap, and collected in second growth north of the airfield, and also visited jungle, with scattered *Agathis*, near the agricultural school in the center of the island. The former was all coralline, the latter partly of volcanic rock. On the 30th we flew to the Wisselmeren

FIG. 5. Jimmi Valley, Northeast New Guinea: *a*, Wahgi-Sepik divide on south side of Jimmi Valley; *b*, *Araucaria* standing above jungle at Wum, 750 meters; *c*, upper Jimmi River, 500 meters; *d*, looking across valley from between Tapibagar and Korop.



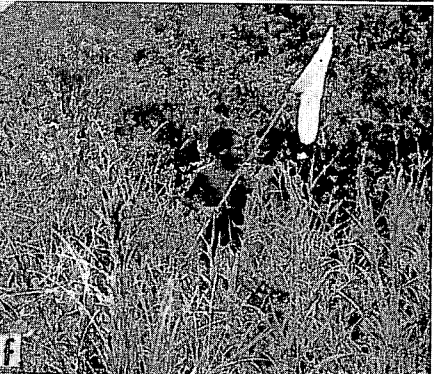
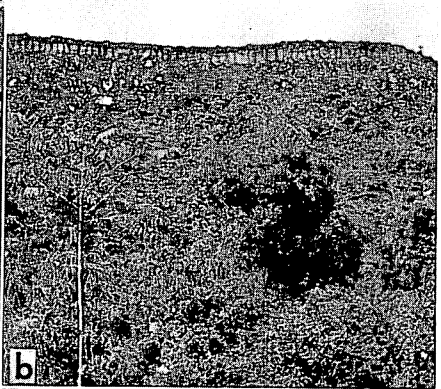
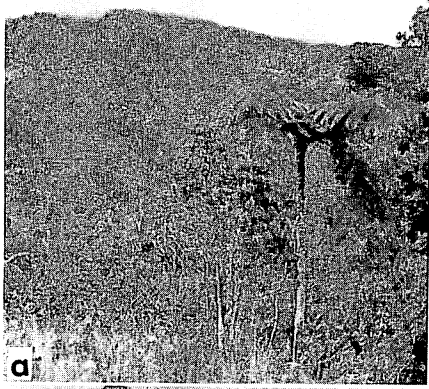
(Wissel Lakes) area of westcentral Netherlands New Guinea, almost directly south of Biak, crossing Japen Island and leaving the sea near the head of Geelvink Bay. We landed on Paniai Lake, the largest of the three lakes, by the settlement of Enagotadi (Enarotali), government headquarters for the highlands. Twenty-two days were spent in this area, visiting the three lakes, and the Kamo Valley to the southwest, a marshy remnant of a large fourth lake.

The Wisselmeren area consists of marine limestone of not very ancient age, perhaps mostly middle Tertiary, again indicating the relative youth of the high interior areas of New Guinea. The altitude of Paniai Lake is 1,742 meters, and it is by far the largest lake. Tage Lake, the smallest and the middle one, is seven meters higher than Paniai, and drains into it through crevices in the limestone ridge which rises five meters above the surface of Tage. Tigi Lake, the southernmost, drains underground to the Oeroemoeka or Jawei River which starts as the outlet of Paniai Lake at its southeast end, near Enagotadi. Formerly, the outlet was at the opposite northwest end, near Waipa, where a deep canyon falls away into the Siriwo River and Geelvink Bay, whereas the outlet now enters the Coral Sea. There is apparently still shifting going on in the rocks. The night before our departure there was quite a strong and long earthquake. The lakes, particularly Paniai, are being reduced in size by deltas of incoming streams turning shallow portions into marshes (fig. 10a). The greatest measured depth of Paniai Lake is 49 meters. The lakes are inhabited by interesting crayfish, but apparently only one species of fish.

Collecting was done from July 30 to August 7 (except day collecting of August 4) on the hills immediately south and east of Enagotadi, at altitudes of 1,750 to 2,050 meters. Most of the collecting was in shrubbery at the edge of forest, and wood-cutting trails through native forest. The forest was of the *Nothofagus* and moss forest types, somewhat similar to those in northeastern New Guinea, but with some noticeable differences, including more Asian types familiar to me, such as *Rhododendron*, *Melastomaceae*, etc. Some of the common types near Enagotadi are *Evodia*, *Dacrydium*, *Xanthomyxus*, *Phyllocladus*, *Mearnsia*, *Wrightia*, *Polyscias*, *Vaccinium*, *Claoxylon*, *Dodonaea*, *Poikilogyne*, *Acalypha*, *Glochidion*, *Ascarina*, *Papuacedrus*, and *Podocarpus*. *Casuarina* grows in the village area, as well as *Piptadenia*. Stag beetles of the genus *Lamprima* were found abundant on the new leaves of citrus trees recently established.

Tage Lake was visited on August 4, walking from Wotai near the start of the Jawei River, and over a low rise. The edge of the lake is marshy, with tall grasses, but there are also trees growing in the marshy areas.

FIG. 6. Near Enagotadi, Paniai Lake, Netherlands New Guinea: *a*, looking north from moss forest, 2,000 meters; *b*, moss forest; *c*, looking northeast, over *Nothofagus* forest; *d*, sweet potato fields near lake, 2,000 meters.



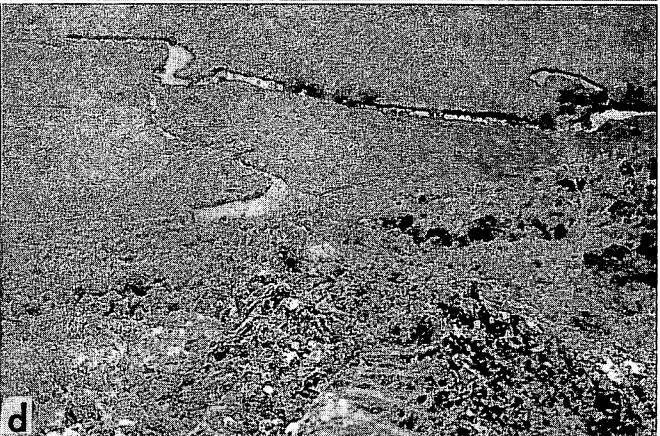
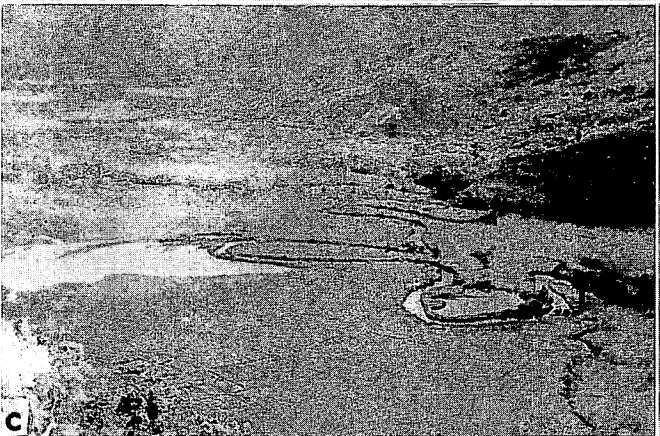
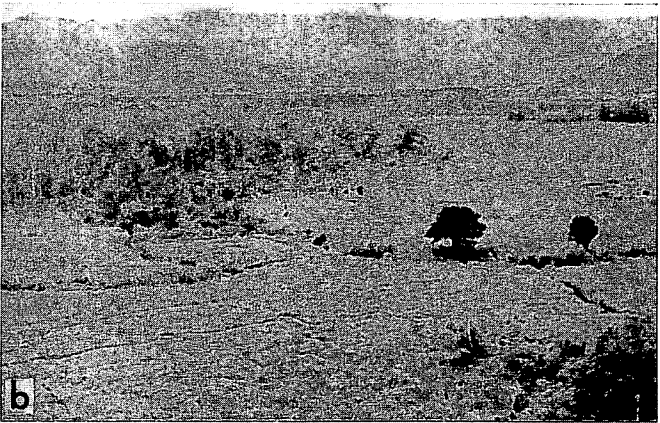
Okaitadi was visited from August 7 to 9. It is located at the west end of Paniai Lake, in a valley between two steep ridges. The floor of the valley is marshy or gravelly, with various grasses and canes. We collected mainly on the north slope, where we operated the light trap. Plants collected here included *Acalypha*, *Schefflera*, *Saurauia*, *Sloanea* and *Gleichenia*.

Obano, in a similar valley draining into the westernmost bay of Paniai Lake, was the next stop. Collecting was done only on the south side of the valley, in second growth. The next day, August 10, we made the long walk from Obano to Ugapuga (Urapura), in the northeast part of the Kamo Valley. The route crossed two passes, of 2,080 and 1,820 meters, the floor of the Kamo at Ugapuga being about 1,530 meters. In the upper part of the valley leading from the lake to the first pass, a landslide the year before had somewhat altered the course of some streams, the main stream at this time being on the side of the valley. With depletion of suitable trees for the large dugout canoes around the lake, canoes are now made in the upper Kamo Valley, and hauled by large gangs over this pass.

Near Ugapuga there are a number of *Araucaria* trees, and plants collected here included *Melastoma*, *Uncaria*, *Macaranga*, *Schefflera*, *Poikilogyne*, and *Rapanea*. Collecting was done in small clearings on the forested hill behind Ugapuga. On August 12 I walked down the swampy valley to Itouda, near the south end of the valley. The marshy area was largely grassy, sometimes partly open, and at intervals there were swampy forests or small thickets of *Pandanus* with a few shrubs. The *Pandanus* was of a type with the fruit spiny and in close bunches. Itouda is at the foot of a steep limestone ridge on the east side of the valley. There is a fair sized pond connected with the river at Itouda, alt. 1,500 meters. Collecting was done on the valley floor, and also on the forested or cultivated portions of the steep ridge to nearly 2,000 meters, including moss forest and some stunted growth on rough portions of the limestone ridge. On August 14 collecting was done in the upper end of the Dabei Valley, over a lower portion of the ridge to the south. There is much limestone outcropping here. The lower end of the Dabei drains into Tigi Lake. Plants collected at Itouda included *Acalypha*, *Ficus*, *Glochidion*, *Triumfetta*, and *Eulalia*, the latter grass with a new species of *Brontispa*.

With the help of J. Pospisil of Yale University, with whom I stayed at Itouda, I obtained a list of insects eaten by the local Me or Ekagi (Kapauku) people. The list includes six common spiders, including three of conspicuous coloration, four types of tettigoniids, a gryllacridid, several locusts, including *Oxya* and *Locusta*, a mole cricket, a small flat green mantid, cockroaches, two types of large pentatomids (including one which once squirted

FIG. 7. Wisselmeren, Netherlands New Guinea: *a*, between Jawei River and Tage Lake, 1,800 meters; *b*, sweet potato field near Tage Lake; *c*, Tage Lake; *d*, along trail from Obano to Kamo Valley, starting ascent to pass from behind marshes; *e*, delta on Paniai Lake below Duroto; *f*, below forest, behind Enagotadi, Paniai Lake.



me painfully in the eye), three types of coreids, gerrids, damsel flies, dragon fly nymphs and adults, a large broad-nosed weevil, and *Polistes* wasps (larvae and pupae). Among insects considered inedible are various beetles, Lepidoptera, asilids and other flies, ants, and meliponid bees. The wax of the latter is used.

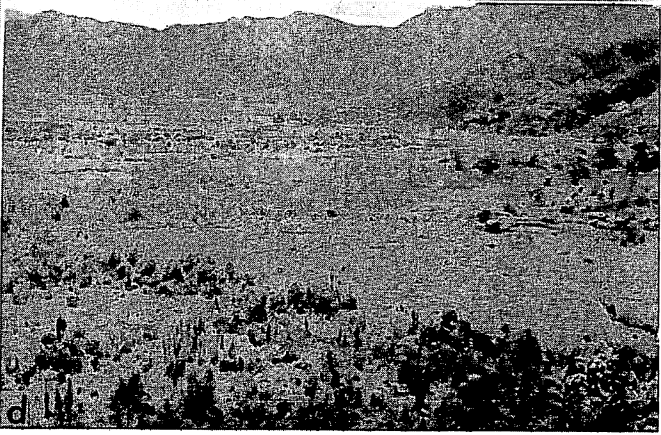
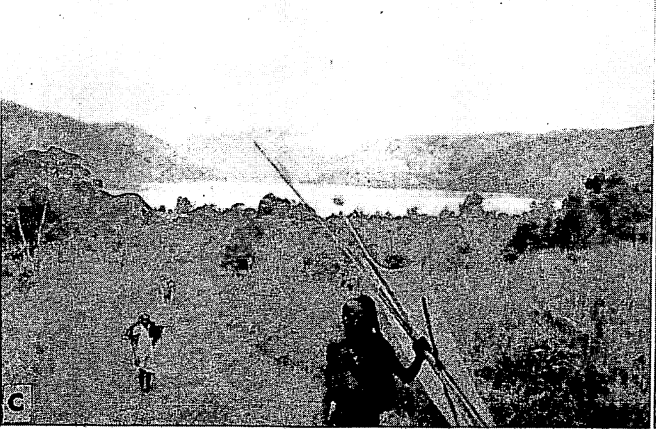
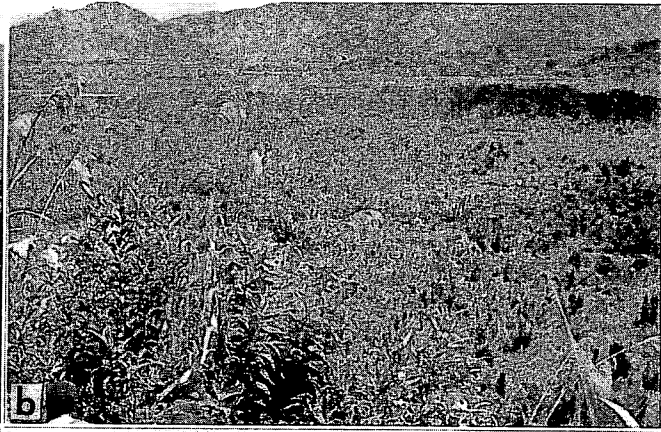
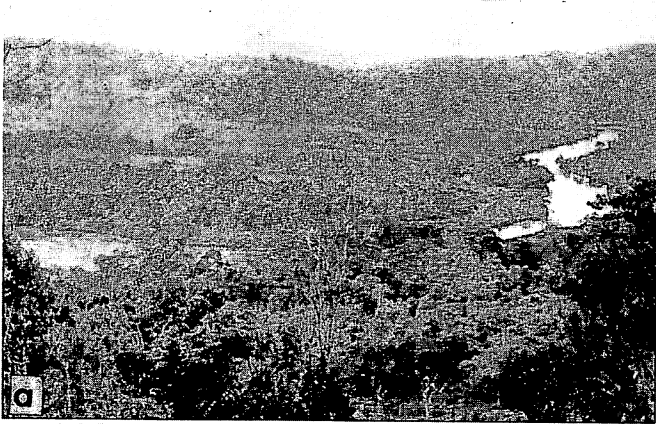
From Itouda I returned to Ugapuga, and on the 16th we climbed over the pass, eastward, to Tigi Lake. Again the valley entering the lake was marshy with scattered small thickets of shrubbery. We reached the lake at Itorikebo (next to Gakokebo) at the northwest end, and crossed the lake to Wagate. At the mouth of the Dabei Valley and back from the southwest shore were forests of trees which from a distance appeared as if dead, but I failed to identify them. Above the marshes here the country was largely plateau of limestone sand, with humus in the forested areas, and some slightly lower streams. Between Wagate and the Jawei river there are several contrasts of vegetation types. On some of the higher flat limestone sand country there were reasonably pure stands of conifers, generally *Dacrydium* and *Papuacedrus* mixed together, with a few shrubs and sedges. The ground was marshy, but fairly solid where the white coral sand was pure, though generally with water standing on the surface. Farther northeast the vegetation was mixed, with more of the widespread trees and shrubs, and the spiny *Pandanus* was common. We reached the Jawei River at Prauw Bivak (Bivak Perahoe), and returned to Enagotadi by boat. After three more days of collecting, two around Enagotadi and one at Duroto (Daroto) at the end of a ridge north and across marshes from Enagotadi, we returned to Biak and then Hollandia by the same route, except for a brief stop at Suarei on Japen Island. In flying from Biak to Hollandia good views were had of the extreme meandering of the Mamberamo and other rivers on the extensive flat coastal areas of northern New Guinea, and likewise with the Sepik and Ramu between Wewak and Madang.

At Hollandia, I collected on August 24 (dry season) on grassy slope and fragments of jungle on south side of valley near Hollandia Stad, partly near where the light trap was operated July 27 and August 23–24, and also across the valley in nearly dry sago palm swamp and on forested hillside and edge of cultivated areas.

NEW BRITAIN

Flying from Lae to Rabaul, on August 27, I proceeded to Keravat and spent a week at the Lowlands Agriculture Experiment Station. August 28 was spent along old jungle roads overgrown with *Alpinia*; the 29th on a trip to coconut plantations along the coast across the Gazelle Peninsula, in

FIG. 8. Kamo Valley, Netherlands New Guinea: *a*, clearing in moss forest, 1,800 meters; *b*, swampy forests and marsh between Ugapuga and Itouda, 1,500 meters; *c*, lower end of valley, Itouda by pond at left; *d*, looking down from limestone ridge behind Itouda.



the Kokopo area. The rest of the time was spent on the flat valley bottom along the road through the experiment station to the foresting areas in jungle along the river. Each day a different area was sampled, mostly in the jungle, but partly in second growth being cleared. The light trap was also operated at each of these points and in clearings near forest behind the station. In much of the jungle area, the kamerere (*Eucalyptus deglupta*) towered above the jungle in scattered growth and was being lumbered. Among plants collected here were *Mallotus*, *Macaranga*, *Ficus*, *Polytoa*, *Inocarpus*, *Saurauia*, *Clerodendrum*, and *Pipturus*.

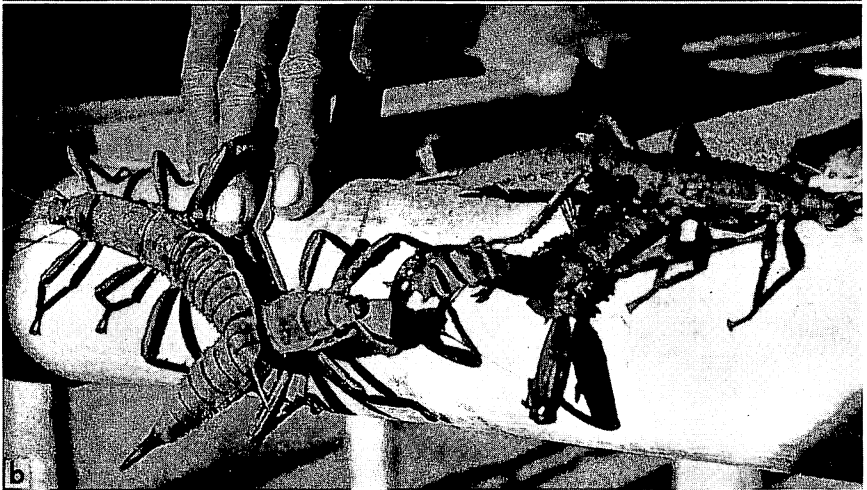
St. Paul's village in the Bainings Mts. on the southwestern side of the Gazelle Peninsula was the next destination. I stayed there from September 3 to 10. The village is a short distance up hill, at 260 meters, from Neu Mobisberg Plantation, slightly inland from Vunamarita and New Masawa Plantation. Above St. Paul's the trail inland continues a considerable distance at about 350 meters altitude along the side of the ridge, and collecting was done along this almost every day for several kilometers. Twice (4th and 9th) the ridge was ascended to different points, and one day (7th) also by a round-about route from the former mission grounds below the village. As an organdie net was used quite a bit here, more smaller Hymenoptera and Diptera were taken. Among plants collected for host data here were *Piper*, *Lepistemon*, *Pipturus*, *Saurauia*, and an urticaceous plant. Coconut palms grew up the the trail at one or two places and other palms grew in the jungle. A large phasmid, *Eurycantha* sp., appeared to be fairly abundant here. Returning to Keravat on the 10th, I had two more days of collecting, in places similar to those tried during the longer visit.

LAE AREA, NORTHEAST NEW GUINEA

Returning to Lae September 13, I spent from the 14th to 17th at the Busu River, east of Lae. This is rich jungle area, with foresting going on in fairly flat country at the edge of foothills of the Rawlinson Range, just south of the Sarowaged Range, about 100 meters altitude. Collecting was done in partial clearings where there were felled trees or stumps and branches.

From September 17 to 20 I stayed at the Bubia Agricultural Station, up the Nadzab Valley about 20 kilometers northwest of Lae. Here, again at about 100 meters or less, collecting was done in clearings in lowlands jungle, at the edge of cacao plantations, in sago swamps, and on forested hillsides at the edge of the valley. The light trap was operated on a low ridge overlooking a small valley behind the station. This was the last collecting locality, except for Sept. 21 to 25 in the Port Moresby area again, visiting some of the same localities.

FIG. 9. Wisselmeren, Netherlands New Guinea: *a*, Jawei River, between Wagate and Prauw Bivak; *b*, Kamo Valley, middle portion; *c*, Tage Lake, beating sheet in foreground; *d*, upper portion of Kamo Valley.



SUMMARY

Though it is impossible to give an adequate summary before studying the collections, a few general impressions might be noted. In general, conspicuous Australian types of insects appeared relatively rare, or restricted to the Port Moresby area, among those visited, except for a few cases of widespread forms. As noted by Toxopeus (1950) there appears to be no true alpine fauna in New Guinea. Forms at high altitudes appear different from those at lower altitudes, but often belong to the same genera as found in the lowlands. Certain genera seem to be quite restricted in altitudinal range, and others to occur from sea level to highest altitudes. Considerable differences in faunal makeup appeared evident in separated areas, but again certain genera seemed to be of general representation. Between the areas visited in the highlands of Northeast New Guinea and westcentral Netherlands New Guinea, where collecting was done largely at similar altitudes, distinct differences were noted. For instance, in the northeast highlands broadnosed weevils seemed dominant, whereas in the Wisselmeren area cryptorrhynchine weevils appeared dominant. In the Chrysomelidae more Asiatic types seemed to be recognized in the Wisselmeren area. As comparing highland and lowland collecting, in general chrysomelids seemed to have greater variety at high altitudes and cerambycids to be much more numerous in species and individuals at lower altitudes. The latter is also true for phasmids and larger insects in many groups, including butterflies.

FIG. 10. View of east end of Paniai Lake, Wisselmeren, Netherlands New Guinea, from Duroto; *b*, adult *Eurycantha* stick insects, St. Pauls, Baining Mts., Gazelle Peninsula, New Britain.