

RESULTS OF THE ARCHBOLD  
EXPEDITIONS. NO. 79

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(1956-1957)

L. J. BRASS

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L. J. BRASS

*Associate Curator, Archbold Collections  
The American Museum of Natural History*

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## INTRODUCTION

IN CONTINUATION OF the biological explorations of the American Museum of Natural History sponsored and for the most part financed by Richard Archbold, the Fifth Archbold Expedition to New Guinea began in the field in March, 1956, and ended in January, 1957. Most of the work of the expedition took place on Normanby Island and Fergusson Island of the D'Entrecasteaux Group, Misima, Sudest, and Rossel of the Louisiade Archipelago, and on Woodlark Island. Collections also were made on Kiriwina Island of the Trobriand Group, and, on the eastern end of the New Guinea mainland, at Mornuna near Samarai, and localities in Milne Bay and Modewa Bay.

The Fourth Archbold Expedition, in 1953, had worked on Goodenough Island in the D'Entrecasteaux Group, and on the Cape Vogel Peninsula and in a strip of territory reaching from Moi Biri Bay on the north coast to the summit of Mt. Dayman on the mainland (Brass, 1956). The third expedition, a joint project with the Government of the Netherlands Indies in 1938-1939, had operated in Netherlands New Guinea and made very large collections in the Mt. Wilhelmina section of the Snow Mountains, on the middle Idenburg River and adjacent mountains, and in the neighborhood of Hollandia (Archbold, Rand, and Brass, 1942). The second expedition, in 1936-1937, was chiefly concerned with the Fly River and Wassi Kussa areas in far western Papua (Rand and Brass, 1940). The first expedition of the series, in 1933-1934, spent most of its time on a traverse from Yule Island on the south coast to the summit of Mt. Albert Edward in east-central Papua and on the Oriomo River in the far western part of that Territory (Archbold and Rand, 1935). Biogeographical relationships between New Guinea and Australia were studied on an expedition to the Cape York Peninsula of northeastern Queensland in 1948 (Tate, 1952; Brass, 1953).

The personnel of the fifth expedition to New Guinea consisted of Leonard J. Brass, leader and botanist; Russell F. Peterson, zoologist; Lionel J. Evennett, transport man, and 10 natives. Evennett was a local resident, engaged in Samarai. He spoke several native

languages, was an excellent bushman and seaman, and in his spare time did much to prosper the collections by night hunting and exploring in caves for bats. With one exception, a man named Tinker from the Waria River, personal servant of Evennett and valuable to the expedition as a hunter, our Papuan personnel were natives of Fergusson and Goodenough Islands, generally known as Gosiagos. We were fortunate in securing the services of three men who had been on the 1953 expedition. Lik-lik and Isulele, Morima men of Fergusson, had been well trained in mammal-collecting techniques by Hobart Van Deusen, mammalogist on that trip. The third old hand was a very good cook and capable and reliable head-boy from Goodenough Island known as Kim rather than by his "book name," Gapodia Abuokela.

A base of supplies was established at Samarai. We shipped out from New York, three months before the planned commencement date for field work, all camp equipment, collecting supplies, and photographic equipment and films. Other requirements such as foodstuffs, general camp supplies, and trade goods were bought in Samarai at reasonable rates; further, most of the grocery items stocked in Samarai were packed for the tropics and for rough transport. In trade goods the only demand in our area was for black twist tobacco, newspaper with which to roll the tobacco into cigarettes, and matches for lighting the cigarettes.

For inter-island travel we depended upon small ships, about 45 to 60 feet in length, available at government-controlled rates for passengers and cargo or on a charter basis. A "mercy flight" Catalina flying-boat service, organized by the Department of Public Health, came into action, with the assistance of a widespread teleradio system operated by private residents and government outposts in regular contact with a central station at Samarai, when a medical emergency arose in the islands and could be reported by "wireless." But the only regular commercial air services were to Samarai, Milne Bay, and Kiriwina, which had flights from Port Moresby weekly.

Of the rather numerous major and minor

military air strips established in the general area during the last world war, only four (at Milne Bay and Dogura on the mainland, on Kiriwina, and at Vivigani on Goodenough Island) remained in regular or occasional use in 1956. Flying-boat charter rates to points we wished to reach in other parts were not attractive, although, as it turned out, we lost valuable time in waiting for erratic boats to take us from island to island.

Motor road transport was available, by special arrangement, on Kiriwina and over a limited area on Misima. Elsewhere our major transport inland was by native porters, hired locally as needed and, rather contrary to expectation, although we paid somewhat above normal rates, nearly always to be had in ample supply. The porters on all the islands asked for payment in money, with some few exceptions, usually older men, who wanted trade tobacco. The government set minimum carrier rates at five shillings per load of 40 pounds for an eight-hour day, the porter to supply his own food. We paid seven shillings on Normanby and six shillings on the other islands, with the additional attraction of rice to eat on the journey. On hard mountain trips the loads were reduced to about 35 pounds, and a few extra cans of beef and some gift tobacco were taken along to reward the carriers. We never had a load badly damaged, or broken into, on the track.

The main interests of the expedition were the collection and field study of mammals and plants, with amphibians and reptiles, fresh-water fishes, crustaceans, and insects and spiders as secondary interests. Ectoparasites of mammals were collected for special studies of the United States Army Medical Research Unit, Kuala Lumpur, Malaya.

The mammal specimens are deposited in the Archbold Collection at the American Museum of Natural History; the other zoological materials, in the main collections of the Museum. The plant collections went to the Rijksherbarium at Leiden. By agreement, the Administration of the Territory of Papua and New Guinea will receive on a preferential basis duplicates of all collections, when such are available, for the Port Moresby Museum and the Forest Herbarium at Lae.

Hobart M. Van Deusen is the final authority for the mammal names cited in this re-

port. Richard G. Zweifel has determined the amphibians; Samuel B. McDowell, Jr., the snakes. In plants, my original sight identifications in the field have been added to, and in some cases corrected by, C. G. G. J. van Steenis and R. C. Bakhuizen van den Brink. The Cyperaceae have been determined by J. H. Kern, and other determinations have been made by various staff botanists of the Rijksherbarium whose names for the most part have not been given in the lists received. Acknowledgment is given in the text for some other determinations.

The map was prepared by Frances W. Zweifel. The photographic illustrations are from 35-mm. Kodachromes made by me.

#### ACKNOWLEDGMENTS

In the first place, Mr. Richard Archbold, Research Associate of the American Museum of Natural History, should have recognition for his interest and generosity in continuing to sponsor investigations which he initiated in 1933 and led in person until 1939. Dr. Harold E. Anthony, Chairman of the Department of Mammals (now retired), gave his full support to the project and contributed valuable advice.

In New York, we were aided in preliminary arrangements by Mr. Stewart W. Jamieson, Consul-General of Australia, and Mr. Ronald L. Gustafson, Vice Consul.

It has been a special pleasure, over the years, to thank the Administration and the Civil Service of Papua (later Papua-New Guinea) for innumerable courtesies and for assistance in the furtherance of our aims. On this occasion we were under particular obligation, at headquarters in Port Moresby, to Mr. D. M. Cleland, Administrator; Mr. J. B. McAdam (Director) and Mr. W. R. Suttie, Department of Forests; Mr. R. E. P. Dwyer, Director, Department of Agriculture, Stock, and Fisheries; Mr. A. A. Roberts, Director, Department of Native Affairs; and Mr. T. Gramslaw, Chief Collector of Customs.

Mr. John S. Womersley, Chief, Division of Botany, Department of Forests, was generous in his help, and for a week on Normanby Island we had the pleasure of his company in the field. Mr. W. Cottrell-Dormer, Regional Agricultural Officer, Samarai, was a fruitful



source of information, and from some of his unpublished field reports kindly made available to us we gained valuable preliminary knowledge of several of the islands.

Mr. Allan T. Timperley, District Commissioner, Milne Bay District, aided us in various ways, as did Assistant District Officers J. S. McLeod of Misima, L. J. Doolan of Losuia, and D. P. Sheekey of Hagita, Milne Bay. To Mr. W. R. Crosbie, Medical Assistant in charge of Mapamoiwa Native Hospital, we were indebted for many kindnesses and some valuable additions to the mammal collection.

Very enjoyable were our relations with the hospitable priests and lay brothers of the Mission of the Sacred Heart: Father K. Twomey and Brother S. F. King of Nimoa; Father Norbert Earl and Brother Patrick Cantwell of Jinju, Rossel Island; Father G. M. Doody and Brother A. A. Smith of Kiriwina; and we are grateful for assistance they gave, and their influence on our behalf with their people. In Methodist territory we had pleasant associations with Seteraki Hau' ofa, and his wife, Mary, Tongan teachers at Loaga, Misima, and Isekele, Fijian teacher at Rambuso, Sudest.

Mr. and Mrs. Norman H. Izod, of Waikaiuna, Normanby Island, were gracious hosts, and in Waikaiuna buildings we had comfortable quarters for our first base camp. On

Misima we owed much to Mr. and Mrs. H. R. Gladstone of Kulumalia, and we were assisted by Mr. A. McA. Thomson of Quartz Mountain and Mr. Eric D. Ryan of Bwagaoia. On Rossel we were greatly indebted to Messrs. Hugh F. and Ronald H. Osborne of Abaleti for transportation and help in many other ways, and to their mother, Mrs. Harry Osborne, for the fine hospitality of her house. At Kulumadau, on Woodlark, Mr. Reginald C. Neate kindly placed a house at our disposal, and, in his absence, Mr. and Mrs. Donald B. Neate did the honors of the island. On Kiriwina, Messrs. J. and R. Lumley of Gosueta helped our party to become established and generously gave free loan of a motor truck. At Mornuna Plantation, near Samarai, Mrs. Ernest Evennett, Sr., was good enough to allow us the use of her house as a collecting base. And in Milne Bay we were assisted by Mahuru Mark, chairman of Ealeba Native Local Government Council.

Vital to an expedition are the functions of its agents. In this we were most fortunate in having Messrs. A. H. Bunting Limited (Mr. G. E. Miller, Manager; Mr. Edward Wilson, Secretary) look after our affairs, as they had in 1953, paying close attention to our supplies, always managing to find boat transport when we needed it, and safely storing our collections. Mr. Miller's house was my home in Samarai.

## GENERAL SURVEY OF THE AREA

ALL WORKING LOCALITIES of the expedition were in the Milne Bay District of the Territory of Papua and New Guinea. The administrative headquarters and commercial center of this district are at Samarai, on Dinner Island, in China Strait. When, in 1949, the Australian Government brought the Territory of Papua and the Trust Territory of New Guinea (the latter originally Kaiser Wilhelm's Land, later the Mandated Territory of New Guinea) under joint administration as the Territory of Papua and New Guinea, the Milne Bay District was formed to include areas that had comprised the Eastern Division and the South-Eastern Division of Papua. The Eastern Division, of which Samarai had always been headquarters, had included the eastern end of the New Guinea mainland and the D'Entrecasteaux Group of islands; the South-Eastern Division, with headquarters last on Misima, took in the Louisiades, Woodlark Island, and the Trobriands. Prior to 1892, when the South-Eastern Division came into being, all of our area was included in the Eastern Division. At that time it was the Eastern Division of the Possession of British New Guinea, which from 1884 to 1888 had been the Protectorate of British New Guinea. Australia assumed authority over the old British dependency in 1902, and it became the Australian Territory of Papua in 1906.

### PHYSIOGRAPHY AND GEOLOGY

Our three collecting areas on the mainland were situated on the very mountainous, nameless peninsula that lies to the south of Milne Bay and to the west of China Strait. The mountains, rising to a maximum of 3750 feet, represent one of the two eastern terminations on the mainland of the great cordillera, some 1500 miles in length, which forms the central mountain axis of New Guinea; the other termination is in East Cape on the north side of Milne Bay and forming the easternmost point of the great island. For about 250 miles on the eastern end of the mainland, the central mountains are known as the Owen Stanley Range.

The D'Entrecasteaux Group consists of three large islands (Goodenough, Fergusson,

and Normanby) and a number of smaller islands and islets of varying character. The main islands are little more than mountain masses rising out of the sea to heights of 8450 feet on Goodenough, 6800 feet on Fergusson, and 3600 feet on Normanby. Fergusson, the largest island, is about 40 miles long and 20 miles in greatest width and has an area of 518 square miles. These islands lie parallel with the easternmost part of the mainland and at their nearest points of separation, across Goschen and Ward Hunt straits, are only 10 to 20 miles from the New Guinea coast.

The Louisiade Archipelago is comprised of many islands, separate or in groups. Of the three large islands (Misima, Sudest, and Rossel), only Sudest, 45 miles in length by as much as 14 miles in width, compares with the main islands of the D'Entrecasteaux in size, and the highest peak, on Misima, is only 3400 feet in altitude. The main islands of the Louisiades are distant 115 to 225 miles from the eastern extremity of the New Guinea mainland, but the widest gap between small islands in this distance is barely 20 miles.

Woodlark Island, about 43 miles long and as much as 18 miles wide, lies 140 miles to the northeast of East Cape, 110 miles from Normanby Island, and has a maximum elevation of 1345 feet. Kiriwina, by far the largest island of the Trobriand Group, is about 28 miles long, 2 to 10 miles wide, and rises at most 180 feet above the sea. It is distant about 90 miles northeast from Cape Vogel, the nearest point on the mainland, 45 miles from Fergusson Island, and 90 miles to the west of Woodlark.

The bulk of the main islands of the D'Entrecasteaux and the Louisiades consists of old metamorphic rocks. Stanley (1921, p. 89) states: "Practically the whole of the Owen Stanley Range and subordinate ranges, the highland portions of the D'Entrecasteaux Group, and the Louisiade Archipelago, are made up of a huge pre-Cambrian complex, consisting of schists and gneisses both of igneous and aqueous origin, impregnated in parts by dykes of both acid and basic character. Gabbros, granites, and syeno-diorites and undetermined rocks, fine grained in texture, which have become highly metamor-



phosed by puckering and shearing, also occur in the series. Quartzites, thick blue-coloured mountain limestones, apparently devoid of fossils, and highly contorted sedimentary deposits . . . are frequently met with, and probably represent the younger beds of the group." Slates have been reported as prominent on Sudest and Rossel. Volcanic deposits, considered Pleistocene in age, are well represented in the D'Entrecasteaux Group, where there is still strong thermal and solfataral activity in two areas on Fergusson Island. Woodlark Island consists largely of raised coral limestones, presently assigned to the Pleistocene, resting on a base of metamorphic and plutonic rocks. The Trobriands are flat islands of raised coral apparently comparable with the coral limestones of Woodlark.

The geological relationships of some of our islands with the mainland of New Guinea are by no means clear. A recent statement is this: "The main cordillera of New Guinea does not end abruptly at the tip of the Papuan Peninsula, but continues to the south-east in a series of small [*sic*] islands. These fall into two fairly distinct groups—the D'Entrecasteaux Islands and the Louisiade Archipelago. Further north is the Trobriand group and Woodlark Island; these islands are physiographically distinct from the main cordillera" (Langford-Smith, 1951, p. 15).

Before this, Montgomery, Osborne, and Glaessner stated (1944, p. 9): "The Louisiades are a partly submerged extension of the Owen Stanley Range, and the D'Entrecasteaux Islands appear as a parallel range north of the south-eastern spur of the main range."

Earlier, we have the study of Carey (1938): "Flanking the shore for about 300 miles between Morobe and the extreme east cape of Papua, there is an extensive Upper Tertiary geosyncline which appears to be still active, and is still for the most part occupied by the sea. A long, narrow, submarine trough, flanked on either side by island festoons, extends from Goodenough Bay for a further 300 miles in a south-south-easterly direction, and seems to be an extension of this geosynclinal axis. The south side of this trough is an archipelago representing the summits of the drowned New Guinea cordillera. On the north side are the D'Entrecasteaux Group,

the Bonvouloir Islands and the Misima group. Cape Vogel is an uparched zone in the centre of this young geosyncline, which has disclosed an Upper Tertiary thickness of over 14,000 feet." Carey named this great downward flexure of the earth's crust the Vogel Geosyncline.

The three statements are in agreement that the Louisiade Archipelago is a partly drowned continuation of the Owen Stanley Range. Montgomery and his co-authors are vague regarding the relationships of the D'Entrecasteaux Group with the New Guinea mainland, as is Carey for the D'Entrecasteaux, the Bonvouloir Islands, and the Misima Group. Further, Carey does not define his "Misima Group," and Misima is essentially a solitary island, though included geographically in the Louisiade Archipelago. In none of the three sources cited is there any reference to the geological relationships of Rossel, the most easterly large island of the Louisiades.

Carey did not suggest any connection between his Vogel Geosyncline and the Central Intermontane Trough, the great lowland depression of structural origin which lies between the main cordillera and the northern ranges of the New Guinea mainland. The Central Intermontane reaches for about 800 miles from Geelvink Bay in Netherlands New Guinea to the head of the Huon Gulf in the east. From Huon Gulf it is considered to curve east into the Planet Deep (7000 to 9000 fathoms), to the south of the island of New Britain. However, a glance at the map suggests that the Intermontane Trough and the Vogel Geosyncline may be coterminous, for the mountains of the south side of the former continue along the coast of Huon Gulf in a more or less straight line to Morobe, while on the north side of the Vogel Geosyncline the mountains of the D'Entrecasteaux Group, Misima, and Rossel are in alignment with the northern ranges of the mainland.

On the south side of the Vogel Geosyncline, strung out from the mainland, are the Moresby Group of fair-sized mountainous islands up to 1740 feet high; the Engineer Group of small islands up to 600 feet high; the Conflict Group, consisting of an atoll ring of low coral islands; the Deboyne Islands up to 700 feet high; and the Calvados Chain of many ele-

vated islands stretching eastward for over 100 miles and ending in the large island of Sudest, which has 10 summits from 1330 to 2645 feet in height.

Carey would appear to infer that Rossel Island lies on the south side of the geosynclinal trough, although it is more in line with the small Renard Islands, Misima, the Bonvouloir Islands, and the D'Entrecasteaux Group on the north side of the trough. The Admiralty Chart 2764, corrected to 1941 but still very incomplete as regards deeper soundings, shows 280 to 359 fathoms in the 20-mile strait between Rossel and Sudest, and up to 900 fathoms in the 8-mile strait between Misima and Panniet of the Deboyne Islands, a depth also present between Misima and the Calvados Chain. Whatever the situation of Rossel may be, the Louisiade Archipelago, consisting principally of Misima, the Deboyne, the Calvados Chain, and Rossel, should be regarded as two closely parallel lines of islands and reefs separated by the Vogel Geosyncline. Misima and Rossel are very mountainous, rugged islands, the former rising to 3400 feet, as stated above, the latter to 2750 feet. On a field view, the botanical relationships of Rossel would appear to be closer with Sudest than with Misima.

Stanley (1923, p. 51), in a discussion of the tectonics of the New Guinea area, refers to a small virgation of the first Australian arc which (from Cape Ward Hunt, on the mainland, according to Stanley's map) "passes through the D'Entrecasteaux Reefs to the Trobriands, Woodlark Island, and the Laughlans." The central ranges of New Guinea are a feature of the first Australian arc. The Laughlans are a group of small, low islands lying 30 to 40 miles to the east of Woodlark.

Living coral reefs are an outstanding feature of this long-unstable area. They are extensively developed in the Louisiade Archipelago, except in the case of Misima Island, which rises from very deep water all around, has only shore reefs or none at all, and at its southeastern corner the shallow Managun Lagoon enclosed in a fringing reef. Terraced formations of raised coral, up to nearly 1000 feet in thickness, indicate for Misima a series of at least five distinct elevations within

Pleistocene to Recent times (Stanley, 1923, p. 14).

Rossel Island, 20 miles long and as much as 9 miles wide, stands in a coral lagoon within a great reef which extends 9 miles to the east and 25 miles to the west of the land, and comes close to the shore to the north and south. Davis (1928, p. 7), in his study of the coral reefs of the world, chose Rossel Reef as an example of the transformation of a typical barrier reef (east and west) to a typical fringing reef (north and south).

A reef very much larger than the Rossel Reef surrounds the Calvados Chain, including Sudest. This is in the form of a barrier reef which for about 8 miles on the north-central coast of Sudest becomes a fringing reef. The immense lagoon it encloses is about 135 miles in length east and west and about 35 miles in greatest width. The southwestern part of the encircling reef is in the form of a sunken barrier, upon which the sea does not break. Extending westward from the southern line of the Calvados Reef is a long barrier, in part submerged, which is a continuation of the off-shore barrier of the southern New Guinea coast and has a total length of about 400 miles, or over 500 miles if the Calvados Reef is included. There is no comparable line of reef on the north side of the Louisiades, or associated with the D'Entrecasteaux Group or the adjacent north coast of the mainland, although Normanby Island is fronted by a barrier reef 20 miles long off its southeastern coast. Active subsidence is indicated for the south, and elevation for the north.

The earth movements that resulted in the separation of the principal island groups of our area from the New Guinea mainland and from one another are considered to have begun in the late Tertiary and to have reached a maximum in the Pliocene or early Pleistocene.

#### CLIMATE AND WEATHER

Our area is better served than many other parts of New Guinea in having rainfall records for six stations over periods of years long enough to give some understanding of the climate, namely, Samarai, Salamo on the south coast of Fergusson Island, Panesesa in the Conflict Group, Bwagaoia on the south

TABLE 1  
AVERAGE MONTHLY AND ANNUAL RAINFALL (IN INCHES)

	Samarai	Salamo	Panasesa	Bwagaioia	Kulumadau	Losuia
Number of years	29	8	9	10	20	23
January	6.92	8.18	7.88	11.14	14.15	16.16
February	7.33	6.37	5.86	13.37	13.06	14.54
March	10.04	7.94	7.26	10.54	15.05	15.67
April	9.76	7.32	6.34	11.32	13.51	12.55
May	12.01	9.24	4.23	12.22	13.86	12.80
June	11.35	14.39	5.72	8.94	12.28	12.72
July	8.08	7.73	4.18	8.36	15.77	11.85
August	8.61	6.30	5.22	9.66	15.61	13.02
September	10.13	10.10	3.68	8.61	14.19	11.89
October	8.71	10.22	5.41	10.61	13.14	9.75
November	8.40	7.65	6.27	10.40	12.14	12.38
December	5.37	5.57	2.94	8.27	12.25	10.44
Total	106.71	101.01	64.99	123.44	165.01	153.77

coast of Misima, Kulumadau on the south coast of Woodlark Island, and Losuia on the west coast of Kiriwina (see table 1). Records of barometric pressure, temperature, and relative humidity have been kept at Samarai, Bwagaioia, Kulumadau, and Losuia. All the stations are coastal, and close to sea level with the exception of Kulumadau which is at an elevation of 360 feet. No meteorological records exist for the mountains of any of our islands, and no published records have been found for any part of Normanby Island, Sudest, or Rossel. On Normanby, rainfall has been recorded since June, 1955, at Waikaiuna on the west coast, and no doubt there are records for Esa'ala Government Station, established on the northeast coast in 1946. At Jinju, on the northeast coast of Rossel, rainfall records have been kept by the Mission of the Sacred Heart since July, 1956.

In a general survey of climatic conditions in Papua-New Guinea, Hounam (1951) gives an excellent outline, but in his rainfall map takes cognizance only of records up to the year 1937, and his text gives no indication that in the study that supported it he used records of later date. The statistical data cited here are drawn from Hounam.

Our area, between 8° and 12° south of the Equator, has no summer or winter, although appreciable seasonal variations in temperature do occur. "The principal climatic varia-

tion is that of the windstream and its associated effects on seasonal rainfall" (Hounam, *op. cit.*, p. 35).

Broadly speaking, the year is divided into two seasons: the season of the southeast trade winds, extending on the average from about early May to the end of October, and that of the northwest monsoon, from after the middle of December through March. In a typical season the southeast trades blow almost continuously and on the coasts, especially during the heat of the day, attain considerable force. The northwest monsoon does not blow steadily. Between the seasons are doldrum periods of a few weeks, with light, fitful, and variable winds, often oppressive heat and humidity because of the lack of wind, local thunderstorms, and brief resurgences and precursory movements of the southeast trades and the northwest winds. Air movements and rain can come from almost any direction in the doldrum periods.

We saw all the changes of season on our expedition. In Samarai in 1956 the northwest monsoon ended about April 3; the first day of southeast wind was on April 7. But in this western part of our area the trades did not begin to blow with any steadiness until May 18 (we were on Fergusson Island then), which was unusually late. On Rossel the strong southeast winds ended and the doldrums began in the first week of October, at which time

a tidal change took place within the barrier reef. The rains of the next northwest season began in Samarai on January 1, ending a dry spell of several weeks and a water shortage relieved for some establishments by supplies brought from a stream on the mainland in drums and tanks on small ships. The town had only one small ground-water well and depended mainly on rain caught from roofs.

The Rossel Lagoon, we were informed by the Osborne brothers, has two tides a day, both of small range and one with barely perceptible rise and fall. During the southeast season the highest tides occur invariably at night, while in the remainder of the year the day tides are the highest.

In the hottest part of the year, December through March, coinciding with the northwest season, average daily maximum temperature is 90.7° to 92.1°, average minimum 75.1° to 76.5° F. at Samarai; average maximum 88.5° to 89.5°, average minimum 73.1° to 74.0° at Losuia. The coolest weather is in August, and for June through September average daily maximum is 83.4° to 85.3°, average minimum 72.5° to 73.8° at Samarai; average maximum 83.3° to 85.4°, average minimum 72.8° to 73.6° at Losuia.

Hounam has pointed out that diurnal changes in temperature and humidity are far greater than seasonal changes and that minimum temperatures vary less from month to month than maximum temperatures. These features of the climate are well illustrated in the monthly means. At Samarai the greatest diurnal variation is 16.6° in February, the smallest 10.0° in August, while variation in monthly maxima over the year is 8.7° and in monthly minima 4.0°. At Losuia, diurnal variation ranges from 15.5° in February and December to 10.3° in July, while change in monthly maxima over the year is 6.0° and in monthly minima only 1.4°. The monthly mean of 9 A.M. relative humidity at Samarai ranges from a high of 84 per cent in June to a low of 75 per cent in January; at Losuia the high is 83 per cent in February, May, and June, the low 76 per cent in November.

On the evidence of the slight seasonal variation in temperature and humidity, it has been held that seasonal changes mean little in living comfort in these parts. With this I

cannot agree. The southeast season is much less trying than the northwest, owing in part to actual temperature differences but more to the evaporative effects of the trade winds in reducing heat stress upon the human body.

The rainfall records support the principle (Brass, 1956, p. 90) that it is chiefly the southeast season that controls the climate in this area, or region. The northwest monsoons bring enough rain to all the islands for the support of a rain-forest vegetation and the requirements of crops. It is the scarcity or abundance of rains in the southeast season that makes a local climate dry or wet in terms of annual precipitation.

The monthly and annual averages do not show that rainfall may vary considerably from year to year and that droughts occur at times even in heavy rainfall areas. Severe droughts, with attendant crop failures and serious food shortages, occurred on parts of Fergusson Island and Goodenough Island in 1900 and 1912. The Trobriands were hard hit by drought and semi-famine in 1902, 1911, and 1914. Lesser abnormal dry spells are by no means uncommon. The latter part of 1956 was such a period, and in that year the coconut plantations of several areas experienced decreased yields owing to low rainfall in 1955.

Hounam continues a fallacy, long current (Smith, 1912, p. 16), that New Guinea is outside the hurricane belt of the Southern Hemisphere. In a previous report (1956, p. 91) I have mentioned a hurricane which struck Fergusson Island and Milne Bay in December, 1898, and another that battered parts of the Louisiade Archipelago in April, 1952. Effects of the latter were apparent in downed timber on Misima in 1956, and recollections of it remained vivid in the minds of the people. These would appear to be the only hurricanes on record for our area.

## HISTORY

The first Europeans to sight the shores of our area appear to have been the company of Louis Vaez de Torres, in the Spanish frigate "Almiranta" coming from the newly discovered New Hebrides in July, 1606. Having lost contact with his commander, Pedro Fernandez de Quiros, in the "Capitana," Torres sailed westward. In latitude 11° 30' S., he came



upon what he called the "beginning of New Guinea," which appears to have been a part of the Louisiades. Unable to weather the easternmost point of this land (Cape Deliverance of Bougainville), he bore away westward along its southern shores and the south coast of the mainland and, passing through what is now called Torres Strait between Australia and New Guinea, eventually reached Manila (Burney, 1806). Important particulars of Torres' voyage, including the discovery of Torres Strait, were kept secret, and not until 1878 was a full report published in Madrid (Zaragoza, 1878), together with four colored maps drawn by Diego de Prado y Tovar, an officer of Torres' (Coello, 1878). From one of these maps, dated July 18, 1606, it is evident that Torres, on discovery bent, made his way through Rocky Pass (his Boca de la Batalla), between Sideia and Sariba Islands of modern maps, examined Jenkins Bay, and looked into Milne Bay, in a land he named Tierra Sanbuenaventura. Another map, titled "La gran baya de San Lorenzo y Puerto de Monterey," and dated August 10, 1606, is undoubtedly of today's Orangerie Bay, Puerto de Monterey being the inner harbor behind Bona Bona Island of recent maps.

The next European navigator to appear was Louis Antoine de Bougainville, in June, 1768, with the frigate "La Boudeuse" and supply ship "L'Etoile," 19 months out of France on a voyage around the world and seriously short of provisions. Encountering the south coast of the mainland at Orangerie Bay, which, in ignorance of Torres' visit, he named (Cul de Sac de l'Orangerie), Bougainville tediously worked his way to windward and in 10 days rounded his Cape Deliverance. To the 320-mile space traversed between Orangerie Bay and Cape Deliverance on Rossel Island, Bougainville gave the name Golfe de la Louisiade.

The northern parts of what came to be called the Louisiade Archipelago remained unknown to Europeans until June, 1793, when Bruny-d'Entrecasteaux, with two frigates, "La Recherche" and "L'Espérance," on a voyage in search of the lost La Pérouse, made a landfall on Rossel Island (named for the then second in command of "La Recherche"). Passing to the north of Ros-

sel, clear of the barrier reef, D'Entrecasteaux named the "Îles du Sud-est," Piron Island, Renard Islands, St. Aignan (Misima), the Deboyne, and other islands. At the Bonvouloir Group communication was had with the natives, who came off in a very big canoe and exchanged sweet potatoes and bananas for various presents. From there the expedition went on to discover the D'Entrecasteaux and Trobriand groups of islands. Running surveys were made to place the near coasts of the discoveries on the chart, and no landing took place. D'Entrecasteaux was ill with scurvy. He died about a month later off the north coast of New Guinea (Rossel, 1808, vol. 1; Beauteemps-Beaupré, 1807).

In 1804, Ruault-Coutance, commanding the French privateer "L'Adèle," entered our area and small Adele (Loa) Island, on the Rossel barrier reef and the easternmost island of the Louisiades, bears the name of his ship. "Mr. Bristow, the master of an English merchant vessel, visited the northern part of the Louisiade Archipelago in 1806, but added nothing of consequence to our knowledge, although various islands were named anew, as if discoveries of his own" (Macgillivray, 1852, vol. 1, pp. 175-176). Woodlark Island was discovered in 1836 or earlier by Captain Grimes of the ship "Woodlark" out of Sydney and the Marshall Bennett Islands in 1836 by Captain Robert L. Hunter of the whaler "Marshall Bennett" (Hunter, 1840).

In May, 1840, a third distinguished French navigator, J. S. C. Dumont d'Urville, visited this area on his second voyage around the world. With the corvettes "L'Astrolabe" and "La Zélée" Dumont d'Urville rounded Cape Deliverance from the east and steered for the island of Sudest. Prevented from near approach by the immense barrier reef, which in thick weather was thought to be continuous with the Rossel reef, the ships proceeded westward, coming in close by day and standing off to sea for safety at night. In five days a running survey was made of islands and coasts which Bougainville had sighted, and a number of features were named, including the Calvados Chain, Lejeune, Teste (Wari), and the Dumoulin Islands. No landing was made, and only once did close approach to the natives take place. This was in Orangerie

Bay, where presents, held out on a plank, were exchanged for coconuts, a stone axe, and some shells.<sup>1</sup>

In 1849 the first detailed nautical surveys were carried out. On June 11 of that year, from a rendezvous off Cape Deliverance, Captain Owen Stanley, commanding the British survey ship "Rattlesnake" and her tender, the schooner "Bramble" (Lieutenant C. B. Yule), began work which, in our area, terminated in Orangerie Bay on the following September 9. Passing along the north coast of Rossel Island and of Piron Island, on June 14 they entered the Calvados barrier reef through Bramble Pass and anchored in Coral Haven. Two days later, the first recorded landing of Europeans in the Louisiades was made on Pig (Nimoa) Island. On a subsequent landing there a threat of hostilities developed, and in a hasty retreat down a steep slope to the boat, carrying a purchased pig on their shoulders, Assistant Surgeon Thomas Huxley, of later fame as a biologist-philosopher, and Marine Artist Brierly "speedily reached the bottom, all three rolling down together" (Macgillivray, *tom. cit.*, p. 194).

After taking on water from Watering Creek on the northwest coast of Sudest, the "Rattlesnake" proceeded to six other anchorages in the Louisiades, the first at Brierly Island, the last at the Duchâteau Islands. Surveys were made from the ship's boats and, farther off, by the very competent Lieutenant Yule in the "Bramble." In these extensive operations the only act of positive hostility by natives occurred when the pinnacle and galley were the object of a dawn attack while anchored close to the south coast of Joannet Island.

Vacating the Duchâteau anchorage on August 4, the "Rattlesnake" passed out to sea and, without anchoring, made traverses off and on the line of barrier reefs that extends westwards from the Louisiades, while the "Bramble" worked inside the reefs. This continued, in often uncomfortable southeast weather, until August 17, when the ship came in on the "Bramble's" signals and anchored in the lee of the largest of the Brumer Islands. Only brief landings were made in 13 days

spent here; no landings during five days at anchor off Dufaure (Bona Bona) Island in Orangerie Bay. Later, after surveys in Torres Strait and parts of the south coast of New Guinea, the "Rattlesnake" returned to the Duchâteau Islands to obtain a meridian distance and anchored there January 6 to 8, 1850.

Stanley had instructions to see that every precaution be taken to avoid conflict with the natives. Huxley considered him timid in the execution of his duties (Huxley, 1936, p. 129). At any rate, few landings were made on the islands, and none was made on the New Guinea mainland, though a brisk trade took place with natives who came off in canoes. In exchange for garden produce, artifacts, and occasional natural history specimens, the natives were especially eager to have axes and knives, and pieces of hoop iron with which to substitute the stone heads of their adzes.

Under suitable circumstances Macgillivray, naturalist on the "Rattlesnake," gave out "useful seeds," unspecified, but he deplored having to plant them "chiefly on uninhabited islands, there seldom having been an opportunity of distributing them among the natives of the shores we visited." The seeds were obtained by Stanley from the government gardens at "Hobart Town," Tasmania. Hobart has a temperate climate, and it was not a base for tropical exploration. Macgillivray, as Lord Derby's naturalist<sup>2</sup> on the survey ship "Fly," knew something of tropical Australia and New Guinea. Therefore, in view of current interest in the history of the introduction of crops into the New Guinea area, one might speculate as to what seeds probably available in Hobart Macgillivray would have thought worth planting. Pumpkins, watermelons, cucumbers, tobacco, and maize would appear likely choices on present knowledge.

Dumont d'Urville had failed in an attempt to find a passage for ships between the New Guinea mainland and the Louisiades or, for that matter, to determine where the mainland ended and the islands began. Torres before him had penetrated only the first

<sup>1</sup> Unless otherwise stated, the above account of French voyages is based on Macgillivray (1852), with additions from original sources.

<sup>2</sup> J. Beete Jukes (1847) was the official naturalist of the expedition.

obstacles. Lieutenant Yule in the "Bramble" carried observations in this direction, but the "S.E. Cape of New Guinea" of Macgillivray's chart illustrating the voyage of the "Rattlesnake" is too far to the east and seems to be a part of Basilaki Island. The southeastern extremity of the mainland remained unknown, and no passage through the very numerous islands and reefs to the east of it was found until 1873, when Captain John Moresby in "H.M.S. Basilisk," a paddlewheel steamer of 1031 tons, conducted surveys during which China Strait was discovered and the accurate charting of Milne Bay and East Cape was begun. Returning in February, 1874, Moresby spent over two months in surveys in our area (which led to the publication of Torres' discoveries in Madrid in 1878) before proceeding to chart the then unknown northeast coast of the mainland between East Cape and Huon Gulf. The Engineer Group, and Moresby (Basilaki), Basilisk (Sideia), and Hayter (Sariba) Islands were delineated and named. What was claimed as the first landing of Europeans in the D'Entrecasteaux Group took place on Cape Ventenat at the southern end of Normanby Island on March 4. With a steam pinnacle towing a whaleboat laden with coal, Moresby, with a party of eight, later started west from Dawson Strait and in about a week laid down some 90 miles of the coasts of Fergusson and Goodenough islands. He named the main islands of this group (Normanby, Fergusson, Goodenough), the straits between them (Dawson, Moresby), and the straits between the islands and the mainland (Goschen, Ward Hunt). Good relations with the natives were maintained in close contacts throughout the area (Moresby, 1876).

Twenty-six years before the discoveries of Moresby and two years before Stanley in the Louisiades, when most of our area was still blank on the charts, the first European settlement took place. On September 15, 1847, a group of French Marists, consisting of Bishop Collomb of Antiphalles, Fathers Montrouzier, Frémont, and Thomassin, and apparently several lay brothers, arrived in the mission ship "Anonyme" at Guasopa, Woodlark Island, to form a mission. Father Villien came in the following April, and soon afterwards left with the Bishop, Father Frémont,

and Brother Optat to found a second station on Rook (Umboi) Island off the west end of New Britain (Montrouzier, 1850). In October, 1852, the Marists handed over their two stations to Italian missionaries, Father Thomassin giving instruction to the priests Carlo Salerio and Timoléon Raimondi, and catechist Louis Sacchini at Guasopa, while Father Frémont conducted Father Superior Reina to Rook Island, where Bishop Collomb and Father Villien had died (Reina, 1853). The Italian mission on Woodlark came to an end, according to one account, by the departure of the missionaries, according to another, by their massacre in 1855 (Murray, 1912). MacGregor (1892), on a visit to Guasopa in 1890, found no recollection of the Italian mission, but the natives remembered the Marists and could give their names. When asked if he knew the language of the Marists, a chief promptly replied, "*Travaillez comme ça.*"

In view of the fact that whalers had been coming into the area for some years, it is not surprising to note from Montrouzier that the numerous natives of Guasopa at once entered freely into trade, demanding especially hatchets and bits of iron. Some spoke a few English words! Macgillivray, as official historian of the "Rattlesnake" after the death of Stanley, gave the impression that the natives they met with had not had contact with white men before. But often the trade with the "Rattlesnake" seemed so spontaneous as to suggest that it was not a new experience for the natives. It is even probable that whalers had been there before the "Rattlesnake," although Macgillivray (1852, vol. 2, p. 68), in referring to whales seen on their voyage, remarked, "Whalers will no doubt find it worth their while—with the characteristic enterprise of their class—to push into these parts of the Coral Sea now first thrown open to them." There was then a well-established whaling industry in Australian ports.

Also preceding the first establishment of government but probably none of them to be considered as settlers or residents, was a sprinkling of adventurous, and by all accounts often not very ethical, British, French, Greek, Chinese, Filipino, Malay, and other traders, trepangers, and seekers of pearls and other primary products, who came in small

ships and in some cases set up stations ashore. In the later stages of the "blackbirding" of South Sea labor for the sugar plantations of Queensland, in about the 1870's and early 1880's recruiters visited our islands, especially, it would seem, the Louisiades, but also the D'Entrecasteaux, some of the small islands, and the mainland. The evils of the traffic led to the retaliatory killing of often quite innocent white men on the coasts.

In December, 1877, the Rev. James Chalmers of the London Missionary Society, having landed Polynesian teachers on Teste Island and East Cape, established headquarters on Suau (Stacey) Island, close to the south coast of the mainland, in the South Cape area (Chalmers and Gill, 1885). It might be mentioned, parenthetically, that this was the only Christian mission in our territory until 1891, when the Wesleyans set up headquarters on Dobu (Goulvain) Island in the D'Entrecasteaux Group. The London Missionary Society was centered on the mainland, and its activities touched only slightly on the nearer islands.

After eastern New Guinea, or parts of it, had thrice been taken possession of for Britain in actions which the Foreign Office refused to ratify, a British protectorate over what is now the Territory of Papua was proclaimed at Port Moresby by Commodore J. E. Erskine on November 6, 1884. The initial administration, vested in a Special Commissioner, was ship-based. It is recorded that at the end of 1885 the only government residence in the protectorate was a two-roomed house built at Port Moresby by Sir Peter Scratchley, the first Special Commissioner, who died of malaria less than four months after taking up his duties in New Guinea. Sir Peter was a wise and liberal man whose philosophy of government, in relation to natives' rights, helped to lay the foundation for the policies of a succession of administrators in whom, for the most part, Papua can take just pride. His very small administrative complement did not, however, include a police force. Policing then and for several subsequent years was done by naval vessels—instruments that combined "the least amount of efficiency with the greatest display of force." During Scratchley's term of office, for example, all the villages of Hoop-iron

Bay, Basilaki Island, were burned by "H.M.S. Diamond" as punishment for the murder of the captain and carpenter of the schooner "Lalla Rookh" (Fort, 1886, for the most part).

In 1887, the worst of rather many incidents of the kind took place. At Joannet Island, where the boats of the "Rattlesnake" had been attacked nearly 40 years before, Captain Craig of the Schooner "Emily," two other white men, and five Malays were murdered, and their vessel was seized, plundered, and burned. Again the "H.M.S. Diamond" retaliated with the firestick and the killing of a few people who could not get away (Murray, *op. cit.*, pp. 78-79). But in this turbulent period plans were made, early in 1888, for the establishment in our area of Samarai Government Station on 59-acre Dinner Island, beautifully situated in China Strait and already a recognized anchorage and a trading station.

Government was eventually brought ashore by Dr. (later Sir) William MacGregor, who on September 4, 1888, formally annexed British New Guinea as a possession and became its first Administrator. On a meager budget of £22,000 a year, of which a substantial part went to maintain a 260-ton steam yacht, the "Merrie England," for visits of inspection and communication with outposts of government, MacGregor embarked upon a program of exploration, pacification, and solid administrative progress which was to continue for a decade. For a time he was obliged to follow the methods of those who preceded him. In 1890, however, he created a force of armed constabulary, mainly of Fijians and Solomon Islanders at first, but gradually becoming a purely native force, under a European commandant. In 1892 a beginning was made in the appointment of village constables as a substitute for the tribal chiefs who in most parts of Papua do not exist or at least have little authority over their people.

Almost coincident with the annexation, payable alluvial gold was discovered on Sudest Island, and a rush of over 300 men set in from Australia. In October, 1888, good gold was found on Misima, and as many as 500 miners were on the ground in the following few months. A justice of the peace, with-

out police or means of transportation, was posted on Sudest early in the gold-rush period. The whole of the Louisiade Archipelago was declared a gold field on May 28, 1889, and about that time the government establishment was moved to Siagara on the north coast of Misima and soon to Bugoya (Bwagaoia) on the southeast coast. By mid-1890, however, most of the payable alluvial had been worked out, and in 1892 the headquarters of what about that time became the South-Eastern Division, in charge of a Resident Magistrate, were moved to small Nivani Island in the Deboyne Group. "Bugoya does not seem to be a healthy place, and suffers from a perennial plague of sandflies, which makes life there miserable"; no planting ground was procurable, and it was difficult for a sailing vessel to get out of the narrow harbor in the southeast season (MacGregor, 1893). It may be remarked in passing that modern drugs have greatly improved the health situation at Bwagaoia and everywhere else in lowland New Guinea, but Bwagaoia still has a bad reputation for sand flies, as indeed do many parts of the Louisiades.

In June, 1895, rich gold, again alluvial, was discovered on Woodlark Island, the inevitable rush set in, and at the peak of it about 500 men were on the field. Woodlark continued to hold a fair number of men, until a new rush, to the Gira (Mambare) field on the mainland, began in 1898. As an illustration of the vicissitudes of alluvial mining, the number of white diggers at June 30, 1899, had fallen to 62 on Woodlark, 16 on Misima, and none on Sudest. Gold was being won in small quantity on all three islands by local natives who had learned the techniques and could work ground too poor to support a white man.

Early reefing operations had failed on Sudest. They were successful on Woodlark, where, at Kulumadau, the first crushing mill started work in 1901, and mines in several localities, of which Kulumadau was the most important, produced much gold, some of it very rich, until war-time 1918, when activities fell to a low ebb. Brief revivals took place in 1920 and 1930, but by that time Misima had assumed first place in reef mining. There, several gold-bearing lodes had attracted attention about 1904, but little was done on

them until 1914, when a strong company began extensive development and construction work at Umuna in the mountains. Production began about 1916, on good ore, but owing to high costs the mine closed down in 1922. The most important of several lode propositions on Misima, Umuna, was not idle for long. Reopened by new owners about 1924, it became an enormously profitable producer which remained in operation until, in the Second World War, the Japanese advance into the Southwest Pacific compelled its abandonment in 1942.

Meanwhile, in this, the most active and prosperous phase of the short history of our area, headquarters for the South-Eastern Division were moved from Nivani to Woodlark in 1901 and back to Bwagaoia in 1920.

Reverting to 1888 and the year or two following, MacGregor, in an effort to keep ahead of eager prospectors for gold and to foster the enterprise and afford it protection by government, made rapid and very discerning examinations of all the principal islands and the parts of the mainland with which we are concerned; mapping unknown or only partially known coasts, crossing or going far into the larger islands, and furnishing, in his annual reports and the appended reports of his few officers, most of the record of events extant for those times and most of the first published impressions and descriptions of this part of the New Guinea area.<sup>1</sup>

The influx on Sudest, Misima, and Woodlark of large numbers of white men, for the most part honorable in the highest frontier tradition, but rugged and disinclined to stand any nonsense, must have had a tranquilizing effect upon the native populations. Virtually the only records of this impact are from the government side. It is reported of Sudest that, although in the early gold-rush days there were many robberies of unguarded miners' camps, only one miner was killed by the natives. The mining invasion, it was evident, came as a godsend to the people of the island, who, though cannibals and engaged

<sup>1</sup> Unless otherwise acknowledged, the bulk of the information in this section, from post-annexation 1888 onward, is from the official annual reports, first of British New Guinea, later of the Territory of Papua, too numerous and complexly drawn upon to be cited in detail.



in internal warfare, were essentially an inoffensive and timid lot, subject to raids by the Calvados Islanders, particularly the piratical seafarers of Brooker (Urban) Island, who robbed the food gardens and carried off Sudest people for their own cannibal feasts. An early effect of the protection afforded by miners and government was the movement of nearly all villages from positions in the hills down to or close to the coast. Most of the gardens still remain in the hills, for the reason that new forest land is available there, while in coastal locations much of the land formerly cultivated has gone to grass.

On Misima a different situation obtained. The more numerous, more energetic, and industrious natives there would appear to have had proper respect for the miners and to have behaved well towards them, except for outbreaks of stealing from camps. But in their own affairs, especially on the north coast, they were a most savage and unruly people who at one time had MacGregor almost in despair in his efforts to bring them under control. The terrain was difficult, and government forces were small. But through the good work of officers, the influence of men appointed as village policemen, and apparently something in the nature of a sharp lesson or two, MacGregor was able to say in his report for 1896-1897, "The tribes of Misima . . . are now so completely pacified that only petty breaches of Native Regulations have to be dealt with there."

On Woodlark, besides the very early settlement of Catholic missionaries, there had been before the discovery of gold an establishment ashore of white traders, at least two of whom were killed by the natives, and in this connection and in measures to curb particularly turbulent sections of the population, several police expeditions were necessary. The miners had little trouble, however, and in their time and since then the natives seem to have been noted chiefly for their extraordinary laziness. At one stage they even had to be stimulated by the government into growing adequate food for their own use.

The exploitation of minerals has not amounted to much on any of the other islands, and no mining of any kind has taken place on Rossel or in the Trobriands. Gold is known to occur on all the principal islands

except Kiriwina, but, leaving Sudest, Misima, and Woodlark out of the discussion, only on Normanby has gold been worked payably, and that on a very small scale. No other mineral has been mined as a profitable export product, although copper was worked on Woodlark years ago and is known on Misima and Sideia, and, beginning about 1898, trial shipments of sulphur were made at intervals from the Seymour Bay thermal area on Fergusson Island.

Rossel Island, in its far eastern position, has been a graveyard for ships, and because of its remoteness it has been less visited than the other islands. Sailing vessels had hard slogging to reach it from Samarai in the southeast season, and in the small, powered vessels of today the voyage can be very uncomfortable, even risky, at that time of the year. The only outside contacts the Rossel people had before the establishment of European influence were with Sudest, with which they traded principally shell money<sup>1</sup> for clay cooking pots and parrots (see p. 51). Noted as stranglers and smotherers rather than fighting men, the Rossel Islanders had an evil reputation. This to some extent was due to the story of the three-masted ship "St. Paul," wrecked in 1858 at Heron Islet on the barrier reef, with 327 Chinese passengers aboard, all but one of whom were reported killed and eaten in the four months that elapsed before the arrival of a rescue ship. MacGregor (1894, pp. 5-7), holding that "There is no tribe on the island that could not be conquered by fifty Chinese armed with stones, which abound everywhere," discredited the story. Others, upon inquiry, became satisfied as to its truth (Murray, 1912, 132-133; Armstrong, 1928). An event that was to have much beneficial influence on the islanders took place in 1903, when a coconut planting and trading business was established by Frank Osborne, first of a family that has been on the island continuously since that time, except for a period during the Second World War. Still, a final settling down to peaceful

<sup>1</sup> Rossel Island, and Vakuta in the Trobriands, were the chief places of manufacture in this area of the shell money commonly called "*sapi-sapi*" (*bau* on Rossel), made from the shells of a *Chama* species (identification by Dr. William K. Emerson, the American Museum of Natural History).

ways would seem not to have taken place on Rossel until some time after 1912.

Kiriwina, with a numerous population, is noted for its rich garden lands, the industry of its cheerful, friendly, but unstable people in producing crops, and women free with their favors. It is extraordinary in this part of the world in having chiefs of real power and above them a paramount chief. The island early became a place of refreshment for whaling ships such as the "Marshall Bennett" which in 1836 called at Cape Denis on the north end of the island, and on this or another visit about that time bought 12 boatloads of fine yams for four bundles of hoop iron (Hunter, 1839). Government authority was introduced here in 1891, when MacGregor landed from the "Merrie England" and walked over much of the island without opposition. An export then existed in yams and *beche-de-mer*. In 1893 began an important new industry in pearls from the small lapi-lapi oyster (*Pinctada vulgaris*), at first in the hands of a low type of Greek and Manila-man. A Wesleyan mission, opened in 1894, met opposition from the traders, under whose influence, it would seem, the natives soon became so threatening that a government patrol was sent through the island to gather and destroy all the weapons it could find. In 1899 the paramount chief, Enamakala, who had been made government chief, was deposed in an almost bloodless revolt, and a police party, landed to settle the affair, fell into an ambush which resulted in some wounded attackers, but no lives lost. A consequence of early associations with men on ships was a high incidence of venereal diseases. The first government establishment therefore was a hospital, opened at Losuia in 1905, in charge of a medical officer with magisterial powers to enforce treatment, but so changed was Kiriwina by then that only local village constables were needed to enforce these powers.

The D'Entrecasteaux Group has always been in a backwash as regards commercial development. Even after 1906, when British New Guinea became the Territory of Papua and a liberalization of the land laws resulted in somewhat of a boom in coconut planting, few plantations were established in the D'Entrecasteaux. The rather numerous popula-

tion early became an important source of indentured labor for other parts of the Territory, first for mining, later for plantations and any other work that offered. In some parts of the D'Entrecasteaux the natives were not readily brought under government control, and until about 1920 the Galia and Ebadidi tribes of the interior of Fergusson Island were permanently at war with each other. When, in 1927, a police post was established at Mapamoiwa, on the southwest coast of Fergusson, its chief purpose was to encourage the planting of coconuts as a native cash crop and increase the production of garden foods. The post subsequently became a native hospital.

Missionary influence was conspicuously absent in the pioneer period of all the gold-fields islands. In 1891, however, the Wesleyan Mission set up general headquarters on Dobu Island (see p. 18) and later in the year a station for the Louisiades on Panaeti in the Deboyne Group, both in charge of European missionaries and with South Sea Islander teachers on outstations. On Dobu, a small volcanic island, lived a strong seafaring community of exceptional ferocity, who, as raiders and cannibals said to have drunk the blood of their victims, were the scourge of the coasts of a large area. Within a year, under the influence of the Rev. W. E. Bromilow and the watchful eye of MacGregor, the Dobu raiders had so far reformed that they gave up carrying arms. Non-European teachers were sent to Misima in 1892. The beginnings on Kiriwina in 1894 are referred to above. A start would appear to have been made on Woodlark in 1901. It is stated in the Annual Report for 1918-1919 that "Sudest and Rossel are still without a missionary." In 1925 a very good hospital was opened by the Methodist (Wesleyan) Mission at Salamo on Fergusson Island, and this station became headquarters for the mission.

The Second World War brought complete disruption of commercial activities in our area, also the closure of the missions except as they could be kept functioning by Polynesian, Fijian, and native teachers who remained when, with the southward advance of the Japanese, nearly all non-combatant Europeans were evacuated to Australia. The

civil administration was withdrawn, and government taken over by ANGAU (Australian New Guinea Administrative Unit), which exercised both military and civil authority. At Nivani in the Deboyne Lagoon, the Japanese in their first strike towards Australia had a seaplane base, and they concentrated ships there before the great Battle of the Coral Sea which was fought off the Louisiades, in part within sight of Misima, in May, 1942. In August, the Japanese were defeated in an attack on Allied installations in Milne Bay which afterwards were expanded into a very important base for land, air, and naval forces. Military staging bases, including airfields, were built in 1943 at Vivigani on Goodenough Island and Guasopa on Woodlark, and an air installation on Kiriwina. Among minor events, much of Samarai was burned under a "scorched earth" manifesto early in the war. Military action, except for occasional air raids on bases, ceased early in our area. But men of the islands were drawn on heavily for compulsory service in labor units, and a few served as volunteer jungle fighters against the Japanese.

In 1956 we found rebuilt in Samarai most of what had been destroyed in the war, but still the town lacked a hotel, where formerly there had been two. Elsewhere, varying amounts of money and effort had been put into the reconditioning of coconut plantations abandoned before the advance of the Japanese and not reopened until towards the end of 1945 at the earliest. The last remnants of the old military dumps in Milne Bay, and what could be salvaged piecemeal from the bush, were being shipped to Japan as scrap metal.

A brief post-war revival of large-scale lode mining on Misima had ended, and only two white men were working gold, quite profitably, on the island. On Sudest, where two white men were planting and trading, natives proclaimed the existence of "plenty gold" which they would not bother to work because of the unattractive price being offered for it and their ability to earn good money by diving for high-priced blacklip pearl shell (*Pinctada margaritifera*) and trochus shell (*Trochus niloticus*) on the coral reefs that surround the island. On Rossel, a younger generation of the pioneer Osborne

family (see p. 20) showed great energy in the rehabilitation of their interests. On Woodlark, Reginald C. Neate and his son Donald owned or operated most of the rather extensive old coconut plantings, were working the mullock dump of the long-abandoned Kulumadau Mine, and prospecting for cooper. From the Trobriands came substantial shipments of copra, also wood carvings for the tourist and primitive art trades, the pearling industry, based on pearls and not the mother shell, having faded into insignificance after the appearance of cultivated pearls on the market. On Normanby the few coconut plantations had been brought back into production, and at Waikaiuna on the west coast a sawmill put into a rich new timber area (see p. 40). The only post-war development of note on Fergusson seemed to have been a vigorous outbreak of the form of social unrest known as "cargo cult," centered at Basima on the northeast coast and promptly dealt with officially.

The post-war government administrative stations for our parts of the Milne Bay District are enumerated on page 9, with the exception of Esa'ala on the northeast coast of Normanby Island. An agricultural extension school for natives, giving special emphasis to rice and coffee culture, was in operation at Kuaro on the mainland opposite Samarai. Another post-war development, organized and directed by government, operated on the village level by natives, and anathematized by the regular traders, was native cooperatives, then confined to Milne Bay and vicinity and Misima, but with a trading vessel active in picking up copra and shell over a wide area in the Louisiades.

In the mission field, the Methodist (originally Wesleyan) Mission was fast losing ground to the Mission of the Sacred Heart, which came in after the war<sup>1</sup> and set up headquarters on Sideia Island, near Samarai. In 1956 the Methodists still had numerous non-white teachers at stations in the outer islands but no European missionary east of

<sup>1</sup> Formerly, by agreement at least on the part of the Protestant denominations, the country was divided into specified working areas to prevent overlapping and confusion in the native mind by exposure to conflicting doctrine and practice.

the D'Entrecasteaux Group. In addition to the stations enumerated on page 9, the Mission of the Sacred Heart had others in various stages of development and in charge of white priests in Milne Bay, Sewa Bay on Normanby, Budoia on Fergusson, and Wataluma on Goodenough Island.

It seems correct to say of the native population that the more deleterious effects of the war had in substantial measure worn off. There had been a return to the normal ways of family and village life which events of the war had badly disrupted through the long absence of a high proportion of the able-bodied men or, in a few areas, the mass evacuation and refugee-camp accommodation

of entire communities from the vicinity of military bases. In the islands we had contacts with rather numerous men who had served in the war, and, with rare exceptions, their attitudes were good. The few examples of insolence were exhibited by types from whom such behavior might have been expected in any case, and the only occurrences were in the Sewa Bay area on Normanby and the Iamelele district on Fergusson. What appear to be the great, lasting changes in the lives of the people are the beneficial, still-unfolding ones that followed upon the replacement by the white man of their stone tools with steel and the abolition of retaliatory murder and intertribal warfare.

## PREVIOUS COLLECTIONS

THE NEW GUINEA MAINLAND, on which we made only minor collections in 1956, is excluded from the geographical coverage of this section. Reference to previous collections from the east end of the mainland and from Goodenough Island, and some remarks of a general nature on the history of biological collecting in Papua, appear in an earlier report (Brass, 1956).

What would appear to have been the first biological work in our area, at least on the land, was begun on Woodlark Island in 1847 and continued to 1852 by Père Montrouzier, one of the early Marist missionaries (see p. 17), who collected and later reported upon (Montrouzier, 1855, 1856a, 1856b) a large number of insects, also many fishes and a few mollusks.

Aboard the survey ship "Rattlesnake" in 1849–1850 were John Macgillivray, naturalist, and Thomas Huxley, officially assistant surgeon. According to Forbes (1852, p. 381), the ship's surgeon, Dr. Thomson, was "an excellent botanist." Huxley paid close attention to the study of mollusks and coelenterates. Macgillivray's interests lay especially in geology and general zoology. His account of the voyage (1852) contains, as appendices, vocabularies made at Brierly Island and the Brumer Islands, and reports on Polyzoa and sertularian zoophytes, mollusks, birds, and a few new species of butterflies and crustaceans, but most of this material is Australian. Other zoological collections of the voyage were published in various catalogues of the British Museum. I cannot learn of any botanical collections made by Thomson, but at Kew<sup>1</sup> there is a list of 28 numbers of plants (444–471) collected by Macgillivray on Pig Island and at the watering place at latitude 11°23' S. and longitude 153°20' E. on "Southeast Island" in the Louisiades.

The next collections in chronological sequence appear to have been those of Dr. Peter Comrie, surgeon of the "Basilisk" in 1874, who collected insects, and a few mammals, birds, reptiles, and land shells, mainly in the Huon Gulf, but some also in the

D'Entrecasteaux and other islands in our area (Comrie, 1876).

Andrew Goldie, a collector of living plants for S. B. Williams of London and of herbarium material for Ferdinand von Mueller of Melbourne,<sup>2</sup> and also a well-known zoological collector, especially of birds, visited the Louisiades and Teste Island in 1878 and western parts of Normanby and Fergusson Islands in 1882. He was accompanied on the latter islands by Carl Hunstein, another general collector, who from this trip sent birds to E. P. Ramsay in Sydney. Goldie's birds from the D'Entrecasteaux went to Osbert Salvin and F. DuCane Godman in London. The collections were not properly labeled, and some islands birds were ascribed to southeast New Guinea (Sharpe, 1883; Rothschild and Hartert, 1914).

In 1884, William E. de M. Armit, who for some years sent specimens to von Mueller and has been described as "a true plant lover," visited Moresby and Basilisk Islands, and the Redlick Group of small, low islands in the Louisiades. Others who collected for von Mueller included Captain Cyprian A. G. Bridge, a British naval officer who commanded the "Espègle" on a visit to the Moresby Group in 1884, and the "Dart" on a visit to the Louisiades and Woodlark Island in 1885.

Important collections were made from 1888 to 1898 under the auspices of Sir William MacGregor, whose extensive travels and explorations are mentioned earlier in this report (pp. 18–21). For administrative purposes, he made one or more rounds of the islands every year. It would seem that in large part MacGregor himself made very extensive and important ethnological collections from Papua which are housed in the Queensland Museum. In the manner of the times, he was credited in the literature with many zoological and botanical collections which, it seems certain, were made not by MacGregor but by officers of his appointment and which MacGregor sent to specialists for report, for example,

<sup>2</sup> The botanical information in this section is drawn largely from Mrs. van Steenis-Kruseman (1950), who gives numerous details of itineraries, data on collections, and references to literature.

<sup>1</sup> Letter from Dr. C. G. G. J. van Steenis, dated December 13, 1955.



zoological materials to C. W. De Vis at the Queensland Museum, and botanical specimens to von Mueller until the death of that eminent botanist in 1896, after which the plants went to Kew. Determinations of many of the collections communicated by MacGregor appeared in appendices to the Annual Reports of British New Guinea.

It is recorded (Tristram, 1889) that Basil H. Thomson, a son of the then Archbishop of York, on a visit to the Louisiades and the D'Entrecasteaux Group in October and November, 1888, on behalf of the Government of New South Wales, collected 44 specimens of birds which he presented to the York Museum. Thomson evidently filled a dual role, for MacGregor (1898 reprint, p. 7), in reporting on his first visit of inspection to the eastern islands in October and November, 1888, describes him (Thomson) as his private secretary. From Thomson himself (1889) we learn, in an account of the same expedition in which MacGregor is not mentioned, that Thomson and a party of four climbed to some height on Mt. Maybole on Fergusson Island to shoot a rare bird of paradise (*Paradisaea decora*), now known to be endemic on Fergusson and Normanby. Besides birds, Thomson collected a few mammals, and botanical specimens for von Mueller. Many of the botanical specimens were too poorly preserved for classification. The islands visited were Sudest, Rossel, Joannet, Misima, Normanby, Fergusson, and Goodenough.

Other early collectors included Nikolaj Nikolajewitsch Miklucho-Maclay, Russian geographer-ethnologist and also a collector of plants and animals (for whom the Maclay Coast of northeast New Guinea is named), who on his fourth visit to New Guinea (the first was in 1871-1872) landed at Samarai in January, 1880, and stayed "for some time." Friedrich H. O. Finsch, German ornithologist and ethnographer, visited the Killerton Islands in Milne Bay, Samarai, and Teste Island in 1885. Lamberto Loria, an Italian who made large anthropological, ethnological, and zoological collections in New Guinea, and also collected some plants, visited Fergusson and Goodenough, the Trobriands, Woodlark, and Samarai in 1890, and based on Kwato Island, near Samarai, for long stays in 1894 and 1896 (Steenis-Kruseman, 1950). Loria

was assisted in 1890 by Amadeo Giulianetti, who later, as an administrative officer and natural history collector in MacGregor's employ, made important collections of birds and plants outside our present area. In 1890 the Rev. George Brown of the Wesleyan Mission, who collected a few plants for von Mueller and jointly with James Cockerell had made rich zoological collections in the Bismarck Archipelago in the 1870's, visited Milne Bay, Teste, and Tubetube Islands, the Louisiades, Woodlark, Laughlans, Kiriwina, Basilaki, and the D'Entrecasteaux Group, including Dobu Island. He collected at least birds and land shells on this trip and possibly made collections on a visit to the D'Entrecasteaux and Panaeti in 1891, but on three later visits, the last in 1905, he seemed solely concerned with mission affairs (Brown, 1908). Normanby Island was visited in 1894 and the Louisiades in 1898 by W. Micholitz, for many years a collector of living plants for J. Sander and Sons of St. Albans, England, and also a collector of mosses and insects (Steenis-Kruseman, *op. cit.*).

The first really large zoological collections to come out of our area, and the greatest of all, were made for Lord Walter Rothschild's Tring Museum by Albert S. Meek and various employees and associates in the years 1894 to probably about 1916. The collections were principally birds<sup>1</sup> and Lepidoptera. Some mammals were collected, and a few reptiles and amphibians and other zoological specimens. Beginning in September, 1894, Meek worked for four months at Nadi on the south coast of Fergusson Island. He reported of the local natives that "... they are frightened at even the idea of ascending the higher mountains of their island" (Rothschild and Hartert, 1896), from which it might be surmised that his party did not collect high on the mountains that rise to about 6000 feet close behind Nadi. In 1895, March to July were spent in the Trobriands, evidently on Kiriwina. Meek went on to Woodlark in July or August, at the time of the first gold discoveries on that island, and camped at Suloya (Suloga), collecting and trading and for six months working a gold claim as

<sup>1</sup> Lord Rothschild's bird collections were purchased by the American Museum of Natural History in 1932.

well, as collecting was not very profitable. Some collecting was done on the "Egham" (Egum) group of islands en route from the Trobriands to Woodlark.

In December, 1896, Meek went to Goodenough Island, but after a stay of six weeks, under frequent threat of attack by the natives, he was taken off by the government for his own safety. In March, 1897, he returned to Woodlark, and during the first half of that year he also spent six weeks at his old camp at Nadi. From a base established at Bwagaoia on Misima in August, 1897, three months were spent in collecting on the lowlands and mountains of this island. Rossel Island was next visited, for a stay of "some two months"; the party felt unsafe with the natives, and consequently collections were not large. At about this time, Kimuta in the Renard Islands was visited. Early in 1898 the party began three months of work on Sudest. According to Rothschild and Hartert (1901), Meek collected birds on Normanby Island in August, 1899, and again in August, 1901, but no mention of these visits is made in a book in which Meek (1913) gave an interesting account of his experiences and from which the above itinerary was drawn. Meek, in his book, made scant reference to his assistants. These, on his first stay at Nadi, were one Gulliver, W. B. Barnard, and Harry Barnard. The Barnards were in the Trobriands with him, Gulliver having died of malaria, and one of the Barnards remained for the first visit to Woodlark. From Goodenough Island in 1896 to Sudest in 1898 a younger brother, W. G. Meek, took part in the work, as did one of two brothers-in-law, Albert and George Eichhorn, beginning with the second visit to Woodlark. While on Goodenough, Meek started to make systematic field notes on birds and insects for Tring, the former usually being sent to Ernst Hartert, the latter to Karl Jordan.

The Eichhorn brothers continued collecting for Tring after Meek's retirement. They were on Rossel Island in the latter part of 1915 and early in 1916 and had a mountain camp at an elevation of about 2100 feet. On Sudest in 1916 they had camps at Bowla on the north coast and on Mt. Rattlesnake (information in part from Hamlin [MS], in part from local sources and references in the literature to collections).

In travels along the coasts on official visits in 1899 to 1903, Lieutenant-Governor George Ruthven Le Hunte collected a number of botanical specimens for F. M. Bailey, of Brisbane, which included materials from our islands. Le Hunte was also interested in birds, although he seems not to have collected any. Several lots of plants were sent to Bailey by Captain Francis R. Barton, who as Commandant of Armed Native Constabulary visited the islands with Le Hunte in 1899, and as Administrator made several visits in 1904-1906. De Vis [1905] described from materials collected by Barton at Busai in the interior of Woodlark Island what would appear to be the only fossil vertebrates known from our area, namely, a dugong (*Halicore brevirostris*), a turtle (*Chelone murua*), and a crocodile (*Gavialis papuensis*).

Plants were collected for Kew by Charles G. Seligman, anthropologist, who worked on Tubetube, the Trobriands, and the Marshall Bennett Islands in 1904. The Rev. Copeland King, a well-known collector of ferns, sent to Edwin B. Copeland, in Manila, several species collected on Woodlark about 1912 or 1913. On our visit to Rossel in 1956 we learned of a representative of Sander and Sons named Frost, who spent about three months there in 1921 or thereabouts, collecting chiefly living plants of *Dendrobium atrovioleaceum*.

In 1928-1929 the Whitney South Sea Expedition of the American Museum of Natural History, operating from the schooner "France" and then led by Hannibal Hamlin, visited many of the islands, collecting mainly birds but also a few mammals, reptiles, and insects. Aided by the Polynesian collectors David, Charlie, and Teora, Hamlin in October, 1928, visited the Bonvouloir Group; Alcester Island; Kulumadau, Suloga Harbor, and Guasopa on Woodlark; Gawa and Dugumenu of the Marshall Bennetts; and Kitava in the Trobriands. Collecting was done on Kaileuna and Kiriwina of the Trobriands on November 1 to 8; Wamea Island, Amphlett Group, on November 10; and at "Kara Kara" (Kalo Kalo?) on the west end of Fergusson during November 12 to 15. Working from the "France," without Hamlin, Charlie and Teora were at Sewa Bay, Normanby Island, December 18 to 23; at Dobu, Decem-

ber 24 to 28; Salamo, Fergusson Island, December 29 to January 18, from where they walked in to Lake Ruaba (Lavu) and collected January 4 to 11. On the north coast of Sudest between February 14 and 23, 1929, the "France" anchored first near Griffin Point, later at Bowla, and Yeina (Piron) Island was also visited. From February 25 to March 4 the ship lay in "Yela Gili Harbor" (at Abaleti) on the south side of Rossel Island, and Hamlin one day climbed to 2000 feet, shooting birds. Hamlin and David collected on Panasesa, Conflict Group, on April 28 and 29 of that year.

After work in the Solomons the Whitney Expedition, then led by W. F. Coultas, returned to Samarai in June, 1930. Hamlin and a temporary member of the expedition named Riddall collected on Panasesa on July 18. From July 20 to 30 they camped at Bwaga Bwaga on the south side of Misima, and on August 2 arrived back in Samarai, with stops at Nivani, Panapompom, and Panasesa Islands. During this time another member of the expedition, W. J. Eyerdam, made a big collection of shells and corals in the Samarai area (Hamlin [MS]).

F. Shaw Mayer visited Fergusson Island in 1935 and from a camp at Taibutu (Saibutu) on the lower southern slopes of the Mt. Maybole mountain mass collected a few

mammals for the British Museum (Laurie, 1952), and probably live birds and bird skins as well.

Although not a "previous" collection, it might be mentioned here that William Brandt, making a general collection of insects for the Bernice P. Bishop Museum, worked at Waikaiuna, Normanby Island, from October 23, 1956, to January 10, 1957, at Kulumadau, Woodlark Island, from late January to early May, and made brief visits to Kiriwina and Kitava in the Trobriands later in May, 1957. Brandt's collecting was part of a very extensive program of the Bishop Museum in entomology in the Southwest Pacific directed by J. Linsley Gressitt.

In summary, it may be stated that prior to our expedition the birds and butterflies of the area had become fairly well known, but little had been done to bring to scientific knowledge the mammals, the amphibians and reptiles, and the plants of the islands. In mammals, Fergusson Island, with 15 or 16 species collected mainly by Meek and Shaw Mayer, was best known, while not a single specimen had been collected on Normanby Island. Only casual attention had been paid to amphibians and reptiles. In plants, scattered small collections had been made, but the islands were virtually unknown botanically.

## ITINERARY AND ROUTES

PETERSON AND I TRAVELED independently from New York to Samarai, he by ship to Brisbane and thence by air. My travel was by QANTAS airline from the United States to Samarai via Sydney, Brisbane, and Port Moresby. After the expedition, we both flew back to the United States by the Sydney-San Francisco route.

The present section contains descriptions of routes and minor collecting localities. Major collecting localities are described in the following section. The numbers of mammals (M), herpetological specimens (H), fresh-water fishes (F), fresh-water crustaceans (C), and plants (P) collected are indicated for camp localities. No attempt was made to count or estimate the numbers of insects and spiders collected at the various camps of the expedition.

### MARCH

Upon arrival at Port Moresby on March 16, 1956, I was met at the airport by Mr. W. R. Suttie, Acting Director, Department of Forests, who was most helpful in expediting necessary official business. Next day I accompanied Mr. John S. Womersley, Forest Botanist, on a visit to a forest survey camp on the Brown River, about 20 miles north of Port Moresby, where a nursery of teak (*Tectona grandis*) was making excellent growth. March 18 was spent on a Sunday excursion to the Mt. Warirata area on the Astrolabe Range, with a party of government scientific personnel and visiting biologists, on which we had the good fortune to find the very rare submerged aquatic plant *Torrenticola queenslandica* growing on living tree roots and volcanic agglomerate rock at an altitude of about 1500 feet in Narigogo Creek, a tributary of the Laloki River.

On March 20 my 12,400-mile journey from New York to Samarai was completed in a two-hour flight in a PBY flying-boat, a type of aircraft that has done splendid service under the rough New Guinea conditions. In Samarai delivery was taken of native helpers who had been recruited by our agents, the cargo from New York was unpacked, and supplies were organized.

### APRIL

Evennett became a member of the expedition on April 1. Peterson arrived in Samarai on April 6, having been delayed on the shipboard part of his journey and thus holding up the start of field work. With supplies for two months, we left Samarai on the 45-foot auxiliary vessel "Kedeluma" during the evening of April 9 and reached Waikaiuna, on the southwest coast of Normanby Island, the following morning. Here, on the invitation of Mr. Norman H. Izod, we established ourselves at a sawmill very well situated for a collecting base and for approach to the higher mountains of the island.

April 16 to 18 was spent by Evennett in an attempt with native guides to find a camp site in the mountains which rise to 3500 feet close behind Cape Prevost. In seven hours of climbing and track cutting from Bwasiaia village, about 3 miles down the coast from Waikaiuna, he succeeded in reaching an altitude of only 2500 feet on rough, rocky slopes uninviting for field work, and no place suitable for a camp was found.

On April 18 Womersley, Mr. E. C. Gray, Regional Forest Officer, and Womersley's native assistant, Michael, joined us at Waikaiuna for a seven-day visit. On April 23-24 a second reconnaissance of the mountains behind Cape Prevost made by Evennett, accompanied by Gray and Michael and new guides, resulted in the opening of a practicable route and the selection of a camp site at about 2700 feet on the north slopes of Mt. Pabinama. The approach was by way of the Lebudowa River, and track was cut from about 1000 to 3000 feet.

In a small launch kindly lent by Mr. Izod, Peterson and Evennett on April 26 visited the Bunama area on the southeastern corner of the island to investigate two big caves reported to exist there and to contain bats. Our information was from sources considered reliable, but, through suspicion of the intentions of our party perhaps, the Bunama people denied any knowledge of caves in their neighborhood. Cave burial was formerly practiced on parts of the island. The Bunama folk may have heard of or seen the desecra-

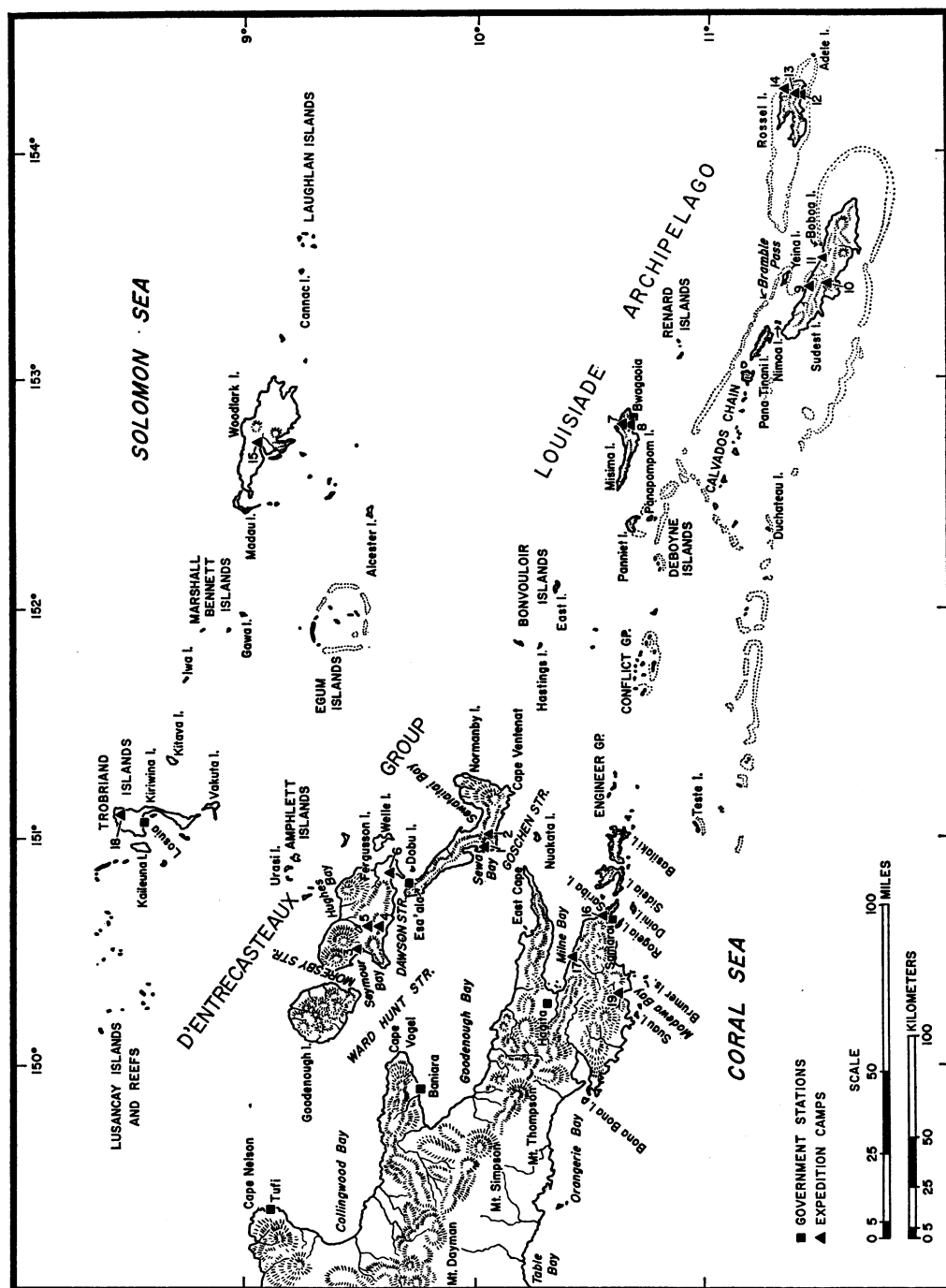


FIG. 1. Map of eastern Papua and outlying islands, showing the working areas of the Fifth Archbold Expedition to New Guinea. Camps of the expedition: 1, Waikaituna; 2, Mt. Pabinama; 3, Jamelele No. 1; 4, Mountains between Agamoia and Ailuluai; 5, Agamoia; 6, Deidei; 7, Mt. Sisa, north slopes; 8, Narian; 9, Joe Landing; 10, Mt. Riu, west slopes; 11, Rambuso; 12, Abaleti; 13, Mt. Rossel, south slopes; 14, Jinju; 15, Kulumadau; 16, Mornuna; 17, Dawa Dawa; 18, Liluta; 19, Modewa.



tion of burial caves by white men. It is possible that they could not believe Peterson and Evennett sought merely to collect bats.

On April 30 we moved in to Mt. Pabinama with 43 carriers and set up our tents and flies at the camp site chosen by Evennett and Gray. The journey occupied seven hours including rest stops. More carriers offered than were needed, eight men coming from as far as Sewataitai Bay on the north side of the island.

The entire route to the mountain camp was through uninhabited primary forest which showed no evidence of former native population. The first mile was nearly level walking on a track we had cut easterly to where the Lebudowa emerged from the mountains. From there we turned south to southeast up the rough, bouldery bed of the stream, which was crossed four times in a short distance, then up a long steep slope to a ridge crest from which we dropped down a little into Butai Creek, a feeder of the Lubudowa. Here, at an elevation of about 1000 feet and the end of an old trail we had followed from the river, a miner named Ballantyne had worked alluvial gold until obliged to leave during the Second World War. The tall rain forest became rather mossy at about this level. The creek had a very bouldery bed, with moderate fall. Tree ferns (*Cyathea*) and birds of paradise (*Paradisaea decora*) had first been observed a little below this on the slopes.

At Ballantyne's Camp we were only two hours on the way, but as most of the carriers had assembled late and without a proper breakfast, we delayed over an hour here to give them a meal. At about 2000 feet, on generally not very steep slopes, oaks (*Quercus*) appeared on a ridge crest in a mixed rain forest in which many tree roots spread over the surface of the ground, and a slender scrambling bamboo and a climbing pitcher-plant (*Nepenthes*) were already in evidence. This forest steadily diminished in height. With a steepening of the slopes and an apparent geological change at about 2250 feet, a conifer (*Dacrydium*) became the characteristic overtopping tree in a stunted, scrubby forest very heavily mossed on trees and ground, in which a subantarctic beech (*Nothofagus*) grew as a small tree or tall shrub.

The camp was in a continuation of good forest which, above the *Dacrydium* zone, had an appearance and composition very different from the rain forest of the lower slopes.

#### MAY

In the fine weather that almost invariably prevailed for our major land transport moves, Peterson and I vacated the Mt. Pabinama Camp (M 48, H 57, F 2, P 249) and returned to Waikaiuna on May 12. That day Evennett returned from an unsuccessful attempt to collect a wallaby (probably *Protemnodon*) known to inhabit natural grasslands and savannas in the Mt. Bwebweso area (see p. 40). Crossing the island to Sewataitai Plantation in Sewataitai Bay and hunting from there, he had encountered feral cattle but no wallabies.

On May 20 we left Waikaiuna (M 163, H 47, P 370) on the "Kedeluma" and in a seven-hour run on a calm sea reached Mapamoiwa on the southwestern end of Fergusson Island, where we stayed the night with Mr. W. R. Crosbie, officer in charge of the Native Hospital. A small bat (*Pipistrellus papuanus*) and a marsupial "flying squirrel" (*Petaurus breviceps*) were shot here at dusk, and Mr. Crosbie later sent to us the only specimen of the small bat *Tadarida* (new species?) collected on the expedition.

In two hours from Mapamoiwa on May 21 we dropped anchor off a beach of dark gray sand at the head of Seymour Bay, and Evennett and I went ashore to investigate possible sites for a base camp. We walked inland on a good government track, first through mangroves, then tall rain forest and patches of food gardens on a very gradually rising, sandy, semi-swampy coastal plain. In about a mile, where savanna-forested hills began, we came to Mabeia village, and a little beyond that to Iamelele No. 1 government resthouse. The resthouse was attractively situated, well placed for approach to the Mt. Maybole mountain massif to the north, and the area had a native population numerous enough to provide the carriers we would need. But the neighborhood did not promise well biologically, and we decided to inspect Fagulu village, 3 miles to the southwest and recommended by a government officer as a base site. The track most of the way passed

through a thermal area devoid of shade, reeking of sulphur, and most unpleasant for travel in the heat of the day. Fagululu we found to be a depressing small place of about six houses, overrun by an extraordinary number of big fat pigs. It occupied a dank hole in tall, half-swampy forest beside a creek running muddy from a recent great landslide in the mountains at its source. Near the village stood a half-finished new resthouse, in a small clearing strewn with pig droppings and smelling of them.

Returning to the beach, we went in the "Kedeluma" to a landing place in mangroves in the northern part of the bay called Iewata, where a dilapidated resthouse and barracks occupied a small piece of more or less dry, crab-holed ground. Inland was better forest than near Iamelele No. 1, but the latter place was much better suited for a transport base, and we needed a good building for storage of the large quantity of supplies which the "Kedeluma" had brought from Samarai. The village policeman of Iamelele had already sounded the *kipi* (conch-shell trumpet) to summon the people from the gardens, and with their willing help all our belongings were stacked inside and underneath the resthouse by nightfall.

On May 24 I visited Saibutu village on the lower southern slopes of the Maybole mountain mass, a walk of one and a half hours from our base camp, and about 600 feet above sea level. The military 1-mile map (1298 Fergusson Island West) is inaccurate for this area in showing the narrow valley in which Saibutu (Taibutu) is situated as grassy, whereas the vegetation is all second-growth rain forest. Not a remnant of the original forest remained between Saibutu and the coastal strip or for at least 500 feet on the very steep slopes above the village. About a mile of secondary savanna was crossed out from the foot hills.

Saibutu was of interest as a collecting locality of Shaw Mayer (see p. 27). An unprofitable attempt to mine muscovite mica had recently been made in nearby mountains. In the village and neighboring Malamodawa hamlet were rough, circular stone platforms from each of which rose three outward-slanting stone slabs. The butchering for cannibal feasts had formerly been done on such struc-

tures; now their use is as village meeting places, the sloping stone slabs serving as back rests for the elders. Similar platforms on Goodenough Island are called *tuwaka* (Brass, 1956, p. 146); on distant Rossel Island they are *chebaga*.

A reconnaissance of the Mt. Maybole mountains was made by Evennett on May 25-27, following a track from Saibutu that led to the isolated mountain villages of Mailolo, thence down to Didiau on the north coast. Evennett camped at an altitude of about 3600 feet between Saibutu and Mailolo and examined the country thereabouts, on which he reported favorably. But on the very steep ascent from Saibutu the path in places clung to high rock walls and was only a few inches wide. Evennett considered it impassable for carriers with box loads, and dangerous even for the unencumbered traveler. And as some box loads were necessary for our collecting equipment and only one track existed, with reluctance we had to give up the idea of working in the mountain area which in scope, topography, and vegetation cover had appeared most promising on the island from an examination of aerial photographs.

Much of the area of Fergusson Island is contained in three large mountain masses. The highest, in the northeastern part of the island, takes its name from a sharp culminating peak which MacGregor called Mt. Kilkeran and on some modern maps appears as Mt. Oitabu (meaning sacred mountain) or Othona Peak, the elevation being given as much as 6800 feet. A second mountain mass, in the form of a long high ridge which occupies most of the south side of the island, is named for a 5977-foot eminence called Mt. Edagwaba, and is separated from the Kilkeran massif by a 2000-foot gap. The Maybole massif, in the northwest and the bulkiest of the three, is isolated from the others by an extensive low interior valley in which, at about 100 feet above sea level, is a sizable lake called Lavu or Ruba on the maps (see pp. 32, 33). MacGregor applied the name Maybole to the whole of this northwestern mountain mass. On the Fergusson Island map of the 4-mile Strategic Series, 1942, Mt. Maybole is an extreme northeastern peak of 2500 feet; the highest named peak thereabouts is Mt. Kaibole, 5616 feet, and it

is indicated that top elevation on this part of the island is 6000 feet.

### JUNE

A four-day reconnaissance by Evennett of the Edagwaba Range ended with his return to Iamelele base camp on June 1. He had succeeded in finding a spot suitable for a collecting camp on the crest of the range, where a native path connecting Agomoia village in the central valley and Ailuluai on the south coast crossed at an altitude of about 3000 feet by aneroid, 4100 feet by the form-lined 1-mile military map of Fergusson Island West.<sup>1</sup> A higher elevation was desirable, but as an attempt on Maybole from the north coast, or on Kilkerran, which appeared to offer the least area at the higher elevations, would have involved moving the base camp, it was decided to use the Edagwaba site, a two-day journey from Iamelele.

On June 4 Peterson and I left Iamelele for the mountains; Evennett, for Mapamoiwa for business talks by radiophone. Heavy rains the previous afternoon had prevented the arrival of carriers from distant villages, and after delaying until mid-morning we started with 37 of our 48 loads, leaving the rest to be sent on by the village policeman. Crossing the thermal area to Fagululu on the south side of the central valley, we began some muddy travel through tall forest on the banks of a creek, which was forded several times, and in 25 minutes entered, on rising ground, fine forest dominated largely by clean-boled dipterocarps. As in a rather similar forest at Wai-kaiuna, characterized by Dipterocarpaceae, the ground was stony.

The dipterocarp forest continued for a good half hour, when we came to a small area of *Melaleuca* savanna, crossed another stream, then, some two hours from Iamelele, began hard going in a succession of small ascents and descents, some of them very steep, in a hilly, forested terrain. An hour of this brought us to the crest of a narrow ridge where old coconut palms marked the site of a former village, and we looked down on Lake Lavu,

about 2 miles to the northeast and beautifully framed by high, blue mountains. Having by this time learned not to place much reliance in the military maps, 1-mile and 4-mile, it was no great surprise to find that the feature shown as the lake on these maps is actually a wooded island in the lake, and instead of a length of about 400 yards, the lake is about 2 miles long and 1 mile wide. An irregular blue line widely encircling the lake on the 1-mile map would appear to be the actual shoreline. Small shifting islands of herbaceous vegetation afloat in the lake would be a hazard for alighting aircraft.

Five hours from Iamelele we stopped to eat at small Niubuwo village, about 1000 feet above sea level and the highest point on the track. On very steep narrow ridges beyond this, oaks grew commonly in tall forest, and pieces of obsidian lay everywhere on the ground. Lilai Creek was crossed 50 minutes from Niubuwo, and close to Agamoia, our night stop, seven hours from Iamelele. There was great activity among the women of this very friendly village when we arrived, and towards dusk they brought us, for payment in tobacco, clay pots of cooked taro and sweet potatoes ample to feed all our company that evening and for breakfast.

The carriers had agreed to take us to the mountain camp, but the lowlanders had had enough, and at "fall-in" time next morning all but a seven-man contingent from Saibutu announced their intention of going home, and asked for their pay. Evennett had arranged with the Agomoia people to take us back to the coast, and I was reluctant to ask more of them, but so eager were they for money that, on the call of the village policeman, 25 volunteers, including six women and three village councillors, soon assembled. With these, and leaving Peterson to attend to delayed transport, I set out from Agamoia and in six hours, including rest stops, reached the camp site, about 3 air miles south of the village.

For the first hour we followed the Lilai Valley, the creek being crossed at about 800 feet at Budagafatugona hamlet, and from Wai-iu hamlet we climbed very steep slopes to the crest of a narrow spur ridge on which, at about 2500 feet, oaks became dominant in the forest. Very tall *Araucaria* trees appeared with the oaks at about 2750 feet, sending

<sup>1</sup> Owing to mishaps to the instrument, aneroid barometer readings after Normanby Island were more than usually undependable, and we were not provided with boiling-point apparatus for the determination of altitudes.

their great shafts high above the forest canopy, and the path began a descent to the bed of a small, rocky stream where, in light rain, we stopped to cook rice for the straggling carriers. This was the last water on the trail. The elevation was about 2600 feet by aneroid. Two hours passed before all the carriers arrived and had eaten, and we made the last climb to the camp site. Some of the slopes had been so very steep that step cutting was necessary to improve the path.

Evennett, upon arrival from Mapamoiwa via the south coast on June 7, reported a good path and moderate slopes on his ascent of the range from Ukaiokaio village. On June 18 we vacated the "Mountain Camp between Agamoia and Ailuluai" (M 48, H 46, P 308) and began collecting at Agamoia.

Guided by a small boy of the village, in the absence of all the able-bodied older males at a distant feast, I visited Lake Lavu on June 21. Much of a walk of one and a half hours was by devious paths through second-growth rain forest on flat lands below the mountains. Where we came to the lake, on its southwest side, a line of low hills rose directly from the water, and the Agamoia people had a fishing place on a point of land between two small bays. The shores there were steep, and the water was deep. The lake is reported to be infested with crocodiles, but I saw none. It has also been said that the lake water is salty or brackish, but it is quite fresh and apparently well stocked with fish. In short time my small guide caught 14 of one species (*Ophiocara aporos*),<sup>1</sup> baiting his hook with a small, pale shrimp caught in the root mass of the "water lettuce" (*Pistia stratiotes*). The only water birds seen were a gray heron and a pair of jacanas.

Agamoia Camp (M 55, H 33, F 3, C 13, P 82) was closed on June 25, and we returned to Iamelele. Two days later this camp (M 79, H 47, P 141) was evacuated, and at a temporary camp on the beach of Seymour Bay we spent the remainder of the month waiting for an overdue boat. During this time we visited the trading establishment of Mrs. Anne Gribben at Nou Nou on Goodenough Island.

## JULY

On July 1 a wet, rough, nine-hour run on the 60-foot "Betty Ann," against a strong southeaster, brought us to Kedidia, a coconut plantation on the southeastern part of Fergusson Island, where we spent the night ashore with Mr. Norman Evennett, owner of the property. Next morning we set up camp at Deidei, about a mile to the southeast of Kedidia, in Gomwa Bay.

On July 7 the "Keduluma" called in at Deidei (M 40, P 45), and we proceeded on her to Samarai to check on the storage of our collections and refit for work in the Louisiades.

Leaving Samarai on the 50-foot scow "Kari" on July 12, we arrived at Bwagaoia, Misima Island, two days later. Strong southeast weather prevailed on this voyage, and where not protected by reefs or islands, the sea was rough. We reached the Conflict Group the first evening and anchored off Gabugabutau Island. In nine hours from there we arrived at Nivani and were hospitably entertained ashore by Mr. and Mrs. Albert Munt.

Coconut-planted Nivani in the Deboyne Lagoon is a small island largely occupied by a hill rising to 250 feet. Close to the north, in the lagoon, is the much larger Panapompom<sup>2</sup> and beyond it the still larger Panaeti. These two hilly islands apparently are of reddish clay; they are given a generally brownish appearance by a type of low, dense forest they carry.

We had no rougher sea travel on the whole expedition than the trip of seven and a half hours from Nivani to Bwagaoia. The native skipper had the native predilection for keeping too close inshore, the shore in this case being the very rugged, exposed south coast of Misima, where the sea pounded on limestone cliffs often towering up hundreds of feet into the dark, low rain clouds that covered the mountains. Occasional small sand beaches occurred at the mouths of streams. Visibility was too poor for us to see clearly the distinctly terraced formation of the elevated limestone which others have described (see p. 12). Near Bwagaoia the cliffs gave way to a flat, low, spray-drenched frontage of very

<sup>1</sup> The fishes were identified by the late John T. Nichols, the American Museum of Natural History.

<sup>2</sup> "Pana" means island.

roughly eroded and undercut, dark, coral limestone covered to about spray line with low, rain-forest second growths on old garden lands. The steep mountains of farther west on the island here tailed off into partly grassy hills receding a little from the coast and of rather soft outline.

Bwagaoia, seat of administration for the Louisiade Sub-District, also had a native hospital, government school, native cooperative store, and a privately owned trade store. It is situated in a very narrow harbor, only 800 yards long and 200 yards wide, with a heavy swell at the entrance in the southeast season, but Misima's only safe all-weather anchorage. There being no resthouse for visitors, we were kindly taken into the houses of Patrol Officer Bruce Teague, temporarily in charge of the station, and Cadet Patrol Officer Ian McCollom.

On July 15 Peterson, Evennett, and I, accompanied by McCollom, walked inland an hour, in almost constant rain, to examine the country and call on Mr. H. R. Gladstone, a miner who lived at Kulumalia at about 500 feet in the mountains, and owned a vacant house on 1435-foot Mt. Sisa which he generously offered for our use. Next day we established camp on Mt. Sisa, transport being provided by Mr. Gladstone with a wheeled tractor pulling a trailer on a graded road, narrow, and past Kulumalia in poor repair, on which, with much pushing in places where rains had washed off the surfacing of crushed stone and exposed the slippery soft porphyry that carries the lode gold on Misima, we traveled 9 miles and reached an altitude of about 1000 feet on the northeastern slopes of the mountain. From there the road continued as a footpath on which our gear and supplies were carried half a mile to the house on the north slopes.

Very little primary forest survived between Bwagaoia and Kulumalia, and none was seen on the coast. Beyond the partly grassy coastal hills, the road passed through slopes clothed mostly with young forest regrowths containing a great abundance of tree ferns, a scrambling fern (*Gleichenia*), and a big-leaved vine of the Convolvulaceae. Primary forest appeared just above Kulumalia and continued much of the way to the camp site, though slopes generally were very steep and the for-

ests not easily accessible. On landslips, and steep slopes disturbed by mining operations, extensive ferneries were formed by the *Gleichenia*, called *wel* on Misima.

The Mt. Sisa Camp (M 128, H 67, C 8, P 235) was closed and we returned to Bwagaoia on July 31.

## AUGUST

Again with transport from Mr. Gladstone, on August 1 we followed a fairly good, unformed motor road along the coast to about 3 miles west of Bwagaoia and established camp near Narian village and the mouth of Cooktown Creek. The route lay under the hills on flat to undulating, rough, coral limestone raised but a few feet above the sea. In one place the road, formerly a tramline, passed through a residual, abrupt-sided ridge of coral in a tunnel some 80 yards long. Good crops of yams and bananas grew in wayside gardens cut out of second-growth rain forest. A sizable coconut plantation the road passed through had a reasonably productive appearance. But cattle seen on Misima were generally undersized and in poor condition, as if through some nutritional deficiency, certainly not shortage of feed.

Peterson made bat-hunting visits to Kulumalia and Bwagaoia from Narian Camp. On August 6 he, Evennett, and McCollom visited a big cave a mile or more up a creek from Ehaus village, about 4 miles west of camp. Caves on three levels were reported. Only the middle-level cave, seemingly called Kuiaba, was entered, in company with villagers from Ehaus. This contained water, also stalactites and stalagmites.

At Ehaus our party saw an old stone "mortar," described as of rough exterior but perfectly smooth interior, and of origin known only as very ancient to the natives. I sent word to the village that I should like to buy this relic, but received no response.

We returned to Bwagaoia from Narian Camp (M 103, H 40, F 6, C 14, P 145) on August 13. Next day we left for Sudest on Mr. Eric Ryan's 40-foot "Titan" and had a rough passage until our entry through the barrier reef of the Calvados Chain, a matter of five hours. In the calm of the great Calvados Lagoon we called in at Panawina to set down a native passenger, later at small

Nigahau Island, where Ryan traded for copra and shell. Our night anchorage was off a pleasant sandy beach on the northwest side of Grassy (Wanim) Island, where we slept ashore in a government resthouse.

The islands of the Calvados Chain have coral-bound shores. All but the smallest are hilly. In the southeast season, when we saw them, they have a rather dry appearance. Native population is only a few hundreds at the present time, but to a considerable extent the islands have been deforested and have gone to grass through past gardening operations of the people. Virgin forest appears to be very limited on most of the islands. We saw much smoke and patches of newly burned grass.

Continuing our leisurely voyage through the islands on August 15, we passed along the south coast of big Pana-tinana or Joannet Island, which carries good forest at its western end. A trading stop was made at a village near Son-of-a-Bitch Point, where attempts by divers to exploit a rich bed of gold-lip pearl shell (*Pinctada maxima*) at 18 fathoms has been costly in lives over the years. We had morning tea with Brother King at Nimoa Mission, Catholic headquarters in the Louisiades, attractively situated and laid out on the south end of Nimoa Island.

Viewed from the north, the west end of Sudest, by far the largest island of the Louisiades, consists of gentle hills and low mountains largely grassy near the coast and darkly forested inland, rising to the interior and especially to the east. A narrow line of mangroves edges most of the coast and is very conspicuous where the hills are grassy. Griffin Point, former chief center on the island for gold mining and marine industries, was then occupied only by natives. Beyond it we entered Gold Rush Channel, and about 5 miles along this narrow passage between barrier reef and coast went ashore at a very small village called Joe Landing and established a base camp.

On August 20–21 Evennett made an examination of 2645-foot Mt. Riu or Rattlesnake, highest peak on the island, and did some track cutting towards its summit. With 39 carriers from far and wide, we moved inland on August 23 and made camp on a westerly spur of Mt. Riu. From about 2 miles

inland this journey of four hours was entirely through uninhabited primary rain forest on the backbone range of the island and easy travel. At Vukunitu Creek, crossed as we entered the forest, we were shown a chair-like rock ledge on which, in the cannibal raiding days in the time of the present elders' grandfathers, it was the custom of the near-coastal men, returning from forays to the then-inhabited interior, to prop up their dead victims, with faces painted, to gaze for the last time in the direction of their home territory.

We had some hard track cutting on Mt. Riu. I continued it on August 25; Evennett completed the job next day. On August 27 I went to the summit (see p. 53), and on August 31 Peterson did also and with two boys camped that night at about 2000 feet. Peterson had over 100 traps, a bat net, and guns and jacklamps for night hunting, but in the pattern of extraordinarily meager results in mammals obtained in the mountains of Sudest, no mammal was taken in traps or net and none seen to shoot.

## SEPTEMBER

Mt. Riu Camp (M 31, H 203, C 11, P 239) was dismantled on September 6 and we returned to Joe Landing. This base (M 80, H 35, P 111) was vacated two days later, when we moved east along the coast 10 miles to Rambuso in the 45-foot cabin cruiser "Polyanna" chartered from Mr. W. Callanan, one of the two white men on the island and resident in Madawa (Bousquet) Bay on the south coast. The smooth, grassy hills which had been such a conspicuous feature of the coast ended about midway between Joe Landing and Rambuso, and beyond that point only a few patches of grass broke the dense forest cover on the eastern half of the island.

From Rambuso (M 114, H 85, F 40, C 8, P 206), again on the "Polyanna," we crossed to Rossel Island on September 25, and, the wind being strong and the sea rough, we ran through Gwe Passage in the Rossel Barrier and took shelter at Bamba, a good small harbor on the southwestern part of the island. Behind a clean sandy beach at Bamba were an outpost coconut plantation of the Osborne Brothers and a government resthouse. And at the very edge of the sea at a



hamlet under big old *Calophyllum* trees was a platform of flat stones and giant clam shells, with two sloping stone slabs rising from it. This structure resembled those of Fergusson and Goodenough Islands (see p. 31). Built in the long ago, it was a talking place, according to a local native.

Rossel is a very mountainous and apparently very wet island, given a gloomy appearance by a dark mantle of forest and by rain clouds which, in our experience in the southeast season, almost always concealed its upper levels and often shadowed the valleys and lower slopes. Proceeding along the coast on September 26, we noted several small grass patches near the sea, the mouths of several apparently fairly extensive low valleys, and, opposite the valleys, breaks in the barrier reef where outflow of fresh water inhibited the growth of coral. The barrier was reëntered through Gware Passage, the approach to Abaleti, headquarters of the Osborne family, and near Abaleti we established ourselves in a government resthouse.

### OCTOBER

On Rossel we were given a warm reception by the Osbornes. We had the great benefit of their advice, their influence with the native people, and from them, gratis, transportation wherever we wished to go on two shallow-draught launches they used on trading trips around the island.

Evennett, on an examination October 2 to 4 of 2750-foot Mt. Rossel, highest peak on the island, was transported to Jinju on the northeast coast, from where he crossed the island back to Abaleti. On October 6 and 7 he visited Loa Island on the southeast corner of the barrier reef, to collect a rat (*Rattus exulans*) which had become a bad pest on the Osborne coconut plantation that occupied most of this spot of land.

With Hugh Osborne on the "Waei-waei," drawing about 3 feet loaded, Evennett and I on October 9 visited Jara in the next bay west of Abaleti, proceeding there outside the reef and returning inside on a higher tide. The Jara bay was small, with steep, partly forested shores, one or more villages, and Methodist and Catholic missions in charge of native teachers. From a landing in a deep

mangrove- and nipa-fringed creek, I botanized in the hills. Accompanying Osborne on his trading, Evennett shot several *Dobsonia moluccensis* fruit bats found hanging in bunches in the tops of coconut palms in second-growth forest. On our return within the reef, 11 dugong feeding in the lagoon shallows were counted by their muddy wakes.

Our collecting at Abaleti (M 85, H 39, C 4, P 173) ended on October 10. On October 11 we moved around to Jinju on the "Waei-waei," a trip of three hours within the reef.

Jinju gave easier and shorter approach to Mt. Rossel than Abaleti. The Catholic Mission had headquarters for the island there and helped us in getting carriers. With 34 loads we left for the mountains early on October 12 and in less than three hours of actual travel reached a camp site which Evennett had chosen at an altitude of about 2300 feet, close under the peak. Following a good path, we first rose fairly steeply through gardens and primary and secondary forest to Dambeni, a village at 600 feet overlooking the lagoon. There began a long, gradual ascent through fine, tall, rain forest to about the 1000-foot level, where we came to a zone of second-growth forest and passed two or three old village sites made conspicuous by planted coconut and betel-nut palms. The path in places lay between low walls of loose stones. These mountain villages had been abandoned for some years on government orders, we were told, the people moving down to Jinju. Above the formerly inhabited zone we crossed a sizable creek, then climbed steeply on a seldom-used trail through tall forest showing evidence of a frequent cloud blanket. Few of the carriers had been at the camp site before. With much excitement, they opened up with their axes and knives a splendid view of the coast from which we had come.

The Osborne brothers visited us here at different times. We were unable to find a route to the summit until Hugh, guided by elderly natives who had come up from Jinju with fresh food, reached the top on October 16. He found there a wine bottle containing the rotted and illegible remains of a note his uncle, Eric Osborne, had left in 1919 or

1921.<sup>1</sup> The climb was made hazardous in one place by a vertical rock face, with few holds for hands or feet. The Osbornes, Evennett, and I left our names in a formalin bottle sealed with dipterocarp resin and tied upside down to a tree on the summit with monel tail wire from the mammal-collecting supplies.

Mt. Rossel Camp (M 25, H 61, P 129) was closed and we moved back to Jinju on October 20. Our field work on the island ended at Jinju (M 69, H 37, P 85) on October 29, when we returned to Abaleti.

On October 31 we left for Woodlark Island, via Bwagaia, on the maiden voyage of the 60-foot motor vessel "Yelangili," owned and built from Rossel timbers by the Osbornes. Our departure was at 3 A.M. A hurricane lamp had been placed on a stick marking the passage through the reef, another on the veranda of the Osborne house. Still, difficulty was experienced in getting out of the harbor. The sea, which five weeks before had been exceedingly rough, now, with the ending of the southeast trades, was so dead calm that no break of water indicated the position of the reef.

#### NOVEMBER

Upon arrival at Kulumadau in Kwaiapan Bay on the southwestern part of Woodlark on November 1, we were met by Donald Neate with launch and tow boat and eventually found ourselves in a comfortable house of the Neate establishment on top of 360-foot Kulumadau Hill. The Neates were also our generous hosts as regards water transport along the coasts.

With Donald on November 8 I visited Lauani Plantation, situated 2 miles up a deep mangrove creek and about that distance west of Kwaiapan Bay. The creek headed perhaps half a mile above the trim plantation buildings, where a great spring issued from the coral limestone country rock, and the creek water was only slightly brackish at high tide. A gregarious, amphibious *Pandanus* lined the banks and, with rampantly climbing aroids and ferns, other amphibious plants, and beds of floating aquatics, gave a rich variety and a

lushness seldom seen even in tropical vegetation.

In search of bat caves, Peterson and Evennett walked overland to Dekoias and Kaurai, in elevated limestone country near the north coast, on November 10. Peterson returned to Kulumadau the following day, Evennett on November 12, the proceeds being one *Miniopterus* shot in Kaurai village. We had had reports of burial caves containing bats on Mt. Kabat (740 feet) 3 miles south of Kaurai, but the local natives disclaimed any knowledge of such caves, and a search without their cooperation was decided against as unlikely to be successful. On November 14 Evennett hired a canoe from Dekoias and from it examined two caves in high sea cliffs in Waspi-mat Bay, but the caves were small and contained only a few *Dobsonia moluccensis*.

With Donald Neate on the 31-foot "Murua" I visited Unkinbod Bay at the west end of the island on November 15 and 16. In this very shallow, mostly mangrove-fringed bay, with a bottom of mud and sand, lapi-lapi oysters were said to be especially abundant but poorly productive of pearls. Kuduia Point, on the east side of the bay and our night anchorage, had a white sand beach and tall *Casuarina equisetifolia* trees fronting mangroves. Our landings next day were on Madau, a long low coral island of hooked shape which forms the west side of the bay and is separated from Woodlark proper by the very narrow Delakawau Passage. Madau (or Tagum) Plantation was approached by a muddy small creek arched over by mangroves. While Neate inspected it, I examined adjoining poor rain forest in which a boat boy shot two fat nicobar pigeons (*Caloenas nicobarica*) for the pot. At Okwasas the island at about its middle was merely a narrow sand spit occupied by a native coconut plantation. Near the north end of Madau we walked inland a short distance to Muniveo village. Elevated 20 or 30 feet, this was the highest land seen on the island. Where not occupied by gardens and second growths, a rich-looking red soil supported tall rain forest, perhaps primary. The island people produced some copra for sale and dived for trochus shell.

An excursion especially important in results was made by Evennett and me on

<sup>1</sup> The first ascent of Mt. Rossel by white men was made by Frank and Eric Osborne in 1909.

November 17 and 18, with Donald Neate, to Luluai on the south-central part of the island. With a small launch, we crossed Wonai Bay, passed through a narrow, creek-like, boat passage between the main island and Nasai Island and landed at Kwagi on the outer coast of the very mountainous Suloga Peninsula. A mile or more of well-made mountain track led from there to Luluai, an old village name applied to a reopened copper mine and a very picturesque camp of the Neates' in a little bay screened by coral reef between two rocky headlands. Almost immediately behind, the mountains, completely forested but for the mine clearing, rose steeply to about 900 feet.

We climbed to the top of the range after a night at Luluai. In an old mining drive at about 300 feet Evennett and others swatted four individuals of the very big-eared *Hipposideros bicolor*, a bat new to the collection. On the broad range top the forest became rather mossy on the ground and the buttressed bases of the larger trees. To a large extent it was a forest of well-spaced great *Eucalyptopsis* trees, with reddish brown, somewhat fibrous boles up to 5 feet in diameter—a forest absolutely virgin and pleasant to walk through after the disturbed growths of most of the Kulumadau area. The genus *Eucalyptopsis* (Myrtaceae) had previously been known only from the upper Fly River, where we discovered it in 1936, another two or three widely separated localities on the New Guinea mainland, and from Boeroe in the Moluccas. Often on Woodlark the trees were over-aged and hollow. No regeneration was observed. But in November, 1958, Forest Officer E. C. Gray found in parts of this forest what he described in an unpublished routine report as a "wheat-field" regeneration of *Eucalyptopsis* 2 to 3 inches high.

In aged second-growth forest at about 200 feet near Kwagai, a plentiful scattering of resonant stone chips<sup>1</sup> indicated the site of an old-time axe or adze manufactory. On the return to Kulumadau, we botanized about the entrance to the boat passage on the

Wonai Bay side, where a hard gray limestone, described by Stanley [1913] as probably Tertiary, rises from the water in generally forested cliffs, presenting sheer walls, or eroded into pinnacles of very jagged form. A little soak of cool fresh water in the limestone was called "Mister Gill" by the natives.

On November 24 we left Kulumadau (M 181, H 88, C 8, P 262) on the "Kedeluma" and after an eight-hour run anchored, rather insecurely, on coral, in the lee of West Islet of the Egum Group. The Egums are an atoll formation of several low peripheral islands and some small islands of different character, up to 130 feet high, in a lagoon about 20 miles in diameter. A population of about 70 people has very good, large, sailing canoes, said to be made on Gawa Island in the Marshall Bennett Group. Only a few acres in area, West Islet consisted of rough coral elevated less than 10 feet and forested, with a patch of coconuts and a small sandy beach at the northwest end. Blue pigeons (*Ducula pistrinaria*) roosted there, coming in numbers towards evening from neighboring Yanaba, largest island of the group. The dainty little fairy tern (*Gygis alba*) was there in plenty, also white-capped noddies (*Anous minutus*),<sup>2</sup> which had laid eggs on beds of sea purslane (*Sesuvium portulacastrum*) on open rocks half wet by spray.

Leaving the Egums before daylight next morning, in 10 hours we crossed to Sewataitai, Normanby Island, and tied up at the plantation pier. This visit was for a last-chance try to collect the wallaby that inhabits grasslands a mile or two south of the plantation (see p. 30). Peterson, Evennett, and two natives hunted for it about sundown, and with headlamps after dark, without success. One seen by Evennett was described as small and dark—probably a form of the sand wallaby, *Protemnodon agilis*.

Samarai was reached, via the south end of Normanby, in 11 hours on November 26. Peterson and Evennett crossed to the adjacent mainland on November 30 and based at Mornuna Plantation to collect mammals.

<sup>1</sup> Identified as a fine-grained argillite by Dr. Brian H. Mason, the American Museum of Natural History.

<sup>2</sup> Dr. E. Thomas Gilliard, the American Museum of Natural History, has been consulted on the identity of the Egum birds.

## DECEMBER

For the concluding field work of the expedition, the party was divided into two units. Peterson and Evennett returned to Samarai from Mornuna (M 39, H 2) on December 4 and left for the Trobriands on the "Chin-ampa" at midnight of December 6. Landing at Losuia on Kiriwina, they were lent a motor truck by the Lumley brothers, first made a reconnaissance by road, and from December 9 to 16 camped at Liluta (M 89, H 17) near the north end of the island. They were back in Samarai on December 20.

From December 2 to 7 I camped at Dawa Dawa (M 1, P 20) on the south shore of Milne Bay. Finding conditions very dry and most unsatisfactory for plants and insects, I returned to Samarai and on December 10 chartered Ernest Evennett's 26-foot launch "Sirius" for an examination of the nearby south coast of the mainland. We landed in Suahia Bay at an abandoned coconut plantation called Matadona and walked a mile or more up Sakari Creek without finding any primary forest. Proceeding west along the coast and also landing at Delina, I decided on Modewa Bay for a collecting locality. From Modewa (P 84) I returned to Samarai on the "Sirius" on December 23.

Peterson left Samarai on his return to the United States on December 28.

## JANUARY, 1957

With the packing of specimens and gear completed, I flew to Port Moresby via Milne Bay on January 3. With expedition business

finished there, I went on to Lae on January 8 and for the next three days was the guest of the Department of Forests on a tour of the hinterland by air and motor road, accompanied by Forest Botanist Womersley.

On January 9 we did a round trip by air to Goroka, Minj, and Nondugl, on the highlands. Nondugl, at 5200 feet in the Wahgi Valley, is the site of an experimental project in raising Romney Marsh sheep, financed by the Hallstrom Trust and the government, and an attractively developed wildlife station, owned by Sir Edward Hallstrom and in charge of the well-known bird and mammal collector F. Shaw Mayer. January 10 and 11 were spent on a visit to Bulolo by road to see the very modern and highly mechanized operations by which magnificent stands of the coniferous softwood tree *Araucaria klinkii* are being exploited on a sustained yield basis and manufactured into plywood, on a planned rotation period of 70 years, as a commercial enterprise owned 51 per cent by the Australian Government. The silvicultural operations are in the hands of the Department of Forests of Papua and New Guinea. Initial trials of "Klinki Pine" as a plantation subject have been only partially successful. *Araucaria cunninghamii*, or "Hoop Pine," which occurs locally at somewhat higher altitudes and produces an even better timber and is well understood by the Australian foresters, had, therefore, until 1957 been the bulk planting stock.

My return journey to the United States began from Lae on January 12.

## COLLECTING STATIONS

### WAIKAIUNA, NORMANBY ISLAND

APRIL 10 TO 30; MAY 12 TO 20

USUALLY PRONOUNCED as if spelled "Wokaiuna," Waikaiuna of the military map (Sewa Bay 4807 1-Inch Series) was the site of a small coconut plantation cut out of primary forest on a somewhat exposed part of the southwest coast, about 2 miles south of the entrance to the fine, landlocked harbor of Sewa Bay. Since the war, a sawmill had been established in a clearing behind the plantation, three-quarters of a mile inland and about 50 feet above sea level. Our base was at the sawmill.

The terrain consisted of a gently sloping coastal plain, roughly 2 miles long and 1 mile wide and very bouldery except on its outer edge. Fronting the plain were narrow, rather steep beaches of gray gravel and sand and here and there small bodies of mangroves. To the north, cutting the plain off from Sewa Bay, were steep hills 200 to 300 feet high. To the south, mountains came down to the sea, exposing reddish volcanic rock in steep Kikisa Point. Inland was an abrupt rise of mountains attaining elevations up to 2800 feet about 3 miles from the coast and dominated by sacred Bwebweso, the upper parts of which were almost treeless. The 1-mile map is wrong in showing all the coastal plain as drained by the Lebudowa River and a tributary, Galakuai Creek. Its southern end has independent drainage, mainly by a fair-sized creek, nameless as far as we know, which heads in the mountains and flows into Waikaiuna Bay.

Except for a hamlet in Waikaiuna Bay, the area had no local native population, the nearest being in Sewa Bay. A government footpath ran parallel with the coast. A tram-line with wooden rails went down to the beach in Waikaiuna Bay, and a motor road through the plantation. Apart from these routes, and snigging lanes by which logs were winched from stump to mill by long wire cables, the area was virtually trackless, although streamways and the beach aided access to some parts, and in general, except for the bouldery ground, the forest was easy to travel through. We cut a trail in about a mile to the Lebu-

dowa, where it emerged from the mountains. Other human disturbance, away from the plantation and sawmill and garden patches in which sawmill employees planted mainly taro, cassava, and bananas, was virtually non-existent.

The vegetation indicated an ample rainfall throughout the year. Records kept for the 10 months up to the end of our visit pointed to an annual precipitation of around 200 inches. Rain fell, chiefly in daylight, during all but six 24-hour periods of our stay, although our return from the mountains was towards the end of a nine-day dry spell without measurable rain. Our heaviest 24-hour fall measured 3 inches; the total for April was 17.65 inches. A high of 41.16 inches for the previous September, and an average of about 7.30 inches for the next four months, suggested the southeast season as the wettest part of the year. The days generally were hot and muggy, especially in the small sawmill clearing. On clear, rainless nights, when cool air came down from the mountains, we were barely comfortable under one blanket and a mosquito net.

Very tall, primary, rain forest of a high commercial quality and volume seldom seen in lowland New Guinea covered much of the coastal plain. Largely, in millable timber, it was a forest of clean-boled dipterocarps, apparently two species of *Anisoptera*, one of *Hopea*, and one of *Vatica* being present. Other large trees included *Pterocarpus indicus*, growing to great size on creek banks, *Pometia pinnata*, *Planchonia timorensis*, *Dracontomelum mangiferum*, *Syzygium*, *Garcinia*, and *Intsia bijuga*. The forest consisted of a well-spaced stand of super-canopy trees, an abundant canopy layer 80 to 120 feet tall, a tall substage of slender trees, an ill-defined lower layer of small trees and saplings, and usually a fairly abundant woody and herbaceous undergrowth of few species. A small-leaved *Amaracarpus* and a *Vavaea* with showy white flowers were features of the woody undergrowth; ferns, Marantaceae, a giant sedge (*Mapania macrocephala*), and a prickly aroid (*Cyrtosperma*), prominent herbaceous elements. Various climbing aroids gave this forest a rich appearance. On poorly

drained ground near the sea it became lush with palms, *Pandanus*, and herbaceous growths. It was a forest poor in epiphytes, and in most other categories deficient in species. A sprinkling of big trees were in flower and attracting birds, and the number of small trees in bloom increased in May.

Variations in habitat included, on sandy beaches, a littoral fringe characterized by giant, leaning, or sprawling *Calophyllum inophyllum* trees, their fragrant white flowers attractive to tube-nosed bats (*Nyctimene*) and sugar gliders (*Petaurus*). Small patches of sago-palm (*Metroxylon*) swamp occurred. Gregarious on a gravel bar separating swampy rain forest from the sea grew a bignoniaceous tree with brilliant big orange-red flowers which van Steenis (1957) has named *Lamiodendron magnificum*, new genus and species. On the plantation near the sea, several open springs and small, sluggish creeks of fresh water bordered by tall reeds (*Phragmites karka*) provided habitats attractive to dragonflies and damselflies, and where water rats (*Hydromys*) were trapped.

The Lebudowa, an important collecting locality, took several forms in a distance of about  $1\frac{1}{2}$  miles. It issued from the mountains a fast stream some 20 yards wide in a rocky, bouldery bed twice that width, soon widened to 100 yards or more, then assumed a braided form, and suddenly went dry with the disappearance of flow below the gray gravel. Reappearing in a tract of swamp with luxuriant vegetation which included tree ferns (*Cyathea*), the water resumed surface flow in many small channels in an extensive *Pandanus copelandii* swamp forest, from which it emerged, a placid, gravelly stream, close to the sea.

Big changes in vegetation took place on the hills. The basal parts of the Bwebweso slopes were steep and very rocky, covered with a tangled, leafless sedge (*Schoenus laevinux*) and carrying a thin, open stand of *Casuarina* and *Metrosideros kasikasi* as small trees. On the first rise of a mountain spur at the head of the nameless stream and up to about 1000 feet, the *Casuarina*, attaining 60 feet, was virtually the only sizable tree in a dense forest of small-leaved, spindly little trees not easy to cut through. Above a conjectural cloud level of about 1100 feet, the small-

leaved, somewhat xerophytic rain forest gave way rather abruptly to a greatly improved mesophytic rain forest from which *Casuarina* dropped out, a *Dacrydium* appeared, and a delicate *Selaginella*, about knee-high, provided most of a thick, uniform, ground cover.

Our mammal collections from Waikaiuna are believed to be the first made on the island. A total of 14 species included the marsupial *Phalanger orientalis* (very variable here), *Petaurus breviceps*, and a bandicoot (*Echymipera rufescens*). In bats were six species: *Pteropus hypomelanus*, *P. conspicillatus*, *Nyctimene major*, *Dobsonia moluccensis*, *Pipistrellus papuanus*, and *Myotis adversus*, some of the latter two having been taken from hollows in the trunks of coconut palms. The rodents comprised *Pogonomys* (*forbesi* group), *Uromys caudimaculatus*, *Hydromys chrysogaster*, *Rattus exulans*, and *R. ruber*. The genus *Pogonomys*, in our experience, is seldom trapped or shot. Here it was always obtained by our cutting down selected big trees with knothole-like hollows showing far above the ground, as many as four (plus five *Petaurus*) being taken from one tree. An incident with a steel trap, from which a sharp-toothed mammal got away, suggested the presence of the small marsupial predator, *Satanellus*. Mention has already been made (see pp. 30 and 38) of attempts to collect a wallaby, probably *Protemnodon agilis*, known to inhabit open country in the Bwebweso area. With regard to this, Thomson (1889) reported, "Normanby Island is the eastern limit of the wallaby, of which we found two varieties," presumably both on this island, but neither collected there by him.

Insects taken at Waikaiuna exceeded in numbers the collections from any other locality on the expedition. This applied both to day-flying forms, collected mainly by a learning "butterfly boy," and to night-fliers, which I collected.

#### MT. PABINAMA, NORMANBY ISLAND

APRIL 30 TO MAY 12

Evennett and Gray, who reconnoitered this highest part of the island (see p. 28) and chose the camp site, had different altitudes on their aneroid barometers. On these and subsequent readings we decided on an official

2700 feet, or 820 meters. The camp site on the northwestern slopes of the mountain could not have been better chosen. Much more extensive benches were discovered, but they were without adequate water supply. The 3400-foot summit of Mt. Pabinama was within easy reach, and only two fairly closely adjacent peaks of 3500 and 3600 feet, unnamed on the maps, exceed this in height. A small amount of clearing opened up a tremendously expansive, if somewhat hazy, view which took in, in the distance, the west end of Fergusson Island, all the high peaks of Goodenough Island, and the south shore and mountains of Goodenough Bay on the mainland. Mt. Obia, 3400 feet high, was barely a mile away to the southwest.

The natives have a legend about Obia, which goes like this: Long ago, when women were scarce, there were two beautiful maidens who refused to take husbands. Finally, in punishment, the chief banished them to the mountain. He gave them eternal youth, but they had to stay on Obia for all time. There they are still, trying to get down to where men live, but prevented from doing so by a guardian snake, the transformation of their father or some other male relative who persuaded them not to marry in the first place.

A good part of our time on Pabinama coincided with a period during which Waikaiuna on the lowlands, only 4 air miles to the northwest, experienced a dry spell with no rain in nine days. It is probable, therefore, that much of our mountain weather was abnormally dry for that season, although it was wet enough to keep mosses and hepatics constantly turgid with moisture, and lamps had to be burned in the tents to dry mammal and bryophyte collections and clothing.<sup>1</sup> In general, though not invariably we had clear, starry nights followed by mist and some rain beginning towards mid-morning and continuing until late afternoon. Two days were wet enough seriously to hamper field work. Shade temperatures in the camp clearing for six days were, maximum 26° to 27.5°, minimum 18 to 19.5° C.

Consisting of steep, narrow spurs alternating with deep ravines carrying small, rocky

streams, this country was so precipitous that we had little freedom of movement except on benches on the northern side of the mountain, of which our camp ground was one of the smallest and two that we found were measurable in acres. A specimen of the country rock from camp level has been identified<sup>2</sup> as pyroxenite, changing to serpentine. A stiff yellow clay underlay a thin, peaty, humus layer. The only paths were of our cutting. But an occasional old lopped-off stub in the forest undergrowth indicated that natives sometimes came up here to hunt wild pigs or to collect aromatic lauraceous barks for their medicine making.

The vegetation at camp level, and for some distance below, and up the slopes to near the mountain top, consisted of a mossy cloud forest of mostly small-leaved trees up to about 60 feet high and 18 to 24 inches in diameter. Important dominants included species of *Xanthomyrtus*, *Garcinia*, *Calophyllum*, *Schizomeria*, *Ilex*, and a *Syzygium* with small white fruits attractive to *Petaurus* and *Nyctimene*. A subantarctic beech (*Nothofagus*) was common. Under the dense canopy developed on benches and less steep slopes, one's progress through the forest was not much encumbered by undergrowth. A thin or broken canopy, general on the steeper slopes, induced through better lighting a greatly increased, often thickly padded and cushioned growth of bryophytes on the trees and extensive entanglements of a slender, scrambling bamboo impossible to penetrate without cutting. Except in terrestrial ferns, which abounded in the gullies and included as tree ferns five species of *Cyathea* and one of *Dicksonia*, the flora could not be called rich. A rather sparse complement of epiphytes, apart from bryophytes, included shrubby *Rhododendron wightianum* with small reddish pink flowers. A palm somewhat resembling a slender coconut protruded in great numbers just above the forest roof.

Covering the mountain summit was a very dense, stiff, mossy scrub often only waist high, composed mainly of three dominants of the forest below, here dwarfed to shrub form. Notable were scrambling pitcher-

<sup>1</sup> Other plant collections were dried at all times with 500-candle-power, kerosene-burning pressure lamps as an artificial source of heat.

<sup>2</sup> By Dr. Brian H. Mason, the American Museum of Natural History.



plants (*Nepenthes*) and two erect, big ferns, *Dipteris conjugata* and *Gleichenia hirta* var. *candida*, and, still more striking, a scattered stand of very dark-colored conifers (*Dacrydium*), stunted to 10 or 15 feet but rising well above the scrub. A similar, less stunted scrub occurred on a spur ridge below the camp (see p. 30), and below this and the cloud forest was mixed rain forest.

Only seven species of mammals were collected here, those in *Pogonomys*, *Hydromys*, *Nyctimene*, and *Dobsonia*, and bristly gray *Rattus ruber*, being species already taken at Waikaiuna. Numerous small rootings under moss-tented, stilted tree roots were attributed to the *Rattus*. Of very special interest, and only one of each of which was trapped, were a brown *Melomys* and a marsupial "rat," *Murexia longicaudata*, the latter seemingly the first record of the genus from east of the New Guinea mainland. *Petaurus*, often heard at night, was not collected. *Phalanger* seemed absent at this altitude, although results from hunting might have been different had we succeeded in employing a native hunter with trained dogs. From a reputed Nimrod who agreed to join us but did not appear, we had the story that his best dog was taken by a crocodile in Sewa Bay, and the remaining one would have been useless alone.

In other zoological results, frogs, represented by seven or eight species, turned up fairly well. There were few lizards and no snakes. Eels were caught in a small stream at camp level. Insect collecting could only be described as poor. Little came from catching sheet and light trap at night; habitat conditions were unsuitable for most butterflies and Odonata.

#### IAMELELE NO. 1, FERGUSSON ISLAND

MAY 21 TO JUNE 4; JUNE 25 TO 27

Three villages or groups of villages several miles apart in the Seymour Bay area have the name "Iamelele," which is also used as a district name. Iamelele No. 1, about  $1\frac{1}{2}$  miles in from the coast and 50 feet above sea level, is the central village group of the near-coastal and thermal area of the bay. The resthouse we occupied was in a small clearing in second-growth forest on the north bank of broad, shallow, sandy, and gravelly Awabula Creek,

where this stream issued from the hills that occupy much of the interior valley. The hills, 200 to 500 feet high thereabouts and steep sided, carried in part a dry *Melaleuca leucadendron* savanna forest, in part an inferior type of rain forest. Much land towards the coast was poorly drained, and nearly all of it was covered with tall rain forest or sago swamp; old cut-off bends of the creek held quiet little ponds surrounded by forest or with reedy banks. On the littoral fringe were mangrove swamps of the *Rhizophora-Bru-guiera-Avicennia* type usual in this region, and on the gray beaches a sand-binding community characterized by trailing *Ipomoea pes-caprae* and *Canavalia maritima*. Bodies of water on the coastal plain too deep for sago palms were occupied by marsh vegetation consisting largely of tangled beds of a floating fern (*Stenochlaena*).

The thermal area has been described in some detail by MacGregor (1898b) and Stanley (1920a). It lies a mile or more in from the coast and appears to be crescent shaped and about 5 miles in length. We saw only a very active part traversed for some 2 miles by a path which went southeast to Fagululu village (see p. 30), and the vicinity of a lake to the northeast of camp, called Aboma by the natives and Sulphur Lake on the maps. Towards Fagululu, three small flat valleys separated by savanna-forested ridges rose in smoking, rocky hills to the east. The first and largest flat contained an area of several acres of small cones or cracked blisters of yellow sulphur; the ground reverberated under our feet, and murmuring and low rumbling sounds came from the depths. The other two valleys had boiling mud springs and bubbling pools of water. Sulphur blows and fumaroles occurred throughout the area. A small, greenish lake had a strongly alkaline taste. Picturesque Lake Aboma, of perhaps 30 to 40 acres, lay deeply embayed between savanna forest ridges rising 100 to 200 feet from its edges. It had the green of paint rather than water and appeared to be deep. In one bay the water was gray, steam rose from it, and there was central movement, as of simmering or boiling. Ducks swam in the roily gray water when I saw the lake early one morning, stretching their wings at times as if enjoying the warmth.

Despite what seemed a careless familiarity in walking about in the thermal area, which they called *mona* (pronounced "morna"), the local natives regarded it with superstitious fear. We had evidence of this one day when, with the idea of attracting wallaby to fresh green feed, I set fire to some grass. Soon the village policeman appeared with a story that my fire had started unusual activity in the nearby thermal area. The sulphur flat was smoking hugely, he said, and hot water flowing in great quantity. Needless to say, the story was a fabrication. Probably less to be doubted was information from another source that women sometimes committed suicide (a not uncommon occurrence on Fergusson) by leaping into the boiling cauldron of the biggest mud spring.

This was an area of relatively low rainfall, with a pronounced dry season in the trade-wind period. We had variable weather. Usually the wind blew from the southeast, bringing light showers in the afternoon, but a four-day shift of wind to the northwest was accompanied by heavy rains.

The rain forest and savanna forest types of vegetation were about equal in area. Most of the rain forest on cultivable ground consisted of second growths of various ages. Some areas had gone to grass, or a man-induced savanna on which *Albizia procera* was the characteristic tree. The natives' gardens seemed never to be located in savanna forest. In physiognomy and floristics this community was depauperate Australian, a poor "tea-tree forest" in which the paper-barked *Melaleuca*, usually stunted and crooked and never more than about 40 feet tall, was virtually the only tree, and herbs and shrubs few in the grass. It was the vegetation of the thermal area. Flourishing on open ground about hot springs and fumaroles was a *Pandanus*, 15 to 25 feet high. On the edges of hot springs grew a small-tree *Fagraea* with big, yellowish, very fragrant flowers. And on dry or wet ground in this habitat shrubby *Nepenthes mirabilis* and erect clumps of fern (*Blechnum*) and sedge (*Lepironia articulata*) were prominent.

Iamelele was primarily a transport base and, biologically, one of the least productive camps of the expedition. The mammal collection consisted of 11 species: *Phalanger*

*orientalis*, *Petaurus breviceps*, *Echymipera rufescens*, *Pteropus hypomelanus*, *Dobsonia moluccensis*, *Nyctimene major*, *Pipistrellus papuanus*, *Kerivoula* (subgenus *Phoniscus*), *Pogonomys (forbesi)* group, *Rattus exulans*, and *R. ruber*. Brilliant *Ornithoptera* butterflies came in numbers to flowering *Hibiscus* in the resthouse clearing. Dragonflies of several species frequented the smaller lake of the thermal area, and two or three dusk-flying species were taken in the camp clearing.

Although the gardens of the natives were in anything but full production, we had brought to us for sale fair quantities of fresh food: chiefly sweet potatoes, pumpkins, bananas, marble-sized tomatoes, and *Gnetum gnemon* greens. However, we found the local people rather too sophisticated. In discovered misdeeds, they stole our mammal traps and got away with a good aluminum frying pan from the cookhouse.

#### MOUNTAINS BETWEEN AGAMOIA AND AILULUAI, FERGUSSON ISLAND

JUNE 5 TO 16

Whatever the altitude of this camp may have been, about 3000 feet by our faulty aneroid or 4100 feet according to the military map, it was undoubtedly the highest collecting camp of the expedition. Well situated except for water, which had to be carried up a climb of 200 to 300 feet, camp was on a bench on the sheltered north side of the Edagwaba Range, only 50 feet below the summit of a rather broad-topped eminence called Oianai. From Oianai the range fell away quickly to the west, towards Cape Mourilyan; to the east it mounted progressively in elongate eminences, separated by narrow notches, and assumed the form of a razorback, in places knife-edged and difficult to traverse, always with precipitous sides, but still entirely forested. Track was cut eastward along the crest for an estimated 2 miles, and 700 feet above camp level. Some felling of trees at camp gave a grand view of the island from Mt. Maybole to the west slopes of Mt. Kilkerran, with, in between, Lake Lavu in the interior valley, Hughes Bay, and the Amphlett Group of islands off the north coast. The island in Lake Lavu (see p. 32) bore 348° magnetic from this position.

Here we were in a wet and misty environment. For two days the weather came from the northeast; heavy rains fell at night, with strong winds; daylight hours were dull to rainy, with some mist. Southeast weather prevailed through the rest of our stay. But it was most variable weather. Mist, from tree-top to ground level, occurred in camp on eight of the 10 southeast days, its onset disparate from about dawn to 3.00 P.M., but most often 8.00 to 9.30 A.M., and lifting by dusk. Only the two mistless days were without rain; strong wind accompanied night rains. Shade temperatures in camp for June 11 to 17 were, maximum 22° to 23.5°, minimum 16° to 19° C.

In major plant communities, a mountain type of tall, fuzzily mossed, mixed rain forest, thrusting upward, occupied the bottom and lower slopes of the ravines. In the sheltered, moist bottoms of ravines it contained a dense low undergrowth of large ferns and especially herbs and soft shrubs of the genera *Elatostema* and *Pilea*, with which occurred stinging, shrubby *Laportea decumaria*.

Next in altitude was a mid-mountain oak forest, encompassing our camp spot and the top of Oianai and covering the upper parts of spur ridges down to at least 700 feet below camp level on both sides of the range. Best developed on the broader ridges and replaced on the steeper slopes by mixed rain forest, the oak forest was dominated by a species with leaves conspicuously brown underneath, with which occurred a small admixture of codominants other than oaks. Wet-looking and 80 to 100 feet high at camp, plentifully mossed on the larger trees and sparsely so on the ground, the forest on the exposed top of Oianai decreased to only 30 or 40 feet in height, with much moss on trees and ground, especially in mounds about the bases of the bigger trees, which developed short stilt roots. Numerous small ferns, and orchids, including a yellow *Calanthe* on the ground and brilliant little dendrobiums on the trees, rooted in the thick moss. A broken canopy in this stunted forest brought in a plentiful woody undergrowth and much scrambling bamboo. Common in the oak forest as a conspicuously emergent tree, going much lower on the southern slopes than on the northern, was a noble *Araucaria* (*A. cunninghamii*?). Called

*aidimola* by the Agamoia people, this striking conifer was clearly distinguishable from the sea off the south coast.

Above the oak forest, the sharp crest of the range to the east of Oianai carried a very stunted, very mossy, scrubby forest in which few trees were in flower or fruit or otherwise recognizable, but which contained, besides rain-forest elements reaching past the oaks from below, higher montane elements such as *Trimenia* and *Linociera*, and, very commonly, a small-leaved *Xanthomyrtus*. *Rhododendron konori* and another species occurred as epiphytic small trees. *Burmannia longifolia* was a common ground plant. An intensive search failed to discover *Nothofagus*, expected to occur here after having been found by us on Mt. Pabinama, and on Goodenough Island in 1953 (Brass, 1956, pp. 142, 149).

Ten species of mammals were collected here, mainly in the oak forest, those in *Phalanger*, *Petaurus*, *Echymipera*, *Dobsonia*, and *Pogonomys* being the same as at Iamelele. Large *Rattus ruber* occurred, too, and collected here but not at Iamelele were *Syconycteris crassa* and the first *Melomys* for the island. A specimen of *Uromys caudimaculatus* was brought to us from the Ukaiokaio coast. Native hunters with dogs, who camped near us for several days in a palm-leaf shelter and were paid on results, added materially to the collections, especially in *Phalanger* and *Echymipera*. They failed, however, to bring in an animal which from local reports and one glimpse caught of it by the cook we thought probably was *Dorcopsis atrata*, a small black wallaby of the mountain forests discovered on Goodenough Island by us in 1953 (Van Deusen, 1957).

Collections in other animal groups at this camp were remarkable chiefly for their paucity. The locality was notably poor in insects, although we had one good swarm night for moths, and rather numerous damselflies were collected, mainly in the forest, far from water.

The trail over the range was well traveled. We had frequent visitors from the Morima (south) coast. They came in curiosity and empty handed, or with a few bananas and sweet potatoes to sell, groups of women and children sometimes making the climb without escort. Two of our visitors were men who had

been with the Archbold Expedition on the Fly River in 1936.

In the first narrow gap on the range top to the east of camp the natives had cut a few trees to make a flyway, which they netted for pigeons. A length of rattan stretched across the gap below the net had small bunches of dry grass tied to it. Watching natives shook the rattan. The attention of the pigeons as they neared the gap was caught by the bobbing bunches of grass, and they flew into the net.

### AGAMOIA, FERGUSON ISLAND

JUNE 18 TO 25

Agamoia village, at an elevation of 400 feet on the 1-mile military map and about 700 feet on average readings of our doubtful aneroid, was situated on the rising southern slopes of the broad interior valley near the middle of the island. It was one of the Ebadidi group of villages. Farther up the valley were the Tutubeia villages. The whole area is sometimes called the Salakahadi (Salakadi of the map), but it would seem that the Salakahadi district proper includes the Tutubeia but not the Ebadidi villages. This fairly populous interior country is recruited for native labor. Government administrative and medical patrols visit it perhaps once or twice a year.

Though a small place of about a dozen houses, Agamoia was of more than ordinary importance in having a resthouse (which we used) for traveling government officers, a village policeman, and an outstation and a native teacher of the Methodist Mission. In many respects it was a typical village, sago thatched, well sited, orderly, and clean-swept, but, except for the resthouse, which had a shallow pit latrine, without sanitary arrangements other than the village pigs and chickens, which seemed effective enough in cleaning up the retiring places.

The village was made attractive by old coconut and betel-nut palms and a variety of useful and ornamental trees and shrubs such as mangoes, papayas, crotons, and *Hibiscus*. Most of the food gardens were higher on the slopes, and, as our visit was at a time of great activity in clearing ground, the majority of the people were living out of the village in garden houses. On Sunday the working

force, and the people of surrounding village communities, came in for church services, held at no particular time but on a summons beaten on some metal object when enough worshipers had gathered in the village. The Agamoia folk were most friendly and cooperative. The population included several men much older than one often sees in New Guinea.

Variable but generally cloudy weather prevailed during our stay. Heavy afternoon rains fell on the first three days. During the next two 24-hour periods the rain came in thunderstorms at night, in considerable quantity. The final two days and two nights were without precipitation.

A visit to Lake Lavu is described on page 33. Most of our collecting was on moderate south slopes of the Lilai Creek watershed. A sizable, rapid, bouldery stream in the foothills, the Lilai flowed into Ataara Creek on the lowland plans of the central valley, thence north to Hughes Bay. The flat valley lands of gray sandy loam had for the most part been cultivated. They carried secondary forest in which some big *ilimo* (*Octomeles sumatrana*) trees grew. The shifting agriculture of the natives had also led to much destruction of original rain forest on the reddish soils of the slopes and its replacement by second growths, or by grass in several open expanses of considerable extent. Some good tall primary forest survived on ridges and in gullies near the village, where a splendid *Dillenia*, with reddish papery bark, was plentiful and conspicuous among big trees.

The nearest grass patch, about a mile down the slopes from the village, had an area of 100 acres or so of ridgy terrain, treeless but for a few small examples of *Faradaya chrysoclada*. It was principally a stand of wide-ranging *Themeda australis* (the "kangaroo grass" of Australia), about 2 feet high, with which grew several minor bunch grasses, purple-flowered *Melastoma polyanthum* in abundance as a shrub, and such herbs as *Osbeckia chinensis*, *Stackhousia intermedia*, *Buchnera tomentosa*, *Crotalaria linifolia*, *Mitrasacme nudicaulis*, and species of *Pimelea* and *Haloragis*. The drier parts had been burned by the natives for hunting purposes.

Sand wallabies (*Protemnodon agilis*) shot on the grass patches at night, or about dusk

or dawn, were collected only in this area on Fergusson, although we saw them on the savannas of Iamelele and at Deidei. The presence of these grassland mammals in such widely separated, isolated areas of grass would appear to indicate either that they travel long distances through the forest, have been carried when young from place to place by the natives as pets and later escaped and multiplied, which could well have happened, even as introductions from the New Guinea mainland, or that a great replacement of grassland or savanna by closed forest has occurred since an ancient establishment of the wallaby on the island. The species commonly shelters in at least the edge of the rain forest by day. Its taxonomic study is awaited with special interest.

Two species of bats, *Hipposideros cervinus* and *Dobsonia moluccensis*, were taken from a cave called Nibothia in forest about a mile east of the village. This cave, which I did not see, was described as hidden under a horse-shoe-shaped waterfall about 40 feet high, the cave being approximately 60 feet long, its entrance waist-deep in water. The *Dobsonia* also was caught, and a *Macroglossus*, in mist nets set high beside night-blooming kapok trees (*Ceiba pentandra*) planted in the village. A specimen of the rare, spotted-tailed *mollipilosus* group of *Pogonomys* was shot at night.

When the short time of six full days spent at Agamoia is considered, mammal results were good. In addition to the species mentioned above, of which *Protemnodon*, the *Hipposideros*, and *Pogonomys* (*mollipilosus* group) were collected nowhere else on the island and *Macroglossus* was an extension of range from the mainland, a total of 11 species included *Phalanger orientalis*, *Petaurus breviceps*, *Pteropus hypomelanus*, *Nyctimene major*, *Pipistrellus papuanus* (which showed wonderful facility in avoiding the nets but was shot in the village clearing), *Pogonomys* (*forbesi* group), and *Rattus ruber*.

#### DEIDEI, GOMWA BAY, FERGUSSON ISLAND

JULY 2 TO 7

The Deidei government resthouse, in which we took up quarters, was at a hamlet called

Falagwa on the 1-mile military map (Fergusson Island East 1297), on the coast of the upper Bwaioa Peninsula and near the head of the bay. Small, though comfortable and dry, the resthouse had the unusual feature of floor coverings of soft *Pandanus*-leaf matting. The regular barrack house for police and other native personnel was provided, and nearby was a spring house, carefully barred so that only small pigs and dogs could get to the water.

The Bwaioa Peninsula is the southernmost part of Fergusson. It also appears to be the driest part. Rainfall must be adequate for food crops, for the peninsula carries a numerous native population, but apparently conditions are too dry climatically or edaphically for the development of good rain forest. We had the misfortune to be there during a spell of dirty southeast weather which turned northeast, torrential and sustained rains coming from both quarters and seriously interfering with our field work.

The Bwaioa country is volcanic. A thermal area is located inland at the base of the peninsula, less than a mile from Deidei. Mt. Oiau, rising to 1200 feet near the center of the peninsula, is an extinct or dormant volcano. Stanley (1920b, p. 77) reported that volcanic ejectamenta comprised nearly the whole of the peninsula and contained an enormous amount of pumice. MacGregor (1898b) remarked upon the fertility of the "brown mould mixed with pumicestone" and the exceptional skill of the natives in cultivating it. On the east coast, much broken coral rock is raised in low headlands and hillocks, and big old *Calophyllum inophyllum*, *Terminalia catappa*, and *Barringtonia speciosa* trees lean out over narrow beaches of dark gray sand.

Different in character from that of Seymour Bay, the thermal area had big boiling springs from which rose clouds of steam unaccompanied by the appearance or smell of sulphur. The hot springs seen were in two closely adjacent groups, not a hundred feet above sea level. The first in from the coast, probably the more extensive but called "Number two," consisted of a low, domed shield of resounding hard gray siliceous sinter, an estimated 100 yards across, through which water boiled in many openings, and more boiling water could be seen by peering into

holes and fissures. In other parts the sinter shield had caved in, leaving dry holes or merely cracked concavities. In one place my guide scratched about under a cornice and brought out a white, crystalline substance with the taste of common salt. The pool highest on the dome, perhaps 30 feet in diameter, was used on occasion for cooking food, and we found our laundry being boiled in it. In the second group, called Seoseolino, or "Number one," an apparently senescent geyser, at intervals of a minute or two spouted 5 or 6 feet in height, with much steam, from an irregular raised cone; below it was a terraced slope colored a rusty red. There are reports of much stronger activity here in the past, when two or three geysers threw to a height of 60 feet.

North of the thermal area, on the uninhabited slopes of volcanic Mt. Masai-ia, is rain forest; about the hot springs and to the south of them on the higher ridges of the peninsula is mostly *Melaleuca leucadendron* savanna or savanna forest. The lower ridges and the valleys seen on the peninsula appeared to have been rain-forested originally, before clearing and cultivation. They were overrun by coarse grasses and scattered trees and shrubs, and small patches of second-growth rain forest occurred. The only primary rain forest observed was on uncultivable swampy ground near the sea. The gardens were big, well fenced against pigs, and planted mainly to yams.

The chief purpose of our short-term visit here was the examination of the savannas for mammals and plants, but the wet weather prevented a satisfactory achievement of this. Plants fell far short of expectations, but, weather notwithstanding, mammals came in well from traps, local natives, and limited night hunting. No addition to our previous total of 18 mammal species for the island was made by the nine species collected here: *Phalanger orientalis*, *Petaurus breviceps*, *Echymipera rufescens*, *Pteropus hypomelanus*, *Pipistrellus papuanus*, *Pogonomys (forbesi) group*, *Uromys caudimaculatus*, *Rattus exulans*, and *R. ruber*. We knew that *Protemnodon agilis* occurred in the savannas and grasslands and *Dugong* in the bay, but efforts to collect them were not successful.

## NORTH SLOPES OF MT. SISA, MISIMA ISLAND<sup>1</sup>

JULY 16 TO 31

Mt. Koiatau, highest peak on Misima, rising to 3400 feet where the island had a width of only 2 to 3 miles, was on a ridge so very steep, so very narrow, and obviously so limited in scope as to be considered unlikely to repay the effort of climbing it. There is no record of a white man's having gone to the summit or attempted the ascent. Reports are that the mountain is unvisited by natives and therefore trackless.

The easy approach to 1435-foot Mt. Sisa, highest peak on the eastern part of the island and source of all the main streams there, is described on page 34. The locality in which we established ourselves, in a tight house of galvanized iron about 1150 feet above sea level, was called Mararoa. From it we looked down to the sea, near Boiu village, 2 or 3 miles to the north-northeast. Nearby, in a steep-sided little ravine, Ara or St. Patrick's Creek, on which the first good strike of alluvial gold on Misima was made in 1889, had its main headwaters in a stream called Gagum, thence flowed to the sea through rugged country to the northwest. From near camp, in clear weather, we had a good view along the backbone ridge of the island to Koiatau and lesser western peaks. The ridges and valleys in that direction carried what appeared to be good primary forest.

Mararoa had a wet climate, mistier than is usual for such low altitude. Variable southeasterly weather prevailed during our first six days there, most of the little rain coming in pre-dawn showers. Then followed a six-day spell of unpleasant mist and drizzle, with heavy, often squally, rain almost every day and night, and only short bursts of sunshine. The trampled clayey ground at camp became an inch deep in slush; several of our natives became sick with colds and malaria. In sunshine, the air had a sparkling quality, perhaps from the glint of the generally smooth leaves of the forest canopy trees. The hurricane of 1952 (see p. 14) had greatly

<sup>1</sup> The name "St. Aignan," given to the island by D'Entrecasteaux in 1793, is no longer in use.

damaged the forest of the upper slopes of Mt. Sisa.

Camp was on a belt of slope from which the original forest had long been removed in gold-mining operations. Concealing numerous old mining shafts, prospecting pits, tunnels, and trenches was a dense, tangled growth of *Gleichenia* and other ferns in which grew scattered shrubs and young trees and, in gullies, many handsome tree ferns (*Cyathea*). In the rather hazardous work of opening up old pack trails of the miners, one of our natives stepped into a deep shaft but saved himself by clinging to the fern that concealed it.

Good primary forest began a short distance down the slopes and appeared to extend to the sea; it also occupied the upper parts of Mt. Sisa. This, on gently sloping ridge points of yellowish clay, at about the 1000- to 1100-foot level, was mid-mountain forest of *Castanopsis* and oaks, characteristically open or at least easy to get about in under the canopy, the most abundant undergrowth elements being a dwarf *Pandanus* with round red fruit heads, a very slender little *Cyathea*, and several stiff ferns. Occupying reddish soils above and below these isolated occurrences on the slopes were mixed rain forests in which a dipterocarp called *rul* by the natives (*Hopea glabrifolia*) figured prominently, and species of *Schizomeria*, *Metrosideros*, *Gynotrochus*, *Elaeocarpus*, *Lophopetalum*, *Buchanania*, *Ternstroemia*, *Mastixia*, and other genera were present in the canopy layer. An abundant, uniform, low undergrowth of a slender *Freycinetia* and a delicate *Selaginella* characterized this forest on some ridge crests. Other selaginellas were prominent with ferns in the ravine of Ara Creek, but the bed and banks of the stream had been much altered by miners working gold, and the flora perhaps had been reduced. The apparent absence of climbing *Calamus* or rattans accentuated a dearth in palms, of which only *Caryota rumphii* and another representative were encountered. Many trees and other plants in flower or fruit in the forests made conditions very satisfactory for botanizing.

A good collection of mammals from this camp comprised 15 species, 10 of them bats, the others being variable *Phalanger orientalis*,

small *Petaurus breviceps*, *Rattus exulans*, *R. ruber*, and, most interesting of all, a small, sandy brown *Melomys*. The bats were *Pteropus hypomelanus*, *Dobsonia moluccensis*, *Syconycteris crassa*, *Nyctimene major*, *Rhinolophus megaphyllus*, *Miniopterus schreibersi*, *M. australis*, *Hipposideros diadema*, *H. cervinus*, and *Aselliscus tricuspidatus*. Bats of the last five species were taken by Peterson on a visit to mine tunnels at Kulumalia on the south slopes of the island. *Syconycteris* was easily caught in nets set in forest pathways. Some of the phalangers were brought to us by natives from the coast. An extensive search in the forests for *Pogonomys* was unsuccessful.

Four species of snakes were collected, also a gecko, several skinks, including a slender, blue-tailed species common on paths and in other open places, and several species of frogs. Ara Creek yielded shrimps of two species. Insect collections were satisfactory, considering the adverse weather conditions experienced, and included some fine butterflies very distinct from any seen in the D'Entrecasteaux Group. Sandflies were a nuisance in the evening.

The mountains were uninhabited, but people of Boiu and some from the south coast visited our camp, bringing a variety of garden produce, eggs, and fish for sale. They were a likable people, very clean in person and dress, and well able to express themselves in English.

## NARIAN, MISIMA ISLAND

AUGUST 1 TO 13

This camp, some 3 miles west of Bwagaoia, was given the name of Narian village, although situated a quarter of a mile west of the village on the east bank of Cooktown (or Sawaia) Creek. Placed in a partial clearing in rain-forest second growths, a couple of hundred yards in from the sea, it was a comfortable camp, protected from sun and wind by the second growths, *kinai* nut trees (*Canarium*), and young coconut palms. The creek, a pleasant, open, gravelly stream with narrow alluvial terraces, could be followed easily for some distance inland by a native garden path, for, as do all the larger streams



we saw on Misima, Cooktown Creek, though deeply downcut in a steep-sided ravine, flowed on a gentle gradient. The dirt motor road we had followed from Bwagaoia continued for a mile or so west to a gold-sluicing show on Bwanitum Creek and Tauhik landing place on the coast, and inland to an abandoned gold mine at an elevation of 400 feet on Quartz Mountain, about 2 miles from camp.

The coast consisted of a series of bold, flat-topped, cliffed headlands, around 100 feet high, with between them either steep sandy beaches, often rough with coral lumps, or a level shelf or terrace of coral rock rising directly from deep water and not much above high tides. Unhindered by any reef, seas raised by the southeast wind pound incessantly on this coast for months on end, but in favorable weather landings are possible in more or less sheltered coves, as at Tauhik and the mouth of Cooktown Creek. The headlands are undercut by wave action and contain many fissures and caves. Undercut vertical cliffs also rise back from the sea a little, indicating a former shoreline. From the terraced coral limestone of the coast the ground rises rather steeply to the mountains of the interior, which are of metamorphic and igneous rocks. A government path follows the coast to the west. On it the cliffed sides of the headlands are scaled by ladders. With even a moderate sea and a low tide, spray goes over the road where it skirts the water under cliffs.

The climate here seemed much drier than on Mt. Sisa, but Bwagaoia's average annual rainfall of 123 inches was perhaps equaled at Narian. Eight of the 11 full days we spent there were without rain; pre-dawn showers fell in two 24-hour periods; on one day we had steady, hard rain accompanied by strong, squally, southeast wind. Although mostly from the southeast, and moderate, the wind varied from east to south and southwest, some of the strongest being from the southwest.

All the coastal slopes and the small valleys had been deforested by a rather numerous native population and occupied by brushy second growths in which patches were cleared for the shifting food gardens. Along the coast were several coconut plantations, the smaller

of native ownership, two larger ones owned by Europeans. The second growths contained *Macaranga*, a genus of quick-growing small trees which usually dominates the community in the New Guinea region, but here *Kleinhovia hospita* was of first importance, and yellow-flowered *Hibiscus tiliaceus* very abundant.

Good primary rain forest occurred on the mountains and was examined on Quartz Mountain. The coral limestone cliffs of the coast yielded many interesting plants found nowhere else on the expedition. In a locality called Tutubia, close to the west of Bwagaoia and under the mountains which there began to rise perhaps half a mile from the sea, was an area of *Melaleuca leucadendron* savanna, also 100 acres or so of undulating open grassland which may have been either savanna or rain forest originally. A rather heavy soil carried fragments of white quartz. The melaleucas, called *giginivana* by the natives, formed thick-boled trees 30 to 40 feet tall. *Imperata cylindrica* (baldy-grass or *kurukuru*) provided most of the ground cover on the savanna, *Themeda australis* (kangaroo-grass) on the open grassland. Associated herbs were mainly those of the habitats on Fergusson Island.

A total of 13 mammal species collected here lacked only *Phalanger*, *Nyctimene*, and *Melomys* of the Mt. Sisa area. New for the collection, and making 16 species for Misima, was *Hipposideros cupidus*, one of five species of bats taken from a cave near Ehaus (see p. 34). Bats were also taken from a large cave called Kebu-bwa on the edge of Coppard's plantation to the east, and from the Quartz Mountain Mine. Previous to our visit, only four species of mammals (*Phalanger orientalis*, *Pteropus hypomelanus*, *Rhinolophus megaphyllus*, and endemic *Kerivoula agnella*) appear to have been known from Misima.

#### JOE LANDING, SUDEST ISLAND<sup>1</sup>

AUGUST 15 TO 23; SEPTEMBER 6 TO 8

Sudest, by far the largest island of the Louisiades and the lowest in average elevation, holds three principal types of environment: (1) the primary forests of the hills and

<sup>1</sup> "Tagula," a native name for the island, has passed into disuse.

lower mountains (true lowlands are represented only by narrow coastal fringes and the lower valleys of the larger streams), (2) secondary grasslands which have replaced the above forests as a result of human disturbance, and (3) forests of the higher mountains. A feasible itinerary precluded an examination of the western end of the island, the northern slopes of which are largely grassy. Behind an abrupt coast at Joe Landing, however, were bald grassy hills aggregating several square miles in area, and behind them a mile or two from the sea, the unbroken forests of the interior. Strips of primary and secondary rain forest remained in ravines in the grasslands, and behind a narrow belt of mangroves along the coast. Primarily, Joe Landing was our point of approach to the mountains. From it native trails, used by pig hunters and gatherers of "Sudest gum,"<sup>1</sup> penetrated to the slopes of Mt. Riu, highest peak on the island.

The name Joe (not Joe's) Landing probably survived from the early gold-mining period (see p. 18) for a village which also had the native name Inagailau. It was a prosperous-looking small place of seven dwellings and a government resthouse, built in a gap in the mangroves which fringe most of this north coast. A shingly beach fronted a narrow, clayey foreland upon which a rocky streamlet debouched from the hills. About a mile inland and 400 feet above sea level was Erinamoia village with 15 houses. A government path followed the coast east and west; another crossed the island to Hinai Bay on the south coast. Responsible for law and order in the general area was Village Policeman Bom, a genial man of middle age and small stature, covered all over with the unsightly, scaly, ringworm infection (*Tinea imbricata*) called *sipoma* in the Motu lingua franca.

Small amounts of copra, black-lip pearl shell, and "gum" were sold to white traders who called in occasionally on boats. The village had many pigs, which, with sago, and baskets made by the women, were traded for clay cooking pots, and seemingly coin of the

realm, to Brooker Island, 70 miles to the west in the Calvados Chain. A big, new, built-up, sailing canoe had been bought from this island for five pigs, 200 pounds of sago, 20 baskets of garden produce, and £40 in cash. Some of the Brooker pottery perhaps went to continue an ancient trade with Rossel Island (see p. 20). This trade survived at least as regards the exchange of red-breasted parrots (*Lorius loratus*?) from Sudest for the shell money called *bagi* or *sapi-sapi* from Rossel, the price for a parrot being a string of shell money worth up to £6, according to Bom.

At Joe Landing we were on the lee side of the island in the southeast season, probably in a rain shadow, certainly in August and September in a dry season of the year. The trade winds reached this coast only as a deflected, cooling breeze. At the time of our arrival, the stiff gray soil of the gardens had become dry and hard, and the crops were suffering from want of rain. But soon this situation was relieved by two days of intermittent heavy showers, attributed to sorcery, whether by the professedly Catholic community of Joe Landing or the Methodists of Erinamoia, my notes do not record. Two days after the rain, old grass was again dry enough to burn.

A plentiful flowering and fruiting in the forests favored botanical collecting, which, for a locality extensively deforested and occupied by migrant grasses and herbs of few species, yielded unexpectedly good results. The forest flora appeared to contain a strong endemic element, besides a considerable number of plants hitherto found by us only on Misima, and, apparently, Louisiade endemics. An oak appeared on ridges at about 500 feet but not in quantity sufficient to characterize the forest. In the prevailing mixed rain forest of not high timber volume *Hopea glabrifolia* was one of the commonest trees on ridges, *Vatica papuana* the commonest in gullies inland. A shaggy-barked *Syzygium*, in profuse flower, made innumerable, conspicuous white patches in the forest roof. Other canopy trees included species of *Parrinari*, *Gordonia*, *Buchanania*, *Dillenia*, *Fagraea*, and *Weinmannia*. An unusual feature of the subsaline ecotone between rain forest and mangroves was the common occurrence,

<sup>1</sup> The resin of two species of Dipterocarpaceae: a reddish kind from a *Vatica* species, a tree called *quimbur* by the natives; a whitish kind from *Hopea glabrifolia* called *walei*.

on crab-holed clayey gray mud, of a slender tree fern (*Cyathea*) and with it, on slight hummocks, a very big form of *Asplenium nidus*, a fern normally epiphytic.

The almost treeless grasslands of the hills carried a soft cover of *Themeda australis*, knee high or less, accompanied by a few minor grasses and a few herbs which also occurred on Misima and Fergusson Island, but here was found *Velleia spathulata*, an Australian element of the Goodeniaceae hitherto known in the New Guinea area only from savannas west of the Fly River, on the mainland, over 700 miles from Joe Landing.

As with plants, mammal collecting had to be wide-ranging, and results were good, except from traps. Collected in familiar species were a very dark form of *Phalanger orientalis*, *Pteropus hypomelanus*, *P. conspicillatus*, *Dobsonia moluccensis*, *Nyctimene major*, *Miniopterus schreibersi*, russet *M. australis*, large *Rattus ruber*, and small *R. exulans*. Trapped on the ground were two immature *Melomys*. Taken always from hollow trees, and very different in appearance from the D'Entrecasteaux species, was a *Pogonomys* of the *forbesi* group. Good series of both species of *Miniopterus* were taken by Peterson from an old mine tunnel in the mountains several miles to the south or southwest. *Nyctimene* fed in numbers in fruiting *Jambosa* trees in the village, but very few insectivorous bats were seen at Joe Landing, a scarcity probably correlated with an extraordinary dearth in insects.

#### WEST SLOPES OF MT. RIU, SUDEST ISLAND

AUGUST 23 TO SEPTEMBER 6

Also called Mt. Rattlesnake for the survey ship "Rattlesnake," which visited the Louisiades in 1849, Mt. Riu, 2645 feet, is a sharp peak which stands well above any other on the backbone ridge of the island, closer to the south coast than to the north. The vegetation of its upper levels indicates a high incidence of cloud cover. In native legend (White, 1894), the mountain is the spirit abode of the Sudest people. There also the principal god dwells among the clouds, with wives and gardens, but indistinguishable to mortal eyes because his form is as mist.

The elevation of the camp was estimated as about 1000 feet. Situated on a knoll on a spur ridge close to a small, running stream, it was at the highest place where Evennett could find water on his reconnaissance of the peak. After a trail had been opened, the top of Riu, not visible from here but about 2 miles distant on a bearing of 105° magnetic, could be reached comfortably in about 90 minutes, excluding rest stops. Although very steep in places, most of the ascent was too gradual to be called a climb.

Here we were in a wet climate. Much rain fell during our 13-day stay, chiefly between midnight and dawn and in the afternoon. Some days were overcast by clouds driving from the southeast, with showers; others, bright and clear. We had trouble in drying clothing and mammal specimens, but upon return to Joe Landing, less than 6 air miles distant, we found that mammal specimens left in the resthouse on pinning boards without attention, had, in the much less rainy and humid climate there, dried perfectly in our absence.

Our spur ridge began several hundred feet below camp, where a hunting path we followed from Joe Landing crossed a sizable stream called Esilava. Above camp a little it bent sharply north away from the peak, around the basin of another big stream which joined the Esilava to flow into Hinai Bay. Where the spur again turned towards Riu, about 400 feet above camp level, the unrecognizable site of a former village, called Jimijimabata, was pointed out by native guides. A small, pure stand of multi-stemmed low oaks was passed through at about 1600 feet. A *Dacrydium*, strikingly coniferous in appearance, came in about here in mixed low forest and continued to about 2000 feet. The hunting path ended there, in a notch in which 12-foot growths of fern indicated disturbance, and it was assumed the Eichhorns (see p. 26) camped on this spot in 1916, although we could find no water. The Eichhorns probably went higher on the mountain, but no sign of a path and no knife cuts were seen in our three hours of hard track cutting to the summit.

The appearance of the *Dacrydium* had marked a changing composition and the beginning of a progressive stunting of the for-

est of the spur crest. A very mossy elfin-wood, 8 to 15 feet high and more or less wind-clipped, began at a deep notch and prominent false peak at about 2300 feet and continued to the summit. Important components of this included species of *Mearnsia*, *Calophyllum*, *Drimys*, *Timonius*, *Ardisia*, and two Lauraceae (one with anise-scented bark), but *Nothofagus* could not be found. A scattered, emergent, pinnate palm recalled those of mountain tops in the D'Entrecasteaux Group. On the summit (a circular, fairly level area about 30 feet wide) in growths stunted to a stiff scrub and in similar places lower on the peak grew a fine *Rhododendron*,<sup>1</sup> with fragrant white flowers.

At camp level we were at about the middle altitudes and probably the climatic optimum of the great, continuous rain forest that covers most of the island. But through geographical attenuation, poorness of soil, or a combination of these and other factors, the forest could not be called rich. Almost everywhere, only a very shallow layer of litter and humus covered a stiff, yellow clay. The big trees spread innumerable stout roots only partly covered by soil, to the discomfort of travelers on worn paths. The forest contained a fairly good variety of canopy and lesser trees, but was very poor in undergrowth species, lianes and epiphytes. Only on open banks of Esilava stream was there approach to luxuriance with the occurrence of numerous large ferns, and big-leaved herbs, shrubs, and undergrowth trees, such as *Marattia*, *Cyathea*, *Stenochlaena*, *Begonia*, *Elatostema*, *Polia*, *Cominsia*, *Piper*, *Saurauia*, *Dolicholobium*, and *Gironniera*. Only a scattering of forest trees was in flower.

Lines of about 150 traps and 25 snares yielded not a single mammal; night hunting gave little despite good terrain, forest easy to get about in, and usually clement weather. Two of the five species collected (*Phalanger orientalis*, *Pteropus hypomelanus*) had been taken at Joe Landing; another (*Petaurus breviceps*) was heard there. A *Pogonomys* (*forbesi* group) differed from the Joe Landing animal in being gray rather than brown and

having a black tail instead of brown. *Syconycteris crassa* was new for the island.

The slack time in mammals led to some diversion of effort to other vertebrates, and a good collection of frogs included the new hylid species *Nyctimystes perimetri* (Zweifel, 1958), also *Hyla* species, *Asterophrys* species, *Metopostira ocellata*, *Baragenys* species, *Oreophryne* species, *Cophixalis oxyrhinus*, *C. verrucosus*, and *Rana* ?*grisea*. Although scarce in the deep forest environment, several species of skinks and two of snakes (*Dendrophis* (*Ahaetulla*) *calligaster*, *Aspidiomorphus schlegheli*) were collected.

Our natives, hunting at night, caught eels in the streams. Evennett contributed, from his night hunts, two species of crayfish-like prawns, one large and brown and resembling a species taken on Misima, the other, found clinging gregariously to rocks in very fast water, small and bluish, with a red mark behind the head. In insects, only a few butterflies and Odonata were caught; light-trap material contained a rather rich assortment of beetles, but few moths. A fine specimen of a giant brown moth with windowed hind wings, *Coscinoscera hercules*,<sup>2</sup> came in to the light one night. Sandflies infested the camp at times, especially in the early morning. Small brown land leeches, picked up by our natives on their bare legs, were a pest in the forest after rain.

## RAMBUSO, SUDEST ISLAND

SEPTEMBER 8 TO 25

At Rambuso on the north coast, 18 miles from the east end of the island, a snug and picturesque small harbor is entered through an opening in the reef opposite the outflow of Rambuso or Proclamation Creek. The coast is less steep-to and climatically wetter than at Joe Landing. Between the sea and a backdrop of dark mountains, 1590 feet high in Mt. Imau and 1950 feet in an eminence unnamed on the chart (British Admiralty 2124, Louisiade Archipelago), rise hills completely forested except for a few garden clearings, some second growths, and one or two small grass patches near the coast. A larger grass area, back in the mountains, is visible only from a

<sup>1</sup> The easternmost known extension of *Rhododendron* into the South Pacific; being described as a new species by H. Sleumer, Riksherbium, Leiden.

<sup>2</sup> Identified by Dr. Charles L. Remington, Yale University, from a color photograph.

distance out at sea. Mangroves edge the harbor and much of the outer coast. What is a barrier reef at Rambuso Entrance becomes a fringing reef a short distance to the west, fronting a broad flat of dead coral, strewn with coral boulders and partly dry at low tide.

We anchored in 4 fathoms off a small gravel beach on the west side of the harbor, tied a sternline to a stump ashore, and could almost step onto the land at a resthouse built on a strip of dry ground between a narrow, eroding beach on the seaward side and a belt of tall mangrove forest inland. Rambuso Creek, flowing through the mangroves close by, provided an excellent water supply. Beyond the creek, the tall mangrove forest had been cut down some years previously. A rickety catwalk of mangrove sticks, several hundred yards in length, led over the logs and mud of the felled area to near the head of the harbor, where Valavela Methodist Mission (see p. 9) occupied the top of a steep, small hill surrounded by food gardens. Another long, weak catwalk carried a government path through a mangrove area west of the resthouse, beyond which most of the native population lived on bits of sandy beaches where canoes could be hauled ashore. About 2 miles west of the resthouse was a small coconut plantation, European-owned but worked by natives. Varivarai village of eight houses stood on high ground on the east side of the harbor, and from it a neglected government path went eastward through ridges forested to the mangrove fringe. A native trail crossed the island from Rambuso to Rewa Bay on the south coast, a reputed six-hour walk.

We had much showery weather here, mostly from the southeast and in the morning. No great amount of rain fell, but only four 24-hour periods were without rain. Beginning on September 20 were several days of high cloud drift from the northwest. A change of season was approaching, from the southeast trades to a period of shifting winds and calms, before the onset of the northwest monsoon. A distinct rise in temperature was noted when the wind dropped.

Limited to the west side of the harbor and the attractive lower valley of Rambuso Creek, a small coastal plain, where well drained, was partly under gardens, and all

had been cultivated. In very tall forest on semi-swampy ground *Pterocarpus indicus* was an abundant tree, scenting the air and strewn the damp ground with its yellow flowers; *Donax canniformis* provided most of a very tall herbaceous undergrowth.

The lower 100 to 200 feet of the slopes had to some extent been cleared for gardens, although the stiff, yellowish soil seemed far from fertile. Very poor at first, the primary forest of the slopes improved generally in composition, height, and timber volume with altitude and distance from the coast. The *Vatica* "gum tree" grew commonly in hollows near the sea; an oak appeared in moist, slightly mossy forest at about 500 feet. As elsewhere on Sudest, palms were poorly represented. Most of the forest trees were in sterile condition.

The grass patches near the coast were not examined. The inland grass area, about 3 miles to the southeast of Rambuso and an estimated 1000 feet above sea level, had a remarkable setting of low forest comprised chiefly of a *Dacrydium* and a *Casuarina* that looked coniferous, a forest very like the sub-alpine of New Guinea in appearance. The grassland, on gray, sandy, probably acid soil, rolling, and at least 100 acres in extent, was dominated by a fine-textured species, sterile and only ankle high. Among associated herbs, an *Eriocaulon* and *Leschenaultia filiformis* were found only here on the islands. An outcropping, brown, slaty rocky was so soft that it could be kicked to pieces. The grass area undoubtedly was the site of a settlement long since abandoned.

Only three species of mammals (*Phalanger orientalis*, *Petaurus breviceps*, and *Pteropus hypomelanus*) were known from Sudest before our visit. A total of 12 species collected at Rambuso added nothing new for the island or our own collections of 13 species from there. Notable, however, were a series of *Rattus ruber*, which infested little Boboa Island on the barrier reef, and a mature specimen of the light brown *Melomys* of the island, trapped in primary forest on the lower slopes. From reports of depredations on the mission teacher's chickens, the presence of marsupial "cats" (*Satanellus*) was suspected, but steel traps failed to catch one. *Pteropus hypome-*

lanus was in a breeding season and carried well-furred young of various ages.

Light-trap results in insects were extremely poor in the sea beach and mangrove environment of camp; sandflies and mosquitoes, moreover, were not troublesome. The valley of Rambuso Creek proved a good catching ground for day-flying insects, the variety in butterflies being such that species new to the collection were brought in almost every day.

Netted in sandy and gravelly pools of the creek were eight species of fishes: *Ophiocara aporos*, *Eleotris fusca*, *Sicyopterus taeniurus*, *Mugil* species, *Pseudomugil novae-guinae*, *Anguilla mauritiana*, *Harengula longiceps*, and *Periophthalmus koelreuteri*. Great schools of sardines entered the harbor and cruised in the shallows, under attack by birds, especially cormorants and white terns, and by natives with nets and spears.

One of the two species of snakes collected on Mt. Riu (*Aspidiomorphus schlegeli*) also occurred at Rambuso, and, in addition, *Candoia (Enygrus) carinata*, *Dendrophis (Ahaetulla) lineolatus*, and *Boiga irregularis*.

The call of the frogmouth (probably *Podargus ocellatus meeki*, the only frogmouth known from the island) differed markedly from any I had heard elsewhere. It began with a succession of bubbly sounds, consisted in the main of familiar frogmouth vocalizations, and ended with two or three sharp, quick clashes of the bill.

At Rambuso we had unusually close contacts with the local natives, and it soon developed that our zoological activities, heralded along the coast, were under suspicion. The people could agree to our collecting cuscus (*Phalanger*) and flying foxes (*Pteropus*) to sell to them in cans, but they did object strongly to such commercialization of the meat of rats! With the establishment of confidence, more visitors came to camp, and the flow of garden produce for sale increased rapidly. With sweet potatoes, taro, cassava, bananas, papayas, pumpkins, limes, and sweet-potato and pumpkin greens from the natives (they were just planting their yams), fish from the reef and the sardine schools, and blue pigeons (*Ducula*) from the forests, with the addition of cuscus and flying-fox meat for native personnel, we fared well in the important matter of fresh food.

## ABALETI, ROSSEL ISLAND<sup>1</sup>

SEPTEMBER 26 TO OCTOBER 11;  
OCTOBER 29 TO 30

At Abaleti on the south coast, Gware Passage in the barrier reef gave entrance to a sheltered bay affording good anchorage for small ships. Into this flowed Yeve Creek, obstructed by a sand bar at its mouth, but deep inside and 50 yards or so wide. About half a mile from the sea, on the western bank, were a covered slipway, large workshops for boat building, and the various buildings of a well-established planting and trading headquarters. The big old house of the Osbornes (see p. 20) and a new one stood on a terrace about 200 feet up on the rise of the mountains behind the plantation. The government rest-house in which we lived was at an elevation of 150 feet on the eastern side of the creek, near a native medical aid post.

Appearing dark blue when not hidden in cloud, about 2000 feet in general elevation and rather level-topped, the mountains rose rapidly inland. A small village stood in the shade of great littoral trees and coconut palms on the low east shore of the bay. Another, Naideta, was located about a mile up the creek, at the head of tidewater, and the entrance to a fairly extensive low valley secluded in the mountains. A track went over the mountains to Jinju on the northeast coast, four or five hours of travel from Abaleti.

Unfortunately, rainfall records have never been kept at Abaleti. As a result of clouds' being bottled up in the valley of Yeve Creek and condensing on the mountains, precipitation is very heavy, conceivably in excess of 200 inches a year. Very heavy rains fell during nine of the 14 days of our first stay, but with the petering out of the trade winds in the first week of October, the weather became notably less rainy, and on October 9 it was observed, for the first time, that the reddish clayey ground of our path down to the creek was not muddy. We were informed that little rain fell during our absence from October 12 to 29.

Most of the bay shoreline consisted of gray sand beaches. Mangroves and nipa

<sup>1</sup> The island is called Yela by the Rossel natives, Roua by the Sudest people.

palms (*Nipa fruticans*) lined the banks of the creek, for the most part, up to tidal limit, although the water stayed fresh, or nearly so, through our visit. The landing place for the resthouse was in a small side creek entirely roofed over by magnificent mangrove forest of tall, straight, rough-barked *Bruguiera* trees. Away from the plantation, which occupied both flats and slopes, the limited amount of level ground in the area was mostly swampy and the habitat of sago palms. The inner Yeve Valley had been greatly disturbed by native cultivation and by cattle and held second-growth forest, bits of sago swamp, and quaggy, grassy glades grazed short by the cattle. The rain-forest second growths contained, besides expected dominants such as *Macaranga*, *Glochidion*, *Ficus*, *Piptadenia novoguineensis*, and *Commersonia bartramia*, species of *Acronychia* and *Ilex* as small trees.

Trails had to be cut to open up for our work most of the primary forest of the slopes, for the natives seemed not to travel far from their gardens and canoes. The forest, however, was easy to penetrate; the slopes were not overly steep. The trees had a well-grown appearance, and some attained large size. But accounts, widely circulated, of the extraordinary wealth of the Rossel forests proved mythical. Few trees bore flowers or fruits to make collectable botanical specimens, and the rains hampered our field work, but the forest, examined up to an elevation of about 1000 feet, was a forest poor indeed floristically, from canopy layer to ground plants. An undergrowth often luxuriant with palms, including attractive juveniles of a tall, fan-leaved *Livistona* and, in gullies, tree ferns (*Cyathea*), nevertheless contained few species, woody or herbaceous. A pendent *Lycopodium* and a few ferns and orchids were common epiphytes on creek banks. The "Rossel Island orchid," *Dendrobium atropurpureum* (see p. 26), also found by us on Sudest and Misima, apparently had been over-collected for export, for few plants were seen here. A *Vatica* from which resin was collected, common on both flats and ridges, seemed identical with the Sudest species. Small pure stands of an oak occurred less than 100 feet above sea level; spindly specimens abounded in mixed rain forest on a ridge crest at about 1000 feet.

For time spent, Abaleti was our least productive lowland camp for mammals, with nine species collected: *Phalanger orientalis*, *Pteropus conspicillatus*, *Dobsonia moluccensis*, *Nyctimene major*, *Syconycteris crassa*, *Hipposideros cervinus*, endemic *Melomys arciium*, *Rattus exulans*, and *Dugong australis*. Most of the specimens of *Hipposideros* were collected by Evennett from rock fissures on the slopes of Mt. Rossel, and by Hugh Osborne in Yongga Bay on the west end of the island. All individuals of *Rattus* were trapped by Evennett on small Loa Island (see p. 36), except one, which was caught in the resthouse, with bread for bait. Our three *Melomys* specimens also call for special comment. One, claimed as shot by a native retainer, bore the marks of someone else's trap; a juvenile was caught by hand one night at our waterplace stream in a forest clearing; the third, shot in primary forest, came in minus its head. The dugong, a big female carrying an almost fully developed male fetus, was shot in daylight by the Osbornes in shallows within the reef.

Though kept in tight, friction-top cans, our pre-mixed "museum" mammal bait of ground ham, raisins, oatmeal, and peanut butter had perhaps lost some of its early attractions by this time, although the same bait brought better results at some subsequent camps.

Our one really productive activity was in light-trapping for insects. The "butterfly boy" somewhat made up for meager catches of Lepidoptera and Odonata by bringing in large numbers of spiders. (The entrance to the inner Yeve Valley would probably have been a better location for insect collecting, although rainfall there, as we observed it in the southeast season, exceeded that of Abaleti.) We saw no land leeches. Sandflies, however, were an ever-present nuisance in daylight hours.

#### SOUTH SLOPES OF MT. ROSSEL, ROSSEL ISLAND

OCTOBER 12 TO 20

Rossel orthography is difficult. The native name for Mt. Rossel sounded like "Mber" or "Mbwer" to me. An ethnologist, who studied the people, wrote the name as Ngwö (the



“ö” pronounced as “er”). The mountain, he states, was made by the local supreme deity, Wonajö, who lives there and on Loa Island. The clouds that almost perpetually cover the peak are the ashes of the first fire, made by Wonajö, which he threw into the sky to conceal the island from the older land of Sudest (Armstrong, 1928, p. 127). It is recorded that pilgrimages were made to the mountain top, and we found there transported sea shells and pieces of coral.<sup>1</sup> But from the fact of our being obliged to cut track to the summit, it might be concluded that at some time after the introduction of Christianity to the island, which would appear to have been in the 1920's, Wonajö lost his power.

Our mountain camp was at an altitude of around 2300 feet in a saddle on the main central ridge of the island. The sharp, narrow summit of Mt. Rossel towered abruptly to 2750 feet, less than half a mile away on a bearing of 25° magnetic. From the saddle, the ridge curved southwest and west, rising only 100 feet or so, and broadening a little. A worn old track, connecting Jinju with Abaleti, passed over the saddle, but the track then in general use crossed the ridge some distance to the southwest. The ridge top at camp was just wide enough for a line of tents and flies, and rough with rounded rocks. Members of the Osborne family had camped there as early as 1909 (see p. 37), and last in 1921. Ground they had cleared was marked by tall tree ferns and an illegible name cut in the bark of a lactiferous tree. Water was got from a little stream some 150 feet down the Jinju slope. The path from the saddle towards Abaleti kept high under the crest of the ridge, then, 20 to 30 minutes from camp, dropped abruptly into the valley of Yeve Creek. At this point of descent, about 2100 feet above sea level, was a place where the natives said two white men had camped, collecting butterflies. This no doubt was the site of the Eichhorn's camp in 1915–1916 (see p. 26).

We arrived at this camp on the second day of a five-day spell of bad weather from the east and northeast, with much rain, driving mist, and some strong wind. Then came

varied weather, with two consecutive days and nights without even a shower. Every day there was mist from impinging high clouds, without regular pattern of occurrence. One night was clear and starry. Too often for sound sleep, condensed mist from trees overhead dripped on the tents through the night. Native visitors from Jinju in the bad weather reported no rain down below.

The low, mossy, wind-clipped forest of the ridge crest reflected the climate. On the almost razor-backed summit of the peak the forest became stunted to a dense scrub or elfin-wood, 6 to 10 feet high, composed chiefly of a *Mearnsia* and a big-leaved *Timonius*. Generally about 15 to 25 feet high elsewhere, the dominant trees of the crest forest included usually small-leaved Lauraceae and Sapotaceae, *Drimys* (with big leaves), *Decaspermum*, *Diospyros*, *Discocalyx*, *Gordonia*, *Myristica*, *Symplocos*, and *Podocarpus*. The uppermost leaf tips of two species of pinnate palms commonly came to about the level of the highest surrounding trees. Stilt roots, forming the framework for mossy mounds several feet high at the bases of the trees, were a striking feature. There was an abundant woody undergrowth. Below the ridge crest, especially in hollows sheltered from wind, the forest, of largely different composition and well grown, was richer in ground plants and had an abundance of a stout *Calypptocalyx* as a substage palm. Everywhere, however, it was a forest depauperate in species, but seemingly of a high degree of specific endemism. For wet, misty mountains of that tropical region, the Rossel heights were phenomenally deficient in orchids and ferns.

The report, “nothing in traps,” came every morning but one, the solitary mammal caught being *Melomys arcium*, with sweet-potato bait. Another specimen of this attractive little rodent was shot by jacklight. Also got by night hunting at this, the most disappointing camp of the expedition for mammals, was a series of ubiquitous *Phalanger orientalis*. *Syconycteris crassa* came from both shooting and netting. Two *Hipposideros cervinus*, caught on different nights in a mist net set in a narrow forest flyway over the path that crossed the saddle, were the only insectivorous bats netted on the expedition.

<sup>1</sup> A sample of the rock of the peak has been described by Dr. Brian H. Mason as schistose greywacke, consisting largely of albite and muscovite.

The facility with which insect-eating bats avoided the nets was often observed. An amazingly efficient echo-location mechanism, attributed to them, seemed poorly if at all developed in the vegetarian Pteropididae of the region, for *Syconycteris* and *Nyctimene* frequently flew into the nets, and sometimes the much larger and higher-flying *Dobsonia*. Fortunately for the frail nets, the still larger *Pteropus* species either flew above them or avoided them.

In subsidiary collecting, good results were had from frog hunting with a lamp at night, the catch including the new *Nyctimystes perimetri*, first taken on Mt. Riu on Sudest, and a very large brown microhylid (*Asterophrys*). One misty evening a 7-foot amethystine python (*Liasis amethystinus*) was brought in. Results in insects were moderately good only in light trapping.

Before our departure, the Osbornes sent up from Abaleti, and we fastened with copper nails to the marked, milky-sapped tree at the edge of camp, a heavy piece of sheet lead with a record of the users of the camp site stamped upon it.

## JINJU, ROSSEL ISLAND

OCTOBER 20 TO 29

Correctly, Jinju is said to be Njin-njiu. A village of a few large houses and a good government resthouse is situated on a sandy beach behind the shallow waters of a coral flat which restricts the use of a small pier to vessels of slight draft. Larger vessels anchor some distance off shore in Heron Opening. Jinju is the central unit of a number of hamlets or little villages in which lives the chief concentration of people on the island. It is built among coconut palms, mango trees, and a scattering of very big *Calophyllum inophyllum* and other littoral trees on a flat, sandy foreland separated from the rise of the hills by a narrow mangrove strip. Wabu Creek enters the sea through mangroves close to the east. Well sited on rising ground is the Rossel Island headquarters of the Mission of the Sacred Heart, established in 1947. On the beach is a Methodist mission in charge of a native teacher.

The Jinju or northeast coast was more or less a lee coast in the trade-wind season and

consequently had a much lower rainfall than Abaleti. The Catholic Mission began to keep rainfall records in July, 1956. Several sustained heavy falls occurred at night, and several days were showery during our short visit, first from a five-day northeasterly air movement, then one from the east.

Only very limited areas of alluvial and colluvial soils had the appearance of marked fertility. The soil of the slopes, and here the slopes were moderate, consisted of 2 or 3 inches of gray organic matter and under that a clayey yellow subsoil. Gardens and second growths generally extended only 200 to 300 feet above sea level, and on both sides of the populated area, within easy reach from the resthouse, primary forest came down to the mangroves. This, as elsewhere on Rossel, was a forest poor in species but in many parts of the area a forest impressively well grown. An off season for flowers and fruits obtained here as at our two previous camp localities on the island. Notable canopy trees included a dipterocarp (?*Hopea*), cut for local lumber uses, the *Vatica* of Abaleti and Sudest, *Artocarpus refractus*, and species of *Terminalia*, *Vavaea*, *Buchanania*, *Intsia*, and *Polyalthia*.

The seven mammal species collected at Jinju added nothing to our previous list of nine for Rossel, a number substantially lower than for any other island visited and, as in the rather disappointing results in botany, not really unexpected for the island most remote from the New Guinea mainland. Only *Phalanger orientalis*, *Pteropus hypomelanus* (not collected by us), and *Melomys arcium* were known from Rossel before our visit. At Jinju, not a single mammal was taken in expedition trap lines, although sweet potato, coconut, and fresh meat from the skinning tables were tried as bait. *Rattus exulans*, the one species trapped, came only from buildings, in considerable numbers from both missions, caught with coconut bait.

The Jinju people were prosperous from the sale of blacklip pearl shell from the barrier reef and of copra from a well-tended, community-owned coconut plantation. At the time of our visit they were busy with the burning of new clearings and the planting of food crops. Taro ranked first in garden products; quantities of sweet potatoes, cassava, and bananas were grown; and, as

minor plantings, sugar cane, pineapples, papayas, maize, *Hibiscus manihot* for greens, tomatoes, and peanuts. We saw no yams. Limes and mangoes were planted in the villages; sago made in the small swamps where the palms grew. Most of the gardens were clear felled. In others, all but the smaller trees were left standing, killed by fire in the old, Stone Age fashion of the Rossel Islanders.

## KULUMADAU, WOODLARK ISLAND<sup>1</sup>

NOVEMBER 1 TO 24

Situated on the top of a 360-foot hill, a mile or more in from the head of Kwaiapan Bay, Kulumadau had been the principal center of gold mining on the island and the site of a government station (see p. 19). In 1956 it consisted of three good houses of European type, a trade store, two or three disintegrating government buildings, and a native hospital staffed by natives. The mullock dump of the Kulumadau Mine was being worked for gold with a Huntington mill and small treatment plant, supplied with water from a sizable old dam. A large cyaniding plant, recently built, was idle. The hill had to be climbed on foot, but a motor road led to its base from two landing places at the head of the bay, the best one in a winding mangrove creek, the other a dilapidated wharf connected with the shore by a long, eroding causeway through the mangroves.

Near Kropan village on the south shore of the bay was the base from which the Neates (see p. 22), who owned all commercial enterprises at Kulumadau, carried out trading with other parts of the island and the Laughlan Group, and stored copra from plantations along the coast. Clay and coral roads, still good for foot traffic, went to former mining centers some miles to the southeast and south and to the massive, reinforced concrete remains of a wireless station of World War I on flat land north from the head of the bay. A good government path crossed the island to Dekoias and Kaurai villages, near the north coast.

Kwaiapan Bay is erroneously portrayed on the 1-mile military map [Corps of Engineers,

United States Army, Woodlark (Murua) Island, sheet 3, 1943], which shows as a big patch of reef in the narrow middle part of the bay what actually is a mangrove island that divides the bay into inner and outer harbors. Big ships can use the outer harbor. Small vessels enter the shallow, mud-bottomed inner harbor by an intricate passage through reefs, canoes by very shallow water on the south side of the mangrove island.

Stanley [1913] has reported on the geology of the island. It appears to have been subjected to a series of elevations and subsidences, and latterly to elevation of about 500 feet. About 300 of its 350 square miles of land area consist of a coral limestone shelf, now considered Pleistocene, superimposed upon basic igneous rocks and sedimentary metamorphics and tilted from north to south. The present heights, consisting principally of the Okiduse Range rising to 1345 feet on the southern part of the island and 740 feet in Mt. Kabat in the north and including Kulumadau Hill and other isolated elevations, were islands in a coral sea. Looking out on the panorama that opened from our house, one gained the indefinable impression that this island was more a part of New Guinea than were the Louisiades. Perhaps it was due to the gentle contours of this western end of the island, rising to the Okiduse Range in the distant east and southeast and giving a feeling of broad spaces.

Rainfall was heavy on Woodlark. Kulumadau had an annual average of 165 inches, nearly evenly distributed through the year. Notwithstanding changes in wind from northwest to southeast, a fairly regular weather pattern obtained in the first two weeks of our visit: cloudy mornings became rainy by 10 or 11 o'clock; this rain ended early in the afternoon, and nights were clear or, at least, not rainy. A near drought prevailed during the rest of our stay, with still variable but lighter winds and increased heat.

Except for an extensive grass patch on the inland slopes of Kulumadau Hill (one of the few on the island) and some grassy tracts near the old wireless station, the whole area away from the settlement was entirely forested. This for the most part was second-growth rain forest, much of it tall and old. Good primary forest began on broad ridges

<sup>1</sup> A native name, "Murua," was formerly in common use for the island.

towards Dekoias. This, and the older secondary forest, differed in structure from the usual tall rain forest in having a discontinuous canopy, a very dense ground cover, 2 or 3 feet high, of coarse mesophytic ferns (chiefly *Blechnum*, *Nephrolepis*, *Diplazium*) and *Selaginella*, a great abundance of few species of epiphytic ferns and lycopods, and also of large root-climbers on the tree trunks (*Rhaphidophora*, *Scindapsus*, *Freycinetia*, *Poikilospermum*, *Stenochlaena*), and of tree ferns (*Cyathea*) and great king ferns (*Angiopteris* and *Marattia*). It was a forest poor in palms. Breadfruit trees (*Artocarpus communis*) were conspicuous in old second growths. The dense, ferny undergrowth, associated with a broken canopy, seemed to occur on all types of soil, but on the rough limestone it hid irregularities of the ground and, where sink holes occurred, made walking unsafe away from trails.

Their lush appearance notwithstanding, the forests of Woodlark were even more deficient in species than those of Rossel Island, which at least had elevations sufficient to bring in rather numerous mountain elements. Study of the plant collections may be expected to reveal a marked degree of endemism. Many of the species occurred also in the Louisiades, but not in the D'Entrecasteaux. A complement of common plants extended from the New Guinea mainland through all the islands.

Very satisfactory mammal collections of 17 species on Woodlark comprised the remarkable dark-spotted endemic *Phalanger orientalis lullulae*, *Petaurus breviceps*, *Pteropus hypomelanus*, *P. conspicillatus*, *Dobsonia* (*moluccensis* group), *Nyctimene major*, *Syconycteris australis*, *S. naias*, *Hipposideros bicolor* (see p. 38), *Emballonura beccarii*, *E. nigrescens*, *Aselliscus tricuspidatus*, *Miniop-terus australis*, *M. schreibersi*, a *Melomys*, *Rattus exulans*, and *R. ruber*. Six of these mammals were already known from Woodlark: *Phalanger*, *Pteropus* (two species), *Syconycteris naias*, *Nyctimene*, and *Aselliscus*. Three of the 12 species of bats (*Syconycteris australis*, *Hipposideros bicolor*, and *Emballonura nigrescens*) had never been collected on any of our islands. Most of the bats were got by shooting, some in nets, and numbers of *Aselliscus* by swatting with switches. Only four of 18

caves and mine tunnels examined contained bats. Most productive was a big cave about a mile northwest of Kulumadau, visited by Evennett, who described its high roof as aglow with the golden gleam of the eyes of *Dobsonia*, and the two species of *Miniop-terus* also were there.

Kulumadau yielded more snakes than any other locality on the expedition, and good collections of lizards and frogs. The snakes were *Candoia* (*Enygrus*) *carinata*, *Stegonotus modestus*, *Dendrophis* (*Ahaetulla*) *lineolatus*, *Toxicocalamus longissimus*, and *Aspidiomorphus mülleri lineatus*.

Day-flying insects, especially butterflies, turned up well. Night catching at first was good for moths, but not beetles and the small things that usually come to a light. Proceeds from this type of collecting fell to virtually nil in the dry weather of the last week of our stay.

## MORNUNA, MAINLAND NEAR SAMARAI

NOVEMBER 30 TO DECEMBER 4

Mornuna is a hilly coconut plantation on the New Guinea mainland 3 to 4 miles north-northeast of Samarai and fronting on China Strait. The mountains that rise behind it, and the small valley of a stream, carry good primary rain forest. The stream flows into a little mangrove-fringed bay, close to the plantation homestead.

Peterson and Evennett collected mammals here while waiting for a boat to take them from Samarai to the Trobriands. In illustration of the superior wealth of the mammal fauna of the mainland as compared with that of the islands we had worked, it may be mentioned that in four nights 14 species of 14 genera were collected: marsupials: *Phalanger orientalis*, *Dactylopsila trivirgata*, *Petaurus breviceps*, and a *Pseudocheirus*; bats: *Dobsonia moluccensis*, *Rousettus amplexicaulis*, *Pteropus neohibernicus*, *Syconycteris crassa*, *Nyctimene albiventer*, *Paranyctimene raptor*, and *Pipistrellus papuanus*; rodents: *Melomys*, *Pogonomys*, and *Uromys caudimaculatus*.

Among the genera, *Pseudocheirus* (ring-tailed possums), *Rousettus*, and *Paranyctimene* were not known from any of the islands; a species of *Dactylopsila* (*D. tatei*) had been

described from Fergusson Island (Laurie, 1952). Identified species of other genera collected at Mornuna but not known from any of our islands were, besides *Dactylopsila trivirgata*, very big *Pteropus neohibernicus* and small *Nyctimene albigaster*.

### DAWA DAWA, MILNE BAY

DECEMBER 2 TO 7

At Dawa Dawa, about the middle of the south coast of Milne Bay, I planned to collect plants and insects, while Peterson and Evennett visited the Trobriands. I knew this to be the dry season for the bay, but not that it was an abnormally dry season and that very little rain had fallen for some weeks before my arrival. Not only were conditions unfavorable for collecting, but the forests proved poor botanically, and I moved out as soon as a passing vessel could be signaled.

This was a very mountainous coast, with a narrow strip of flat ground between sandy beaches of the bay and a fronting range which rose steeply to over 3000 feet. Dawa Dawa had five houses (including a good one of quasi-European style, which I rented) built at the base of a long gravel spit on the east side of the Dawa Dawa River mouth. It was a place of occasional extra-domestic activity, for gravel was taken from there for construction work in Samarai, and logs were floated down the river to be towed away to sawmills. Before and during the Second World War considerable quantities of timber had been taken out in this way. A small coconut plantation occupied the opposite bank of the estuary.

The Milne Bay natives were an advanced people who had achieved a measure of self government in the form of a local Government Council. They had not, however, learned to care for animals. Dawa Dawa was infested by mangy, weak, mongrel dogs which snapped and snarled at one another at all hours of the day and night. A newly oiled pair of leather boots of mine, which the cook left too close to the ground, perhaps appeased for a time the hunger of the dogs that got away with them.

Coconut groves, a few gardens, and second-growth rain forest occupied the low coastal strip and extended a little distance up the

steep, rubbly slopes to primary forest. The river at its mouth was about 200 yards wide, deep inside an entrance bar, and only half salty. Using a borrowed fiberglass dinghy, which we dragged or carried up gravelly rapids and rowed on deep reaches, we could follow the river about 6 miles to a position behind the coast range, beyond which the only hill visible upstream was no more than 400 or 500 feet high. The first 4 miles, by the windings and sharp bends of the river, were in a very narrow, scenic valley cut through the coastal mountains. Steep slopes rising from the river, or from small alluvial terraces, were covered on their lower parts by second-growth rain forest, where not occupied by gardens planted chiefly to taro. Above this disturbed zone, and on the more precipitous lower slopes, was primary rain forest. Several small village communities lived on the river. Near our farthest point a patch of second growths was being cleared for an experimental native planting of Arabian coffee, fostered by the government. Local informants told me that much sago was made up-river in times of scarcity of garden crops.

On December 5, in fresh water above the first rapids, countless small, speckled, silvery fishes, about  $1\frac{1}{4}$  inches long, were making their way upstream. This, apparently, was the annual visitation of the "whitebait" of the region. My boys used a basket to sieve out a quantity to eat, but, unfortunately, I neglected to preserve specimens for identification.

A young bandicoot, *Echymipera kalubu*, brought in by a native and the only mammal specimen collected here, appeared to be the first record of the species from southeastern New Guinea.

### LILUTA, KIRIWINA, TROBRIAND ISLANDS

DECEMBER 9 TO 16

Liluta is a village situated about a mile in from the northeastern coast of Kiriwina, largest of the Trobriands. Peterson and Evennett, who collected mammals here, occupied a school building of the Mission of the Sacred Heart. They landed at Losuia, 10 or 11 miles to the southwest, and for transport had the use of a borrowed motor truck. An

Allied air base was located on Kiriwina in the Second World War, and war-time motor roads still give access to most parts of the island. Kiriwina has normally an ample rainfall (154 inches at Losuia), but very dry conditions obtained during the visit of our party, and they were obliged to haul water to Liluta.

A low island of Pleistocene coral limestone in the form of a question mark, Kiriwina is about 28 miles long and 2 to 10 miles wide. A rim ridge of rough coral and sea-facing cliffs rises 50 to 100 feet on the eastern, northern, and northwestern coasts. From this coastal ridge on the broad northern part of the island, the ground slopes gradually to central marsh and swamp, and much of the west coast is low-lying and swampy. Between ridge and wet ground, the bulk of a population of about 7500 people live and have their gardens. Such tall primary forest as survives is principally on the coastal ridge, and it has been disturbed for the timber uses of the people. Owing to population pressure, the arable land has generally to be returned to cultivation at intervals too short to permit the tall growth of secondary forest. A brushwood condition therefore results, and Evennett informed me that grassy tracts occur.

The people are famed for their industry as gardeners and the productivity they achieve. MacGregor (1894, p. xiii) called Kiriwina and neighboring Kaileuna "the gardens of the Possession." Le Hunte (1900, p. 31) wrote of the numerous large food gardens, well fenced, clean, and high yielding, "the yam gardens, with their luxuriant vines trained round high poles, having much the appearance of English hopfields. Taro grows abundantly, and we noticed patches of maize." The sago palm apparently has been introduced since that time as a source of thatch, and the people do not understand the utilization of its starch as food (Austen, 1936, p. 16).

Government explorations on Kiriwina began in 1891, the Methodist Mission opened in 1894, a government station and hospital in 1905 (see p. 21). Malinowski (1922) had lived on the island, studied the people, and knew the language well. Only in about 1931, however, was the discovery made of ancient megalithic structures, about which the present people appear to have no legends. The

largest standing stone measured over 13 feet in height above the ground, nearly 7 feet broad, and 10 inches thick. Many prostrate slabs exceeded this size (Williams, 1936; Hall, 1949).

In the short stay of our party the rather surprising total of 19 mammal species was collected, but only five of them were non-volant. Eleven or 12 of the species were known from the island before: *Phalanger orientalis*, *Protemnodon agilis*, *Pteropus hypomelanus*, *P. conspicillatus*, endemic *Dobsonia remota*, another *Dobsonia* reported as *D. moluccensis pannietensis* but doubtfully this subspecies, *Nyctimene major*, *Syconycteris crassa*, *Emballoneura beccarii*, *Hipposideros diadema*, *H. cervinus*, and *Aselliscus tricuspidatus*. Our additions to the previously known mammal fauna were: *Echymipera rufescens*, *Hipposideros cupidus*, *Rhinolophus euryotis* (new for Papua-New Guinea), *Miniopteris australis*, *M. schreibersi*, *Hydromys chrysogaster*, and *Rattus exulans*. Good collections of bats were made in two big caves near Olevilevi on the east coast about east of Losuia. Only *Dobsonia moluccensis* was found in a big cave near Kaibola on the north coast.

Among the especially interesting mammals on Kiriwina is *Protemnodon agilis*, which at this time seems inseparable taxonomically from the subspecies *papuanus* of the New Guinea mainland. Earlier in this report (p. 47) notice is taken of the possibility that *Protemnodon* was carried by man from the mainland to Fergusson Island, a possibility suggested earlier for Goodenough Island (Brass, 1956, p. 141) and now advanced for Kiriwina. Both the ancient and the present peoples of Kiriwina should perhaps be considered as possible transporting agents. The latter make, or made until recently, trading expeditions to Goodenough and Fergusson Islands (Gilmour, 1905), but seem to have had no direct contact with the mainland. For an introduction of the present wallaby population by the ancient people, it would be necessary to assume the existence in their time of grassland on the island and its maintenance to this day, unless the animal on Kiriwina was able to adapt to a forest environment. It is a grassland animal elsewhere, although it will shelter in forest. In this connection it may be noted that Austen (1936, p. 14) refers to the

Kiriwina wallaby as the "scrub wallaby," the term "scrub" probably being used in the Queensland sense to mean rain forest.

### MODEWA, MODEWA BAY

DECEMBER 10 TO 23

Modewa, about 25 miles west of Samarai, is on a stretch of the mainland south coast called the Suau Coast, from Suau Island, 5 miles farther west. Two miles wide at its mouth, the bay has at its head, where the government resthouse stands, a sweeping steep beach of dark gray sand. In southeast weather a swell dumps on this beach, and in the trade-wind season landing must often be difficult. A numerous native population lives principally in a linear shore village at the eastern head of the bay. Farther east, the continuity of the beach is broken by high, rocky headlands. Gara River enters the bay about a mile west of the resthouse. Behind the bay, from about its center eastward, a steep mountain ridge up to 1450 feet high runs parallel with the coast and close to the sea. I collected plants and insects here, while Peterson and Evennett visited the Trobriands.

The near-drought that prevailed in Milne Bay and the Trobriands was perhaps even more severe at Modewa, where no good rain had fallen in the six weeks before my arrival. The dry weather continued for another eight days. There was anxiety about the village water supply, which issued clear and cool, but slackening, from a rock crack at the base of the mountain ridge. So parched was the forest that the leaves of the undergrowth, and the smaller trees, wilted in the heat of the day, and the numerous epiphytic ferns were shriveled or lax. On the 4500-foot Cloudy (or Gugu-sari) Mountains, 6 miles to the northwest, dark rain clouds closed down daily about mid-afternoon, with thunder. At length the dry spell broke with heavy, squally showers from the southwest. Annual average rainfall at Modewa was probably 80 to 100 inches.

The native gardens were scattered, many of them up the river, and from the sea the

locality appeared almost entirely forested behind a shoreline strip of grassy coconut groves. The people were living largely on sago at the time of my visit.

The Gara River and its left-hand branch, the Harala-ama (Modewa River on some maps), gave access to a very extensive tract of at first generally hilly, then flat and low-lying interior, inhabited by only two small village communities, and little disturbed even near the coast, where the Modewa people had gardens and made sago. The lower tidal terraces of the rivers carried the finest mangrove forest I had seen anywhere. The principal tree, a small-leaved *Bruguiera*, grew at least 100 feet high, with the trunks startlingly straight and the larger ones a good 2 feet in diameter. Timber volume was high, but the area was perhaps too small to be attractive commercially.

The main Gara was followed by canoe for a distance estimated at 8 miles, where it became generally shallow and partly choked with drift trees, but was still tidal, though the water had been fresh for a mile or two. No hills were visible from this point. The Harala-ama could be followed only 5 or 6 miles by canoe. Rising in the Cloudy Mountains and considerably smaller than the Gara, it was much cluttered with trees that had fallen in from eroding banks of reddish yellow soil, and the canoe had to be dragged over several gravelly rapids for us to get as far as we did. We walked about a mile beyond this, through tall, flood-plain rain forest, to the site of old Gunaheda village on a small rise of ground. The people had moved farther up river, leaving a few coconut palms and crotons in surroundings of *kuru-kuru* grass.

Modewa gave access to a large area of fairly diverse ecology. Increased but still not very highly rewarding botanical results could have been expected from the locality under more favorable seasonal conditions. In insects, the greatly richer and more diversified fauna of the mainland, as compared with that of the islands, was especially evident in butterflies. Only scant catches were made at the light, even after the ending of the dry weather.



## MAJOR PLANT COMMUNITIES

THE OPINION WAS FORMED that on the mountains of the islands visited by this expedition scope as a rule was too limited, and slopes often too steep, for the development of the distinct zonation of major plant communities that one finds on the much bulkier, generally less precipitous, and much loftier mountains of the New Guinea mainland, although montane elements were present on all the islands, and on most of the islands in considerable strength.

The following preliminary classification of major plant communities of the New Guinea area was proposed by me in 1941:

	METERS
Savanna and savanna forest	0-1700
Monsoon forest	0- 450
Rain forest	0-2400
Mid-mountain forest	480-2350
Beech forest	850-3100
Mossy forest	1500-3200
Subalpine forest	3000-4050
Alpine grassland	2900 up to permanent snow line

Only the savanna and savanna forest, rain forest, and mid-mountain forest were met with as distinct communities on the expedition of the current report.

Fergusson Island and Misima had impoverished representations of the savanna and savanna-forest vegetation, with tree stocking almost entirely of *Melaleuca leucadendron*, and it was reported to occur in the Mt. Bwebweso-Sewataitai Bay area of Normanby Island. On Fergusson, fairly extensive savanna forests occurred in the thermal area of Seymour Bay, in the Mapamoiwa-Cape Mourilyan area (Brass, 1956, p. 146), and on the Bwaioa Peninsula. These were the driest parts of the island, though rainfall must still have been rather substantial. The small area of savanna on Misima occurred under a rainfall of 123 inches, well distributed through the year. *Themeda australis* and other grasses and herbs of the savannas became established on deforested rain-forest lands on all the islands.

Mixed tropical rain forests, occupying lowlands and the lower mountains, were the

principal plant cover everywhere. Extensive disturbance by native populations, and replacement of the primary vegetation by second-growth forest or by grass, had taken place in the lower parts of this forest on Fergusson and Sudest, and in some degree the process was in operation on the other islands. Trees of the Dipterocarpaceae, a family noted for its timber trees, formed a major part of the stocking in exceptionally fine forest in the Waikaiuna area on Normanby and near Fagululu on Fergusson. Dipterocarps were important, too, on Misima, Sudest, and Rossel, but apparently absent from Woodlark. The mountain rain forests examined on Woodlark were remarkable in being in large part a stand of big *Eucalyptopsis* trees (see p. 38). Mangroves, in the rain-forest hydrosere, occurred on all the islands and were especially a feature of Sudest and Rossel, the shores of which they occupied in a virtually continuous narrow fringe. Sago swamps, present throughout on lowlands, were notable in the Seymour Bay area on Fergusson for the exceptionally large size attained by the palms.

The mid-mountain forest is essentially a forest of oaks and *Castanopsis* of the Fagaceae, in which other trees occur, among them, commonly on the mainland, *Engelhardtia* of the Juglandaceae. Small patches of this forest appeared, surrounded by rain forest, on mountain ridges of all the islands on which botanical collections were made, except Woodlark. But only on the mountains of Fergusson Island, at 2500 to 4000 feet, did it assume the character of a distinct zone above the rain forest. Prominent in this forest as a very tall, emergent tree on the Edagwaba Range on Fergusson was an *Araucaria* like *A. cunninghamii*. Patches of oaks grew close to sea level on Rossel. Often on the islands on mountain ridges where oak forest could be expected to occur, the oaks were there but only as a scattering in the rain forest.

Beeches (*Nothofagus*) were found only on Mt. Pabinama on Normanby, and there only as a component of a mixed, mossy cloud forest at 2600 to 3400 feet on the mountain top. Although apparently absent from the Edagwaba Range on Fergusson, beeches may

be expected to occur on the bulkier Mt. Maybole mountain mass of this island. They grow in mixed forest above the mid-mountain forest, upward from about 5200 feet, on neighboring Goodenough Island (Brass, 1956, pp. 142, 149). Beeches form extensive, nearly pure forest on the mountains of the New Guinea mainland, usually very tall, sometimes stunted to scrub.

"Mossy forest" as a name for a forest of particular composition will have to be dropped, for many kinds of forest, very different floristically, may be mossy. Our mossy forest, on the mainland, is characterized chiefly by small-leaved *Xanthomyrtus* and *Decaspermum* of the Myrtaceae and coniferous *Phyllocladus*, and may be an elfin-wood or quite tall forest, according to exposure to wind and other factors. At map heights of 4200 to nearly 5000 feet on the very steep

comb of Edagwaba Range, our highest altitudes on this expedition, a *Xanthomyrtus* was plentiful in stunted forest also strong in rain-forest elements. The summit forest of Mt. Pabinama, where a *Xanthomyrtus* occurred in quantity, and other montane elements including *Nothofagus* were present, was the nearest approach to our mossy forest of the mainland. The stunted cloud forests of the heights of Sudest and Rossel in the Louisiades were largely different floristically, although a *Decaspermum* occurred on Mt. Rossel, and *Mearnsia*, prominent in the Louisiades, had appeared also on Mt. Pabinama. Perhaps all these cloud forests, where not strong in rain-forest elements, should be included as islands variants in our mossy forest of the mainland. In them, as far east as Sudest, occur *Rhododendron* species that are characteristically more than middle montane.

## RESULTS OF THE EXPEDITION

THE FOLLOWING COLLECTIONS were made:

Mammals	1,382 specimens
Birds	20 specimens
Amphibians and reptiles	907 specimens
Fresh-water fishes	57 specimens
Fresh-water crustaceans	66 specimens
Insects and spiders	72,257 specimens
Ectoparasites of mammals	70 specimens
Plants	2,657 numbers
Geological specimens	10
Native artifacts	55

The vertebrate animals and the ectoparasites were collected by Peterson; the Crustacea, in part by Peterson, in part by Brass; the insects and spiders, plants, geological specimens, and artifacts, by Brass.

With the exception of the plants, all collections are deposited in the American Museum of Natural History, where Hobart M. Van Deusen is studying the mammals, Richard G. Zweifel the frogs. Insects of various groups have been placed with specialists for determination. Duplicates of the artifacts have been presented to the Administration of Papua and New Guinea for the Port Moresby Museum; duplicates of the zoological collec-

tions will be sent to Port Moresby after study.

An effort was made to collect vascular plants in series of eight specimens, and such specimens numbered 14,640; there were 230 collections of cellular cryptograms, chiefly bryophytes. The study and distribution of the plant collections were undertaken by the Rijksherbarium, Leiden, and this institution has sent sets of duplicates to Lae, the Arnold Arboretum, the United States National Herbarium, Kew, Stockholm, Manila, Bogor, and Canberra. In addition to the botanical collections mentioned above, 316 seeds of five species of palms were sent by air to the Fairchild Tropical Garden in Florida.

A photographic record of the expedition consists of 1538 35-mm. Kodachrome transparencies. No moving pictures were made.

A mimeographed list of publications based entirely or in substantial part on the collections and activities of the Archbold Expeditions to New Guinea and Australia, containing at present (September 5, 1958) 242 titles, may be had upon request to Archbold Expeditions, the American Museum of Natural History, Central Park West at 79th Street, New York 24, New York.

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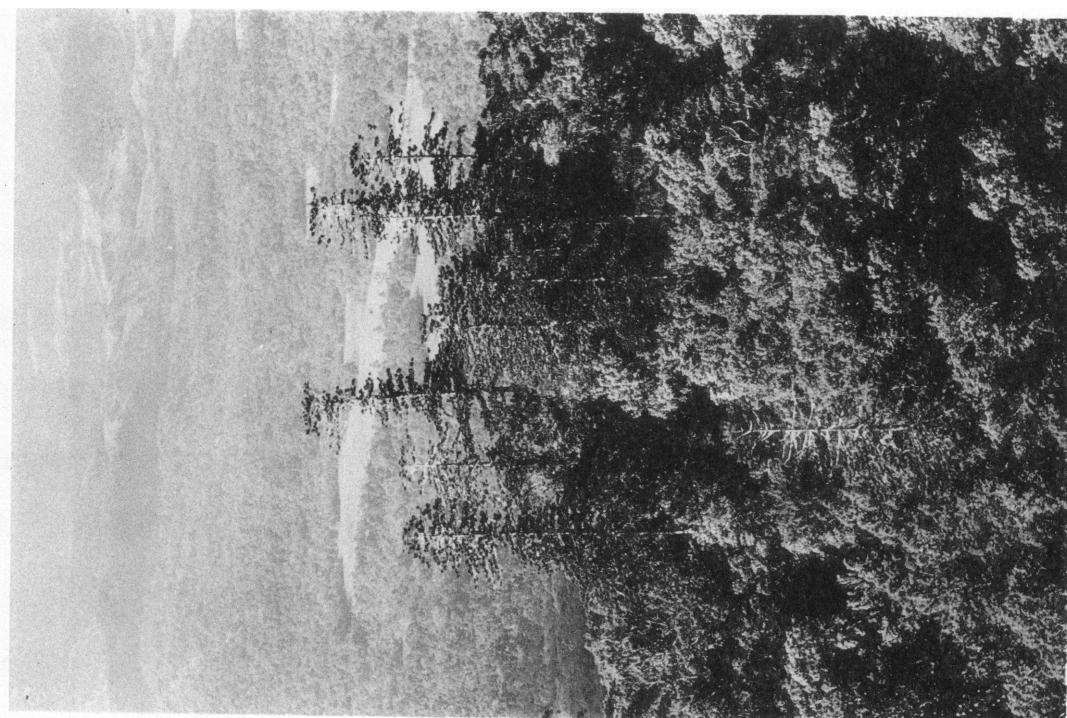


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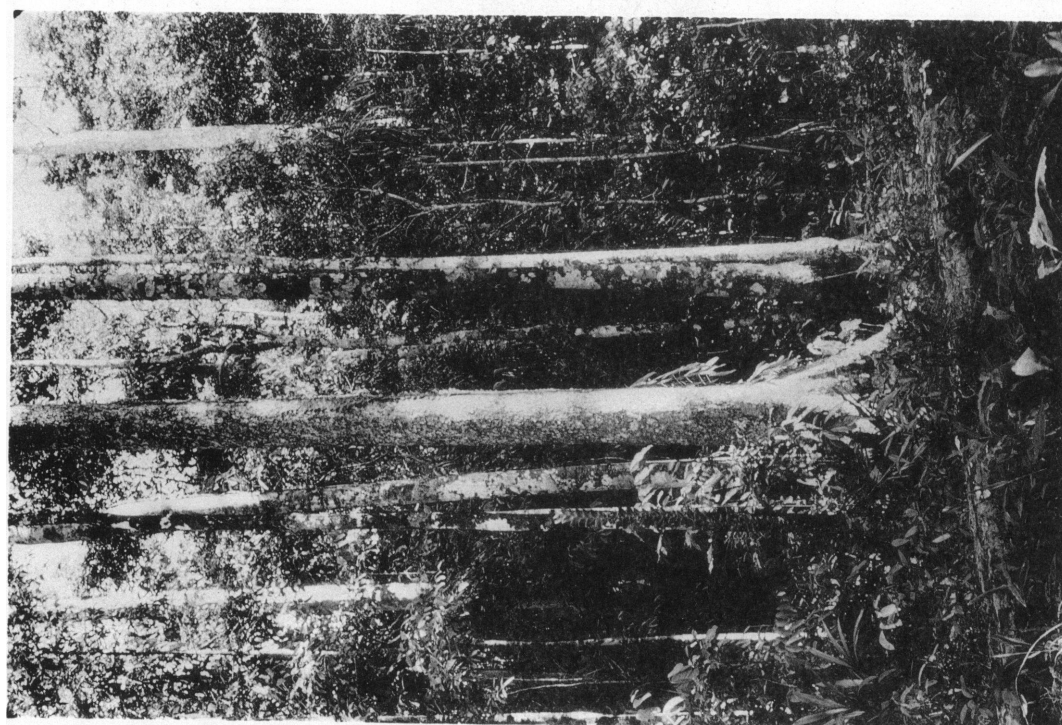


2

1. Normanby Island. Mt. Bwebweso from near the mouth of Lebudowa River
2. Normanby Island. Mt. Obia viewed over stunted scrub and emergent *Dacrydium* trees at about 3300 feet on the western crest of Mt. Pabinama



2



1

1. Normanby Island. Tall lowland rain forest at Waikaiuna dominated by Dipterocarpaceae
2. Fergusson Island. *Araucaria* trees protruding high above midmountain oak forest at about 2800 feet on the north slopes of Edagwaba Range; the pale areas are grass patches in the interior valley



1

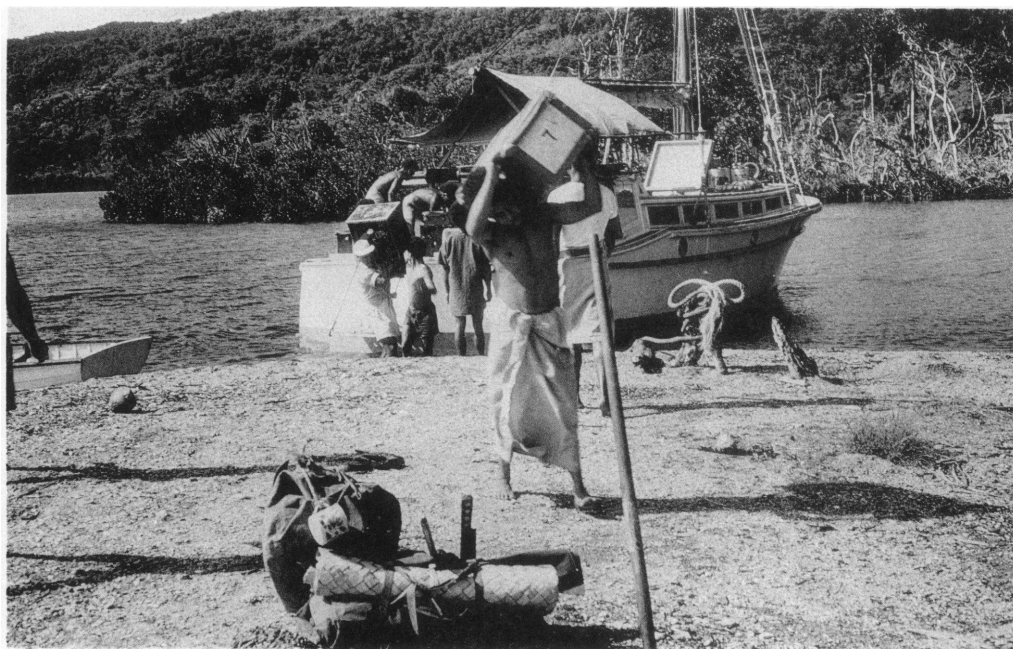


2

1. Rossel Island. Expedition carriers in Dambeni hamlet, at 600 feet on the mountain slopes above Jinju

2. Rossel Island. View about north from the summit of Mt. Rossel; Heron Opening, in the barrier reef, shows in the upper left





1



2

1. Sudest Island. The resthouse landing place in Rambuso Inlet
2. Sudest Island. Valley of Rambuso Creek. Garden of giant taro (*Alocasia*), with sago palms (*Metroxylon*) on wet ground to the left and another garden clearing on the slopes



1

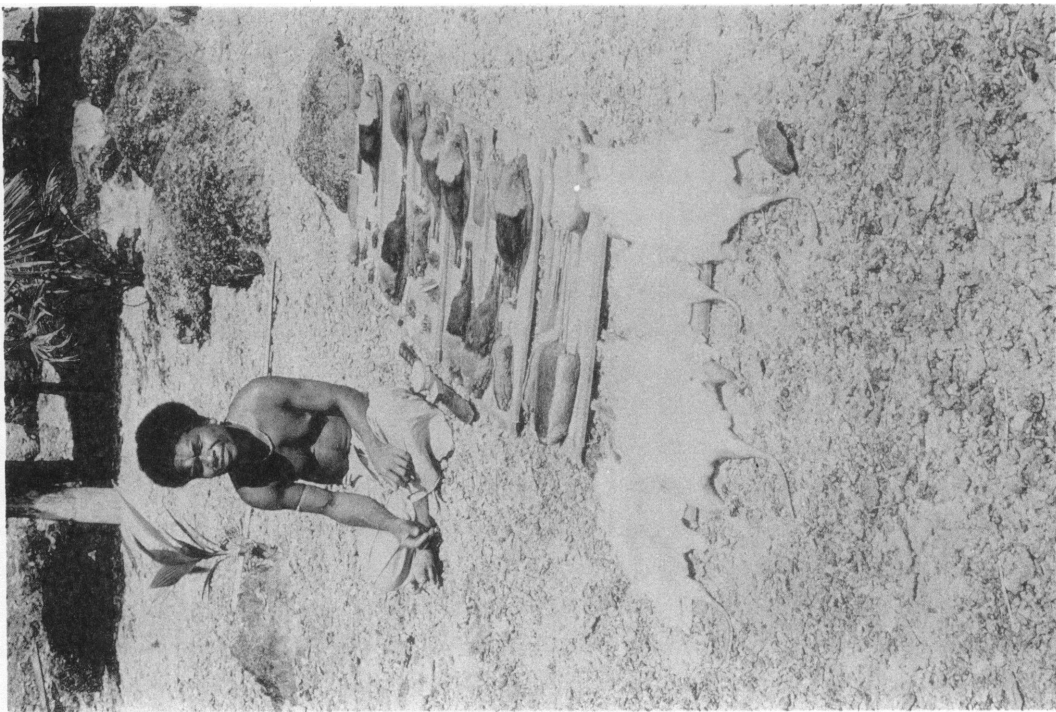
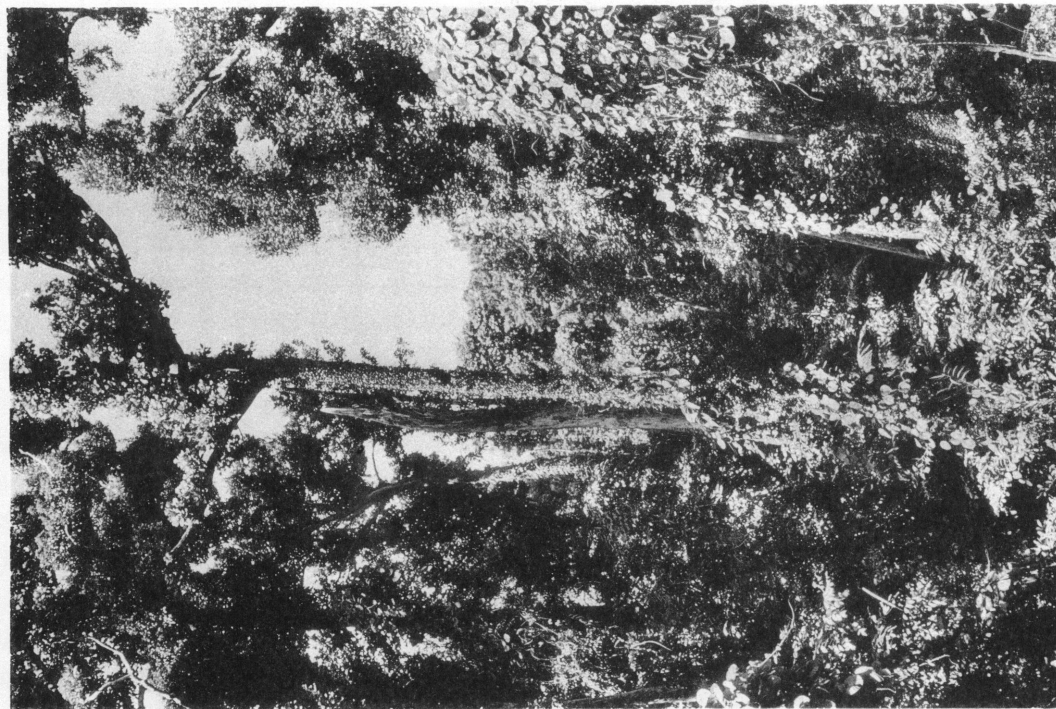


2

1. Misima Island. Unbroken rain forest clothes the backbone range westward from near the expedition camp on the north slopes of Mt. Sisa

2. Sudest Island. Joe Landing viewed from Gold Rush Channel. Strips of second growths occur in gullies on deforested grassy ridges fronting the sea





1. Misima Island. Face of the rain forest at 500 feet on Quartz Mountain  
2. Misima Island. Lik-lik guards mammal skins drying in the sun at Narian



1



2

1. Fergusson Island. View northeast over Lake Lavu to Hughes Bay and the high Amphlett Islands from about 700 feet on the Fagululu-Agamoia trail

2. Misima Island. Beach line and headland terraces of coral limestone at Narian on the south coast



1



2

1. Fergusson Island. Sulphur flats, bordered by *Melaleuca* and *Pandanus* trees, in the thermal area between Iamelele No. 1 and Fagululu
2. Fergusson Island. Agamoia village. The resthouse and an expedition fly in background







