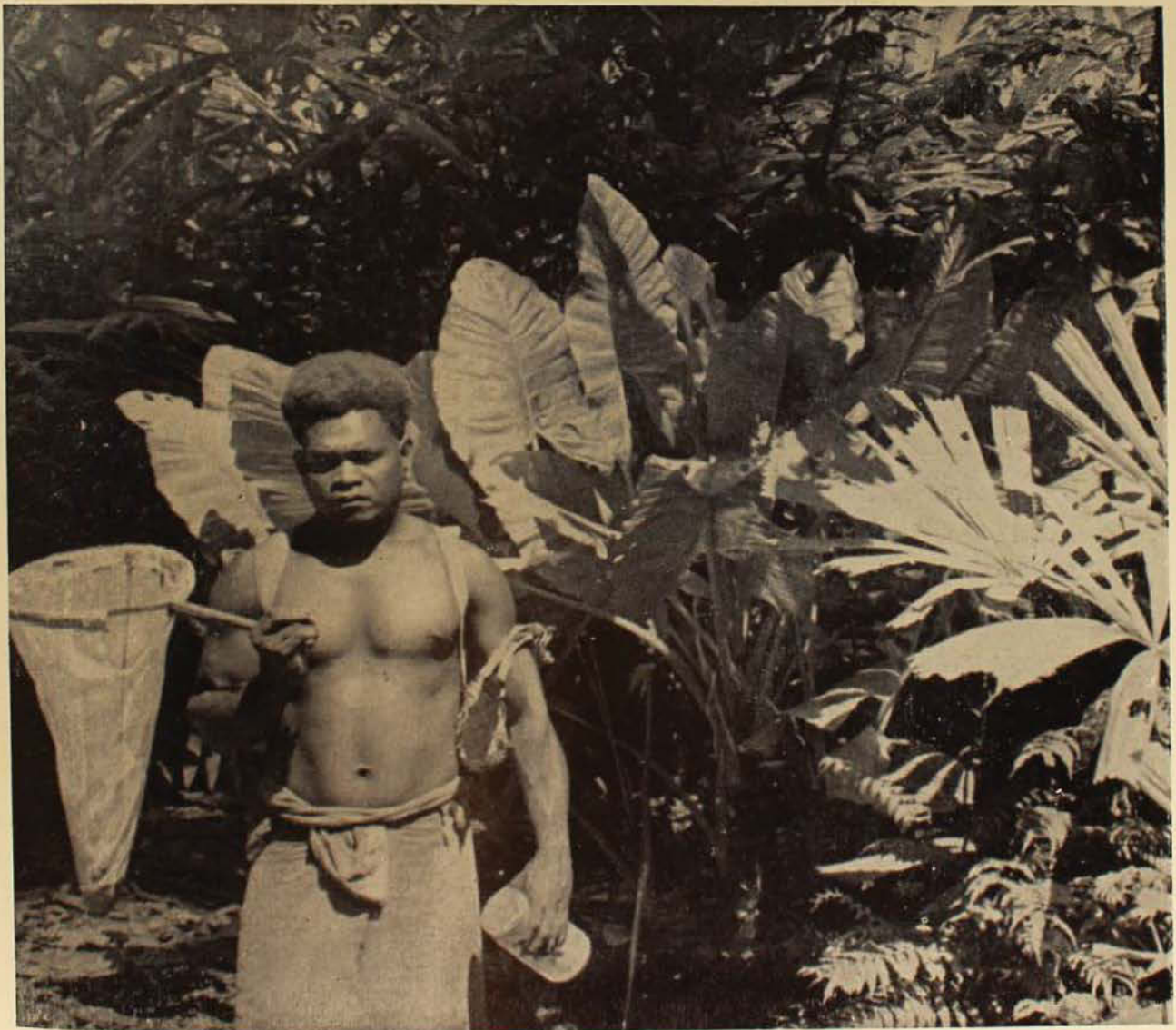


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VOL. XII, No. 12

Price—TWO SHILLINGS



A New Britain native equipped for insect collecting in rainforest near Rabaul.  
(See Article Page 402.)

★

SPECIAL "NEW GUINEA" ISSUE.

# THE AUSTRALIAN MUSEUM

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● OUR FRONT COVER: J. J. H. Szent-Ivany, author of the article "New Guinea Insects" (see Page 402), supplied this illustration of a New Britain native who assisted him in collecting insects in rainforest near the Lowlands Agricultural Station at Keravat, near Rabaul. The insect world of New Guinea and the adjacent islands is but little known and a vast amount of collecting and identification of specimens remains to be done before even a simple entomological picture of the area emerges.



B. P. Bertram del.

## THE ISLAND OF NEW GUINEA

AUSTRALIANS are becoming increasingly aware of New Guinea—its proximity, its native problems, its potential wealth, its position in world politics. This issue of *The Australian Museum Magazine* does not deal with the island in terms of current events but aims to present some details of its natural history. To readers already interested in this subject it will supply a useful collection of facts relating to the area; for others with less definite interests in "flora and fauna" it will perhaps provide some additions to general knowledge of the second largest island in the world.

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## New Guinea: Physical Geography and Environment

By DONALD F. McMICHAEL

**A** PART from continental Australia, New Guinea is the second largest island in the world. Its total area of almost 317,000 square miles is exceeded only by Greenland, and its length of about 1,500 miles is about the same as the distance between Perth and Adelaide; at its widest part it is more than 450 miles across, but in other places less than 100 miles separates north and south coasts.

A glance at the map will reveal that the island is very much elongated in a north-west—south-east direction, with a large central bulge on the southern coast. It is roughly similar in shape to a roosting bird, and because of this the head-like protrusion at the north-western end, which is joined to the rest of the island by a very narrow strip of land, is known as the Vogelkop or Bird's Head. Much of the coastline is rather straight, but a number of major embayments are to be seen, including Geelvink Bay and Maccluer Gulf in Dutch New Guinea, and Astrolabe Bay, Huon Gulf and the Gulf of Papua in the Australian territory.

Politically the country has been divided into three parts, the largest portion being Dutch New Guinea which includes all the

territory west of Longitude 141° E., except for a small portion, cut out by the Upper Fly River, which is included in Papua. Originally known as British New Guinea, Papua is the southern portion of the Australian half of the island, the northern portion being the United Nations Trust Territory of New Guinea (which prior to World War I was German New Guinea). The Trust Territory includes politically the islands of the Admiralty Group, the Bismarck Archipelago and part of the Solomon Group, but zoologically these are rather distinct from New Guinea proper. The Louisiades, the Trobriands and other islands adjacent to the Papuan coast, on the other hand, have a close zoological relationship with the mainland, as do the islands off the Dutch New Guinea coast.

Most of New Guinea is comparatively young from a geological point of view. It consists of a massive central mountain range, or cordillera, which runs practically the whole length of the island, from the Vogelkop to Milne Bay. This cordillera completely separates the northern and southern drainage, with significant results on the nature of the freshwater faunas, but it does not in fact consist of a single

chain of mountains; it is rather a series of range systems lying along the same axis, and a number of broad, highland valleys lie between the ranges. The cordillera is the result of Mesozoic and Tertiary mountain building, more or less contemporaneous with the formation of the Himalayan and Andean chains of Asia and America, and it ranks with them as one of the great mountain systems of the world. Many of its peaks exceed 15,000 feet in height, and are above the snow-line, while in Dutch New Guinea small glaciers are known to form. The highest mountain is Carstensztop in Dutch New Guinea, which reaches about 16,400 feet, while the highest peak in the Australian territories is Mt. Wilhelm, which rises to 15,400 feet in the Bismarck Range.

Running more or less parallel to the central cordillera along the north coast is a second series of ranges which may be much older geologically, for they include rocks of Mesozoic and Palaeozoic age, and it has even been suggested that some of the oldest of these have not been submerged since Pre-Cambrian time, over 500,000,000 years ago! These ranges are mostly of only moderate height, though in the east, the Finisterres and the Surawageds have peaks over 10,000 feet high. Separating these northern ranges and the central cordillera is a great central depression, extending from the eastern edge of Geelvink Bay through to Huon Gulf. This is a more or less continuous trough, of structural origin, which now forms the basins of a series of large rivers which drain the greater portion of the northern section of the island. In Dutch New Guinea the depression is known as the Meervlakte, a great area of sago palm swampland, through which the Idenburg and Rouffaer Rivers flow in opposite directions till they join to form the mighty Mamberamo which flows north to the sea. In Australian New Guinea, the Sepik River drains eastward from the Western Highlands while the Ramu flows in a north-westerly direction, draining the Eastern Highlands and the Finisterres, the two rivers almost meeting as they reach the sea. A fourth great river, the Markham, occupies the eastern end of the depression, but drains south-east into Huon Gulf.

On the south coast, the central mountain ranges are bordered by a narrow strip of coastal plain at both the eastern and western extremities of New Guinea, but in the middle is a huge bulge of coastal lowland, known as the Fly-Digoel depression. Its name comes from the two major river systems, the Fly River of Australian Papua, and the Digoel River of Dutch New Guinea. This is an area of generally low elevation, forming an extensive foothill zone to the central ranges, consisting mostly of Pleistocene sediments which represent the flood-plain deposits of the two rivers.

Along the northern coastline, there is evidence of recent and continuing elevation, while the southern coast appears to be slowly sinking, with consequent deltaic embayments and swampy lowlands. Along the south-eastern coast of Dutch New Guinea is one of the greatest areas of swampland in the world, where the river systems join one another in a maze of meandering waterways and it is said to be possible to travel by canoe for hundreds of miles along the coast, without entering the sea.

No account of the physical geography of New Guinea would be complete without mention of the numerous volcanoes along its northern coast and in the Owen Stanley Ranges of Papua. Some of these are still very active, and one at least has violently erupted in recent years with disastrous results. (See "The Burning Cloud of Mt. Lamington", R. O. Chalmers, this magazine, X, 7:207.)

New Guinea lies on the Australian continental shelf (the Sahul Shelf) and is separated by areas of comparatively deep sea from the main Indo-Malayan continental shelf (Sunda Shelf) and from the islands east and west of New Guinea. Across Torres Strait is a very shallow sea, not exceeding 10 fathoms in depth, and it would take only a small fall in sea-level to join New Guinea to the Australian mainland. This has undoubtedly happened a number of times in geological history, and has resulted in a considerable interchange of plants and animals between Queensland and New Guinea. Whether New Guinea and Australia have always shared the same

continental shelf, however, is another question. There is some evidence to suggest that the two lands have existed for very long periods in isolation from each other.

The topography of New Guinea is such that, despite its tropical location, a wide variety of climatic zones is present, which has resulted in a number of different vegetational zones, and consequently a great range of environments in which animals of widely varying types have developed. Over much of the country, rainfall is fairly uniformly heavy, ranging from 100 to 250 inches, but a few areas like Port Moresby have a very low rainfall (below 50 inches) because of local topography. The island experiences a typical monsoonal climate, with two well marked seasons, the North-West Monsoon from December to March and the South-East Tradewinds from May to October. This results in fairly definite wet and dry seasons, which may be during the monsoon or the tradewinds, depending on the location and local topography. Temperatures along the coast are uniformly high, and coupled with high humidity make for a typically tropical climate. At higher altitudes, temperatures are correspondingly lower, though humidity is still high as a rule. On the coast, the annual temperature range is between 70 and 90° F., with a daily range of 10 to 15°, while the temperature drops below freezing above 15,000 feet which is the approximate position of the snow-line. Day-length is almost uniform throughout the year.

The greater part of New Guinea is covered with dense, tropical rainforest. If the sub-tropical and mountain forests above 3,000 feet are included, then it can be said that, with the exception of comparatively small areas of highland grasslands, and the alpine scrub and tundra on peaks over 10,500 feet, the island is clothed with an unending mantle of forest, cut only by narrow rivers and precipitous escarpments. Along the coast and in the Central Depression, there are thousands of square miles of mangrove forest and sago palm and Nipa palm swamps. At higher altitudes, the forests are characterised by a variety of dominant species including southern pines (*Araucaria*), southern beech (*Nothofagus*), and *Podocarpus*. In the highland valleys, between 3,000 and 8,000 feet, large tracts of grassland occur, though it is thought that these are the result of continuous burning of the forest over centuries by the indigenous population. Above 10,500 feet, alpine scrub, peat-bogs, and tundras of grasses, sedges and ferns occur.

Within this land are some of the most fascinating people, plants and animals in the world. Within its still unexplored mountain ranges may lie as yet unknown forms of life, immense wealth in oil and minerals, and people whose culture survives unchanged from the stone-age. New Guinea remains a land of mystery, a hard and difficult land, but one with enormous promise for the future.

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## Notes and News

### Fulbright Scholar

Mr. Donald Francois, M.Sc., an American Fulbright Scholar, has been attached to the research staff of the Museum since last August. Mr. Francois, who previously assisted in teaching in the Department of Zoology and Entomology at The Ohio State University, has undertaken an investigation of the freshwater crayfish fauna of New South Wales, along similiar lines to the research work he has completed in the United States.

### Rare Animal

A specimen of a potoroo (*Potorous tridactylus*) has been received at the Australian Museum. This

animal, which is related to the rat-kangaroos, is now rare in New South Wales, not having been recorded in the State since 1913. It is still common in Tasmania. The specimen obtained by the Museum was killed by a dog near Gosford, New South Wales.

### Long Toms

Dr. G. F. Mees, formerly of Leiden Museum, Holland, and now appointed to the Western Australian Museum, Perth, spent some time at the Australian Museum recently, examining the fishes known as Long Toms (family Belonidae).

# Geology of the Island of New Guinea

By G. A. V. STANLEY

THE island of New Guinea forms the northern margin of the Australian continent. The Sahul Shelf off the coast of north-west Australia; the shallow Arafura Sea and Torres Strait; the continental shelf of eastern Australia and its northerly continuation across the Coral Sea into the Gulf of Papua and eastwards into the barrier reefs of the Louisiade Archipelago and the Trobriand Shelf, bind New Guinea to Australia. These shallow areas of sea are indicated approximately on the sketch map below, as is the Planet (or New Britain-Bougainville) Deep. Recent soundings in this Deep were made by the Russian research ship *Vityaz* and a maximum depth of 5,140 fathoms was found.

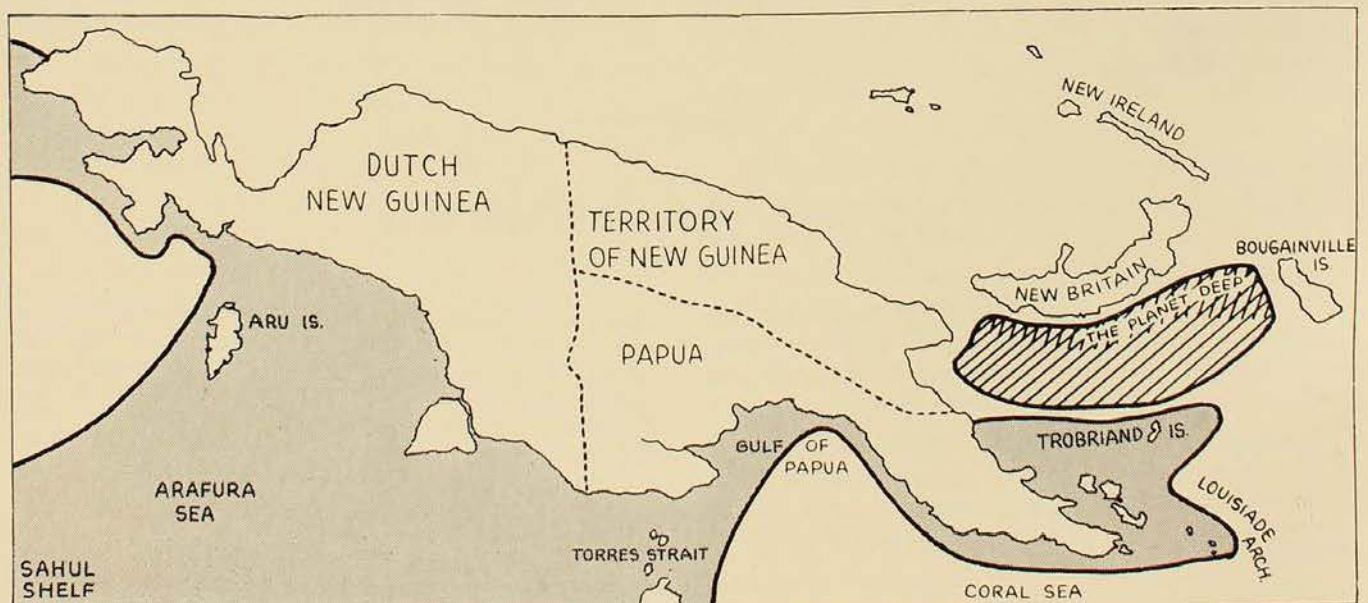
The geology of Dutch New Guinea has been described in outline by several writers<sup>1</sup>, as has the geology of what is nowadays the Territory of Papua and New

Guinea<sup>2</sup>. A great deal of geological work in both Dutch and Australian New Guinea has been done by combinations of two or more of the major oil companies but much of the results remains unpublished.

The mainland of the island of New Guinea is about the same size as New South Wales. In 1939 I estimated that 37 per cent. of the whole island was still unmapped, even by the sketchiest of reconnaissance methods. During the last war a great impetus was given to New Guinea cartography and aerial surveys by Army aircraft have left hardly any corner unknown. Strictly speaking, "accurate" surveys are restricted to those made for title purposes, to some areas of the coast where naval hydrographers have carried

<sup>1</sup> Brouwer (1925), Rutten (1927), Zwierzycki (1924, 1928) et al. and most recently by van Bemmelen (1949).

<sup>2</sup> Gibb Maitland (1892), Haddon (1894), Richarz (1910), Sapper and Lauterbach (1910), David (1914), E. R. Stanley (1920, 1923, 1924), Hodge Smith (1943), Montgomery, Osborne and Glaessner (1946), David (edited by Browne, 1950).



It would take only a small fall in sea-level to join New Guinea to the Australian mainland. In this sketch map the shallower waters are shown in grey.





Short natives frequently found in the mountain villages of the Torricelli Mountains, Aitape area, Sepik district, are shown here with the author.

Photo.—Author.

out careful triangulation, or, again, to some geological structures which have been mapped in large-scale detail for the purpose of making a drilling location. Although complaints are made from time to time, for all practical purposes at the present stage of New Guinea's development, the island is adequately mapped. There is currently an acute lack of licensed surveyors in New Guinea.

Maps show that there is a great snow-capped (in part) Central Range from west to east, rising to 15,508 feet above sea-level in Carstensztops, and forming the backbone of the island. To the north of this is a great east-west lowland which separates the Central Range from a series of mountain blocks, which form coastal ranges along the northern coast. To seaward of the north coast, at its eastern end, lies a chain of volcanoes, all more or less active. South of the Central Range the land falls away into great swampy plains which pass imperceptibly under the waters of the Arapura Sea and the Papuan Gulf. Many extinct volcanoes, some of them deeply dissected, are scattered along the Central

Range in Australian New Guinea, but appear to be lacking in Dutch New Guinea.

Metamorphic rocks, apparently of great age, are common in the Central Range, and in many places they are pierced by granites and diorites of unknown age. The oldest fossils yet found come from Dutch New Guinea. They comprise erinoids, brachiopods and trilobites, and occur in sandstones, shales and limestones of Silurian or Devonian age. Dark shales containing fossil plants from the southern slopes of the Snow Mountains of Dutch New Guinea indicate an Upper Carboniferous age. In Australian New Guinea a re-crystallised limestone was found near Mt. Hagen by K. M. Llewellyn (1950) in which Dr. M. F. Glaessner recognised corals and brachiopods of Permian age.

Jurassic and Cretaceous rocks occur widely in both Dutch and Australian New Guinea in various facies and in either thick and continuous sections or else involved as slice after slice in complex fault belts. Sometimes the Cretaceous beds are metamorphosed, as in the Kaindi Series near

Wau, where most of the thin limestone bands are completely re-crystallised and where the age is recognised only by the presence in sandier beds of fossils in the form of moulds, often greatly distorted in shape by pressure, but still recognisable to palaeontologists. Near Port Moresby, in the Cretaceous, there is a characteristic association of serpentines with siliceous cherts, the actual structure being still uncertain. It would seem that there is a gradual transition upwards into beds with *Nummulites* (unicellular animals) of Eocene age, these fossils being found both in thin lenses of limestone and occasionally in the cherts.

The Tertiary rocks of New Guinea are by far the most impressive to the geologist who works there. Limestones of all kinds, sands and mudstones and conglomerates predominate, and everywhere there is an element of volcanic material varying from the finest dust to thick conglomerates and lavas. Often the Tertiary rocks accumulated in great ocean depths (called "idio-geosynclines" by Umbgrove (1933)) where continuing subsidence due to folding during deposition has resulted in deposits of enormous thickness—some 20,000 to 40,000 feet, which is horrifying to geologists trained in lands less mobile than New Guinea.

#### VOLCANOES AND GLACIERS

The active and recently extinct volcanoes of New Guinea are of great interest. In Dutch New Guinea only the Umsini volcano, in the Arfak Mountains (behind Manokwari in the north-eastern side of the Vogelkop) is known to have been active in modern times, about 1864. The extinct volcanoes which occur as some of the crests and along the southern slopes of the Central Range in Australian New Guinea are either missing (or possibly have not been recognised as such) in Dutch New Guinea. The violent eruption of Mt. Lamington, 25 miles south-west of Buna, in 1952, was of news interest all over the world, as was the outburst in 1937 which threatened for some days to bury Rabaul like another Pompeii. But never a year passes without one or other of the volcanoes in Papua and New Guinea erupting.

Currently, Manam Island is in eruption (off the coast of Bogia, about 40 miles east of the mouth of the Sepik River). The active submarine volcano in St. Andrew's Strait, between Lou and Baluan Islands, near Manus, is also of great interest.

Earthquakes are common phenomena in New Guinea. At Rabaul there is an observatory in charge of G. A. Taylor, G.C., of the Bureau of Mineral Resources, which takes care of both vulcanological and seismic work.

Snowfields and small glaciers are found in Dutch New Guinea, in the Snow Mountains (the Carstensch Toppen or Group). In Australian New Guinea snow has been seen at Mt. Wilhelm by airmen flying nearby, but the height, 15,400 feet, is just too low for it to lie there for very long. During the Pleistocene undoubtedly many peaks of the Central Range were glaciated and to-day moraines, cirques and basin-like lakes remain as evidence.

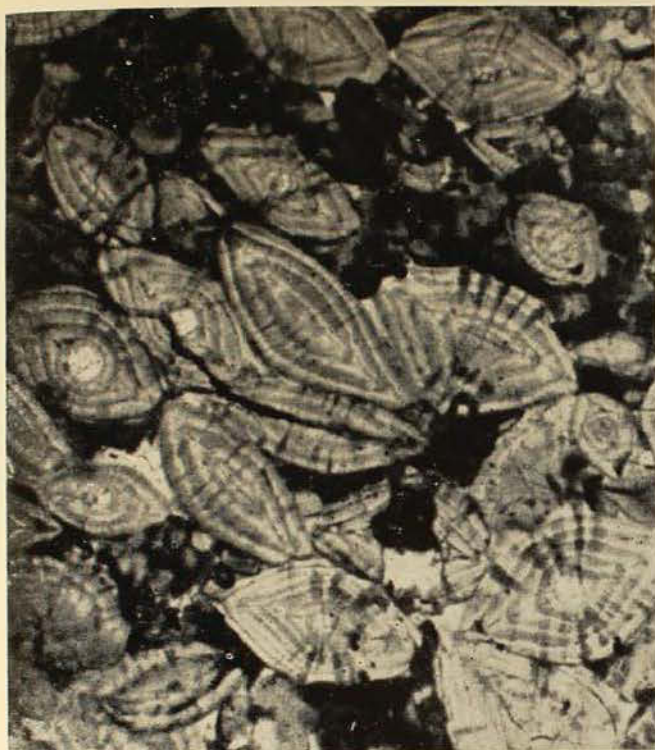
#### OILFIELDS

The only producing oilfields in New Guinea are in the Vogelkop area of Dutch New Guinea. Production is from the Klasafet Limestone of Miocene age. The Klamono field, connected to Sorong by a pipeline about 30 miles long, was discovered shortly before the Japanese entered the war. Other producers are the Mogoi and Wasian fields, about 140 miles east-southeast of Klamono, and Seleh, about 40 miles south-west of Klamono, discovered in 1954 but not yet in production. Over recent years production from Dutch New Guinea fields as a whole has progressively declined. The hopes of oil production in Australian New Guinea are centred in the Delta District of Papua where three holes are being drilled at depths of up to 13,000 feet. Considerable quantities of gas have been struck but there is no production of oil so far.

#### GOLD

No commercial coal seams are known in New Guinea but many beds of lignite of inferior quality have been noted by geologists. There is no production of tin. Gold deposits are widespread but in many parts

are too diluted to be worked. The Bulolo Valley and Edie Creek areas are now nearly worked out. Natives of New Guinea, who can mine much more cheaply than can Europeans, are increasingly producing gold in small but significant quantities and they may well make new and valuable finds.



Nummulitic limestone (above) in thin section, magnified about nine times. Such foraminiferal limestones may be the source of petroleum in New Guinea.

In New Guinea the Pliocene beds are often greatly disturbed by earth-movements. The native outlined at the right-hand corner gives the scale.



Photos.—Author.

### THE FUTURE?

Bauxite, nickel, manganese, monazite and copper are known, but lead, zinc, and iron ores in sufficient quantity and quality are not. Phosphates are being sought by a party from the Bureau of Mineral Resources, working in Australian New Guinea and the British Solomon Islands. Sulphur has been dabbled with but costs of production, lack of quality and quantity are stumbling blocks. Limestone deposits are widespread and easily accessible. The Cretaceous limestones at Port Moresby make an attractive building stone and the crushed material is used for surfacing roads. A cement works is contemplated. Cinnabar, the chief ore of mercury, is also reported.

The future of New Guinea lies possibly in oil and certainly in agriculture, stock and fisheries.

G. A. V. STANLEY is a Sydney University graduate who has spent most of his working life in Papua and New Guinea as an oil company geologist, although over the years he has visited Rennell Island (B.S.I. Protectorate) searching for phosphate rock, and Java and Sumatra to observe oilfield undertakings. During the last war he served as a Lieutenant (R.A.N.V.R.) with a branch of the Allied Intelligence Bureau and was awarded the D.S.C.



The trunkless palm, *Nipa fruticans*, will not tolerate saline water. It grows in tidal river mouths where the water is almost fresh.

Photo.—Author.

## New Guinea Vegetation

By J. S. WOMERSLEY

Chief, Division of Botany, Department of Forests, Lae.

THE island of New Guinea and the associated archipelago have vegetation formations which range from equatorial lowland evergreen rainforest to alpine tundra. Only the desert and steppe formations of areas of impoverished rainfall are unknown in New Guinea.

Broadly the vegetation may be classified on the basis of altitude thus:

Sea-level to 3,000 feet—tropical lowland forest.

3,000 feet to 6,500 feet—subtropical forests.

6,500 feet to 10,500 feet—montane [mountainous country] forests.

10,500 feet to 12,000 feet—alpine scrubs.

above 12,000 feet—alpine tundra.

above 16,000 feet—permanent snow.

Tropical lowland forest covers a far greater area than the other communities together. It also includes the greatest diversity of biological habitats. Throughout most of the coastal areas, water supply to plant communities is abundant, sometimes excessive. We find therefore that the vegetation of the lowlands includes communities specialized to live under conditions of a superabundance of water. Let us start on

the shallow sandy beach near Port Moresby. At very low tides the sand is exposed but generally a shallow covering of water flows around the plants of *Cymodocea rotundata* growing in the marine meadows. True marine seaweeds, abundant in temperate waters, are quite rare in the warm tropical seas. Few species have been recorded from New Guinea waters.

On muddy shores and in tidal estuaries vast areas of mangrove forests and *Nipa* palm swamps are found. Periodic inundation by salt or brackish water is required for the development of mangroves. In the shallow waters of the Gulf of Papua we find ideal conditions prevailing for the existence of the extensive mangrove forests now being developed for the commercial extraction of cutch [gum used for tanning] from the bark of certain species. Floristically the mangrove community is not rich when compared with lowland rainforest. The very specialized habitat is in part responsible for this. The New Guinea mangrove formations are usually dominated by species of *Rhizophora* or *Bruguiera* which often form trees exceeding 100 feet in height. The bole, however, is slender but aerial roots and stilt roots are a usual feature, both of which make penetration of a mangrove forest on foot difficult. On the banks of tidal creeks where a little sunshine is able to penetrate the otherwise

sombre gloom, communities of erect semi-woody herbs with blue flowers are found, *Acanthus ilicifolius* and *A. ebracteatus*.

Estuaries with brackish or fresh water rarely carry mangroves. More usual is a dense community of rather twisty many-branched trees, *Avicennia marina* and *Sonneratia caseolaris*. This community is very well developed on accreting shores. In tidal river mouths where the water is almost fresh, at least at low tide, there is a community of the trunkless palm, *Nipa fruticans*. This palm will not tolerate saline water.

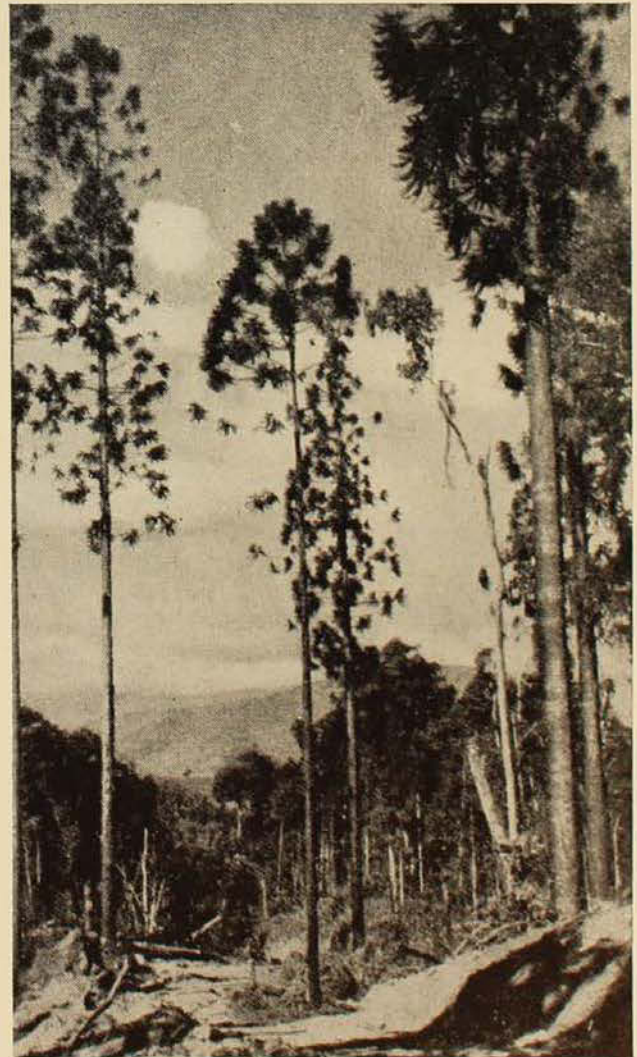
Large areas of lowland New Guinea are subject to periodic flooding by river water during the flood season of the year. The normal vegetation of country so flooded is a swamp forest with its canopy of shady trees reaching 100 feet in height or more. Perhaps as an adaptation to cope with the anaerobic conditions of the soil when flooded, many of the tree species develop large spreading buttresses, which, in some species, are divided and re-divided into finger-like processes. Some of the second-storey trees may actually be stilt-rooted. Ground cover is sparse, frequently being absent over wide areas. Palm thickets occur spasmodically as do dense clumps of rattans.

When inundation by fresh water is practically continuous, pure stands of the sago palm (*Metroxylon rumphii*) develop. Some strains of this plant are used by the native peoples for the production of sago starch. When the palm is about to flower a tall trunk is produced, sometimes up to forty feet high, on the top of which the inflorescence grows. In this tall trunk starch accumulates which, by a process of washing and filtration, is concentrated in a usable form for native foodstuff. Where slightly drier conditions prevail, perhaps due to a change in the course of a river, various tree species invade the sago swamp. Among them may be *Camptosperma brevipetiolata*, *Couthovia* sp., *Evodia elleryana*

and *Terminalia* spp. With a further decrease in inundation the tree-storey increases numerically until no *Metroxylon* is found, but a closed canopy of forest trees has formed.

On coasts where there is a shelving sandy beach herbaceous vines are the first colonisers. *Canavalia maritima*, *Vigna marina* and *Ipomoea pes-caprae* form a dense cover on the strand. On the landward edge the first shrubby plant is often *Vitex trifoliata*. Frequently, large trees of *Calophyllum inophyllum*, *Thespesia populnea*, *Hibiscus tiliaceus* and others overhang the water. *Aegiceras corniculatum*, with its curious curved claw-like fruits, is sometimes locally abundant. Rapidly accreting coastal sandbanks may be colonised by *Casuarina equisetifolia*.

On gently rising, well drained soils the strand formations quickly give way to



*Araucaria hunsteinii* trees near Bulolo, Morobe District, N.G. Altitude about 3,000 ft; overall heights of trees about 200 feet.

Photo.—J. B. McAdam.



These Begonias were photographed (by F. Hurley) at 7,000 feet on the slopes of Mt. Tafa.

lowland rainforest. Low-lying ground behind the beaches is usually occupied by Swamp Forest or Metroxylon swamp.

The drained tropical lowland forests include a diversity of formations which can only be briefly described here, although in terms of area covered and economic value as a source of timber these formations exceed all others. The following rather broad formations may be recognised in the drained lowland tropical forest.

#### 1. OCTOMELES SUMATRANA AND EUCALYPTUS DEGLUPTA FORESTS

Both species are pioneer colonisers on bare sand-banks in rivers and on volcanic slopes, hence the communities are generally poor floristically. The seedlings of both species grow at a fantastic rate on favourable sites, rapidly out-stripping all other species which happen to germinate. Formations which have been initially dominated by *Eucalyptus deglupta* and/or *Octomeles sumatrana* are gradually invaded by seeds and seedlings of rainforest species as the micro-climate under the canopy becomes more favourable for their establishment. Among these should be mentioned *Dracontomelum mangiferum*, *Pometia pinnata*, *Homalium foetidum*, *Pterocarpus indicus*, *Intsia bijuga* and *Celtis* spp.

#### 2. MONSOON FORESTS

Where rainfall is markedly seasonal, with a pronounced dry season of considerable duration, the climax forest differs from the rainforest of regions of high uniformly distributed rainfall in the much greater number of tree species which become leafless for a considerable period of the year. This period of leaflessness is associated with the dry season. The canopy is usually slightly more open than in rainforest but the lower storeys are less well developed, except where a soakage occurs. Here dense thickets of palms and lianes are found. The floristic composition of monsoon forest as seen on the coastal plain west of Port Moresby is not strikingly different from that on the coastal plain west of Lae. The big difference is that in the monsoon community the deciduous species remain leafless for a considerable period.

With decreasing rainfall the monsoon forest becomes very susceptible to changes in succession due to mankind or fire. Probably most, if not all, of the savannah formations in New Guinea are man induced. Once established the grassland is perpetuated by periodic burning. Only fire-tolerant species of *Eucalyptus*, *E. confertiflora*, *E. papuana* and *E. alba* in the lower altitudes survive. At Sogeri *Eucalyptus terebinthifolia* is found in these grasslands. *Albizia procera*, a savannah species of the Markham and Sepik valleys as well as elsewhere, is not fire-tolerant until the crown is well clear of the tallest grass. This only occurs where fire is absent for several years. Elsewhere can be found a large woody root stock from which new shoots grow only to be burnt back each year before exceeding the height of the grass.

#### 3. LOWLAND DRAINED RAIN FORESTS

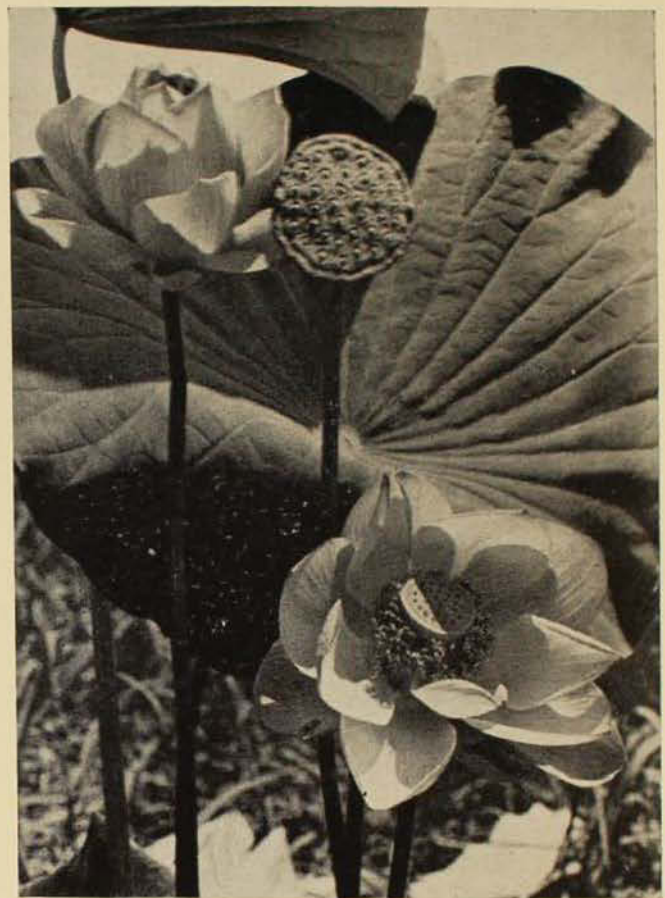
The rainforests of the high rainfall well drained soils of lowland New Guinea are subject to a tremendous impact by the indigenous population who use the land favoured by good drainage and abundant

rain for food-producing gardens. There is little doubt that the climatic climax community of these lowland well drained areas is very rare, if extant, today. In its place we find a patchwork quilt of multitudinous seral stages. At one extreme there is the producing garden, at the other a tall closed forest, several storeyed and floristically very rich. Lianas are abundant. There is a ground cover of suppressed seedlings each waiting its chance through a windfall or death of a large tree to join in the frantic race to the light. Very rarely is this lowland rain forest of restricted composition. As many as one hundred different species may take their place among the canopy. Certain species do occur more frequently than others, the commonest being *Pometia pinnata*, *Pterocarpus indicus*, *Intsia bijuga* and *Vitex cofassus*.

#### 4. LOWLAND RIDGE FORESTS AND FORESTS ON POOR SOILS.

Throughout lowland New Guinea the well drained ridges are covered by a forest in which members of the family *Dipterocarpaceae* are common. Usually forming large trees which burst through the canopy, *Anisoptera polyandra* and *Hopea* spp. are very abundant. The same species may also be found on more gently sloping soils which are usually porous. The sub-canopy storeys are not well developed even though the canopy is by no means tightly closed.

Ascending now in altitude we find between 2,000 feet and 6,000 feet a zone in which beeches (family *Fagaceae*) are abundant. Forests composed almost exclusively of *Castanopsis acuminatissima* are widespread between 2,000 and 4,000 feet, particularly on the Papuan side of the island. At higher altitudes the acorn-bearing oaks belonging to the genera *Pasania* and *Lithocarpus* occur. In general the oak forests are of a shorter stature than the lowland rain forests. In certain localities, now probably but remnants of a vast forest belt, we find the oak forests giving way to the magnificent *Araucaria* forests of which the well known Bulolo valley is probably the finest example. The *Araucaria* trees tower majestically 100 feet or more above the closed canopy of the oak forests, itself some 80 feet above the



Giant lotus from Lake Murray.

Photo.—F. Hurley.

ground. Two species of *Araucaria* are found in New Guinea, the klinkii pine, *Araucaria hunsteinii* (syn. *A. klinkii*) and the hoop pine *Araucaria cunninghamii*. The closed canopy includes many tree-forming species in addition to the oaks. Among these should be mentioned the families *Lauraceae*, *Sapindaceae*, *Meliaceae* and *Ulmaceae*.

Reaching further into the mountains the oak forests give way to *Nothofagus* forests. Generally found between 6,500 feet and 10,000 feet these forests often consist of one or at most a few species of *Nothofagus*, particularly *N. grandis*, *N. carrii* and *N. perryi*. Associated species are mainly *Coniferae*, some of which provide timber of considerable local value. Among the herbaceous flora of the montane *Nothofagus* forest mention should be made of the showy species of *Impatiens*, *Cardyline* and *Begonias*, many of which are cultivated by the local inhabitants for garden borders and roadsides. Many species of *Rhododendron* are also found in this zone, some with

large showy blooms, others much smaller, some being large terrestrial shrubs, others small epiphytes on the branches of the trees.

Above the *Nothofagus* forests the effect of altitude and low night temperatures is reflected in the thinning and stunting of the forest. Trees become dwarfed to little more than shrubs. Above 12,000 feet woody vegetation gradually disappears. Scattered bushes of *Coprosma*, *Drimys*, *Detzneria tubata*, etc. are left to remind us of the woody vegetation so richly developed at lower altitudes. The herbs however continue to flourish and here species of *Ranunculus*, *Gentiana*, *Scrophulariaceae* and *Umbelliferae* may be found, reminding one of the European alps. Permanent snow is reached in Dutch New Guinea above 16,000 feet.

In this brief introduction to the main vegetation types of New Guinea much has been omitted and generalised. I cannot conclude, though, without mentioning the vast wealth of the epiphytic flora at all altitudinal levels. Here, dwelling among the branches of trees is a plant world dominated by orchids and ferns. *Medinilla*s with showy pink blooms, *Hoyas* in red, pink or white trail from the branches. The magnificent red-flowered species of the leguminous genus *Mucuna* make a splash of colour on the forest edge.

Among this amazingly rich flora there are still many plants to be discovered. The energy of keen field workers prepared to live in the tropics will in the course of time add greatly to our knowledge of the floristics and ecology of the New Guinea flora.

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## Mammals of New Guinea

By B. J. MARLOW

THE mammals of New Guinea are of great interest, showing many similarities with their mainland counterparts, for in Australia, too, only monotremes, marsupials, rodents and bats are present with any diversity of species.

Some interesting problems in dispersal are presented by the two former groups, since the monotremes which are confined to this area, and which are the most primitive mammals, can only be traced back in the fossil record for about a million years, into the Pleistocene.

The marsupials arose in North America, and although they can be traced as fossils to a very early period in the history of mammals no remains of them have been found in Asia and it is difficult to explain how they arrived in Australia from North America. It has been suggested that they travelled across a southern continent known as Gondwanaland which was

thought to have originally joined South America with South Africa, Antarctica and Australasia.

It is less difficult to explain the presence of placentals in New Guinea. The rodents are believed to have come via the Philippines and Celebes, either by raft transportation or across temporary land bridges, while water barriers are no impediment to bats which are the only mammals with the power of true flight.

The only other placental mammals in New Guinea are wild pigs, feral dogs, one species of deer and a palm civet on Aru Island, all of which have probably been introduced by man.

### MONOTREMES

Since the platypus is absent from New Guinea, this group of primitive egg-laying mammals is represented only by the echidnas. Although the short-beaked





A captive tree-kangaroo (*Dendrolagus ursinus*) at Hollandia, Dutch New Guinea.

Photo.—D. F. McMichael.

echidna also occurs in Australia, the long-beaked echidnas are unique to New Guinea. Of these there are three species, one from Dutch New Guinea with only three toes on the fore-feet and two from north-east New Guinea with five toes on the fore-feet. These animals are larger and more heavily built than the short-beaked species and have thick black hair on the back which partly conceals the white spines. They also have longer limbs and are considerably more active. All echidnas feed on ants and termites which they lick up with their long tongues having previously broken into a nest with their claws.

#### MARSUPIALS OR POUCHED MAMMALS

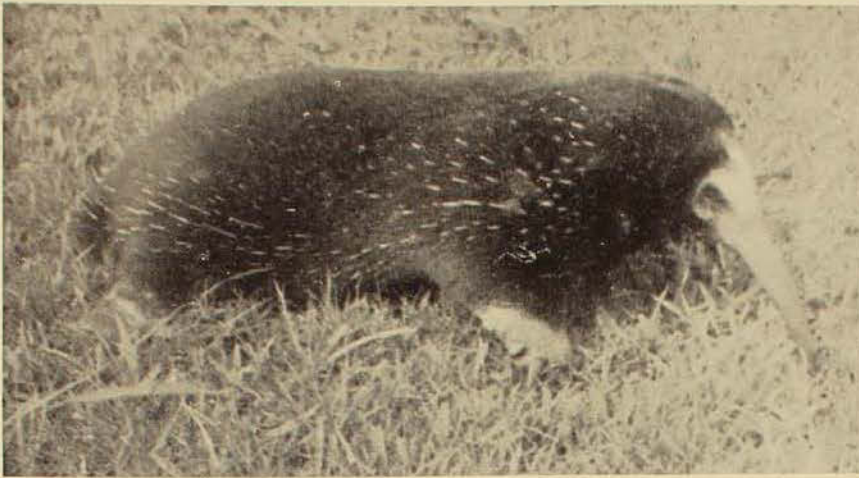
All the families of marsupials which occur in Australia are also represented in New Guinea (with the exception of marsupial moles and wombats) and include carnivorous marsupials, bandicoots, possums and kangaroos.

#### CARNIVOROUS MARSUPIALS

There are two distinct types—large arboreal carnivores, such as the native cats, and small insectivorous mouse-like animals.

The latter may be distinguished from true mice (which are rodents) by the presence of numerous small incisor teeth in the front of the jaws instead of the large gnawing incisors of rodents. Many of these marsupial mice are closely allied to forms which are found on the mainland of Australia. Similarly, the native cat, which is a small spotted tree-living animal, is related to those that occur in north Queensland and the Northern Territory. On the other hand, some of the carnivorous marsupials are unique to New Guinea. Among these are certain species allied to the native cats but which are marked with black stripes on the back instead of the more normal spotted pattern.

One unique species of marsupial mouse is of special interest. This animal (*Murexia longicaudata*) is the least specialized in its dentition of all the carnivorous marsupials in Australasia and is believed by some authorities to be ancestral to the Thylacine or Tasmanian Wolf. Other writers, however, have suggested that the Thylacine is descended from certain extinct South American carnivorous marsupials known as Borhyaenids.



Left: A long-beaked echidna (*Zaglossus bartoni*) from New Guinea. All echidnas feed on ants and termites.

Photo.—R. Mackay.

Below: This striped possum (*Dactylopsila trivirgata*) is a close relative of the long-fingered striped possum.

Photo.—H. Burrell.

### BANDICOOTS

These animals resemble large rats superficially, but, again, are easily distinguished, by their numerous incisor teeth and in having the second and third toe of the hind-foot fused together to resemble one toe bearing two claws. This latter character is also common to the possums and wallabies.

Only two forms of bandicoot are common both to New Guinea and Australia. The remainder are all unique to the New Guinea area, and it is here that the largest species occur. Among these is a species (*Peroryctes raffrayanus*) which is about 28 inches in total length and is similar to the common Australian long-nosed bandicoot except for its shorter ears. A small black mouse-like bandicoot is also present.

Bandicoots occur in both dense rain-forest and in grassland plains where they feed on insect larvae and other small animals which they dig out of the ground with their fore-claws.

Of the two forms which also occur in Australia, one is a close relative of the short-nosed bandicoot, while the other form (which is distinguished by its fewer incisor teeth) is really a New Guinea group which is known from Australia only by a single sub-species.

### POSSUMS

The most typical members of this family in New Guinea are the cuscuses which comprise many species widely distributed throughout the island and extending into



north Queensland. These slow climbing animals have been compared with sloths, but unlike them are more omnivorous in diet. They are distinguished by their long prehensile tail which is completely naked for about the terminal half, and by their thick woolly fur which varies from dark brown to white with blotches of yellow, orange or rufous according to the species.

The ring-tail possums are well represented in New Guinea and also occur in Australia. They are characterised by their



Adult female and juvenile male spotted cuscus (*Phalanger maculatus*). Cuscuses are the most typical members of the possum family to be found in New Guinea.

Photo.—H. Chargois.

long prehensile tails which are covered with short hair at the tip and which are often carried in a tight coil. Although the Australian species normally have a white tip on the tail this is not so in the New Guinea forms. These animals are related to the koalas, which are absent from New Guinea, and like them feed mainly on leaves and oppose both the thumb and second digit of the hand against the remainder when climbing.

Brush-tailed possums are absent from New Guinea and gliders are poorly represented. The common sugar glider (*Petaurus breviceps*), which is widely distributed in Australia, is the only species there. It is an ashy-grey animal about the size of a rat and has a membrane along its flanks which enables it to glide for appreciable distances.

A Sugar Glider (*Petaurus breviceps*) eating a cicada. This animal occurs both in eastern Australia and New Guinea.

Photo.—H. Hughes.

Two other species of possums which are unique to New Guinea deserve special mention. The first of these is the pen-tailed phalanger (*Distocurus pennatus*) which is a striking fawn animal with a black and



white head, closely related to the feather-tailed gliders of Australia. It has a long tapering tail which bears a fringe of stiff hairs on each side, but unlike the "feather-tail" has no gliding membrane. Feather-tail gliders have been reported from the islands north of New Guinea but not from the main island itself. The second species is the long-fingered, striped possum which is closely allied to the black and white striped possums of New Guinea and north Queensland. This animal (*Dactylonax palpator*) is striped with broad black and white bands and shows a remarkable similarity in its habits to the Aye-Aye, which is a highly specialized lemur from Madagascar, for both these animals have a long thin finger on the hand with which they extract the larvae of wood-boring beetles from their tunnels.

#### KANGAROOS

The tree-kangaroos are the most characteristic members of this family in New Guinea where they extend throughout the island and into north Queensland. There are several species and many of them are brightly coloured with various combinations of chestnut, yellow and brown. As a rule the Queensland species are more sombre. These animals have become secondarily adapted to an arboreal life which is reflected by the reduction in size of the hind-foot, in comparison with other kangaroos, and by the long tail, which is not prehensile but which is used more as an organ of balance. They live in small parties consisting of a male and several females.

Only one group of the kangaroo family is confined to New Guinea; these are small animals known as *Dorcopsis* wallabies, which inhabit the dense forests.

Two species of scrub pademelons exist, one of which is also common to eastern Queensland and New South Wales.

The last species of this family which occurs in southern New Guinea is the common sandy or agile wallaby of northern Australia.

True kangaroos and rat-kangaroos are absent.

The last marsupial of New Guinea that must be considered is the large fossil *Nototherium*, a close relative of *Diprotodon* which has been recorded from Pleistocene deposits.

#### BATS

Among the many species of fruit bat or flying fox which are present, the majority are unique to the island, although a few, such as the spectacled fruit bat, are common to Australia also.

The naked-shouldered fruit bats, which are unique to the New Guinea area, are of special interest since one species (*Dobsonia viridis*) has green algae growing on its hair in a manner similar to the sloths of South America.

In the case of the many species of small insectivorous bats a converse situation exists since only a few species are unique while the majority are common to Australia. Among the small bats may be listed sheath-tailed bats, horse-shoe bats, free-tailed bats and many species of simple nosed bats.

An interesting distribution is shown by the false vampire bats which occur both in the Celebes and Australia yet which are absent from New Guinea.

#### RODENTS

Many of the rodents are typical small rat-like forms which live in the forests and grassland and which need not be considered further here. Two groups, however, are of special interest. The first of these are the water rats. In addition to the common Australian water rat, there exists a large number of species of this group which are unique to this region. These species may be arranged in an interesting evolutionary series which is based on the molar or grinding teeth. There has been a tendency to reduce the number of these teeth in this group, and the most primitive member (*Leptomys elegans*) still retains the normal number of three molars in each half of each jaw. Consecutive stages in reduction can be traced through the group until a recently discovered species (*Mayermys ellermani*) is reached which shows the unique condition of having only one molar in each half of each jaw. This means that

when the paired incisors above and below are also considered, the animal has only eight teeth, which is the lowest dental formula for any mammal which has teeth.

Another species in this group, Monckton's water rat (*Crossomys moncktoni*), has a keel of hairs on the under-surface of the tail which turns it into a flat vertical paddle. This phenomenon is also shown by certain European water shrews.

The other group of rodents is that of the mosaic-tailed rats. These animals are characterised by their long naked prehensile tails on which the scales abut like a mosaic rather than overlapping as in the more typical rats. They are active climbers of large size being exceeded in New Guinea only by one species of true rat (*Mallomys rothschildi*) which is about 35 inches in total length.

#### GENERAL RELATIONSHIP

In spite of the fact that approximately 50 per cent. of the genera of mammals which occur in New Guinea are unique to that area, the general relationship of the class is obviously close to Australia; this is particularly so in the case of the marsu-

pials and monotremes. Several groups of marsupials in Australia would appear to have been derived from New Guinea forms, particularly the tree-kangaroos, euscuses, striped possums, ring-tailed possums and probably the short-nosed bandicoots.

In the case of the rodents, however, the family Muridae, which contains all the Australasian rodents, arose in Europe during the Miocene and radiated through Asia into the Oriental region. An imaginary line, known as Wallace's line, which lies between the Celebes and Borneo, separates the faunas of the Oriental and Australasian regions. There is only one genus (*Xeromys*) in the Muridae which occurs naturally on both sides of this line and this animal is considered to be the precursor of the water rats of Australasia. The mechanism by which the other rodents arrived in this region remains obscure.

The distribution of bats which can fly is of minor significance in a consideration of the origin and dispersal of mammals in a region like Australasia, yet it is interesting to notice that even in this group there are many genera which are unique to Australia and New Guinea.

## Book Review

AN ILLUSTRATED INDEX OF TASMANIAN SHELLS. By W. L. May (1923). Revised by J. Hope Macpherson, 1958. Government Printer, Tasmania. Price 10/6d., posted.

May's well known "Index" of the Tasmanian shell fauna has long been a standard reference for both amateur shell collectors and professional malacologists. The work has, however, been out of print for some time, and during the thirty-five years since it was first issued the nomenclature of the Australian molluscan fauna has changed considerably, so that many collectors would be unfamiliar with the scientific names used by May.

It is therefore pleasing to see the work re-issued with an up-to-date nomenclature and the addition of some of the species which have been described or recorded from Tasmanian waters in the meanwhile. New South Wales collectors, who have always had cause to refer to the Index because of the many local species illustrated therein, will find the revised edition especially useful, though they will still find some unfamiliar names for well known species. Miss Macpherson's

nomenclatural treatment has been conservative, using broad generic groups to some extent, rather than the restricted genera familiar to New South Wales collectors. This of course, is mainly a matter of scientific opinion, but the reviewer feels that broad genera are of more value and will probably come to be generally accepted.

The format of the book is not the most satisfactory, but undoubtedly contributes to the low cost, an important factor for the average collector. A few mis-spellings are unfortunate, and the figures (prepared by May) are not always accurate. Still, they are generally adequate for identification, and Tasmania remains the only State with a fully illustrated handbook of shells. Miss Macpherson has added the dates of publication of the scientific names, as well as the genera in which the species were originally described. These will be of great value to those wishing to refer to the original publications. Land, freshwater and marine shells are included, but not the shell-less marine mollusca. The work should find a place on the shelves of every shell collector.

D. F. McM.

# Birds of New Guinea

By ALLEN KEAST



The Lesser Bird of Paradise (*Paradisea minor*), characterised by light yellow plumes, is mainly an inhabitant of western New Guinea (as far east as Madang and Astralobe Bay). A close relative, the Red-plumed Bird of Paradise (*Paradisea raggiana*), whose plumes are orange-brown in colour, extends through the jungles of the eastern half of the island to within a few miles of Port Moresby and Lae.

Photo.—F. Hurley. Australian Museum Copyright.

ACCORDING to the estimate of Dr. E. Mayr and Dr. D. L. Serventy the number of bird species occurring in New Guinea is 650 and in Australia 651. Thus New Guinea, notwithstanding its small size, has a rich bird fauna.

The New Guinea and Australian birds differ chiefly in that the former, for the most part, are inhabitants of and specialized for, life under conditions of dense forest. The Australian list, whilst also made up largely of bush birds, contrasts in that sea birds form an important element. Many southern petrels and albatrosses seasonally visit southern Australia but keep clear of tropical waters. Water-birds such as herons, cormorants, ducks, spoonbills, ibises, breed for the most part in the extensive swamps and marshes of southern Australia. Only some of these birds occur as breeding populations in, or even visit, New Guinea. The New Guinea list is somewhat supplemented by a series of tropical water-bird species. There is one

unique duck, Salvadori's Duck, which lives on lakes and streams towards the tops of the Owen Stanley, Oranje, and Wharton Ranges.

Of the true New Guinea birds two groups, in particular, stand out. These are the giant flightless cassowaries and the paradise birds. There are three species of the former, with the smallest standing some 3 feet high and the largest about 5 feet. They differ from emus chiefly in being of stockier build and in inhabiting jungle. The cassowary has a greatly lengthened nail on the inner toe of each foot, and this is used in fighting. It is a formidable weapon but, fortunately, the birds prefer to keep well away from humans. Cassowaries are mixed feeders but have a special liking for fallen fruits. The large, greenish eggs, typically 3 to 5 in number, are laid on the jungle floor.

The paradise birds attracted the attention of the early voyagers by their magnificent colouring, gaudy and bizarre display

plumes. They were at first believed to be without legs for, in preparing the trade skins, the natives removed these. The name "birds of paradise" hence has an obvious origin: the birds' beauty was in excess of anything to be expected on earth and, since they could not alight, they spent their whole lives flying through the air!

There are some 35 different species of paradise birds, as well as numerous distinctive races. It is the males that are brightly coloured, typical females being brown. In the different species the males may be dominantly blue (the so-called Blue Bird of Paradise) or, more commonly, red or gold. Others appear at first sight black, but when caught in the light have a gloss and sheen equal to that of shot silk. The shape and kind of plumes are very variable. Some have bunches of delicately-coloured feathers on the sides of their bodies; others have exaggerated and enlarged head or tail feathers. Birds of paradise are believed to be polygamous. The courtship displays of the males are just as bizarre as the birds themselves. The cock birds jump up and down, hang upside down, raise and lower their plumes, twist and turn, uttering harsh cries throughout. All the domestic chores, from the construction of the shallow stick nest to incubation and raising of the young, fall to the females.

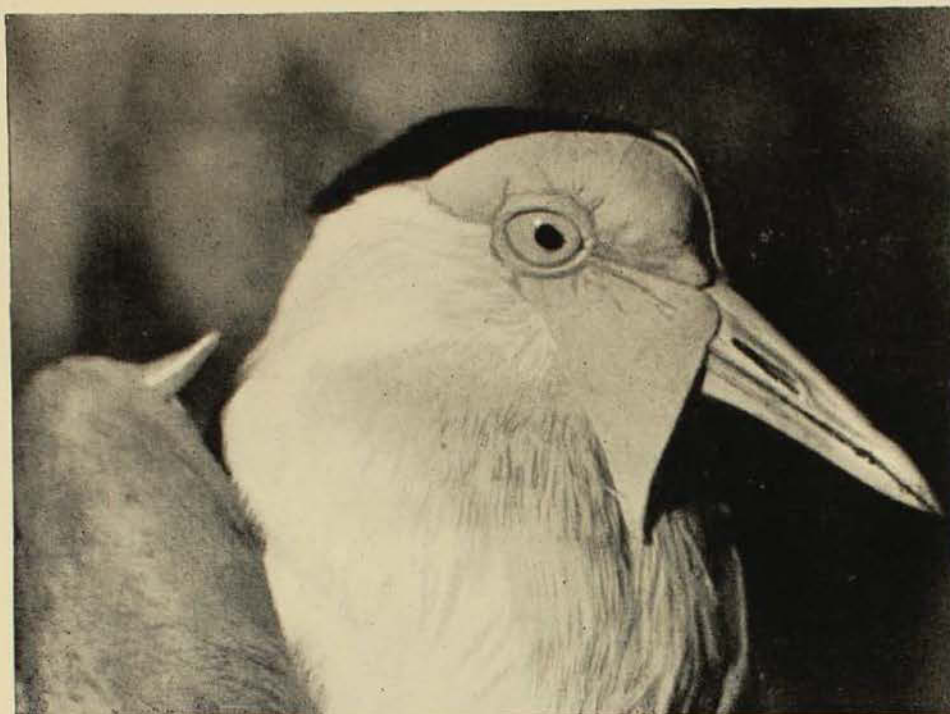
Some paradise birds can be seen quite near to the towns. Thus the Little King Bird of Paradise (*Cicinnurus regius*) is recorded from the upper Laloki River behind Port Moresby and the Count Raggi's bird (*Paradisaea apoda*) with its beautiful orange-brown display plumes, occurs in the jungle near Lae.

To provide a detailed account of the birds of New Guinea or to describe how various ones can be identified is beyond the scope of this article. Identification in the field is complicated by the absence of a suitable low-priced book. It is doubtful, moreover, if there are more than a couple of people living who could identify all the birds on sight. However, it is possible to discuss some of the general types and to list a few of the species common near Port Moresby and Lae.

New Guinea has a parrot fauna as diverse and colourful as that of Australia. There are about 48 different species and they range from large black Palm Cockatoos, black and red Pesqui Parrots, and White Cockatoos, down to tiny Pygmy Parrots no larger than a finch. All the parrots are brilliant in their colouring. Pigeons and doves are also numerous, and there are about 42 species. Peaceful Doves, small and grey, and with a distinctive "doodle-doo" call, are common ground-feeders in the dry open country of the south. The fruit-pigeons, by contrast, are jungle dwellers. Most of them are green but with patches of different colours on the crown and under-surface. They are difficult to see amongst the leaves. A striking pigeon, however, is the large nomadic Torres Strait Pigeon, which is white, with black on the wings. It is a swift flyer and is generally to be seen along the coastal streams and jungle fringes. New Guinea has the world's largest pigeons, the Goura Pigeons of the jungle mountains. These have a body almost as large as that of a fowl. They are mostly greyish in colour and have a series of ornamental feathers sticking up from the crown of the head.

Hawks are numerous and widespread in New Guinea but, because of the denseness of the vegetation, less noticeable than in Australia. There is a large endemic eagle, *Harpyopsis novaeguineae*. The Australian Whistling and Wedge-tailed Eagles occur in parts. The White-breasted and Red-backed Sea-eagles are a feature of the coastal areas. New Guinea has 22 different kingfisher species and 21 cuckoo species. There are 10 bowerbirds and catbirds and 60 honeyeater species.

The Port Moresby area is most interesting from the bird viewpoint for, in addition to terns and frigate-birds to be seen offshore, it contains an "Australian segment" (living in the dry eucalypt-covered hillsides). By contrast, the jungles along the upper Laloki and in the vicinity of the rubber plantations, are populated by "true" New Guinea birds. Thus, within a few miles of the town one sees Fawn-breasted Bower-birds, Papuan and Black-faced Cuckoo-shrikes, Yellow-tinted and



The Masked Plover (*Lobibyx miles*) is a common bird in tilled fields and along the open banks of streams. The bill and flesh about the face are yellow and there is a spur on the wing.

Photo.—Author.

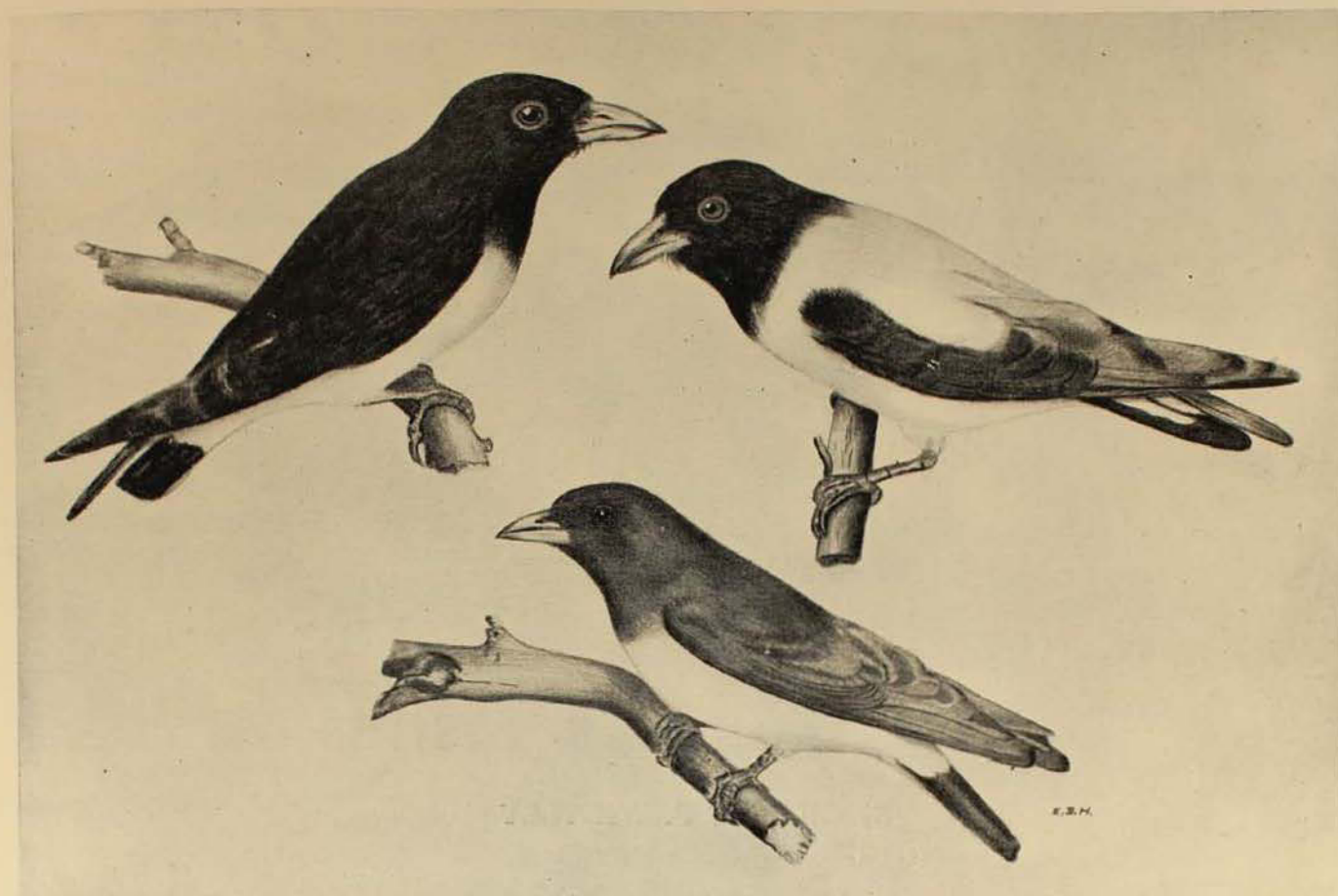
Rufous-banded Honeyeaters, the New Guinea Friar-bird, Black-backed Butcher-birds, the Willie Wagtail, Sacred Kingfishers, Rainbow-birds, and Tree Martins (the last three being winter visitors from Australia). The Swamp Pheasant or Coucal and the diminutive Yellow Sunbird frequent the hillside areas of dense growth called "mist pockets". Other species, illustrations of which can also be found in the Australian bird book, *What Bird is That?* (N. W. Cayley) are the mangrove-dwelling Dusky and Varied Honeyeaters.

A journey to Rouna Falls (near Port Moresby) and beyond brings the observer amongst quite different birds. Around the falls and adjacent cliffs one sees the tiny bluish-black swiftlets, whose method of flight is quite bat-like. The little New Guinea black-and-white wrens (*Malurus alboscapulatus*) frequent the grassy thickets. Further along the road, where it is fringed by rubber trees or jungle, the Papuan Minahs (*Mino dumontii*) fly in noisy and straggling groups. Those who have seen the introduced Indian Minah in Australia will recognise this bird as being a close relative. It is characterized by being black on the back and tail, white on the rump, yellowish on the abdomen, yellow area of bare flesh on the face, and with yellow bill and legs. Here too there are

Long-tailed Kingfishers, Papuan Hornbills, Shining Starlings, Gaudichaud's Kingfisher (blue-black above, white throat, chestnut abdomen), and Eclectus Parrots (large parrots in which the female is red with a blue abdomen, and the male green but with red under the wings).

The immediate vicinity of Lae is jungle-covered and the would-be bird-watcher finds himself straining his eyes to try to make out the multitudinous songsters in the high leafy canopy. Much better results will be had, however, if he concentrates on the areas of secondary growth for not only are the birds lower down there, but the cover is much less dense. In jungle areas one finds that the common pied butcher-bird (*Cracticus cassicus*) has a white back. A tiny brown bird is frequently seen and hangs a draping dome-shaped nest from a sapling. It is a warbler, *Gerygone magnirostris*. A second sun-bird now accompanies the yellow species. It is jet black with a pale blue patch on the shoulders and a bluish sheen on the top of the head. This is the Black Sun-bird (*Cinnyris sericea*) and along with the other species it flutters in front of the pawpaw flowers in the centre of Lae itself. Drongos, black and with long distinctly-forked tails, flutter out over the cleared spaces and compete with the circling wood-swallows



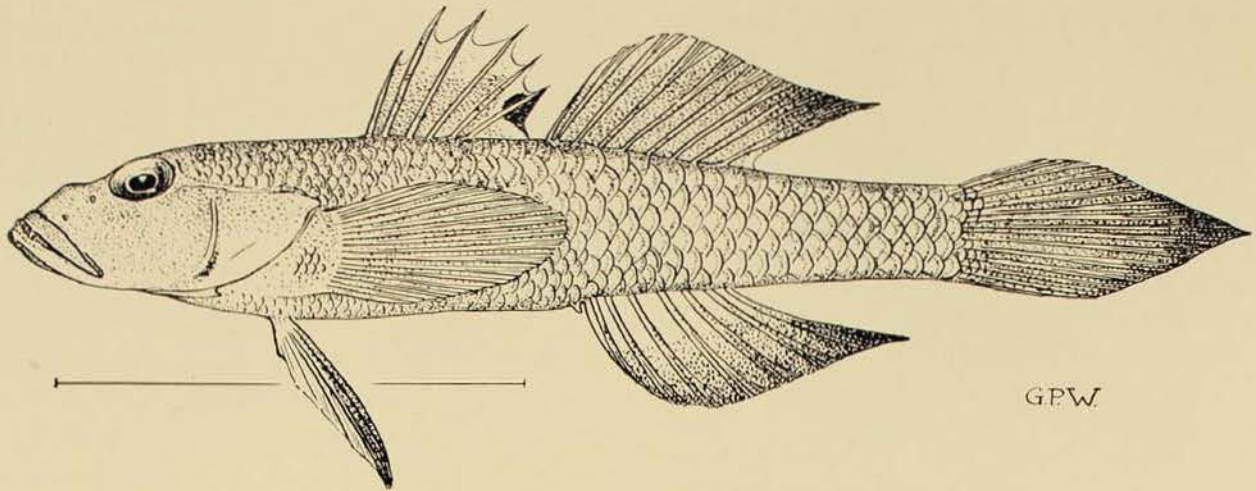


The three black and white wood-swallows of New Guinea. *Upper left:* The Great Wood-swallow (*Artamus maximus*) of the New Guinea highlands. *Upper right:* The White-backed Wood-swallow (*A. insignis*) of New Britain and New Ireland. *Lower:* The White-breasted Wood-swallow (*A. leucorhynchus*), a common bird of the towns and native villages throughout New Guinea.

E. S. Hoskin del.

for insect food. The tiny swiftlets and the swallow *Hirundo tahitica* are also there. Presently a giant hornbill or black Palm Cockatoo will fly far overhead. Shining Starlings and Papuan Minahs are squabbling about the houses. The foreshore has its group of Reef Herons (some white, some grey, but all belonging to the same species), the odd migratory Sacred Kingfisher perched on a mangrove stick or log as he watches for the unwary crab, and

inevitably the Red-backed Sea-eagle spiraling overhead. Here and there on the mud-flats are sandpipers, Arctic migrants that winter south of the Equator. But back from the beach, just as beyond the settlement itself, the jungle forms a continuous curtain, and from it issues the loud and continuous clamour of upwards of 50 bird species. These are the shy and cover-loving ones that are so hard to see, very difficult to identify.



A freshwater goby (*Glossogobius?*) from Kwan Stream, Sepik water-shed, 3,000 to 3,500 feet above sea-level. Length  $2\frac{5}{8}$  inches.

## New Guinea's Fishes

By GILBERT P. WHITLEY

**T**HERE is, as yet, no book dealing with the fishes of New Guinea, but Mr. Ian Munro, of the C.S.I.R.O. Division of Fisheries, Cronulla, has prepared a list of the species for the *Papua and New Guinea Agricultural Journal* (in press) and is working on a larger, illustrated book. The appearance of both these publications is eagerly awaited because the waters of Papua and New Guinea are, ichthyologically, amongst the least-known areas anywhere. H. W. Fowler's *Fishes of Oceania*, published in Honolulu from 1928 to 1934, included all the species then recorded, but many more have been discovered in the last quarter of a century and Mr. Munro tells me that some 1,430 different species are now known from New Guinea (988 of them from Australian territorial waters there). Exploration is still going on, so that it would not be surprising if, in time, two or three thousand species of fishes should be recorded from this area.

These fishes are found in freshwater, in the mountain ponds and rivers and in great lakes, some of which may have been cut off from the sea by comparatively re-

cent geological movements; others inhabit the great coastward-flowing rivers, like the Sepik and the Fly, the latter with its silt and deltas extending into the Gulf of Papua where some very extraordinary mud-living fishes (still to be made known to science) have evolved.

### MARINE FISHES

In the seas around New Guinea there are fishes in amazing variety: in two sample hauls of a seine net at Kapakapa, I obtained from a creek 67 fish belonging to 13 different species, whilst on the beach only a few yards away, 130 specimens belonging to 11 species, different from the creek ones were obtained. At Mukawa Bay, north-eastern Papua, on another occasion, 102 specimens of 22 different species were netted, and at Sinapa 106 examples of 21 kinds.

When demolition work was being carried out at the end of the wharf at Port Moresby in September, 1948, an explosion stunned 29 species amongst the random sample of 221 specimens I was able to observe at the time; many more fish were destroyed.

Away from the beach, amongst outcrops of coral, it was possible to gather entirely different kinds again: the gloriously tinted demoiselles and parrot fishes and the myriad other species restricted to the coral. Beyond the reefs at the surface of the open sea there is a rich variety of still other forms: flying fishes, marlin, devil rays, leaping wolf herrings, tunnies, sharks, dolphin, wahoo and game fishes; also the herrings and small fishes upon which they feed. Then the deep water, still mostly unexplored, has its own fish-occupants, down to great depths. These abyssal fishes have only been netted by specially equipped expeditions such as the *Challenger* and the *Dana*.

The principal commercial fishes of New Guinea and the methods of capturing them are as follows:

*Trolling*: Spanish mackerel, pikes, jobfish, trevally and various tunas.

*Handlines*: Bass (several species of *Lutjanus*); cods and coral "trout" (various species of *Epinephelus*, *Variola* and *Plectropomus*); sweetlips, threadfins and wrasse.

*Beach seines*: Trevally, batfish, queenfish, mullet, garfish and many other kinds.

*Native reef fishing*: Mackerel, tuna, runner, malabur (*Selar*), parrot fish, unicorn fish, goatfish and minor kinds of fishes.

According to the Territory of Papua Annual Report for 1955-56 "no statistics are available regarding the quantity and value of fish and shell-fish caught, the whole of which is consumed locally."

Japanese fishermen regularly take commercial catches from New Guinea, and even much further afield, back to Japan.

The marine fishes of New Guinea are similar to those found over a wide area, from the Red Sea to Madagascar and across the Indo-Australian archipelagoes

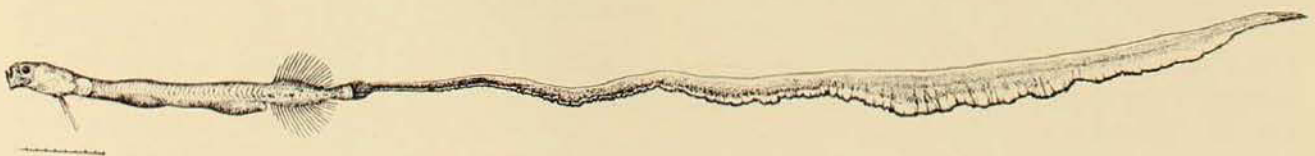
to the southern Pacific Ocean, although there seems to be a local difference between those of the north and south coasts, the line of separation being near Samarai. Sharks, rays and game fishes occur, but are incompletely classified because their large size prevents their collection for scientific study.

The fishes of the coral reefs are brightly coloured, and there are many different kinds. Amongst mangrove swamps, off sandy beaches and in estuaries, different, more modestly tinted fishes are found, grey and silvery, and these are more palatable than the gaudy reef species. Here too is found the Mud-skipper, a quaint little goby only a few inches long, which hops along the mud or even climbs the roots of trees, rolling its prominent eyes in search of crabs and other food. If kept under water this fish will drown!

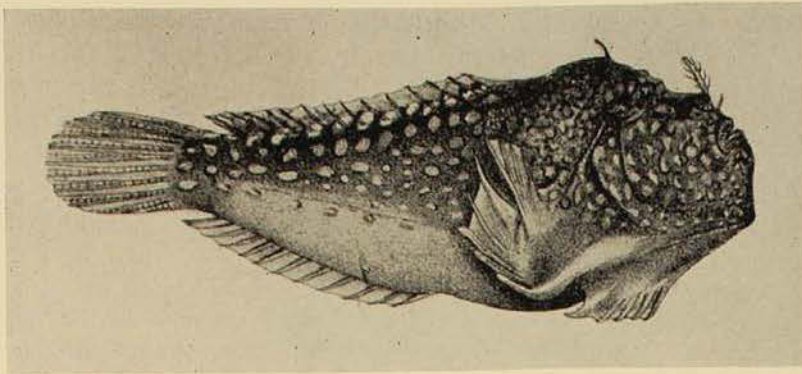
A few of the coral-reef fishes are poisonous to eat, notably the pear-shaped toadfishes and porcupine fishes, and possibly some of the larger kinds, especially if they are not freshly cleaned.

Stonefishes, catfishes and stingrays have venomous spines which can inflict bad wounds, whilst eels and groppers are sometimes vicious.

To the list of dangerous fishes we should perhaps add the Long Tom's name, for last May it was reported in the Press that a garfish or long-tom had killed a native fisherman at Rigo, 60 miles east of Port Moresby. The man was crouched on a reef with a torch in one hand and a spear in the other when the fish, attracted by the flaming torch, leapt from the water and punctured his jugular vein with its "beak."



The Tapetail (*Eutaeniophorus festivus*), a remarkable fish just over 5½ inches long discovered by the Dana Expedition to the north of New Guinea. A long streamer, three times the length of the fish itself, grows out from the tail.



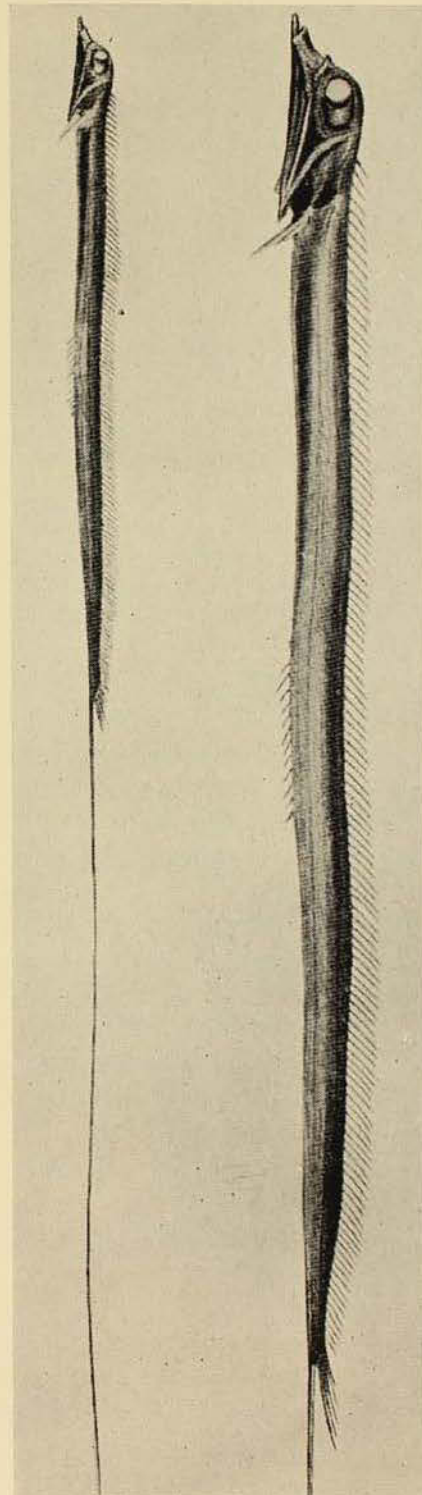
Left: A remarkable little Angler Fish (*Tetrabrachium ocellatum*) trawled by the Challenger Expedition south of New Guinea.

After Gunther.

The largest "fish" in Papua as, indeed, it is in the world, is the Whale Shark, first recorded from south-east of Papua in the 1880's, and subsequently sighted again there by United States Servicemen during World War II. No Australian or Papuan specimens of the Whale Shark have been accurately measured; in other seas this shark reaches at least 60 feet in length.

#### FRESHWATER FISHES \*

The freshwater fishes found north of a line running from about Geelvink Bay to Samarai are different from the southern ones. Some freshwater sunfishes in this northern region have evolved into specialized genera, and the last species of freshwater eel to have been described (*Anguilla interioris*) was discovered in the mountain streams of this northern area, which has been named Gaimardian after a French naturalist who worked there. The southern rivers of New Guinea and the Aru Islands have fishes, molluses and other animals belonging to the same species as those in Australian rivers from north-east of Broome across to the western half of Cape York; thus the fishes of the Fly River and the rivers flowing into the Gulf of Carpentaria are of similar types and it is thought that all these rivers may have flowed into one another and towards the Sahul Bank in Pleistocene times when the land (now sea-bottom) between Australia and New Guinea was dry or under shallower water than it is now. This is called the Leichhardtian region.



The Pillar-eyed Threadtail (*Stylophorus chordatus*) which swims facing upwards; the eyes are telescopic. Discovered in 1791, this odd fish was not found again for many years but has recently been reported from off New Guinea.

From "Galathea Deep Sea Expedition"

\* An account of "Fishes from inland New Guinea," collected in 1954 by Messrs. Troughton and Camps of the Australian Museum, appeared in *Records of the Australian Museum* vol. xxiv, No. 3, 1956, pp. 23-30, and included a bibliography of the freshwater fishes of Papua-New Guinea. Some foreign freshwater fishes (*Salmo*, *Tilapia*, *Trichogaster* and *Ospromemus*) have been introduced in recent years.

The Burramundi (*Scleropages leichhardti*) found in the Digoel River, southern New Guinea, is of interest not only because of its unusual appearance, but because it is one of the few ancient types of fishes which either antedate or have crossed Wallace's Line, that zoogeographical separation between Bali and Lombok, Borneo and the Celebes, which has prevented the freshwater fishes of Asia from entering New Guinea and Australia. A few of the catfishes have similarly trespassed into the rivers of New Guinea, where certain kinds incubate their eggs in their mouths. Due to some local condition, probably muddiness, peculiar rearing habits have been developed.

At Kapakapa I collected a male Soldier Fish (*Yarica*) whose mouth was crammed with eggs in which the eyes of the next generation could be distinguished; the father fish does not feed when thus engaged as nursemaid. When caught he spat out the eggs in a ball but I put them back in his mouth and let him go.

Another method of caring for eggs and young is practised by the Nursery Fish (*Kurtus gulliveri*). This is a humpbacked, transparent river fish which is said to grow to 17 inches in length. On top of his head the adult male develops a hook which holds the eggs (laid by the female) inside its crook, where they are united by numerous interlacing filaments. So they are carried around by the father fish, like bunches of grapes, until the young hatch.

The Archer or Rifle Fish (*Toxotes*) is a surface-swimming fish, usually less than 1 foot long, yellow, with several large dark blotches on the sides. It can shoot jets of water at insects on the foliage overhanging the banks, thus bringing them down to where it can eat them. The mouth, when closed, has a central orifice, like that of a garden hose, and there is a groove along the top of the fish's mouth which forms a nozzle so that when it compresses its gill-covers and lifts the floor of the mouth, a jet of water can be expelled up to a height of 4 or 5 feet. Uncanny accuracy is shown in hitting a mark as the fish sees well through water and air with its large and

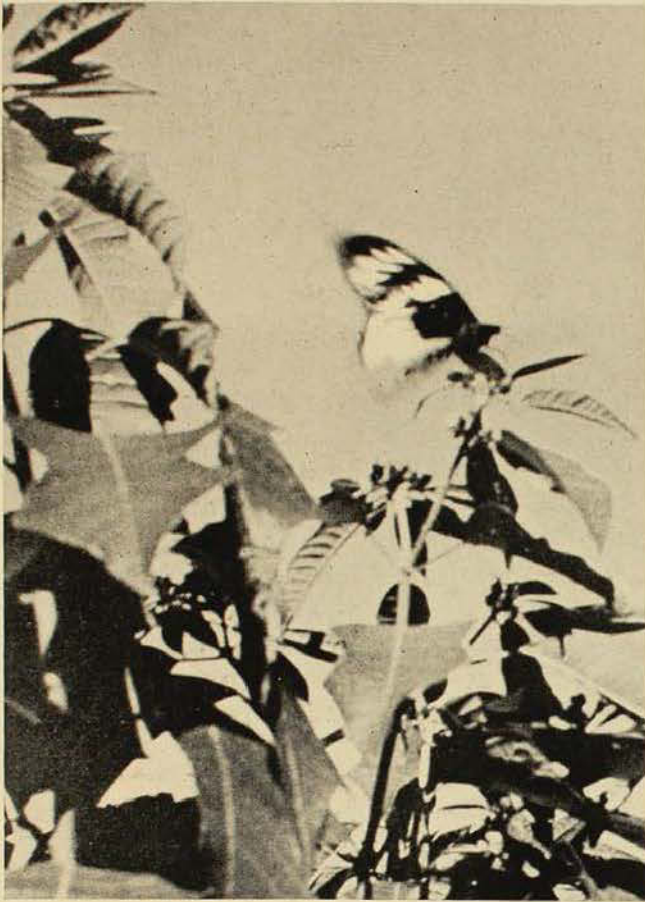
mobile eyes. It has even been known to shoot at, and extinguish, the lighted end of a man's cigarette, and the shooting habit is practised even by young fish only an inch long.

The Blue Eyes (*Pseudomugil*) and the freshwater Sunfishes (family Melanotaenidae) are dainty little fishes found only in the rivers of Australia and New Guinea. There are many species, all of them useful as destroyers of mosquito larvae and thus of value in combating malaria and other mosquito-borne diseases. They enter the shallowest water and some kinds have little teeth outside (as well as in) the jaws for nibbling their food. The Dutch zoologist Max Weber wrote of them, "when standing bare-legged in the clear water, I could feel and see how the fishes scraped at the skin of my legs."

Other modest little scavengers of the rivers and estuaries are the gobies and gudgeons, of which there are many kinds, generally too small for human food, but of value because they keep down mosquito larvae and dispose of impurities in the water.

A species of Long Tom (*Stenocaulus perornatus*) with ornate spots, and long, toothed jaws, preys on smaller fishes in the rivers of New Guinea.

In Lake Sentani, which has been separated from the sea by land-elevation, sharks, sawfishes and other fishes, originally marine, have become landlocked in freshwater. A large shark from there was recently packed in oil-drums and sent to Holland for identification. Another large shark was reported 500 miles up the Fly River. The freshwater sawfish of New Guinea has been identified as the same species as Leichhardt discovered in the Lynd River, Queensland, in June, 1845 (*Pristiopsis leichhardti*). As well as in Lake Sentani, sawfishes have been reported from the Laloki River, near Port Moresby and more than 500 miles from the sea up the Sepik River. There is a curious belief amongst certain primitive Philippine natives that all freshwater sharks are females and that the sawfishes are their males!



Female of the Common New Guinea Birdwing (*Troides priamus*) above Poinsettia flowers at Golden Ridges, near Wau (5,000 feet).

Photo.—Author.

## New Guinea Insects

By J. J. H. SZENT-IVANY

Department of Agriculture, Stock and Fisheries,  
Port Moresby

THE study of insects in tropical countries is fascinating for both the professional entomologist and the amateur who takes up insect collecting as a spare-time hobby. Tropical countries, with their thick rainforests, are usually rich in insects. The Territory of Papua and New Guinea, with its high rainfall and dense vegetation has not only a very rich but a very interesting insect fauna. It is interesting because of the diversity of forms within certain groups and because of the complex nature of this fauna. However, the insect world of New Guinea is still very little known and at a rough estimate only half of the Territory's insect species has been described and given scientific names.

The richness of New Guinea fauna was recognized by the early explorers, but a systematic survey of fauna was begun only a few years ago. The main reason for this tardiness was the difficulty of visiting certain areas where the natives had not been brought under Australian control. But now nearly all the Territory is under control and the time is ripe for a more detailed survey.

Insect collecting has been carried out in many districts of Papua and New Guinea by entomologists of the Department of Agriculture and by visiting Australian, English and American scientists. In the last three years a group of entomologists, working under the auspices of the Bishop Museum (Honolulu), collected nearly one million insects. Two Canadian scientists also caught about a million insects during a four months expedition in 1957. Most of these were night-flying insects and they were captured in ultra-violet light traps.

Early explorers believed that New Guinea was a typical part of the Australian zoogeographical region, but as a result of more recent investigations it has been found that the insect fauna of the "Papuan Subregion" has many Asian elements and a large number of "endemic" forms which have not been found in any other part of the world. A number of typical Australian species seem to be prevalent in the southern Papuan eucalypt savannah which, in many ways, looks much the same as some parts of Queensland. Endemic and Asian elements are more numerous in the rainforest, which covers most of the area. Insects can be collected from sea level up to the altitudes of 14,000 to 15,000 feet. There are many beautifully coloured and some very odd looking insects in the picturesque country of the Central Highlands.

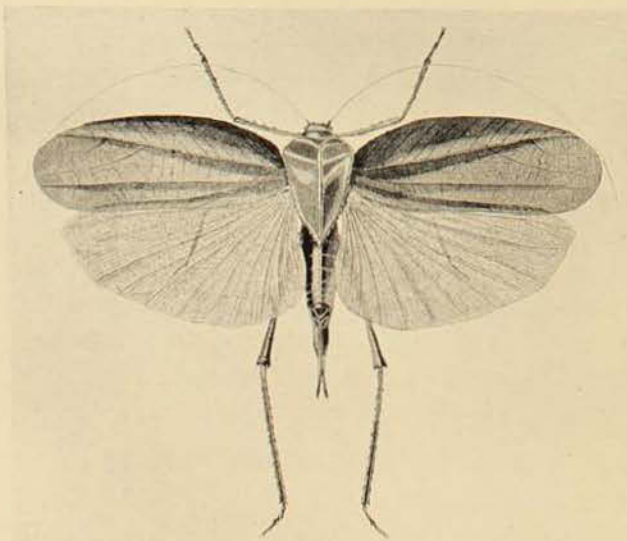
In a short article only a few typical insects can be mentioned—species with strange appearance, brilliant colours, gigantic size or peculiar habits.

#### STICK INSECTS

These plant-feeding insects, known by the scientific name of Phasmodea, are sometimes called "walking sticks" because of their long thin bodies and their resemblance to the branches of the trees and shrubs on which they rest. Some species reach the length of 9 to 10 inches; others have very powerful spines giving them a fierce appearance. However, they are harmless creatures, feeding on the foliage of trees and shrubs of the forest. One species (*Anchiale maculata*) has been found to cause minor leaf damage to cocoa trees in New Britain.

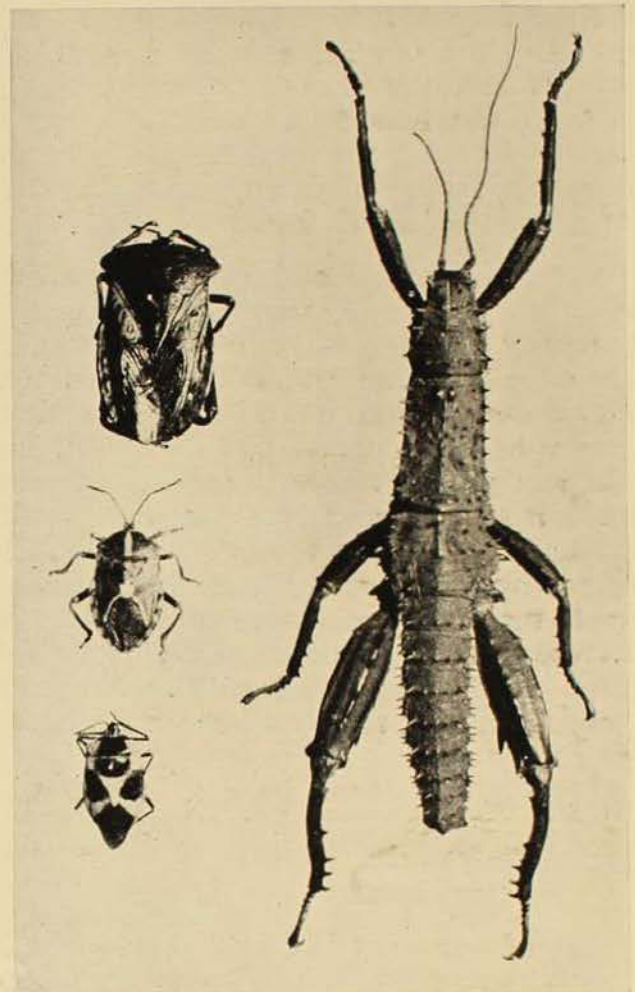
#### GRASSHOPPERS

There are many very peculiar looking insects amongst the various families of grasshoppers. Members of the family of "coconut hoppers" have remarkably long antennae. A small group of the family of Long-horned Grasshoppers have drum-shaped backs and they reach gigantic sizes. Recent investigations by a Dutch entomologist have shown that undescribed new forms can be found even amongst the large and largest species.



This Giant Long-horned Grasshopper, *Siliquofera grandis*, a native of New Guinea and Aru Island, has a wing-span of 9 inches.

After Blanchard.



New Guinea Plant Bugs.—Top: *Oncomeris flavicornis*. Middle: *Rhoecocoris antennatus*. Bottom: *Catacarthus sumptuosus*. Right: Spiny Phasma, *Eurycantha horrida*, from New Guinea.

Photo.—G. C. Clutton.

#### BUGS, CICADAS AND LEAFHOPPERS

Some brilliant metallic green, blue and red coloured insects are found amongst the plant-sap sucking "jewel bugs," a sub-family of the large family of shield bugs. They occur from sea level to altitudes of 8,000 to 9,000 feet and despite their abundance and their beautiful colours many species are still undescribed and unnamed.

Cicadas, often called "locusts" in Australia, are very abundant on the islands round New Guinea. During my first visit to the damp swampy rainforest of southern Bougainville I was thrilled to hear all day the soft "bell ringing" of a medium-sized, simple grey-coloured species. The insufficiently known genus *Sawda* has

several large colourful species in the Central Highlands. These large cicadas are rarely seen during the day but they appear in large numbers round electric lamps at night. I found the largest species in the Bismarck Range in damp, mossy forest at an altitude of 8,000 feet.

There are many odd looking creatures amongst the small relatives of cicadas, generally called "leafhoppers", representing some ten families. It is believed that only a small percentage of the New Guinea species has been named and described. The wingless young stages (nymphs) of some species are covered with a rich white feather-like substance. A New Guinea cocoa planter, who was rather worried about the great abundance of a species on his cocoa trees, gave them the very apt name of "jumping feathers". However, these "jumping feathers" are quite harmless; they have not caused the slightest damage to the cocoa trees.

#### BUTTERFLIES AND MOTHS

One of our most beautiful butterflies is the Common New Guinea Birdwing (*Troides priamus*). The large green male with its bright yellow abdomen, and the giant black and white female with some red underneath, are often seen on bright sunny mornings circling around the pink blossoms of hibiscus bushes in New Guinea gardens. This remarkable butterfly has several geographical varieties some of which have blue-winged males. There is a large blue variety in New Ireland, Bougainville and on the British Solomon Islands and a small blue variety on Misima and Rossel Islands. The orange coloured variety in Indonesia probably represents a distinct species.

The New Guinea Birdwing has also three geographical varieties in Australia. One of its relatives, the Queen Alexandra Birdwing, is believed to be the largest butterfly in the world. This rare species is known to occur only in a small restricted area in Central Papua. A third species, the Highland Birdwing, is bright green and golden coloured and it can be found up to 7,000 feet in the Eastern Highlands.

Less colourful is the black and yellow Helena Birdwing, which is very common in the coastal area of the Madang and Morobe districts. It is also abundant at higher levels such as the coffee-growing Wau valley. Birdwings are insects of the rainforest and their big fleshy caterpillars feed on the *Aristolochia* vine.

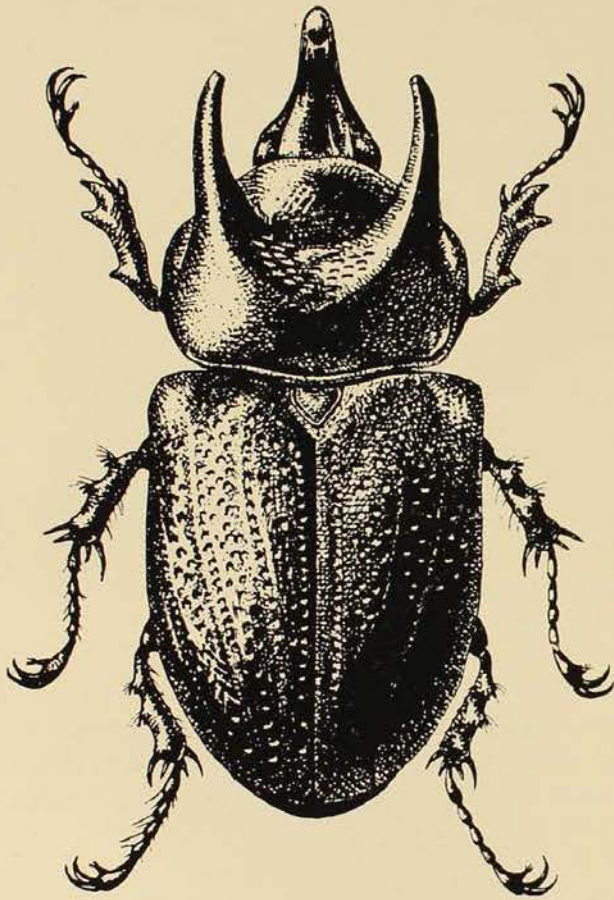
Well known also in Australia are the Swallowtail Butterflies. They are close relatives of the birdwings. There are many species in New Guinea but I will mention only two. The first is the bright blue and black winged Ulysses Butterfly, sometimes called Blue Emperor, which is a regular visitor of hibiscus, frangipani and other flowers in New Guinea gardens. The other one is the Highland Swallowtail or Weiske's Butterfly, a smallish species with a very unusual combination of violet, blue and green on its wings. I have found it as high as 10,000 feet in the Bismarck Range. It flies along the mountain creeks in the company of many, many kinds of Mistletoe Whites or *Delias* Butterflies. More than fifty species have been described from the Papuan region. One of the best places to collect these butterflies is Edie Creek near Wau (7,000 feet) where more than fifteen species can be collected in a relatively small area. It is remarkable that the upper surface of the wings of most species is white with a wider or narrower black margin and it is the lower surface which is more colourful. It shows various combinations of brown, red, yellow, orange, black and white.

There are many large and conspicuous moths in New Guinea with long tails on their hindwings, such as the Hercules Moth, a Giant Silkmoth, the dark-brown, silvery-white striped *Nyctalaemon* Moth and its bright-coloured day-flying relatives. However, some families with much smaller representatives are more interesting to professional entomologists. One of the richest families is called the *Pyralidae*. The two Canadian scientists who visited New Guinea last year collected more than 1,000 different kinds of these. Many of them were new discoveries.



## BEETLES

Beetles represent the most abundant insect Order in the world. One of the most interesting beetle families in New Guinea is that of the Rhinoceros Beetles. It includes smallish species from a half-inch in



A New Britain Coconut Rhinoceros Beetle  
(*Scapanes grossepunctatus*).

M. L. Szent-Ivany del.

length to large and very large forms. They all are uniformly black or brown coloured and many species have peculiar horns of different sizes. The largest species, *Oryctes centaurus*, bores into the unopened fronds of coconut and sago palms. Its larvae are large, fat, greyish-white grubs which are considered to be a delicacy by some of the native peoples. A smaller relative, the Asiatic Rhinoceros Beetle, was accidentally introduced during the war and it became a quite serious pest of young

coconuts on the Gazelle Peninsula of New Britain. There is a large collection of Rhinoceros Beetles in the entomological laboratory of the Department of Agriculture, Port Moresby.

The family of weevils has more species than any other insect family. One of the largest New Guinea species is the Black Palm Weevil, a pest of coconut palms. Various species have been found boring into the stem and branches of cocoa trees and coffee bushes. Some Highland forms have conspicuous horns and large tubercles and many species in the lowlands are very colourful.

The large group of Leaf Beetles, representing several families, are smallish or very small insects and many of them are metallic green or blue. A collection of over 1,000 New Guinea species is awaiting scientific study in the Bishop Museum, Honolulu.

The largest beetles of New Guinea are found in the family of the Longicorn or Long-horned Beetles. A giant species, *Hastertia bougainvillei*, was named after the well known French explorer. However, there are also very small species amongst longicorn beetles, measuring only 1/16 of an inch. Some of these have become adapted to introduced crops as host plants.

For the collector and the zoogeographer the insect world of New Guinea is most interesting. But we shall be unable to give a true picture of the origin of this fauna until a survey has been undertaken and the collected materials identified by specialists in the various groups.

J. J. H. SZENT-IVANY is Entomologist with the Department of Agriculture, Stock and Fisheries, Port Moresby. Born in Hungary in 1910 his citizenship has been altered three times by political events—from Hungarian to Czechoslovakian, to Hungarian, to Australian. Dr. Szent-Ivany obtained his Ph.D. in 1936 from Pazmany Peter University of Science, Budapest, and was afterwards on the staff of the Hungarian Museum of Natural Science and later the University of Science, Szeged, Hungary. He came to Australia as a migrant in 1950 and worked for 3½ years as a Government clerk before taking up his present position. He is Chairman of the Standing Committee on Pacific Entomology.



Pygmoid types of the Mafulu tribe, Evesi village, Ononghe—a mountainous district inland from Yule Island and Mekeo, Papua. The average height of such tribesmen would be about 4 feet 10 inches.

Photo.—F. Hurley.

## Peoples of New Guinea

By A. P. ELKIN

Emeritus Professor of the University of Sydney

**N**EW GUINEA is a most exciting island. It presents some coastal fringes, with waving palm trees, bright beaches and thatched village houses, sometimes built on piles out in the reef-protected sea, over which canoes ply as in an idyllic Venice. Such is the eagerly awaited picture of a tropic isle which the newcomer hopes to see.

Other parts of the coast, however, particularly on the south, consist of immense mud flats through which, by many-channelled mouths, great river systems meander sluggishly in the dry season out to sea; but in the "wet", when driven by torrential rains over steep descents and baulked by powerful tides, these same rivers rage furiously as they hurl water, mud and trees towards the ocean. And yet even in these uninviting regions, tens of thousands of people live in pile dwellings on the mud-flats, in some districts in long, divided houses, each house a village, and paddle or pole their log canoes along myriad waterways. Out of the swamps they obtain food from the sago palm, and on higher ground tend their gardens.

Except in the great delta regions, a hinterland of hills and gorges arises not far from the coast, effectively separating tribes from one another by concealing mists and rains, by rushing torrents, and by fears of the stranger who is but dimly seen. So the hamlets and villages are on the crests of hills and the "roads" wind along the razor-like edges of the ridges and spurs.

The most astounding feature of New Guinea, however, is the great central mountain system, nearly as long as the island itself. And here is a marvellous circumstance of modern times: although many exploring and patrol parties had pushed up the great river systems and valleys far into the mountainous backbone, and although aeroplanes flew about the mountains on many and varied missions in post-World War I years, yet up to the early 1930's we thought that about half of the central region of the island was uninhabited, and indeed uninhabitable, by reason of its rugged nature and inhospitable rainforests.



Both this man and his wife are from Goroka. The man is taller than usual—about 5 feet 9 inches; the woman's height is 4 feet 4½ inches.

Photo.—Author.



A true pygmy from the Schrader Range, New Guinea; height about 4 feet 5 inches. He is wearing a cassowary headdress and an arrow guard on his right wrist.

Photo.—Author.

Then the miracle happened: a revelation occurred. Prospectors and Administration officers moving *not* from the coast, but from the upland Bulolo-Wau goldfields of the eastern interior, reached the top of a divide and looking west saw unmistakable signs of human habitation. Within three years exploration revealed an enormous population of what we now know to be about 600,000 in the Australian Territories alone. These live partly in expansive valleys about 5,000 or 6,000 feet above sea-level, guarded by high forbidding ranges. Others live on the mountain sides, up to a height of 10,000 feet. All alike are good gardeners, efficient house-builders and, as we have learnt, shrewd business folk. Quite amazing, too, was the discovery that apart from those in the two eastern valleys (Kainantu and Goroka), these people do not live in villages but in homesteads as our farmers usually do. They meet for business, ceremonies and gossip in well-kept public parks.

The Dutch, too, thanks partly to an accidental aeroplane landing, learnt about the same period that the mountainous interior of the western half of New Guinea was also thickly populated.

The natives came to New Guinea in a past period or in periods as yet undated, and did so, according to linguistic and anthropological analyses, in more than one wave. The physical geography of the island has had a bearing on the great diversity of peoples and languages.

If we go from one end of the island to the other we are amazed by the variety of types. There are the medium-to-small, light brown, frizzly-haired "races" of the eastern end of Papua and the nearby archipelagoes, who are usually called Papuo-Melanesians and are regarded as being predominantly Melanesian; they speak Melanesian varieties of language. The deltas and swampy lands and most of the coasts are occupied by relatively tall, dark-brown, frizzly-haired peoples, generally called Papuan, whose complex languages are very different from the Melanesian tongues. But Papuo-Melanesians and Papuans vary among themselves and so

can be subdivided into further groups which have resulted from migrations and miscegenation and local variation.

This is nothing, however, to the differences seen when we get into the mountainous hinterland and the central ranges—into regions where groups could, and did, live in a high degree of isolation for long periods of time. They were in very many cases shut off from each other by mountain barriers and almost impassable ravines and torrents, by tropical rains and frequent opaque mists, by barren “no-man’s” lands and by impenetrable jungles. So they inbred. The types were affected by environmental factors—the available foods, the altitudes, and the kind of life forced on them. Possibly, too, an ideal type appeared which was sought and fixed in mating.

Moreover, isolation and adaptation result not only in outward differences but even more importantly, they give rise to a bond of sentiment and belief centring on the local environment, and also to distinct dialects and customs. Once this occurs the groups across the barriers become regarded as strange, dangerous and treacherous, who will attack and kill with both material weapons and also with sorcery. This fear and its consequent watchfulness emphasize the isolation and put a premium on endogamy (inbreeding). Of course there was never complete isolation and studies are in progress to determine the “new” characters introduced by immigrant groups or by contact with neighbouring groups.

As a result of some such process we find the pygmoid Kukukuku in the interior mountainous region between Kerema and Wau, and slightly bigger Mafulu and other tribes on their east. In the eastern valleys of the Central Highlands are peoples of varying stature from pygmy size to tall; but as we pass west along the island’s backbone we notice that they tend to get

stockier in build and present distinct features of face and head. And beyond Mt. Hagen, in the Wabag sub-district, we see a large population living at heights of from over 6,000 feet to 10,000 feet on a nearly complete vegetarian diet, consisting mainly of sweet potato. They are well developed in the chest and shoulders and leg muscles. They can yodel with great volume. But they are a short people, barely averaging five feet. Many men are two or three inches less, and many women shorter still. Indeed women of four feet five inches are not uncommon.

This short, strongly built stature is surely an adaptation to a very rugged, mountainous environment, just as the Wabagas’ high haemoglobin values can be correlated with the varying high altitudes at which they live.

Even more striking is the reddish-white to white skin of a noticeable percentage of the population of both sexes and all ages. In every other feature these individuals seem to be the same as their own full brothers and sisters. Readers of J. Hide’s *Papuan Wonderland* will remember his discovery of a red-skinned people, just as further on he came across a race of black-skinned Pharoahs. A light skin mutation (or could it be an hereditary factor from a cross which occurred perhaps centuries ago?) persists and appears in a proportion of the population, which has yet to be determined.

In addition to these and other types, there are a few groups of true pygmies, such as the slightly built, light brown Aiome race in the Schrader Range, and the Tapiro and Pesechem in the Netherlands region.

New Guinea is, indeed, a veritable laboratory of human variation—of the evolution of races.

Breeding experiments with marsupial mice (*Antechinus flavipes*) are being conducted at the Australian Museum by Mr. B. J. Marlow, Curator of Mammals. Four litters (two of 8, one of 6 and one of 3 young) have been born. One mouse weighed at birth turned the scales at 16.4 milligrammes.

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To Students and Pupils of Schools and Colleges special facilities for Study will be afforded if the Director is previously advised of intended visits. A trained teacher is available for advice and assistance.

Children under 12 years of age, unless accompanied by older people, may be refused admittance.

Gifts of even the commonest specimens of Natural History (if in good condition), specimens of Minerals, Fossils, Coins, and Native Handiwork, are always welcome.

The office is open from 9.30 a.m. to 1 p.m.; and 2 to 4.30 p.m. (Monday to Friday), and visitors applying for information there will receive every attention from the Museum Officials.

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