

Above: *Cherax murido* Holthuis, one of the common crayfish of Paniai Lake, named "murido" by the local people. Reproduction slightly less than life-size. Right: Map of the Wissel Lakes region in west central Netherlands New Guinea. Altitudes are shown in metres. (Nederzettingen bergpapoea's = settlement of mountain Papuans.)

## Freshwater Crayfish In Netherlands New Guinea Mountains

TWENTY years ago hardly anything was known about the fauna and flora, or the people, of the central mountain region of Netherlands New Guinea. A few expeditions had managed to penetrate into the area, but could spend only a very short time there. It is not surprising, therefore, that it was as late as 1936 that a complex of three fair-sized lakes was discovered in this region.

In November 1938 a government post was erected at Enarotali, a native village situated on the shore of Paniai Lake. In World War II, with the advance of the Japanese invasion forces, the government personnel and other white inhabitants of Enarotali were evacuated by air to Australia.

After the war the government post was re-established, and the Protestant and Roman Catholic missionaries also returned. A few missionaries and police

\* National Museum of Natural History, Leiden, Holland.

Catching freshwater crayfish for food is a regular occupation of Papuans living in the Wissel Lakes region of Netherlands New Guinea. In this way they add some much-needed protein to their diet. This article is especially timely, as one of the tasks of the Commission's fisheries officer who is now working in Netherlands New Guinea is to explore the possibilities of introducing new species of edible pond fish to natural waters of the territory, in order to provide more protein in the local diet.

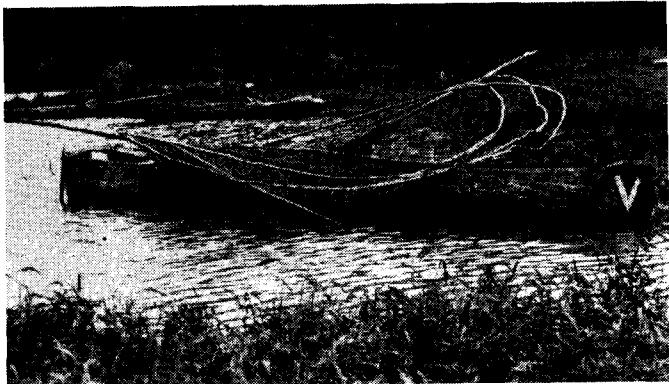
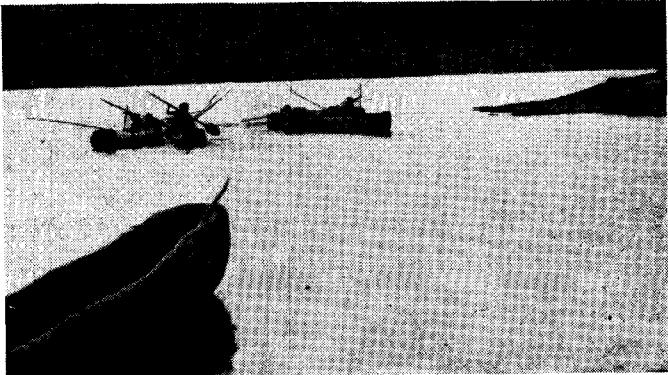
By L. B. HOLTHUIS\*

officers are stationed elsewhere in the region, but Enarotali is by far the most important white settlement there.

The lakes, which in honour of their discoverer F. J. Wissel were named *Wissel meren* (Wissel Lakes), are three

in number. Paniai Lake is the largest. Roughly rectangular, it measures about 9 by 16 km.<sup>1</sup> Tage Lake, the smallest of the three, is elongate, being about 8 km.

<sup>1</sup> One kilometre equals five-eighths of a mile.



Above: Women fishing for crayfish with sink-nets in Tage Lake. The canoes are made from hollowed-out tree trunks, the ends being chopped off square. Right (top): Native canoe with sink-net on Paniai Lake shore. Sink-nets are each mounted on a rattan hoop about 13 feet in diameter, strengthened by a stick bound to it cross-wise. Right (bottom): Native canoes on Paniai Lake shore, showing covering of leaves used as protection against the weather.

long by 3 km. wide. It lies to the south of Paniai Lake, a narrow strip of land separating the two. Tigi Lake, in size intermediate between Paniai and Tage, lies still farther to the south. Roughly triangular in shape, its maximum distance across is about 8 km.

Tage Lake is highest, being at an altitude of 1749 m. above sea-level. The altitude of Paniai Lake is 1742 m. and that of Tigi Lake 1640 m. Several rivers of varying size enter the lakes, but each possesses only a single effluent river. In the case of Tage Lake this is the Dimija River, which connects Tage with Paniai Lake by crossing the narrow strip of land separating the two. For the first 40 m. the Dimija River is subterranean; at a point on the northern shore of Tage Lake the water disappears among the rocks, to appear suddenly some distance to the north as a sizeable brook which

is navigable for its entire length by native canoes.

The effluent of Paniai Lake is a large river which leads to the sea. In its upper reaches it is named Jawej by the natives. Near the south coast of New Guinea the Jawej joins the Oeta River, which empties in the Arafura Sea. Tige Lake is connected with the Jawej River by a subterranean stream which starts at the south-east end of the lake, near the native village of Meijepa.

In some places the shores of the lakes, of calcareous rocks, are very steep. The water is quite deep close inshore. In other localities, especially near the

mouths of the rivers, the shores are low and swampy, and the depth increases very gradually from the shore.

Large parts of Paniai Lake are quite deep, around 30 m. Greatest depth is 50 m. Tage Lake is on the whole also fairly deep. Tigi Lake is, however, for the larger part rather shallow.

The aquatic vegetation of the lakes in the shallow parts is quite dense, consisting mainly of what we took to be pond weeds (*Potamogeton*) and stoneworts (*Chara*), but of course our identifications cannot be trusted. The few plankton samples taken were rather poor.

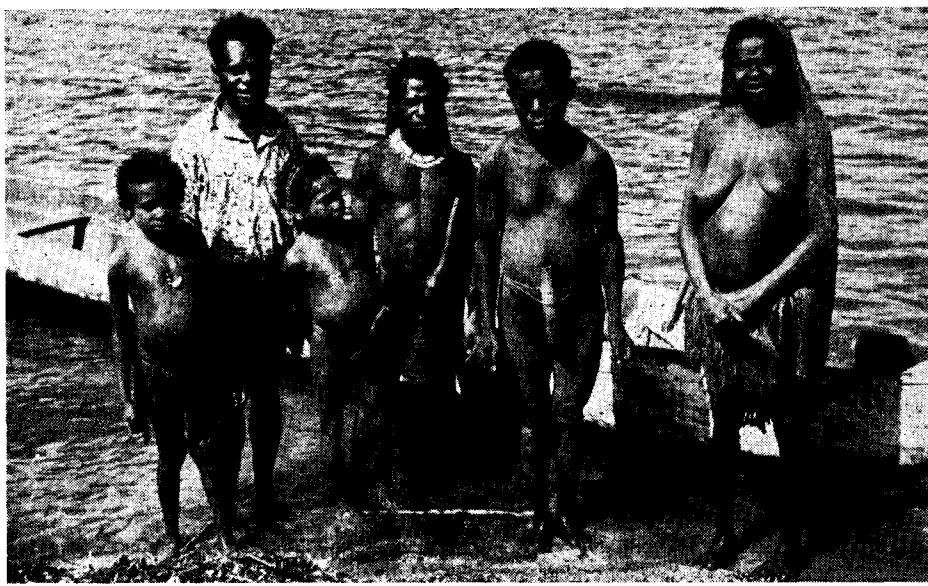
Practically all the reports dealing with the economic situation of the population of the Wessel Lake area mention the fact that crayfish occur in large numbers in the lakes, and that they are fished for there extensively by the natives. Freshwater crayfish have always played an important role in zoogeography<sup>2</sup>, and they may be considered to be the special pets of the students of this branch of zoology. In itself the distribution of the superfamily Astacidea, which contains all the freshwater crayfish, is most remarkable by its discontinuity.

This superfamily consists of three families: the Astacidae, the Parastacidae and the Austroastacidae. The Astacidae are found exclusively in the northern hemisphere. The other two families are restricted to the southern hemisphere, their range nowhere touching that of the Astacidae. The Austroastacidae form a

<sup>2</sup> Relating to the geographic distribution of these animals.



View of Tigi Lake, showing the low swampy shore and some native huts.



A native family on the shore of the Jawei River near Panai Lake, with the author's guide, Bottelier, in European clothes.

very small family, containing two species which are found only in S.E. Australia.

The discontinuous distribution of the Parastacidae, however, is most unusual. Of the eleven genera which form this family, one is exclusively found in South America, one is known only from Madagascar, one is restricted to New Zealand, while the others occur in Australia. Of these Australian crayfish genera, one is found also in New Guinea and the nearby islands. We see thus that crayfish are not found in northern South America, in the larger part of Central America and the West Indies, in the African mainland, and in the whole of Southern Asia.

For the general problems of zoogeography the curious distribution of the whole of the group of freshwater crayfish proves to be of the utmost interest. Likewise the distribution of the Parastacidae in the New Guinea region is very important for the understanding of the zoogeography of that area. The crayfish are found in New Guinea proper, in the Aru Islands and at Misool Island, but not at all in the Malay Archipelago. This, like the presence of marsupials in New Guinea, clearly shows the close affinities of the New Guinea fauna with that of Australia.

The explanation for this phenomenon is sought in the theory that during part of the tertiary or post-tertiary period, the sea level was far lower than it is today, and that at the time New Guinea must have formed part of the Australian continent. This theory is supported by the fact that Australia and New Guinea are situated on a shallow submarine plateau, the Sahul Plateau, which lies less than 200 m. under the actual surface of the sea, and during the tertiary or post-tertiary period may have been dry land. The Aru Islands and Misool also are situated on the Sahul Plateau.

Thorough investigations of the islands

just outside the plateau (like the Kei Islands and Ceram) until now have failed to produce any evidence that crayfish do occur there, so that it is practically certain that the range of the Parastacidae in this part of the world coincides with the former extent of the Australian continent. Another very interesting feature is the fact that until now in New Guinea, crayfish have been found only south of the great northwest-southeast watershed. They are not represented in any of the collections made in the basins of the rivers flowing to the north coast of New Guinea. It seems that the central mountain range has been an impassable barrier for these animals.

The crayfish in New Guinea all belong to one genus, namely *Cherax* Erichson. This genus is represented there by several species which are grouped into the two subgenera *Cherax* s.s. and *Astaconeephrops* Nobili. This latter subgenus is found in the entire southern part of New Guinea, the separate species also having quite an extensive range of distribution. In Netherlands New Guinea the subgenus *Cherax* has only been found in the Wissel Lakes region, where it is represented by at least eight species.

As already noted, crayfish are an important source of food in the Wissel Lakes area. With the pigs that are raised there, crayfish form practically the only source of protein for the native population. Fish are extremely scarce in the lakes. (One species of *Oxyeleotris* occurs there in small numbers, being found mostly in and near the rivers.)

Fishing for crayfish is mainly carried out by the women. For this operation extensive use is made of praus (native canoes). These are hollowed-out tree trunks with the fore and aft ends squarely chopped off, which makes them rather clumsy in appearance and not too man-

ageable. The paddles consist of a long handle and a broad, oval blade.

In the morning and even at night one sees a considerable number of praus on the lakes. The number fishing every day on Tigi Lake alone was estimated by Mr. Catto, the American missionary of this region, to be about 500, an estimate which is fully supported by my own observations. Fishing in Panai Lake is probably less intensive, as large parts of it are too deep.

The women fish with nets, adopting two methods. Firstly, they use enormous handnets, which are about 2 m. in diameter, with a long handle of about 4 m. The nets are woven of some kind of string made of fibres, the origin of which is unknown to me. These handnets are used by women who stand upright in the praus and scrape with the nets over the bottom of the lake. With the handle of the net used as a lever over the straight rear end of the prau, the net is hoisted out of the water and then its contents are searched for crayfish. Handnets also are used by women who wade backwards through the shallow parts of the lake, pulling the net through the weeds.

The second method used by the women is with sink-nets. These are circular nets with a diameter of about 4 m. which are kept spread out by a hoop made of a slender rattan twig which surrounds the entire net. A thin stick is fastened cross-wise over the net in order to give it more strength.

Dead fish (*Oxyeleotris*) and tubers of *Ipomoea batatas* are fastened with string to this net, which is then lowered to the bottom of the lake in fairly deep spots (about 20 m. depth). A thin rattan string is attached to the net, its free end being fastened to a float, of rattan or bamboo, which indicates the position of the net. After having been left for some time on the bottom of the lake, the net is hoisted to the surface, with the crayfish which, attracted by the bait, have ventured on to it. The crayfish are kept alive in woven bags.

The praus generally are manned by women, who sometimes take their children with them. The praus may carry covers of large leaves, under which the women and children find shelter from wet weather. Generally, fire is also carried in the canoes in the form of one or more rather thick smouldering branches placed on a layer of sand on the bottom. Sometimes a small fire is made in the boat which then, by the column of smoke, gives the queer impression of being a small steamer.

In the boats the nets are carried on two sticks which are placed crosswise, each sticking out over one side of the boat. In Tigi Lake we observed the women leaving the village in the morning walking with the woven nets to the shore of the lake, where the wooden and rattan parts of the nets had been left lying overnight in the grass. The woven part of the net then was fastened to the

hoop, and everything was loaded into the canoe, after which the new day's labour could begin.

In Paniai we sometimes saw the praus at night on the lake, the fires in the canoes then indicating their presence. The fires were badly needed, as the nights are very cool in this region, and as the natives, apart from a scanty pubic cover (a grass skirt for the women, a pubic gourd for the men) and some ornaments, wear no clothing at all.

In the afternoon, fishing is impossible, as around one o'clock a strong north-west wind starts blowing across the lake, producing waves which constitute a danger for the praus. For this reason, the women always leave the lake at the end of the morning.

The men, too, catch crayfish, but never on such an extensive scale as the women.

I received the strong impression that catching crayfish is for the men more of a sport, while for the women it is an important task. The men do not use nets but obtain their prey by diving. They jump overboard or dive near the shore for the crayfish hiding under rocks.

In the early reports concerning the Wessel Lakes mention is made that crayfish were fished for with spears and with bows and arrows. That this method of fishing was actually used was borne out by the material brought home by the 1939 expedition, which contained a fair number of specimens of crayfish with holes in the carapace, or abdomen.

However, during my visit I nowhere observed it in use, and on enquiry was told it is not now employed. The only thing that looked something like it was carried out by two small girls of about

four and seven years, who in the Jaweji River were hunting shrimps (*Macrobrachium spec.*) with a kind of fish-spear, a thin bamboo stick ending in about five diverging prongs. The spear is thrust over a shrimp, which is caught between the prongs. The latter are very blunt and they do not—and in fact could not—piece the shrimp.

There are reports that crayfish are not fished for during a certain season, but no positive confirmation could be obtained. When at the end of February I asked for a certain kind of crayfish I had obtained abundantly in January, I was told it was unobtainable because it "had left" (for deeper water?). There may be a migration which at times results in the absence of crayfish from shallow waters, but this is still one of the points about which we know little.



The guar, or cluster bean, useful not only as a food plant, but also as a fodder, a ground crop and for green manuring.



Guar pods, edible when young.

## A Useful Plant Grown In Fiji

By JACQUES BARRAU



Guar flower. Pencil indicates size.

In some Indian vegetable gardens in Viti Levu may be found a legume grown for its edible pods. This is the "Guar" or "cluster bean", *Cyamopsis psoralioides* D.C. (*C. tetragonolobus* Taub.). While the seeds are sometimes eaten, the young pods are mostly used. They are on sale occasionally on the market in Suva.

The plant is little known in the South Pacific. It is useful not only as a food plant but also as a fodder, a ground crop and for green manuring, according to H. F. MacMillan (TROPICAL PLANTING AND GARDENING, London, 1954).

This plant could thrive in any South Pacific island receiving from 40" to 80" of rainfall annually.

Recently the Guar became the subject of increasing interest in the United States as a possible new crop for the south-west part of that country. The reason is that the seeds of *C. psoralioides* can be processed in a flour yielding a gum, manno-galactan, which has a wide range of industrial uses.

According to a report from the United States Congress Commission on the increased industrial use of agricultural products (Washington 1957) this gum can be used in paper, rubber, textiles, cosmetics, pharmaceutical and food industries. For the last-named it is useful in the industrial processing of ice cream mixes, cheese-spread and salad-dressing.