NOTES

ON THE

BOATS, APPARATUS, AND FISHING METHODS EMPLOYED BY THE NATIVES OF THE SOUTH SEA ISLANDS, AND RESULTS OF FISHING TRIALS BY THE ALBATROSS,

BY

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CANOES TRADING AROUND THE STEAMSHIP ALBATROSS, CAROLINE ISLANDS.

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On August 23, 1899, the U. S. Fish Commission steamer *Albatross* sailed from San Francisco for the South Sea Islands, touching at the island of Nukuhiva, Marquesas group, September 17, and from that time until February 21, 1900, ten groups of islands were visited and landings were made at 59 places. While fishing is carried on at all the inhabited islands in each group, yet in no one place is it prosecuted to any great extent, but is a local affair and hardly considered beyond the needs of home consumption. Tahiti seems to be the only island where commercial fishing is carried on, and here only to a limited extent, at Papeete. The natives here are given more to tilling the soil, leaving the fisheries to a small colony of Gilbert Islanders, who were brought to Tahiti a number of years ago for that purpose. These fishermen follow their calling the year round, but the average weekly catch is small, not exceeding the amount that would be required to supply a town of 1,500 people.

In the present paper are given notes on the fisheries, fishing boats, and fishing appliances of the various islands, in the order in which they were visited. The results of the fishing done by the *Albatross* are also recorded, together with some reference to the collecting of natural-history specimens.

For the photographs and sketches with which the report is illustrated I am indebted to Mr. Alexander Agassiz, Mr. C. H. Townsend, Mr. A. G. Mayer, Mr. W. McM. Woodworth, Mr. H. C. Fassett, and Mr. V. Arnkil.

THE MARQUESAS ISLANDS.

The first landing was at Tai-o-hae, Nukuhiva Island, Marquesas group. This is a small village comprising some three or four hundred natives and a sprinkling of white people. The white colony is composed chiefly of French government officials and business men. The natives live largely on the products of the soil, such as cocoanuts,

bananas, oranges, breadfruit, etc. Their wants are so easily supplied that the taking of fish for food is of minor importance. It is said that the other settlements on the island pay as little attention to fishing as do the natives of Tai-o-hae.

The fishing is conducted with seine, hook and line, and spear. The seines are machine-made, 40 to 60 fathoms long, and 2½ to 3 fathoms deep; size of mesh, 2½ and 3½ inches stretch measure. In the early days the seines were knit by the natives, but soon after trading vessels began touching at the island and stores were established the knitting of nets was practically given up. Hand-line fishing is confined to rocky areas at the mouth of the harbor. The water is comparatively deep close to the shore, and twenty-odd fathoms in the middle of the channel. By anchoring their canoes near the projecting rocks or drifting with the tide or wind along the shores fairly good catches are made. The fisherman either starts out very early in the morning or about an hour before sundown. At other times it is almost useless to try for bottom fish. Usually much patience is necessary in fishing with hand lines, for these fish do not readily take the hook; but as the native has abundance of time, it matters but little if an hour or two is consumed in securing a single fish.

The fish taken with spear are quite large and are caught outside the harbor by the aid of a torch. The spears have four iron prongs fastened closely together at the end of a pole, with the barbs on the inside of the circle facing each other. The pole is 8 to 9 feet long, with a line attached to the end to prevent it from being lost and also to draw it back when a fish has been missed. At certain seasons of the year large numbers of fish are sometimes taken in a comparatively short time. The fishing excursions are generally made on the dark of the moon, fish being most numerous at that time.

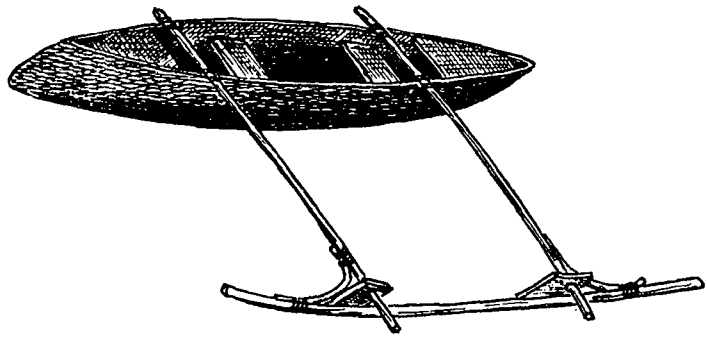
At the head of the harbor are two beaches, each making off shallow for about 200 feet, then suddenly falling off into comparatively deep water. The bottom at this depth, so far as could be observed, is composed of fine sand with a few rocks. Both beaches are about a half mile long, suddenly terminating in volcanic rock and small beach bowlders. In front of the village the beach is very rocky.

During the stay at Nukuhiva collections were made chiefly with drag seine. Six hauls were made on the beaches, taking seven species of fish, including a number of bonito, pompano, and a small sardine, with others not identified; specimens of all were saved.

A cod trawl was set near the entrance of the harbor, the inner end in 6 fathoms of water, the outer end in 23 fathoms; hard bottom in shore and quite soft in the middle of the channel; the bait used was salt herring and smelts. The trawl remained down about two hours with negative results. The bait had not been touched. Unsuccessful trials were made with hand lines. We were informed by a native that

anywhere off the mouth of the harbor bottom fish were plentiful, but he probably meant surface fish. Neither the trials with hand lines nor with trawl could be considered a fair test of the ground, as tropical fish do not bite readily on salt bait, and satisfactory results may rarely be expected from using it.

The boats in use on this part of the island are the canoe and whaleboat. The style of canoe has undergone little change for many years, except that the large canoe has been discarded for the whaleboat, it having been introduced among these people by the early whalers. Whaleboats are used mostly for making passages to different parts of the island and to other islands, and do the work formerly performed by large canoes; they range in length from 26 to 35 feet and are modeled from the regular New Bedford boat. These boats cost from $200 to $250, according to size and finish. The dimensions of one were as follows: Length, 26 feet; width, 5½ feet; depth, 2 feet; number of thwarts, 6. The mast steps through the second thwart from the bow;



Canoe, Nukuhiva Island.

standing platform aft 5½ feet long and 2 feet wide on the forward end, raised 9 inches above the keel. Boat decked over fore and aft, 2½ feet forward and 4 feet aft; ceiled to the risings. Excellent workmanship is displayed in the build and all the fittings. The sails are cotton and are cut according to whaleboat fashion; sprit, boom, and high peak.

Whales and black-fish make their appearance each season, and these boats are then most useful. Many of the inhabitants have been engaged in the whale fishery, sailing in ships from New Bedford and San Francisco, and they capture whales and black-fish by the white man's method. Black-fish entering the harbor are often captured by being driven ashore in the same manner as on the coast of New England.

Nearly every native owns a canoe, varying in length from 12 to 20 feet. A small one measured 12 feet long, 3½ feet across the gunwales, and 1 foot wide at bottom; depth, 2 feet. This canoe, like others observed, had three thwarts with a hole through the forward one for stepping the mast. A majority of the canoes were dugouts, but a

number were put together in clinker-built style, except the bottom, that being composed of a solid piece, probably the bottom of an old canoe. This style is no doubt a departure from the original build. It is important that the bottoms of canoes should be of hard wood, in order to withstand the hard usage received in landing through the surf on the beach. Both ends of the canoe are alike, there being nothing to indicate bow or stern. The only distinguishing mark is the outrigger, or that portion of it that sets in the water, one end being pointed, so as to offer little resistance. The outrigger float is 4 to 5 inches wide and 3 inches deep; sometimes a round pole is used. The bow of the canoe is indicated by the sharp end of the outrigger, which is on the right of the man paddling, or starboard side. The outrigger is to give the canoe stability, as without it she would not set upright in the water, the width not corresponding to the depth.

From the gunwale to the outrigger float of these canoes is on an average 7 feet. The outrigger frame consists of 5 pieces of wood, namely, 2 poles or crosspieces seized across the gunwales 4½ feet apart, one forward and the other aft of center; 2 stanchions connecting crosspieces to the outrigger float, and a brace which is seized to crosspieces just outside the gunwale. That part of the crosspieces between the gunwales answers the purpose of thwarts, the upper side being hewn to a flat surface. The outboard ends are seized to the perpendicular pieces, or stanchions, the length of which is, as a rule, the distance from the gunwale to the water line. These pieces are seized to the top side of the float, the seizings extending all the way round the float, but done so neatly as to offer little resistance to the water. The crosspieces, float, and stanchions are braced with withes to prevent them from being twisted and thrown out of position by coming in contact with rocks, sunken logs, and branches of trees. The material used in seizing the outrigger frame together is cocoanut fiber twisted into a small line. Both paddles and oars are used, one equally as well as the other.

We saw no canoes under sail. The large war canoes which were at one time common have gone out of existence. It is quite evident that the small canoes are built with less care than formerly.

THE PAUMOTU ISLANDS.

On the morning of September 21 the *Albatross* anchored off the village at Rahiroa Island, Paumotu group, where it remained until the morning of the 24th.

So far as the investigations extended no suitable beaches for hauling a seine were found. In a few places small collecting seines could be used, but great care is necessary in evading small pieces of coral, sticking up an inch or two through the sand, barely visible to the eye. One of these pieces is sufficient to render the net useless. Besides the live coral many pieces of fossil coral are scattered over the bottom.

The best place for collecting with a seine was in a small bay near the mouth of the entrance to the lagoon, about a half mile from the western end of Mohican Island. Here in most parts the water is shallow and at low tide the flats are bare. A channel some 300 feet wide follows from the head of the bay along the west side where fish school at full tide. The bottom of the channel, however, is strewn with live and dead coral and tree branches.

The shore collection consisted of holothurians, small shells of various species, and a number of small-sized tridacna. A few fishes were found under rocks. A trammel net was set near the ship at the surface; the depth of water, 3 fathoms. On account of the jagged bottom it was not deemed advisable to set the net near it. At the end of 3½ hours the net was hauled, taking from it 38 fish, all of one species. For fear that sharks would get into the net and destroy it, no trials were made during the night.

A crab net was set from the ship and a large fish taken, weighing 38 pounds. Its color was green, and in general appearance it resembled the fathead of California. It being too large for a specimen, it was used for bait.

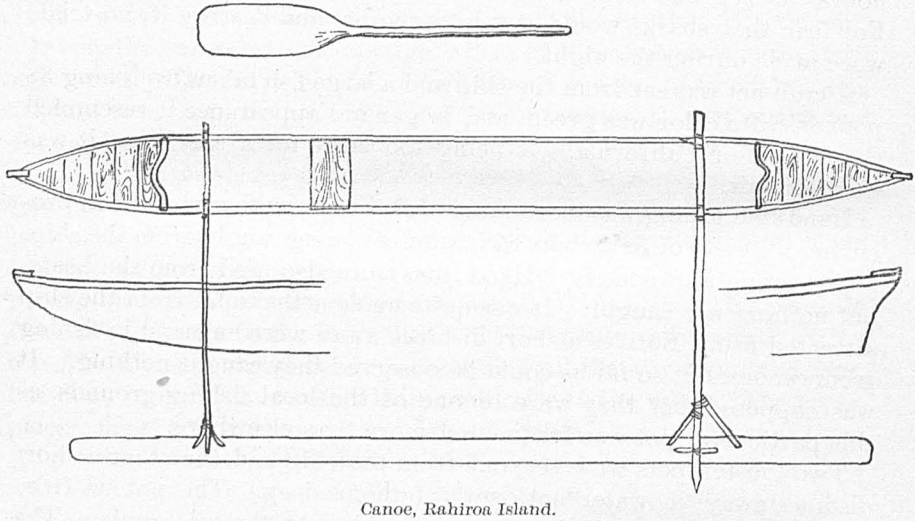
Hand-line fishing was more successful than any other method in procuring a variety of fish, about 80 in number being caught from the ship, representing nine species. Hand lines were also used from the boats, but nothing was caught. It was quite evident that offal from the ship attracted fish. Natives a short distance away were engaged in fishing from canoes, but so far as could be observed they caught nothing. It was supposed that they were on one of the local fishing-grounds, as this particular spot was frequented more than elsewhere.

Two lobster pots were set, one from the ship and the other a short distance away, in water not over 5 fathoms deep. The pot set from the ship took a fish 3¾ feet long belonging to the eel family. The bait in the other trap was partially eaten, probably by small fishes. Shells of crayfish were noticed on the beach in several places. This species is taken chiefly with spear at night by the aid of a torch.

The trials with drag seines were almost a complete failure, owing to the roughness of the bottom. In several hauls made with a 25 and 75 foot net six species were secured, among which were twelve mullet, a trigger-fish, a pompano, and a number of small coral-fish. The hauls were made in the bay to the westward of Mohican Island. It was impossible to make a complete haul with either seine, and it was only by lifting the foot line and bag of the seine over the sharp coral patches that a partial haul was made.

Near the place where the trials with drag seines were made were three inclosures made of fossil coral piled to the height of 3 feet, which at a distance resembled stone walls. The inclosures were rectangular in shape, 50 feet long by 25 feet wide, with an opening at the

offshore end 6 feet wide. From the center of the opening or mouth was a lead 75 feet long, built of the same kind of material. Inside the traps the bowlders and coral had been cleared away, leaving the bottom smooth. These inclosures, or traps, as they are commonly called, are entered by various kinds of fish at every tide. There is nothing to prevent them from making their escape at all times. At low water and at half tide the natives repair to them armed with dip nets and spears. The fishermen approach the traps cautiously and take their positions. At a given signal each man arises from his stooping position and takes a quick survey of the inside, ready to strike with his spear the first fish noticed. A commotion and general stampede quickly follows the appearance of a human form above the wall. Frequently a half dozen



Canoe, Rahiroa Island.

or more fish are speared before reaching the mouth of the trap. Here they are met with dip nets. Many large fish escape, but a considerable number of small ones are captured.

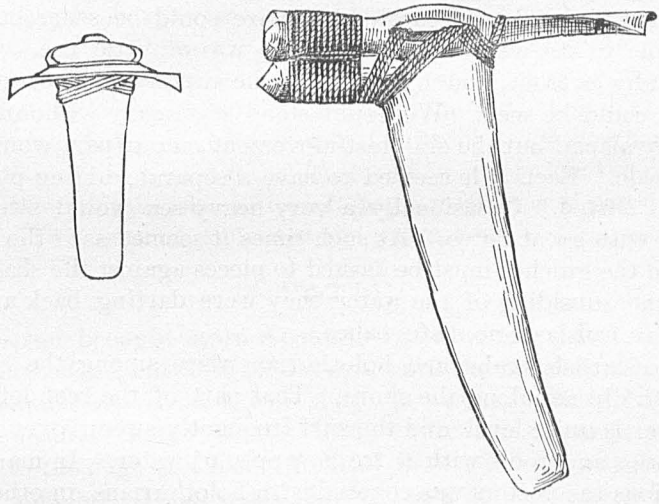
No large amount of fish is required at one time. As all fish caught must be consumed within a few hours, there is no incentive to lay in more than can be eaten at one meal. The spears used by these people are of the same pattern as those observed at the Marquesas Islands.

Mr. Agassiz and party made a trip in the steam launch across the lagoon to the opposite side of the atoll, a distance of 15 miles, and while studying the formation of coral several rock fish-traps were observed, one of which led into a ravine. On inquiry it was learned that fishing excursions are frequently made to this part of the atoll.

The hand lines used for bottom fish have a single hook and sinker attached. Trolling hooks are larger and are fastened to a long lanyard covered with heavy canvas. The object of the lanyard is to prevent

the line from being bitten off. If the line were attached directly to the hook, few fish would be caught. No ordinary line would last through one fishing trial. The hooks are home-made and the workmanship is neat, but they of course lack the finish of a machine-made hook. They are manufactured out of such iron as may be at hand, old bolts and nails being brought into use when better material is not obtainable. No wooden or bone hooks were seen, they having disappeared some years ago. The fishing lines were machine-made.

The canoes of this island show no marked difference from those of Nukuhiva except that they are all dugouts, with no devices of the white man attached, and fall short in workmanship of most of those found throughout Alaska. A number of sloop-rigged boats, 25 to 40 feet in length, were hauled up on the beach. They call for no special mention,



Large and Small Adze used in making Canoes, Paumotu Islands.

having been brought here by white traders. One boat was on the stocks about half planked. Her dimensions were: Length over all, 38 feet; width, 9½ feet; depth, 3 feet; timbers, 16 inches apart. The work displayed was fairly good. Her lines were copied from one of the boats lying on the beach. I was informed that she was being built by two natives. She had been on the stocks for a long time, as most of the material in her indicated.

MAKATEA ISLAND.

On the morning of October 6 a collecting party was landed on the northwest side of this island. Our collecting was confined to the reef, where with difficulty we succeeded in taking a few fish with a small Baird seine and a dip net. The reef here is so rough that only in a very few places could the seine be hauled, and in the favorable

spots it was found possible to drag it only a few feet at a time, and the fish usually escaped long before the net could be landed. The most successful method of capture was to place the seine across the mouth of pools in the reef, made by the action of the sea, and drive the fish into it. The seine was used as a kind of dip net, a man stationed at each end to lift it up at a moment's notice when the fish crossed the foot-line. In this way 150 small fish of five species were captured.

On the reef were hundreds of pools, many of which were connected by channels through which the fish made their escape to the sea. During the high water the sea breaks over the entire reef, and on receding leaves many small fish in the pools. At the outer edge of the reef, where the water suddenly makes off deep and the sea breaks heavily against the ragged coral, forcing its way into the numerous cuts and ravines, fish of considerable size could be seen; but it was impossible to use a seine, and a dip net was of little use. The fish were as shy as trout, and by the time the dip net touched the water not one could be seen. We could stand stationary without causing them any alarm, but the slightest movement on our part would create a stampede. Each fish seemed to have a separate hiding-place, into which it darted. Occasionally a very heavy sea would sweep over the reef with great force. At such times it seemed as if the fish concealed in the gulches must be dashed to pieces against the sharp coral, but on the subsiding of the water they were darting back and forth as if there had been no disturbance.

Shells, starfish, crabs, and holothurians were among the life gathered with dip net along the shore. That part of the reef left bare at low water is quite level, and the surf frequently sweeps over it, filling the cavities and pools with a fresh supply of water. In many of the depressions the bottom was covered with holothurians, in others small starfish and shells; crabs were found under the edge of bowlders.

Hauled up on the beach was an old canoe, of the same model as those observed at Tahiti. Length, 10 feet; width, 14 inches; depth, 11 inches; outrigger float, 9½ feet long, 3¾ inches in diameter, extending out by the bow 6 inches. The outrigger float was made of koa wood. This wood is very light and buoyant. The crosspieces connecting the float to the canoe were 5 feet long; forward crosspiece projecting out by opposite gunwale 18 inches, the after one flush with it. The canoe was poorly made, and on the whole a poor specimen.

NIAU ISLAND.

On the morning of October 7 a landing was made on this island. The atoll has no passage leading into it and canoes have to be taken across the rim into the lagoon, a distance of about a third of a mile. The natives informed us that most of the fishing was done in the lagoon,

although there was some hand-line fishing off the outside reef. Fish from the lagoon are much preferred to those from outside. A trader, the only white person on the island, told us that only one species of fish was found in the lagoon. It is said to be of fine quality and furnishes the natives with a large amount of their food.

Samples of coral and shells were obtained from the beach and 2 fish from the lagoon.

Strung along the beach were seines drying on racks, others were in sheds, and piled in the corner of one shed was a lot of webbing, seine rope, and corks. The webbing was machine-made, of 2½-inch mesh, stretch measure. The only canoes seen were engaged in fishing some little distance from our anchorage.

The beach on the lagoon side of the island is composed of fine coral sand and minute shells. The water deepens gradually and as far as we could see the beach continued smooth. Our stay being short, we had no time to investigate the surroundings. No fishing was going on in the lagoon, but the trader informed us that a haul or two with a seine seldom failed to capture all the fish required. On the opposite side of the lagoon the sea breaks over the rim in rough weather. The water in the lagoon is said to be considerably salter than the ocean.

The natives of this island are left to themselves a greater part of the time. They seemed contented and prosperous.

APATAKI ISLAND.

A short run brought us to Apataki, where we arrived in the evening, and lay off the entrance of the pass until the next morning, when a party landed and remained on shore two hours. No collection of fishes was made. In the passage leading into the lagoon were many fish close to the edge of a bank of coral; they could not be taken with hook and line, and it was impossible to use a seine. The only thing we saw in the way of fishing gear was a trolling hook, made of iron, and attached to a long snood, which was served with canvas. The line was common white cotton, machine-made.

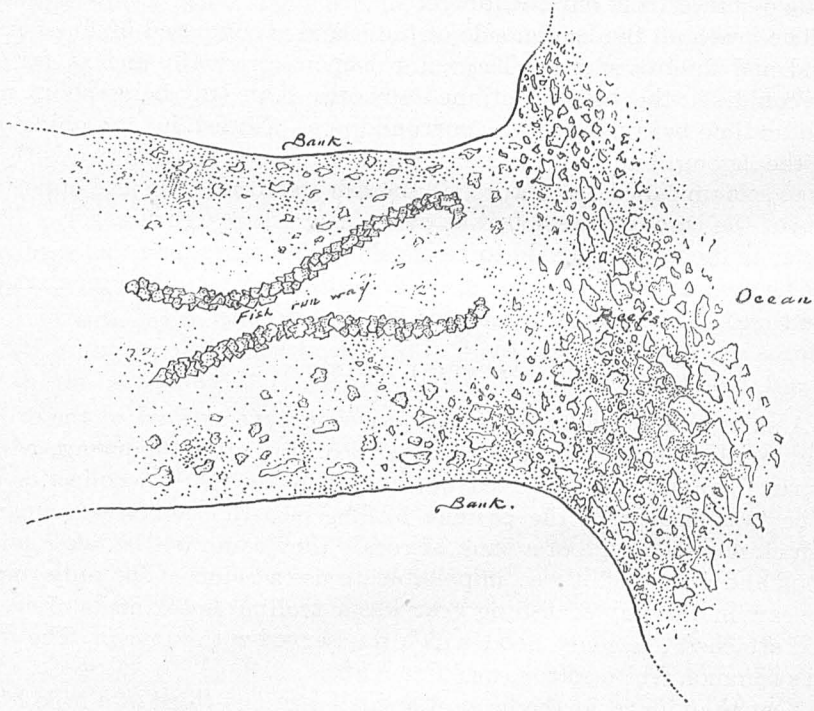
Near the village, at the head of a small arm one-third of a mile long and about 600 feet wide at the mouth, was a trap made of coral rock. The head of the arm is cut off from the ocean by a wall of old coral which has been thrown up by the sea. When the sea is heavy it breaks over the wall and pours into the arm, and we were informed that at such times fish were brought in over the wall. Near this wall was the fish-trap, 100 feet wide at the mouth, with sides 250 feet long, gradually coming together near the middle and widening toward the rear end. Fish can enter the runway from two directions; in rough weather at the mouth, and in smooth from the rear. On each side of the runway the bank is high, and an observer can see if there be any fish in it. A white trader informed us that when fish have entered in

sufficient numbers the natives station themselves at the mouth and rear of the runway to prevent their escape, while others use the spear from the sides.

When the people of these islands see a strange ship in the harbor, their curiosity is aroused and all work is suspended. This often prevented us from seeing the different native methods of fishing.

TIKEI.

The following day a landing was made on this island. The shore line and beaches here are very rough and no attempt was made to operate the seine. A few crabs, an eel, and a balloon-fish were cap-



Stone Fish-trap, Apataki.

tured with a dip net. In a small pond of brackish water about half a mile from our landing-place, and near a cut through which the sea sometimes flows, were some 25 or 30 mullet; but none could be obtained, as the collecting seine had been left in the boat. There were no inhabitants on the island.

ROTOAVA, FAKARAVA ISLAND.

This is one of the most important islands in the Paumotu group. The *Albatross* remained here from October 10 until the morning of the 14th. The evening of our arrival a trammel gill net was set near the

ship in 7 fathoms of water, and a lobster pot was set close to the shore in 5 fathoms of water. The net remained down forty-eight hours and was visited morning and evening, and obtained a shark and one small fish, the same species as those taken in the net at Nukuhiva. The ground having been given a fair trial, the net was taken up and set near the edge of a patch of coral, part of the coral being awash at low water. One end of the net was set in shallow water and the other in about 4 fathoms, the foot line just clear of the bottom. Had any part of the net come in contact with the sharp, ragged bottom it is very doubtful if it could have been recovered. Numerous fish had been seen around the coral patch and the indications seemed favorable for capturing a number of them, but nothing was taken in the net, although it was down eleven hours.

Hand-line fishing was carried on from the dory on the edge of the above-mentioned reef or patch, taking four fish during an afternoon, all of the same species. No other kind could be induced to take the hook or come anywhere near it. A small trawl line, rigged with 120 very fine hooks and baited with pieces of fresh meat, fresh crabs, and fish, remained down long enough to convince us that nothing would be gained by leaving it longer. A place was selected for the trawl where the fish were plentiful, the water being clear and the bottom composed largely of white material, so that there was no trouble in placing the hooks just where desired. Some hooks ran at the base of branches of coral, others across little gullies, and a few on comparatively smooth bottom. It seemed as if one or more fish must be taken, but at the time we were not familiar with the habits of tropical fish.

The line attached to the lobster pot caught under a branch of coral and was cut off, thus causing the loss of the pot. A wire trap made after the pattern of those used in various parts of South America—that is, heart-shape, with the opening in the large end—was set in the same place where the trawl had been, baited with fresh fish and a live one for a decoy. This device also met with negative results.

The best results were obtained with a 15-foot collecting seine. It was hauled fully 50 times, covering a stretch of beach about 3 miles, from the village eastward. At all times great care had to be exercised in hauling it, the bottom in most places being covered with live coral. The places where the bottom was at all smooth covered small areas, and in these a man had to be stationed at the foot line to lift it over the coral. In many cases the seine could not be landed on the beach, but had to be gathered into a small compass and carried to the shore. The catch comprised half-beaks, pompano, flounders, and several other species of small fish not then identified.

On the reef outside the lagoon a fairly good collection of fishes was made with the dip net. A seine could not be used in the usual way. At low tide a platform of old beach rock is left partly bare; over this

the surf occasionally sweeps. On the platform are many small pools and miniature lakes, in which fish abound, having been left there by the outgoing tide. Sometimes when the sea breaks heavily against the outer reef a portion of the platform is covered to a depth of a foot or more, and fish may then be seen swimming in toward the shore. In walking over the platform small schools of fish were frightened from pools and out from under shelving coral. In a few instances the seine was dropped in front of them, they striking it before realizing that anything lay in their path, but only three times was this method successful.

The best results were obtained by turning over rocks in the pools and standing by with dip nets to capture any fish that might come forth. Altogether some 30 species were collected, the largest number yet taken at one place. Previous to starting on the cruise it was generally thought there would be no difficulty in capturing fish of every kind in great numbers at most of the South Sea Islands; but we soon learned that only occasionally can a collection be made representing many species, unless a long time be devoted to it, and of course this was out of the question.

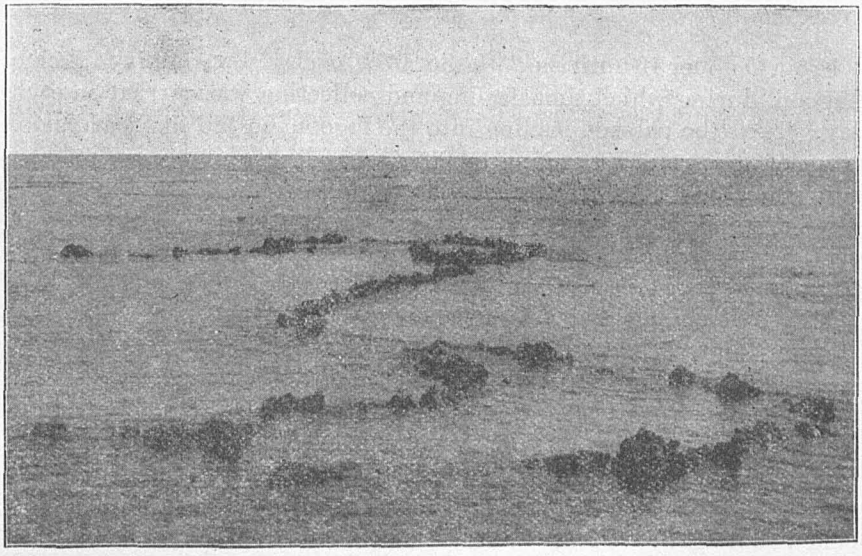
We were told that on the southeast side of the island spiny lobsters in considerable quantities are frequently taken at night by the aid of torches carried in the hand and fires built on the beach. The light has a tendency to bring them forth from their hiding-places, when they are either speared or are captured with dip nets. Occasionally lobsters are found in the lagoon near the village. One evening while at Fakarava fires were built along the beach to attract lobsters, but none came out. The natives claim that only on the dark of the moon can lobsters be found; at other times artificial light will not attract them from their hiding-places.

The lobster is highly prized as food, and excursions lasting several days are made to obtain it, several families making up the party. It makes no particular difference how long they remain away from home, as on nearly all the islands forming the atoll huts are built to accommodate parties of this kind, and under any circumstances it takes but a short time to construct a shelter to fill all the requirements for temporary housekeeping.

In a small coral inclosure on the beach near the village were several large fish, all of the same species. They had been in the inclosure for some time, and were taken in the lagoon 5 or 6 miles offshore. They were said to be poisonous; but the same species caught on ground near the coast line were eaten almost every day. It was furthermore stated that most fish taken in deep parts of this lagoon were unfit to eat. Just why the same species of fish should be poisonous in one locality and edible in another, from places separated by only a few miles, is hard to say. One of the captive fish was caught and placed in alcohol.

At Papeete we were informed by Mr. Salmon, a native of Tahiti, that at a great many places in the Society and Paumotu groups certain kinds of fish were poisonous in some localities and good in others. In particular, on one side of the channel leading into Raroia the fish are good, but on the other side they are considered poisonous and are never eaten. The distance between the two fishing-grounds is less than a mile. The natives of the island do not advance any theory as to the cause, but merely state what experience has taught them.

To arrive at a definite conclusion regarding the poisonous qualities of these fish, considerable time would have to be spent in investigating the grounds. It is reasonable to suppose that in fish caught on grounds situated a long distance from the village and exposed to the heat for several hours before they are cleaned poisonous gases would form,



Stone Fish-trap, Anaa Atoll, on the Reef.

making the fish unfit for food. Many considered poisonous might be edible if cleaned before decomposition set in; but in the locality mentioned the two fishing-grounds are only a short distance from the village.

ANAA ATOLL.

Only a brief stop was made here. A party was landed in the dory, near the passage leading into the lagoon, to collect samples of coral rock. While on shore we saw a number of natives on the reef engaged in spearing fish in a stone trap. On a long coral reef situated between two small islands 11 of these traps were counted, 100 to 200 feet apart, facing in different directions and so built that fish could enter from the outside reef or from the lagoon side. At high water the reef is partially covered, and at times the sea breaks over it into the lagoon.

RAROIA ATOLL.

On the afternoon of the 16th the *Albatross* coasted off this atoll. There are a number of boat passages leading into the lagoon, but no channel large enough for a ship. The atoll is fast breaking up, and in many places the sea has cut through the reef and worn away portions of the islands. The main village is on the eastern end of the island. Several canoes and sailboats were noticed in the lagoon, and many nets were drying on racks. So far as could be observed from the ship, the beaches seemed to be better suited for operating a seine than at most atolls. The number of nets noticed indicated this to be the case. The rim of the atoll being considerably broken forms numerous channels through which fish can pass. Every feature of the lagoon and surrounding reefs pointed to its being a prolific fishing-ground.

MAKEMO.

From October 19 until the 25th the *Albatross* lay at anchor in Makemo Lagoon, during which time fishing and collecting was carried on each day. Near the passage leading into the lagoon, on the starboard side, is a reef about 1,800 feet long by 200 feet wide. The reef is awash at high water, and at times is a favorite fishing-ground. On the southeast side the reef makes off quite steep; on the northwest side with a gentle slope. On the reef were three fish-traps, built on the same general plan as those observed at other islands.

Most of the people were away engaged in the pearl fishery at Hikueru, and what reef fishing was done was by women and boys. We saw an exhibition of patience on the part of an old man seated on the top of a coral stone wharf engaged in enticing a fish from its hiding-place. The water was surging in and out through the crevices formed by the irregular shape of the coral rock. In one hand the man held a short stick, to which a piece of bait was tied; in the other hand he held a short gaff. Occasionally the fish would make a sudden dart at the tempting bait, usually getting a small piece, but always quick enough to escape the gaff. The man remained at his post nearly four hours before capturing the fish.

A lobster pot baited with fish and meat failed to catch anything. In the evening an occasional fish would be caught with hook and line from over the ship's side, but taken as a whole this method was not a success, only four fish being taken; one was said by the natives to be good; the others were pronounced poisonous. Hand-line fishing was carried on each day, but few fish were caught, with little variation in the species. They ranged in length from 8 to 22 inches. Specimens were saved.

Collecting with seine was carried on, but not always with encouraging results. In 50 trials 44 fish were caught, many of which had not before been taken by us. The result shows a great deal of work

for a small number of fish. Sometimes four or five hauls were made without taking a single specimen. In many places the bottom was quite smooth; but owing to the clear water the seine was visible a long distance, and this, combined with the natural shyness of the fish, caused seining to be abandoned. Satisfactory results were obtained only by stretching the seine across the mouth of narrow passages and driving the fish into it, a man being stationed at each end to lift it up when they crossed the foot line. Only a few at a time could be caught in this way, for they would invariably dart under rocks or hide under coral. Turning over loose rocks and bowlders was found to be a fairly successful way of capture. As this caused the water to become very muddy, the fish then would be as likely to dart in one direction as another in their efforts to escape, and a considerable number were caught. On another occasion when this method was employed 80 fish were taken, including 6 species not previously taken by us. The following day 100 fish were captured, and the next day fully as many more.

Several hauls were made with the seine on the beach near the outlet of the passage on the lagoon side, it being quite free from coral and other material injurious to a net; nothing was obtained. Previous to setting the seine fish were schooling near the shore, but they soon disappeared and did not return. Running parallel to the beach some little distance back, and almost hidden from view by a thick growth of vegetation, we found a slough about 30 feet wide and on an average 3 feet deep, in which fish were plentiful. The bottom and banks were composed of fine coral sand mixed with decayed vegetation. In many places were branches of cocoanut trees, which made it difficult to haul the seine. If an attempt was made to clear away the obstacles the fish scattered in every direction. By forming the seine into a kind of trap and driving the fish into it we collected a variety of species. At a deep pool near the mouth of the slough fully an hour was spent in capturing two beautifully colored fish.

Our experience showed that with our apparatus only a few fish at a time could be taken, the color of the nets, seines, and hand lines having considerable to do with the many unsuccessful trials.

A trammel net was set in 7 fathoms of water close to a coral reef. Fish were numerous around it, but nothing was caught.

In a narrow cut leading from the lagoon to the outside reef, through which the tide ebbed and flowed, a wire trap was set in 3 feet of water, baited with pieces of fish and a live fish for a decoy. In the cut were many holes, varying in depth from 5 to 6 feet and 10 to 20 feet across; some were much wider at the bottom than at the top, thus forming overhanging shelves under which fish lurked. Standing a short distance away, in a position commanding a full view of the openings, a sight was presented very much like a row of aquariums. A step or

two nearer and a general stampede would follow, and immediately not a fish was to be seen, and to all appearances they had made their escape; and such was the case so far as their safety was concerned. It was discovered that the fish could escape by a number of passages, in which they concealed themselves. An unsuccessful effort was made to frighten them out, standing by with a dip net to capture those that might appear.

The wire trap captured 2 fish on the first trial and 4 more on the second. The third trial gave very good results, amounting to 20 fish, representing 5 species. In the last trial the trap remained down twenty-four hours and contained 24 fish when taken up, among which were 4 species not before taken. By the different methods employed at this island 300 fish were taken.

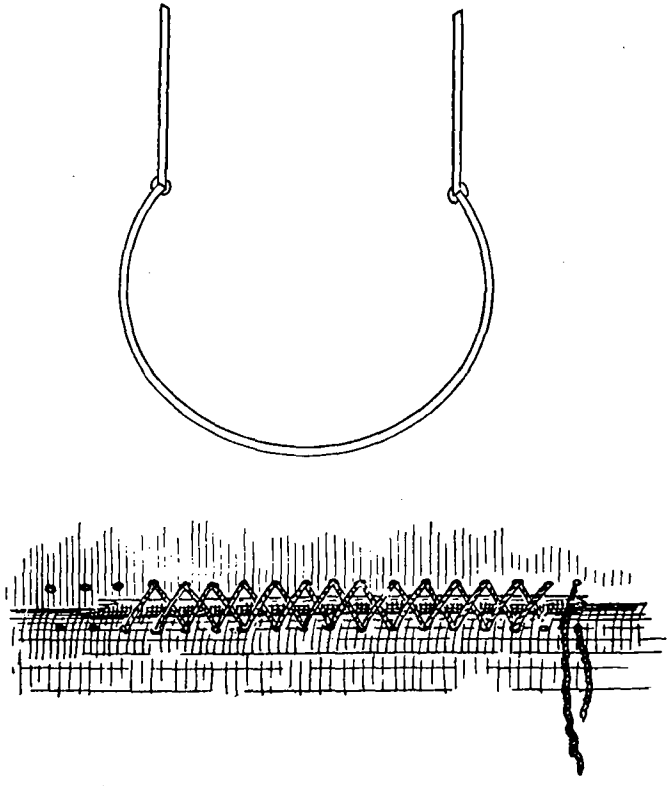
Shore collections were made on the outside reef, extending over a mile or more, and on the beaches in the lagoon. Among the material gathered were holothurians, sea-urchins, starfishes, shells, and crabs. The fringing reef on both sides of the passage leading into the lagoon is very rough, being composed chiefly of huge coral slabs, in which shallow places have been hollowed out by the action of the sea and are filled with water at each tide. In all these pools fish were noticed, but were hard to capture on account of the numerous outlets from one pool to another. Some, however, were taken and found to be the same species as those caught in the seine and trap.

The reef makes off from the beach about 500 feet. It is quite level, and when the tide is flooding the sea breaks on the outer edge and rushes in for a distance of several hundred feet, covering the reef to a depth of about 6 inches; receding, it leaves the reef bare except the pools, each incoming wave giving them a fresh supply of water. After a while the water begins to remain on the reef, only a portion of it running off. At this time fish are seen darting in various directions ahead of the incoming wave. Many of those that have been confined to the pools and channels now leave their narrow surroundings and mingle with other fish just in from the sea. At this time the natives usually repair to the reef to get their daily supply of fish.

Near the outer edge of the reef fewer fish were found in the pools than further up. Fish are abundant in gullies along the outer edge, where the reef makes off suddenly into the deep water, leaving many rough and jagged places 6 to 8 feet long and 2 to 4 feet wide, into which the sea breaks with considerable force even in moderate weather. Standing upon a shelf formed by the indentations fish could be seen at a depth of 10 or 15 feet. Frequently a heavy sea would surge in, churning the water into foam with sufficient force apparently to destroy all life within its reach. In some of these places the collecting seine was let down and held in position by the aid of a dip-net handle and a long pole, thinking that the surging might cause at least one fish to become entangled in the folds of the net; but before the

seine could be gathered up and brought to the surface the fish had either escaped into cavities in the coral or out to sea. We saw no exhibitions of skill in capturing fish with spear or other apparatus, and found no places on the reef where a seine could be operated.

But few canoes were seen on the island of Makemo, and only one well constructed and finished, that might be considered a representative type. Length, 17 feet; width, 14 inches; depth, 18 inches; the widest part 9 inches below the gunwale, just where the top and bottom join together; the bottom dug out of a single piece of hard wood, the



Showing cross-section of Makemo Canoe, and the way top and bottom are joined together.

top made of strips of soft wood. The two main parts, top and bottom, were neatly joined together with thread made of cocoanut fiber. Between the seams were strips of pandanus leaf, covered with a pitch substance which answers the same purpose as a thread of wicking. Both sides of the seam were covered with a strip of bamboo, and the seizings passing round the strips through holes bored three-fourths of an inch from the edge, each seizing crossing the other, forming a diamond pattern. The work was neatly done and looked strong and durable. The length of the outrigger was 15 feet, connected to the

canoe by three crosspieces. The float and other parts of the outrigger did not seem to have been made with any particular design; any piece of wood that was at hand seems to have been used. Bow of the canoe straight, with a sort of a billet-head projecting outboard; stern raking; bottom straight fore and aft and flat thwartships. This seems to be the prevailing style all through the Paumotus. The dugout part of the canoe was 1½ inches thick. It is no doubt necessary in these waters for the bottoms of canoes to be heavy, for in landing through the surf they are frequently subject to hard usage. Two other canoes measured 11 and 13 feet, respectively, and turned up considerably at the bow and stern; outriggers corresponding in size to the length of the canoes. These two canoes were painted blue, which did not add to their appearance.

Any departure from the original method of making detracts from the beauty of the canoes. Here, as at other islands visited, less attention is now paid to canoe-making than formerly. At one time the wood for every part was carefully selected, but little effort is now made to keep up to the old standard. In the place of neatly finished outriggers seized together with coir sennit, we find many of them poorly made and fastened with nails and pieces of wire. The large sailing canoe has been supplanted by sloop-rigged boats.

HIKUERU ATOLL.

On the morning of the 25th the vessel left Makemo and in the afternoon of the 26th lay to off Hikueru Atoll. This atoll lies 400 miles to the eastward of Tahiti and has a lagoon 10 miles in diameter. There is no passage leading into it, and canoes and other small craft are hauled across the rim from the outside beach. Canoes can be taken across without much trouble, but many of the large sailboats have to be transported on temporary ways. The distance is less than a quarter of a mile, with a good road all the way. The most difficult part is first landing the boats and canoes safely on the outside beach, out of the way of the surf.

The boat which took us in was 32 feet long and 8 feet wide, and sharp at both ends, steered with an oar, the same pattern and length as used in a whaleboat. This style of boat is chiefly for landing cargo from schooners that call at the island during the pearl-fishing season. The ordinary ship's boat would be of little service for this purpose, as in a short time she would either be smashed to pieces or have her bottom worn through by the ragged coral. Tons of freight are landed in a day, and so skillful are the natives in handling boats in a sea on a reef that an accident seldom happens to either boat or cargo.

Launching a boat through the surf is frequently more difficult than making a landing. In the former case the boat is almost carried over the platform reef to its edge. Those who are to embark take their

places in the boat, and when a favorable opportunity for launching arrives, from 10 to 12 men take hold of the gunwales and plunge her into the incoming surf. The bow oars have already been fixed in the rowlocks to keep her head to the sea until the others can be shipped. By this time the men on the outside are up to their waist in water, and sometimes they are carried off their feet by the undertow. To most people this would be a very serious matter, but to a native it signifies but little. The outer edge of the reef is very sharp and ragged, and should a boat be caught under it as the sea falls off the platform she would either capsize or be dashed to pieces against the coral by the next incoming sea.

THE PEARL FISHERY.

There are many other islands in the group where pearl fishing is carried on, but Hikueru is the most important. The fishery is regulated by the French government, the lagoon being thrown open every third year. Only one lagoon is fished at a time, and in consequence all divers assemble at one place. This year (1899) being the open season for this island, natives from almost every island in the Paumotu group are represented. Three firms control the fishery—one French, a German, and an American firm. This season fishing commenced October 5, and 55 tons of shells had been taken up to October 27. The last season the lagoon was fished, 380 tons of shells were taken out. From this amount $3,000 worth of pearls were found. As compared to other parts of the world where pearl fishing is carried on, it is said that this amount of pearls is small for the quantity of shells taken. Here the finding of pearls is incidental. The main object is gathering the shells.

For a number of years "machine diving" was carried on—that is, the men dressed in diving suits. By this process a much greater amount of shells was taken each season. Thinking that this method was fast exterminating the fishery, a law was passed prohibiting it, since which time all diving has been performed in the original way of going down naked. Diving is performed in depths ranging from 5 to 20 fathoms, the average probably being 10 to 15 fathoms.

Each company employs its divers for the season; they are bound by contract to fish for no other company, and are paid so much a ton for shells, the price being governed by the quality. The shells are divided into three grades. First-class shells are worth $1,500 to $1,800 per ton; second-class, $1,200 to $1,400, and third-class frequently less than $1,000, sometimes as low as $250, Chilian money. The prices vary to some extent each year, according to supply and demand. Germany is the principal market for pearl shells and pearls, the price for both being regulated in that country and forwarded to agents at Papeete before the season opens.

All pearls belong to the divers finding them, they having the privilege of selling to the highest bidder. Usually they sell to the firm employing them. On the strength of the high wages earned, each season there is a considerable rush to the lagoon where pearl-diving is to be conducted. At the time of our visit there were 3,500 natives either directly or indirectly engaged in the fishery, many of them from distant islands.

In moving from their homes the natives bring a large portion of their household effects with them—in some cases even the houses they are to occupy. The houses are very light, made of cocoanut palms and pandanus leaves, put together in sections and easily transported. The representatives from different islands form separate settlements, and for a distance of several miles along the beach clusters of houses and small villages are built among the cocoanut palms. The various villages are in every way the same as if they were located on the island homes of the people occupying them. Women and children are brought to the island and housekeeping goes on in the usual manner. Many of the women and young girls take part in the diving, and we were informed that they are equally as good divers as the men, in depths not over 10 or 12 fathoms.

Besides those engaged in the fishery, many native and a few white traders deal in pearls to some extent, but chiefly in articles in demand by the fishermen. A generous portion of the wages earned by the divers finds its way into the hands of the trader. The natives, both male and female, are fond of display, and gaudy patterns of goods are purchased to a much greater extent than seems necessary.

On Saturday hardly any work is performed. During the afternoon trading is extensively carried on, and in the early evening preparations are made for a grand dance and good time generally. Early Saturday morning canoes and cutters begin to arrive at the main village loaded with people from all parts of the lagoon, coming to remain over Sunday and take part in the festivities. We were informed that it was not unusual to see 100 or more anchored in front of the village. We were advised to remain over Saturday, being promised a unique entertainment.

Pearl-diving is carried on in all parts of the lagoon where the water is not too deep. The right depths are found near the coral patches, many of which are awash. These coral growths vary in size, from 10 to 15 feet across the top, others 100 feet or more, descending with a gradual slope, pearl shells being found around their base. Numerous coral patches are scattered along the inner rim of the atoll, from ½ to 1½ miles from the beach. Many were noticed farther offshore, but we saw no fishing going on near them.

Every part of the lagoon is free to all divers, no one company having exclusive rights or privileges. Divers employed by different companies

can work together on the same ground if they choose, and sometimes do, but as a rule they prefer not to interfere with each other.

Shortly after our arrival, arrangements were made to visit the pearl-diving grounds situated about 8 miles away. We took passage in one of the small cutters employed in the fishery, and on arriving at our destination made fast to a cutter anchored over a submerged growth of coral. Two other cutters were at anchor close by. Three divers were on one boat and five were on the other, one of whom was a woman. Each of the divers is provided with a water-glass, with which he scans the bottom before going down. The glass is similar to that used by the fishermen of Papeete, with a notch in the side in which to rest the neck. It is 16 inches square at the top, 12 inches at the bottom, and 12 inches deep. By its aid the bottom can be seen to a depth of 20 fathoms, and shells located. Before diving in deep water the bottom is inspected through the glass. By locating a clump of shells before going down, much labor is saved. Instead of the diver exhausting his energy in diving at random and searching for shells after reaching bottom, he goes directly to the spot where the shells lie. At other times, in shallow water, he goes down to explore the bottom. In this way clusters of shells are located before any are taken.

Before descending, the divers sit around on deck for some little time inflating their lungs to the fullest capacity, exhaling the air through the mouth, making a low whistling sound. No clothing is worn except a breechcloth. Over the shoulders is carried a bag net in which to put the shells. The net is made of cocoanut fiber, about 20 inches deep by 12 inches wide; size of mesh, 2¾ inches. It offers little resistance and will carry all the shells a man can bring to the surface. In the left hand is carried a pearl shell, which serves the same purpose as a knife. With it obstacles are removed from the bottom and shells loosened from their bed. The right hand is protected by a white cotton mitten; sometimes cotton cloth is wound around the hand.

When ready to descend the diver slips over the side of the boat, holding to the rail with one hand and having a water-glass in the other. Locating some particular point at the bottom, he lets go of the rail, drops the glass, takes a deep breath, and sinks out of sight feet first. Descending about 10 feet, he quickly turns head downward and swims to the bottom. A water-glass distinctly discloses every movement, his brown body forming a striking contrast to the clear water and variegated colorings of the bottom. When hardly a third of the distance has been reached he has the appearance of being on bottom, so transparent is the water. On reaching it he places himself in a horizontal position, seemingly hauling himself along from one point to another. For some time active diving was carried on in comparatively shallow depths, from 10 to 12 fathoms.

One man consented to give an exhibition dive in deep water. The

cutter was dropped off a short distance from the shoal and a sounding made in 17 fathoms of water. We watched through water-glasses the diver's movements from the time of sinking below the surface until rising to the top again, two minutes and forty seconds. One shell was brought up. Long before reaching bottom we thought it would be impossible for him to accomplish the feat, but in this we were mistaken. Reaching his destination, he began picking over pieces of coral, brushing aside stones, broken shells, etc., in the same manner as if he were at work in a garden. He investigated the bottom some 60 or 70 feet from the initial point of landing. When ready to ascend he stood erect and came up as if being pulled with considerable force, shooting out of water halfway to the waist. He seemed to suffer no unusual discomfort, and in a short time was ready to go down again. There is a record of a dive of 23 fathoms. The length of time the diver remained down we did not learn.

Canoes are very little used in the pearl fishery, being of little service as compared to the boats. The boats are cutter-rigged, easy to handle, and capable of carrying considerable cargo. They are mostly built on the same design, there being hardly any appreciable variation. All those examined were keel, straight stem, square stern, and carvel-built, with a cock-pit aft. They have accommodations in the cabin for about four people and in the hold can carry a considerable quantity of freight. Between the trunk of the house and the rail is a walking space of 14 inches. Measurements were taken of two of these cutters. One was 16 feet long, 6½ feet wide, and 2 feet deep. The other was 23 feet in length, 8½ feet in width, and 2¾ feet in depth. Other and larger cutters were seen at anchor some distance from the beach. Each cutter carries a small tender. There are 350 boats engaged in the fishery. The cost of an average cutter, about 22 feet over all, rigged and ready for use, is $350. They are built in Papeete and owned largely by the companies operating the fishery.

We saw but few canoes. Those examined were superior to many observed at other islands. The top and bottom are made of separate pieces, the upper part of soft wood and the lower of hard wood, and fastened together with line made of cocoanut fiber, the seams having strips of pandanus leaves between them. In length the canoes varied a foot or two, in width a few inches. One was 9 feet long, 10 inches wide, and 16 inches deep; outrigger float 7 feet long, 4 feet from the side, and 5½ feet between the stanchions connecting the crosspieces to the float. Another canoe was 11 feet long, 11 inches wide, and 18 inches deep, built the same as the first. They were round on the bottom and straight fore and aft. There were no paddles lying about, neither were there any sails. In the lagoon there must have been many types of canoes, but as the people owning them were so widely scattered we saw only a few.

AKIAKI ISLAND.

On October 30 we touched at Akiaki, a small island not over a mile in circumference. It has considerable more soil than most islands visited in this group and is covered with a heavy growth of vegetation. No collecting of fish was done, our time on shore being limited to less than an hour. There are no permanent inhabitants, but the number of turtle here attract natives from adjacent islands. As fast as turtles are caught they are taken to the middle of the island and placed in a small pond, where they are kept until a sufficient number have been captured, when they are taken away alive and sold.

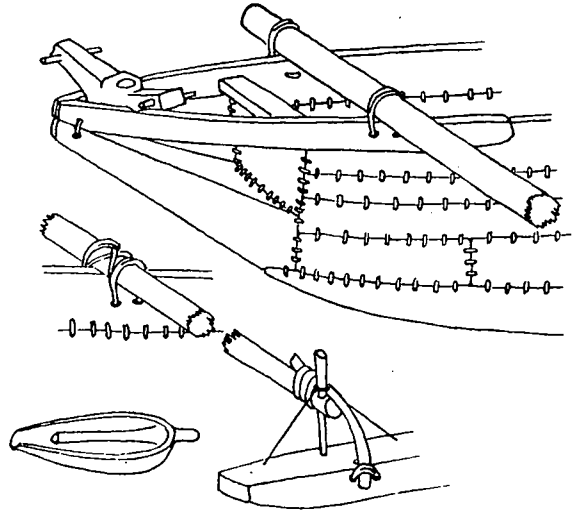
NUKUTAVAKE.

About an hour was passed here in collecting specimens of coral rock and other material. The inhabitants, numbering possibly 100, live entirely by themselves and seem to be contented. There are no white people among them. The village is built close to the beach, as is usually the custom in the South Seas. The houses, canoes, and everything connected with the village had the appearance of having undergone little change through the introduction of modern things. As near as we could learn, no white men had ever lived among these people, but they, of course, had come somewhat in contact with white people at different islands. The houses are neatly built and a great deal of skill is exhibited in decoration, the interior in every way corresponding with the outside.

Mr. A. G. Mayer made a sketch showing half of a canoe, illustrating all the essential parts. Length, 17 feet; width, 3¾ feet; depth, 2½ feet; very sharp on the bottom and having a great deal of dead rise. The bottom, or that part of it corresponding to the keel and garboard strake of a boat, was made of one piece, dug out of a log. The outrigger float was 19 feet long, 12 inches wide, 8 inches deep, flat on the under side, and turned up slightly at each end and attached to the frame 9 feet from the side, which gives the canoe considerable stability. The crosspieces forming the framework project outboard on the opposite side 3 feet and are fastened to the gunwales with coir sennit. The stanchions connecting crosspieces with outrigger float, 20 inches long, are seized together with sennit and braced fore and aft with the same material and counterbraced just inside the stanchions with a stout withe; the outer end of brace is fastened to the outside edge of float, the seizing passing through holes about 3 inches apart. The holes are formed on a curve, one leading into the other, deep enough to give the required strength.

The canoes showed original design and workmanship of a very superior quality. All canoes examined at other islands were crude as compared to these. The Nukutavake canoe is put together in somewhat the same manner as a boat or vessel, the construction being

altogether different from the ordinary dugout or the canoes at two places previously mentioned. The accompanying sketches will show the build, model, and neat workmanship. No metal is used; the planking and other parts are seized together with the usual cocoanut fiber so universally used throughout the South Seas. The seams of the planking are covered with bamboo strips, and between them is a coating of gum and narrow strips of pandanus leaves. Each canoe has two sets of floor timbers, one set 3 feet from the bow and the other 6 feet from the stern; also a mast step, the mast partner situated just aft of the forward crosspiece and fitted to the gunwales. On one canoe a temporary bowsprit was rigged, the heel of which was fastened to the underneath side of crosspiece. We saw no masts, sails, or paddles.



Canoe, Nukutavake.

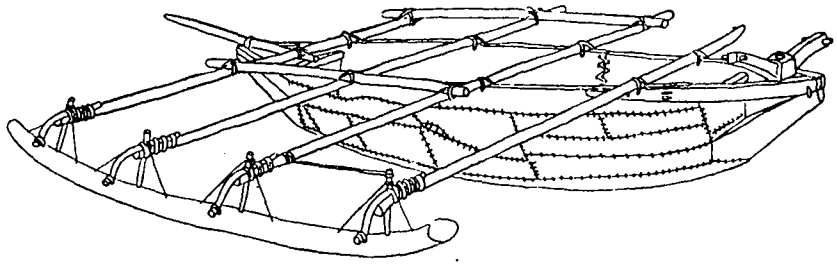
The measurements of two other canoes were taken, of essentially the same design as the one described except the outrigger float, which was round and more curved, the forward end round-pointed, the after end square. The first was 14 feet long, 2 feet wide, and 23 inches deep; very sharp on the bottom and a slight turn of the bilge; no floor timbers. The outrigger frame consisted of three crosspieces. The second was 13½ feet long, 3 feet beam, and 2 feet deep. Being a foot wider, this canoe had a more rounding bilge. The bow and stern are alike. A head rail extends out from the main body of the canoe 2½ feet, to which the forward and after crosspieces are fastened, and from the keel a cutwater runs up and connects with the head rail, giving strength and adding considerably to the general appearance. The cutwater is made of one piece of wood, and, as will be observed in the sketch, is neatly fitted to the keel, planks, and head rail. The cleats at the stern are for making fast the sheet and for placing the steering

paddle against when going through the surf and narrow passages. Two braces, one forward and another aft, answer as thwarts. Heavy material is stowed in the bottom, and the occupants arrange themselves on the two thwarts and framework of the outrigger.

We saw no tools of any kind lying about, and the time being short we had no opportunity of investigating among the houses for such implements as are used in building either house or canoe.

Getting out the planks, head rails, cutwater, and outrigger float from the rough log, made smooth and fitted so perfectly without the use of modern tools, must indeed be a long and laborious task. The tools used are evidently crude, for long before the coming of the white man to this region, when visits were frequently made to distant islands, it is said that canoes were made larger and superior to those of the present time.

The outrigger floats are of hard wood and have the appearance of being heavy. The style of bailer is the same as found at other islands.



Canoe, Nukutavake.

A strong feature which presents itself in favor of the built canoe over that of the dugout is that under most circumstances it is likely to be more serviceable. In case of the latter having a plank smashed or a section of the bottom torn off it is comparatively easy to replace it. If the dugout meets with a serious accident, such as splitting open the bottom or having the bow or side smashed in, either one of which is likely to occur, the work of repairing the damage is considerable.

At most of the important islands in the Paumotu group schooners and cutters have taken the place of the large canoe. Much quicker passages can be made in them, and since the gathering and shipping of copra has expanded and become a permanent business, and is to some extent carried on by the natives, the schooner and cutter have been more in demand.

WHITSUNDAY ISLAND.

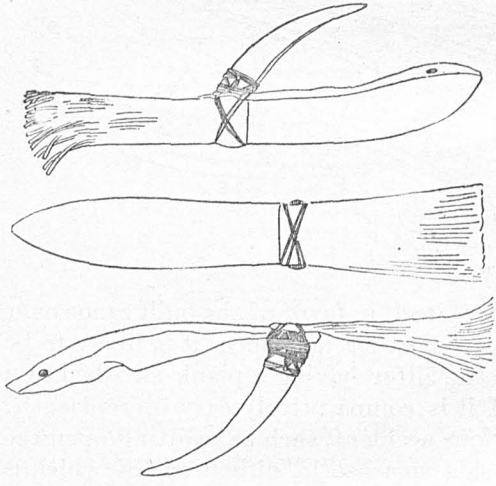
On October 31 the ship lay to off Pinaki or Whitsunday Island, situated but a short distance from Nukutavake. The island is small and uninhabited, but is visited occasionally by people from neighboring islands. A boat was lowered and a landing made near the passage

into the lagoon. The passage, which is about a third of a mile long and 200 feet wide, runs nearly dry at low water; at high water a small boat can enter. Some fish were seen in the passage, but none in the lagoon.

Strewn along the beach of the lagoon were numerous tridacna shells, in some places heaped up in long rows; and scattered over the lagoon there were counted 116 piles of shells, which at a distance resembled haystacks covered with canvas. At one end of the lagoon, about 110 yards from the beach, was a platform erected upon posts, probably for drying the meat of the tridacna. We could see no reason for using the platform to dry copra, it being too far from the shore, and besides there is only a scant growth of cocoanut trees on the island.

HEREHERETUE ISLAND.

On the morning of November 3 the *Albatross* arrived off this island. It is situated 370 miles to the westward of Whitsunday, and is quite isolated; the nearest island to it (Anu-Anuraro) is 90 miles to the eastward. A party was landed and a visit made to the village. A wide, fringing reef makes off in front of the village, on which are pools and miniature ponds at low water. One fish was captured in a dip net.

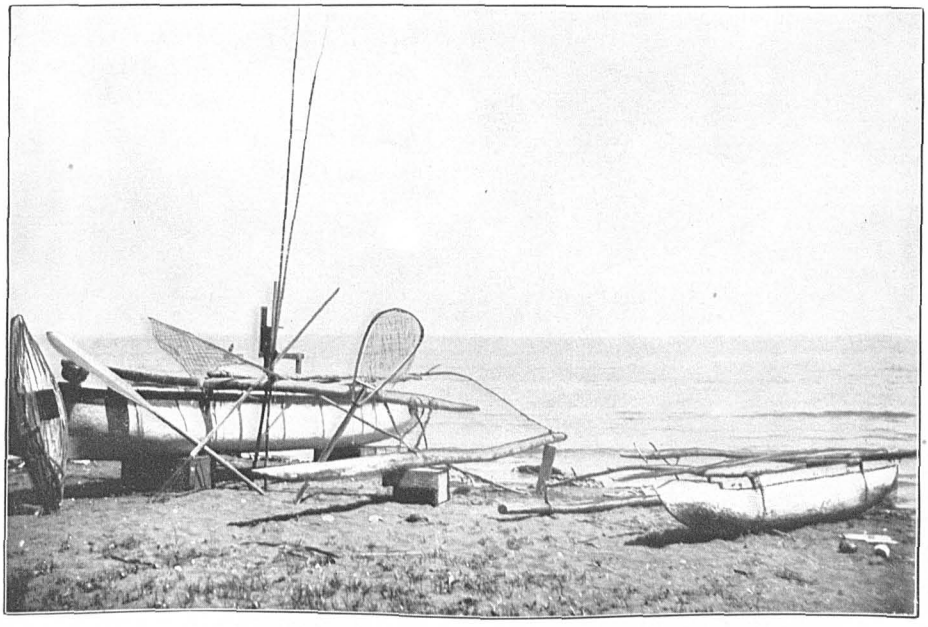


Fish-hooks, Hereheretue Island.

Few people were on the island; we were informed that many were at Hikueru, engaged in the pearl fishery. We saw no people fishing, either on the reef or from a canoe. A native who could speak a little English told us that fishing is done only with hook and line and with spear. Hooks are made from the pearl shell. A piece of shell is formed into the shank of the hook by rubbing it against a stone; the bow is made of bone, and sometimes shell, and sharpened to a point in the same manner as the shank. Holes are drilled in both, and fastened together with cocoanut fiber.

On the lower part of the hook is fastened a bunch of goat's hair, and sometimes narrow strips of pandanus leaves, to attract fish. The body of the hook is highly polished, and can be seen in the water for a long distance. There being no barb on the hook, a fish can be captured only by keeping the line taut, not allowing it to slack in the slightest degree.

CANOE, MAKEMO.



CANOES, PADDLE, DIP NETS, AND FISH CAR, PAPEETE.

The hooks vary from 3 to 6 inches in length, and are used both for trolling and bottom fish. In trolling the bare hook is used; for bottom fish, bait is tied round the bow and shank, leaving the point exposed. Fishing at the bottom is very destructive to hooks and lines; a large supply was noticed in the houses.

Two very poor dugouts were lying upon the beach, the best canoes being probably at Hikueru. The larger of the two was 16 feet long, 18 inches wide, and 12 inches deep. The outrigger frame was built out 5 feet from the side. Outrigger float 12 feet long, crosspieces of frame 9 feet apart. The outrigger frame was made of tree branches, and fastened together with bits of old string and wire. Bow of canoe quite blunt; stern sharp. It would seem that the shape of these canoes is governed rather by the shape of the log from which they are made than by any particular design. Both canoes were fitted with a sprit sail and temporary shrouds. The shrouds were made fast to the crosspieces and were unfastened each time the sail is taken in. The indications are that these people are fast discarding their own methods and adopting new processes in canoe-making.

THE SOCIETY ISLANDS.

The *Albatross* arrived in the harbor of Papeete, island of Tahiti, on the afternoon of September 27 and remained there until October 5. Fishing was carried on with hand lines, gill nets, and seine, but the results were meager. It was found that fish would seldom take the hook, however tempting the bait might be. Wire fish-traps were made and set in shallow water where fish were known to be plentiful. They remained down several days with negative results. Each time a trap was visited several species of fish could be seen swimming about as if investigating the contents, but their curiosity did not lead them into it.

A crab net and a lobster pot were set off the northern end of Motu-uta Island; nothing was taken in them. One afternoon in this locality we succeeded in taking three fish with hook and line. Trials were made in the same place the following day, but nothing was caught.

The beaches in the harbor are composed principally of coral and old beach rock, to such an extent that it is almost impossible to find a place where a seine can be hauled without injury. Fish of many varieties were observed in all parts of the harbor, particularly on the spots where the traps were set. A trammel net was set off the northern end of the coral reef fringing Motu-uta Island, in 3½ and 5 fathoms of water, the deepest part being on the outer end. The net remained down thirty-six hours and during that time was "under run" several times, but although fish were noticed in the vicinity of the net none was obtained. The clearness of the water was no doubt the cause of fish not entering the net.

We soon learned from observation and by personal experience that we could obtain but few fish with our apparatus. Nearly all of the fishing in the immediate vicinity of Papeete is performed with spears (usually single-pronged) with the aid of an ordinary water-glass. This fishing is generally conducted at half tide on the coral reefs, where the water is 3 or 4 feet deep; early in the morning, when the tide serves right, is the best time. Naked, except a cloth about his loins, with spear in the right hand, a water-glass in the left hand, and the painter of the canoe tied around his waist, the fisherman picks his way over the reef. The canoe is towed along to put the catch in, and also to paddle over deep places, and for crossing to the outer reef if necessary. The water-glass is such as is in common use everywhere, a foot square at the top, 12 inches deep, tapering to 8 inches square at the bottom, in which is set a piece of window glass. In one edge of the top a semicircular place is cut in which to rest the neck. The fisherman places his head inside and pushes the box ahead of him, carefully scanning the bottom. By the aid of the glass any fish that may be lurking near can be distinctly seen. The progress over the bottom is necessarily slow, as each step is likely to bring forth a number of fish, and to hurry would greatly lessen the chance of capturing one. Coral fishes are very shy, and the least movement on the part of the fisherman causes them to dart under branches of coral, into some hole near by, or to conceal themselves under the many overhanging shelves which mark the dividing line between shallow and deep water.

In order to catch fish in this manner it is necessary to be familiar with all parts of the reef and to know just where the kinds of fish sought are to be found at different periods. A lifetime of experience has taught these people to become very expert, but with all their skill no great amount of fish is caught at one time. Sometimes a fisherman will be an hour or more traveling over the rough bottom up to his arms in water, and during that time cover a mile or more without capturing a single fish, but as he has plenty of time at his command it matters little whether he uses one hour or a half day in obtaining the amount of fish desired. It is astonishing how these people can travel in bare feet over the sharp and jagged coral. One shod with stout shoes finds it difficult to make much headway even in comparatively smooth places.

About 2 miles north and east of the town there is a small stretch of beach where drag-seine fishing is carried on to a limited extent. The fish taken are for home consumption. The length of the seine corresponds to the size of the beach. Two of them were measured, one 5 and the other 10 fathoms long; 10 and 15 feet deep; size of mesh, 2 and 3 inches, stretch measure. For floats pieces of wood are used, of no regular form or size; on the foot-rope pieces of sheet lead are wound. On one small seine, made of coarse mosquito netting, blocks

of wood were used for floats, and to the foot-line were fastened shells for sinkers. The seines had no bags and were hauled without seine ropes, in the same manner as a small collecting seine. They are used mostly by women and children.

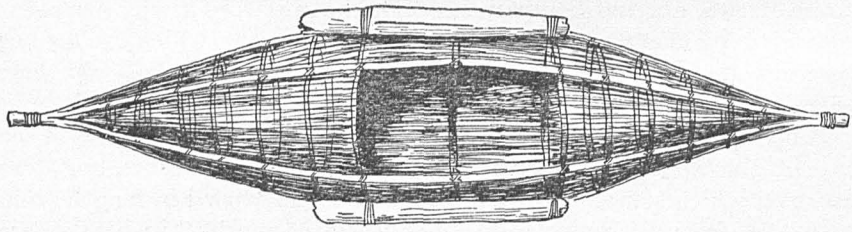
At Point Venus, 5½ miles from Papeete, is a seining-ground where a large seine is operated by Gilbert Island fishermen. These people settled here a number of years ago as a fishing colony. No description can be given of the seine or other apparatus, as no visit was made to that locality. About 8 miles to the westward of Papeete is a fishing village of considerable importance, inhabited by Gilbert Islanders. We learned that most of the fish in Papeete market are caught by these people. Their homes are scattered along the beach for several miles, there being no method displayed in laying out the village. On beaches where seines can be hauled houses are built near the water's edge. They are mostly hidden from view by the dense growth of trees, and many times we were about to pass on, thinking there were no inhabitants near, when our attention would be attracted by a net or fish trap among the trees. On making an investigation we usually found a house or two, and more apparatus. The people were kindly disposed, and tried in every way to explain the manner in which the fishing gear was used, but without much success, as they spoke only their native tongue.

It being Sunday, no fishing was going on and we were unable to see any of the apparatus operated. Arranged along the beaches were racks on which seines were drying. The seines varied in length from 60 to 120 feet; 30 to 44 meshes deep; size of mesh, 3 inches; single head and foot line; floats on the head-line made of koa, a wood that is very light and more durable than cork. The floats were 4 inches long by 2½ inches in diameter, placed 5 inches apart. The leads on the foot-line were 3 inches apart, made of heavy sheet lead and wrapped around in Italian style. This is a very good way to lead a seine, for should there be too much lead it is easily removed, and on the other hand if there be not enough it is easy to put more on.

We were informed that all the webbing used in making nets is imported from San Francisco. The water being exceptionally clear, tanned nets are not used. The less conspicuous a net is in the water the more fish it will catch. All tropical fish are shy, but those inhabiting coral reefs are unusually so. No gill nets are used.

Bamboo fish-cars of various sizes, which at first we supposed to be fish-traps, were noticed. The largest was 7 feet long and 3 feet in diameter across the center, gradually tapering to 4 inches on the ends. The length and shape depend on the size of the bamboo from which the car is made. Bamboo of the desired sizes is selected and split longitudinally between the nodes into strips about one-half inch wide, care being taken not to separate the ends of the strips from the nodes. The

stick having been divided into as many strips or sections as required, an opening between them is made and a wooden hoop, about 4 inches in diameter, is inserted, turned at right angles, and gradually forced into one end. This causes the openings to spread. The first hoop now being in position, a larger one is put in 1 foot from the first. This admits the large middle hoops, which are placed 7 inches each side of the center. The strips are now stretched apart to their fullest capacity, with a space of 3 inches between them. To prevent small fish from making their escape the openings are reduced one-half by inserting other strips made of the same material, the ends held in place by a serving of cocoanut fiber, and fastened to the hoops with the same material. In the top of the car is a door 15 inches square, and on each side of it, lengthwise of the car, is a piece of koa wood, 2 feet long and 3 inches in diameter, serving as a float and keeping the door of the car always at the surface. The cars are light and durable; they are made for towing, and both ends having the same shape they offer little resistance to the water.



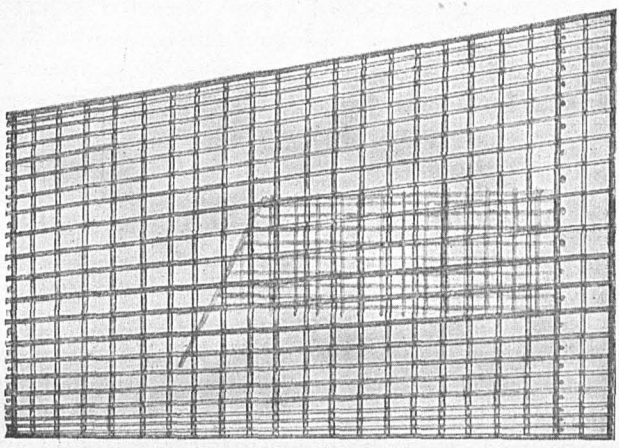
Bamboo Fish-car, Papeete.

Live-cars are very necessary in these waters, for fish deteriorate quickly and will keep but a few hours at most. Those caught in the afternoon, unless placed in a car, are not fit for market the following morning. When a distant fishing-ground is visited a car is taken into the canoe, and if fish are caught it is towed back. Cars are always kept ready for use; when containing fish they are anchored in some sheltered place where the water is smooth.

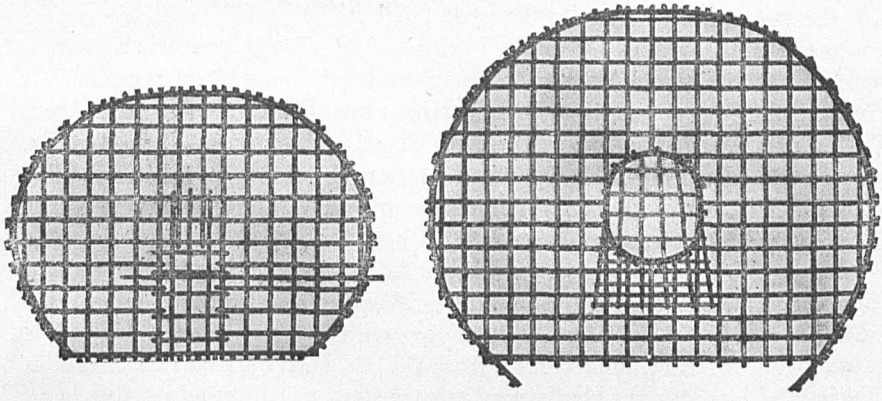
Trap fishing is followed by these people to a considerable extent. We saw several traps, all of the same type and size, $2\frac{3}{4}$ feet long; one end 2 feet wide by 1 foot deep, the other 2 feet wide and 18 inches deep; straight on the sides and ends, oval on top and flat on the bottom. They are made of withes and seized together with cocoanut-fiber twine, forming a network of meshes $1\frac{1}{2}$ inches square. The top extends out over the front end 3 inches; this probably is purely ornamental. The funnel or lead is 19 inches long and 6 inches square at the opening. Just inside the mouth it is oval in shape, gradually tapering to a point. The last 6 inches on the bottom side of the funnel is open; the extreme end is closed. This forces the fish to find their way into

the main portion of the trap from the underneath side of the funnel. In trying to find a way of escape from a trap, fish usually seek places near the middle or top, and by having the outlet concealed near the bottom, there is little chance for escape. The fish are removed through a door in the rear.

Traps are set both in shallow and deep water, near the edge of coral patches, or further offshore, in deep water, close to the fringing reef; also in ravines, runways, and holes among the coral, where the choicest



Fish-trap, Papeete, Side View.



Fish-trap, Papeete, End Views.

of fish exist, that can not be caught except by trap. A trap may be set in a well-selected place for 24 hours or more, without taking a single fish; and then again a dozen may be caught in a few hours. Fish inhabiting waters adjacent to coral reefs are very erratic, and a fair catch made in a particular locality one day is no sign that the same thing can be repeated the next day.

It is stated that no natives of Tahiti use traps of their own inven-

tion, and that a great many of the fishing devices have been introduced by the natives of the Gilbert Islands. It is probable, however, that before these people came to the island the natives paid more attention to fishing than they do now.

Torch fishing is carried on almost every evening when the weather is favorable. Soon after the sun sets the canoes paddle across the harbor and out through the passage in the reef. The fishing-ground being reached, torches of cocoanut husks are lighted. Both the large and the small fish are attracted; the large ones are speared, and the small ones taken in dip nets. Back and forth, about a half mile off the reef, the procession of torches may be seen far into the night. At certain seasons considerable quantities of flying-fish are captured by "torching." We were told that on these excursions the fish-car is frequently brought into service.

If fish are plentiful in the first part of the night, and "torching" has been a success, the fishermen leave the ground early; but if they are scarce, the morning is well advanced before the work is abandoned. Just at the break of day the fishermen bring in the night's catch and the fish that have been held over in cars. Groups of men and boys may be seen coming along the road with large baskets slung over their shoulders filled with fish. Occasionally a team is seen laden with fish, but for the most part the carrying is done on the shoulders. Long distances are covered, partly by canoe and the rest by foot. Many fishermen, however, land their catch in canoes on the beach in front of the town, and then take it to the market.

In the market, located in the middle of the town, there is a considerable variety of fish displayed in amounts of 50 and 100 pounds. It is a large 1-story building with the sides open to admit the free circulation of air. A portion of the floor space is divided into small stalls. There are also long tables arranged along the floor, on which the fish are placed before the customer in wrappings of fresh leaves and in baskets made of cocoanut leaves.

The price of fish varies from day to day, according to the supply and demand. As a rule, fish of all kinds bring high prices, owing to the difficulty of catching them and their rapid deterioration. Ice is too expensive for use, and even if it could be had here at a reasonable figure the chances are that very little of it would be used on fish.

The canoes of Papeete vary but little in shape and are similar in construction to those observed at Nukuhiva, previously mentioned. The art of canoe-making has rapidly declined since the island has been ruled by Europeans. Previous to that period and for some time after, the building of canoes was one of the principal occupations of the people throughout the Society Islands and Paumotu group. Skill of no mean quality is exhibited in the old-style canoe, now only seen in private collections. They were large and composed of many pieces,

and great care was taken in decorating the war canoe with carvings and shells. The canoe for common use was far superior to most of those now seen among the islands adjacent to Tahiti.

The average length of the canoes measured was 23 feet; 19 inches wide and 18 inches deep, width carried well forward and aft; outrigger 18 feet long, 6½ feet from the side of the canoe; 13 feet between crosspieces leading to outrigger, the forward one connected with it by a stanchion 12 inches high, the after one leading directly to it and fastened with the usual cocoanut fiber. The stanchions are braced with withes. Wire is sometimes used.

There seems to be no special pattern for the outrigger float. All styles were noticed—round, square, some sharp on the forward end and others blunt. The main body of the canoe is quite symmetrical, yet there is a decided lack of finish.

Both long and short handled dip nets are used. The bow is 2½ feet long by 1¼ feet wide; size of mesh 3 inches. The web is made of cocoanut and pandanus fiber. The large nets are of the former and some small ones of the latter material. The net hangs about 14 inches below the bow on the outer part and not over 3 inches on that part next the handle, thus forming a kind of a pocket. The nets are necessarily very light, for they must be handled very quickly when fishing with them on the reef and from the canoe.

Canoe-bailers are made of one piece of wood, and are shaped like a hand flour-scoop, except that the bottom is nearly flat. The handle is on the inside and projects from the top horizontally toward the mouth. By having the handle on the inside the person who is bailing can work much longer without the hand becoming cramped than would be possible with the ordinary boat-bailer. The size of bailers examined was 17 inches long, 7 inches wide, and 3 inches deep. To make a bailer of this kind with tools such as were formerly used must have been slow and tedious work; but with modern tools at hand it is quite a simple matter; yet the introduction of modern tools has not improved the workmanship of anything connected with the canoes.

It has been mentioned that large canoes have been mostly supplanted by clinker-built boats varying in length from 30 to 40 feet; 32 feet is about the average length, 5 to 6 feet wide, and 2 feet deep. Square stern and straight stem is the prevailing style. They are keel boats, straight on bottom, with little sheer. They are rigged with spritsails and carry two masts stepped well aft, with shrouds permanently fixed to masthead, temporarily set up to eye-bolts in the gunwale. They are well supplied with thwarts, generally seven, followed by large stern sheets.

We were informed that these boats were all built by the natives. Good workmanship is displayed in every detail, showing that what they have lost in the art of canoe-making has been made up in modern

boat-building. The cost of a boat all rigged is $250. No fishing is done in them, but they are used in making passages to distant parts of Tahiti and the island of Moorea. The people of Moorea have the same kind of a boat, and it is not unusual to see a dozen or more of them lying at anchor off the beach in the harbor of Papeete, loading with general cargo, such as can be carried in an open boat. The weather at most seasons of the year being pleasant, passages from one island to another are made with safety. Many parts of the coast line of Tahiti are protected by outlying barrier reefs, inside of which canoes and boats can navigate in smooth water when it is choppy outside.

From November 6 to the 15th the *Albatross* again lay in the harbor of Papeete. This time less general collecting was done than during our previous visit. The material collected at the various islands was packed and made ready for shipment to Washington.

Wire fish-traps were set on the reef in shallow water off the southeast side of Motu-uta Island, remaining down from the 7th until the 14th. After having been set 24 hours they were hauled, but nothing was in them. At the end of two days two of the traps were shifted farther in on the reef in shallower water. Here nothing was caught, and they were shifted back to where they were first set. Nothing was taken until the third day, when 4 fish were found in them, and immediately following these 11 others were caught, all in traps having live fish in them for a decoy. The first decoy was caught on a hook; the first four specimens taken in the traps were also used for decoys.

However plentiful fish may be around a trap, they seldom enter it the first day or two. It has to be carefully investigated from a distance until a certain amount of confidence is gained before approaching nearer. Native fishermen rarely visit a trap under four or five days from the time it is set.

On the morning of November 15 the ship left Papeete and steamed over to the island of Moorea, where it lay to off the northern end during the afternoon and part of the evening. In the afternoon several schools of horse mackerel passed by, followed by large flocks of birds.

The following day we skirted the shores of Huaheine, Raiatea, and Tahaa islands. In the passage separating Raiatea and Tahaa a large number of canoes were engaged in fishing. The islands are circled by a barrier reef forming a channel from a half to a mile wide. In the evening the ship anchored in Hurepiti Bay on the southwest side of Tahaa. At the entrance of the passage were two natives fishing with spears; they were up to their knees in water and towing their canoes after them. The shore in all parts of the bay is very precipitous, cocoanut trees and other vegetation growing to the water's edge. The beaches are narrow and steep and at high water are covered. Only a few huts were visible from our anchorage, and they were built on piling over the water.

The surface electric light attracted a number of small fishes and several forms of crustacea. A crab net and wire fish trap were set, but neither took anything; the former was hauled repeatedly, the latter was taken up in the morning.

BORA BORA.

This is one of the important islands of the Society group, situated 10 miles from Tahaa. The village has a population of about 750 people. One day was spent here collecting and gathering information. Very little fishing is done near the village; the principal grounds are on the west side of Tupua Island, 2 miles distant. We were informed that a number of stone traps were located on this part of the island. The beach on the north and west sides is said to be free from coral and rock and a suitable place for operating seines.

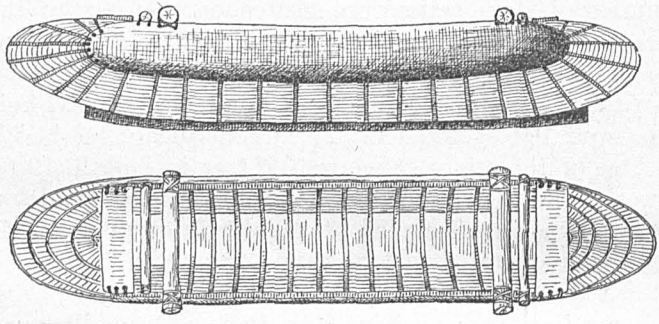
Fish are taken here by hook and line, seines, and traps. Seines vary in length from 100 to 150 feet; 2½ fathoms deep; mesh, 2½ and 3½ inches. One of the seines measured 60 feet in length, 12 feet deep, 5½-inch mesh. For floats pieces of koa wood are used, and for sinkers pieces of coral rock are fastened at regular intervals to the foot-line. These seines are operated in two ways—dragged ashore on the beach and used as a kind of a trap. The seine is carried on the shoulders of the fishermen to the place where it is to be set, and dropped gently into the water, forming a semicircle, sometimes the mouth facing offshore and at other times inshore, this being regulated by the position of the fish; one man stands at each side of the mouth, holding the ends, and two are at the bunt; several canoes are stationed off the mouth, and a number of men form a line between the canoes and the mouth of the seine, thus forming a lead; everything being ready, the canoes slowly approach the net, keeping the paddles splashing all the while to frighten the fish toward the seine. Some of the fish will, of course, escape, but the continual kicking and the splashing of the paddles has the effect of driving others into the net. The seine is then closed up, the foot-line drawn together, picked up, carried to the shore, and the contents placed in live-cars.

Live-cars serve to carry live bait to the fishing-ground and to take back alive the fish caught. The live fish taken to the fishing-grounds are not used in connection with the seine; they are liberated on the reef in places where large species of edible fish are known to exist, to attract them from their hiding-places, the fishermen standing by with spears to capture them as they come forth in pursuit of the small fry. This is one of the favorite methods of fishing, not, however, on account of capturing any more fish than with the seine, but for the amount of sport connected with it.

The cars are made of stout withes woven together basket fashion, over a light frame. In shape they are somewhat like a dugout with a very blunt bow and stern. There is more work in one of them than

in an ordinary canoe. An effort was made to purchase one, but the owner could not be persuaded to part with it. Length of car, 9 feet 6 inches; width, 3 feet; depth, 2 feet 6 inches.

Almost every species of fish, including sharks, found on the reef are taken in the stone traps. Most of the small fish are speared; sharks are taken in seines, the seine placed at the mouth of the trap and dragged inside toward the head, which causes the sharks to become entangled in its folds, when they are easily captured. Sharks are taken mostly for their fins and tails; they are sold to traders, who in turn dispose of them to Chinese.



Fish-car, Bora Bora.

The beach in front of the village proved too rough for seine work. Hauls were made in all the available places, including two sloughs; mullet and crabs were the principal species taken. A fish-trap and a crab net set on a reef close to the ship were found empty, and hand lines were also tried unsuccessfully.

THE COOK ISLANDS.

On November 21 we arrived at Aitutaki, an island belonging to the Cook or Hervey group. Having been informed that our time on shore would be limited, the only apparatus taken ashore was a small seine. The beach near the village was found to be very smooth. The seine was hauled six times, and five species of fish were caught.

We learned that nearly all of the fish consumed at the village were taken on the reef and off a number of islets lying to the southward. On the reef surrounding the islets are several stone traps built on the same plan as those in the Paumotu group. The rim of the barrier reef near the village is quite wide, and on it are many pools in which fish are found at low water.

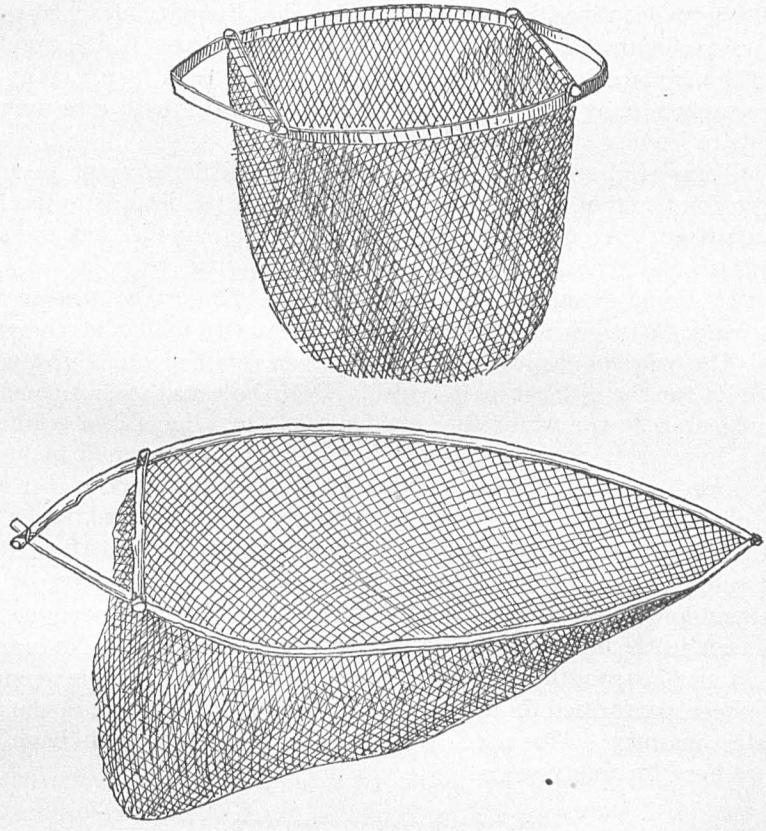
The natives of this island have three ways of taking fish from the traps—with spear, with a basket-shaped dip net, and with a heavy piece of webbing used in the manner of a drag seine, as at Bora Bora. Many of the fish which enter the traps are comparatively large, and the apparatus for capturing them is correspondingly strong.

The bow of the basket-shaped net is 9 feet long and 3 feet wide,

LARGE DIP NET, AITUTAKI.

FISH TRAP, AITUTAKI.

consisting of a withe bent to the desired shape, and a brace on either end which forms a handle. The net is 3 feet deep and made of cocoanut fiber and cotton webbing. As much cotton is now used as native material, it being supplied by traders. It takes two men to handle the net; it is held across the mouth of the trap and the fish are driven toward it from the other end. As fast as fish are caught they are thrown into a canoe.



Large Dip Nets, Aitutaki.

Shark nets are of heavy material, are 40 to 50 feet long, 6 feet deep, and have a mesh from 5 to 6 inches. Occasionally sharks enter the traps. As soon as one comes in contact with the net, it is wrapped up in it, which renders it helpless, and it is then easily dispatched.

Hook-and-line fishing is carried on outside the lagoon, off the reef, the hooks being similar to those described on page 768. This hook was at one time the only style in use in most parts of the South Seas.

The wicker-work fish-traps differ in design from those observed at other islands. They average 2 feet in diameter at the bottom, 1 foot across the top, and 20 inches high. The mouth or lead is at the top

and extends to within 4 inches of the bottom; diameter of lead, 5½ inches. The bait is fastened at the top between the lead and the inner side of the trap. A door opens on the side. In order for a fish to reach the bait it must pass through the funnel out into the trap and then to the top. When once through the funnel it is very difficult for a fish to escape. The traps are set in various depths of water, in the lagoon, on the reef, and outside. Stones are fastened to the bottom to anchor them. Instead of a single buoy at the surface to mark the spot where set, pieces of wood about 7 inches long are attached to the buoy line about 5 or 6 feet apart. A string of these floats, reaching from the surface to the bottom, is attached to each trap. Why one large surface buoy is not used instead of so many small ones we were unable to learn.

The canoes observed on this island do not differ, except in a few minor points, from those of Tahiti and many of the islands in the Paumotu group. At the first glance it was quite evident that the style and finish had undergone a change from the original; they lacked many qualities found in canoes at isolated islands. One canoe measured 13 feet long, 13 inches wide at the gunwale, and 16 inches at the water line. The original shape of the log had been retained amidships, which accounts for the difference in width. Both bow and stern turned up, commencing at the water line and carried out almost to a point. A deck covered the forward part 2½ feet and on the after end 14 inches. There were mast steps both fore and aft; mast partners on the after side of crosspieces. Outrigger 6 feet from the side; outrigger float 12 feet long, 6 inches wide, and 4 inches thick, turned up at each end. Crosspieces of frame 7 feet apart and connected to the float by pins or stanchions, consisting of a tree branch, the butt ends wedged into holes cut in the float and the crosspieces seized to them. No brace of any kind to strengthen frame. As little work as possible seems to have been performed on the canoes of this island, and that in the most careless manner. This arises from the fact that whale boats have been in use here for many years.

NIUE OR SAVAGE ISLAND.

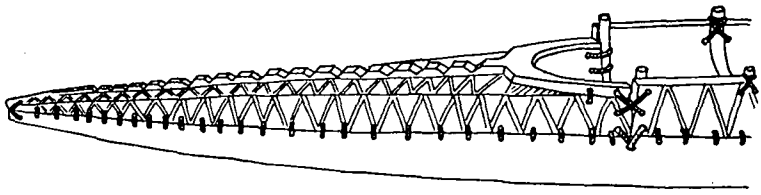
We arrived at this island November 25 and landed at Alofi village on the northwest side. There are ten other villages, two of which are considerably larger than Alofi. The total population of the island is about 4,000. We saw nothing to indicate that any great amount of fishing is carried on. There is no barrier reef to form a lagoon, and the fringing reef on this side of the island being narrow, the opportunities for extensive fishing are limited.

The only fishing apparatus observed was a net 60 feet long, 6 feet deep, with a 2-inch mesh. It could have been used either as a drag seine or gill net, but was probably put to the former use. The floats

were made of koa wood, 3 inches long, 1 inch in diameter, and 10 feet apart. On the foot line were fastened pieces of coral. The head and foot ropes are made of the usual cocoanut fiber, the webbing of some native material unknown to us.

In some respects the Niue canoe is different from any heretofore examined, particularly in ornamental display. It also has a crowning deck 8 feet forward and 7 feet aft. The main body is practically the same as found at many other islands; that is, the bottom is dug from a single log, the top is made of several pieces, and the two parts are joined together with cocoanut-fiber twine; pandanus leaf between the seams, covered with a white pitchy substance. On account of the scarcity of logs of suitable size the bottom is solid and the top is built up of strips.

At the place where we landed there were several canoes hauled high up on the bluff, there being no beach on this part of the island, and as the fringing reef is narrow it affords no protection. The canoes were covered with heavy matting and palm leaves to protect them from the



Sketch of Half Canoe, Savage Island.

sun. Seeing that we were interested in the canoes, the natives gave every opportunity to photograph and take measurements, and were apparently pleased that we were interested in things which they possessed. The large canoe measured 25 feet over all; decked over forward and aft, the deck hewn out of a solid piece, carved on the top and sides; width of canoe, 16 inches at the gunwales and 18 inches where the top and bottom join together; depth, 13 inches; outrigger float, 10 feet long, 5½ feet from the side; outrigger frame, consisting of 3 crosspieces 3 feet apart, fastened to the gunwales with coir sennit and connected to the float by stanchions 12 inches high. In the canoe under each crosspiece was a spreader, consisting of a withe bow bent in, the top or ends about an inch above the gunwales, the bow part raised from the bottom 7 inches. The bottom of the canoe being solid, no strengthening timbers were needed. Hanging to the outside gunwales was a single row of sea shells, all of one species and evenly matched as to size. There was nothing in this and other canoes examined to indicate that sails are used.

The people of this island do not seem to depend so much on fish as those living on atolls. Here the ground is more productive and furnishes food in abundance.

THE TONGA ISLANDS.

EUA.

Our next landing-place was Eua, a small island in the Tonga group, surrounded by a fringing reef and covered with a rich growth of vegetation. The eastern shore is very precipitous, with a number of small caves close to the water's edge, into which the sea rushes with great force. Many "blow holes" were observed in the old coral rock. In a few places small sandy beaches had formed immediately in the rear of the beach rock, but its ragged front would prevent any attempt at collecting with a seine.

The ship lay to off English Roads, and a party landed at Ohonua village, on the western side of the island, a place of about 300 inhabitants. We could find no suitable places on the reef for collecting with a seine. In a small stream on the outskirts of the village 14 mullet were caught in a Baird seine. Numerous snags in the stream prevented even a small seine being used to advantage. We followed up the stream for a half mile without finding any better seining-ground than at the mouth. By clearing out the bed of the stream fairly good results might possibly have been obtained.

While there were no canoes at the village or anywhere in the immediate surroundings, it is unlikely that these people are without them. There may have been a number away on some excursion at a distant part of the island.

Hauled up under cover, near the mouth of the stream, was a square-stern, straight-stem, clinker-built boat, sloop-rigged, 25 feet long and 9 feet wide, decked over and with a standing room or cockpit aft, and a 2 by 3 foot hatch forward leading into the hold. This boat had probably been purchased from some passing trader and used only in visiting neighboring or distant islands. It apparently had not been in the water for a long time.

The entire absence of nets or other apparatus led us to believe that but little fishing is carried on at this island, and as near as we could learn it is all done with spear. In the evening three men, carrying torches of cocoanut husks, were engaged in spearing fish on the reef.

TONGA TABU.

A visit of two days was made to Nukualofa, on the island of Tonga Tabu. Shore collecting was carried on at both stages of the tide. A platform makes off a long distance from the shore, and, like most reefs of its kind, exposed at low water, contains many pools in which are small fish. Compared to many other reefs of a similar character, a scarcity of fish and other animal life was found. At low water a collecting seine was taken to the reef and repeated trials were made in the pools, but with only negative results when used in the ordinary way. By using it in the manner of a trap, as was previously done at

other islands, a few fish were captured. Several species of crabs were taken with a dip net. It was impossible to haul a seine on any part of the reef visited. Spear, trap, and dip net are more useful and are used by the natives.

In front of the town, and for a number of miles on either side, is a long, narrow, sandy beach; this suddenly merges into the reef platform, and it is only when the tide is high that a seine can be hauled on any part of it. One afternoon was spent in fishing with seine along this beach. The principal part of the catch was mullet, and flounders were also taken in a number of hauls.

Hand-lines with various kinds of bait were over the side of the ship most of the time, but not even a bite was felt. A crab net was set and repeatedly hauled without results.

Four wire traps were set on the reef, two near a native trap, and two on the edge of the reef, in about 6 feet of water. They were down 24 hours and were visited three times, but nothing was taken in them.

A trammel net was set in 12 fathoms of water, remaining down 24 hours; no fish were found in it.

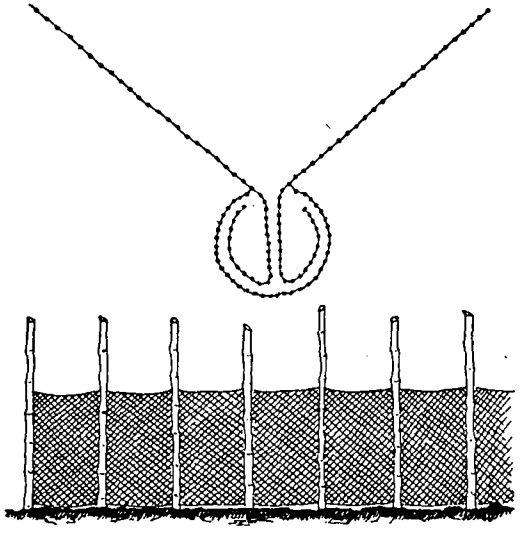
The natives of Nukualofa do not apply themselves very industriously to fishing, but are more given to raising fruit for the Australian and New Zealand markets, there being a line of steamers plying between those countries and Tonga. Since this line was established the natives have given less attention to fishing than formerly. The making of fine canoes and fishing apparatus is looked upon as of minor importance as compared to labor which will bring them a few dollars.

So far as we could learn, no fishermen are regularly engaged, except when the steamer arrives; then men and boys repair to the reef and capture enough for her wants; at other times the women and children do most of the fishing, supplying the immediate wants of the town.

Like most places in the South Seas, fishing here is to a considerable extent carried on in the night. Spearing is the principal method of capture, though hook-and-line fishing is at times performed. We saw none of the latter and very little of the former method. One evening a few men and boys gathered on the reef, the men with spears and the boys carrying torches. When the tide is high a canoe to hold the fish is generally towed along the beach by one or two boys. When the reef is bare, baskets made of palm leaves are carried on the backs of men, women, and boys to deposit the catch in. At high water fishermen confine themselves close to the beach, where mullet generally school in considerable numbers. At other times they travel over the reef, searching in all the pools for fish, jumping from one to another in bare feet over the sharp coral, ever on the alert for the slightest movement in the water. The light of the torches thrown suddenly into the pools or little channels will startle fish that may be at or near the surface, causing them to dart into holes or try to make their escape

through an outlet. It is then that the accuracy of aim is exhibited by the spearman.

On the outer edge of the reef was a native fish-trap, unlike all others noticed, and built of bamboo poles and wire netting. The stakes were 8 feet long and 3 feet apart, driven in the crevices in the coral. The wire was attached to the stakes 3 feet from the top. At high water the top of the wire was just awash; offshore lead, 200 feet; inshore lead, 150 feet. The trap proper was built somewhat in the shape of a heart, 60 feet in diameter. This was the only trap noticed. There may have been others elsewhere of different construction, for the reef covers a large area. Our work kept us within a few miles of the village, and only a small portion of the fishing-ground was explored.



Fish-trap, Nukualofa.

The canoes of Tonga do not materially differ from many of those noticed in the Paumotus. The natives of Tonga Tabu, like the people of many other islands, have been too long associated with civilization not to have lost a great deal of their ability as canoe-builders, and probably never again will the beautifully made canoes be seen among the islands of this group. Boats of every description are fast supplanting the dugout and all other forms of canoes.

One canoe was measured, which will answer as a type: Length, 17 feet; width, 14 inches; depth, 15 inches, dug from one piece of wood. A top rail 4 inches deep and 1 inch thick ran the whole length, and was seized on with the usual cocoanut-fiber thread. The holes through which the seizing passed were 4 inches apart, and on each side of the seam was a bamboo strip; no gum or pitch in the seam. At the water line the canoe was 2 inches wider than at the gunwales; very round on the sides and bottom. Stem straight, stern tapering nearly to a point. There were two thwarts, one forward, the other aft, and both nailed to the gunwales. The crosspieces forming the frame of the outrigger were 6 feet apart, and they were also nailed to the gunwale, the outer ends being fastened to the float by withes wound around pegs. The float of the outrigger was made of koa wood, 10 feet long, 4½ inches in diameter, and 3½ feet from the side.

NAMUKA.

This is a small island belonging to the Tonga group, about 58 miles north of Nukualofa. The *Albatross* arrived here December 2 and anchored 2 miles off the village. No collecting was done on Namuka, but a landing was made on an islet not far from our anchorage, where we found fairly good beaches for hauling a seine. A reef surrounds the islet, and between its inner edge and the shore is a level stretch covered with coral sand. It makes off from the shore quite steep for about 30 feet, then continues level fully 100 feet, terminating in a fringe of old coral, on the outside of which commences a growth of live coral.

Nine hauls were made with the seine along the beach. The result was a few half-beaks, crabs, a small flounder, and a variety of coral fishes. The water was exceptionally clear, which, in all cases, is against successful results. There was a scarcity of life on the reef and in consequence a very small collection was obtained. In a hut were four natives, they having come across from Namuka the evening before to fish on the reef. They had taken one fish, which they were eating at the time we met them. A number of small seines were hanging in the trees in front of the hut; they were machine-knit and require no special mention.

The canoes belonging to the natives were about the same as those we saw at Nukualofa, except that they were decked over forward and aft; the deck was made of tops and sides of boxes.

A wire trap was set on the reef, in which a hermit crab was taken. Hand lines over the ship's side caught nothing.

VAVAU.

A run of 110 miles in a north and easterly direction brought the *Albatross* to Vavau, the last island visited in the Tonga group, where we remained part of two days, anchored off Neiafu.

While Vavau in most parts is rugged and precipitous, with promontories projecting into the sea, yet in the harbor of Neiafu was found the best beach for seining since leaving Nukuhiva, Marquesas Islands. This beach lies about a mile from the village; it makes off to a point and is very smooth, being composed of fine coral, sand, and mud. In all other parts of the harbor within 3 or 4 miles of the village the shore is very steep, and in the few places where small beaches appear they are strewn with masses of broken coral.

It was stated that the natives do but little fishing in the harbor, the water being too deep. At one time dynamite was used in capturing fish. For a number of years its use has been prohibited, since which time fishing has been performed by simple methods.

On the beach above mentioned the seine took 350 fish in number, among which were half-beaks (two species), mullet, and many small fry;

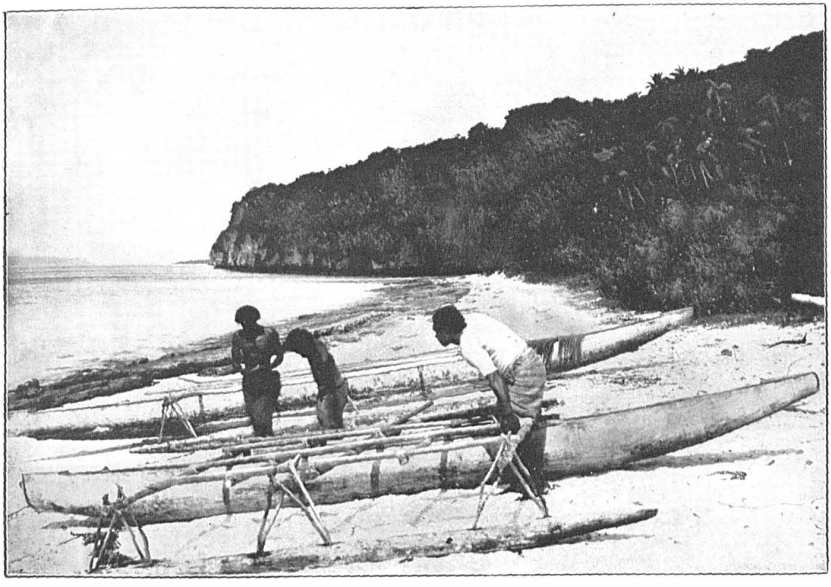
specimens of each kind were saved. Just back of the beach on a high bluff is a small village. As the seine was being hauled the natives came down to the beach to watch the operation. They seemed astonished that we should save fish for which they had no use. They would pick out certain kinds of fish, point to their mouths, shake their heads, as much to say that they were unfit to eat. A fish not fit to eat was, in their estimation, of no value. We were informed by a white man, who had a boat-building establishment at the foot of the bluff and on the upper side of the beach, that the people of this village do but little fishing.

A trammel net was set in 24 fathoms of water not far from the ship and close to the beach. Fish were abundant, but none was taken.

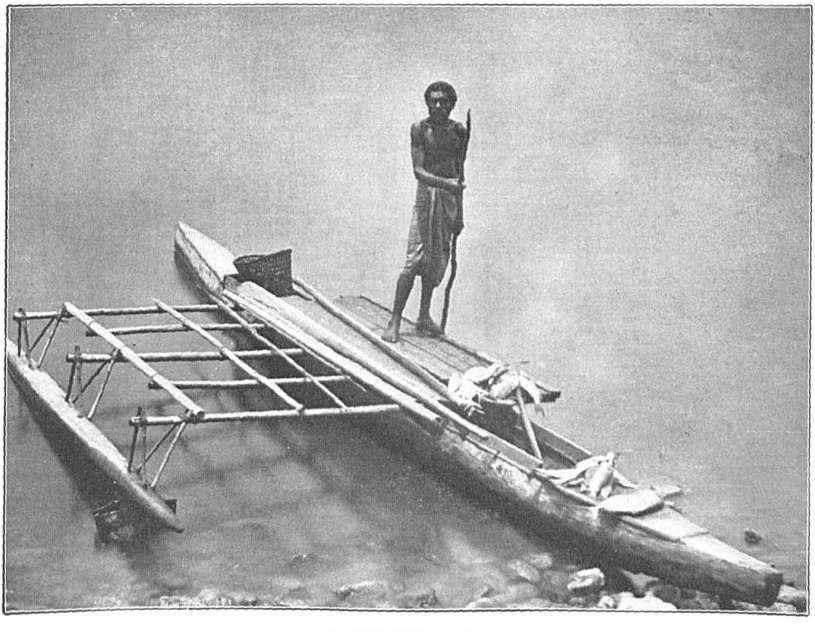
Just back of the village is a lagoon, in which the natives do most of their fishing. Its entrance is cut off from the harbor by a high bluff, around which the distance is about 7 miles. The beach in the lagoon is smooth and makes off from the shore a long distance, and so far as we could see is free from coral. A number of seines were hanging over poles to dry; they were cotton and machine-made. The people were all too busy trading with the ship's company to do any fishing, consequently we saw none of their methods in operation. If one could remain long enough at each island to witness the various occupations of the people many interesting facts could be learned.

A favorite way of fishing is for men, women, and children to turn out in a body, surround a school of fish in canoes, pushing before them long branches of cocoanut palms. The branches frighten the fish and cause them to crowd together; they are then easily driven into shallow water and kept there by continual working of the leaves. Quantities of poisonous berries are then thrown among the fish, which cause them to rise to the surface in a stupefied condition, when they are captured with spear and dip net.

The canoe of this island is practically the same as that of Tonga. It is said that about thirty years ago canoes ranging from 40 to 60 feet were common among the islands, but it is doubtful if there is now one in the entire Tonga group. Large canoes were built of many pieces, the logs being too small to produce one much over 20 feet in length. The cutter, schooner, and small sailboat, introduced about forty years ago, have taken the place of sailing canoes. The canoes of to-day are made with modern tools; those previous to the coming of the white man with native manufactured tools. The fact that a white man can build a cutter and several rowboats in the same time it takes a native to build a dugout has a tendency to discourage the latter from entering into competition, and, moreover, his association with civilization has not made him more energetic than he formerly was.



CANOE, KAMBARA.



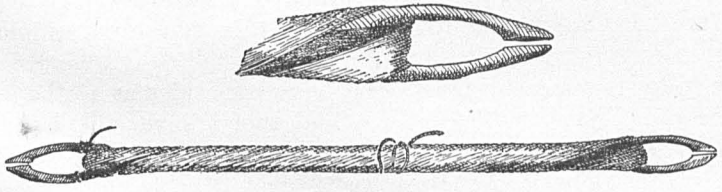
CANOE, SUVA, FIJI.

THE FIJI ISLANDS.

Kambara was the first island landed on in this group. It is small and somewhat isolated, and as a result its people have retained many of their old customs.

Fishing is carried on in the usual manner of natives, whose only object is to supply their immediate wants. Basket fish-traps, hook and line, spears, and seines are used. The reef extends off from the shore but a short distance. At low tide it is mostly bare, leaving the usual pools from which fish are captured with spear. The traps are the same kind as described on page 780. They are set in deep pools on the reef, and when the sea is smooth are placed in deep water on the outside of the reef. Stones are put in the bottom for ballast. We did not see any buoys used for marking the position of the traps.

On the village side of the island, the side on which we landed, the beach is not suitable for collecting with seine; but several attempts were made, meeting with poor success, tearing the net badly. The result was 1 flounder and 5 gar-fish.



Needle, Kambara, Fiji.

While we saw no beaches where seines could be used, yet no doubt there are places where they can be operated, for in walking through the village we came across several seines 40 to 50 feet in length and 6 to 9 feet deep. The mesh was small, averaging 2 inches. The seines were made of fine cotton twine and were hand-knit, with floats of koa wood, and small pieces of coral seized to the foot line. A bamboo mesh board is used, the same pattern as seen in all parts of the United States. The needle is like that used by Italian and other fishermen in the Mediterranean, and is also found in the Tonga group and Society Islands.

At Kambara, for the first time, we saw the double canoe of the South Pacific, but at a great disadvantage, it being hauled up on the beach and covered over with palm leaves. There were also on the beach several single dugout canoes, one of which was measured. It was 31 feet long, 2 feet wide at the gunwales, $2\frac{3}{4}$ feet at the turn of the bilge, and $2\frac{1}{4}$ feet deep; round-sided and quite flat on the bottom; bow quite sharp; straight stem; stern gradually tapering to almost a point. In digging out the canoe, raised portions of wood 2 inches wide and 1 inch deep had been left, forming clamp and bilge strakes. Body of

the canoe three-fourths of an inch thick. Outrigger float, 18 feet long and 15 inches square, turned up at each end and shaped like the bow of a boat. Distance of float from the side of canoe 7½ feet. The framework of the outrigger consisted of 5 crosspieces 3½ feet apart and projecting out by opposite gunwale 12 inches, fastened to pole running parallel with the canoe. The stanchions connecting the outer ends of the frame to the float were 15 inches high, and were made of tree branches cut to form a fork, the butt ends being inserted in the float, the crosspieces seized to the upper ends of the fork. The frame was braced with 4 poles. These canoes have no braces, ribs, or thwarts on the inside, neither do they carry a sail. In every part they are neatly made, much care having been taken to make them smooth.

In every detail the double canoe displayed fine workmanship, showing that the old style of canoe-making, at least on this island, is not lost. It would be quite difficult to describe a double canoe; there are so many parts connected with it and so peculiarly put together that almost any description given will convey little meaning unless accompanied by a series of photographs or sketches. Photographs should be taken from various points of view under sail. At this late date these are hard to obtain, for canoes of this type are seldom seen except in remote regions.

The following measurements may give some idea as to the general features of a Fijian double canoe. One canoe is invariably larger than the other, and the smaller is to the larger what an outrigger is to a single canoe. The larger canoe was 40 feet 9 inches long, 22 inches wide at the gunwales and 27 inches at the bilge. The other measured 37⅛ feet, 20½ inches wide at the gunwales and 23 inches at the turn of the bilge; depth of each 2 feet 5 inches. Each canoe was dug from a single log. They were 7⅛ feet apart, connected by what may be called a platform 16 feet long, 10 feet 10 inches wide, projecting out over the opposite gunwale of each canoe and raised up 12½ inches, the forward and after ends resting on thick pieces of wood neatly fitted in thwartships, which form a double bulkhead. Between the bulkheads on each side a heavy piece of wood was fitted to the gunwale, the whole forming a kind of coaming; similar fittings were on the small canoe.

The platform connecting the canoes was made of stout poles and seized to the coamings 15 inches apart. That part of the platform covering the large canoe was covered with planks 5 inches wide and 3 inches thick, and fastened to the poles by cross seizings of heavy cocoanut sennit. On the platform in the center of the large canoe was a thatched-roof house, one side of which was open. In it was a bunk large enough for two people. The house was 6¾ feet long, 4 feet wide, and on the front side 3 feet high, the roof sloping to the platform in the rear. On each end of the platform near the outside

edge was a hole 8 inches square, in which the steering paddle is placed. Again, on one side of the platform, over the hold of the canoe, was an opening 3 feet long by 18 inches wide, through which water is bailed.

The bow and stern of the main canoe differ considerably, the stern ending somewhat in the shape of a top, big end up, 7 inches deep and 5 inches across; the bow gracefully shaped, sharp and slightly turned up from where the water line begins. On the outside of each canoe, commencing at the break of the platform, 14 inches from the side, on

Small Sailing Canoe, Fiji.

a level with tne gunwale and joining at the bow and stern, was a pole rail, and on the platform above a protection rail 8 feet long and 2 feet high. On the top side of the platform was the mast step, carved out of a solid piece of wood, resembling the hub of a carriage wheel; the step was lashed to the heavy planking of the platform. The foot of the mast in these canoes is not placed in the step, but rests against it, first on one side and then on the other, according to which end of the canoe points to the wind. The head of the mast always leans

forward, and as the bow and stern alternate in position when working to windward, it necessitates the shifting of the mast each time the course is changed.

It is well known among seafaring men that the South Sea canoe does not tack in beating to windward in the same manner as a sail boat—that is, first presenting one side to the wind and then the other. With the canoe the same side is always to windward. In running before the wind great care has to be taken not to jibe the sail.

There were no sails or masts to be seen. The double canoe is steered with two paddles. Those that we saw were 13 feet long, the blades a little over 6 feet, made of hard wood, and very heavy.

At the village a double canoe, larger than the one just described, was in process of construction. It was 48 feet long, 2¾ feet wide on top, and 3¼ feet at the turn of the bilge, and 2¾ feet deep. That work had only recently ceased was indicated by the newly made chips lying about. Our appearance off the island had no doubt put a stop to any work that might have been going on at the time of our arrival. The body of the canoe was nearly completed, and heavy pieces of timber for the connecting framework were on the ground ready to be worked

Steering Paddle for Double Canoe, Kambara.

into shape. No tools were in sight, but the marks in the wood led us to believe that an adze and broad-ax had been used. Ridges of wood had been left inside of both of the canoes, representing clamp and bilge strakes. No trees were noticed on the island that at all corresponded with the size of the canoes. It was not learned where the timber came from for building.

SUVA, VITI LEVU ISLAND.

In the harbor of Suva a fairly good collection of fishes was obtained, mostly taken in seines. Three sizes of seines were used, namely, 15, 75, and 150 foot. In the afternoon and the evening of our arrival hand lines were kept over the side and were carefully tended, but with no success. Two wire traps, set close by, captured 2 fish, both of the same species. After dark the surface electric light was put over, which attracted a number of small fry, and several species were taken with a dip net.

The following day and during the time we lay at Suva hand lines of various sizes were employed in different localities with negative results. Wire fish-traps and crab nets were set in a number of places,

the former taking 4 fish (2 species) the latter nothing. A trammel net set in 12 fathoms of water, not far from our anchorage, was down three days; it was "under run" each morning, but failed to catch anything.

No great amount of shore collecting was done in the immediate vicinity of Suva. The seines were operated in a number of places near Suvavu, a small village 1½ miles from Suva, on the north side of the harbor. Hauls were also made at the mouths of Wai Lami and Wai Navasi rivers. These streams converge into one at their mouths, forming a shallow basin. At low water the basin nearly runs dry, except in the middle, where a small channel has been cut through the soft mud and sand by the current. On the banks of the streams and on either side of the basin along the shore it is impossible to haul a seine at high water, owing to the heavy growth of mangrove trees. These not only cover the beach proper, but in many places extend some 30 or 40 yards below the beach line. Fully 100 yards from the shore the bottom is smooth. Beyond this point commences the reef, upon which numerous patches of coral appear, which extend offshore some 1,500 feet and at low tide are just submerged beneath the surface. It was found that the seine could be used to the best advantage at half tide, as it was then free from the coral below and the mangrove trees above.

A short distance to the westward of the above-mentioned streams, and directly in front of Half Cast Village, is a short beach, where several good hauls were made. Altogether 500 fish were caught here and off the mouths of the streams, among which were many mullet. About a dozen species were secured.

Our success was largely due to the condition of the water, which at most times was roily, caused by the seine stirring up the sand and muddy deposit. In places of this kind it is quite an easy matter to catch fish, and an extended stay in this locality would no doubt result in a collection above the average.

The natives of Suva do not seem to be energetic fishermen. During the time the *Albatross* remained in the harbor we saw no fishing going on. On a number of occasions, however, several parties were observed taking fish from a trap. Judging from the number of traps which were located in different parts of the harbor it would seem that fishing with hook and line, spear, or other apparatus is not carried on to any great extent.

Suva is a town of considerable importance, having a line of steamers touching regularly at different islands in the group, and the large steamers employed between Sydney and Melbourne call here at frequent intervals, creating a demand for native labor. It is therefore natural that at times an occupation like fishing should be abandoned for work more profitable.

The formation of the harbor and the many small streams emptying into it, together with the long flat reefs bordering the shore line, makes a desirable place for traps, and the work of tending them is slight as compared to chasing fish with spear and dragging with seine. Thirty-odd traps were counted, scattered along the shore for a distance of about 2 miles. These traps must capture more than enough fish to supply the town and surrounding villages. No regular markets are maintained.

The traps examined were of the same shape as the one described at Nukualofa, except that on the side of the pocket is a smaller one 8 feet in diameter, from which the fish are taken. The traps are made of bamboo poles and palm leaves, the poles driven into the sand and dead coral 4 to 5 feet apart, the average height 6 feet. The palm leaves reach within 6 inches of the top; average diameter of pocket 30 feet; the leads vary in length from 150 to 300 feet.

The cost of a trap of this kind is within the reach of every native who has a shore privilege.

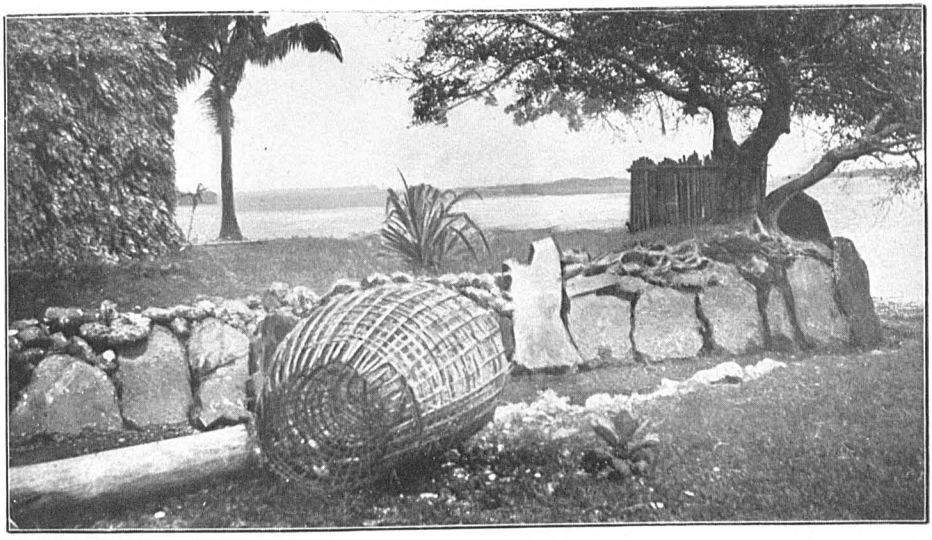
At Vavau we were informed that when we reached Suva we would be apt to see many of the large sailing canoes, but only small paddling canoes, such as are employed about the harbor peddling fruit, fish, etc., were seen.

The large canoe of early days seems to have been supplanted by the English cutter. Those used here average from 40 to 50 feet in length, 10 to 12 feet beam, deep draft, and cost from $400 to $600. They carry a large spread of canvas, mainsail, fore-staysail, jib, and club-topsail. They are easy to handle, sail well, are seaworthy, and carry considerable cargo. The natives living on the large islands of the group were quick to see the superior qualities of the cutter, which for cruising among the islands is as serviceable as the canoe and in many respects superior.

If there be many large canoes in the Fijis they are no doubt confined to the outlying islands like Kambara, where little communication with the main islands is carried on. While the cutter possesses qualities not found in the canoe, yet, on the other hand, there is something about the latter that appeals even to the white man; their barbaric beauty, unique and original design, harmonize so perfectly with the surroundings and people that it is a pity they are passing away. To visit the Fiji Islands without seeing the big sailing canoe, manned by natives in their picturesque dress, is as unromantic as to visit Venice and find the steam launch substituted for gondolas.

The single dugout canoe of Suva does not materially differ in general build from many seen at other islands, except that in the center they are platformed over, the platform being 7 to 10 feet long and 5 to 7 feet wide, projecting out over each side from 12 to 18 inches. The platform is used for stowing things upon, such as fruit, vegetables, fish, etc. On no occasion did we observe anything stowed in the

FISHING TRAP NET, CLOSING IN ON SCHOOL OF FISH WITH SHORT DRAG SEINES, FIJI ISLANDS.



FISH TRAP, MBAU, FIJI ISLANDS.

FIJI CANOE, HUT, AND NATIVE.

bottom. It is evident that this type of canoe is not used much outside of the harbor; but it is well adapted to carrying light freight from point to point along the shore and peddling among the vessels in the harbor. There are no particular points of good workmanship in these canoes; nails, wire, bits of string, and rope are freely used in fastening the outrigger frame together. Some canoes have three and others four crosspieces to the outrigger frame; the majority have four.

At Suvavu several canoes were hauled up on the beach. The largest was 30 feet long, 14 inches wide, and 14 inches deep, and straight-sided; the bow and stern the same shape—very sharp, straight on the bottom fore and aft, turning up quickly at either end. Some were made of two pieces; this one was made from one piece. The bow and stern were decked over, and in the middle portion was a kind of a washboard, 10 feet long and 4 inches high, which joins to the deck. The platform and outrigger frame were attached to the washboard. The platform was 8½ feet long by 3½ feet wide; there was an open space on one end for bailing out the canoe. The platform and washboard were made of boards which evidently had been picked up on the beach. The outrigger float was 12 feet long, pointed on the ends; distance from the side of the canoe 7 feet. Stanchions connecting float to the outrigger frame were made of withes 12 inches high and four attached to each crosspiece.

The natives of Suva do not propel their canoes in the same manner that most natives do. Instead of sitting or squatting down, using the paddle at the side, these people stand up and scull. The paddle is placed in one of the holes of the framework at the side of the canoe and the sculling is performed in a manner directly opposite to the way a white man sculls. The Fijian style is to face toward the bow with handle of the paddle in front of him, it resting against the after side of the crosspiece. The result is the same as in the ordinary way of sculling except that there seems to be less power exhibited. The paddle is kept perpendicular in the water, which gives it less leverage than if held at a slant. Two or three men can scull at the same time.

We saw no canoes fitted with masts and sails, but were informed that small sail canoes are frequently seen in the harbor.

Natives living in the interior of the island bring their products to market down river in what may be termed freight rafts, made of bamboo poles lashed together in the shape of a double canoe. Each bunch of poles is about 40 feet long and 4 to 5 feet in diameter in the center, tapering at the ends. The bunches are placed side by side a few feet apart, and connected by a bridge of the same material; on this bridge is a platform housed over in a manner somewhat similar to a native hut on shore, top and sides thatched. Under this cover are the living quarters. This style of canoe is frequently seen at the wharves at Suva.

THE ELLICE ISLANDS.

Leaving the Fiji Islands the *Albatross* proceeded to Funafuti, an atoll in the Ellice group, arriving off the pass at Funafuti on the morning of December 23, and anchoring later in the day off Fongafale village, about 8 miles from the mouth of the pass. The village and general surroundings of the atoll resemble that of Fakarava in the Paumotus. In front of the village is a long beach where seines were dragged each day. In all the trials about 1,400 fish were caught, among which were some 16 or 18 species. The beach is smooth for about 100 feet below high-water mark; from this point, for 200 feet or more, the bottom is very rough, being covered with a growth of live coral; from here on into comparatively deep water the bottom presents a smooth, sandy appearance. Where the fish were most plentiful it was found impossible to haul the seine. We found this to be the case at most places in the South Seas.

Only 2 fish were caught with hand lines from the ship. A crab net and several wire fish-traps were baited and set on the reef until the morning of our departure. Each time they were visited many fish were seen around them, but nothing was taken.

On Christmas an excursion was made to an island 6 miles from the village, four natives accompanying the party as pilots. Several long trials were made with hand lines on favorite "spots" known to the natives. The catch amounted to 11 fish, 4 species, all of which were saved. The native fishermen used the same kind of fishing gear that we did. Instead of baiting the hooks in the usual manner, they seized it to the shank, in the manner of the Alaskan Indians.

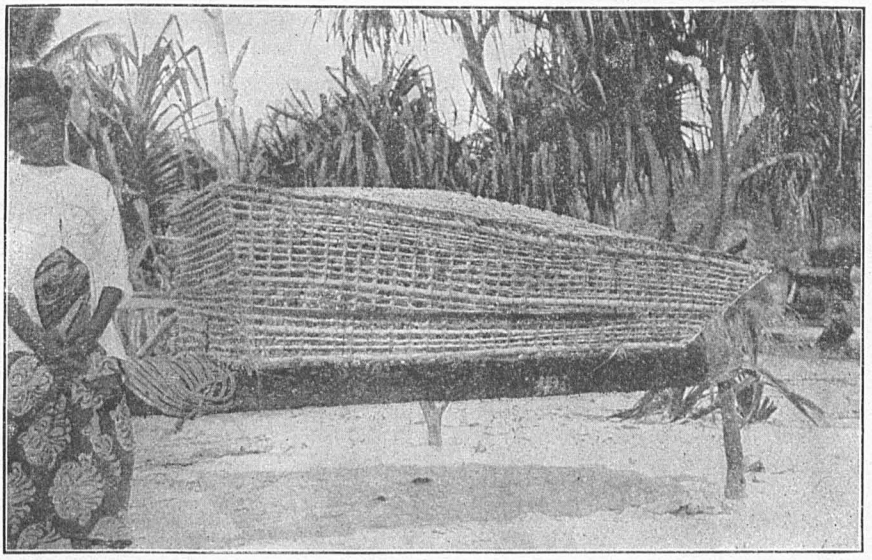
By the aid of the electric surface light displayed over the ship's side a number of small fishes were taken.

Small drag seines are used, knit of cotton twine, like those observed at Kambara. The manufacture of small seines from native material seems to have been wholly abandoned, it being easier to procure net twine from passing vessels than to make the original article from cocoanut husks and pandanus leaves. Large seines, made of coarse, heavy material (cocoanut-fiber twine), are used in capturing turtle. These seines vary in length from 60 to 100 feet; depth, 9 to 12 feet; mesh, 5½ inches. Turtle in this region are not numerous, but appear periodically and are a delicacy much sought after.

In hand-line fishing common steel hooks are generally used, but when they are not to be had the native hook is resorted to. American and English hooks are much preferred. Hooks and lines were given to the men who accompanied us on the fishing excursion, and they seemed to greatly appreciate the gift. There being no trader on the island, hooks, lines, and useful articles are not always easy to obtain. Steamers and small trading vessels sometimes call here, supplying the people with such articles as they may need.

The spear is used in capturing fish on the reefs. Its pole is 8 to 10 feet long, to which is fastened a single iron prong with a barb at the extreme end. Wooden spears have long since been discarded.

Wickerwork fish-traps are set on the reef near the village and on distant fishing-grounds among the islands forming the atoll. These traps are made in a sort of network fashion, the openings 2¼ inches long by three-fourths inch wide. Size of trap, 60 inches long on top by 50 inches on bottom; front end slanting considerably, back end slightly. Front end 38 inches wide and 12 inches deep; depth measured on the slant. Rear end 35 inches wide and 19 inches deep. Mouth of funnel or lead 11½ inches across by 8½ inches deep, carrying its size inside for about a foot, then gradually tapering, ending almost in a point. As the open-



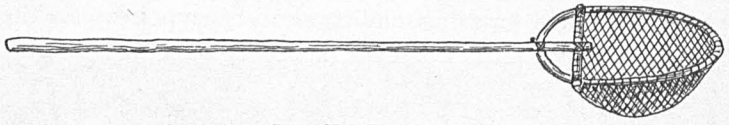
Fish-trap, Funafuti.

ing is at the extreme end and on the underneath side, there is very little chance of a fish making its escape when once in the trap. A pole runs lengthwise through the top part of the trap, from which the inner end of the lead is suspended. In the rear end is the door from which the fish are taken. Traps are baited with fish hung near the end of the lead, the bait being plainly seen from the outside. They are set in depths of 5 to 20 fathoms, and at distances from the village varying from 2 to 10 miles. They are not lifted for several days.

Coral reefs and shoals are numerous off the islands in the lagoon and on the rim of the atoll; to these the natives repair for hand-line fishing. Flying-fish, in their season, appear in considerable numbers; also gar-fish and bonito. Unfortunately we saw no fishing by the natives, except as previously mentioned. Torching for flying-fish is one of the favorite sports. The fish are attracted to the canoes by the

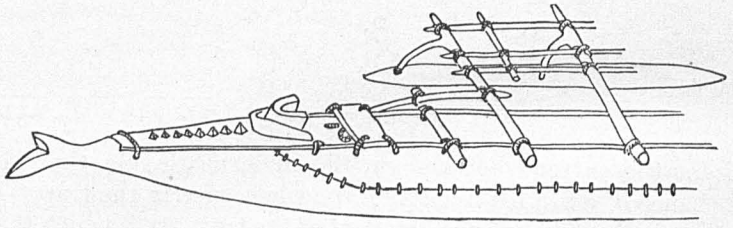
light, and scooped up in long-handled dip nets. The nets are oblong in shape, nearly the same pattern as those observed at Tahiti.

The dugout prevails in the Ellice Group, and is unchanged in most respects from many which have been described, but in ornamentation and small details a considerable difference is noticed. This canoe is 27 feet long, 17 inches wide, and 21 inches deep, with a kind of deck forward and aft 45 inches long. Each deck is made from a single piece of wood, and on the after one the top is serrated, supposably to represent the teeth of a sperm whale. The stern is formed like the tail of a fish. The bow is free from embellishment of any kind.



Scoop Net, Funafuti.

Just forward of the row of notches the deck is raised at an angle of 6 inches, forming a sort of break $1\frac{1}{2}$ inches high. On top of the break is carved a ball, with a groove in the upper part. In the groove the fishing pole is placed, the butt thrust into a becket attached to the under side of the thwart. This is the only thwart in the canoe and is used chiefly by the person engaged in fishing. There are three braces, however, which may be used to sit on when paddling. The canoe is straight-sided, also quite straight on the bottom, with an easy turn at the bow and stern. Three crosspieces connect with outrigger float; the float is $11\frac{3}{4}$ feet long and $5\frac{1}{2}$ inches in diameter. The crosspieces and

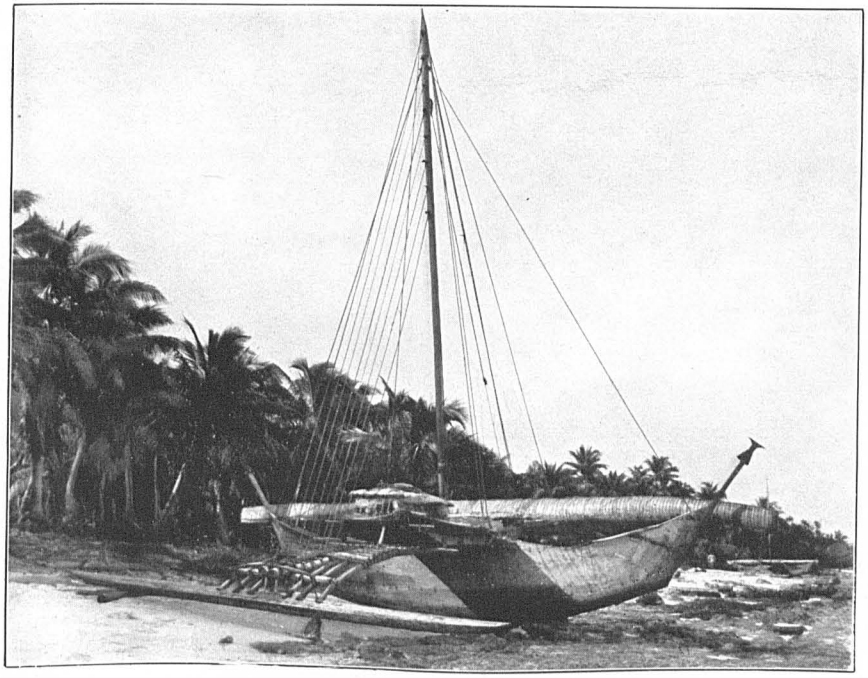


Sketch showing Stern of Funafuti Canoe.

stanchions are formed out of one piece. Heretofore, in all the canoes examined, the float was attached to the outrigger frame directly under the ends of the crosspieces; in this one the stanchions project outboard at an angle, and are fastened to the float by means of pegs and sennit. Flat, narrow strips of cocoanut wood run parallel to the gunwale and are fastened to top side of the crosspieces, on which are carried spears, fishing poles, paddles, etc.

The style of paddle does not need description. The bailer is shaped like a common flour scoop. None of the canoes was rigged for sailing.

CANOE FUNAFUT.



SAILING CANOE, RONGELAB. (See page 806.)

THE GILBERT ISLANDS.

While coasting off the south shore of Arorai Island, we saw a large gathering of people on the edge of the reef fishing with hook and line. The lines were attached to long poles. Stormy weather prevailed and the sea was breaking against and sweeping in over the reef. We were of the opinion that the condition of the weather and roughness of the sea were the means of bringing in fish that do not approach the reef in milder weather. We learned that this was the case among many of the islands. The ship lay too far offshore to see the size of fish which were caught.

In the course of half an hour a canoe was launched through the breakers and came off to the ship; shortly after another one came off. Each made several attempts before succeeding in getting clear of the reef.

The canoes were entirely different from any of those we had seen. We had suddenly left the region of the dugout and entered that of the built-up canoe. In shape they somewhat resembled the sea-otter boat of Alaska. Their estimated length was 22 feet; width, 4 feet; depth, 20 inches; material cocoanut wood. Each had 7 sets of timbers; keel about 5 inches wide, planking 4 to 6 inches wide without butts, that is, each plank running unbroken from stem to stern and fastened to the stem and stern posts with cocoanut fiber thread. The edges of the planks were fastened together in the same manner.

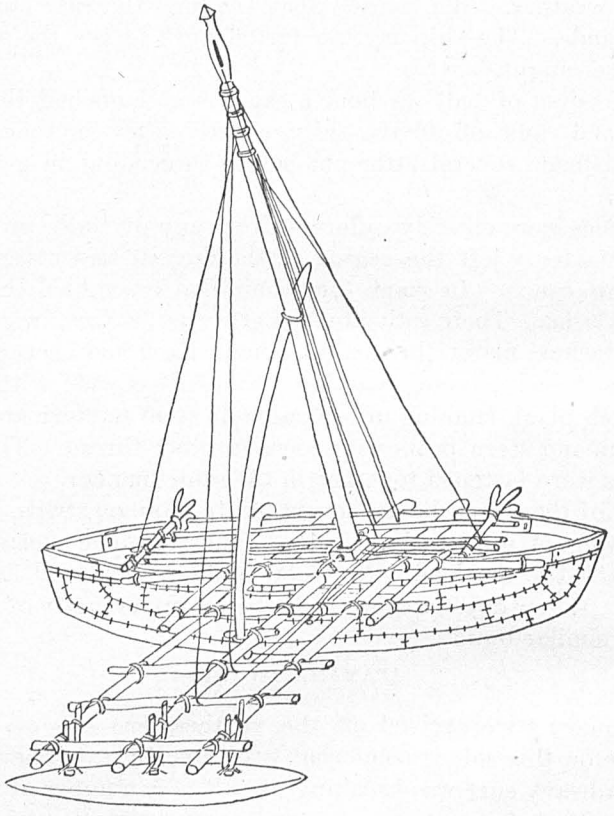
Instead of the seams being covered with bamboo strips, they had a thick coating of gum on both sides. The stem and stern post were neatly scarfed to the keel. No metal could be observed in their construction. A few days later we had a better opportunity of examining canoes of similar build.

APAMAMA ISLAND.

On January 1 we arrived off the northeastern side of Apamama. The shore on this side is somewhat protected by a barrier reef. At the time a heavy surf was breaking over it. A number of small bays and indentations fringe the upper beach, a few almost cutting through the rim of the atoll into the lagoon. On a small isthmus formed by one of these cuts is a village; in front of it is a sea wall built of blocks of coral rock. On the lagoon side of the island, about a third of a mile from where we landed, is another village. There were only old people and children at home, the rest of the inhabitants having gone on a visit to a distant island in the lagoon. Each house seemed to have a water privilege, and all along the beach were net-drying racks.

The canoes of Apamama are built in the manner of a boat. A frame is gotten out and put together in the usual way. The timbers are round, consisting of heavy withes bent to the desired shape.

The length of the average canoe is 15½ feet; width, 20 inches; depth, 2 feet; very sharp on the bottom, the sides rising almost V-shape; bow and stern are alike. Outrigger 7½ feet from the side; outrigger-float 8 feet long, 7 inches wide, turned up and pointed at each end. The framework of the outrigger consists of three crosspieces of cocoanut wood. Seized to the crosspieces at right angles are four braces at nearly equal distances apart. Under the crosspieces, near the gunwale, is a brace three-fourths of an inch in diameter, extending fore and aft

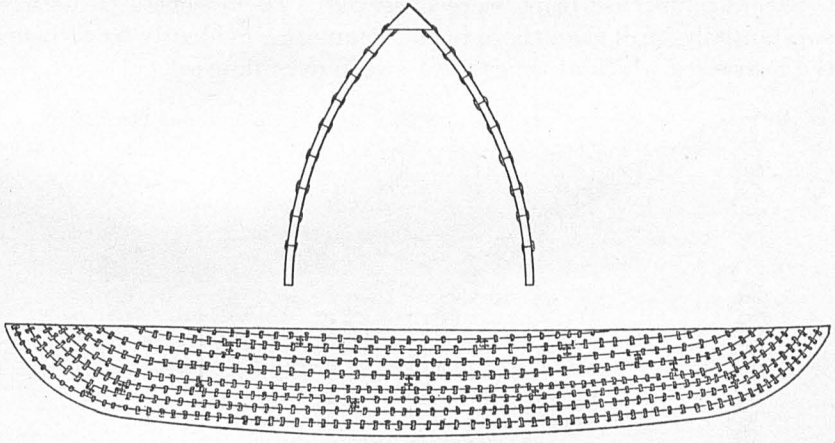


Canoe, Apamama and Tarawa.

to within 3 feet of the bow and about the same distance from the stern, the ends fastened to the gunwale and the middle portion to the crosspieces. On the frame of the outrigger, between the gunwales, are several strips seized lengthwise. These act as an additional brace and also take the place of thwarts. The stanchions connecting the ends of outrigger frame to the float consist of forks of tree branches, the single part fitted into holes in the float. On the outer end of the outrigger is temporarily fitted a notched stick in which the fishing pole is placed. This is quite necessary, as the poles are 12 to 15 feet long and heavy.

When hand lines are used, either in trolling or for bottom fish, they are hauled over the forks of the outside braces. The sketch shows these and also the arrangement of frame, braces, and other parts referred to.

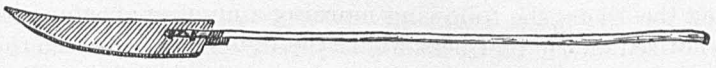
It will be noticed that the mast is not stepped in the bottom of the canoe, but on top of the middle crosspiece of outrigger frame. The step consists of a thick piece of board, 3 by 4 inches, hollowed out in the center in which the foot of the mast is placed. In the bow and stern there is another step, half the size of the former, against which the tack end of the boom is placed. We could not learn whether cotton or mat sails are used. In addition to the shrouds and stays which keep the mast in place there is a heavy wooden support, the lower end fastened out-board to the middle crosspiece, the upper end halfway up the mast.



Sketch of Canoe showing Style of Planking, Apamama.

This canoe is planked in a peculiar manner. Instead of the ends of the planking being fitted to the stem and stern post, as is ordinarily the case, the garboard strake continued along the keel and up the stem and stern. The second strake follows in the same way, and so on, each succeeding row of planking being shorter than the one preceding it.

The canoe proper does not compare in strength with the outrigger frame, mast, braces, etc. The plank is only one-half inch thick, and is considerably weakened by the numerous holes in the edge, through



Apamama Canoe Paddle.

which the seizings are put in binding the plank together. A canoe of this build is not equal to the dugout for landing through the surf on a rough beach. This was clearly illustrated by the number of broken

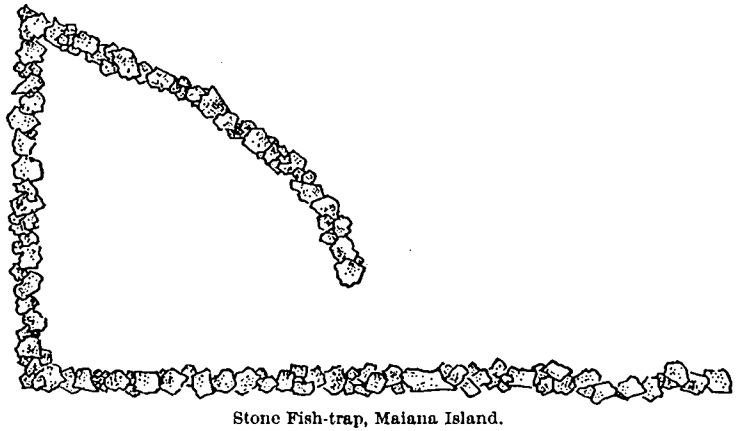
canoes lying on the beach and triced up in trees. When a canoe is damaged so that it can not be repaired, the pieces are saved and used in building a new one.

The paddle resembles a spoon oar. The bailer is made of one piece of wood, and is very narrow to fit the bottom of the canoe; handle on the outside like a dory scoop.

MAIANA ISLAND.

After leaving Apamama the ship skirted the eastern shore of Maiana Island. From our view the beach inside the fringing reef appeared to be steep. A few huts could be seen, half concealed by cocoanut palms, and some of the natives were along the beach fishing with rod and line.

Several stone fish-traps were observed. They seemed to be more substantially built than those in the Paumotus, evidently to withstand the heavy sea which at times must sweep over the reef.



Stone Fish-trap, Maiana Island.

TARAWA OR KNOX ISLAND.

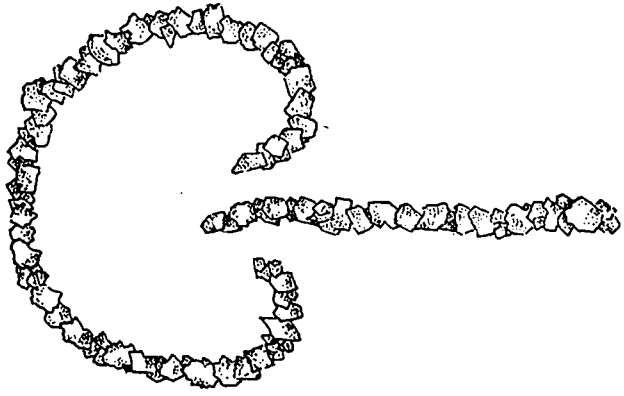
In the evening of the same day (January 2) the ship lay off the south side of Tarawa. Quite a quantity of surface life was attracted around the ship by the electric light.

The reef on this side of the island makes offshore a considerable distance. Late in the evening many lights were seen moving on the reef, about 2 miles distant, indicating that natives were fishing. On leaving the island the following morning a number of stone fish-traps were noticed on the reef near where the lights had been seen the night before. In shape these traps resemble a palm-leaf fan. We judged them to be about 4 feet high and fully 3 feet thick; the lead was estimated to be 75 or 80 feet, and the diameter of trap about 50 feet. The shape of these traps differs greatly from those observed at Maiana Island, only a few miles distant. The same style of canoe, however, is found at both islands.

APAIANG AND MARAKI ISLANDS.

In the evening of January 3 the *Albatross* lay to off the southern shore of Apaiang. The surface light attracted numerous forms of minute life. The next morning, as the ship steamed on her way northward, we saw at a distance what looked like a double canoe. Later in the day we reached Maraki Island and steamed along its south and east side. We did not land, but had a good opportunity of viewing the shore line and fringing reef. On the reef were many pools and small channels leading from one to the other.

Near the outer edge of the reef are outcroppings of old coral, in many places forming barricades between the pools. Some of the walls thrown up formed natural fish-traps, in some of which men, women, and children were fishing. In a dozen or more places along the beach,



Stone Fish-trap, Tarawa Island.

wood and cocoanut husks were piled up, presumably for lighting at night to attract fish to the beach. Scattered over the reef was a considerable number of fish-traps similar to those seen at Tarawa.

In the afternoon a party landed on the west side of Maraki. The upper beach on this side of the island is sandy, but immediately below are many bowlders of old coral rock, making it difficult to land, unless the sea is smooth.

There is no great difference in the canoes of this island from those of Apamama and Tarawa except that the bottom of the canoe here is dug out of a solid piece of cocoanut wood and is round. The planking is the same kind and thickness as the Apamama canoe and put on in a similar manner, only there is a less number of strakes.

TARI-TARI.

This island was approached from the east side. On the south and east side the rim of the atoll is cut through in several places, forming small islets. The channels between the islets are bare at low water,

but at high tide in stormy weather the sea must pour into the lagoon with great force. Outside the channels is a fringing reef platform on which are many pools. We subsequently learned that this reef is one of the favorite fishing-places on this side of the atoll.

The ship came to anchor in the lagoon off Butaritari, a village of considerable importance in this region. In the evening collecting was performed by the aid of the electric surface light. Besides a large quantity of crustacea we captured a considerable number of vertebrates. Two bonitos were caught on hook and line.

The following day a seaman of the *Albatross* accompanied Mr. Palmer, a merchant of the village, and several natives to one of the outer reefs to fish with dynamite. It is unlawful for a native to use explosives in taking fish unless in company with a white man. The seaman brought back between 40 or 50 small fish and 11 larger ones, varying from 6 to 12 inches in length. Twelve varieties were taken, and samples of each were placed in alcohol. Hand-line fishing and the use of wire traps and crab nets proved a failure.

The people of this group have always been credited with being the best fishermen and using the greatest variety of fishing apparatus of any natives in the South Seas. We unfortunately found but little fishing gear of any kind. Two wickerwork fish-traps, nearly the same pattern as those seen at Funafuti, were purchased.

We were informed that the scarcity of native fishing apparatus among these people is due largely to traders, there being many stationed in various parts of the atoll, who discourage native manufacture and lead the people to either forget how or not care to make any article which may be substituted at the store by something inferior in quality but sold for a high price.

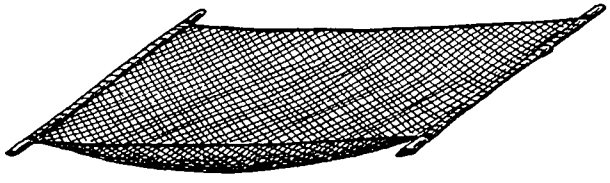
The canoes of Tari-Tari differ in some respects from those of Apamama and Tarawa. They are more nearly like the canoe of Maraki; that is, the bottom is one solid piece of wood, and the sides and top are planked. Two canoes were being built in the village, a departure from the original type, flat on the bottom and made of 1½-inch boards. The first strake was also boards and flaring outward like a dory. This type is comparatively new in canoe-making and was probably introduced by the traders. Above the garboard strake the planking is put on in the manner of the Apamama canoe. A canoe of this kind is much better adapted to landing on a rough beach or reef than one with a fragile bottom.

In a village a few miles from Butaritari were a number of canoes that had been given a coat of coal tar.

THE MARSHALL ISLANDS.

We arrived off the southeast coast of Jaluit Island January 9. This part of the island is low, with but a scant growth of cocoanut palms; pandanus trees and a thick growth of underbrush reach as far as the beach. The ship entered the lagoon through the southeast pass and anchored off Jaluit, situated on Jaluit Atoll.

All the beaches on this part of the atoll are very rough and make off with a gradual descent. Seines over 15 or 20 feet in length can not be hauled on them. In front of the village is an accumulation of sand, but in most places north and south, immediately below high-water mark, the shore is covered with sharp coral and coral slabs. The reef is about 600 feet wide. Outside the lagoon, opposite the village and for a couple of miles south, the reef is narrower. Above the reef the beach is high, composed of a banked-up mass of broken coral rock thrown up by the sea. Lower down, some 30 feet from the line of



Hand Net, Jaluit.

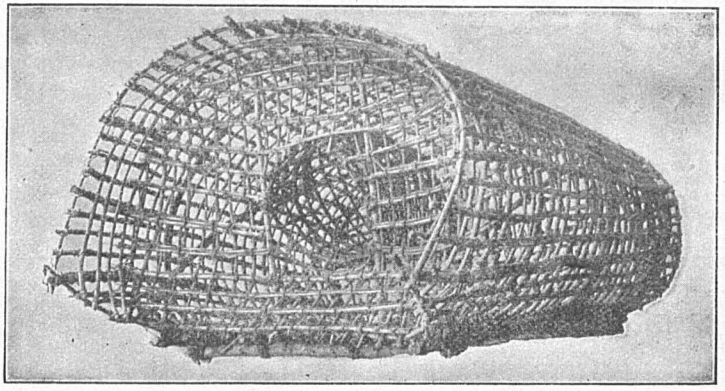
String of Cocoanut Leaves used with Hand Net.

vegetation, the reef platform commences and makes off quite level. This reef is the principal fishing-ground in the vicinity of the village. Most of the fish consumed by these people are taken on reefs situated some 8 miles north of the pass. We were informed that there is a prolific ground at a small islet in the lagoon 4½ miles from the village. During our stay here the people went on no fishing excursions.

Hand lines from over the ship's side took 7 fish in number, 5 species. On a submerged reef near the ship the wire fish-traps caught 5 fish, 3 species. The crab net and hand lines had no success. Fish were plentiful about the ship, but could not be induced to take the hook. A trammel net set 24 hours in 12 fathoms of water had in it 2 sharks and a small coral-fish. One end of the net caught on the bottom and was badly torn.

Several trials were made with a collecting seine on a beach adjacent to the village; altogether a half bushel of small fry was taken. In a pool on the reef about a mile farther south 19 species were captured by barricading the pool. No attempt was made to haul the seine.

Fish are chiefly taken by spear, net, and trap. The net is neither a drag seine nor a gill net. Attached to poles, a piece of cotton webbing, 8 by 4 feet, is used as a barricade and scoop, in conjunction with a string of cocoanut leaves. Four men repair to the reef, two carrying the net and the other two the string of leaves. The leaves are about a foot long, split into shreds, one end fastened to a sennit rope about 60 feet long. In the water the leaves swing back and forth like seaweed attached to a rock. A school or a number of fish being seen, the men carrying the string separate and endeavor to get between the fish and the outer edge of the reef. This being accomplished, they draw together and at the same time approach the men holding the net, dropping the fringe-work of leaves behind them. The object is to drive the fish toward the men with the net, they frequently shifting their position according to the way the fish move, either to the right or left. Fish once inclosed in the circle of leaves will not attempt to pass under

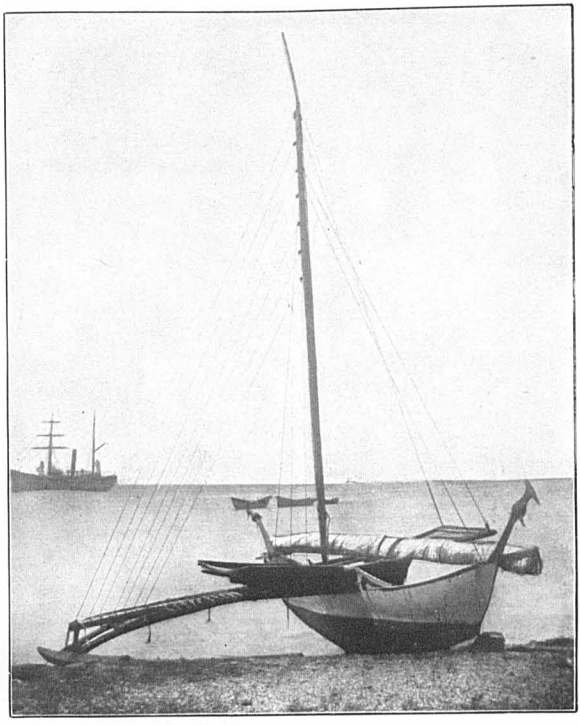


Fish-trap, Jaluit.

it. The circle is gradually made smaller and smaller by drawing the string together. At last the fish are forced over the net and lifted up in it, taken out and placed in baskets. Repeated hauls are made, and frequently a distance of 2 or 3 miles is covered in a single tide.

The original spear of bone has given way to one of iron.

Another simple device for catching fish is with a braided rope of cocoanut leaves 10 to 12 feet long. These ropes are operated at high water on the beach in the lagoon near the village, men, women, and children taking part. In the evening, when the tide serves right, a dozen or more people may be seen sitting on the beach attentively watching for signs of fish to appear. Not until the school is within a few feet of the beach is any attempt made to secure it, at which time the natives rush into the water, surround the school, and frighten it to the beach by pushing the leaves through the water. In this way the fish are crowded to the shore and thrown on the beach with dip-nets, several people being stationed at the water's edge for that purpose.

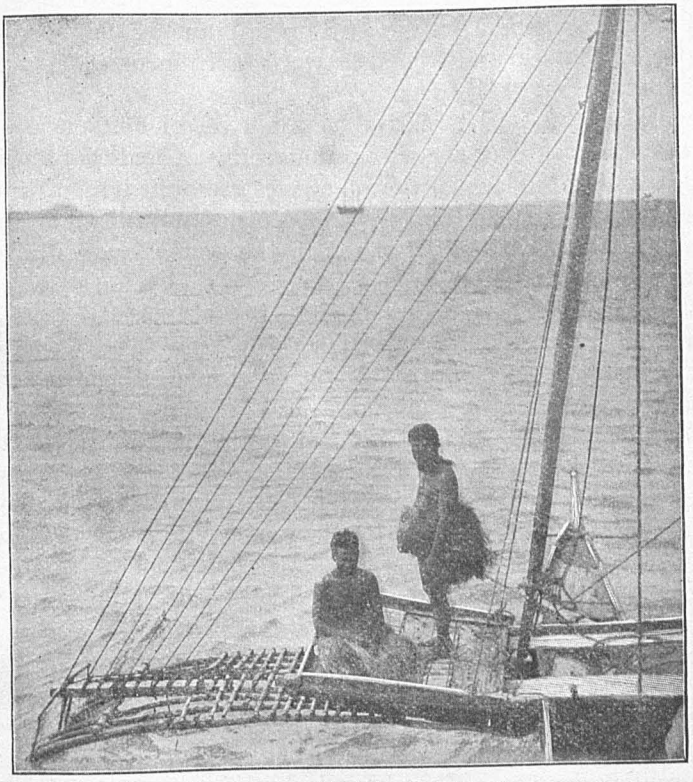


MARSHALL ISLAND CANOE ON BEACH.

MARSHALL ISLAND CANOE UNDER SAIL.

Fish are daily caught in this manner; it would seem easy for them to make their escape, but such is not the case.

Fishing with wickerwork fish-traps is quite extensively carried on. The traps are made of pliable withes and put together with cocoanut thread. They vary little in size and none in shape. The average size is 31 inches long, 30 inches wide, and 20 inches deep; the front end is concaved 5½ inches; door in rear 5½ by 7 inches; the mouth of the lead is 9 inches in diameter, 2½ feet long, and shaped like a powderhorn, the concave side next to the bottom of the trap. About a foot of the lead



Sailing Canoe, Jaluit, Marshall Islands.

on the underneath side is open. Traps are set in deep places on the edge of the reef and in channels. There are few places in the lagoon, any considerable distance from the shore, the fish from which are considered fit to eat. We were told by our native pilot that poisonous fish were plentiful in all parts of the lagoon and that no fish should be eaten before being examined by some of the people on shore.

At Jaluit we found a sailing and paddling canoe of an entirely new style, and made principally of bread-fruit wood. They are constructed more on the order of a vessel than any previously examined. The planking is heavy, varying in thickness from 2 to 3 inches. The largest

tree on the island would be too small to make a dugout shaped like these. The largest canoe now found in the Marshall Islands is said to be much smaller than many of those built before the advent of the white man, when canoes 60 and 70 feet long are said to have been common, and long distances were traveled in them, many families taking passage. Canoes of such size have long since been supplanted by schooners ranging from 20 to 40 tons. The schooners are for the most part owned by the chiefs and kings, as the common people are not able to accumulate in a lifetime a sufficient amount of money to purchase one.

Land tenure, or feudal system, still prevails among these people. It was reported that several kings have a yearly income of $5,000, all derived from copra.

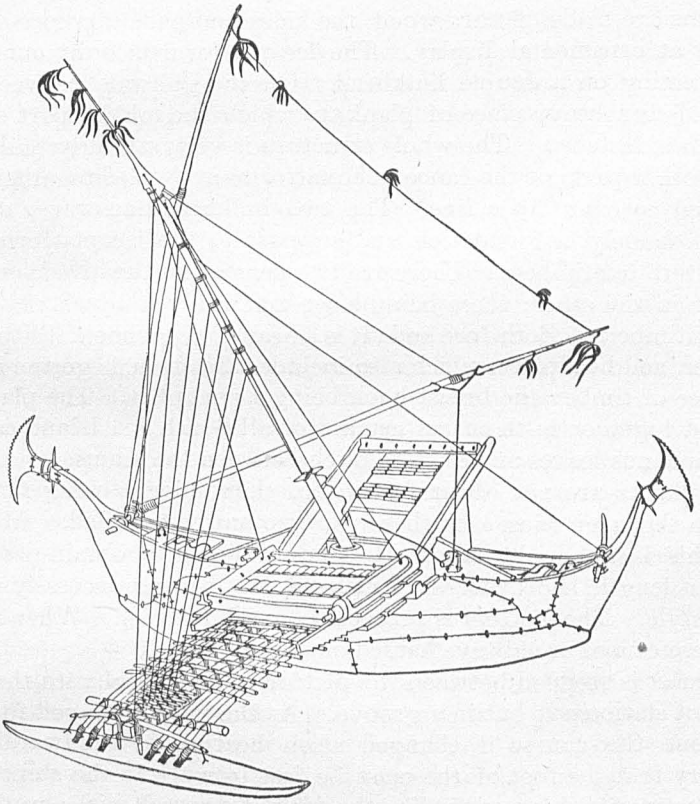
In several of the islands native boat and vessel builders are doing good work, their skill in canoe-building being of material aid in constructing a vessel. Many of the schooners are built in San Francisco.

At the village were four large sailing canoes and fully a dozen small ones. We seldom saw a small canoe in the water, and only on two occasions were the large ones afloat, and one of these times it was at our request. Although these people have long been associated with white men, the shape, build, and rig of the primitive canoe have been retained to a remarkable degree, more than at most places where civilizing influences have existed for the same length of time.

The Marshall Island canoe is too complicated in its construction to attempt a full description of all its parts; the sketch here given will be more comprehensive than a written description. It may be well, however, to give a brief account of the manner in which they are put together. Heretofore the canoes that have come under our notice have been more or less symmetrical—that is, both sides alike, but in this canoe we find one side larger than the other, the outrigger side being more rounding and fuller than the lee side. To illustrate, if a line be drawn from the center of stem and stern, it will be found that there is a difference of several inches between the two sides, the outrigger side always the larger. Whether the canoe be large or small, it is built in this peculiar manner. The object in building the lee side with so much more dead-rise than the weather side is on account of its presenting a flat and nearly perpendicular surface to the water, which acts in the same manner as a centerboard.

The sailing canoes were all about one size, not varying over a foot in length and a few inches in width. The dimensions of the one we measured were as follows: Length, 20¾ feet over all, and 17¾ feet on the water-line; width, 30 inches; depth, 31½ inches; draught, 27 inches, greatest in the center, rocker keel. The outrigger float was of hard wood, 17½ feet long, 10¾ inches wide, and 9 inches thick, and round on the bottom. If a section of the float should be cut off, it would represent an inverted top. The float is well proportioned, very straight

on the bottom lengthwise, and slightly turned up at each end. Length of outrigger frame, 11¼ feet; width, 46 inches, composed of eight pieces, two centerpieces, 3 inches square, forming a kind of backbone. The side pieces fasten directly to the float, forming a slight curve at the ends. The center frames project out from the side on a level. The bend in the side pieces is formed by a cross piece thrust under the center frames, and the side pieces seized to it. On top of the middle frames, near the outer ends, is a strong withe nearly 5 feet long, with



Sketch of Marshall Island Canoe.

the ends drawn down and fastened with sennit to the top of the float. The holes in the top of the float are mortised out from each side, leaving over the holes solid wood 3 inches long by 2 inches deep, around which the sennit is passed in seizing the ends of the cross pieces to the float. Near the outer end of the center frame are seven short pieces, to which the shrouds are fastened. Arranged inside of these, extending all the way across the frame, are eight other pieces, which give considerable support to the structure and are used for fastening things upon.

Commencing at the weather side of the mast and projecting out by the gunwale 2½ feet, and securely fastened to gunwale and outrigger frame, is a raised platform, used for seats and also for stowing articles on. In a moderate breeze the occupants of the canoe, except the man steering and the one who tends the sail, seat themselves on the platform; as the wind increases in force they move farther out on the outrigger frame, acting as shifting ballast. On the lee side is another platform, larger than the first, used for the same purpose, care being taken, however, to have the weights evenly distributed. Both of the platforms are made of hard wood, the sides and ends carved, with an attempt at ornamental display. The lee platform is built out at an angle, resting on a double bulkhead. On the gunwale between the bulkheads is a heavy piece of plank, to which the middle part of the platform is fastened. The whole structure is very strongly built and, like all other parts of the canoe, the platforms are seized together with the usual cocoanut-fiber line. The two bulkheads answer a double purpose, namely, a foundation and support to the lee platform, and a substitute for timbers. There are two permanent thwarts in one end and one in the other; these being large and heavy, they also take the place of timbers. Both fore and aft is a heavy breast-hook. The bow, cutwater, and headpiece, which also includes the stern, is gotten out of one piece of timber, the breast-hook being a part of it. The planking is seized together in the usual manner of all South Sea Island canoes, with pandanus leaves and a white pitch between the seams.

The planks are not of uniform size, short pieces being fitted in between the large ones, as if there were no more to be had. In many cases this is no doubt true. It being difficult to obtain wood of sufficient length, short pieces are utilized, this being a necessity rather than a style. The bottom is protected by a false keel. When not in use, these canoes are always hauled out on the beach.

The mast is stepped between the platforms on a level with the gunwale, not stationary, but in a groove. As the mast is stayed forward each time the course is changed when beating to windward, it is necessary that the foot of the mast be free to work in the step. The gunwales are fitted somewhat like the deck of a vessel, with a waterway 4½ inches wide, and above what may be called a rail, 2⅜ inches high, all cut from one piece of wood. Considerable cargo can be carried in the hold, but it must consist of material that will not be injured by getting wet, for in a choppy sea considerable water is taken aboard.

The sail is made of strips of matting sewed together, in shape very much like the sail of the Italian fishing felucca of San Francisco and the Mediterranean, except that it has a boom. The mast is 23 feet long and 3½ inches in diameter at the step, carrying its size all the way up. The masthead and topmast is made of one piece, of much harder wood than the mast, scarfed on and neatly seized. There are no blocks.

The halyards are rove through holes in the head of the mast. The wood being very hard, the holes become very smooth. The gaff is 24 feet long and 2¾ inches in diameter in the middle, tapering to 2 inches at the ends; boom the same length as the gaff, but heavier. It is oval-shaped, the sail bent to the narrow edge.

The mast is supported by seven shrouds, all on the weather or outrigger side, one leading from the masthead and the others arranged equal distances apart below it and fastened to the outrigger frame. Besides the shrouds are two masthead stays made fast to pins at the bow and stern. The pins are also used for fastening the tack of the sail. The stays are temporarily made fast, one being slacked up and the other hauled taut each time a tack is made. This admits of the masthead being hauled forward. The halliards, a single part, is made fast to a cleat 2½ feet above the foot of the mast. The sheet is also a single part made fast to a bridle on the boom, and the hauling part to a cleat on the weather side of the gunwale just abaft the platform. We were told that cotton sails have been tried, but were too heavy and hold too much wind. The mat sails are lighter and more porous, allowing a portion of the wind to pass through them. This is very essential, particularly when a strong breeze is blowing accompanied by occasional squalls. At such times the sail has to be handled quickly, and as there are no reef points or any means of reefing the sail in the ordinary way, it is triced up by means of a spiller. This brings the weight of the boom and sail near the masthead, and in the case of a cotton sail being used it would make the canoe top-heavy. The spiller consists of a line made fast to the boom in the center of the sheet bridle, passing up the lee side of the sail through a hole in the masthead a little above where the halliards reeve; thence to the forward side of the weather platform, where it is made fast. There are two of these spillers, but only one is used at a time. The second one is on the opposite side of the sail, also rove through the masthead and the end fastened to the other side of the weather platform. By this means there is always a spiller on the lee side of the sail ready for use.

Ordinarily three men are required to sail a canoe—one to steer, one to tend the tack of the sail, and the other stationed at the spilling line. When a squall strikes or a sudden gust of wind comes up, the boom is lifted by pulling on the spiller. This immediately decreases the sail area as much or as little as may be desired, regulated according to the strength of the wind. The force of the wind having passed, the spilling line is slacked away and the boom and sail drop dropped down. If the breeze be steady, but too strong to carry all sail, the boom is hauled up, reducing the sail to the required area that can be carried.

When running free, or with the wind abeam, there is little difficulty in handling a canoe of this rig. In beating to windward, however, more or less complications are likely to arise, such as getting the sail

aback or the boom getting adrift, either of which might cause considerable disaster in a stiff breeze. Should the sail get aback in a strong wind, the mast would go over the weather side, there being no shrouds or stays on the lee side to prevent it.

As previously stated, an outrigger canoe in beating to windward does not come in stays and go about on the other tack, and it may be interesting to some to know how windward work is performed with the wind always blowing against the same side. This is done by the bow and stern changing places, as it were, in such a manner to permit first one end and then the other to point to windward. When a tack is to be made, or we might say a hitch made to windward, the sheet is eased off and the tack lashing on the lower end of the gaff removed, at the same time slacking up the forward masthead stay and hauling taut on the after one, until the masthead falls forward on a line with the stern. The tack of the sail is now swung aft, always on the lee side of the mast. As the tack is carried aft the bow swings off, and what was formerly the stern now becomes the bow, which now points to windward. The tack is lashed to the pin at the bow, the sheet hauled in, and the canoe is on her course, having made little or no leeway, the time occupied being not over half a minute. While a canoe can not be put about as quickly as a sailboat, yet the quickness with which everything is performed is remarkable considering the number of things to be done.

The steering is done with a paddle 10 feet long; near the upper part of the blade is attached a lanyard, half the length of the canoe, the end of which is made fast under the lee platform. When all is ready for tacking, the man steering drops the paddle overboard and stands by to receive the tack of the sail as it is swung to him. Having secured it in position he hauls taut the mast stay, sees that the spilling line is clear and ready for use, and then takes the part of a lookout. In the meantime the other man has hauled in the sheet, made it fast, picked up the paddle which was floated aft, and becomes steersman. Thus they alternate in positions.

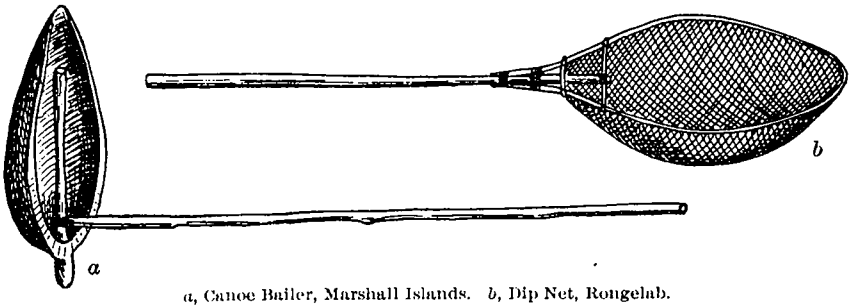
At times considerable water is taken in, and as the canoe is deep it necessitates a long-handled bailer, which is similar to the one noticed at Nukutavake, with a stick lashed to the handle for lowering it into the bottom of the canoe and hauling the water up.

Considerable care is taken of the sails, as they last but a short time if not protected from the weather. When the canoe is not under way the sail is lowered, neatly furled, and covered with mats, the mats made to fit the sail. When a shower comes up while making a passage, the sail is lowered and furled and the canoe is allowed to drift until the rain passes over.

On the morning of January 14 the *Albatross* steamed out of the lagoon through the pass on the south and west side of the island. The

rim of the atoll is very open here and there are many cuts where the sea enters at high water. Many bonito and flying-fish were schooling off the cuts and along the fringing reef. On the following morning we arrived off the southern end of Elmore or Odia Atoll. Skirting along the shore to the westward, we saw no huts or other signs of habitation until we approached a narrow cut leading into the lagoon; here five people were fishing with dip nets and spears. The fringing reef on this side of the atoll is very narrow, as are the beaches. We frequently ran into schools of flying-fish.

Late in the afternoon we arrived off Namu Atoll, approaching it from the south side. The beaches are narrow, with considerable rock scattered over the ground. The rim of the atoll is broken into many islets. Near the edge of the reef were numerous fish jumping. Two natives were fishing with hand lines from a canoe and several more people were fishing on the reef. A mile or so away smoke was seen



a, Canoe Bailer, Marshall Islands. b, Dip Net, Rongelab.

rising from among the palm trees, indicating the presence of a village. Shortly after we ran into an immense flock of birds feeding on crustacea or small fish. Bonito in considerable numbers were about, evidently feeding on the same material.

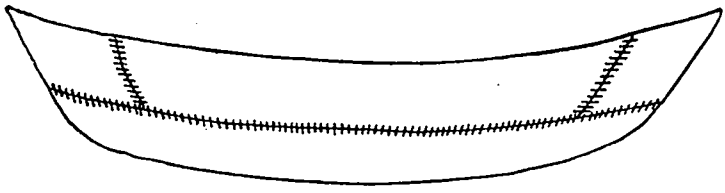
RONGELAB ATOLL.

In the afternoon of January 17 the ship entered the lagoon of Rongelab Atoll and came to anchor off the village on Rongelappelap Island, one of the most northern atolls in the Ralick Chain, 380 miles from Jaluit. In the immediate vicinity of the village there are no seining beaches. About a third of a mile to the eastward there is a small, smooth beach, and near the entrance to the pass there is another which covers a considerable stretch of ground. At all other places as viewed from the ship the shore presents a very rough appearance. We observed no reefs or pools such as are found at most atolls.

In the evening hand lines were put over the ship's side in 25 fathoms of water; character of bottom very rough. Sharks were plentiful, carrying away most of the hooks and sinkers. Two fish were caught. The surface electric light attracted a few small forms of animal life.

There was a scarcity of fishing apparatus to be found at Rongelab. We saw no wicker-work fish-traps in the village or stone traps about the island. Shell fish-hooks, 3 dip nets, and 2 small pieces of net were observed, the net the size of those used at Jaluit in connection with the string of cocoanut leaves. Probably these were used in the same manner. The dip net used by these people is 3½ feet long, 13 inches wide in the center, and tapering toward the outer end and at the handle. The handle is 6 feet long and 2 inches in diameter; size of mesh in net 2 inches. The bow is cut from two pieces of wood, flaring out at the top edge, forming a thin lip turned outward. The outer part of the bow is jointed together and seized; the inner ends are fastened to the handle by two neatly-worked grommets. The handle extends into the body of the net 14 inches, and across the end of the handle is a spreader or brace.

Three sailing canoes were hauled up on the beach and, like those of Jaluit, they were well protected from the weather. They were found to be the same build and rig as the Jaluit canoe, excepting that on the



Showing Build of Rongelab Canoe.

weather platform there is a bunk house 6 feet long, 4½ feet wide, and 2½ feet high; frame made of withes and covered with coarse matting of pandanus leaves. This apartment is occupied by women and children, when they are on board; at other times by the men.

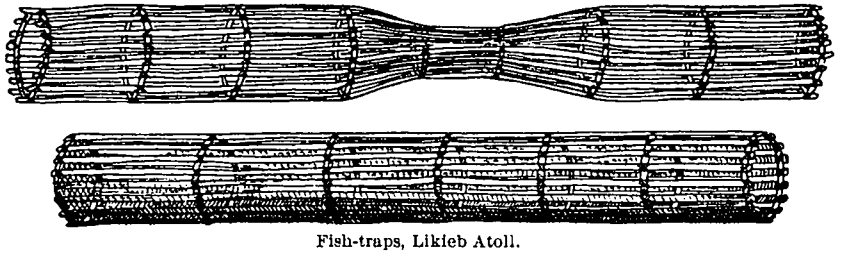
While the small canoes are of the same type as the large, they are invariably made of fewer pieces, always five; at least all those we saw were made of that number; the bow, stern, and bottom are dug out of one piece. Unlike the small canoes of Jaluit, these carry a sail. The mast is unshipped each time the sail is taken in, and is handled in the manner of a spritsail. Instead of from five to seven shrouds, as the large canoes have, there is only one, set up with a toggle at the outer end of the outrigger frame.

LIKIEB ATOLL.

On the morning of January 18 the *Albatross* left Rongelab Atoll. When off South Pass many flying-fish and bonito were observed. On the morning of the 20th we arrived off the southwest end of Likieb Atoll, about 135 miles from Rongelab. This atoll belongs to the Ratack Chain, which lies to the eastward of the Ralick Chain and parallel to each other, both comprised in the Marshall Archipelago.

A mile or so from the shore the beach has the appearance of being perfectly smooth, but on nearer approach a fringing reef covered with old coral comes into view. Near a narrow cut on the west end of the beach is a long wall of upheaved beach rock, and across the mouth of the cut are scattering bowlders; immediately on the inside of the cut the bottom is quite smooth. We subsequently learned this to be one of the native fishing-grounds. The beach above the reef on either side of the cut is composed of very white sand, and makes off with a gentle slope; the reef also makes off quite level.

South and east of Mat Island is a chain of islets, with submerged reefs between. The islets vary in size and shape, each one encircled by a sandy beach. A few of the reefs, or broken parts of the atoll rim lying between the islets, are out of water; at high tide and when the sea is running high they are awash. Further to the south the reefs are covered with small bowlders and patches of live coral. Two islets inside the lagoon afford the only places in this vicinity where collecting with a seine might be carried on with success.



Fish-traps, Likieb Atoll.

There are no seining-beaches near the village, the entire shore being covered with fine coral. At a point some little distance to the northward is a sandy beach where collecting may be done at high water. Just below low-water mark a profusion of coral heads appear. Our time being limited, we did no shore collecting.

In the evening the usual number of hand lines were put over the ship's side, and a crab net and fish-traps were set, but without results. A few gar-fish, shrimp, and a number of small fry, which had the appearance of young sardines, were attracted by the surface light and taken in dip nets. Some 20 feet below the light were some large fish, but they would approach no nearer.

The fish-traps are constructed on the order of a fyke net and similar to the salmon stream traps used by the Indians of southeast Alaska. They are cylinder-shaped, 8 to 12 feet long, and 10 inches in diameter, and are much less complicated than those seen by us elsewhere, consisting merely of a number of wooden hoops set 12 to 14 inches apart, having withes and bamboo strips seized on the outside; spaces between the strips, 2 inches. Some of the traps have one end larger than the other. The lower or bottom end is covered with a piece of webbing,

easily put on or removed. This style of trap is used in narrow cuts and channels, or in other places where fish may be driven.

Traps are placed near the entrance of channels and narrow cuts, or in rock pools on the reef. When fish are seen near the mouth of a channel, a trap is placed in it and there is an effort made to drive the fish into the channel. In many instances this proves a success. By forcing the fish into the narrow passage, more or less of them must necessarily enter the trap. The trap is then taken out, the contents are emptied upon the beach, and a lookout is kept for another school. The morning or evening is the most favorable time for taking fish in this manner.

Hook-and-line fishing is also carried on in the morning or in the evening just before dark. Rods are generally used, the fishermen standing on the coral rock, casting out into deep water. American and English hooks are preferred to their own make. In trolling in the passage or outside the lagoon for bonito or other fish a steel hook is used in connection with the pearl-shell hook, the native hook being fastened above. The bright color of the shell hook attracts the fish, at which he bites. If he escapes, he is generally caught by the other.

In capturing fish of all kinds on the reef, spears made of common rod iron and fish-hooks straightened out are used. Turtle are taken at all seasons, mostly on and around isolated islands. Flying-fish are most abundant from January to May. They are caught at night, being attracted to the canoes by torches and scooped up in dip nets, all of the canoes of the village engaging in the fishery.

At Likieb we found the same style of sailing canoe as at Rongelab and Jaluit. The small canoes, however, differ slightly; some are fitted with sails, while others of equal size are wholly propelled by paddles. There is not the noticeable difference between the lee and weather side of these canoes as compared to those at other islands in the Marshall Island group. Neither is the same style of top plan strictly adhered to. Some changes also have been made in the bottom; the change has come about gradually, covering a period of about fifteen years. The following are the dimensions of one of the old-type canoes: Length over all, 13 feet 2 inches; 7½ inches from the gunwale to the water line, and 16½ inches from water line to keel, making a depth of 24 inches; width, 15 inches; very sharp on the bottom, with the weather side slightly rounded out. Outrigger float, 8½ feet long, 7 inches wide, and 6½ inches thick. The outrigger frame is made up of 5 crosspieces, with a backbone of 2 larger pieces, the light ones being fastened to the weather gunwale, the heavy pieces to both gunwales. On the outrigger side there is a platform 24 inches square and on the lee side one 22 inches square, both raised 2½ inches above the gunwale.

The other canoe, which is a departure from the old style, is flat on the bottom and is deep in proportion to the width. Although flat

on the bottom, it would not remain upright on the water without the outrigger. The float is the same as on the large canoes. The outrigger frame is a rude affair, made of two strips of joist nailed together. The canoe itself is made of logs in the usual manner and fastened with cocoanut fiber. Forward and aft of the outrigger frame is a half-deck. This leaves an opening on either side of the crosspieces to stand in when paddling. A canoe of this kind was just finished and ready to put in the water, with the following dimensions: Length, 15 feet; width, 17 inches; 1 foot wide 2 feet from the bow and the same width 2 feet 7 inches from the stern; waterways all the way round, 4 inches wide, except where joining to the solid part of the bow and stern—at these points it narrows to 2 inches; outrigger float, 13 feet long, 9½ inches wide, and 8 inches thick; distance from the side, 7¼ feet; the outrigger frame consists of two pieces of joist.

A canoe was being constructed out of boards on the plan of a dory, with an outrigger like the one just described. The old method of canoe-building is being abandoned gradually, and in a few years the large sailing canoe, and also the small ones, will have disappeared.

At this late day no very long passages are made in canoes; formerly, before the introduction of sailboats and schooners, canoes of large size were common. Inquiring into the merits of the sailing canoe as compared to the average sailboat of equal length, we were informed that a canoe in windward work, when the sea is choppy, is not equal to a fast-sailing boat, but with a beam wind and running before it she is superior. In beating to windward the canoe is somewhat handicapped by the large amount of water she takes in, and in a rough sea almost constant bailing is required. While the canoe possesses fairly good seagoing qualities, white people living in the islands claim that it falls short of the average boat for all-round work. Formerly many canoes were lost in making passages to distant islands.

A Portuguese from a whaling ship landed on this island about forty years ago and shortly after married a native woman and became a trader. With him was the beginning of a change in affairs pertaining to the island. We were informed by him that a number of years ago Capt. Charles Foster, of Oakland, Cal., built a 40-ton schooner here, and among those whom he had to help him were the two sons of the Portuguese trader. From Captain Foster they learned much about shipbuilding, and soon began building boats and schooners for themselves. That they have progressed wonderfully is clearly shown in the schooners and boats launched from their yard, which compare favorably with many of those built in California and brought here to sell.

The shipyard is on the beach at the village. It is sheltered from the rain and heat by a high roof. Tools of all kinds, such as used in a shipyard, were lying about, and some of the most improved make.

The sailboats built here vary in length from 22 to 35 feet, equally divided between the square and sharp stern. A schooner of about 12 tons, recently launched, lay at anchor in the lagoon. On being asked the cost of such a schooner ready for sea, the builder stated that if a chief should purchase her the price would be $1,000, but that any other person could purchase her for considerably less. Nearly all of the chiefs in these islands are wealthy and the other natives correspondingly poor, hence the two prices. Even the poorest person among the natives aspires to have a small schooner.

The knees and timbers for vessels and boats are cut on an island on the western side of the lagoon. The wood is called "kauoe," and looks like black walnut. With age it becomes very hard, and is said to be as durable as oak. The wood used in other parts—such as plank, spars, booms, gaffs, etc.—is shipped from New Zealand.

WOTJE ATOLL.

Just before dark, January 21, the *Albatross* entered Rurick Pass, Wotje Atoll, and came to anchor in the lagoon in 25 fathoms of water. Here the surface light attracted but a small amount of life. Hand-line fishing was a failure. The rim of the atoll here is nearly submerged, there being but few places where the sea breaks in ordinary weather; but the submerged part of the rim could be plainly seen, reflecting a pale greenish color along the middle, intermingled with bluish tints at the edges, which, combined with an occasional comber, breaking and splashing its white foam in streaks over the surface, made a strong combination of colors. The main channel could be distinguished by its water being the same color as the sea outside.

The following day we entered the passage on the southern side of the atoll, steamed across the lagoon, and anchored off the village. The inhabitants number about 200, and seem to have had little communication with the outside world. The beaches are smooth high up, near the margin of the palm trees, but rough a short distance below. No seining was done; neither were any fish seen near the shore except two sharks about 200 yards from the beach.

The canoes at this island did not differ noticeably from those at Jaluit and Rongelab. Two styles of fish-traps are used—the one described at Jaluit and that mentioned at Likieb, the latter being the more common. One cylinder trap was 14 feet long. The man who owned it was not inclined to part with it at any price. No spears, nets, or other fishing apparatus were found in the village.

In the evening a considerable amount of minute surface life was collected and 3 specimens of coral-fish. Among the other fishes attracted by the light and captured were half-beaks and a species resembling young herring. Several natives, returning from a fishing trip, came on board with 2 craw-fish, which were purchased and placed in alcohol.

ARHNO ATOLL.

Early in the afternoon of January 24 we entered Dodo Passage, 160 miles from our last anchorage, steamed along the shore of the lagoon, and came to anchor off Terranova village.

Hand-line fishing from the ship was not very successful, and fishing with traps was a complete failure. The surface light was the means of attracting coral-fishes, young octopus, a small eel, several species of small fry, a number of annelids, and various forms of crustacea.

For several miles each side of the village the reef on the lagoon side is very rough and jagged, and several trials with a seine proved a failure. At extreme high tide it is possible to use a seine to some advantage, provided the fish come close inshore; otherwise nothing can be accomplished with this apparatus. In subsequent trials with a 15-foot seine over the same ground we came across a small sandy spot, in a bend partially hidden by coral bowlders, where 15 mullet and 2 bonito were taken. On the outside reef, in the rear of the village, we found a mass of coral slabs, forming a sea wall all along the beach, protecting the cocoanut and pandanus trees from the surf. Just below the wall is a strip of sandy beach 25 or 30 feet wide, suddenly merging into a smooth, level platform, on which we found many pools. The platform averages 300 feet in width, upon which the sea breaks heavily, sweeping over it at a depth of a foot or more, filling the pools and churning the water into foam. Many fish were seen darting in every direction. At another time we visited the reef when the tide was out. A heavy sea was breaking against its outer edge, sweeping part way up the platform. Fish were plentiful, but owing to the clearness of the water the seine failed to capture any, although a small collection was made with a dip net in the pools farther up. No natives were fishing at the time. We were informed that the short square net and rope of cocoanut leaves were employed and that hours were frequently spent without taking a single fish. At other times large numbers are captured in a few trials. Much depends on the state of the tide and the force and direction of the wind. Under these circumstances we were not surprised at the smallness of our catch.

Late in the afternoon of the same day we landed on an island in the lagoon, about three-fourths of a mile from the ship and about the same distance from the main shore. At the time of our arrival a heavy rain squall came up, which lasted until dark, preventing us from testing the ground with a seine. Earlier in the day a party anchored in the dinghy off the island close to the shore, among a lot of coral heads, two natives selecting the places for fishing. In trials lasting about three hours 7 fish were caught, among which were 4 species. The only bait which they could be induced to take was hermit crabs.

Three miles to the north and east of Terranova lies another village, and about halfway between them are three stone traps and the ruins of several others, built of coral slabs and pieces of broken coral.

The canoes observed at Arhno were small dugouts and require no special mention.

On the morning of January 28 the *Albatross* left the lagoon and made a detour around the northern shore of the atoll, thence skirting along the western shore. Here the rim of the atoll is submerged in many places, forming many islands, some of which are inhabited. We were told at Jaluit that this atoll supported nearly 2,000 people, but saw nothing to lead us to believe that such a number exist here. In coasting along the shore we saw many fish-traps.

At the islands we visited in the Marshall Archipelago the contrast between the build of the canoes and that of the houses was very noticeable. Much care is taken in the make of the former, but very little in the latter. In all other groups visited well-made houses and huts were noticed.

THE CAROLINE ISLANDS.

On the 29th we arrived at Jaluit and remained there till February 5. Leaving the Marshall Islands, the ship proceeded to Kusaie, the most eastern island in the Caroline group, a little over 400 miles from Jaluit, and came to anchor in Port Lottin, the most southern harbor on the island. The island is volcanic, 8½ miles long by 5½ miles wide. Its highest point is 2,155 feet. A heavy and luxuriant growth of vegetation covers the entire island almost to its highest part.

The harbor is small, and is fringed with coral reefs on the east and west sides; at the head is a long stretch of sand and mud, forming a bar, which at low water is bare. The bar has been formed by two small rivers that empty into the harbor above. About 150 feet is the average width of the rivers at their mouths, narrowing to less than 50 feet half a mile up; the depth varies from 2 to 5 feet, with an occasional sand bar where a canoe will barely float. The village is on the east side of the harbor at the mouth of the river.

In the rivers were many small fish, but repeated trials and failures demonstrated that they would not take a hook. A fair representation of the fishes inhabiting the rivers was taken in a small collecting seine. A large seine can not be hauled, owing to the tree stumps and branches strewn over the bottom. Two large eels were caught and off the mouth of the river, inside the bar, several hundred mullet were taken.

Very little hook-and-line fishing is carried on by these people. Nets are used for the most part, although spears are sometimes operated on the reef. Women do all the fishing, we were informed, and during our stay here we saw no men taking part in it. This is probably due to the fishing-grounds lying so close to the village, protected from the sea. The fringing reef on the south and east sides of the island makes

off a considerable distance, in some places a third of a mile, in others a few hundred feet, forming a shallow lagoon, in which fishing may be performed in all weather. During a storm, when the sea is breaking on the outside reef the lagoon is smooth.

The reef nets are 75 to 100 feet long and average 8 feet in depth, with a 3½-inch mesh. They are made of two-stranded cocoanut fiber, which is strong and capable of bearing considerable strain; floats of koa wood, 6 inches long and 2½ inches in diameter, are placed from 4 to 5 inches apart. On the foot line are heavy shells. These nets answer every purpose of a seine, though not used in the same manner. They are not dragged, chiefly on account of the rough bottom; neither is a canoe used in setting them.

From 10 to 12 women gather a net up in their arms and carry it to the edge of the lagoon, where they wait for the appearance of fish. When a school or a number of fish is seen the women form a semicircle, carrying the net in front of them, wading out and dropping it around the place where the fish were observed, and quickly drawing

Dip Net, Kusaie.

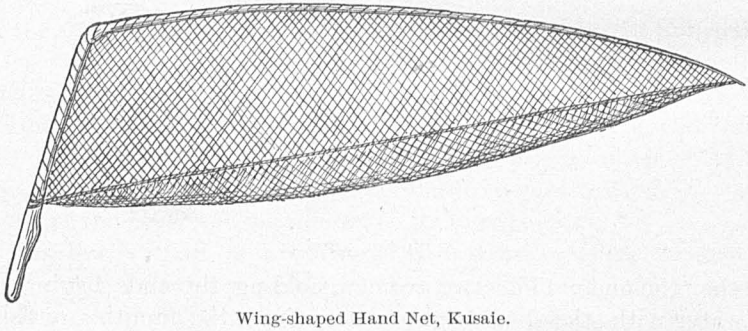
together the ends. The two women holding the ends begin beating the water with sticks, to frighten away from the mouth any fish that may be near it. Soon one of the women steps over the net and also splashes the water with a stick. This causes the fish to scatter, many of them jumping over the cork rope. Fish that jump over the net are prevented from making their escape by a second net, 20 by 8 feet, attached to poles, the poles resting on the bottom and held at an angle.

The hand net is hung so as to form a kind of bag into which the fish fall. In addition to the square hand net for capturing fish that jump over the cork line, large dip nets are held in readiness by the women stationed along the outside. Finally, the large net is gathered into a small compass, picked up, and the contents are emptied into the baskets. After a haul has been made, the net is carried to another part of the lagoon or reef and is again set. This performance is frequently repeated with no success.

Our experience had been that few fish could be approached near enough to capture with a seine, even when exercising great caution, and how these people managed to capture a single individual with such rude apparatus was to us a source of considerable wonder.

The dip nets used in connection with the reef net are 9¼ feet long, including the handle; net part or bow, 44 inches long by 28 inches wide, tapering where it joins on to the handle. The bow is made of withes, the net of cocoanut thread, and the handle of koa wood. The material of which the net is made is very light, which makes it easy to handle. It differs in style from most dip nets in having a deep bag varying from 18 inches to 2 feet. The extra length of bag is for carrying fish while wading in the water over the reef.

Considerable success is obtained with a wing-shaped hand net 3 to 4 feet in length and 18 to 22 inches in width, the greatest width being next the handle, tapering toward the outer end. In fishing on the reef, in pools, or in streams they take the place of dip nets, and are more effective, being easier to handle on account of their lightness and shape. The material of which they are made (pandanus) is strong; size of mesh, 2 inches. These nets are used to advantage among bowlders on the reef and in streams where fallen limbs and snags are numerous. Women and young girls operate them mostly, although

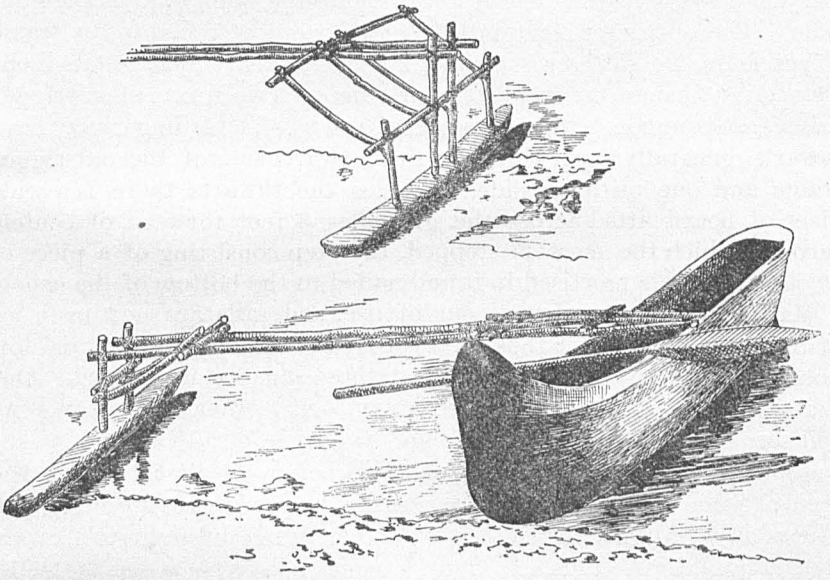


Wing-shaped Hand Net, Kusaie.

boys sometimes take part. In the lagoon or on the reef fishing is performed some little distance from the beach, gradually working in shore. By wading out from the shore and working toward it double the amount of fish are taken than otherwise would be, because when a fish is startled from its hiding or feeding place its natural tendency is to escape into deeper water. In doing so it immediately comes in contact with the barricade of nets. Each person carries two nets, one in each hand. As the fish dart out from behind rocks or other places of concealment a net is dropped in front of them and they are captured. Sometimes the net in one hand is used and sometimes the other, it depending on the movements of the fish. In addition to the nets each person carries a short stick with which to beat the water and turn over stones. Frequently small boys are pressed into service, they standing at the water's edge, turning over stones, and keeping up a splashing of the water, the fisherwomen on the alert with their nets to capture fish that may come their way. When a dozen or more people are in line along the beach it is quite difficult for all the fish to make their escape.

In company with Dr. Woodworth the writer visited a village about 5½ miles from Port Lottin, on the east side of the island, not far from Chabrol Harbor. About half the distance led us up the river emptying into Port Lottin Harbor. We were taken in a canoe poled along by two natives. On the left bank of the stream is an impenetrable network of mangrove trees; on the right bank are vegetable ivory and palm trees, their tops forming an arch over the stream. The stream is said to contain a variety of fish, but very hard to catch.

The village consists of a single row of houses built close to the beach, and in front of each house is a fishing-ground. Some women were starting out on a fishing excursion in the lagoon, where at low water the depth is about 3 feet. At high water the sea breaks over the



Canoe and two Styles of Outrigger, Kusaie.

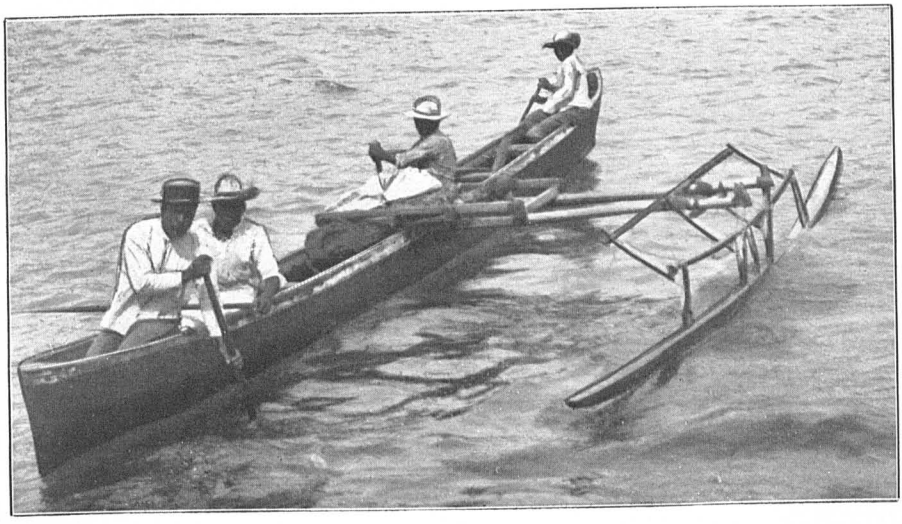
outside reef, bringing in quantities of mullet and other species, the outgoing tide leaving some of the fish in the shallow water of the lagoon. The fishing party had a reef net, 2 pole nets, and 3 dip nets. There is fully as much sport as labor connected with the fishing, for a great deal of the time playful antics are kept up, the young girls taking special delight in playing pranks on the older women, such as tripping them up, sending them sprawling into the water, throwing dip nets over their heads, and finally all becoming engaged in a friendly fight. If no fish are taken at one tide it matters but little, for an abundance may be caught the next. A half or even a whole day thus spent with meager results seems to amply repay these people for time and labor expended. Hand nets, previously spoken of, are used on the reef and also in the stream.

All the canoes that came under our observation were dugouts of inferior make. Most of the harbor canoes are propelled by poles, some fitted with sails. In times past it is stated that sailing canoes of large dimensions were common in all parts of the island; but for many years there has been no occasion to build canoes larger than is required around the harbor and in the lagoons. In the rare visits to other islands passage is taken on some coasting vessel.

A variation from 14 to 28 feet was noticed in the canoes on this part of the island. The 14-foot canoe is on an average 11 inches wide and 10 to 12 inches deep; thickness at the gunwales 1 inch, increasing to 1½ inches at the bottom, and a considerable thickness of wood at the bow and stern to give strength; round-bottomed; straight fore and aft, and 2 to 3 inches wider at the turn of the bilge than at the gunwale. The outrigger float is 10 feet long and attached to the frame 6 feet from the side; crosspieces of frame 9 inches apart; stanchions connecting float to the frame 9 inches high. Two forms of outrigger frames are common, both shown in the sketch. The sailing canoes have thwarts, generally four, three on the forward side of the out-rigger frame and one on after side. Besides the thwarts there is a wide piece of board fitted across the gunwales 3 feet forward of center, through which the mast is stepped, the step consisting of a piece of wood with a hole mortised in it and nailed to the bottom of the canoe.

Mat sails long since went out of use, and sails are now made of drilling, patterned after those of a cat-rigged boat—high peak and low boom; but unlike the cat-rigged boat these sails are unshipped. One canoe was seen under sail, and contrary to any other sailing canoe we had seen she was handled in the same manner as a sailboat, that is, she was put about on opposite tacks. This being the first time we had seen a canoe handled in such a manner, we were greatly interested. The wind was light and the sea smooth. When brought to leeward the outrigger buried itself. Had the wind been fresh, accompanied by a choppy sea, we could see no reason why the canoe should not capsize. This kind of sailing might be practiced in smooth weather, but in rough weather it is doubtful if it could be done without some danger.

The floats of the outrigger of canoes used in the streams are considerably turned up at the forward end to prevent them from catching under logs, limbs, and twigs. The necessity of this was fully demonstrated in our trip down river, for in many cases the float ran up over branches and other obstacles protruding from the river bank, causing the whole structure to twist as if it were about to break. In coming down river it is quite impossible at times to avoid these obstacles, especially when making a sharp turn. In a number of instances the outrigger shot under projecting limbs and half-sunken trees, bringing the canoe up all standing crosswise the stream. No damage was done other than taking in water. Had the outrigger been put together with nails the whole thing would have been carried away.



CANOE, KUSAIE, CAROLINE ISLANDS.

PONAPI CANOE.

PONAPI ISLAND.

A run of 150 miles brought us off Pingelap Island, where we arrived early in the afternoon of February 10. We did not land, all photographic work being performed from the ship. While lying to, several canoes came off well filled with people, among whom were the king and a white man. Pingelap is a small island about 5 miles long by less than 3 wide, yet it supports nearly 1,000 people. All the canoes that came off were small, estimated length varying from 14 to 16 feet—the same type as the Arhno canoe. While lying to, several large schools of flying-fish passed us; barracuda were also plentiful, and on the passage to Ponapi both species were frequently around the ship.

We dropped anchor in Kiti Harbor, Ponapi Island, the following afternoon, February 11. The inhabitants do not seem to be much given to fishing; at least it is not so extensively carried on as at Kusaie. Here the fishing is performed chiefly by the men. Both the outer and inner harbors are surrounded by reefs. A mountain stream empties at the head of the inner harbor.

Hanging up in a shed with canoes were reef and hand nets, the same as used at Kusaie. The spears were fish-hooks straightened and lashed to poles. No other kind of fishing gear was observed. At low tide in the inner and outer harbor reefs and spits are exposed, just such places where rock pools are numerous and fish abound.

There are no seining beaches in the harbor, all the reefs and spits being too rough for seine work. About half a mile from the mouth of the stream a 50 and a 15 foot seine were dragged. Like most streams in the Tropics, it was filled with snags, there being few places free of them. In eight trials 6 mullet, a number of half-beaks, and considerable small fry were taken. In and about the mouth of the stream the bottom is largely composed of stones and broken coral. Several trials were attempted here, and each time a number of fish were in the seine, but the seine would "foul" with rock, snag, or coral, and before it could be cleared the fish escaped.

A party rowed up the river about 2 miles and tried for fish with rod and fly and bait. Nothing was caught; not even a bite was felt, although an abundance of fish was seen. To obtain a collection representing even one-half the fresh and salt water species to be found here would require many days of patient fishing.

On one of the reefs in the harbor, about a mile from the village and not far from our anchorage, a collection of star-fishes, shells, annelids, and crabs was made.

There is not the marked difference in the size of the Ponapi canoe as noticed at many other islands. A difference of 2 feet is the maximum; average length, 26½ feet; width, 13½ inches; depth, 17½ inches. Outrigger float, 20 feet long; stanchions connecting float to outrigger

frame, 18 inches high; crosspieces to the frame, 3 feet 5 inches apart; platform, 23 inches wide and 41 inches long, built out 18 inches on the outrigger side. Each canoe has 6 thwarts, 3 forward and 3 aft of the platform. Between the crosspieces which form the bed of the platform are 4 other pieces, and under these are 3 others running at right angles to the top ones and parallel with the canoe, forming a bracework to the outrigger frame. We saw no built-up canoes; all that came under our observation were dugouts, but much lighter than any met with elsewhere. The model is fine and well proportioned. The bow commences to turn up abreast the end of the float, extending out gracefully, slightly flaring at the extreme end, but fairly sharp where it enters the water. The stern runs out in the same manner and forms what might be termed an overhang. Stripped of the outrigger and rigged with mast and sail these canoes would look very much like a small modern yacht. To add to this appearance they are painted with a native dye which gives the wood a decided mahogany color, the dye, or paint being put on very skillfully.

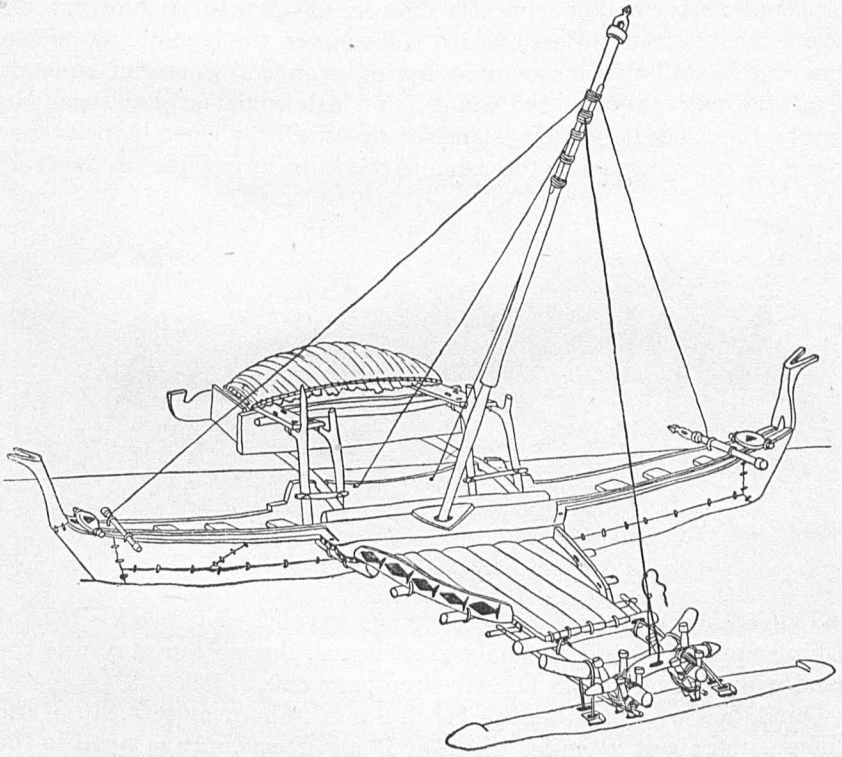
The crosspieces and entire framework of the outrigger differ from those of any canoe previously seen. Heretofore the outrigger float had been joined to the frame by stanchions in the middle; in these canoes not only have they the middle stanchions, but also a set of three on each end. The end ones, however, instead of being fastened to the frame, are attached to a brace which projects from the side at either end. The braces start from the side of the canoe at a sharp angle, meeting in the center of the outboard end of the outrigger frame. The end stanchions are composed of withes, projecting out horizontally from the brace to a point directly over the float, then bent at right angle downward and fastened to the float. The middle stanchions are also withes 3 feet 5 inches apart, each set made of six small withes placed close together at the top and spread at the bottom. The outrigger, though light, is strong and durable.

The platform which covers the middle of the canoe is braced and counterbraced, and, unlike the Marshall Island canoe, is set low. The thwarts are flush with the gunwales, dovetailed in. On different parts of the outrigger frame, particularly on the float where the stanchions join, are fancy cross-seizings of cocoanut-fiber thread. Some are to give additional strength, others are purely ornamental. Every part of the Ponapi canoe is well proportioned, and the workmanship would do credit to skilled mechanics.

On the part of the island which we visited there is an absence of sailing canoes; we saw none fitted with masts or sails, neither did we see any sailboats. Usually, even in isolated islands, where the people have long mingled with civilization, modern sailboats are found. It is presumed that modern tools are used in building a class of canoes so nicely finished as these.

TRUK GROUP.

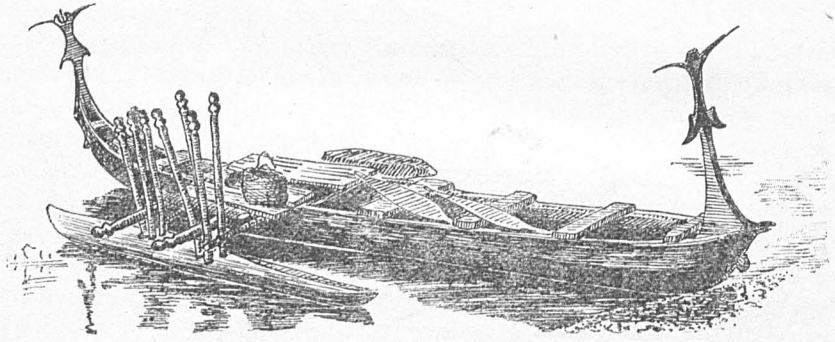
Leaving Ponapi on February 12, the *Albatross* headed for the Truk Group—a part of the Caroline Islands nearly 400 miles westward of Ponapi. In the afternoon of the 14th the ship lay to off Namo Island, and in the evening canoes came off. Torching for fish on the reef and beach continued from dark until after midnight. We did not land to see the fishing, and it was too dark to examine the canoes that came off to the ship.



Sailing Canoe, Truk Group.

The following morning we passed through the outer rim of reefs encircling the Truk Group and anchored on the west side of Moen Island off the village. Truk Group consists of 13 islands and numerous islets encompassed by a series of broken reefs 35 miles in diameter. Many parts of the rim are submerged with islets between, some of which are barely above the surface at high water. The present condition of the atoll rim seems to indicate that at one time it was wholly above high-water mark, but has gradually subsided, leaving only the most prominent parts exposed. In most parts the reef is quite wide, in a number of places a mile or more, over which are scattered many bowlders of old coral rock.

For several miles, commencing at the village and running to the northward, is a series of smooth beaches, interrupted by an occasional stretch of coral. All of the beaches make offshore for some little distance. Some are protected from the wind, which has a long sweep across the lagoon, by islets lying from a quarter to a half mile offshore. In these sheltered places women were fishing with hand nets at the time of our arrival. It was noticed here, as at Kusaie, that in connection with fishing more or less play was indulged in. No men were engaged in fishing or any other labor, probably because nearly all of the people of the neighboring islands were at war with each other. It is said that the many islets, shoals, and reefs in the lagoon and on the rim of the atoll afford excellent fishing-grounds, where in time of peace the natives of all the islands find fish sufficiently abundant to supply their needs. Each island is practically independent, its surrounding reefs supplying the fish and the hillside yielding all the fruit



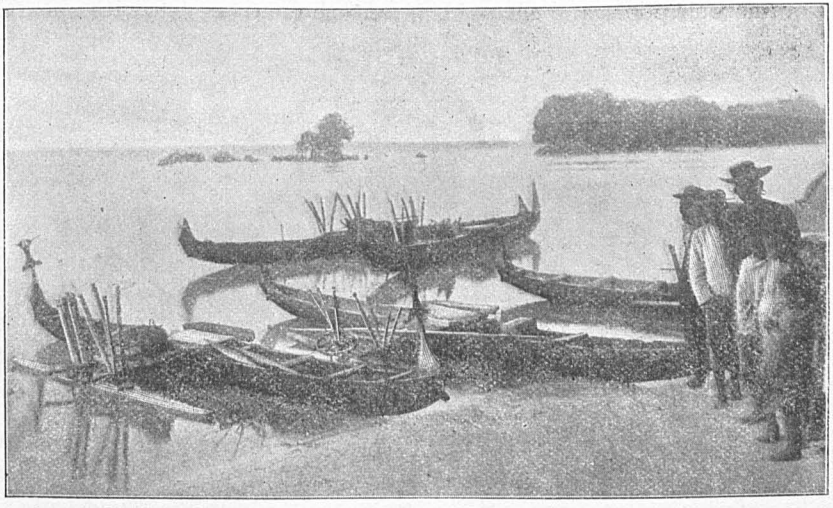
Paddling Canoe, Truk Group.

and vegetables required. These people may have different kinds of fishing apparatus, but the only kind in use during our stay was the hand wing-shaped net, as described on page 820.

Our seines were used on the beach for a mile or more north of the village, and about 2½ miles south of it an afternoon was spent in the same work, meeting with considerable success. In the catch were small flounders, mullet, crabs, starfish, and shells. Large schools of mullet kept a considerable distance from the shore, only a few at a time approaching near enough for capture.

In this group there is a wide difference between the sailing canoe and the canoe propelled by paddles. The former, both in construction and general appearance, is similar to that of the Marshall Islands. The latter is a dugout, and in no way resembles the former. Without knowing that both styles of canoes were made by the same people, one would naturally suppose that each had been made by a people entirely unlike in taste and separated by a long distance. The average length of the sailing canoe is 28 feet; width, 16 inches; depth, 37 inches; thick-

ness of planking, 1½ to 2 inches; outrigger float, 9½ feet long and 8¼ feet distant from the side of canoe; crosspieces of frame, 30 inches apart; length of platform on outrigger frame, 7 feet; stanchions connecting crosspieces to the float, 15 inches high, 4 on each, and carved at the top. It will be noticed that the outrigger float, framework, and platform vary slightly from the Marshall Island canoe. The built-up platform on the lee side is also different in detail and like the canoe of Rongelab is covered with a thatched roof. The sail plan and rig is practically the same as the sailing canoes in the Marshall Islands. Mat sails are still used, of the same material as in all parts of the South Seas where cotton has not been introduced. A rudder 4½ feet long, 10 inches wide, and 2 inches thick is used instead of a paddle for steering. It is detachable and is shifted from end to end of the canoe when a tack is



Canoes on Beach, Truk Group.

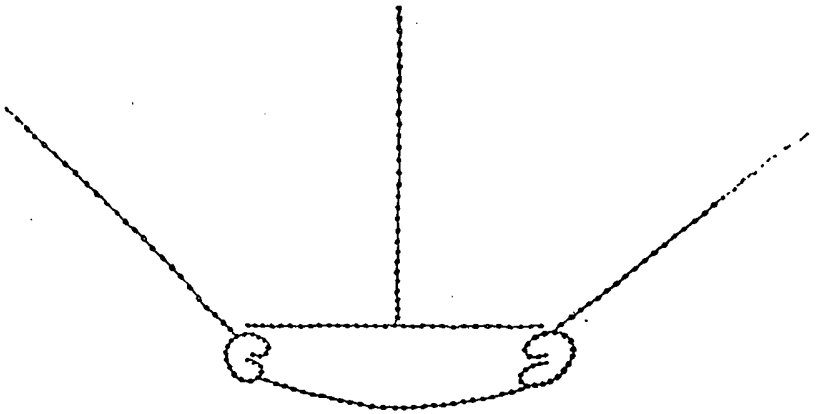
made. It is held in position by a wooden pin against which the top part rests. Round the pin and head of the rudder is a grommet to prevent it from slipping down.

In the village four canoes were building. One had recently been worked on; the others were covered with matting, no work having been performed on them for at least several weeks. Probably the war had something to do with the suspension of labor, not only on the canoes, but with almost everything else. A dozen or more small canoes were about the ship most of the time, manned by half-naked people, whose bodies and faces were decorated with native paint, presenting a barbaric picture. These canoes are ornamented at the bow and stern with carved pieces of wood on the order of a gondola. The stanchions on the outrigger are carved at the top; they are much longer than seems necessary, but without the extra length and the decorations the canoe would not be considered by the natives as finished.

GUAM

On the morning of February 21 we sighted Guam, approaching it from the southern side. At a distance this part of the island has the appearance of the southern coast of California. The interior portion is similar to Makatea, in the Paumotu group, it having a mesa surrounded by perpendicular cliffs. The shore line on the south and east side is fringed with narrow, sandy patches, with an occasional outcropping of coral rock. Passing around the northern end of the island, down the west shore in sight of Agana, gave an excellent view of the coast. Early in the afternoon the ship came to anchor in the harbor of San Luis d'Apara.

In all parts of the harbor the beaches are extremely rough and ragged. At low tide reefs covering large areas are exposed, on which are numerous pools and channels where the natives fish with spears,



Double Fish-trap, Guam.

mostly at night. As observed at most places, reef fishing here at night is carried on by the aid of torches.

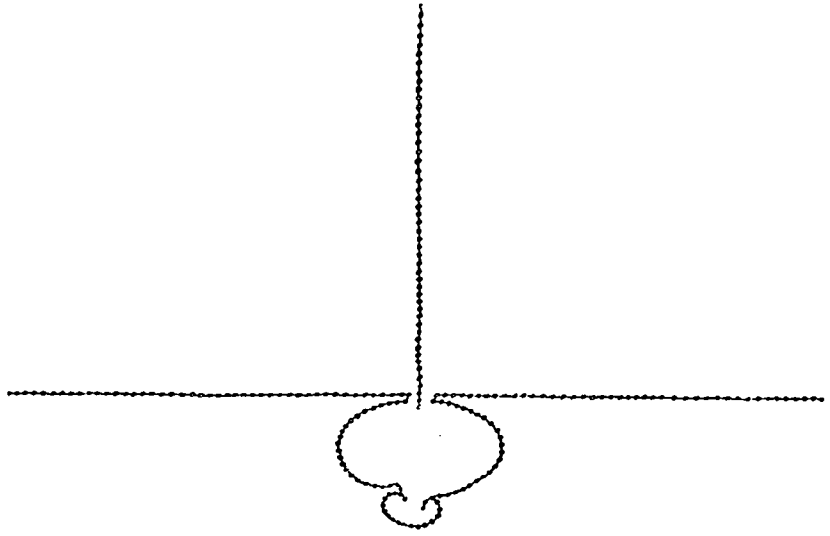
The people of Guam do not engage in fishing as much as most natives in the islands of the Pacific. They are given more to tilling the soil, and fishing seems to be a secondary consideration.

Many of the inhabitants of San Luis d'Apara living near the shore have fish-traps extending out from the beach in front of their houses. The traps are of two kinds—double and single pocket. The pocket of the single trap is about 60 feet in diameter, with two wings 150 feet each, and a lead of 200 feet. The pockets of the double trap are built 60 feet apart and connected by a bamboo fence. From each pocket is a wing varying in length from 100 to 400 feet, according to the location of the trap. The leads vary from 200 to 300 feet.

In constructing traps, bamboo is wholly used. Poles are driven into the sand and coral, placed 4 feet apart, and around them is woven, basket fashion, strips of bamboo twisted into a rope.

Only an inferior type of dugout is now seen; the original design has long since departed. The canoe now used averages 27 feet long, 18 inches wide, and 13 inches deep; width carried well forward; straight on the bottom; little or no sheer, and full at the bow and stern. There is no attempt to decorate these canoes; they are as plain as it is possible to make them.

There is no platform or framework on the outrigger, only two cross-pieces, fastened to the float by wooden pins, and to the gunwales by



Single Fish-trap, Guam.

seizings; outrigger float, made of hard wood, 9 feet long, 7 inches wide, and 8 inches deep; sharp at each end.

On account of the harbor being shallow in most parts very little paddling is done; a man stands in each end and with long poles pushes the canoe along at a good rate of speed. There is very little occasion for going outside of the harbor, which in a measure may account for no larger or better canoes being built.