FOREWORD

Sir Peter H. Buck (Te Rangi Hiroa), Director of Bishop Museum from 1936 until his death on December 1, 1951, was a remarkable man. Son of a Maori chiefess and an Irish father, he was born in Urenui, New Zealand, August 15, 1880. In a career marked by achievement, he served variously as physician, public servant, elected representative, teacher, administrator, and research scholar. His contributions to Pacific ethnology are those for which he is most noted, but his experience and accomplishments in other fields afforded an unparalleled richness of background which made his anthropological eminence possible.

Arts and Crafts of Hawaii was Sir Peter's final scholarly contribution, culminating a prolific career of similar interest and publication dating from his first ethnological paper on the Maori art of weaving, published in 1911. Dr. Buck concentrated on Polynesian arts and crafts because he felt this was a neglected field. In this he was correct. There continues to be a general dearth of interest in material culture among anthropologists. Dr. Buck expanded his initial interest in Maori arts and crafts to other Polynesian island cultures, notably those of Samoa, the Cook Islands, Kapingamarangi, and Hawaii. His meticulous and elaborately illustrated studies led from relatively mundane factual descriptive treatments of specific features to problems of broad interpretive importance with significance for Pacific island culture history. Dr. Buck placed these theoretical concerns under the general heading of "diffusion and evolution." A more elaborate designation would have listed also such things as independent development, cultural transfer, migration theory, and human adaptation to environment.

The first edition of *Arts and Crafts of Hawaii* appeared in 1957 as a single casebound volume. It grew not only out of Dr. Buck's unique knowledge of Polynesian material culture gleaned from field work, extensive examination of the literature, and familiarity with collections at Bishop Museum, but also from numerous visits to mainland and European museums and private collections over a span of more than three decades. Further, he benefited greatly from the contributions of many colleagues on the Museum staff and, indeed, throughout the world.

When it became evident early in 1964 that the original edition of this book would soon be out of print, the decision was made, in response to numerous requests and suggestions, to reprint the work not as a single volume but in a series of separate booklets, one to contain each major section of the text and one to contain the comprehensive index. The fourteen booklets together contain every word of the original edition, and no changes

or additions have been made. The author wrote them as autonomous sections, capable of standing alone, rather than as chapters. It is felt that this altered presentation will allow the contents to be used with greater ease and will allow as well for their broader distribution. It will also allow for expansion and revision through time by other students of Hawaiian material culture who will take their inspiration from Buck's pioneering efforts. Although the survey of Hawaiian arts and crafts is magnificently comprehensive and resulted from at least sixteen years of intensive work, Sir Peter would have been the last to claim that the treatment is complete. Had he lived longer, the contents would have been expanded, beyond a doubt.

Finally, it should be noted that the reprinting of any document as it appeared at a given point in time often does the author an injustice. Discoveries and developments subsequent to the time of the writing cannot be included and, for this reason, what may seem to be incompleteness and even some errors of fact may result. Dr. Buck's work endures the test of time remarkably well. A classic work, appreciated by professionals and lay readers alike, it stands as a lasting tribute to the passing cultures of Polynesia, provided by one of their own, possessed of rare scholarly eloquence.

ROLAND W. FORCE

Bernice P. Bishop Museum
Honolulu, Hawaii
August, 1964

CONTENTS

ARTS AND CRAFTS OF HAWAII

BY TE RANGI HIROA
(PETER H. BUCK)

VII
Fishing

Arts and Crafts of Hawaii

By

TE RANGI HIROA (PETER H. BUCK)

SECTION VII

Fishing

BERNICE P. BISHOP MUSEUM SPECIAL PUBLICATION 45

REPRINTED BY BISHOP MUSEUM PRESS

1964

LIST OF SECTIONS

First Published 1957

Reprinted in Separate Sections 1964

VII

FISHING

GENERAL

Fishing was the most varied and extensive food-procuring occupation of the Hawaiians. Agriculture, though of great importance, did not require the varied tools and methods necessary for fishing. The agriculturalist knew well the limited plot of land he had for cultivation, but the fisherman had to know the character of the bottom of the sea both within and beyond the reef. Boys helping their parents in certain fishing operations within the reef learned where the rocky patches were that could be surrounded with a gill net or avoided in drawing a seine. They learned the sandy places that afforded a suitable site for setting the net in a fish drive. They became acquainted with the contour of the reef and the clefts and crevices where fish could be grasped by hand or caught in hand nets. They grew to excel in diving to locate fishes, to free nets, and to set traps. The area of sea bottom and the water above stretching between the shore and the bounding reef of their family territory was their marine garden and was cultivated as assiduously as any area of dry land.

Beyond the reef, the sea bottom gave up its hidden sources of food to the expert fisherman. Down to 20 fathoms, he could explore the bottom visually after chewed roasted *kukui* nuts were spat on the surface to aid visibility. He saw squids on the bottom and lowered his squid lure. He went to places frequented by the *uhu* fish and watched them enter his dip net, attracted by the antics of a decoy which he manipulated from above with a line. Beyond the 20-fathom depth, he discovered fishing grounds by experiment with ground bait (*palu*) and baited hooks. Profitable grounds were fixed by taking cross bearings with prominent land features. Knowledge acquired by successive generations of fishermen was handed down, adding to the equipment of practical knowledge. The fishing grounds in shallow depths of 80 fathoms or so were termed *kukaula*, and deep grounds between 200 and 400 fathoms were alluded to as *pohakialoa*. Between the shallow and the deep grounds were the *ka'aka'a* grounds of variable depths.

Competition among fishermen for big catches led to secrecy on the part of the lucky finder of good fishing grounds and on the part of his descendants. Kamakau tells that when a fisherman intended to fish on his secret ground, he

baited his hooks ashore and attached a number by their short snoods to the line. He left in the early morning to avoid being recognized. On reaching the ground at daylight, he lowered the fairly heavy stone sinker and the line. When "every hook was taken by a fish," the fisherman drew up the line part way to raise the stone sinker from the bottom, tied the line around the bow of the canoe, and sailed away from the fishing ground towing the line and fishes in the water. When he was out of sight or at a good distance from the ground, the line was hauled in with its catch. The fisherman then returned to shore satisfied that by concealing the location of his secret fishing ground he had prevented it from becoming common property. Perhaps it was such secrecy which initiated the use of multiple hooks on a single line.

The professional fishermen (*lawai'a*) incurred a good deal of expense in setting himself up in business. He had to buy a fishing canoe from the people of the upland where the large *koa* trees grew. He had to buy his fishing lines from the same people, as they also had access to the *olona* plants. And fishing nets are said to have been made inland. Thus the upland people who lived away from the sea controlled the supply of necessary fishing material, and the fishermen paid off their debts from their catches. In fact, the fishermen often had few left for themselves out of a large catch. In addition, they had to provide themselves with hooks of various kinds, stone weights and sinkers of different sizes, and ropes large and small. Probably the fishermen made the hooks themselves, as marine shell, turtle shell, and bone, both canine and human, were available to them. Even so, there were expert hook makers who traded their goods to the less skillful.

The fisherman's life was strenuous and he had to make the most of seasons and weather. During the winter days, when rain flooded the streams, inshore fishing was impossible, for the sea floor was covered with mud and silt. During such periods, he had to turn to the deep sea, where he had nothing to fear so long as there were no adverse winds. Moreover, the wet season of *ho'oilo* (winter) was good for line fishing, as is indicated by the saying "fish lines are wet in *ho'oilo*."

The fisherman relied on his experience, inherited knowledge, and skills. He knew the use of various types of hooks for different kinds of fish and the kind of bait best for each. A fisherman who understood the properties of bait would make a good catch, and some fishermen were considered lucky in themselves through some "attraction" for fishes. Kamakau, whose similes seem to have been influenced a good deal by women, says of the lucky fisherman, "He was like a lucky woman who attracts men by the fragrance of her skin."

Like other fields of activity, fishing had its gods, or *'aumakua*, who brought luck to the respectful fisherman who paid homage to them by some offering. Most *'aumakua* were deified ancestors. The principal fishing god was Kuula, who

was a great fisherman of ancient times. Others were Hinahele, who owned the *ʻohua* fish; Kanemakua, a form of Kane wherein he appeared as an old man; Kapukapu; Kinilau; Kanekoa; and Kalamainuu, the goddess of trap makers.

Fishing shrines (*koʻa*) consisted of heaps of stones on the water's edge, and men going out to fish contributed a stone to the shrine. It is evident from the remains of hooks found on these shrines that they also were given as offerings. On returning from a successful fishing expedition, the fishermen made offerings of fish on their local altars (*kuahu* or *lele*). When the *ʻaumakua* were treated as a male and female pair, the fisherman took a fish in each hand, laid the right-hand fish on the right side of the altar for the male god and the left-hand fish on the left side for the goddess. Respect having been paid to the gods, the catch was distributed among the people.

METHODS

The various methods of catching fish consisted of catching by hand, spearing, noosing, netting, trapping, and line and hook fishing.

Catching by Hand

Catching by hand, or groping (*haha*), was a simple form of fishing used by both men and women in shallow water around rocks. They dived down in the likely places and thrust their hands under rocks, in holes and crevices, and under coral projections where the fishes could not escape. They were brought out and put in a bag attached to the waist. Crayfish were so caught, and Kamakau lists *hou, ʻolali, pakauele, lelo* [trepang], and *paoʻo* as some of the other fishes caught in this way.

Kamakau gives a curious description of how sea eels were caught by hand. He says that the fisherman selected an opening in a rock in the interior of which sea eels lurked. He chewed some *aʻama* crab and placed some in the palm of his hand, where it was held down by the thumb. He stretched his fingers widely apart with the back of the hand against the rock and the fingers against the sides of the opening. He spat out some chewed crab to attract the eels. Then the head of an eel appeared between the fisherman's fingers as it came out to feed from the bait in the palm of the hand. Kamakau makes the extraordinary statement that "six eels might be caught at once between the fingers of the hands. The fisherman would press his fingers tight together, holding the heads firmly . . . and bite each eel in the middle of the body while the eel opened its mouth and bit at his cheek, his neck, or the base of his ears." The fishing was done at night and the fisherman was under water as he caught the eels. He carried a bag attached to his waist to hold the catch. This account sounds suspiciously like a fish story.

Spearing

Fish spears (*ʻoiʻa*) were made of straight sticks of *kauila, oʻa, koaiʻe, uhiuhi,* or other hard wood. Their length was 6 or 7 feet; they were slender and sharply pointed at one end; and the butt ends were trimmed to a lesser thickness than the shafts. In modern times an iron point was lashed to the shaft, and now it may be tipped with multiple-forked iron points.

Most of the spearing was under water for different kinds of rock fishes. The fisherman, from experience, knew the likely spots by large coral rocks or the steep face of the reefs. Beckley describes the method very clearly in the following statement (1883, p. 1):

> . . . Diving to a well-known station . . . the diver places himself in a half crouching position on his left foot, with the right foot free and extended behind, his left hand holding on to the rock to steady himself, watches and waits for fish. Fish in only two positions are noticed by him, those passing before and parallel to him, and those coming straight towards his face. He always aims a little in advance, as, by the time the fish is struck, its motion has carried it so far forward that it will be hit on the gills or middle of the body and thus secured, but if the spear were aimed at the body it would be very apt to hit the tail, or pass behind. When the fish is hit, the force of the blow generally carries the spear right through to the hand, thus bringing the fish up to the lower part or handle of the spear, where it remains whilst the fisherman strikes rapidly at other fish in succession should they come in a huakai (train) as they usually do.

The *ʻoʻopuhue* (porcupine fish) was speared from above water as were, sometimes, large fishes in connection with deep-sea line and hook fishing. Torch-light spearing was also used in the waters inside the reef at night with torches; and squids were speared in shallow water.

Noosing

According to Kamakau and Beckley (1883, pp. 10, 11), sharks were caught in a slip noose after a preliminary feeding. Kamakau gives the five kinds of shark as *luhia, lalakea, lelewaʻa, pahaha,* and *niuhi.* Beckley lists the five kinds as *mano kihikihi* (hammerheads), which were eaten; *lalakea,* with a white fin, also eaten; *mano kanaka* (man shark), which were regarded as the spirits of ancestors and were fed with *ʻawa* and bananas; *mano,* the large white shark "which was not particularly ravenous"; and the *niuhi,* which was large and fierce and even attacked canoes. Beckley says that a green light shone from the eyes of the *niuhi* and that when fishermen saw this green light, they took to precipitate flight. She writes that the *mano kihikihi* and small *lalakea* were caught in "old nets," that the large *lalakea* and others were caught on a hook, and that it was the *niuhi* which was caught by noosing.

To catch the *niuhi,* which is a deep-sea shark, baked flesh wrapped in ti leaves and pounded *ʻawa* mixed with a little water and carried in large gourds were taken many miles out by a fleet of canoes. At the selected spot, which was

comparatively shallow, the canoes anchored. The bait was thrown out, a few bundles at a time, to attract the sharks. This evidently was repeated on succeeding days, for Beckley states that the *niuhi* appeared on the third or fourth day. It was fed as fast as it could swallow and so grew comparatively tame, coming close to be fed. Bundles of liver mixed with *'awa* were thrown out and the *niuhi* became satiated, and stupified with the *'awa*. By this time it was evidently being fed close to the canoe side, for a slip noose was passed over its head and the canoe started for shore, leading the *niuhi*. The *niuhi* was run up into shallow water, where it was stranded and killed. A fisherman who had slipped the noose over the head of the *niuhi* acquired great prestige (*mana*).

Kamakau also gives a detailed account of noosing sharks, but some of his details are incredible. According to him, the bait used was a pig cut up and allowed to decompose in a container to which pebbles and *kukui*-nut shells were added. When the fleet set out, the decomposed meat, enclosed in a net bundle, was tied to the fore outrigger boom. Seawater was splashed over the bait and it was stirred with paddles to spread the scent. Sharks were attracted and grew so tame with feeding that they allowed their heads to be patted. The noose was slipped over a shark's head, care being taken to turn the palms away, as the shark would snap at anything white. The noose was slipped down to the middle of the body, the shark's head being pressed down with a foot while the loop was fixed. The concluding stage was the same as that described by Beckley.

Kamakau states that Oahu was famous for catching sharks by hand. The following statement is quoted in full: "To the native son, the shark was a horse to be bridled, its fin serving as the pommel of a Mexican saddle. I have seen men skilled in herding sharks riding a shark like a horse, turning the shark to this side and that until carried to shore, where the shark died."

NETS AND NETTING

INTRODUCTION

Nets (*'upena*) were made in a variety of sizes and forms, for netting was the most diversified and profitable method of catching fish. Contributions to the literature have been made by Beckley (1883, pp. 12-20) and Cobb (1905, pp. 721-734); and both Kamakau and Malo (1951, pp. 78, 210) describe the varieties of nets, but it is not always clear whether the names given apply to nets or to the style of fishing. Stokes (1906, pp. 105-162) describes the method of making nets and discusses the collection of 36 nets in Bishop Museum.

For this study, I have made a critical examination of the Bishop Museum nets, which include types that are no longer used, and have made a thorough study of the literature in an attempt to describe the various types of nets with more detail than has hitherto been recorded.

MATERIAL

The best netting twine was made of *olona* because it was strong and light, but cord made from *hau* bark was useful as a substitute. A thick rope made of undressed *hau* bark was used for shark nets. One of the Museum hand nets is of *wauke;* but Stokes (1906, p. 155) suggests that it was used because of a shortage of *olona* twine. Coir cord was used rarely. The *ahu'awa*, a sedge, was used in the large-meshed turtle nets. Stokes (1906, pp. 105-106) gives the following methods for preparing various materials:

> Ahuawa . . . was prepared by drawing the freshly plucked stem between two rounded sticks tightly compressed for the purpose of removing the juices . . . then spinning the fresh fibre into cord. . . . The hau, waoke and olonâ were . . . macerated in running water and scraped with a pearl shell or turtle rib. . . . The grasses were braided . . . while the material was green. The spinning of cord, *hilo*, was always done on the bare thigh by women. . . . Men generally attended to the braiding.

IMPLEMENTS

The implements used in net making were the mesh gauge; the netting needle, or shuttle; and the net mender.

Mesh Gauges

Mesh gauges (*haha*) which regulated the size of the meshes (*maka*) were of different widths; and the length, which was of no importance, also varied. They were made of turtle shell, bone, ivory, and wood. In the Museum collec-

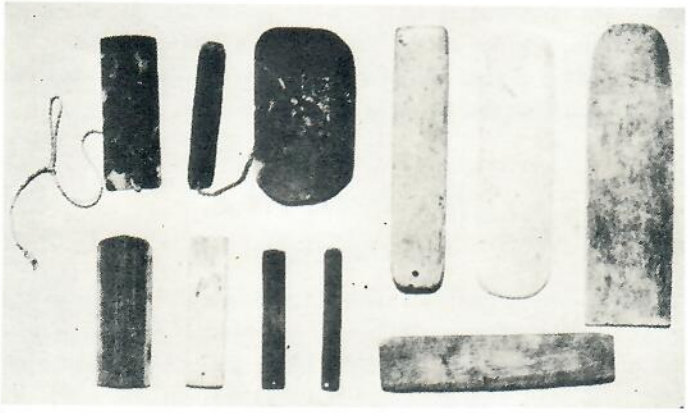

Figure 201.—Mesh gauges.

tion of 38 gauges, turtle shell is used in 27; bone and ivory, in six; and wood, in three; two are made of iron and brass respectively.

Turtle shell gauges range in width from 0.5 inch to 2.9 inches and in length from 3 to 7.2 inches. All are 1 mm. thick. They are rectangular in shape, but some are rounded off at the corners of one or both ends. Some have a hole

pierced through one end for a thread loop. The bone and ivory gauges follow the rectangular shape, but they range from 2 to 4 mm. in thickness. An exception is one made from a piece of whale rib (3917) which is 8 mm. thick. Of the three wooden gauges, two are made of bamboo and one is of *naio*. They follow the general shape of the other gauges, but are 2 mm. thick. The two metal gauges are narrow and 1 mm. thick. Gauges of various sizes are shown in figure 201.

Netting Needles

The netting needle (*hi'a*), or shuttle, follows the general Polynesian pattern of a large slit eye at each end; but in other Polynesian shuttles the intermediate part between the two eyes was of the same width as the widest part of the eyes, whereas in the Hawaiian shuttle the intermediate part was thinned down into a rounded shaft. Each eye was formed of two curved limbs enclosing a circular or elliptical space, and the end was slit to admit the cord for winding between the two eyes (fig. 202).

In the Museum series of 52 Hawaiian shuttles, 39 are of *kauila* or *naio* wood and 13 are of bone or whale ivory. The lengths range from 5 to 9 inches, the majority being between 6 and 7 inches. The outside width of the expanded eye part ranges from 0.4 inch to 1 inch, with the largest number at 0.6 inch. Many of the bone or ivory shuttles are small, with an eye width of 0.4 inch. The diameters of the shaft in 28 shuttles are 0.25 and 0.3 inch; and in two large, roughly

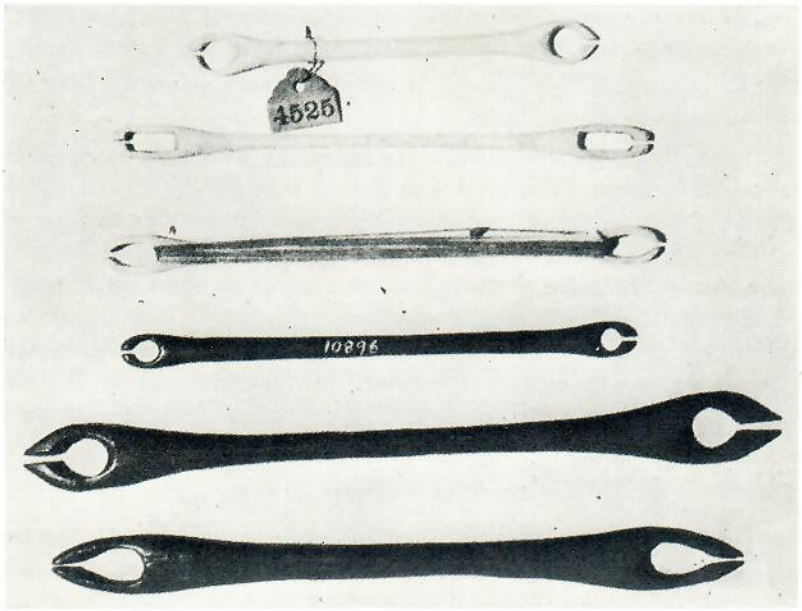

Figure 202—Netting needles, or shuttles.

made shuttles of imported fine-grained wood, the diameters are 0.6 inch. The shape of the eye varies from circular to rectangular and elliptical, with the elliptical form by far the most general (fig. 202).

A well-made netting needle in the Museum collection (176) has an interesting history, which is recorded by Stokes (1906, p. 109). It is said to have been made from the shin bone of Kuliakalanaia, an expert fisherman of Kohala, Hawaii, who was without hair on his limbs. As fishes were said to be attracted by the bones of such individuals, he was slain to provide material for fishing implements. The tibia of the right leg was made into the netting needle by one Lualauoho, for nets made with such an implement also retained the attraction for fishes. Kama, the son of the implement maker, inherited the netting needle and had wonderful results with his nets. When he died in 1886, at more than 100 years of age, the needle passed to his grandson, who sold it in 1887. It eventually found rest in Bishop Museum. The shape of this needle (fig. 203, *a*) is the common Polynesian pattern and does not conform to the Hawaiian form. Furthermore, it is made of ivory. As Stokes was skeptical about a fisherman ever possessing ivory shin bones, he sent a sketch of the implement to Professor O. T. Mason, a recognized authority, who identified it as an "Eskimo netting needle." Stokes explains its presence in Hawaii as due to native seamen who often accompanied summer cruises to the whaling waters off the coast of Alaska. The story illustrates once more the fact that the technique of an artifact is more reliable than oral histories, no matter how plausible.

In more recent times, most of the netting needles of European form were made with bamboo; and they had the closed eye, tongue, and fork so characteristic of the foreign article (fig. 203, *b*). In the Museum collection are three needles of bamboo and one of cow horn.

For making the large-meshed shark and turtle nets, no shuttle was used. Stokes (1906, p. 108) states: "The cord was wound over the hand and elbow for several turns, the hank thus formed doubled, and wound with the rest of the cord until a pear-shaped ball was made. The cord could then be drawn from the inside through the point of the ball which retained its shape until expended." This is the craftsman's coil used throughout Polynesia in lashing canoes and houses. In the Hawaiian technique, the pear-shaped ball was passed through the large meshes which were spaced by drawing down the cord with the left hand to the required size of the mesh and then making the netting knot with the right hand.

Net Menders

Net menders (*kiʻoʻe*) were straight pieces of wood, having the thicker handle cut down with a sharp shoulder at its junction with the thinner point part (fig. 203, *c*). In the Museum series of 22, with the exception of one abnormally large specimen, the lengths range from 5 to 7 inches; the handle

thicknesses from 0.25 to 0.3 inch; and the point lengths, from 1.5 to 2.4 inches. The point part at the handle junction is consistently 0.2 inch thick, trimming down to 0.15 or 0.1 inch at the end of the point.

The method of attaching the cord to the mender is described and figured by Stokes (1906, p. 108). Briefly, the cord was attached to the point part with a series of half-hitches forming loops which were made around the fingers of the hand holding the tool (fig. 156). When the cord got too short, the forward half-hitch was unhitched to release another length of cord.

As its name indicates, the *ki'o'e* was used to mend holes in the nets; and it was probably used to join pieces together by running the cord through the

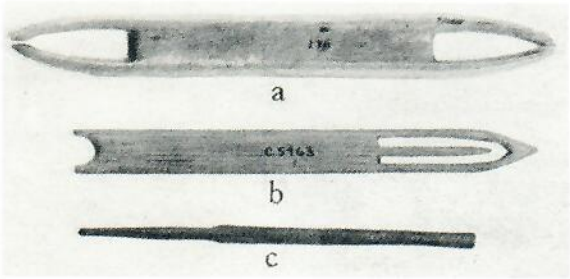

FIGURE 203.—Modern netting needles and net mender: **a**, ivory Eskimo needle; **b**, of bamboo; **c**, net mender.

marginal meshes of the two edges. It was also used as the needle in nets with fine meshes. In the *nae* nets, with a very fine mesh of 0.25 or 0.2 inch, a piece of coconut leaflet midrib was used instead of the thicker net mender.

MESH TECHNIQUE

The setting up of the first row of meshes is described and figured by Stokes (1906, pp. 152-153, fig. 163), and his original figure has been adapted by me in figure 204, the explanation of which follows.

The shuttle, or needle, shown in *a* (1) is filled from the ball of cord (2) and left connected with it. The netter then ties a separate length of cord into a loop (3, 4), which he stretches between his two big toes. The cord (5) from the ball is passed over and under both limbs of the toe loop (3, 4) for three turns from right to left. The mesh gauge (6) is held below the nearest limb (3) of the toe loop at the same distance from it as its own width and the shuttle cord (7) passes behind it. In *b* the shuttle brings the cord (7) up over the front of the gauge, passes over the near toe cord (3), over and around the ball cord between the two limbs (3, 4) of the toe loop, and brings it down in the loop (8) to the upper edge of the mesh gauge.

In *c*, with the loop held against the upper edge of the mesh gauge by the operator's left thumb, the shuttle makes the characteristic fisherman's knot (9). In *d* the fisherman's, or netting, knot is drawn taut and the first mesh (1') is completed. Note that the upper part of the mesh is formed by the ball cord and the lower part by the shuttle cord passing behind

the gauge and up in front of it. After forming the knot, the shuttle passes up under the near limb (3) of the toe cord, over and around the ball cord between the two limbs of the toe loop, and draws down a second loop (10) to the upper edge of the gauge to form the second mesh (2′).

After the mesh technique is established (*e*), the needle, having made the knot on the upper edge of the gauge, is passed alternately over and under the near limb (3) of the toe loop to draw down a mesh loop from the ball cord in its course between the two limbs of the toe loop. This ensures that the upper mesh loop will cross over the single near limb (3) of the toe loop.

The three turns of the ball cord around the taut toe loop kept the cord at the right tension in the formation of the upper half of the meshes. Cord for the continuation of the upper loops was drawn from the ball by loosening the windings around the toe loop.

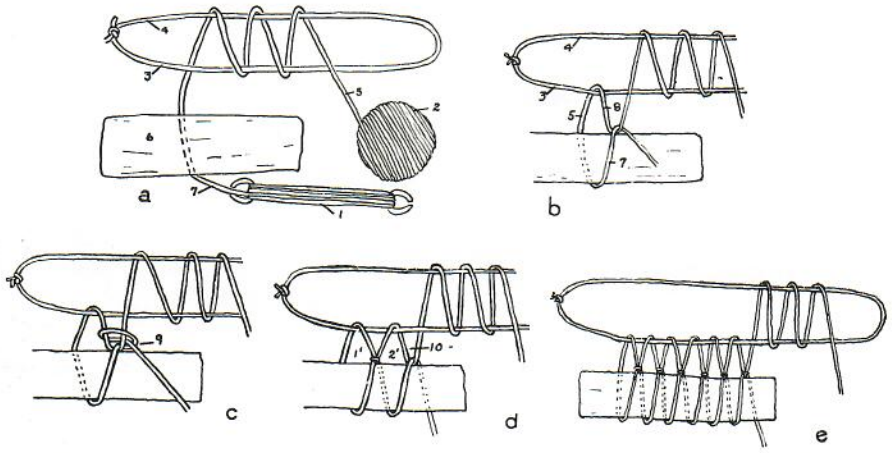

FIGURE 204.—Mesh technique: **a-d,** first row, showing (1) shuttle, (2) ball of cord, (3-5) active cord, (6) mesh gauge, (7) shuttle cord, (8) loop, (9) fisherman's knot, (10) second loop, (1′-2′) first and second meshes; **e,** succeeding meshes.

The first row of meshes was continued until the number required for the depth of the net was reached. The ball cord was cut off at the last netting knot, as it was no longer required to form the upper half of the meshes. It was usual to swing the first row around, as shown in figure 205 and described below.

In *a* the last mesh (10) with the attached needle and cord (1) is on the left, ready to start the second row. The mesh gauge (2) is placed against the lower ends of the completed meshes. The needle with its cord passes down behind the gauge, as before, is brought up in front of it, passes through the completed mesh (10), and the netting knot is tied at the upper edge of the gauge. This technique is continued until the second row is completed on the end mesh of the first row. The completed row is swung around to the left; and so, by successive rows, the length of the net is completed.

In some nets, the depth or width is gradually increased by adding extra meshes, or accrues, in successive mesh rows. This method is shown in *b*. After a normal mesh (1) is

made and an extra loop (2) is made and tied above it to the same upper mesh (3) with the usual netting knot, the cord goes on to make a normal mesh (4) with the next upper mesh (5). The details of the second knot are shown in *c*.

To narrow a net, a dropped mesh, or stole mesh, is accomplished by passing the needle through two adjacent meshes instead of one and tying the two meshes together with the one knot. The details of the knot are shown in *d*, in which the two meshes (1, 2) are brought together for the one knot.

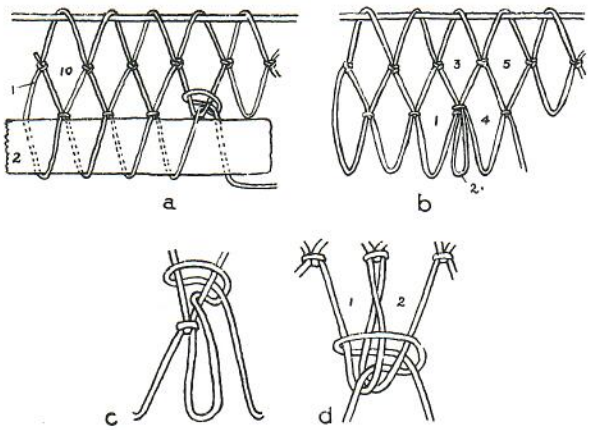

FIGURE 205.—Mesh technique: **a**, second row, showing last mesh of first row (10), to which is attached the needle and cord (1); mesh gauge (2). **b**, extra-mesh method, showing (1) normal mesh, (2) extra loop, (3) upper mesh, (4) normal mesh, (5) next upper mesh. **c**, details of second knot. **d**, details of knot for narrowing net, showing two meshes (1, 2).

The Hawaiians indicated the size of the meshes by the number of fingers which could be inserted in the mesh. The number with the prefix *ma* gave the size, and intermediate sizes were indicated by adding the words *'oa* or *'oene* to the smaller size; for instance, *makahi 'oa* for a mesh greater than one finger but less than two. Two small sizes less than *makahi* were given the special terms of *nae* and *nukunukua'ula*. Stokes (1906, p.107) correlates the native terms with English measurements as follows:

nae, 0.25 inch
nukunukua'ula, 0.5 inch
makahi (one finger), 1 inch
makahi 'oene, 1.5 inches
malua (2 fingers), 2 inches
malua 'oa, 2.5 inches
makolu (3 fingers), 3 inches
makolu 'oa, 3.5 inches
maha (4 fingers), 4 inches
mahae, 4+ inches
malewa, 7+ inches

NET JOINING

The edges of certain parts of bag nets are joined to form the bag, and gill nets may be joined together temporarily to increase their length. Stokes (1906, p. 156) describes five different forms of joining as follows: (1) a separate cord (*'aea*) is run through the meshes of the two sides in turn; (2) opposite meshes of the two edges are tied together with an overhand knot by a separate cord; (3) a separate cord joins alternate meshes on each side with an overhand knot and gives the appearance of continuous netting; (4) makes a row of meshes on one edge and runs the shuttle in turn through the mesh loops on the other edge; (5) the two edges are joined by the usual netting knots with the shuttle.

Some of the smaller nets have been cut from large nets, hence the marginal meshes show knots instead of clear loops, and the cut edges show that the nets have stood up well.

Large nets with big meshes were sometimes joined with a rope by means of Stokes' joining method 1. The rope was termed *kakai*. The joining together of nets was termed *paku'iku'i*.

GILL NETS

Gill nets (*'upena ku'u*) were made by establishing the depth with the first row of meshes, and the Hawaiians recorded the depth by means of the total number of meshes in the row. By repeating the depth rows, the length desired was obtained. Length was usually designated by the number of arm spans or fathoms termed *anana*. The eight nets in the Museum collection range in length from 27 feet to 92 feet, falling within the scope of gill nets. In depth, they range from 6.5 feet to 10.5 feet, and the mesh range is 1.5 to 2.5 inches. One deeply tanned net (B.9323) is 20 feet long, 16.75 feet deep, has a fine mesh of 0.75 inch, has part of a head rope threaded through the marginal meshes, and has no foot rope. This net probably had some specific use.

Stout cords or fine ropes termed *'alihi* were threaded through the marginal meshes of the upper and lower edges. The upper, or head, cord had floats (*pikoi*) attached to it, hence was distinguished as the *'alihi pikoi*. The lower, or foot, cord carried sinkers of stone (*pohaku*) and thus received the name of *'alihi pohaku*. On modern nets, lead (*kepau*) has taken the place of stone, and the foot cord with lead sinkers is termed *'alihi kepau*.

Some of the Museum gill nets retain a few floats, but most of the floats and all sinkers were probably removed by the original owners to make the nets less cumbersome in storage.

While the Museum nets are cataloged under the general term of *'upena ku'u*, they had distinguishing terms based upon the way in which they were used. This is illustrated in the two methods described by Beckley (1883, p. 12) as follows:

The *ʻupena hoʻolewalewa* (hanging net) was a gill net with a 2- to 2.5-inch mesh. It was stretched at high tide between two points across fish runs in shallow waters with a long sandy opening in coral places. One or two persons worked the net, passing backward and forward on the seaward side to take out the fish as fast as they were caught in the meshes. This method was used only at night. The net was also left overnight and the fishes, caught by the gills, taken out in the morning. The *ʻupena ʻapoʻapo* (encircling net) was another method of using the same net. A place where fish were seen or were likely to be was encircled with the net. The fisherman entered the circle and beat the water to drive the fish into the net where they were enmeshed.

Net Floats

Net floats (*pikoi*) were made of pieces of *hau* and, less frequently, of *kukui* wood. Though the very light *wiliwili* is said to lack durability, the floats on some of the Museum nets are recorded as being made of it. The net floats used on various nets may be classed in three forms: cylindrical, D-shaped, and wedge-shaped.

The cylindrical float, common in the Polynesian islands, was made of short sections of the natural bough or stem of the selected plant. The wood was about 2.5 inches in diameter and cut off in lengths of 2 to 4 inches. The bark was re-

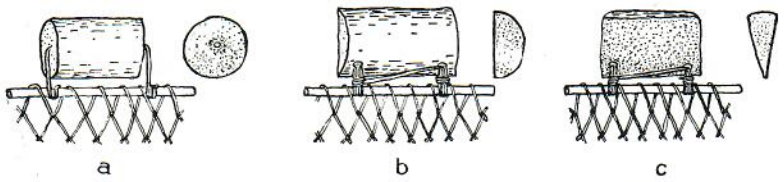

Figure 206.—Net floats: **a**, cylindrical; **b**, D-shaped; **c**, wedge-shaped.

moved and a long central hole bored through the pith canal, though the holes in the floats of one net are off center. A binding cord was passed through the hole and tied at each end to the head rope of the net (fig. 206, *a*). A single float on a large bag net had the hole bored through the side, and the binding cord made a single tie with the head rope. The *wiliwili* floats on a fine-meshed net in the Museum (7072) range in length from 2.25 to 2.5 inches with diameters of 1.25 to 1.5 inches. They are tied closely together as if to make up for their small size.

D-shaped floats were made by splitting cylindrical sections in half lengthwise usually through the pith canal. Thus one surface was flat and the other was formed by the curved outer surface of the wood. They were usually made from longer and thicker wood sections than were the cylindrical floats. (A typical specimen is 4.7 inches long, 2.7 inches deep, and 1.2 inches in maximum

thickness.) Two holes were bored toward the ends of a long edge and the binding cord was passed through an end hole and around the head rope in a number of turns, then around the binding between the float and the rope. The binding cord was usually carried along to the other hole and a similar tie made (fig. 206, *b*).

The wedge-shaped floats are somewhat unique in shape. They were made by cutting out a wedge-shaped piece from a circular section of wood. A typical float from a seine net in Bishop Museum (758) is made from a section of *wiliwili* 4 inches long. The base of the wedge formed by the outer surface of the section is 1.1 inches wide. The two sides are cut down at a slant for a depth of 2.5 inches to meet in a blunt edge 0.4 inch thick. The ends of the base are rounded off, and a hole is bored at each end near the blunt edge of the wedge. The wedge-shaped float was attached to the head rope in the same way as the D-shaped floats (fig. 206, *c*).

SEINE NETS

Seine nets (*ʻupena paloa*) were made like the gill nets but were much longer, as the name *paloa* implies. They were fitted with a head rope with floats and a foot rope with stone sinkers. Some nets had the middle, or bag, deeper than the wings and of a finer mesh. Cobb (1905, p. 721) describes the nets as follows: "At Hilo, the large seines used on the beach average 250 feet in length with bag 7 feet deep, and a mesh of one half inch. The wings average 4 feet in depth with a mesh of 1 inch. They are usually made of No. 9 to No. 8 cotton twine. On Maui, seines 150 feet long, 8 to 12 feet deep, with a 1¼ inch mesh, are used. They have no bag, and several of them are often laced together and used as one net."

Some of the long nets were given specific names based upon the kind of fishes caught or the method of using the nets. The following descriptions are after Beckley (1883, pp. 12-13).

The *ʻoʻio* net (*ʻupena ʻoʻio*) is 80 to 150 fathoms long and 2 to 3 fathoms deep, with a 3-to 4-inch mesh. It was used in deep water near the reef. The fishermen went out in canoes, and the lookout (*kilo*) stood in the bow watching for a school of *ʻoʻio*. When a school was sighted, the canoes followed at a respectful distance until the fishes moved into a sandy-bottomed fishing ground termed *kuʻuna* (*kuʻu*, to let down). One canoe approached cautiously and stationed itself at the place where the net was to be dropped. Another canoe, with a similar net, made a wide circuit until it was opposite the first canoe with the school of *ʻoʻio* between them. One end of each net was dropped simultaneously, and the two canoes paddled swiftly in a semicircle to meet the dropped end of the other net, paying out their own net as they went. The first canoe to reach the end of the other net kept on paddling on the outer side of the circle, still drawing its own net after it to diminish the size of the circle. It made two or

three rings of netting around the fish so that if they did bear down the float line of the inner circle with their weight, their escape was prevented by the outer rings. When the head fisherman was satisfied that everything was secure, he gave the signal and all the fishermen jumped overboard into the circle. They beat the water with their hands or with paddles to drive the fishes into the net, where they were caught in the meshes.

ʻUpena kaka refers to a method in which the net or nets were dropped in a semicircle in shallow water for mullet or *ʻoʻio*. A man at each end held the end sticks (*kuku*) of the net upright. The other fishermen, who made their way to a position opposite the net, spread out fanwise and moved in quickly toward the net. They beat the water with their hands to drive the fish into the net semicircle. As the driving party neared the net, the two end men moved quickly toward each other to completely enclose the fishes. The ends of the net were gathered together to reduce the size of the circle. This method was used day or night; but night fishing yielded better results, for numbers of rock fishes (*iʻa koʻa*) and fishes which had come in from the sea (*iʻa hele*) were caught.

The finest net of the *ʻupena paloa* class, according to Beckley, was made with the *nukunukuaʻula* mesh, which was 0.5 inch. The net was 40 to 60 fathoms long with a depth of 1.5 fathoms. Like other seine nets, it was fitted with wooden floats and stone sinkers. It was drawn in shallow water to catch small mullet and milk fish (*awa*) with which to stock the fish ponds.

An *ʻupena paloa* with 1- to 2-inch mesh was used for the larger mullet, *awa*, *weke*, and *paʻuʻu ulua*.

HAND NETS

The term hand net is here applied to small bag nets supported by some form of wooden frame and used by one person. The six specimens in the Museum divide into two forms: (1) an oval frame coming to a point at one end and (2) a frame of two straight sticks. The nets with oval frames were used as scoop nets, and it is convenient to describe them as such.

Scoop Nets

The four scoop nets in the Museum collection have the same general construction: a length of pliable wood bent in a distal curve, the ends brought together to fix the shape. As it is not possible to make a large frame out of one length of wood, extra pieces are spliced on at the sides. A short crossbar is usually lashed to the two sides of the frame near their junction at the pointed end, which was used as a handle.

The smallest net (10376) has a frame formed of a pliable wood strip, 55.5 inches long, 0.5 inch wide, and 0.3 inch thick (fig. 207, *a*). The wood is bent in the middle in a curve, and the two ends are inserted through the marginal meshes at the sides of the net. A crossbar, 8.5 inches long, is tied to the two

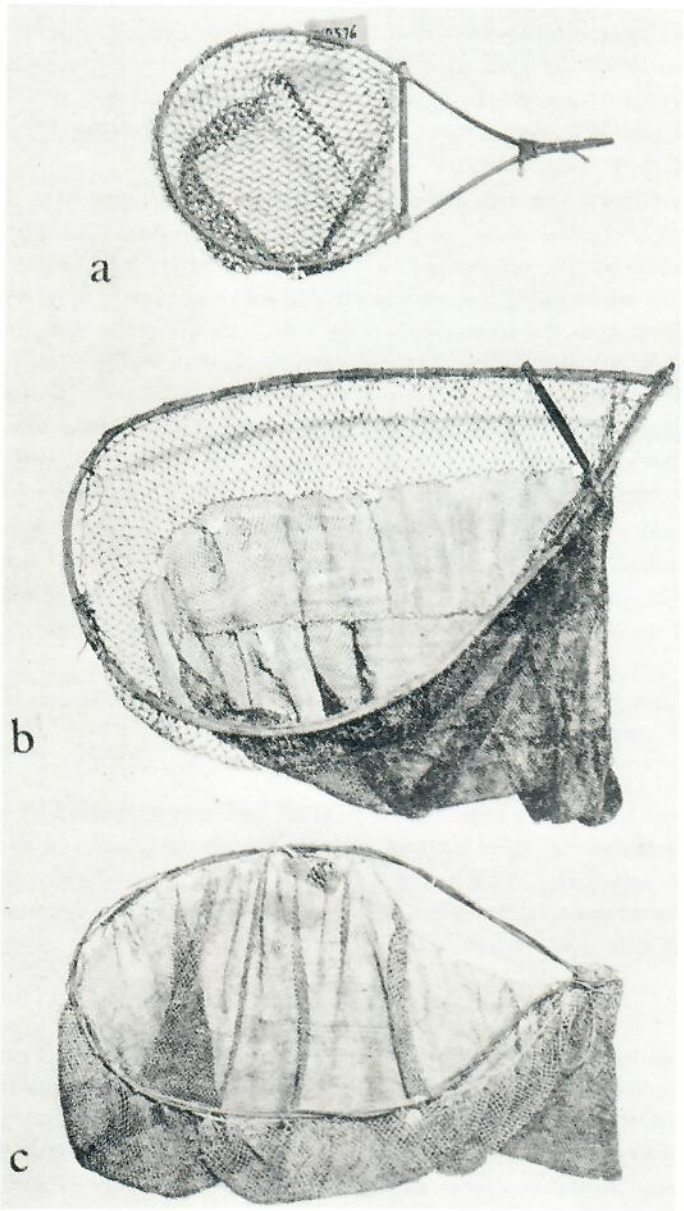

FIGURE 207.—Scoop nets: **a,** smallest net with pliable wood frame and crossbar; **b,** larger net with extended rod frame and crossbar; **c,** with vine frame, lacking crossbar.

sides of the frame at a distance of 12 inches from the far end of the frame. The crossbar fixes the shape of the frame, which is 12 inches at its widest part. The two ends of the hoop are brought together 5.5 inches from the crossbar and lashed together. The ends extend 4.75 inches to form the handle. The unattached far end of the net is tied to the frame by a continuous cord, which makes double half-hitches through a marginal mesh and around the frame at intervals of 1 to 1.5 inches. The near end of the net is fixed in front of the crossbar by a double cord which passes through the marginal meshes and is tied to the frame on each side. The net material is coir cord, the mesh is 0.5 inch, and the depth of the bag in the center is about 7 inches. This type of net was used for scooping up fishes that had been surrounded by seine or gill nets.

The frame of a larger scoop net (761) is formed of a rod 72 inches long and 0.5 inch thick to which is added a piece 11 inches long with a 4-inch overlap (fig. 207, *b*). When bent around to make the ends meet, the hoop is 32 inches long and 17 inches at its greatest width. An 8-inch crossbar with notched ends is lashed to the two sides at 6.5 inches from the lashed ends, which form a handle. The upper part of the net is a piece 5 inches deep with a 0.5-inch mesh. Rectangular pieces of *nae* netting with a 0.2-inch mesh are joined to the upper piece and to each other by means of a cord threaded through the marginal meshes on each edge. In all, 15 pieces of *nae* netting of different sizes are joined and arranged to form a bag net which slopes downward for a depth of 21 inches near the handle end. The upper strip, made to fit the circumference of the frame, has a cord run through the upper marginal meshes and fixed to the frame by a binding cord in single half-hitches at intervals of 2.5 inches. This net was used to catch *pao'o* and *'i'iao*, small fishes which required the fine-meshed *nae* net to hold them. Thus the net was named *'upena pao'o* or *'upena 'i'iao*.

Another form of scoop net (765) has a frame constructed from two long vines only 0.15 to 0.2 inch thick (fig. 207, *c*). The two vines are bent in a curve at the middle, twisted over each other, and their ends tied together, making a frame 28 inches long and 10 inches at its widest part. No crossbar is used. The net of fine-meshed *nae* is 88 inches long and 10 inches deep. It is doubled lengthwise, and the edges at the bottom and the open end are joined together by the netting technique to form a bag 44 inches long and 10 inches deep. A double cord is threaded through the upper marginal meshes and attached to the frame by a binding cord which passes in long spiral turns around the cord and the frame. In making the spiral turns, the extra length of netting is gathered in along the marginal cord and the short extra length left over is drawn in and tied to the pointed end of the frame. The ends of the binding cord are tied to the frame on each side with overhand knots some inches from the pointed end of the frame, with the result that some of the marginal meshes sag down from the frame. These nets were used by women, usually at night, to catch a small

rock fish named *pao'o* and *'opae* (shrimps). The nets were named *'upena pao'o* and *'upena 'opae*, respectively.

A very large scoop net (5176) has a frame formed of three sticks: two side sticks, 6 feet 1 inch and 6 feet 6 inches long and 1 inch thick, and an end stick, 6 feet 9 inches long and 0.75 inch thick. The ends of the end stick are lashed to the ends of the two side sticks with a 5-inch overlap. The end stick is curved by means of the free ends of the sticks being brought together and lashed. A cross-bar 11 inches long is tied to the two sides 16 inches from the pointed end of the frame. The net, which forms a bag 3 feet deep, has a 1-inch mesh. A cord run through the upper marginal meshes of the net is tied to the frame by means of a binding cord and half-hitches at 2- to 4-inch intervals. This net is old and torn, and fractures in the brittle side sticks have been splinted by someone in the Museum. There is no record of the name for this net or of its specific use.

TWO-HANDLED SCOOP NETS

Nets with two parallel sticks instead of a hoop for the frame were termed *'upena ahu'ulu*. In one Museum specimen (764) the two sticks are 44 inches long and 0.4 to 0.2 inch thick. The net, composed of dyed *wauke*, according to Stokes (1906, p. 155), has been cut from a larger net to a rectangular piece 34 inches long and 24 inches deep and has a 1.25-inch mesh. The depth is reduced to 12 inches by doubling the net, and the two open ends are closed by a cord which makes overhand knots on alternate meshes of the two edges, thus forming a bag 34 inches long and 12 inches deep. The two sticks are inserted through the marginal meshes of the two upper edges, and the far ends of the two sticks are tied with a cross cord which passes through a marginal mesh with an interspace of 1.5 inches between the sticks. At the handle end of the net, the sticks are similarly tied 2.5 inches apart; and from there, the sticks extend 10 inches as handles (fig. 208, *a*).

In a similar net (763) the two sticks are also 44 inches long and 0.3 inch thick. The net of brown cord and a 0.75-inch mesh is cut from a larger net to a length of 67 inches and a depth of 16 inches. The net is doubled lengthwise, and the bottom and the open end are closed by a cord which ties opposite marginal meshes together with an overhand knot. The bag is 33.5 inches across and 16 inches deep. The two sticks are attached in exactly the same way as those in the preceding net (764), but the distances between them are 2 inches at the outside and 2.5 inches at the handle. Beckley (1883, p. 15) terms this net *'upena ulu'ulu*, or diver's net. She gives the measurements as 30 inches long and 30 inches deep, the mesh as 2 inches, and the space between the sticks as 6 inches. This net was used by men. A man dove down to small caves or holes and placed a net across the opening. He inserted a *pula* (broom) into the cavity and gently drove the fishes out into the open mouth of the net, then he brought the two sticks to-

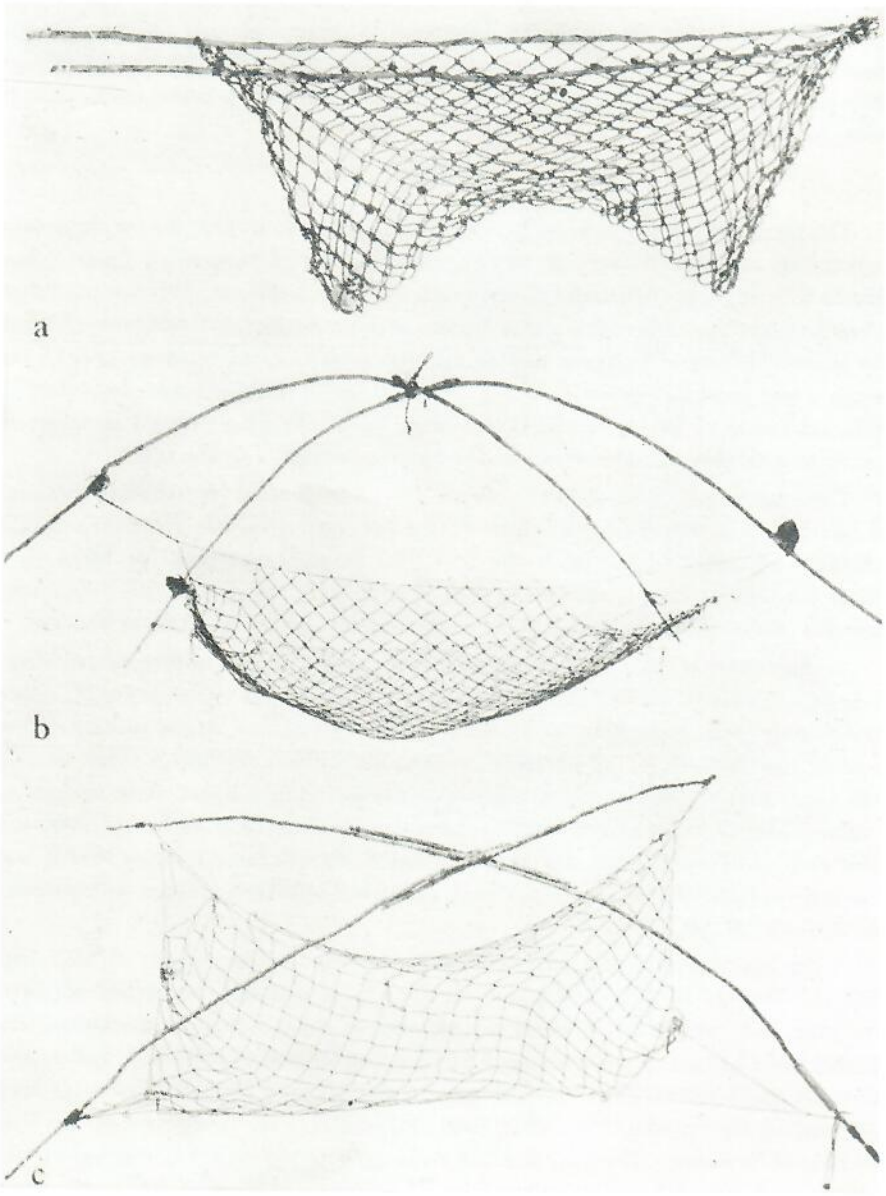

FIGURE 208.—**a,** two-handled scoop net; **b,** orthodox dip net; **c,** rectangular dip net made with reef knots.

gether to close the net opening. He placed his broom over the closed opening and came to the surface, where he emptied the catch into his canoe.

It is evident that the sticks in these two Museum nets are tied too closely together. Probably the ties were lengthened in actual use, though Kamakau says that pressure against the fixed ends from the handles bent the sticks into a wider opening.

Dip Nets

The term dip net is confined herein to square pieces of net tied by their four corners to the arched ends of two crossed sticks and suspended from a line tied to the crossing of the sticks. There was no bag in the net until the weight of a fish brought the ends of the sticks closer together as the net was drawn through the water. Sinkers of stone and, later, of lead were tied to the lower part of the sticks a few inches from their ends. Dip nets were of different sizes for catching different kinds of fishes. In the larger ones, the sticks were spliced in order to maintain a thickness that would bend to the requirements of the net.

The crab net (*'upena papa'i*) differed from the general type described above in having a circular hoop to which a bag net was attached. Four equidistant strings were attached to the frame and then brought together for tying to a single suspensory cord. Such a net was figured by Cobb (1905, pl. 103), who shows a stone sinker suspended from the outside of the bottom of the net.

A Museum specimen (762) labeled *'upena papa'i* is unsatisfactory evidence. It is described by Stokes (1906, p. 157) as a flat circular sieve 20 to 23 inches in diameter, with a circular-hoop frame. When I examined it, the lashing of the ends of the hoop stick had loosened so that the ends projected. A thick cord is tied alternately to the two sides with clove hitches an inch apart. A second set of cords crosses at right angles and is tied to each of the first set by an overhand knot as it crosses. It is not netting, as Stokes observes, and he states that it was "mainly useful in throwing crabs ashore after they had been enticed within range by a piece of bait."

A dip net of the orthodox type (766) is recorded as an *'upena 'aki'iki'i* (fig. 208, *b*). The net is 33 inches square with a 1.5-inch mesh. The arched supports are four rods which are 41 inches long and 0.4 to 0.3 inch in thickness. The thicker ends of two of the rods are trimmed flat on one side for 6.5 inches, and the ends are notched. The flat sides are overlapped and lashed together at each end and in the middle. The other two rods are treated similarly but have an overlap of 5 inches. The two flexible rods are 76 inches long, crossed in the middle, and lashed firmly together with diagonal turns. A marginal cord which runs through the meshes of the four edges of the net is tied at the four corners of the net in such a manner that a 7-inch loop of the marginal cord is formed at each corner. These four loops are tied to the lower part of the four sticks about 7 inches from their ends. The four ties draw the four limbs into taut

arches. Small stone sinkers are tied to each limb above the net lashing with transverse turns around sinker and stick, followed by a few turns around the lashing between the sinker and the stick. On each of the four sides the sticks are 48 inches apart; diagonally, 68 inches. This net was used for catching *pahuhu*, a young stage in the growth of the *uhu*.

A larger dip net termed *'upena uhu* (fig. 208, *c*) was made for catching the full sized *uhu*. In Bishop Museum specimen 767 the net is a rectangular piece of netting 56 inches long by 45 inches wide, made of thick cord (0.1 inch) and with a 2.75-inch mesh. Unlike the other nets in which the usual netting knot was used, the meshes of this net are made with reef knots. Each of the two arched rods is formed of two pieces 53 and 50 inches long and 0.5 to 0.3 inch thick. The thick ends are trimmed flat on one side for a 4-inch overlap, which is lashed at each end. In addition, a third rod, 24 inches long, is laid evenly over the middle part and its two notched ends are lashed to the long rods on each side. A middle lashing is made around the three rods with an intermediate lashing on each side. The short rod materially strengthens the middle join by its longer overlap. Kamakau states that the sticks were of *walahe'e* (*Canthium odoratum*) wood. The two compound sticks are crossed in the middle line; but instead of being lashed firmly together, thick cord from the under stick is carried upward for 2.5 inches before it is lashed to the middle of the upper stick. This form of tie gives considerable play to the two arches; and from the crossed position, they can be brought close together in the same line. Cords through the marginal meshes are tied to the four limbs with a stretch of 5 inches between the net corner and the stick and a distance of 5.5 inches from the ends of the sticks. Lead sinkers are wrapped around each stick just above the net tie.

A larger *uhu* net in the Museum (768) has cross sticks 8 feet 9 inches long, each formed of two pieces with a 3.5-inch overlap. The sticks are 0.6 inch thick at one end and 0.4 inch at the other end. The net, with a 2.5-inch mesh, is a rectangular piece 6 feet long and 4 feet deep. The play of the middle lashing between the two sticks is 1 inch. The other details are similar to those of the preceding net (767).

The *uhu* net was used in water where the bottom could be seen after chewed *kukui* nuts were spat over the surface. Beckley (1883, pp. 15-16) and Kamakau give good accounts of this form of fishing. The fisherman, on reaching the fishing ground, caught an *uhu* on a hook and kept it alive as a decoy. After a line was passed through a gill opening and the mouth and tied, the decoy was lowered to the bottom and moved about with the line to attract the attention of other *uhu*, a process termed *ho'ohaehae* (teasing). When other fish were attracted, the net was carefully lowered to a short distance from the decoy, which was gently drawn onto the net. When a fish followed the decoy onto the net, it was quickly drawn up. The flexible arches bent over as the weight of the fish caused the net to sag into a bag. Hawaiian fishermen found from experience that the *uhu* tried to

escape by diving downward and that a form of net without a deep bag was sufficient for their capture. It is said that there was a trick to pulling the net string so that the two arched sticks swung together from the crossed position.

BAG NETS

Nets with a bag or enclosure, into which fish were driven, were made in several forms. The Museum collection of 10 bag nets includes four types: a fine-meshed net termed *'upena nae kuku*, a net for flying fish (*malolo*), and two different kinds of tubular nets.

Nae Kuku Bag Net

Nae kuku bag nets were made from pieces of *nae* netting, which had an 0.25-inch mesh. The pieces, rectangular in shape, were joined together, usually by a cord passed through the marginal meshes of adjoining meshes. The large rectangular piece so formed was doubled on itself and the bottom or one end was closed by the marginal cord method to form a rectangular bag open at one end

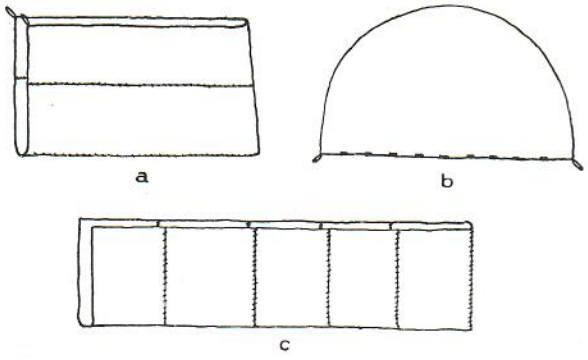

Figure 209.—*Nae kuku* bag nets: **a**, joining of two pieces of netting to form bag; **b**, attachment of *'alihi* cords; **c**, large net made of five long pieces of net.

and along the upper edge. A strong cord, corresponding to the *'alihi* cords of gill and seine nets, was attached along the free edges. In the Museum series of six *nae kuku* nets the bag and the attachment of the cord are formed in the same way. When the net was in use, a stick (*kuku*) was used at each end of the foot rope.

In the smallest net of the series (B.2985) the bag is formed of two pieces of *nae*, each 10 feet long, and 15 and 18 inches deep respectively. The two pieces are joined on their long edges and the whole piece doubled over from right to left to form a double rectangular piece 5 feet long and 33 inches deep (fig. 209, *a*). Owing to the lengthwise doubling, the right end is closed but the bottom is

open. The bottom edges of the two sides are joined by a marginal cord (*'aea*) to form a bag open on the left end and on the upper border.

To prepare for the attachment of the *'alihi* cords, a continuous cord, which may be termed the mesh cord, is passed through the marginal meshes of the left edges and another through the upper edges. The left edges and upper edges form two continuous lines at right angles to each other when the bag net is opened out. A stout three-ply *'alihi* cord is laid along the edges and tied to the mesh cord by a separate binding cord which makes single half-hitches around them at intervals of 2 to 4 inches, as shown in figure 209, *b*. At the two corners where the left and upper edges meet, the *'alihi* cord is formed into short loops before it continues on; and the loops are fixed at their crossing by transverse turns of a separate thread. The *'alihi* cord on the left functioned like the foot rope in gill nets with sinkers; and the upper *'alihi* cord, though joined at right angles with the other, functioned like the head rope with floats. When opened out, the foot rope is twice 33 inches wide, or 5 feet 6 inches, and the head rope is 10 feet long.

In the largest of the six *nae* nets (757) the bag is formed of five long pieces of *nae* netting, 10 feet 8 inches long but varying in width from 4 feet 7 inches to 5 feet 4 inches (fig. 209, *c*). The five pieces are joined on their long edges by the *'aea* cord method to form a single rectangular piece 25 feet 2 inches long and 10 feet 8 inches deep. It is doubled from below upward which reduces the depth to 5 feet 4 inches, but the length remains at 25 feet 2 inches. The bottom of the bag is closed by the fold, but the two ends are open until the right end is closed by an *'aea* cord. The foot rope on the left and the head rope on the upper border are attached in the way just described.

Though the large net and the small net are folded differently, the result is similar. The other nets follow one or the other of the two ways of folding. There is also variation in that the single rectangular piece may be made up of a number of pieces of different sizes, sometimes with different sized meshes. However, they are all rectangular and fit together to form the larger rectangular piece. Most of the pieces have been cut from older nets, as the cut edges plainly show. Some pieces of net in the Museum collection, ranging in length from 2 feet to one very long piece 34 feet long and 6 feet 3 inches in depth, were evidently reserve stock.

The foot ropes in all the Museum nets are weighted with lead sinkers formed of short flat pieces which are bent around it at intervals of 14 to 18 inches. And in all of these nets the floats are missing from the head rope.

In use, the foot rope with its sinkers was stretched to full length on the sea bottom. The lower ends of the two sticks (*kuku*) were stuck through the loop at each end of the foot rope. Beckley (1883, p. 14) says that in the smaller nets the sticks were about 3 feet long. The sticks, which were probably also attached to the adjacent sides of the head rope, were held upright or at a slant by two men

while the rest of the head rope with its floats curved behind, thus forming an irregular rectangular opening to the shallow bag. A thick, bushy rope of twisted beach morning-glory was attached to each of the *kuku* side sticks. These ropes were drawn forward in a semicircle, sweeping shoals of fry before them until enough were partly enclosed, when the two ends were brought rapidly together to complete a circle. The circle was gradually decreased by overlapping the ends, driving the fishes into the bag nets. This net was used to catch mullet fry for stocking the fishponds or for eating; and such other small fishes as the *nehu, piha,* and *ʻiʻiao* were also caught for bait or for eating.

Beckley (1883, p. 16) evidently distinguished the smaller *nae kuku* nets as *pua* nets and the larger ones as *ʻupena ʻiʻiao* and *ʻupena nehu,* according to their use at the time. The *ʻiʻiao* and *nehu* are small fish which come in immense shoals at certain seasons. They were much used as bait and were also pickled and dried for eating.

ʻOhua Bag Net

The *ʻohua* is a small fish, highly prized by the Hawaiians, which lives in and on the coarse *kala* seaweed growing on coral in shallow water (Beckley, 1883, p. 14). The net used for it is the *ʻupena ʻohua,* represented in the Museum by one specimen (7072). This net is made much like the *nae* nets. Stokes (1906, p. 162), who describes the Museum specimen, states that it is made of "pieces of netting purchased from and netted by the Chinese from Chinese fibre and run together by natives by *aea* (marginal cord) in what is probably one of their ancient forms of fish nets." The foreign make of the netting probably accounts for the fact that the meshes are made with a reef knot instead of the usual fisherman's knot characteristic of the Hawaiian technique, yet the mesh is the *nae* style and is 0.25 inch. Four pieces are joined together to make the bag shape shown in figure 210. At the tapering end is a hole 2 inches in diameter which could be closed during operations. The full length of the doubled foot rope is 11.8 feet; that of the head rope, 19.5 feet at full stretch. Both the ropes, or rather thick cords, are threaded directly through the marginal meshes of the free edges. Small flat pieces of lead are bent around the foot cord at intervals of 14 to 18 inches, as in the *nae kuku* nets. Fortunately, this net has a full complement of cylindrical floats strung close together on a separate float cord. The 81 floats of *wiliwili* wood average 2.25 inches in length and 1.5 inches in diameter. The float cord, which is the same length as the head rope, is attached to the head rope by a separate binding cord, which makes half-hitches around the two ropes in the close intervals between adjacent floats. Long cords are attached to the corners at the ends of the foot rope for tying to the *kuku* side sticks when the net is in use.

Beckley (1883, pp. 14-15) gives the following clear description of the *ʻupena ʻohua* fishing method, a variation of *nae kuku* fishing but on a larger scale.

> . . . Long ropes, one, two, or even three hundred fathoms in length having dry ki leaves braided on them by the stems, the blade ends of the leaves hanging loose and free, are

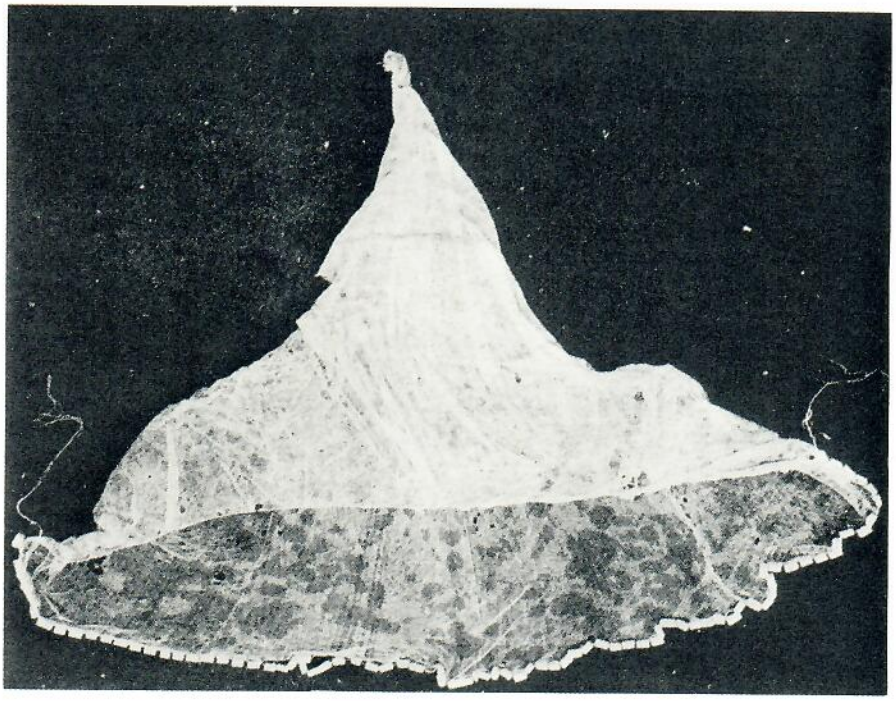

FIGURE 210.—*'Ohua* bag net.

started from a given place in opposite directions to sweep around and finally enclose a circle which is afterwards reduced in the same manner as in long, or pua fishing. Great numbers of men, women and children assist at this kind of fishing to hold the ropes down to the bottom, and by the splashing and disturbance of the limu drive the fish away from the ropes and into the net. Persons are generally stationed every yard or so on the ropes for this purpose and also to disentangle the ropes if caught on a rock or other obstruction. When the circle is narrowed to from ten to fifteen feet in diameter, one end of the ropes is untied and the ends attached to the ends of the kuku of the bag net, forming a guard on each side, and the circle further reduced till the fish are all driven into the net.

PAPA BAG NET

The *'upena papa* bag net is described by Beckley (1883, p. 18) as being larger than the *'ohua* net but resembling it in general shape. A bag net in the Museum collection (760) is cataloged as an *'upena makahi*; but as *makahi* is a general term for a one-finger mesh, which is descriptive of one feature of the net, it cannot be regarded as a specific term for the net. To judge from its size and its resemblance to the *'ohua* net, it is probable that the Museum net belongs to the *'upena papa.*

The Museum net, when flattened out, is 26 feet wide at its open mouth and 20 feet long with an additional cylindrical bag extending another 3 feet from the narrow end. The main, or funnel, part is made up of pieces of netting with a 1.4-

inch mesh. A long piece 6 inches deep runs transversely around the mouth and is fitted with a cord through the marginal meshes of the free edge to define the mouth. Other pieces are joined lengthwise with an *'aea* cord to form the shape shown in figure 211, *a*. The cylindrical bag at the small end is 2.5 feet wide on the flat and is 3 feet long. It has a finer mesh (0.75 inch) than that of the funnel. Though the free end is open, it has an attached cord with which to close the opening when the net is in use. Around the mouth are eight double cords 14 inches long, attached to the marginal cord at equal intervals and knotted at their free ends to form loops. Smaller loops, 3 inches long, are also attached to the marginal cord at 2-inch intervals.

According to the Museum catalog, this net was used for catching *malolo, pu'uki'i* [*puhiki'i*], and other fishes.

Another bag net in the Museum (B.7355) resembles the above-described net in principle but is longer and narrower. Its total length is 34 feet. The mouth

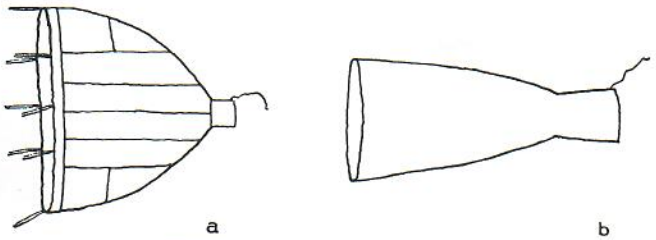

FIGURE 211.—**a, b,** *papa* bag nets.

opening is 13 feet 7 inches deep; but the net reduces to a width of 11.5 feet in the middle, to 3 feet 9 inches at its narrowest part (where it joins a pocket 7.5 feet long), and to 5 feet 10 inches at its outer end (fig. 211, *b*).

The method of using the net is given by Beckley (1883, pp. 18-19), who says the term *lau kapalili* (trembling leaf ropes) stems from the use of two ropes (*lau*) 300 or 400 fathoms long with ti leaves attached in the same way as the *lau* used with *'ohua* nets. She adds the following information.

The *lau* ropes from two or more *'ohua* nets were joined to make two long ropes, which were piled with the net on a double canoe and taken out to two or three miles from shore. A fleet of 60 to 80 single canoes accompanied the double canoe, in which the head fisherman rode. Operations were begun at the proper distance and exactly opposite the final drawing place. The end of one rope was joined to the end of the other and two canoes manned by eight or 10 strong men took the free end of the *lau*, one each. The two canoes started off in opposite directions and parallel with the shore, while the double canoe remained stationary with the middle of the *lau* ropes. The rest of the canoes divided into two groups which followed the two leading canoes and stationed themselves at intervals along the *lau* to help in pulling it. With the *lau* paid out, the two leading canoes curved

in to form a semicircle, at the same time moving steadily toward the shore. When a perfect semicircle had been formed by the *lau*, the double canoe and the others moved gradually forward with it as the leading canoes pulled with all their strength toward the shore. As each end landed, the crewmen leaped out of the leading canoes to haul on the *lau*, at the same time moving toward each other to narrow the semicircle. Meanwhile, most of the canoes kept backing the double canoe which kept to the middle of the *lau* where the two ends were tied. On arriving at a clear sandy space a few rods from the shore, the *lau* ropes were untied and attached to each side of the *papa* net which was dropped into the water. Men, women, and children gathered closely on the *lau*, especially where it joined the net, and they made a great disturbance with their feet to drive all the fishes into the net. The *lau* and the net were finally drawn ashore.

Kolo Bag Net

The *'upena kolo* is described by Beckley (1883, p. 18) as an immense bag net, 16 to 24 fathoms in depth, made of small-meshed netting. It was narrow at the extreme end but widened out into an immense flaring mouth. Long nets termed *pepeiao* (ears), 16 to 20 fathoms deep, were attached on each side of the bag net. This net could be used in only a few places, such as Honolulu Harbor and Puuloa. It was swept from one side of the harbor to the other, scooping up every kind of fish; and, adds Beckley, many sharks a fathom long were caught. The net was generally used when the mullet was in roe, and it was designed for catching large quantities of that fish. It required a great many hands to manage the net.

Malolo Bag Net

The flying fish bag net (*hano malolo*) in Bishop Museum (5310) is a stretch of open netting 32 feet long with the addition at one end of a tubular portion 9 feet long. The length of netting is made up of seven pieces which range from 3.5 feet to 10 feet in length and are joined by means of a thin rope through the marginal meshes of adjoining edges. The plain end is 24 feet 8 inches wide, gradually narrowing to 15 feet 9 inches in the middle and 8.5 feet at the tubular junction. The open part of the net is made of ordinary cord netting with a 1.25-inch mesh. The tubular part, or bag, is 8.5 inches wide at the bottom with an arch of 12.5 feet to complete the tube, which is open at its free end. A strong cord is attached to the meshes near the outer opening evidently to close it when the net is in use. The cord of the bag part is much thicker (0.2 inch) than that used in the rest of the net, and its mesh is smaller (0.75 inch). A rope is run through the marginal meshes of one long edge, and a cord is run through the other edge. In addition, two thick ropes are stretched along the under surface and tied at intervals to the net meshes with strips of *hau* bast. Ropes are also attached to the corners of the free end. A single cylindrical float is tied to the

upper side of the bag, but it is probable that additional floats were used in actual netting.

Beckley (1883, pp. 17-18) gives the following information about the use of the flying-fish net. The net was taken out into deep water with a fleet of 20 to 40 canoes in attendance, and women often went to help in paddling the canoes. A lookout (*kilo*) went ahead in a light canoe, followed by the head fisherman with the net. On seeing a strong ripple on the water, the indication of a shoal of flying fish, the lookout signaled and pointed to the spot. The attendant canoes paddled wide to surround the spot. The head fisherman studied the set of the current and decided on the best place to drop the net. With the net spread, the canoes all paddled toward it, splashing the water to drive the fish inside. Beckley adds that flying fish do not dive to any depth and that they can be driven in any direction when surrounded by canoes. According to her, the fleet went miles out to sea after flying fish, hence this form of fishing was referred to as *lawai'a o kaiuli* (fishing in the blue sea).

A Hawaiian fisherman gave me additional information. He said that the net was let down lengthwise with the bag part kept near the surface by the floats. The ropes tied to the corners of the lower end of the net were held by men in a canoe on each side and some distance apart. As the driving canoes came in close, a diver went down to see if the fish had passed the end of the net. If so, he came up with one arm stretched vertically above his head as the signal of entry. The men in the two canoes hauled vigorously on the ropes to bring up the lower end, and the fishes were thereby driven into the bag.

Beckley (1883, p. 17) states that the *hano malolo* net was also used to catch *iheihe*, which appear in shoals at the same season as the flying fish, and *akule*, another shoal fish.

FISH TRAPS

INTRODUCTION

Traps of various sizes were made for catching small freshwater fish and prawns in streams and for trapping small or large fishes in the sea. Permanent traps were made of the aerial roots of the *'ie'ie*. Small temporary traps were roughly made of the vines of *'awikiwiki* (*Canavalia galeata*) and, according to legend, of *'inalua* (*Cardiospermum halicacabum*).

The Bishop Museum series of 22 traps contains three distinct types: low, circular traps with the entrance above; long, cylindrical traps with openings at the ends; and funnel-shaped traps with the small end closed. Before construction, the bark was removed from the aerial roots which were used in split or unsplit lengths to provide warps and wefts, as in the process of making twined baskets. The warps were the passive elements which were combined with the active wefts by the process of twining.

LOWER, CIRCULAR TRAPS

The nine low, circular traps in the Museum are small, ranging from 3 to 7.5 inches in height and from 5 to 11 inches in greatest diameter. Much larger traps are described in the literature for catching large sea fish, and the indications are that they were made with the same technique used in the small traps. The general name was *hina'i* (basket), qualified by the name of the fish for which it was made; *hina'i 'o'opu*, for instance. However, the term *'ie* in combination with the name of the fish was also used for the larger traps; *'ie palani* and *'ie kala*, for instance. The small traps were set in the freshwater streams for *'o'opu* and in the shallow sea for *hinalea*, which were in much demand for bait.

All traps had a funnel or open cylinder which projected downward into the trap from the upper surface, with which it was continuous in structure. An opening was also made on the bottom of the trap for easy extraction of the

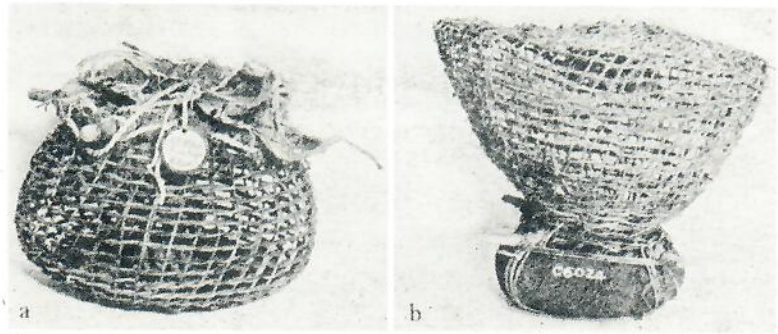

FIGURE 212.—Low, circular traps: **a**, typical form; **b**, with stone sinker.

catch. In use, the bottom opening was closed with a flat stone which served to anchor the trap. All traps were started at the inner, or lower, end of the funnel; and on completion of the funnel, the twining was expanded into the body of the trap and then reduced gradually to the rim of the lower opening, which completed the trap.

A typical trap (10986) made of thin vines (fig. 212, *a*) was started at the funnel opening. The commencement is shown in figure 213 and described below.

In the first step (*a*) a long warp (1) is enclosed at its middle by another strip (1') which is doubled around it and so forms a single-pair weft. Next (*b*), the warp (1) is turned upward with a U-turn, a second warp (2) is added to it, and the pair is enclosed in the next half twist of the weft. In *c*, the technique established, the lower part of the second warp (2) is turned up, a third warp (3) is added to it, and the next half turn of the weft encloses the double warp so formed. Warps are added until there are 20. The first weft round which joins them together is bent around in a circle, and the lower part of the warp 20 is turned up to form a double warp with the left limb of the first warp (1) and thus fixes the circular opening with a smooth edge formed by the U-turns of the warps. The first weft round (1') turns upward without a break to make the diagonal row (2'), to reach a

distance of 2 inches from the first round. It then commences a second weft round (3′) parallel with the first, which after completing the round of the warp on the seventh and eighth warps (7, 8), forms the upper boundary of the entrance funnel, which in this trap is cylindrical, the diameter of the lower and upper ends being 2.5 inches.

The completed outer opening (*d*) is turned toward the worker. The double warps which emerge from each of the turns of the last weft row (3′) are flattened out at right angles to take part in the formation of the upper surface of the trap. The double warps are separated to form 40 single warps, and the continuous weft row (4′) is inclined outward at the point where it overlaps the last weft row (3′) to twine around the single warps until it reaches the desired spacing of 0.5 inch (5′). From now on, the weft continues in spiral rounds parallel to each other until the fifth round completes the upper surface. With the increasing circumference of the rounds, the interwarp spaces widen from 0.3 inch to 0.5 inch on the fifth round.

The completed upper surface turns downward and the warps curve upward to form the body of the trap. After four rounds, the trap reaches its greater diameter, 8.5 inches. The increase in diameter is obtained by increasing the interwarp spaces, which on the fourth round, reach 0.7 inch. There is thus no necessity for adding fresh warps. In the continuous weft rounds, however, when a weft ply runs short, a new one is added (*e*), in which the shortening ply (1) is turned upward on a warp and the fresh ply (3) is added as shown.

From the widest part, the body is gradually reduced in diameter by bringing the warps closer together; and toward the end, two warps are brought together and treated as double warps (*f*). After 10 weft rounds, the trap has reached its maximum height of 5 inches, and it is finished off by bending the free ends of the double warps around the warp in front (on the right) and then over the outer side of the last weft round (*g*). The rim opening, which is to be the bottom opening, is 5 inches in diameter.

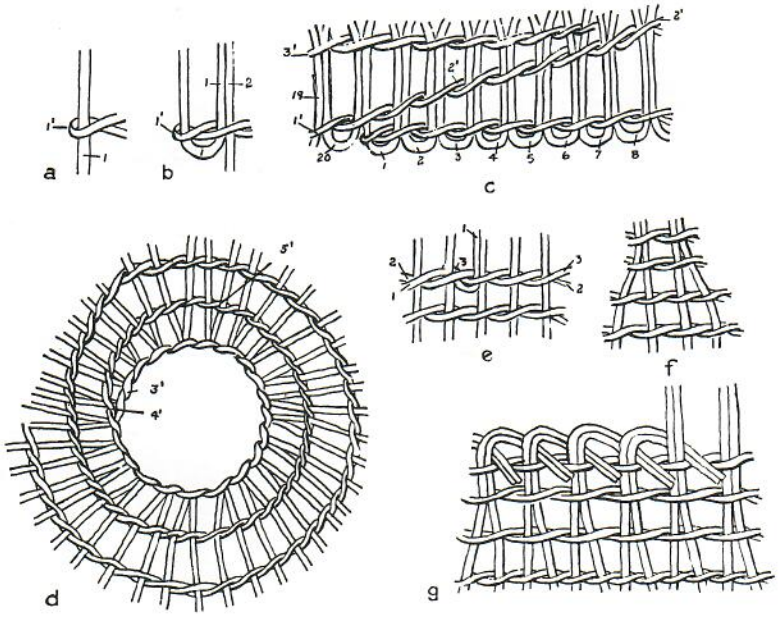

FIGURE 213.—Circular trap construction: **a-c,** funnel commencement, showing warps (1-8, 19, 20) and wefts (1′-3′); **d,** completed outer opening, showing overlap of continuous weft row over last weft row (3′-4′) and point where it reaches desired spacing (5′); **e,** 1-3, adding new weft ply; **f,** decreasing warps; **g,** rim finish.

When the trap was in use, the bottom opening was closed by two sticks pushed through under the rim finish across the opening and at right angles to each other. The sticks are 9 inches long and 0.4 inch thick. The four ends project for 2 inches beyond the trap rim. In the trap described (10986), material, apparently moss, is packed around the rim, and folded pandanus leaf is placed over the opening, resting on the crossed sticks below. This arrangement is a bed for the stone sinker, which, however is absent.

In another trap (C.6024), a large flat stone sinker is still in position. The lashing is made with a thin vine which is looped over the under side of the sinker and around the opposite ends of one stick, then crossed with loops between the ends of the other stick. The lashing concludes with circumferential turns around the upper surface of the stone below the ends of the stick, as is plainly shown in figure 212, *b*.

A good deal of variation in minor details is found among the traps of this series. Variations in the commencement of the lower end of the funnel are shown in figure 214, *a-c*. In figure 214, *c*, the warp lengths are double, and after the U-turns, the warps are in four pieces for the length of the funnel. On

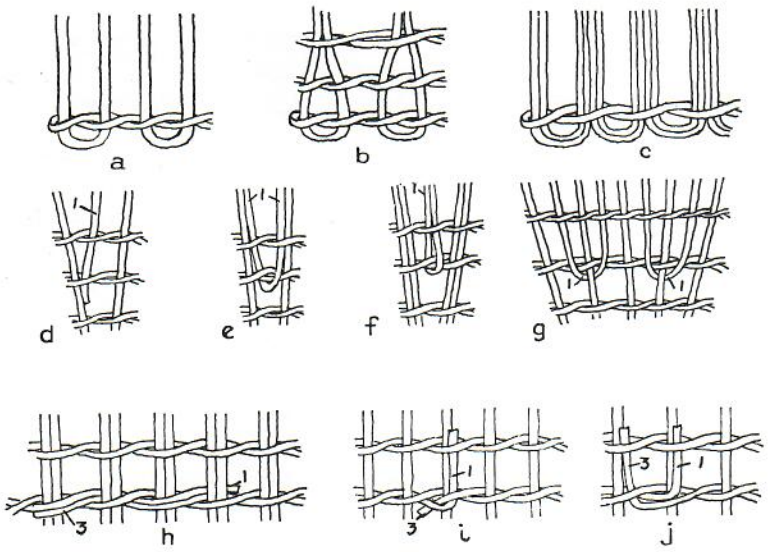

FIGURE 214.—Circular traps: **a-c,** variations in funnel commencement: *c*, showing warp lengths doubled and, after U-turns, in four pieces. **d-g,** extra warps for expansion of body: *d*, single warp (1) added; *e*, addition (1) doubled around weft row and limbs added to warps on either side for strength; *f*, double trap warps and additional warp (1) doubled; *g*, single warp (1), by doubling around a warp below a weft row, adds two new warps. **h-j,** variations in new weft plies: *h*, new ply (3) combines with shortening ply and twines around a few warps before old ply (1) is dropped; *i*, end of new ply (3) is caught in loop of old ply (1) as it turns up on a warp and end of old ply is secured by next weft round; *j*, both ends of old ply (1) and new ply (3) turned up on adjacent warps and secured by next weft round.

the commencement of the upper surface, they divide into double wefts, and later divide again into singles. Thus a full quota of warps is provided at the funnel commencement. In some traps, extra warps have been added to provide for the expansion of the body (fig. 214, *d-g*). Variations in the addition of new weft plies are shown in figure 214, *h-j*. Variations in the rim finish are illustrated in figure 215, *a-f*.

Small traps with a stone sinker attached and baited with crushed prawns or crabs were set in the streams by women to catch *ʻoʻopu*. When so used, they were termed *hinaʻi* [*hanai?*] *ʻoʻopu*. The same type of trap similarly baited and set in the shallow waters of the sea to catch the small *hinalea* fish was termed *hinaʻi hinalea*. Kamakau says that the *hinalea* basket was old in origin and perhaps provided the pattern for the large *kala* baskets used at Kaena. His con-

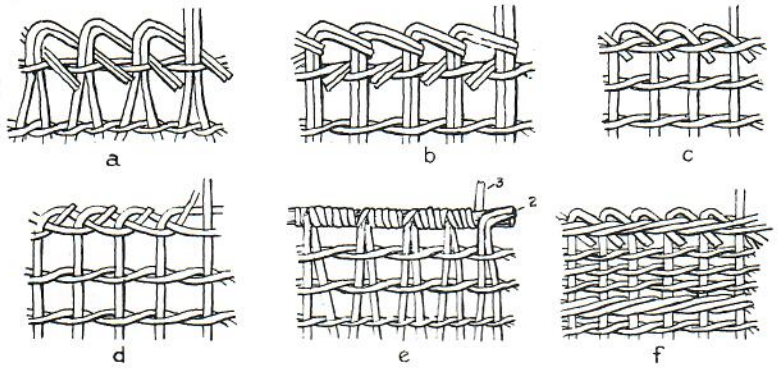

FIGURE 215.—Circular traps, showing variations in rim finish: **a,** simple form shown in figure 213, *g*; **b,** with warp ends bent over outer side of warp in front (right), doubled around it and crossed over outer side of last weft round; **c,** common form with warp ends bent down in front and fixed by a ply of last weft round; **d,** warp ends braided; **e,** reinforced by loop (1) on which warp ends (2) are bent forward and fixed by another length (3) wrapped around them; **f,** similar to *c*, but with last weft round in twill.

tention is based on an old myth about a female ogress (*ʻeʻepa*) named Kalamainuu who acquired a lover named Punaaikoae by assuming a handsome human form when they were together. However, when Hinale and Akilolo informed Punaaikoae that his paramour's normal form was not human, he secretly spied upon her, and he fled in horror upon seeing her true form. Kuao and Ahilea told the ogress the names of the two who had revealed her secret. After trying in vain to capture the informers, she was told that the culprits were inordinately fond of sand crabs and they could be caught in a trap baited with these crabs. The instructions for making the trap were as follows: "Go gather some *ʻinalua* vines under tapu and, on your return, weave, beginning at the opening. When the part that goes inward is formed, bend back to shape the basket. Add some *ʻinalua* to increase the size of the basket as you work

downward, and when it is large enough, decrease the *'inalua* that are standing upright, and keep on decreasing. In that way the bottom of the basket is shaped and finished." The basket was to be baited with chewed sand crabs, weighted with stones, and set in a depression in the sea.

The ogress did as directed and her enemies were caught in the trap basket. She tore them to pieces and cast them into the water, where they became *hinalea* fish. Kalamainuu was placed among the female gods as the patron of basket trap manufacture.

The *hina'i ho'olu'ulu'u* was a temporary trap made of vines of *'awikiwiki*, leaves and all, for taking *hinalea*. Beckley (1883, p. 5) reports that this basket was 3 to 4 feet in circumference and about 1.5 feet in depth. She says that pounded shrimp wrapped in coconut fiber [coconut-leaf stipule] was sometimes used but usually the scent of the leaves was sufficient to attract the fish. After the introduction of the weeping willow, traps were made from its thin branches. Easily detachable stones were used to weigh the traps down.

These traps were used by women, who waded out and set them in small sandy openings in coral ground or the reef on a calm sunny day at low tide. They moved to a distance and watched the fish enter the trap. When full, the trap was taken up and emptied into large gourds with small mouths. Then the trap was moved to fresh ground.

Men also used these traps, with cracked sea urchins for bait. They set them in deep water and placed stones around them to keep them anchored for a day or two until the traps were full of fishes.

The *hina'i 'ui'ui* is described by Beckley (1883, p. 6) as a trap of the same size as the *hina'i ho'olu'ulu'u* but wider-mouthed. Two crossed sticks were arched above the opening and attached to the sides of the trap. A line was attached to the arch crossing to allow the trap to be used in deep water. Some *pohuehue* vine, with its leaves, was twisted around part of the arch for shade. The trap was used to take the *'ui'ui*, a small flat fish which appears in shoals at intervals of 10, 15, or 20 years. The bait used was cooked pumpkin, cooked sweet potato, and ripe papaya.

Canoes worked into the midst of a school of *'ui'ui* and lowered the traps a few feet. When full, a trap was emptied into the canoe and lowered again, with more bait if necessary. The fishing went on until the canoe was full or the fishermen tired of the sport. When the *'ui'ui* first arrived they were fat and had large livers; but those which came after a month were thin and tasted strong and rancid.

The *hina'i palani* is described by Kamakau as smaller than the *kala* trap and used for catching *palani, uhu, kumu, kahala,* squids, and other fishes. Its use was similar to that described for the *kala* basket in that the fish were fed at some selected spot. The bait, partly roasted sweet potato strung on a cord and tied to a stone, was placed in a basket which was lowered on a line long

enough to reach the bottom and with a float tied to the upper end. The feeding was continued for four or five days. At the end of that period the fisherman drew up the bait basket and examined the partly nibbled sweet potato for the marks of teeth; small marks indicating the *palani;* large, the *uhu;* and sharp cuts, the *kahala* and *ulua.* Satisfied that fish came to feed at the spot, he lowered a large feeding basket termed *'api,* in which were stones and several strings of sweet potato. The feeding went on for some days, until the fish became accustomed to staying in the basket. Then the fisherman skipped a day before lowering a number of basket traps baited with sweet potato roasted early that morning. He returned later in the day and drew one of his trap baskets to near the surface. To quote Kamakau, "When he looked in, the basket was filled with fish bright as *ko'olau* blossoms. He stood erect to draw it in and it came to the surface with a splashing of sea spray and a roaring like the sound of a waterfall."

The fisherman continued to rebait baskets until nightfall, for the fish entered eagerly, then reset his traps and returned to shore. The next day he repeated the process until no more fish entered the baskets.

The *'ie kala* was the largest form of trap. Beckley (1883, pp. 6, 7) describes it as a round, rather flat basket, 4 to 5 feet in diameter, 2.5 to 3 feet in depth, and about 1.5 feet across the mouth. A small cylinder or cone of wicker was attached by the large end to the mouth and turned inward toward the bottom of the basket. The inner end of the cone was just large enough for the *kala* fish to pass through. According to Kamakau, the uprights were formed of *lama* wood, *'auka,* or *ninika,* and *'ie* (*'ie'ie*) vine was woven through the sticks. It is evident that the "uprights" were the warps and that pliable sticks were used to strengthen the baskets, but *'ie'ie* vines or roots were used for the wefts. The bait for the *kala* fish was the seaweed named *kala* from which the fish gets its name. Ripe breadfruit, cooked pumpkin, half-roasted sweet potato, and papaya were also used.

A similar basket, termed *'api,* wider in the mouth and without the funnel to give fish free entrance and exit, was used as a feeding basket. Any of the baits mentioned above were placed in the basket and the fish allowed to feed for a week or two, when they became fat, fine-flavored, and very tame. Trap baskets termed *'ie lawe* (taking baskets) were then baited and lowered beside the feeding basket. When full, they were drawn up without disturbing the fish still using the feeding basket. *'Ie lawe,* baited properly, were also used for other kinds of fishes; but the results were never as good as with *kala,* of which large catches were made.

Eels caught in a trap were considered the best eating. The eel trap, or eel basket, according to Kamakau, was large with a squat-shaped body and a special compartment for the bait, which consisted of tainted flesh. To prevent the first eels from consuming all the bait, it was poured in through a narrow hole in the side of the basket and the hole closed. The basket had a stone tied to the bottom

as a sinker and a long cord with a float for lowering and drawing it up. It was set at night in depressions in the coral near the reef with its position marked by the float. It was lifted in the morning and taken ashore, where the eels were poured out, probably through a lower opening like that of the small traps.

The eels referred to were sea eels, there being no fresh-water eels in the Hawaiian streams.

LONG CYLINDRICAL TRAPS

A long cylindrical trap (*hina'i 'o'opu*) was made for catching *'o'opu* in fresh-water streams. While the body of the trap is not exactly cylindrical, the term is convenient to distinguish the type from the low circular traps. It resembles one form of twined basket, shown in figure 108; but it has a funnel opening at one end and the other, open, end is without a cover. The single specimen in Bishop Museum (6694) is 23 inches long and 9.75 inches in greatest diameter. The material is split *'ie'ie* aerial root, of which fairly wide composite warps are formed, but the weft plies consist of single split lengths (fig. 216, *a*).

The technique is similar to that used in the circular traps in that it begins at the inner opening of the funnel. The warps consist of 11 lengths doubled in

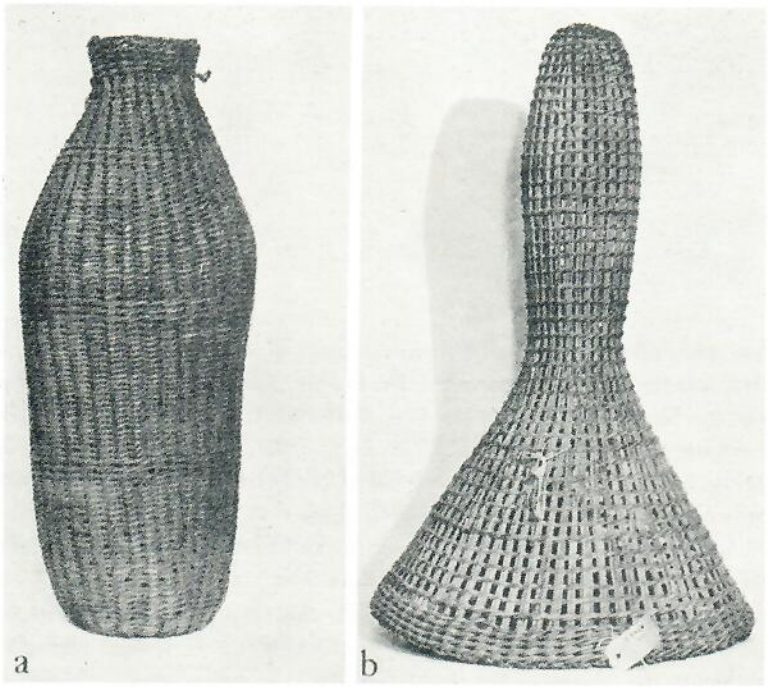

FIGURE 216.—**a,** long, cylindrical fish trap; **b,** funnel-shaped trap.

the middle, with a U-turn to form two limbs. The limbs of adjacent lengths placed side by side are treated as double warps which are enclosed in the twilled twine of a two-ply weft. Occasionally two adjacent limbs are crossed over each other but remain together as a double warp. The continuous weft makes two rounds of the double warps; then the double warps are separated into singles (fig. 217, *a*), thus making 22. A check twine is continued for 12 close rounds, the warp interspaces being gradually widened to increase the diameter of the funnel. At the inner opening, the funnel diameter is 3 inches, increasing in the funnel length (4.75 inches) to 6 inches at the outer opening (fig. 217, *b*, 1, 2). With the outer opening downward, the warps are bent upward in a curve to enter into the structure of the body of the trap in the same way as that used in circular traps.

From the bend, five rounds of check are made, then a third ply is added to form three rounds of twill which are followed by 20 rounds of check, again succeeded by three rounds of twill (fig. 217, *b*, 3). Between the bend and the twilled rounds, 15 warps are added, making a total of 35 warps and thus gradually increasing the diameter of the trap. The twining is continued with several rows of check interspaced with triple rounds of twill. The number of warps remains at 35, but the individual warps are widened by the addition of extra strips. The weft rounds are close together, with five rounds to the inch. The diameter of the trap increases to 7.5 inches, then to 9.75 inches at its widest part toward

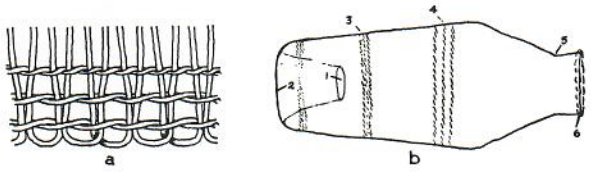

FIGURE 217.—Long, cylindrical fish trap: **a**, commencement technique; **b**, longitudinal section, showing inner opening (1) and outer opening (2), three rounds of twill (3, 4), neck of trap (5), rim opening (6).

the upper end, which is marked by three rounds of twill (fig. 217, *b*, 4). At this point, the warps are 0.7 inches wide. From this point, the diameter of the trap is gradually decreased by running two warps together until, at the neck (fig. 217, *b*, 5), they are reduced from 35 to 21 and the diameter of the trap is 4.25 inches. The neck is formed by one round of check and five rounds of twill, and the rim is completed by doubling the warp ends down under the neck rounds on the next warp, as in the common finish of the funnel traps. The rim opening (fig. 217, *b*, 6), like the neck, is 4.25 inches in diameter.

I was puzzled about the lack of a cover for this trap and regarding its particular use until Charles M. Cooke, III brought an elderly Hawaiian named Kaleohano Kalihi to the Museum. He recognized the trap immediately, though he had not seen one since childhood. According to Kalihi, it was set lengthwise in the

main freshwater stream (*kahawai*) without bait and without cover. The *'o'opu* entered the trap to rest, for it is characteristic of that fish to enter even old cans that have been cast into the stream. On visiting her trap, the fisherwoman simply placed her hand over the open end opposite the funnel end and lifted the trap and its contents.

FUNNEL-SHAPED TRAPS

Funnel-shaped traps for catching shrimps (*'opae*) in freshwater streams were termed *hina'i 'opae*. They were made of split and unsplit *'ie'ie* aerial roots, in shape resembling a large funnel with the small end closed. In the Bishop Museum collection of 12 such traps, three are small and may have been made as samplers. They average 9 inches in length and 6 inches in diameter at the large open rim. The nine normal-sized specimens range from 17 to 29 inches in length, 10 to 17 inches in rim diameter, and 3 to 5.5 inches in the diameter of the tubular part.

The technique is twining with a two- or three-ply weft around composite warps, formed usually of three or more lengths of split *'ie'ie*, though occasionally

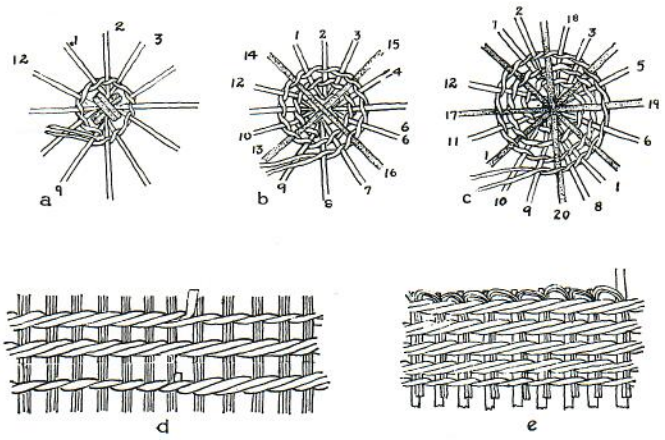

FIGURE 218.—Funnel-shaped trap technique: **a-c,** commencement: *a,* showing warps 1-12; *b,* showing warps 1-16, the two new ones (13-16) stippled; *c,* showing final 20 warps, added ones (13-20) stippled. **d,** changes in weaving. **e,** rim finish.

unsplit single or double warps are used. The twining process is similar to that of the twined baskets, the closed blunt end of the trap corresponding to the bottom of the basket.

In a typical trap (C.5982), two sets of three composite warps are crossed at right angles at their middle and lashed together with oblique turns of a piece of split vine (fig. 216, *b*). The four sets of three radiate from the center to form 12 warps, as shown in figure 218, *a*. A single weft piece is doubled around the

ninth radial to form a single-pair weft, which is carried with an over-twine around all the radials in the first circular weft round. When the twine approaches the commencement, it is bent outward to form the beginning of the second round. A new warp length is laid across the center of the work to add the two new warps (fig. 218, *b*, 13, 15). The twine is completed over the ninth warp, including the new warp, and stops temporarily on the twelfth warp. A second length is laid over the center at right angles to the first to form the additional warps (fig. 218, *b*, 14, 16). The weft twine is continued to complete the second round and includes the new warps (fig. 218, *b*, 14, 15, 16). Thus the second weft round fixes four new warps and raises the number of radials from 12 to 16. The third weft round (fig. 218, *c*) continues to the eleventh radial, where another warp length is laid across the center, bisecting the angle formed by the previous additions. The seventeenth radial is included in the twine, which continues to the second warp, when another warp length is laid across the center at right angles to the first. One end (radial 18) is included in the twine. The fourth round continues its course around the radials and includes the other ends, radials 19 and 20, of the new additions. Thus on the completion of the third weft round, the total number of radials is raised from 16 to 20, the full number required.

In the actual trap (C.5982), the second round is changed from a two-ply check to a twilled twine by adding a third length of vine to make a three-ply weft in which each ply passes over two warps. The twilled twine is continued until the diameter of the surface reaches 3 inches, when, with the completed surface below, the warps are bent upward to form the tubular part of the trap. Two warps are joined together as one; and the total number of warps forming the tube is 19. The twilled twine continues in spiral, parallel rounds up the sides for six rounds, when one ply of the weft is dropped. The twining continues in a two-ply check for six rounds. A third ply is added to the weft to make one twilled round, when it is dropped and the two-ply check is resumed for five rounds. The twine again changes to a three-ply twill for four rounds, which completes the tubular part of the trap. The changes from check to twill and from twill to check are shown in figure 218, *d*. The length of the tubular part is 13 inches, and it expands toward the middle to a diameter of 5.5 inches, contracting toward the end of the tube to 4.3 inches. The weft rounds are spaced 0.6 inch apart.

From the end of the tubular section, the warps are bent outward at an obtuse angle. Ten single warps are spaced evenly among the others to form a total of 29 warps for the expanded part of the trap. These are fixed by a continuation of the twine in check. The check twine is continued in groups of five or six rounds, with single rows of twill between them. As the diameter of the trap increases, the interwarp spaces widen; and toward the upper part, occasional single warps are added to aid in the even expansion. New weft plies are added in the same way as in the low circular traps (fig. 213, *e*). The expanded part is finished off with one round of check and four rounds of twill. The rim has been formed by cutting

off one piece of the three-piece warps and doubling the other two down on the next warp, where they are covered by the last five rounds of the twined weft, as shown in figure 218, *e*. It is probable, that the warp ends were pushed down after the twined rows were completed.

The expanded part of the trap is 15 inches in length and the diameter at the rim is 17 inches, the total length of the trap being 28 inches.

The other traps follow a similar general technique with slight variations. An old trap in Bishop Museum (3841) has the single-pair twine throughout and another (3846) has a double weft throughout. In another old trap (B.2824), a double weft with an under-twine in check is used throughout. Variations in the addition of fresh weft pieces and the increasing or diminishing of the number of warps are similar to those in the low circular traps (fig. 213). The rim finish in some traps has been formed by turning down the whole warp on the next warp instead of part of a warp.

Two of the large traps (L.1820 and C.5982) have a small accessory funnel, open at both ends. The smaller open end starts with the same technique as the funnels of the low circular traps (fig. 213). The single-pair twine continues in spiral rounds, with the diameter of the funnel gradually increasing by the addition of some new warps. The last two rounds are made close together with a three-ply weft in twill. The rim has been formed by doubling down the warp ends under the two twilled rounds on the next warp. The funnel is inserted into the tubular part of the trap and its rim is caught against the bend of the expanded part of the trap. It was easily removed to pour out the catch. One funnel (C.5982) is 4.75 inches long, 2 inches in diameter at the narrow end, and 4 inches at the rim (fig. 216, *b*). The other funnel (L.1820) is 5.5 inches long, 2.4 inches at the narrow end, and 4.25 inches at the rim.

The method of using these traps is described by Beckley (1883, pp. 4, 5) as follows:

> . . . This is used in mountain shrimping, and women always attend to it. They move in a crouching position through the water, moving small stones and thrusting sticks under the large ones to drive the shrimp to a suitable place which is always some place where the grass, ferns, or branches of trees droop over on the water; the shrimps take refuge in or under these and the fisherwoman places her basket under the leaves and lifts them out of the water, when the shrimps drop into the basket; she then unties the small end and drops them into a small mouthed gourd attached to a string, which she keeps floating after her for that purpose, and putting some fern leaves inside the gourd to keep the shrimps from creeping out, as these are lively little fellows who live a long time out of water and scamper about on terra firma like cockroaches.

It is not clear what Mrs. Beckley meant by "untying" the small end of the trap, for in all such traps in the Museum series, the small end is permanently closed. Perhaps she was referring to the small funnel, which may have been tied in when in use. If not, she had in mind some trap not represented in the Bishop Museum collection.