COMMERCIAL UTILIZATION OF DOLPHINS (PORPOISES) IN CEYLON

A. W. LANTZ AND C. GUNASEKERA

DOLPHINS popularly known here as porpoise to the English-speaking, as " Mulla " to the Sinhalese and as " Ongil " to the Tamils are actually small whales (mammals). Strictly speaking the name " porpoise " should be reserved exclusively for the small, *beakless* members of one family of whales, the *Delphinidae*. They have a triangular dorsal fin and spade-shaped teeth. Correctly used the name dolphin applies only to the remaining members of that family. Their jaws are narrow and long enough to be called a beak (fig. 1). Because a well-known fish (*Coryphaena*) also called " dolphin " is frequently taken about Ceylon by oru troll fishermen, many people have tried to avoid confusion by referring to our mammalian dolphins as porpoises. In avoiding this confusion, however, they create another which is almost as serious. The authors prefer to retain the name dolphin for this mammal.

From observations made on captured dolphins there appears to be two species abundant in waters adjacent to Ceylon. They are particularly numerous in the areas around Negombo and Trincomalee during the fishing seasons. Mr. P. H. D. H. de Silva of the National Museums, Ceylon, had identified these species as the common dolphin * (*Delphinus delphis linne*) and bottle-nosed dolphin † (*Tursiops truncatus*).

The belly and lower sides of the common dolphin are brilliantly white throughout (fig. 2). The back is black. The beak is well-defined, narrow 5 to 6 inches long with 80-102 pairs of teeth in the upper and lower jaws (including right and left side) and are about 1/8″ in diameter. This dolphin is usually under 8 feet in length.

The belly of the bottle-nosed dolphin (fig. 1) is grey or brownish from the head to the vent but darker from the vent to the tail like the rest of the body. The beak is shorter but nevertheless well-defined 2 to 4 inches and there are 40-50 pairs of teeth in the upper and lower jaws counting both right and left sides. The tooth diameter ranges up to $\frac{3}{8}$″ and the total length of mature animals up to 12 ft.

Both species are fast-moving predators with world-wide distribution ranging over fishing grounds in shoals consuming large quantities of fish. Their food habits have not been carefully studied in our waters but they are known to feed on herring, squid and other small fish which they catch alive. If fish are scarce they will often attack those that are caught in fishermen's nets and in so doing damage or destroy the nets. Damage of this kind is serious at certain times and places. Off Negombo, for instance, gill netting has to be abandoned in January and February almost every year because of common dolphin. The local fishermen regard them as the vermin of the sea. Dolphins have been and still are used as food in some places and in Ceylon where the growing scarcity of foodstuffs, particularly of protein foods is one of the acute problems they should find a ready market. Dolphin catching should therefore have several benefits—it should reduce their destruction of fish and fishing gear and at the same time increase the food supply directly and possibly provide other products. Interest in all these aspects of the dolphin problem prompted this investigation of methods of capturing and using them.

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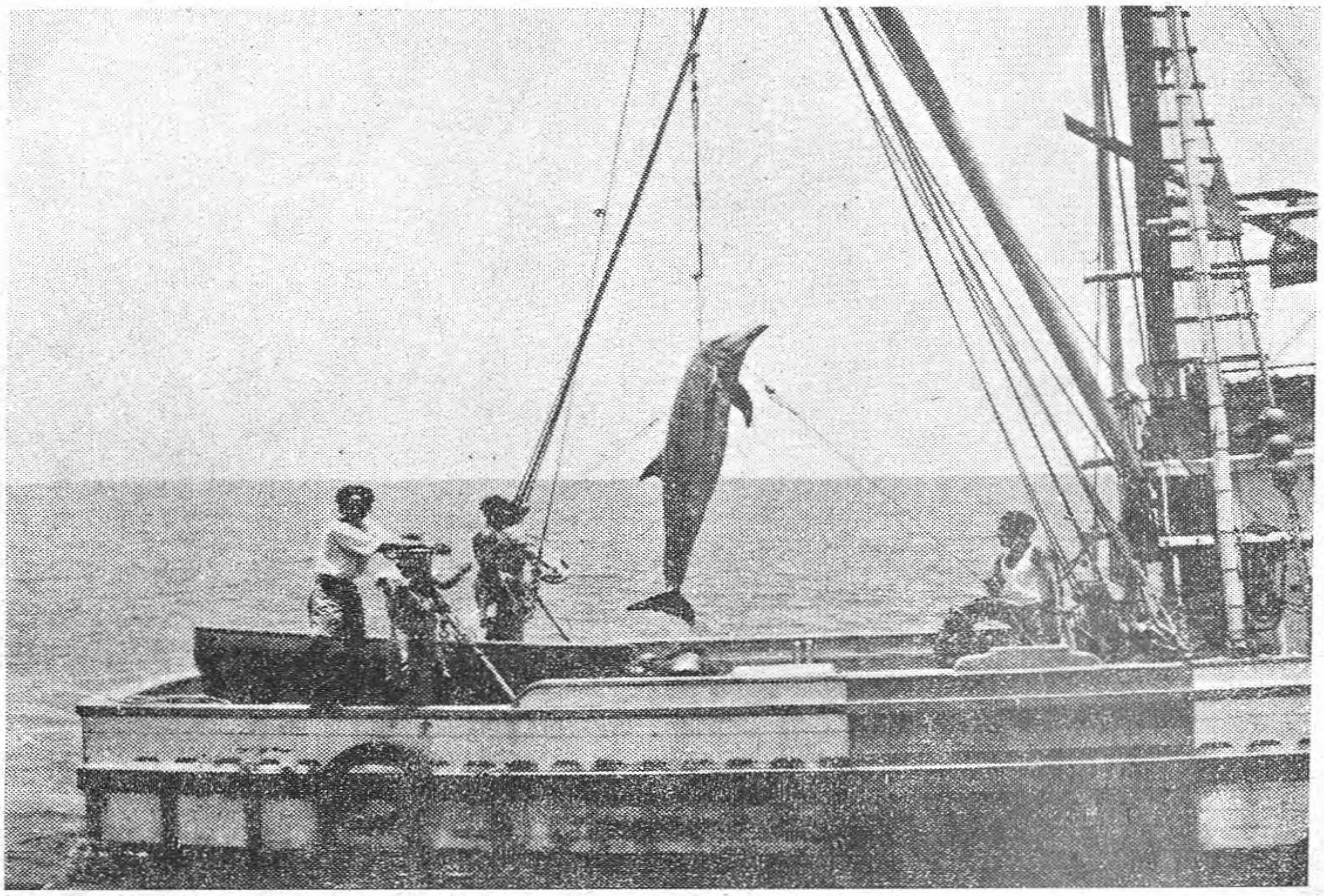

Figure 1.—A bottle-nosed dolphin lifted aboard by the winch operated by Ceylonese crew aboard the " Canadian "

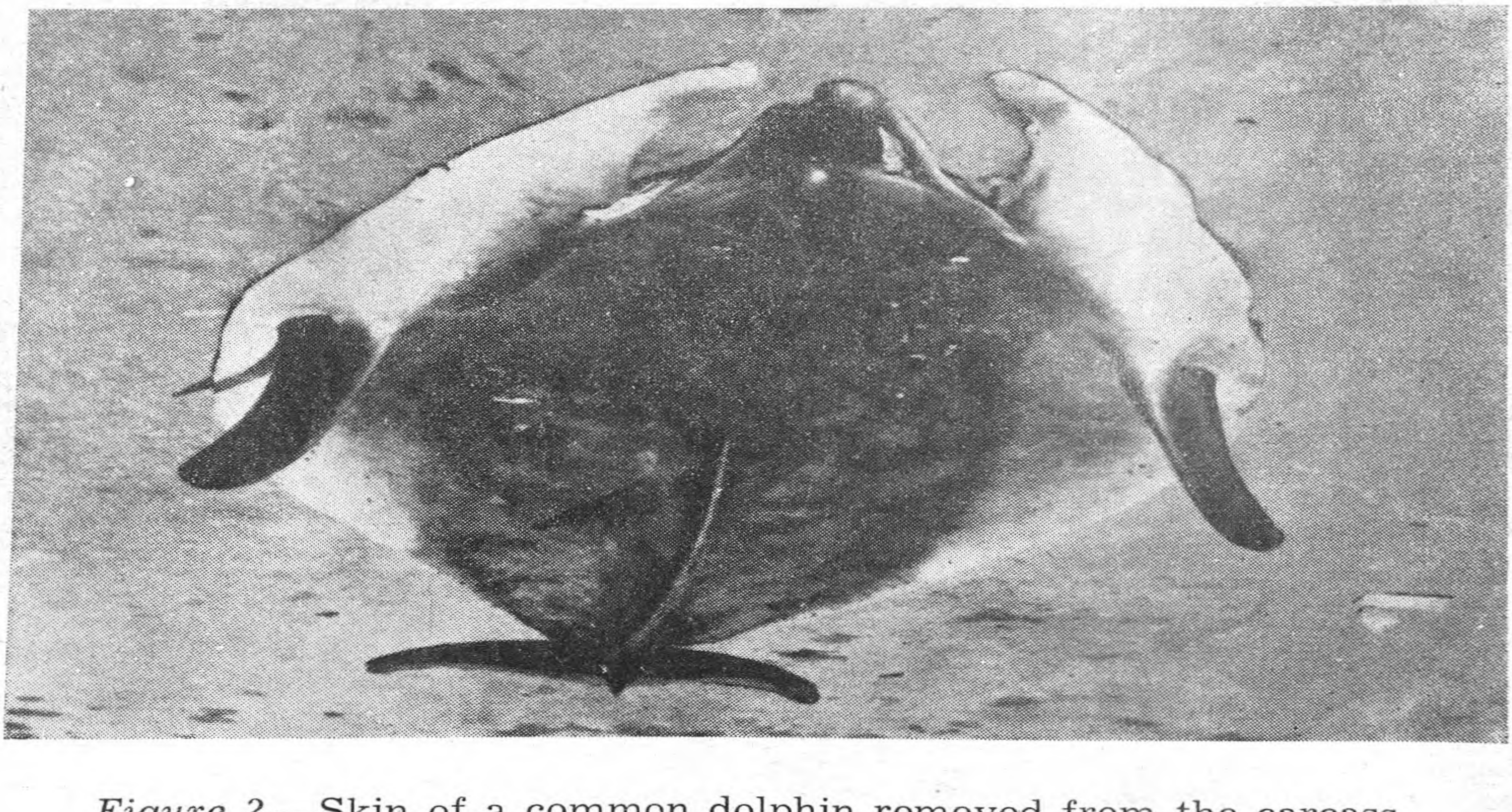

Figure 2.—Skin of a common dolphin removed from the carcass

CATCHING DOLPHINS

IN the latter part of 1953 Captain F. Homer of the research vessel "Canadian" was allocated the problem of investigating methods of capturing dolphins. His work has been continued on a smaller scale in 1954.

Though dolphins have been caught in nets in various parts of the world, special heavy nets and large boats would be required. For local conditions Captain Homer found that harpooning with a swordfish harpoon such as is used on the U. S. A. west coast was the most effective means of capture. This harpoon is a simple device (fig. 3) consisting of a slender wooden shaft $12\frac{1}{2}$ ft. long to which was affixed a slender $1\frac{1}{2}$ ft. metal rod on which is set a detachable brass spearhead called a dart. The dart (fig. 4) is connected by a ring through its eye with a fifty foot line

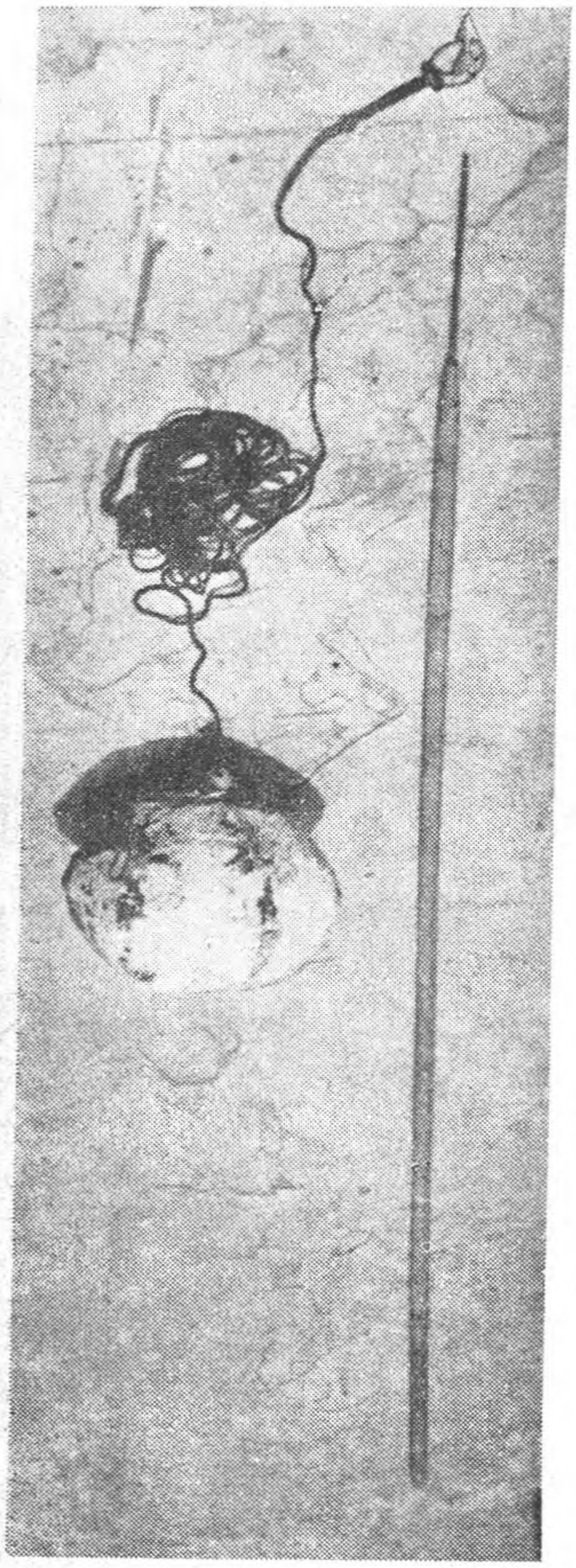

Figure 3.—Harpoon assembly—spearhead detached from the harpoon shaft

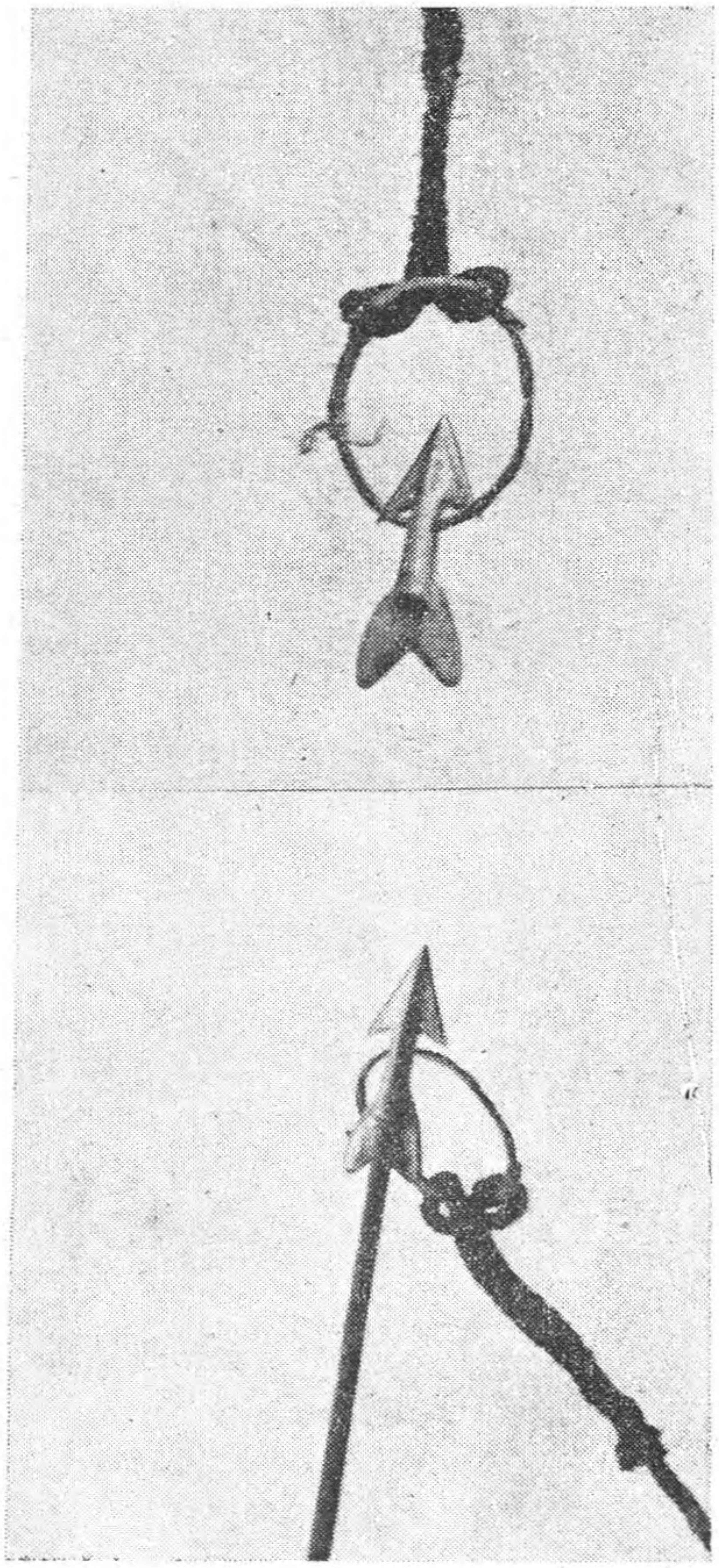

Figure 4.—Detachable spearhead of the harpoon

attached to a leather, plastic or canvas bladder buoy. (fig. 5). This buoy served as a marker to indicate to the fishing craft the location of a harpooned dolphin

Schools of fish are migratory as they seek food and since the fish are food for the dolphins, schools of the mammals follow the schools of fish. Normally dolphins have no fear of motor boats and often play about the bow of the boat. Advantage is taken of their habit of rising to the surface periodically for a quick breath of air to harpoon them. A narrow railed platform 8 feet long called a pulpit was built to project forward from the bow of the " Canadian ".

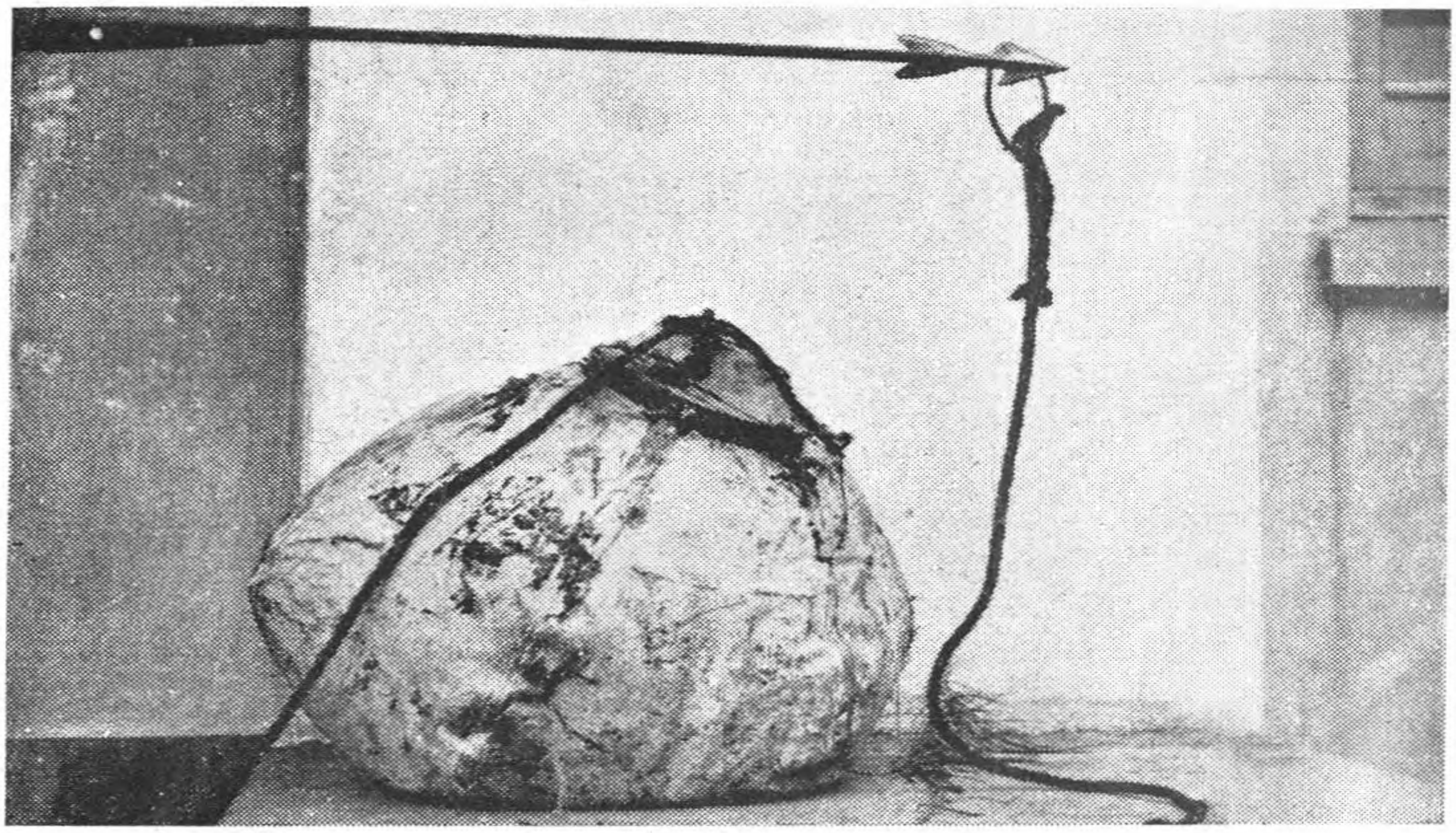

Figure 5.—Bladder buoy showing attached rope and harpoon

As the boat approaches a school of dolphin the man assigned to the pulpit stands with harpoon poised. The other members of the crew stand-by on deck some with harpoons ready to strike at any dolphin straying close to the sides of the boat. Dolphin move with lightning speed and to be successful an operator must be dexterous and accurate and know where to strike them. The middle upper back is the favourite spot because there the dart can be buried deep in firm muscle. Dolphins usually come so close to the boat that the harpooner can keep hold of the shaft. It is possible to throw the harpoon at the moving dolphin but for this an extra line is attached to the shaft to help the operator recover it.

After the thrust the buoy line frees itself from the keeper, (which is a hook on the harpoon shaft), and the dart now deeply imbedded separates from the bit. The dolphin dives tailing out the buoy line and the crew immediately toss the buoy overboard. A fresh dart is quickly set on the bit and its line rigged to the harpoon shaft as the operator makes ready to strike again.

The number of dolphin harpooned at one time depends on the alertness and the skill of the crew. Captain Homer was sometimes able to harpoon 10 or 12 before the school was sufficiently frightened to disperse. Once this occurred, the hunt in the area was over because the animals which are able to travel much faster than ordinary motor boats cannot be pursued. Thereafter the boat collected its booty by following the buoys and hauling the attached catch on board. With large bottle-nosed dolphins a winch, a gaff and a special line is necessary for this operation. The small common dolphins can be hauled aboard by the dart line without even a gaff.

In our trials over 100 dolphins were captured. This number was not large enough to seriously reduce the dolphins population and thus aid fish stocks but it was enough to show what could be expected and provided all the material needed for the experiments. The object of the work was to find worthwhile uses for the animals.

USE OF DOLPHIN MEAT

THE flesh of the dolphin is nutritious. The dolphin carcasses can be butchered in a manner similar to that employed for beef. The raw meat has much the same texture as beef—possibly a little more fibrous. In colour it is very dark. Some people are inclined to think that this is caused by improper handling but that is not true.

Fresh Meat

Several housewives were requested to make cooking trials with fresh dolphin flesh prepared in both western and eastern methods. The recipes developed by these housewives appear on the following pages. When cooked, dolphin flesh was still dark but it was palatable with a flavour similar to beaf and with a texture somewhat like beef liver. The favourable results of the cooking tests persuaded the Department of Fisheries to conduct a marketing test, selling the fresh meat at 25 cents a pound. It proved popular especially among those who find fish too expensive and the tests showed that there was a ready market for dolphin meat particularly in those seasons when fish was in short supply.

RECIPES FOR COOKING DOLPHIN MEAT

LAYERED MEAT LOAF

1 cup sliced raw breadfruit
2 cups chopped celery
2 cups ground dolphin meat
1 cup sliced raw onion
1 cup chopped green pepper
2 cups Tomatoes.

Brown the meat in dripping then put ingredients in layers in shallow greased dish. Season each layer with salt and pepper. Bake in moderate oven two hours.

MEAT CASSEROLE

½ cup uncooked rice
1½ cups. tomatoes
1 lb. chopped cooked dolphin meat
2 tbsps. chopped onion
2 tbsps. chopped celery
½ cup grated cheddar cheese
¼ cup breadcrumbs moistened with margarine
1 tbsp. curry stuffs.

Cook rice until tender in boiling salted water, to which 1 tbsp. of vinegar has been added. Rinse in cold water. Add to the rice—tomatoes, meat, onion and celery together with curry stuffs. Place in greased dish. Sprinkle with grated cheese and crumbs. Bake 25 minutes in moderate oven.

DOLPHIN CUTLET

1 lb. dolphin meat
¼ lb. mashed potatoes
1 tbsp. chopped onion
1 egg
Juice of 1 lime
1 tbsp. chopped fennel
Powdered cloves, cinnamon, pepper and salt.

To the minced meat add mashed potatoes, onion and fennel, then add a pinch of pepper cloves, cinnamon and salt to taste. Mix well together and add the lime juice and slightly beaten egg. Divide the mixture and roll into twelve round cakes. Dip in egg and then in breadcrumbs and fry in dripping until nicely browned.

ROAST DOLPHIN

1 piece of dolphin meat—6-7 lbs.
6 oz. dripping
1½ tsps. salt
¼ tsps. pepper
⅛ tsps. ginger (ground)
2 tsps. oil
¾ cup margarine
2 cups of meat stock
1/3 cup flour.

Mix the dripping with salt, pepper and ginger and rub into the meat, then rub the meat with oil. Place the meat in a roasting pan and pour over it the melted margarine or oil if desired. Roast in a moderate oven for three hours or until the meat is brown and tender. Baste with meat stock often during cooking. When roast is tender, place on a platter and keep warm. Skim the fat from the gravy. Rub the flour into a third of a cup of fat and make a smooth paste with a piece of meat stock. Add this to the gravy in the pan and stir until thickened.

BROILED DOLPHIN

Broiled until tender and serve as beefsteak with fried onions.

DOLPHIN CURRY

2 lbs. of dolphin meat
15 dried chillies
A pinch of saffron (ground)
1 dessert spoonful of chopped onion
2 pieces of green ginger, chopped
¼ tsp. fenugreek
½ stem of lemon grass
1-2″ piece of cinnamon
Juice of a lime
1 dessert spoonful of ghee
6 ozs. of thick coconut milk
18 ozs. of second extract of coconut milk.

Cut the meat in small pieces and put into a chatty with the second extract of coconut milk, chillies, saffron, ginger, salt. Add half the quantity of onions, lemon grass, curry leaves, cinnamon and fenugreek. Boil until the meat is tender then add the thick milk and lime juice and boil another ten minutes. Heat the ghee in a chatty. Fry the remainder of the ingredients, then add the meat mixture and simmer together for ten minutes.

Dried Meat

At Negombo local fishermen prepare dried salt meat by cutting dolphin flesh into long thin strips, packing with salt and drying the salted strips on the hot sands of the beach.

An experimental batch of salted strips (one inch thick) showed a tendency to develop fungus unless carefully handled. When first packed in salt, blood and slime ooze out and must be drained off completely as this slime decomposes quickly. Direct drying in a hot sun was important as drying in the shade stimulated fungus growth. A few strips were dried in good condition to a hard consistency in 18 days. However these too developed fungus after about two weeks storage at room temperature. Mechanical salt drying would undoubtedly produce a superior product.

Dried salt dolphin flesh when in good condition proved quite palatable and resembled other varieties of salt meat such as salt beef.

Pickled Meat

As a further means of utilizing the flesh of the dolphin, experiments into curing were undertaken.

Equipment.—A refrigerated tank was constructed according to a design provided by the senior author. The external dimensions of the apparatus are 58″ × 26″ × 26″ the tank itself holding 26 gallons of water (4 cu. ft.). Due to a false bottom over the refrigeration coils of copper tubing the space for curing was reduced to about 2 cu. ft. Cooling is by a Freon air-cooled refrigeration unit with automatic temperature control powered by a ½ h.p. electric motor. Agitation is through a small, non-automatic stirrer placed at one end of the tank. The walls of the tank are mild steel internally coated with a zinc paint and externally covered with thick cork insulation. It takes about 18 hours for 26 gallons of brine to be cooled to 40°F from a room temperature of 85° F.

Pickle.—In curing meats the usual practice is to use a pickle in which the salt acts as a preservative, the sugar as a flavouring agent and the nitrite as a colour forming and fixing agent as well as a preservative. The nitrite penetration is indicated by a visible change in the colour of beef or pork as the cure progresses. The pickle used for curing the dolphin's meat was a standard sweet pickle mixture consisting of a 70° brine contraining **2** per cent. sugar and 0.05 per cent. (500 parts per million) sodium nitrite weight. A 70° brine is prepared by dissolving common salt in water unti specific gravity reading of 1.14 is obtained on a simple hydrometer or a re ing of 70° on a salinometer (which has a scale giving 0° for pure water 100° for water saturated with salt). In common terms the salt used roughly 2¼ lbs. salt per gallon of water.

Method.—The pickle was poured into the tank and cooled to 40°F ± 1°F. The pickle was maintained at a temperature of 40°F as spoilage occurs above 50° F and curing is inhibited below 30° F. Chunks of meat 2″ thick were weighted down in the pickle. It was hoped that colour change in the flesh would mark the progress of the curing. However no such colour change was visible, despite the fact that during curing of beef or pork a bright reddish colour is produced as the cure penetrates the flesh. In an effort to detect visible changes, the first batch of dolphin meat was kept an excess time (4 months) in the pickle and analysis showed an uniform distribution of nitrite amounting to 200 p.p.m. through the meat.

Penetration of the pickle has to be determined by nitrite analysis since there was no colour change visible to indicate the progress of curing of dolphin meat. In the second batch of meat a weekly analysis showed presence of nitrite in the centre (1″ from surface) of meat chunks after 3 weeks, but these results may have been affected by the original condition of the meat which had been stored at too high temperatures before curing. A third batch of fresh meat in excellent condition showed nitrite in the centre after 10 days in the pickle.

In this sample the nitrite content of the centre was 15 p.p.m. while surface nitrite varied from point to point from 50 to 100 p.p.m. (North American legal limit 200 p.p.m.). The cured flesh has been stored in the refrigerator (50°F) for test of keeping quality.

Conclusion.—Under controlled laboratory conditions dolphin meat can be cured in saturated salt solution without the addition of sodium nitrite to the pickle. Sugar is necessary for flavour development and controlled temperature is essential for satisfactory curing. The pickle described under heading " Pickle " will produce a superior cured meat product.

After leaching out the salt and cooking, the pickled meat was as appetizing as in the fresh state. Two-inch thick strips of dolphin meat can can be cured by keeping in 70° brine containing 2 per cent. sugar and 0.05 per cent sodium nitrite at 40°F for 10 days. When pickle is washed off, the meat may be safely stored at 50°F or lower temperature for at least 6 months and possibly for indefinite periods.

TANNING DOLPHIN SKIN

DOLPHIN skin appeared to have possibilities as a leather, a request was therefore made to the Department of Industries to carry out leather-making tests. Subsequently the Government Leather Factory has produced two kinds of leather of excellent quality from dolphin skins.

Biscuit-Coloured Leather (Light coloured)

There are six steps in the process of making biscuit-coloured leather—

1. *Skinning.*—Skin and layer of blubber which is about one inch thick were peeled off the body using a sharp knife. Blubber was scrapped off the skin with a fleshing knife (fig. 6) and processed for oil. The skin was washed thoroughly in running water.

2. *Liming.*—A thick paste of slaked lime and water was applied to skin and left exposed to air overnight. The following day the skin with paste, was placed in a vat of saturated lime water solution and allowed to stand for 9 days. Fresh lime was added from time to time when considered necessary by the experienced operator. At the end of the liming process, the hides were taken from the vat and drained (fig. 7). Hair and residual blubber were then scrapped off and tag ends of leather trimmed using special knives.

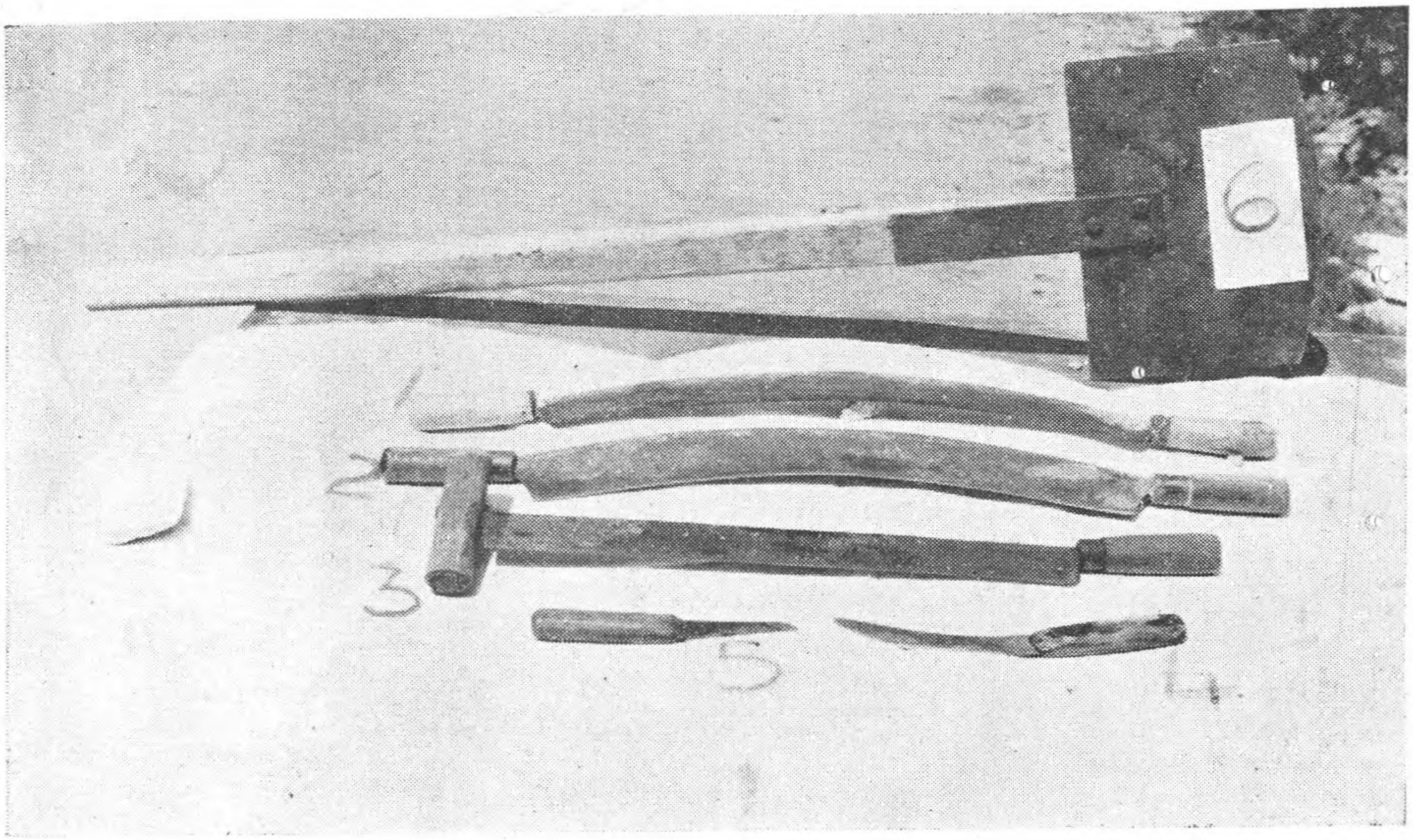

Figure 6.—Equipment used during tanning processing.

1. Fleshing knife.
2. Scudding knife—also used for de-hairing.
3. Shaving knife.
4. Trimming knife.
5. Flaying knife for removing skin.
6. Hand staker.

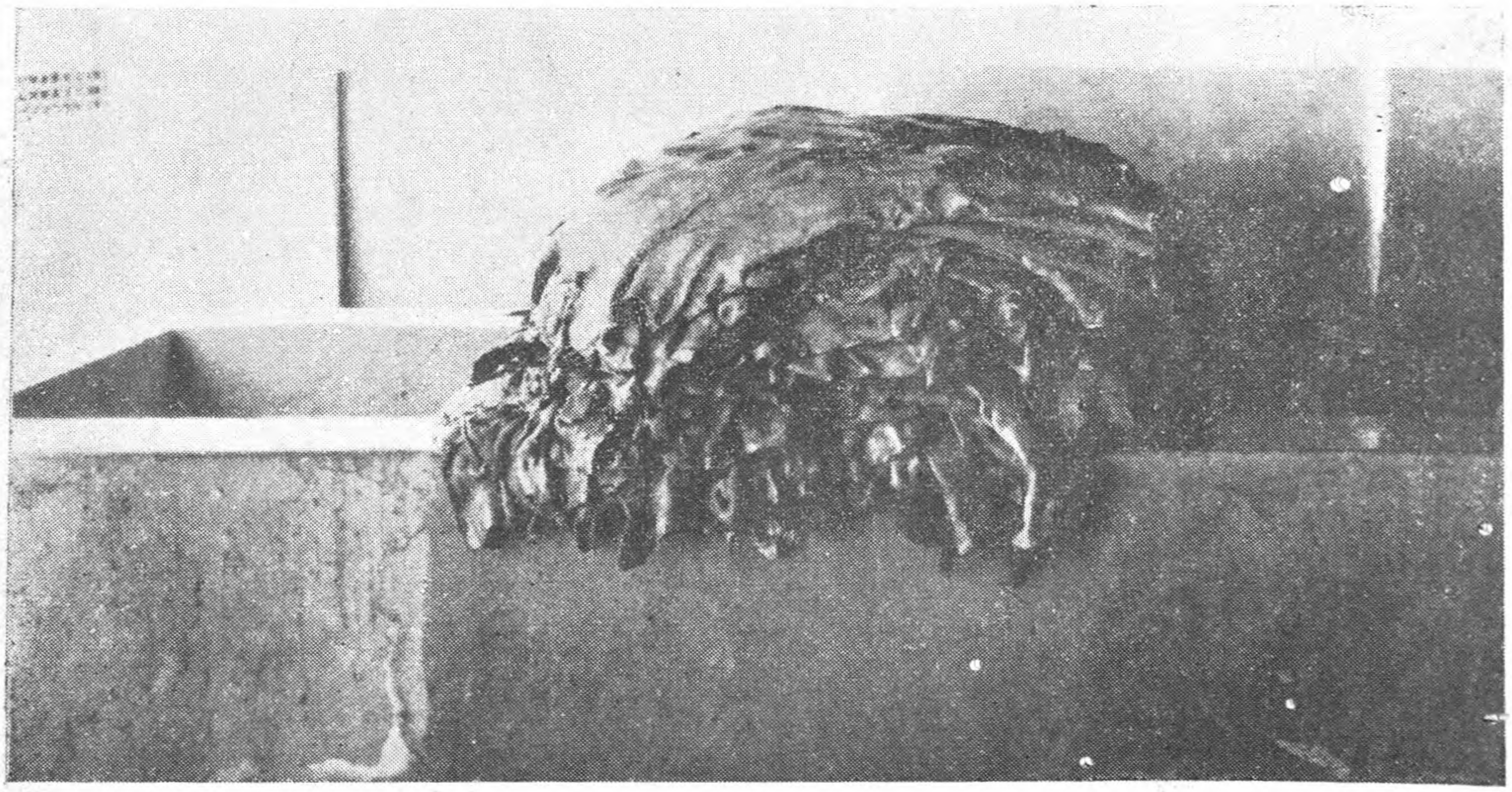

Figure 7.—Draining skins removed from lime vat.

3. *Deliming.*—The skin was immersed in a vat of 1 per cent. boric acid solution and left overnight. It was then scraped with a special scudding knife (fig. 8) to remove deposits and dirt and then washed well.

Figure 8.—Operators at Government tanning factory using scudding knives on leather

4. *Tanning.*—The skin was immersed in a vat containing a blend of liquid extracts from locally grown Ranawara bark and imported wattle bark ; both extracts cause tanning.

The extracts of bark are prepared by soaking in cold or warm water. The concentration of the extract is described by its specific gravity measured by a hydrometer calibrated in " barkometer degrees " such that 1° corresponds with a specific gravity of 1.001, 2° with 1.002, etc.

The concentration of liquor used for initial stages of tanning is 4° which is gradually increased to 12° by adding concentrate during tanning. At regular intervals the skin was handled i.e. pulled in and out of the liquor. Tanning was found to be complete in about three weeks when the skin was removed and washed by dipping into water.

5. *Bleaching.*—For the next two days the skin was immersed in a vat containing local myrabalan (gall-nut) liquor which is prepared by soaking gall-nuts in water. The strength of this solution was adjusted so that the skin turned pale brown and any heavy stains from the earlier process were bleached out. Excess liquor was drained off and the skin rinsed with water.
6. *Finishing.*—A high grade purified mineral oil was then smeared on the grain side (hair side), and the skin hung until oil penetrated the entire skin, displacing the water. The leather was then worked over a hand-staker (fig. 6) which stretches and softens it and finally buffed in a smoothing process which may be done by machine or with sand paper. (fig. 9).

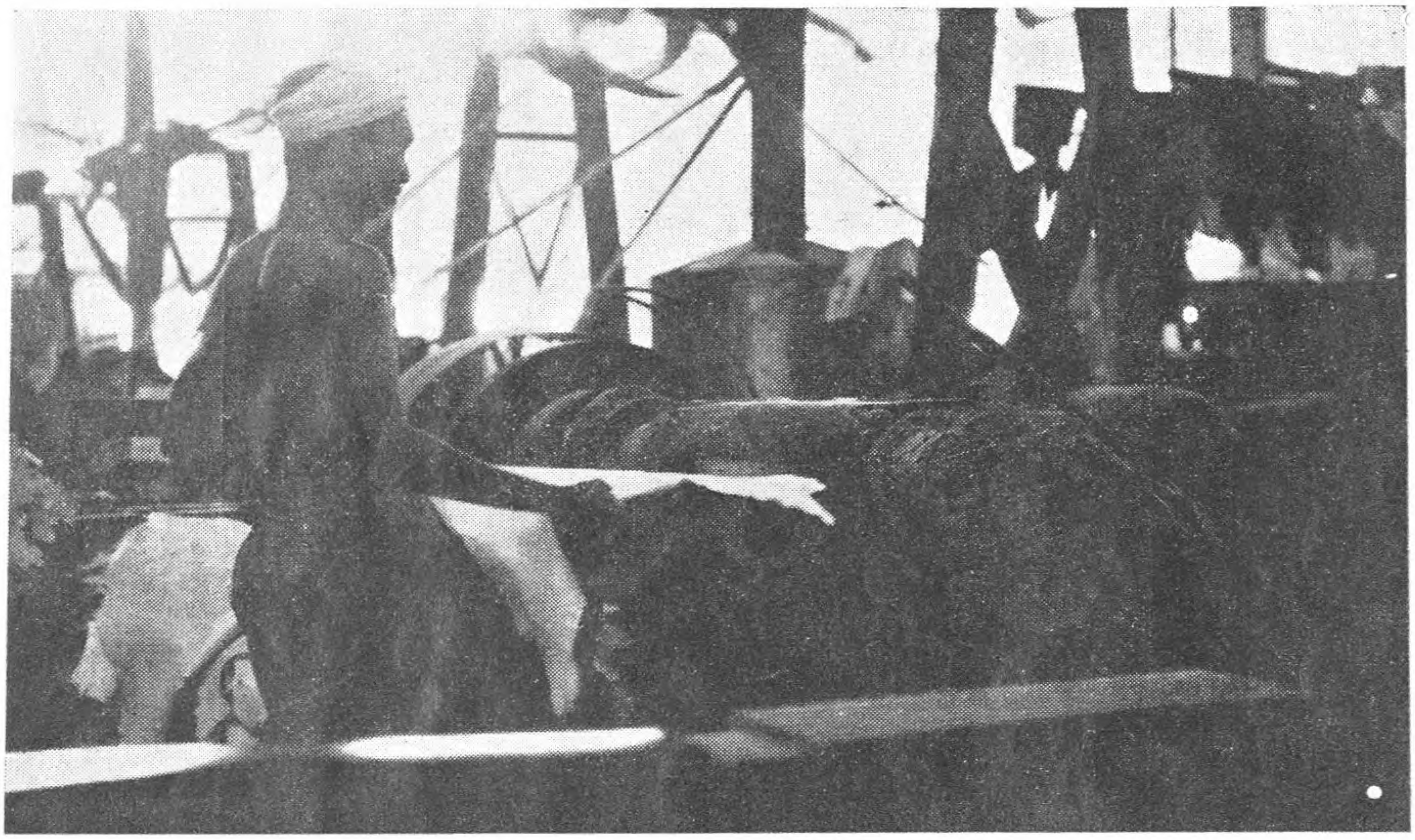

Figure 9.—Machine buffing of leather.

Black leather

The hides to be made into black leather are put through the same treatment as in making biscuit-coloured leather up to the end of de-liming. The several steps are as follows :—

1. Skinning.
2. Liming.
3. De-liming.
4. *Pickling.* The hides after draining from the lime vat are immersed in 5 per cent. salt and ½ per cent. sulphuric acid and shaken up at intervals for 1½ hours. This process renders the skin slightly acidic and prepares it for the special type of tanning required.
5. *Tanning.* The pickled skin is next immersed in a vat containing an acidic liquid called 33 per cent. basic chrome liquor. The acidity of the liquor was gradually decreased during tanning by adding sodium carbonate between ⅛ and ¼ per cent. of the weight of the skin. The skin was handled (shaken up) at regular intervals. Tanning was complete in about three days.

6. *Washing.* The liquor was drained from the skin which was then washed in running water for several hours. Residual acid was neutralized using concentrated borax solution (borax used was about 1 per cent. of skin weight) and the skin was washed again.
7. *Dyeing.* The leather was impregnated with two dye-stuffs called chlorozal black and nigrosine using about 1 per cent. of total dye (calculated on skin weight). The leather was hand-staked and tacked on a board, allowed to set in a stretched condition and finished by buffing. (Figs. 9 and 10.)

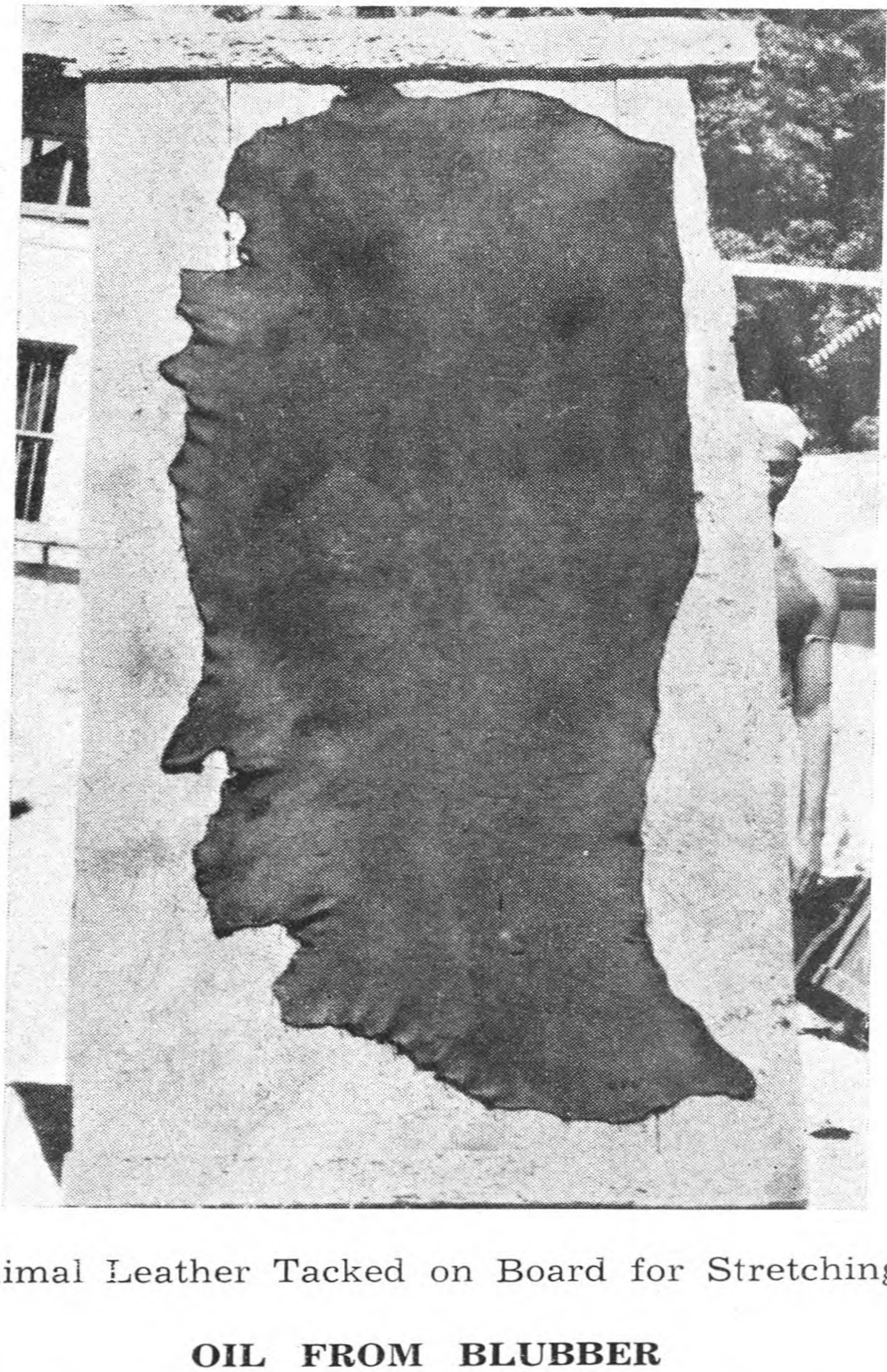

Figure 10—Animal Leather Tacked on Board for Stretching.

OIL FROM BLUBBER

A sample of oil was prepared by mincing the blubber and heating with open steam for about four hours. A shorter time may be required using steam under pressure. Oil up to 50 per cent. of the total blubber was recovered. The oil was washed with dilute alkali (sodium carbonate) to remove free fatty acids, washed free of alkali and dehydrated using anhydrous sodium sulphate. The viscosity of the oil was very low (between 5 and 10 centipoises) and its specific gravity was 0.9224 both values being obtained at 30°C. The oil has been found useful as an industrial lubricant, and oil from head and jaw blubber is specially recommended as a lubricant for watches and other precision instruments. A trial oiling of a watch with oil prepared here has proved satisfactory.

MEAL

WASTE portions of the dolphin such as head, bones and viscera can be converted into a meal by a process of boiling, crushing, pressing out the oil and water, drying and grinding. Meals prepared in this way from fish are extensively used in animal foods and for treating soils deficient in nutritive elements.

The analysis of a specimen common dolphin given below indicates that a high quality meal could be made from it—

Part	*Per cent. of Total body weight*	*Per cent. Moisture*	*Per cent. Ash*	*Per cent. Fat*	*Per cent. Protein*	*Calories/lb*
Edible flesh	38	73·0	1·8	1·5	23·5	500
Skin and blubber	16	26·0	10·0	50·2	14·0	2,370
Head	10	57·7	19·0	5·4	18·0	562
Bones	16·5	41·5	30·0	3·3	25·0	604
Tail and fins	2·5	23·5	8·0	48·5	19·9	2,416
Liver	2·5	76·0	4·0	2·0	8·7	246
Intestines	7	81·0	2·5	7·0	8·0	465
Other viscera	4	81·0	2·0	2·5	8·3	260

Notes.—(1) Protein =Nitrogen × 6.25 : Calories calculated from fat and protein on the basis 1 per cent. fat = 42.2 Calories and 1 per cent. protein =18.6 Calories (per pound of constituent);

(2) Oil from liver had a Vitamin A potency of over 6,000 iu/g but the yield was low. It required 500 lbs. of liver to yield a gallon of oil. Twenty lbs. of shark liver will yield a gallon of oil of similar vitamin potency.

SUMMARY

Conclusions

Two species of mammal dolphin are found in waters adjacent to Ceylon, namely the common dolphin (*Delphinus delphis*) and the bottled-nosed dolphin (*Tursiops truncatus*). Both these species are predators and cause damage to finishing nets by attacking fish trapped in them. This menace to nets is particularly pronounced when fish populations in a particular area become somewhat depleted.

Dolphin can be successfully captured from a motor boat by use of a simple hand harpoon with a detachable dart and bladder buoy.

Fresh dolphin meat when placed on the market sold readily despite some local prejudice against the naturally dark coloured meat. The flesh of the dolphin is nutritious and can be used successfully in both western and eastern types of cookery. An effort should be made to popularize the dolphin flesh as a high quality protein food. The price should be reasonable so that low-income groups may benefit from its use and nutritional properties.

The meat can be cured in a standard sweet pickle mixture and yields a product which can be stored for months under refrigeration.

The flesh can be dried and a dried salt meat produced. Mechanical drying of the flesh would undoubtedly improve this product since fungus growth during sun drying is very difficult to control.

The skin of the dolphin can be tanned to yield at least two kinds of excellent quality leather.

The blubber layer which lies immediately under the skin can be rendered into commercially valuable oil.

Unused portions such as parts of the head, the bones, viscera and flesh trimmings can be processed into meal for additions to animal feeds or for soil fertilization. The process of manufacture is similar to that used for production of fish meals.

It appears from observations made during this investigation that Government aid from the Naval or other Services may be necessary to aid the fishermen in reducing this menace to fish populations and fishing nets. This was particularly evident in the Negombo and Trincomalee areas.

It has been shown conclusively that there are commercial possibilities in the capture and utilization of dolphin. In some countries, particularly Japan, the meat finds ready sale. It may be possible to open a market for export sale of surplus meat in the event of large catches.

Due to the present lack of equipment, no effort was made to preserve the flesh by canning processes. However, that method may also prove satisfactory, particularly in processed meat products.

It is hoped that this bulletin will encourage commercial exploitation of the dolphin resources. There can be no doubt it would prove beneficial not only to the fishermen but to the population as a whole.

References

1. Tressler and Lemon "Marine Products of Commerce".
2. Norman and Fraser "Giant Fishes, Whales and Dolphins".
3. Moulton "Meat through the Microscope".
4. Methods of Analysis (Association of Official Agricultural Chemists) (1950).
5. Schimdt—Fisheries Research Board of Canada. Pacific Coast Station Progress Report 75 (1948).
6. Tarr, Lantz and Carter—Fisheries Research Board of Canada, Pacific Coast Station Progress Report 84 (1950).

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CONTENTS

Note : In view of the absence of both authors from the Island when this paper went to press, it has become necessary to insert explanatory footnotes in relation to certain sections of the text as an alternative to amending the text.—*Editor.*

INTRODUCTION

SETTING a net in the water and hauling it up onto the beach manually by its two ends is one of the oldest methods of catching fish and it is still employed in several parts of the world—Ceylon is one of these. Here there are several hundreds of beach seines operated by several thousands of fishermen and they contribute 35–40 per cent. of Ceylon's total annual fish catch. This means that beach seining has been and still is Ceylon's most important single method of fishing. In recent years the beach seine fishery has encountered difficulties which threaten its existence and the seiners have appealed repeatedly to the Department of Fisheries to undertake remedial action. There have been many and conflicting representations as to what this action should be, and the Department is seeking for a wise course through the confusion. As part of its search it asked its Research Division in April, 1953, to undertake a study of the seine fishery, to describe it, study the nature of its problems and to present any recommendations that seemed appropriate and consistent with the welfare of the fishing industry as a whole. The following is a report on the preliminary phases of that study.

DESCRIPTION OF SEINE

General Type

The name "beach seine" and its equivalents, "madel" in Sinhalese and "karavalai" in Tamil, refer not to one particular kind of net but rather to a style of net that shows many variations both in structure and size. Except for a few which will be mentioned later, most of these variations are slight and related to the depth of the water or the character of the bottom in the area in which the nets are used or the special varieties of fish they are designed to take. In some districts fishermen use different cod ends in the same nets for different varieties of fish. In all these instances, however, the differences are so slight that a general description will apply to all.

The usual form of a beach seine is illustrated in fig. 1. It consists of a cod end, a large body, two enormous wings and two hauling ropes of variable length. When completely set out the seine may measure more than three miles in length and when wet it may weigh upwards of two tons.

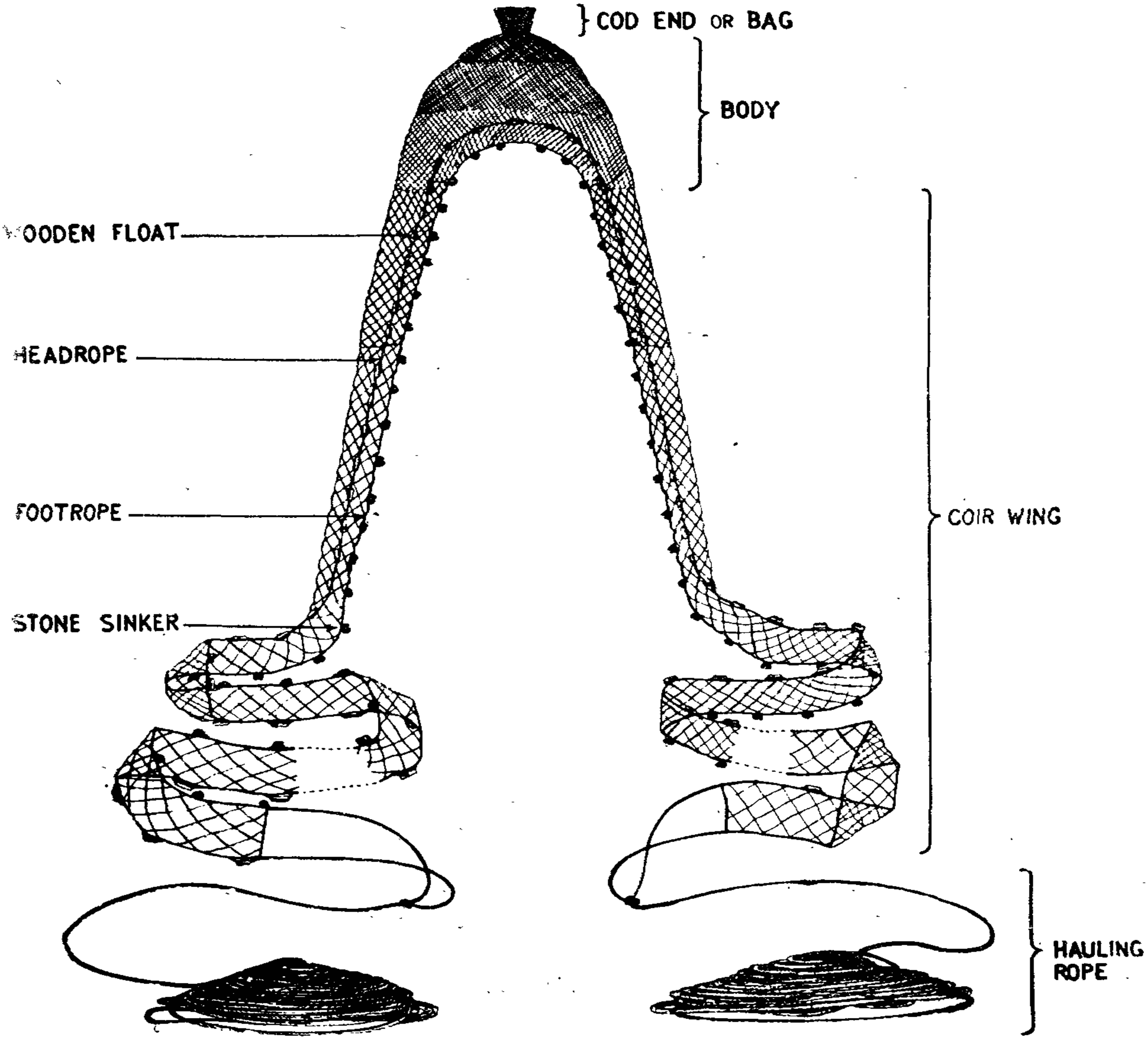

Fig. 1.—*Diagram of beach seine to show main features of construction*

Cod End.—The cod end is usually in the shape of a trapezium the two ends being parallel and the sides slanting from the wide, free, bunt end (8–12 feet wide when laid flat) to the narrow mouth (5–8 feet wide when laid flat). The length varies from 10 to 15 feet. The capacity of an average-sized cod end is 1½ to 2 tons of fish. The net is made of either hemp or cotton yarn[1] but in either case it must be strong to stand the stress of fishing. The mesh-size is usually small but varies somewhat. Mesh-sizes of 0·3′ to 0·6′ (inside stretched) are common when small fish are predominant but meshes of 0·8′ to 1·5′ are used when larger fish are being taken.

The forward end of the cod end may be fastened permanently to the body of the net or made attachable and detachable by a series of 50 to 60 marginal loops through which a lacing rope may be quickly and easily passed to connect them with a corresponding set of loops on the after (hind) end of the body. Permanently attached cod ends usually have an opening at one corner of the after or bunt end for emptying out the catch. During fishing operations this is closed by a slip string. Detachable cod ends lack such an opening. For emptying they are merely detached by unlacing from the body and the catch is poured out through the mouth. The loop system for detaching is convenient in another way. The operators keep a series of cod ends with different-sized mesh. When they wish to switch from one type of fishing to another they merely switch cod ends.

The cod end is usually treated with an extract of mangrove bark to reduce rotting and chafing of the twine and this stains it dark brown or even black.

Body.—The body is roughly cone-shaped (fig. 1) and about 40 feet long when measured from its mouth (middle of the footrope) to its after end. When laid flat on the beach its narrow end has a width of 8–12 feet which increases to about 20–30 feet at the middle and 40–60 feet at the mouth.

The after end of the body which joins the cod end is straight. The forward, or mouth end, on the other hand, is "U"-shaped and the corners of the mouth merge almost imperceptibly with the wings. The upper border of the forward end of the body is formed by a "headrope" which is buoyed with wooden floats, and its lower border by a "footrope" which is weighted with pierced stones. Both headrope and footrope are continuous with corresponding parts of the two wings.

The body is not made in one piece but composed of successive hollow cylindrical sections 3 to 5 feet long which are joined end-to-end to form the cone. The sections are knit of cotton twine that is somewhat lighter than that used in the cod end and the mesh-size usually increases progressively, section by section, from the after end. To illustrate, one of the typical net bodies studied had 9 sections whose inside stretched mesh measurements, starting at the after end, were as follows: 0·5, 0·7, 0·9, 1·2, 1·8, 2·0, 2·2 and 2·5 inches.

Like the cod end, the body is treated with mangrove bark extract to preserve the twine and this stains it brown or black.

Wings.—Taken together the two wings (fig. 1) make up about half the bulk of the seine. They are identical and each is like a very long coarse-meshed gill net attached at one end to the corner of the mouth of the body and at the other to the hauling rope. The length and height of the wing when suspended in the water depends partly on the size and number of its meshes and partly on the extent to which it is stretched. In operation the wing of a typical net measures about 225 fathoms long and 3 or 4 fathoms deep.

[1] *Note by Editor*: In the Galle area, the cod end is made of coir string.

The wings are made entirely of coarse coir twine whose diameter varies from 0·2" to 0·3" and corresponds closely with what European manufacturers describe as "5-pound line", but it is not laid (twisted) nearly so hard. The wings are like the body in that they are composed of sections instead of being made in one piece. These sections vary in length from 25 to 40 feet. As mentioned above the mesh-size is uniform throughout each separate section of the body but in the wings the mesh-size almost always varies not only from one section to another but also within each section showing a gradual increase from the after to the forward end. The size is usually increased every fourth mesh. Table I illustrates these features for the wing of one net that may be regarded as typical of those examined during this study.

Table I

INSIDE, STRETCHED-MESH MEASUREMENTS FOR DIFFERENT PARTS OF THE WING OF A TYPICAL BEACH SEINE, STARTING AT THE AFTER END

Section No. starting at after end	*Mesh-size at after end (inches)*	*Mesh-size increase at every 4th mesh (inches)*
1	9	1
2	15	1½
3	28	2
4	36	2½
5	56	3
6	80	3

Hauling Rope.—The ropes, one of which is attached to each wing for hauling the net, are by far the longest part of the beach seine, nearly as bulky as the wings, and constitute almost half the total bulk. They are made of coir, have a circumference of 3–4 inches and for convenience in handling are made up in coils of about 240 feet each. The number of coils used on each wing may vary greatly from set to set and is determined largely by the distance of the set from shore. The length of rope used on each wing when "seining blind" is usually about 1,500 feet.

Other Types of Beach Seine

There are two commonly used types of beach seine that differ so remarkably from the form just described that they require separate mention.

The Kachchidela is widely used in the south of the Island about Galle and Matara. The body and cod end of this net form an open trough instead of a funnel with a blind-end and its sides are buoyed with wooden floats. Both body and cod end are knit of coarse coir twine and the mesh of the cod end is so fine that it looks more like a mat than a net. The footropes of the body and the wings are similar to those of the regular seine and are in contact with the bottom while the net is being hauled. The cod end meanwhile is held at the surface by a "paru", a large oared boat equipped with an outrigger (fig. 2), and onto it the fish swim after making their way through the trough formed by the wings and the body. From there they are continuously scooped into the paru with a short-handled dip net. There is therefore no accumulation of fish in this cod end as in the regular type of beach seine.

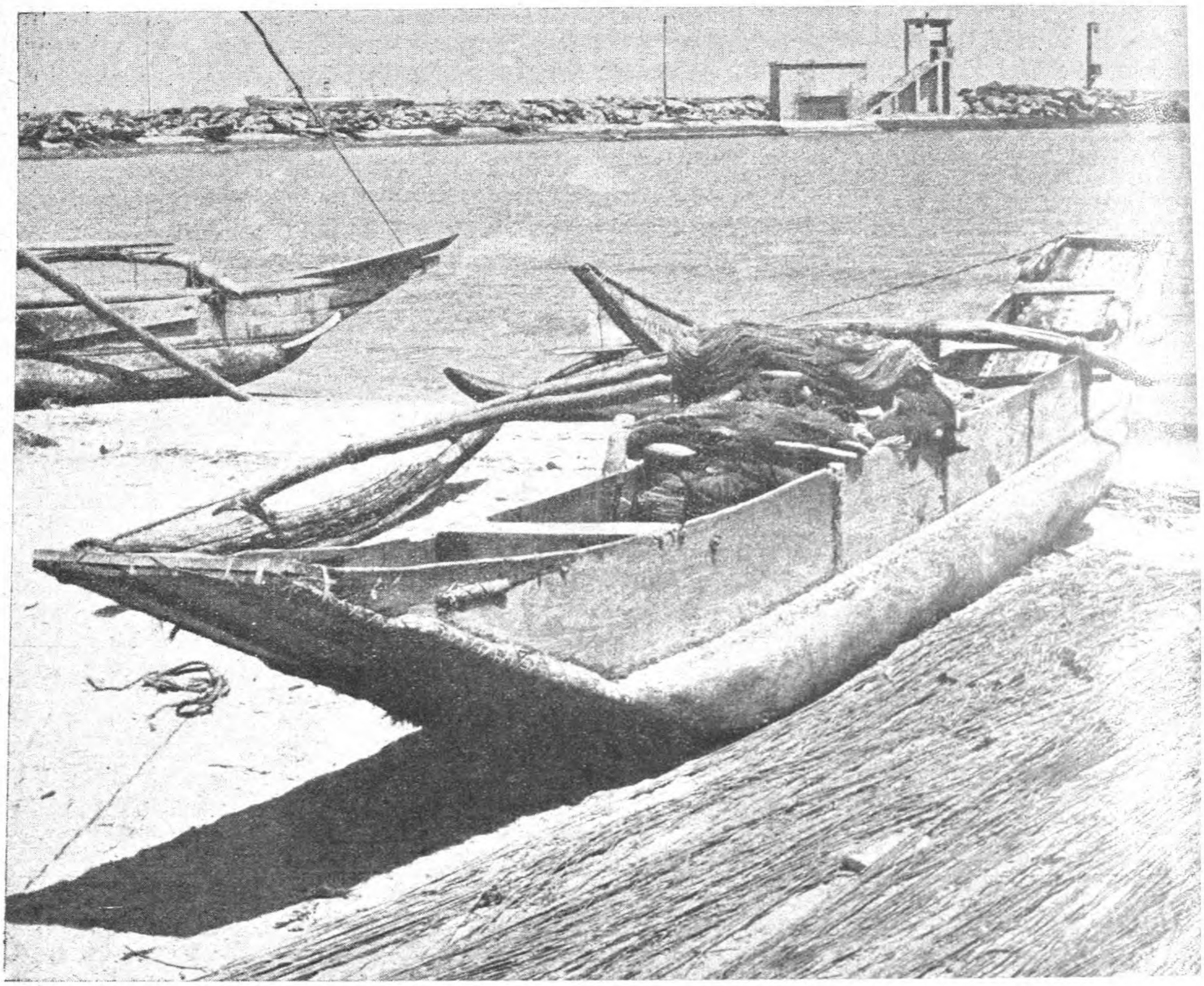

FIG. 2.—*Paru at Mutwal loaded and ready to be launched for blind seining*

The Sāla dela and Halmessan dela (herring and sprat nets) are built on the same lines as the regular beach seine but all the netting is of cotton and/or hemp twine and in any one net the mesh-size is uniform throughout the body and wings. There is, however, some difference from net to net and stretched mesh measurements of 0·5″ to 1″ are common. The cod end mesh-size is always finer, varying from 0·25″ to 0·5″.

OPERATION

General Features

Beach seining can be carried on only in relatively calm waters and is therefore a seasonal operation in areas which are fully exposed to the monsoons (fig. 3). From April to September most of the west-coast waters are exposed to the south-west monsoon and seining is possible then only on the east coast. Similarly, from October to March, east-coast waters are exposed to the north-east monsoon and seining is possible only on the protected west coast. In the areas about Mannar and Kalpitiya, however, fishing takes place throughout the year because there is always a lee coast during both monsoons.

Because of this operational restriction imposed by the weather, most beach seine owners and their men have in the course of time devised district-to-district migration

FIG. 3.—*Map showing centres of beach seining, the* 100-*fathom line and railroads*

cycles so that they are always working areas where fishing is " in season ". A group almost never visits more than two areas in the course of a year, but at each place it settles in a " padu ". A padu is a specified area of beach and the adjacent water, the exclusive use of which is leased by the Government to a net owner. He alone may fish the water comprehended by his padu, and he alone may set up " wadies " (fishing camps), beach boats, dry and stack nets and cure fish on that section of beach.[2]

Each net owner has 20 to 70 men to operate his nets. They may be engaged either on a fixed salary or on a share basis. Most of the men have no special knowledge of fishing and they are regarded merely as sources of hauling power. The leader or "mandradi", however, is an experienced fisherman and he is responsible for managing and directing the entire labour force. He usually has a special contract with the net owner which affords him a relatively better income than the rest of the crew.

There are two quite different methods of operating beach seines. In most padus the seining is " blind "—that is, the net is set and hauled two or three times a day whether there are signs of fish in the area or not. The quality and quantity of catch from the day's first set usually determines whether further sets are worthwhile. In some places, however, *e.g.* Marawila on the central west coast, the operation is regulated to take advantage of the appearance of shoals of fish. This seining of shoals is most common when such varieties as paraw, herring and blood-fish (bonito) are being exploited. The surface-feeding habits and migration behaviours of these fish are familiar to the fishermen who have developed special operational tactics for taking them. Spotters are appointed who spend many hours either on the beach or far out at sea on " teppams " (log rafts, fig. 4) watching the surface for signs of shoals of fish. When they feel sure they have sighted a shoal that can be surrounded they signal the waiting crews of the two net boats, who may be on shore or afloat, to come and set the nets. The two types of operation are so different as to warrant the separate treatment accorded them below.

FIG. 4.—*A 16-man crew at Sinnapadu half-way through a hauling operation. The whole of the rope and part of the wing have been beached. Three men have entered the water to scare the encircled fish away from the wing into the body*[3]. *A similar crew not seen in the photograph was working on the other end of the net a hundred yards down the beach to the right. At the left a teppam, turned upside down on the beach, is drying in the sun.*

[2] *Note by Editor :* Alternatively, a padu comprehends a sufficient length of beach to permit the operation of a beach seine, and a number of operators work a series of adjacent padus in rotation according to a roster which they prepare or the Government sets out for them.

Seining Blind

Net loading.—In blind fishing the net is kept in one place and is loaded from the beach, where it has been dried and repaired since its last use, into a large vallam or paru (fig. 2). One rope is coiled on the bottom of the boat, on top of this a wing is laid, then the body and cod end, then the other wing and finally the other rope. Three or four men take about half an hour to complete this loading operation.

Setting.—When setting begins the free end of the upper hauling rope is given to men on the beach or fastened to some fixed object there. Then the boat with eight men aboard is rowed out from shore along an arched course. Four men row, three attend to the net and one, the mandradi, directs operations. The various parts of the seine are paid out in the reverse order of loading and the free end of the second rope is finally brought to the beach at a point about 100 yards from the first end.

Five of the boatmen then go ashore to assist with hauling after which the mandradi with two rowers in the boat immediately moves back out to a position directly over the mouth of the net and moors the boat there to the centre of the buoyed headrope of the body of the net. From this point the mandradi directs the net-hauling by signals to the shore crews.

Hauling.—By this time 10 to 15 men have taken up their hauling positions on the beach along each rope exerting a steady pull (fig. 4) and watching the mandradi's signals so as to keep the two sides of the net coming in at about the same rate and the mouth of the net properly open. As the rope and wings are drawn in they are coiled up or laid on the beach, at the end of the line of haulers, so they can be readily spread for drying later on.

As the body of the net approaches shore and the weight of the cod end increases from the concentration of fish in it, more and more men join the haulers to hasten the operation while it is becoming increasingly difficult. If the catch is good and the net really heavy, temporary assistance is required and usually willingly given by crews from neighbouring wadies. Sometimes 40–50 men are required on each rope to haul the net. This is most likely to happen when the current and wind are against the course of the net.

Towards the end of the haul some of the fish, charging about in the confined and ever-decreasing space enclosed by the net, escape through or under the wings unless some precaution is taken. A few men, usually the younger ones, are therefore stationed in the water in a single file along the outsides of the wings (figs. 4 and 5). They hold up the headropes of the wings [3], splash the water with sticks and shout and frighten the fish backward from the space between the wings into the body of the net. Sometimes a file of men will stretch a gill net between themselves and the wing and parallel to it to catch fish that escape through or under the wings in spite of efforts to chase them back into the body.

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[3] *Note by Editor :* **The men in the water on each wing also press the footrope down to the sea bed with their feet, to prevent fish from escaping under the footrope.**

FIG. 5.—*A late stage in the hauling of a beach seine at Mutwal near Colombo. The ropes and the greater portions of the coir wings have already been beached. The point of union of the coarse-meshed wing and finemeshed body shows well on the right where part of the net is being held above water. The position of the floats on the body headrope clearly indicates the form of the net as it is hauled through the water*

Finally the whole of the body is brought to the shore-line, and the headrope and footrope are raised above the surface and no more fish can escape. Usually the whole body and cod end are carried ashore either separately or in one piece. If the catch is good, however, they are too heavy to be carried thus and spare cod ends are taken into the water and filled with portable loads of fish emptied from the full one until what is left is light enough to be carried ashore. The catches in seining blind usually vary from 10 to 1,000 pounds, or more.

In seining blind the net is seldom set more than a mile from shore and the complete setting and hauling operation usually takes 2–3 hours.

Seining Shoals

Net Loading.—When the net is to be used for seining shoals of fish that have been sighted it is dissembled and the parts loaded into 3 boats. This leaves all three light and quickly manoeuverable. One carries one coir wing only, the second carries the cod end, body and second wing and the third only the coir ropes. Spotters on 3 or 4 teppams survey the surrounding areas and warn the first and second vallams of approaching shoals.

Setting.—When a set is to be made the first two boats move quickly to a position just in front of the shoal and a two-man teppam quickly takes up a position alongside each boat. One teppam is given a wing-end and the other a body-end which they join together and lower into the water. Meanwhile the boats quickly move out in front of and along the sides of the shoal paying out the net as they go. Finally they bring the two free wing-ends together and tie them so that the shoal of fish is completely encircled by a wall of net. At this point a signal is made to the third boat to come out with the rope. It has been standing by at the beach until this stage of the proceedings. One end of one of its two ropes is made fast ashore or left with a hauling crew and the boat sets off paying out more of this first rope as it goes until it reaches the net. The tied-together wing ends are then separated, the free end of the first rope is tied to one wing and a free end of the second rope tied to the other. The third boat then returns to shore paying out the second rope as it goes and lands about 200 yards from its original stand-by post. Here it turns over the free end of the second rope to a second beach gang which has assembled there for hauling.

Hauling.—Hauling is much the same as in seining blind. As the net is drawn to shore the teppams follow along the outside splashing the water to frighten the fish to prevent them from escaping through and under the wings. Occasionally currents tend to carry the net offshore and large crews of haulers are required to prevent it from being carried away and lost. Sometimes, too, the current carries the net along shore so that the final beaching point may be as far as 2 miles from the point where hauling began. If it drifts over rocky bottom the teppam men who follow along must lift the footrope to prevent snagging and tearing and at such times they must be careful to prevent fish from escaping.

In seining shoals the net is often set as far as three miles from shore and it may take 3 or 4 hours to complete the hauling.

Fewer sets are made in seining shoals than in seining blind, but generally the catch per set is heavier. The poundage varies from ¼ ton to 4 tons.

Catch Sorting

Regardless of the method of seining the treatment of the catch is the same. It is quickly sorted into types and usually taken in shallow circular baskets, about 2 feet in diameter across and holding about 70 lbs., to the wadies to be disposed of in whatever way the operators decide. At certain times in some centres the demand is so great that the fish are taken directly from the net to the auction shed and sold immediately, or sold immediately at point of landing.

CATCH

A good account of beach seine catches has never been written and the data assembled previous to and during this study are sufficient to permit only broad generalizations. However, these are so obvious in many cases and at the same time so seldom recognized that it seems worthwhile compiling what deductions can be made about total annual landings, year-to-year variations and long-term trends in volume of catch, seasonal changes in landings, the relative importance of beach seine landings compared with landings from the fisheries as a whole, the efficiency of the beach seine as a fishing instrument and something about the age and species-composition of catches which help explain observed fluctuations in landings. These conclusions and what is known about the gear itself and the disposition of the catch should affect the Government's attitude toward the problems of management and conservation and the policies to be pursued in dealing with them.

Changes as Indicated by Fisheries Statistics

Serious efforts by the Department of Fisheries to assess Ceylon's annual fish landings began in 1952. Two years' data have been published (De Zylva, 1953 and 1954) and advance figures have been obtained from the statistical division for a third year for this study. In these presentations the catches of the beach seines are shown under the headings " Small shore-seine catches Group I and Group II ". All are summarized in Table II.

Table II

TOTAL ANNUAL LANDINGS (POUNDS WET WEIGHT) FROM BEACH SEINES COMPARED WITH THOSE FROM OTHER SOURCES, 1952–1954

Year	*Beach Seine*	*Wadge Bank Trawlers*	*All other sources combined*	*Total Catch*
1952	24,804,000	650,000	31,500,000	56,904,000
Per cent. of total landings	43·6%	1·1%	55·3%	100%
1953	19,508,000	2,580,000	34,200,000	56,288,000
Per cent. of total landings	34·7%	4·5%	60·8%	100%
1954	24,520,000	2,995,500	37,830,000	65,345,500
Per cent. of total landings	37·5%	4·5%	58·0%	100%
Average for 3 years	22,944,000	2,075,166	34,510,000	59,529,166
Per cent. of total landings	38·6%	3·3%	58·1%	100%

Table II indicates that all of Ceylon's fisheries combined land about 60 million pounds of fish each year and that approximately 23,000,000 pounds (40 per cent.) of this, valued roughly at Rs. 11,500,000, is taken in beach seines. From this it is clear, as was stated in the introduction, that the beach seine is the most important single source of Ceylon's fish supply. As such it commands the attention of all who are interested in our national welfare and should not be interfered with by Government or any other agency without the most careful forethought.

Table II indicates that the total landings from all sources were about the same in 1952 and 1953 and rose by more than 15 per cent. in 1954 to over 65 million pounds. In contrast the beach seine catch seems to have dropped by 5 million pounds (20 per cent.) from 1952 to 1953 and the relative importance of beach seining as a source of fish decreased. Its contribution to the total catch fell from 43 per cent. to 35 per cent. The volume of the catch was restored in 1954 to practically the 1952 level, but even so it then constituted only 38 per cent. of the landings from all sources. Beach seining seems in general to be losing in its relative importance as a source of fish.

In some quarters both the fluctuations recorded and the suggested decrease in relative importance of beach seining are viewed with alarm. Actually a 20 per cent. change in landings is common in almost any large fishery and examples of it have been recorded for Ceylon (Sivalingam and Medcof, 1955). Unless subsidiary information is available on fishing conditions and on how much fishing effort was expended during the changes, the changes in themselves have little meaning. No critical information of this sort is available for beach seining. With some reservations the same may be said about the decreasing relative importance of beach seining in the face of a rising total production from other sources.

Furthermore, it is doubtful in this case that 20 per cent. is a very reliable measure of the year-to-year fluctuations that may have taken place because the Fisheries Department's methods of statistics collection admittedly leave something to be desired (De Zylva, 1953). No one has ventured a critical opinion of their likely margin of error, but some believe it could be as great as or greater than 20 per cent. Even if the assessment methods were faultless and the subsidiary information on fishing conditions and effort were available, it would be foolish to suggest that three years' records were sufficient to establish a norm, much less to give a true indication of downward trends away from it. In other words, the statistics on beach seine landings collected so far are only beginning to have meaning and it is not reasonable to make more than tentative deductions from them, or to become alarmed to the extent of contriving and applying corrective measures to such poorly understood conditions.

With certain reservations the same may be said of the minor change in the relative importance of beach seining in the fisheries as a whole. At the same time, it would be wrong to disregard the implications of the records because the apparent trends may shortly be exaggerated to the extent where their meaning is no longer ambiguous and it might be too late when that happens for composed thinking in time to apply well considered corrective measures. In this connction it is wise to consider what the industry has to say on the subject.

Changes as Reported by the Industry and Reputed Causes

Fishermen contend almost unanimously and quite sincerely that beach seine catches and fish abundance are dropping and have been dropping for several years and that the stocks of fish available to them are decreasing in spite of what the statistics say and in spite of the fact that they can muster only a few and incomplete reliable data to support this view.

The disparity between the deductions from the Department's statistics and the opinion of the fishermen is regarded by some as evidence of the unreliability of the statistics. However, if weaknesses in the statistics are to be admitted, weaknesses in the opinions expressed by fishermen must also be admitted.

A beach seine fisherman's opinions of changes in the total landings and abundance of fish are usually based on the size of the catches realized from the operation of the particular net with which he is associated. This can be a faulty basis for judgment as a little reflection will indicate. If the total number of nets operated in an area is constant and the catch per net falls, then it is safe to assume that the total catch has also fallen. If, on the other hand, the number of nets is increasing or decreasing the catch per net may fall or rise without any accompanying change in the total catch or abundance of available fish. The opinions of individual fishermen are therefore not to be relied upon, although not necessarily neglected, in such matter. As already indicated, the statistics assembled by the Fisheries Inspectors do not include an assessment of the number of seines operated. In fact, there has been only one published estimate of the number of beach seines operated in Ceylon (John, 1951).

Net owners often operate several nets over a wide area and they are likely to have reasonably comprehensive ideas of the total picture. They know in a general way how many nets they and their competitors are operating from year to year and how the total catch is distributed among them. Their opinions may reasonably command more respect than those of fishermen even when equally unsupported by numerical data. Actually both fishermen and net owners maintain that in past few years—

(1) The total number of nets being operated has increased ;

(2) The catch per net has decreased ;

(3) The decrease in catch per net has been so drastic that it cannot be explained simply on the basis of increased numbers of nets operated and that it impossible to escape the conclusion that there has been a steady declin in the total catch from beach seines and the fish available to them ;

(4) This alleged drop in total catch results from competition for and over-fishin of several varieties of fish taken both by beach seines and by severa different kinds of fishing devices whose numbers are also increasir rapidly.

The explanations offered above in (4) for this reported change in catch are even more seriously lacking in sound support than the change itself because so far there are no critical statistics and no immediate provision for gathering them on subjects like the numbers of nets of various sorts that operate in competition with beach seines. In a sense, therefore, the listing of explanations of a reputed decline is beside the point, but, on the other hand, it is of interest to record what is said as a guide to thinking on this subject. Some say that drift netting mostly by teppams has increased to such an extent as to completely explain any drop in beach seine catches because gill nets catch large quantities of fish usually taken in beach seines and frighten off those they do not catch by breaking up their schools. Others say that dynamiting of fish (an illegal practice) has now become the principal method of fishing in their districts and that this destroys not only the desirable fish themselves but also their eggs and the organisms on which fish feed so that the areas are deprived of stocks of useful fish and, what is even worse, cease to be attractive to other fish that might migrate into them. Others say beach seine operations themselves account for the decrease, that the mesh of the cod end is so small that the net destroys so many juvenile fish that too few are left to serve as parent stock to maintain production.

The suggestions for remedying the supposed depleted condition of the fish stocks are as various and conflicting as the explanations offered for it and most of them equally lacking in reliability. Nearly all of them call for drastic reductions in fishing effort especially with types of gear that compete most closely with beach seines. Loud cries are heard from beach seiners on all sides for the Department to choose among all these suggestions and do something. However, of the proposed remedies, stamping out dynamiting is the only one offered so far that seems likely to do more good than harm.

Seasonal Variations in Landings

The Inspectors of the Department of Fisheries submit monthly reports of catches made in their districts, a summary of which is published in the annual administration reports. A study of the original monthly reports themselves suggests that there are remarkable season-to-season changes in the size and composition of beach seine catches and no one seems to find fault with this conclusion. In the " off " season in some areas catches approach zero. This appears to be partly because unfavourable weather prevents operation of the net and partly because fish in the exploitable inshore waters are scarce—perhaps because of the disturbance of heavy wave action. Some idea of the variations in catch per net haul may be had from Table III although much greater variations have been observed.

Table III

SUMMARY DATA DESCRIBING BEACH SEINE OPERATIONS OBSERVED DURING THIS STUDY AT DIFFERENT TIMES AND PLACES

Area and Date	*Hours fished** *(No.)*	*No. of Men*	*Fishing effort* *(man-hours)*	*Total catch* *(lbs.)*	*Catch/Man/Hour* *(lbs.)*
Marawila					
11·12·53	4	50	200	800	4
14·12·53	8	70	560	275	0·5
Mutwal					
5· 5·53	3	17	51	65	1·3
9·11·53	1·5	14	21	51	2·4
11·11·53	2·5	18	45	50	1·1
2· 4·54	3	18	54	21	0·4
8· 4·54	2·5	16	40	10	0·3
23·10·54	2·5	18	45	4	0·1
30·10·54	2	16	32	10	0·3
Kuchchaveli					
30·7·53	4·5	25	113	1,910	17
Nilaveli					
28· 7·53	3·5	32	112	800	7·1
25· 6·54	4	34	136	20	0·1
Tangalle					
17·11·53	4	54	216	1,450	6·7
Karaduwa					
2·10·53	3	27	81	4	0
Sinnapadu					
11·12·53	3·5	40	140	30	0·2
23· 1·54	4	37	148	270	1·7
Pesalai					
30· 4·54	3·5	36	126	280	2·2
4· 5·54	4	32	128	150	1·1
Nadukuda					
6· 5·54	3·5	30	105	80	0·8
Peparapitti					
22· 6·54	4	30	120	60	0·5
Nayaru					
23· 6·54	3	31	93	40	0·4
Average	3·5	30·7	122·2	304	2·3

* Hours fished is the time from when the setting begins until the cod end is carried up onto the beach.

The detailed unpublished records of the Inspectors show that some varieties of fish such as the Clupeoids occur regularly in the catches the year round, suggesting that they spend their entire lives in the narrow ribbon of inshore water that is exploitable by beach seines. Other varieties such as the Indian mackerel (Kumbala) occur in unusual abundance in certain months then disappear completely or almost completely. The former varieties are referred to in this report as " resident stock " and the latter as " migrants ".

The resident stock is regarded as the " pot boiler "—they keep things going—but the money makers are all members of the migrant stocks. It is their appearance, or failure of appearance, that makes or breaks a year's beach seine operations. Little is known of the factors determining the entrance of important numbers of migrants into the areas exploited by beach seines, but the importance of exploring these is generally recognized (Sette, 1949), and they are receiving some attention from fisheries biologists. Less attention is paid to members of the resident stock, but they should not be disregarded. Frequently such changes are determined by hydrographic phenomena the study of which might permit useful predictions of when and where fish will be available. So far no efforts have been made in Ceylon in this direction.[4]

Efficiency of the Beach Seine

Table II summarizing data gathered by Fisheries Inspectors shows that the beach seine is the principal contributor to the fish markets of Ceylon—each year it provides roughly 23 million pounds of fish. Table III based on the authors' own observations of seine hauls selected at random, shows how this vast supply was made possible. For every 2·3 pounds of fish caught, some beach seiner spends on the average a full hour hauling on a rope or rowing a boat. Putting it another way, 1952's 25-million-pound catch of beach seine fish was made possible by 11 million hours of human fishing effort. It must be stressed that this takes into consideration only the time spent strictly on fishing itself and does not include the great amount of time consumed in preparatory and maintenance work—constructing nets, washing, drying and mending them and standing around on the beach hoping to see a shoal of fish worth trying to catch.

Eleven million man-hours is an enormous expenditure of energy and it is proper to ask if this disposition of manpower is in the nation's best interests. A small number of data bearing on this subject have been gathered by the authors. More are desirable for critical judgment, but it would be wrong to neglect the records at hand merely on that account. Table IV summarizes the observations and suggests that beach seining and trolling are about on a par in production efficiency, but that fishermen would more than double their contribution to Ceylon's food supply if they were to give up beach seining and go hand-lining or gill-netting from teppams.

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[4] *Note by Editor:* Some hydrographic studies have been made, *e.g.* Ceylon Journal of Science, Sec. C, Vol. IV, and Reports of the Marine Biologist, 1909–1939. These have been suspended due to lack of specialised personnel on the staff.

In other words, the beach seine is a relatively inefficient fishing device. It creates an even less favourable impression when compared with longlining as practised from kattamarams or mechanized boats.

Table IV

COMPARISON OF CATCH PER UNIT OF EFFORT BY BEACH SEINERS, TEPPAM MEN (HANDLINERS AND GILLNETTERS) AND ORU MEN (TROLLERS) AT TWO FISHING CENTRES

Area and Date		Catch/Man/Hour (lbs.)				
		Beach Seine		Handlining and Gillnetting (Teppam)		Trolling (Oru)
Marawila						
11·12·53	...	4	...	5	..	1·7
14·12·53	...	0·5	...	3	...	1·2
Mutwal						
5· 5·53	...	1·3	...	2·1	...	2·[illegible]
9·11·53	...	2·4	...	6	...	3·1
11·11·53	...	1·1	...	4·1	...	2·8
2· 4·54	...	0·4	...	2·4	...	1·2
8· 4·54	...	0·3	...	1·4	...	0·6
Average	...	1·4	...	3·4	...	1·9

The implications of this deduction must be recognized in any rational consideration of Ceylon's fishery problems and it is pertinent to ask why the catches are so low and if they could be improved. So far this subject has been scarcely touched, but the observations made are all so clearly indicative and accord so well that they might be referred to here. In mid-December, 1953, the authors aboard M.V. "North Star" made a sonic-meter exploration of one of Ceylon's best west-coast beach seining grounds—the district from Marawila to Sinnapadu—when the fishery was at or near its annual maximum. At the same time that it registers depth on the paper ribbon passing through it, the sonic-meter also makes a trace record of any mid-water objects that are good reflectors of high frequency sound. Shoals of fish usually show up very well and for this reason the sonic-meter is now considered to be an indispensable part of the gear used in some fisheries such as the Canadian Pacific coast purse-seine herring fishery. By passing over any shoal of fish from different angles at some chosen uniform speed, the extent of the shoal can be calculated with fair precision, and with experience an operator can learn to estimate the weight of fish that can be recovered from it.

Mr. W. Babcock, Master of the "North Star" at the time referred to, is experienced in this kind of survey and in a 20-mile run over the seinable bottom the meter recorded only three small shoals from each of which he estimated that a fine-meshed purse seine should recover about a ton of fish. Few of the beach seine catches obtained there at that time by seining surfacing shoals approached this volume even remotely. From this Mr. Babcock concluded tentatively that the beach seine could not be an efficient fish seining device as compared with a purse seine.

In the section above headed " Operation ", it was pointed out that so many fish regularly escape through or under the wings of the beach seines during the last stages of hauling that gill nets are set outside and parallel to the wings to catch the escapees. In some places owing to the nature of the bottom the wings are held high up during hauling. To capture the thousands of fishes that escape, as many as three banks of gill nets are sometimes placed thus, one outside the other and all parallel to the wings. Besides these, one or more very long gill nets may be set behind the cod end towards the end of the haul and finally hauled on to the beach like the seine itself. The fact that it is worthwhile to set so many auxiliary nets outside the beach seine supports Mr. Babcock's conclusion that the beach seine is an inefficient device for straining fish from the water.

Judging from the performances of types of seines used in other countries, *e.g.* purse seines in Malaya, it seems reasonable that the beach seine could be substantially improved and that determined efforts should be made to devise a better type. So far as is known, industry is making little or no effort in that direction. One or two operators have made trials with entirely different kinds of seines hoping to find one that is less wasteful of man-power. This is an encouraging sign. Many people not engaged in the fisheries have expressed the opinion that the beach seine is an out-moded fishing device that should be and will be discarded soon and that it is not worth spending time in searching for improvements in it. Even if in time it does disappear, the investigators hold that so long as the beach seine continues to be such an important contributor to the nation's food supply it is worth tyring to improve, and that modifications should be sought now. The changes needed are such as to improve the net for taking small shoals of fish, to minimize the labour requirements and to reduce the loss of fish through and under the net and thus raise the efficiency (catch per man per hour).

Species-Composition of Catch

One of the most striking features of beach seine catches is the great number of species of fish involved. Occasionally a clear haul of one variety is obtained but generally there are at least a dozen species well represented and stray specimens of as many more. So far the writers have identified 53 species in the catches and there are several others whose classification is still doubtful. The former are listed according to family in Table V which also gives data on the mean size of random samples of each variety found in typical seine hauls and their size at maturity in the Indian Ocean as a whole according to Weber and Beaufort (1913–1940), Day (1878–88) or Deraniyagala (1952).

Of the identified species 14 belong to the herring family (*Clupeidae*)—more than to any other family—11 to the horse mackerel or paraw family (*Carangidae*) and 9 to the silver belly family (*Leiognathidae*). The statistics supplied by the Fisheries Inspectors indicate that the order of importance of the three families in contributing to the volume of beach catches is the same as the above. Precise quantitative statements about the relative importance of the several species cannot be made because they are not separately reported in the statistical returns.

It was hoped that records compiled during this study would soon demonstrate this, but that hope has been discouraged by observations of enormous fluctuations in the relative importance of species both with time and place. These variations are illustrated in Tables III and IV. Some species like the pomfret (*Pampus argenteus*) are available only at one or two points on the coast, sometimes in enormous numbers for brief periods only and almost nowhere else. It is impossible therefore to provide even an approximate numerical expression of the relative importance of the species from the few data assembled so far.

Table V

NAMES, MEAN SIZES OF RANDOM SAMPLES AND ULTIMATE SIZES OF IDENTIFIED SPECIES OF FISH TAKEN IN BEACH SEINE HAULS STUDIED AT VARIOUS PLACES IN CEYLON

Family and Scientific Name	*Common Names English (E) Sinhalese (S) Tamil (T)*	*Area and collection date of sample*	*Mean length of fish in sample (mm.)*	*Length at maturity (mm.)*
Clupeidae—				
Clupea (Harengula) longiceps ...	*E.* Oil Sardine ... *S.* Pesalaya ... *T.* Pesalai	Nilaveli ... 28· 7·53	44 ...	160
Do. fimbriata ...	*E.* Fringe-scale Sardine *S.* Gal Salaya ... *T.* Chalai	Tangalle ... 17·11·53	48 ...	185
Do. moluccensis ...	*E.* Spotted herring ... *S.* Korrumburua *T.* Koramburu Chalai	Karaduwa 2·10·53	104 ...	160
Clupea (Amblygaster) leiogaster	*E.* Herring ... *S.* Hurulla *T.* Kirimeen chalai	Alampil ... 29· 9·53	62 ...	200
Stolephorus indicus ...	*E.* Anchovy, Sprat ... *S.* Halmassa *T.* Nethali	Mutwal ... 8· 5·53	36 ...	145
Do. commersonii ...	*E.* Sprat, Anchovy ... *S.* Halmassa *T.* Nethali	Karaduwa 2·10·53	28 ...	125
Dussumieria acuta ...	*E.* Round herring ... *S.* Thondaya *T.* Thondai	Mutwal ... 8· 5·53	157 ...	165
Do. hasseltii ...	Same as acuta ...	Tangalle ... 17·11·53	164 ...	170
Engraulis purava ...	*E.* Anchovy ...	Sinnapadu 11·12·53	64 ...	200
Do. kammalensis ...	*E.* Anchovy ...	do. ...	57 ...	112
Do. malabaricus ...	*E.* Anchovy ...	do. ...	45 ...	—
Do. mystax ...	*E.* Anchovy ... *S.* Ata lagga *T.* Laagen	do. ...	72 ...	190
Do. setirostris ...	*E.* Anchovy ... *S.* Ravul lagga *T.* Laagen	Hikkaduwa ... 23·11·53	111 ...	170
Opisthopterus macrognathus ...	*E.* Razor edge ... *S.* Thottawa *T.* Thota	Sinnapadu 11·12·53	84 ...	225

Table V (*continued*)

Family and Scientific Name	*Common Names English (E) Sinhalese (S) Tamil (T)*	*Area and collection date of sample*	*Mean length of fish in sample (mm.)*	*Length at maturity (mm.)*
Chirocentridae				
Chirocentrus dorab	*E.* Wolf herring *S.* Podi katuwalla *T.* Mullu vallai	Mutwal 8· 5·53	475	3,600[1]
Carangidae				
Caranx (Caranx) sexfasciatus	*E.* Horse mackerel *S.* Inguru parawa *T.* Kallam parei	Alampil 29· 9·53	152	1,000
Do. melampygus	*E.* Black-tipped trevally	Nilaveli 28· 7·53	107	300
Do. ignobilis	*E.* Yellowfin trevally *S.* Atanagul parawa *T.* Atanagul parei	Karaduwa 2·10·53	304	700
Caranx (Carangoides) armatus	*E.* Armed trevally	Karaduwa 2·10·53	175	500
Do. praeustus	*E.* Brown-backed trevally	do.	140	200
Caranx (Selaroides) leptolepis	*E.* Slender- scaledscad	do.	98	160
Caranx (Selar) mate	*E.* Onofinletscad	do.	147	270
Do. malam	*E.* Banded scad *S.* Pothu parawa	Tangalle 17·11·53	70	200
Chorinemus tol	*E.* Queen fish *S.* Kattawa *T.* Katta	Mutwal 8·5·54	42	500
Trachinotus bailloni	*E.* Dart	Alampil 29· 7·53	320	500
Alectis indica	*E.* Indian Thread-finned trevally *S.* Kannadi parawa *T.* Perumpareh		74	1,500
Scombridae				
Euthynnus (Katsuwonus) pelamis	*E.* Skipjack or Bonito *S.* Balaya *T.* Shurai	Marawila 14·12·53	347	650[2]
Rastrelliger kanagurta	*E.* Indian mackerel *S.* Kumbalava *T.* Kumbala	Sinnapadu 23· 1·54	154	390
Scomberomoridae				
Scomberomorus guttatus	*E.* Spotted Sier *S.* Alu thora *T.* Nei arekula	Mutwal 5· 5·53	58	1,800

Table V (*continued*)

Family and Scientific Name	*Common Names English (E) Sinhalese (S) Tamil (T)*	*Area and collection date of sample*	*Mean length of fish in sample (mm.)*	*Length at maturity (mm.)*
Leiognathidae				
Leiognathus ruconius ...	*E.* Silver belly ... *S.* Vali panna *T.* Karel	Karaduwa 2·10·53	62 ...	80
Do. insidiator ...	*E.* Silver belly ...	Nilaveli ... 28· 7·53	36 ...	100
Do. blochi ...	*E.* Silver belly ...	do. ...	47 ...	70 (1)
Do. lineolatus ...	*E.* Silver belly ...	Karaduwa 2·10·53	58 ...	98
Do. splendens ...	*E.* Silver belly ... *S.* Katu Karalla *T.* Karel	Mutwal ... 5· 5·53	107 ...	140
Do. equulus ...	*E.* Silver belly ... *S.* Mas Karalla *T.* Karel	do. ...	52 ...	220
Do. dussumieri ...	*E.* Silver belly ...	do. ...	68 ...	180
Gerres punctatus ...	*E.* Long rayed silver biddy *S.* Oleya *T.* Uduwan	Nilaveli ... 28· 7·53	69 ...	120
Gazza minuta ...	*E.* Slimy ... *S.* Mas panna *T.* Karel	do. ...	124 ...	150
Sphyraenidae				
Sphyraena jello ...	*E.* Barracouda ... *S.* Jeelava *T.* Seela	Mutwal ... 5· 5·53	218 ...	1,500
Do. obtusata ...	*E.* Striped barracouda *S.* Theliya *T.* Seela	Tangalle ... 17·11·53	157 ...	400
Hemirhamphidae				
Hemirhamphus quoyi ...	*E.* Half beak ... *S.* Muralla *T.* Murel	Nilaveli ... 28· 7·53	184 ...	300
Lactaridae				
Lactarius lactarius ...	*E.* White fish *S.* Pulunna ... *T.* Kuddippu	Moratuwa ...	206 ...	275
Mullidae				
Mulloidichthys auriflamma ...	*E.* Goat fish ...	Mutwal ... 5· 5·53	205 ...	250
Upeneus lnzonius ...	*E.* Goat fish ... *S.* Nagareya ... *T.* Nakkerai	Karaduwa ... 2· 1·53	137 ...	250

Table V *(continued)*

Family and Scientific Name	*Common Names English (E) Sinhalese (S) Tamil (T)*	*Area and collection date of sample*	*Mean length of fish in sample (mm.)*	*Length at maturity, (mm.)*
Bothidae				
Pseudorhombus javanicus ...	*E.* Flounder ...	Nilaveli ...	140 ...	150
	E. Patha mediya ...	28· 1·53		
	E. Patha madi			
Scatophagidae				
Scatophagus argus ...	*E.* Spotted butter fish	Karaduwa ...	170 ...	300
	S. Pulli ilathaya ...	2·10·53		
	T. Pulli ilethi			
Elopsidae				
Elops saurus ...	*E.* Giant herring ...	Mutwal ...	514 ...	680
	S. Mannava ...	8· 5·53		
	T. Manna			
Labridae				
Cymolutes lecluse ...	*E.* Parrot fish ...	Nilaveli ...	132 ...	185
	S. Gireva ...	28· 7·53		
	T. Kili meen			
Platycephalidae				
Platycephalus insidiator ...	*E.* Flat head ...	Nilaveli ...	310 ...	—
	S. Mudhu valigouva...	28· 7·53		
	T. Eriyal			
Polynemidae				
Polynemus indicus ...	*E.* Thread fin ...	do. ...	72 ...	1,000
Do. sextarius ...	*S.* Kalawa ...	Hikkaduwa...	137 ...	190
...	*T.* Kala	24·11·53		
Myctophoidae				
	E. Lizard fish			
Saurida tumbil ...	*S.* Mudhu balla ...	Nilaveli ...	162 ...	420
	T. Nai meen	28· 7·53		
Sillaginidae				
Sillago sihama ...	*E.* Whiting ...	do. ...	84 ...	300
	S. Kalanda			
	T. Kilaken			
Theraponidae				
Therapon jarbua ...	*E.* Tiger fish ...	do. ...	124 ...	252
	S. Iri bateya			
	T. Keeli			

(1) According to Day.

(2) According to Deraniyagala.

All others according to Weber and Beaufort.

It is important to decide which are the most important species because it is to them that the industry and fisheries biologists and technolgists should direct their attention. Too often this seemingly obvious fact is disregarded in programming and fisheries investigators undertake studies that have appeal to themselves as biologists o to administrative officers with sectional interests or interests in carrying out spectacular projects.

Other Features of Catch

Table V shows that the average size of the fish taken is quite small— something less than 200 mm. (8″). This would be expected because most of the species involved mature at a small size. The table further indicates that the bulk of the catch is composed of immature fish. The implications of this feature in relation to fisheries management schemes will be referred to later in this paper.

Besides the fish mentioned here, a variety of other creatures has been observed in beach seine catches, including prawns, squids, jelly fish and sea snakes. The prawns seldom occur in sufficient numbers to make it worthwhile to market them[5], but they are invariably collected along with other " titbits " as food either by the beach seiners themselves or by by-standers who come to the beach for that purpose. The squids are usually disposed of in the same way or sold as bait to hook-and-line fishermen of the district. Jelly fish are properly rated as nuisances. Fishermen generally believe that their presence in an area discourages schools of desirable fish from entering it and there seems to be some basis for this (Warfel and Manacop, 1950). Sometimes they occur in such numbers as to completely foul the net and this adds greatly to the labour of net washing and cleaning before the next haul.

Sea snakes are frequently encircled by the net and in daylight hauls on the central west coast they are often seen escaping over the headrope toward the end of a haul. In twilight or night hauls they are not infrequently taken in the cod end. Ordinarily the fishermen pick them up by the tail and toss them back into the sea disregarding the risk involved in handling these venomous creatures (Smith, 1926). Although west-coast beach seiners have stated to the authors that there have been many casualties from sea-snake bites, Wall (1921, p. 318) says : " There are scarcely any records of casulaties even among fishermen who haul them in their nets by the dozen everyday ". Mr. P. N. D. N. de Silva, Assistant in Zoology, National Museums Colombo, has examined specimens taken from beach-seine catches during this study and identified the following species : *Enhydrina schistosa* and *Achrochordus granulatus* (Schneider).

Seaweeds not infrequently cause a good deal of trouble. At times it is almost impossible to haul beach seines in Koddiyar Bay because detached agar weed, *Gracillaria confervoides*, floating or submerged, plugs the nets. The same problem sometimes presents itself on the west coast just north and south of the Mannar peninsula where both *G. confervoides* and *G. lichenoides* are involved. These weeds probably could be profitably used (Durairatnam and Medcof, 1954) if serious efforts were made to cure and market them.

DISPOSAL OF CATCH

Treatment

Compared with other countries (Cutting, 1951, Table 8) there is little diversity in the disposal of the catch. It is used almost exclusively and directly as food for humans. Within these limits it is treated in several ways. It may be sold by

[5] *Note by Editor :* Except in Pesalai area from where they are regularly sent to Colombo by train in considerable quantities.

auction by the net operator himself or through an auctioneer on the beach at the spot where the seine is hauled. In anticipation of the catch there is often an assembly of bicycle peddlers, women hucksters who carry basketloads of fish on their heads, and the familiar "pingo" carriers, all of whom distribute fish to neighbouring villages. Often the catch is taken to an auction shed, of which there is usually one at every fishing centre, where it is sold to the same group. As an alternative to this, especially in the remoter districts, the catch may be taken to the wadi, packed in boxes with ice or ice and sand, and sent to markets by rail or van at whatever time this can be arranged. Rather than transporting the fish in the fresh state it may be dried near the wadi on the beach. Drying may or may not involve splitting, gutting and salting.[6]

Factors Determining Treatment

Firth (1946) has discussed the advantages and disadvantages of these two treatments as far as Malaya is concerned, and the conditions are essentially the same in Ceylon. Most people prefer to keep to the fresh trade even if this does mean sacrificing extra rupees which they could earn if they dried the fish at times of glut. Dried fish represents extra work and tied-up capital. In any particular case a number of factors determine how the catch is disposed of—fresh or dried.

Probably the kind of fish composing the catch is the commonest factor in this determination. A catch of sprats, for instance, is almost invariably dried. It is spread on the beach without salting, quickly dried, packed in bags, stored and marketed at some convenient time. They store well if kept dry and it is hard to imagine how these fish could be handled more quickly and provide a readily acceptable low-priced commodity. Third grade fish like sharks and skates may be sold fresh if there is a local market, but if they are to be transported they must be dried. They are worth too little to be sent great distances with expense on ice. Second grade fish, e.g. herring, are variously handled depending on local and distant market conditions at the time of catch. On the other hand, first grade fish like seer and paraw are almost invariably sold fresh. These fish are so popular and command such a price that it pays to spend the money for rapid transport of them iced in boxes even to distant markets.

The next most important factor determining disposition is probably the volume of the catch in relation to the capacity of the local market to absorb it. If the catch is of a sort that may be sold either fresh or dried and is too large to be absorbed by the local market, the producer must decide how he should transport it to the distant markets—fresh or dried. Unless the fish is first grade, it is usually dried on the spot. If the outside market prices are not especially favourable at the time, even the first grade fish may be salted and dried. This is most likely to happen when the situation is complicated by transport problems and lack of up-to-date market information. If the road, railway or sea transport time is long on account of distance, poor road condition, or poor service, the fish may spoil in transit or reach the market at a time of glut which means a loss to the shipper. Under such conditions a producer may decide to avoid the risk of marketing the catch in the perishable fresh state and dry it even if it is composed of first grade fish. Karaduwa on Karativu Island, 125 miles from Colombo, the principal market, is not too well informed of fluctuating fish market prices. To get fish to Colombo requires freighting by launch for 25 miles to Kalpitiya and then transportation by van for the other 100 miles. It is seldom worthwhile marketing fresh fish from Karaduwa, even

[6] *Note by Editor:* This of course, is dependant on the species of fish, and the size of the individual body to be dried.

of first grade types, and about 75 per cent. of the beach seine catch is dried.[7] Negombo, on the other hand, is close to Colombo, connected with it by a paved road and well informed about the city's changing market conditions. It is therefore worthwhile sending even second grade fish to Colombo fresh.

Condition of Marketed Fish

Almost all fish are transported " round" (without gutting) and considering the conditions they are exposed to they reach the market in a fairly good state. The authors' impression is that the condition is better than would be expected judging from what is known of the keeping qualities of temperate zone catches which have been carefully studied and extensively reported on by investigators in other countries. Despite all this the tropical temperatures do encourage rapid deterioration as the odours about some of Colombo's fish markets convincingly prove. To describe much of the fish that is marketed in them as "fresh" is an abuse of language and there is no doubt that the consumers are justified in some of their complaints that the system of disposing of fish catches should be modified to provide them with better quality fish for which they pay very dearly as compared with buyers in other countries.

PROBLEMS OF THE FISHERY

There is a great deal of superficial thinking about the beach seine fishery and its problems. Many forget its relationships with the fisheries as a whole or the vast sociological changes now under way in Ceylon which affect fishermen as well as other parts of the population. Too often they mistake the financial stresses and other symptoms of basic difficulties for the real ills. As a result there is lack of agreement among many with sincere interests in diagnosing the difficulties and prescribing remedies. Important progress in the resolution of these problems requires a clear statement of them, the exposure of the weaknesses of some of the opinions that have been expressed about them and the good points of others, and an outline of a few guiding principles for criticizing still others that may be brought forward.

Lack of Information

Without doubt the chief difficulty of the fishery today is the lack of organised information about it. Neither industry nor Government has anything but scrappy knowledge and general ideas about the size of their stocks, their natural mortality rates and their reproductive capacities, what their movements are and how their availability to the beach seine is affected by weather, water currents, depth and temperature of water and the appearance of natural enemies. There is no better information on the fishery effort being expended and what proportion of the supply is now being used, and therefore no reliable basis for predicting whether catches are likely to remain more or less constant, increase or decrease, and whether management is needed. What is even worse, what reliable information is available is often not used because many fishery regulations are drafted by temporary commissions in the settlement of disputes rather than by the best informed on such matters. These are stubborn problems that can be resolved only by intensive study, careful application of a good system of statistics collection over a period of years to provide the basic information and some adjustment of the present system of law-making. This work is neither easy nor spectacular, but until it is done nobody can know what are the best interests of the beach seine fishery in relation to the country as a

[7] *Note by Editor :* Nevertheless, whenever boat transport to Kalpitiya is available, the bulk of large fish caught at Karaduwa is sent on ice to Colombo.

whole, or be sure how to design fishery regulations to ensure the best use of the fish stocks. In this sense the present lack of information about the beach seine fishery is its chief obstacle to progress.

Operators' Attitudes

The second serious problem so far as the future welfare of the beach seine fishery is concerned seems to be the unrealistic attitude of the operators themselves towards it. Many of them have come to consider that they are an important and necessary part of the fisheries as a whole and that it is up to Government to enable them to maintain that position by preventing changes—they themselves need not struggle to maintain it. What they fail to realise is that the fisheries, like other industries, undergo evolutionary changes which are usually for the betterment of all concerned. Eventually the use of beach seines may disappear but, whether it does or not, beach seiners should recognise that in the long run they are likely to be better off themselves by accepting changes or even hastening them, rather than opposing them. This attitude has never been fostered by Government policy which has been and still is obviously patronizing to beach seiners. Setting up and maintaining the padu system has to a large extent protected beach seiners from competition among themselves and with fishermen using other types of gear. With this background it is not surprising to hear requests from beach seiners in some districts for further Government protection. Some have asked that gillnetters and even handliners be restricted from operating opposite padus even at distances beyond the seinable limits. Such requests coming from the nation's most important branch of the fisheries are symptoms of a distinctly unhealthy state. As was shown earlier, the relative efficiency of the beach seine is low and should be improved. Some operators are willing to admit this and very few are willing to do something about it, but at the same time all wish to preserve their special privileges. Improvements in the fisheries and consequent benefits to the country at large are not to be expected while this undemocratic spirit persists and it would seem obvious that Government should not encourage it by extending what is already an exclusively sheltering protection.

Scarcity of Fish

Scarcity of fish seems to be the third outstanding obstacle to development of the fishery. In describing the 1953 sonic-meter survey of west coast grounds conducted by M.V. "North Star" it was pointed out that shoals of fish registered were few and small. Other sonic-meter records covering hundreds of sea miles travelled by both "North Star" and her sister ship "Canadian", in the two years since these boats came to Ceylon, suggest that the survey results are typical. The shoals recorded either in seinable depths or beyond were few and small. Only on two occasions were large shoals encountered and both were a considerable distance from the shore. One of them was interrupted but seemed to be one vast shoal because the spaces between parts were not great. This mass encountered at night off the west coast opposite Puttalam took two hours to pass through ("North Star" cruising speed is 5 to 6 knots) and was assumed by Mr. Pinchin (Skipper of "North Star") to have been composed of fish, although he did not try to sample it. Judging from reports given the authors by people who have made aeroplane flights from Colombo to Jaffna, similar but smaller shoals occasionally surface in this area during the day.

The interpretation of the sonic-meter records is doubtful because so little is known of the habits of the fish that are involved. Some varieties may swim in loose shoals not compact enough to produce good records. This was found to be true of visible shoals of pomfret feeding near the surface off Alampil in July, 1954. If this held true for the varieties that are most important in the beach seine fishery, then the records would have little meaning. Mr. Babcock was inclined to put the simplest interpretation on the records—no tracings, no shoals. Tentatively this seems best because, up to now, it has not been shown to be inconsistent with other observations. On this basis it is concluded that large shoals of fish are really great rarities, and when they do occur, they are likely to be outside the reach of beach seines and that ordinarily beach seiners must depend on the few small shoals that enter their padus. In other words, the resources of any padu are limited regardless of the extent to which the beach seine operator may improve the structure of his net or the method of operating it. He must always depend on the vagaries of fish movements. Because of this limitation large increase in production should not be expected from beach seiners. What seems to be required for a large increase is a mobile capture device that can operate without dependence on distance from shore or depth of water and be able to take shoals that occur either inside or outside the range of beach seines. Purse-seiners or box trawls may be the answer. Thorough trials will prove them good or bad.

Loose Thinking about Problems

These three seem to be the major problems. Other features of the fishery are often represented as major problems, but on examination most of them will be found to be symptoms of these three and not really fundamental. Some operators complain that the high costs of labour are putting them out of business, but most of them remain solvent. The high labour costs seem to be offset by the already high and rising market price of fish and this has saved beach seiners, but it will not save them indefinitely. In other industries that are facing this same problem it is being met not only by price rises but also by improvements in methods that reduce the labour requirements. Human labour is never cheap enough to waste in beach seiners' operations. It may not be unfair, therefore, to interpret the complaints of high labour costs as admissions of weakness on the part of beach seiners in not developing methods and equipment that give higher returns in pounds of fish per hour of labour expended. This seems possible through modification of the net as already suggested or by perfecting mechanical methods of hauling nets. This scheme has been shown to have promising possibilities, but few operators have shown more than passing interest in it—a symptom of the second of the three fundamental problems referred to. Government should do all it can to encourage effort along these lines (Glanville, 1954).

Others, not beach seine operators, claim that large quantities of small fish taken in the seines are too small to be used and are left to rot on the beach. They further claim that, even if they were used, the capture of these immature fish which have never spawned should be prevented by law so as to avoid depleting the parent stocks and depressing long-term production. The observations made during this study offer no support for the first of these claims. As pointed out already, there is seldom any serious waste—even the smallest fish in the catch are ordinarily used—and the few occasions when wastage occurs are so rare as to have no important effect on stocks as a whole. Even if wastage were very much commoner, it is hard to imagine how it could affect stocks because beach seiners exploit only the narrow ribbon of water next the shore and even parts of that cannot be touched because of bottom obstructions. In other words, there should be ample opportunity for unmolested parent stocks to maintain themselves. The notion that fish that have not yet spawned should not be taken, fostered by such writers as Roughley (1951), is a view abandoned long ago by serious students of fisheries management. If the taking of such fish were banned, several of the world's most important fisheries would disappear—for instance, the sardine/herring fishery of the east coast and the salmon fishery of the west coast of North America. From all this it follows that no matter how often, or how emphatically, or by whom, the statement is made that the mesh size of beach seine cod ends should be increased to permit the escape of small fish to build up parent stocks, it cannot be justified at present. There is no sound reason to believe that such a law would help the beach seiner or any other fisherman and they are all suspicious of it.

Setting up minimum legal size limits is easy and many Governments have been deceived into thinking that they could thereby accomplish something of lasting importance. However, years of experience in fisheries management in other countries have proved that except in a few cases (mostly in fresh water streams and lakes) size limit restrictions do more harm than good. Argument pro and con over this point has probably done more than anything else to prevent the development of a sound set of Government regulations for beach seines because whenever revision of existing regulations is considered this argument distracts attention from the need for information—the fundamental problem that underlies it. Some people are not aware or have not stopped to consider that mesh regulations may be good or bad and that only a study of growth rates, natural mortality rates, exploitation rates of the fish stocks, and trial fishing with test nets, can decide whether mesh-size regulations are necessary. All should be wise enough to learn from the mistakes of administrators of other countries and should restrict the fisherman's operations only when there is a real assurance that they are damaging his and the country's interests. Right now, when the seiner is in difficulty, seems a most inopportune time to harass him with restrictive laws of dubious value.

Other examples of what are often mistaken for fundamental problems could be quoted, but, like those already dealt with, almost all can be shown to be manifestation of the three real problems referred to earlier in this section. Likewise, most of the proposed corrective measures can be shown to be faulty on the basis of the principles outlined in this discussion.

SUMMARY

1. The structure and operation of beach seines have been described from the results of two years' study. Beach seining is a very old method of fishing, but to Ceylon it is still the most important source of fish. This is partly because Government affords beach seiners special fishing privileges. It contributes annually about 23 million pounds of fish—roughly 35 to 40 per cent. of the total fish landings from all sources.

2. The catch is disposed of fresh or dried, depending on a number of factors such as its species-composition and the distance from and the price fluctuations in the markets.

3. Catches vary seasonally depending on weather and the availability of fish in the narrow ribbon of seinable inshore water—usually not more than 2 miles wide. They comprise about 50 species of which the Clupeoids, Carangids and Leiognathids are the most important, and in that order, both as regards number of species represented and total poundage catch. Most of the fish taken are immature shoaling species that are small at maturity. They fall into two groups, resident species which are available in small numbers more or less regularly, and migratory species that appear seasonally and then only sporadically in large numbers. Too often they are so far offshore that they are not within the beach seining areas. It is the behaviour of this latter group that determines the success or failure of a year's operations.

4. Beach seiners claim that the catch per net and total catch by all nets have decreased steadily for several years and that operation costs have risen so as to be now almost prohibitive. On the basis of these claims they have appealed to Government for remedial action in the form of further protection from competition with other types of fishing. There is no reliable statistical evidence to show trends in beach seine landings or catch per unit of effort, but costs of operation do seem to be increasing.

5. Study of operations indicate that the catch per hour of human labour is very low (a little over two pounds per man-hour of actual fishing) partly because the beach seine is an inefficient fishing device and partly too, it seems, because the shoals of fish entering the narrow ribbon of seinable inshore water are few and small. Other types of fishing now carried on in Ceylon give higher yields per unit of effort and other untested methods promise equally well. In trying to help beach seiners, administrators must be careful not to work against the country's long-term interests by discouraging these more efficient methods because they are likely eventually to replace beach seines.

6. The financial stresses appear to be symptoms of serious fundamental problems which are discussed and the general unhealthy state of the fishery is attributable, at least in part, to over-protection of beach seiners by Government from competition among themselves and with other branches of the fisheries. There is no reason to believe that matters will be improved by introducing new laws restricting mesh-size of the cod end or that further protective legislation will be lastingly helpful. What Government could do is to encourage by every possible means the improvement of the efficiency of the gear and methods of operating it.

REFERENCES

Blegvad, H. 1951—Report to the Minister of Industries, Industrial Research and Fisheries. Sessional Paper VI. (1951) : 17–39, Ceylon Govt. Press.

Canagaratnam, P. and J. C. Medcof, 1955—Ceylon beach seine fishery Fish. Res. Stn., Dept. Fish. Ceylon, Prog. Rep. 1 : 17–23

Cutting, C. L. 1951—Economic aspects of the utilization of fish. Biochem. Soc. Symposia, 6 : 86–105.

Day, F. 1878–88—Fishes of India, Vols. 1 and 2, London.

Deraniyagala, P. E. P. 1952—A coloured atlas of some vertebrates from Ceylon, 1 : 1–150, National Museums, Colombo, Ceylon Govt. Press.

De Zylva, E. R. A. 1953—Administration Report of the Acting Director of Fisheries for 1952 : 1–26, Ceylon Govt. Press.

do. 1954—Ibid. for 1953 : 1–40.

Durairatnam, M. and J. C. Medcof, 1954—Ceylon's red seaweed resources. Ceylon Trade J., 19 (4) : 1–6.

Firth, R. 1946—Malay fishermen : Their peasant economy. Kegan Pane, Trench, Trubner and Co., Publishers, London. 354 pp.

Glanville, A. 1954—Report to the Government of Ceylon on the mechanization of fishing operations. F. A. O. Rep. 284 : 1–24, Rome.

John, C. C. 1951—Some suggestions for developing the fisheries of Ceylon. Sessional Paper VI (1951) : 110–151, Ceylon Govt. Press.

Roughley, T. C. 1951—Fish and fisheries of Australia. Angus and Robertson Publishers, Sydney. 343 pp.

Sette, O. E. 1949—Methods of biological research on pelagic fisheries resources. Proc. Indo Pac. Fish. Counc., 1st meeting, Sec. 4 : 132–138.

Sivalingam, S. and J. C. Medcof, 1955—Study of Wadge Bank trawl fishery. Fish. Res. Stn., Dept. Fish. Ceylon, Prog. Rep. 1 : 10–13

Smith, 1926—Monograph of the sea-snakes (Hydrophiidae). British Museum (Nat. Hist.), London. 130 pp.

Wall, F. 1921—*Ophidia taprobanica* or the Snakes of Ceylon. Ceylon Govt. Press. 581 pp.

Warfel, H. E. and P. R. Manacop, 1950—Otter trawl explorations in Philippine waters. Dept. Interior, U. S. Fish and Wildlife Serv., Res. Rep. 25 : 1–49.

Weber, M. and L. F. de Beaufort, 1913–40. The fishes of the Indo-Australian Archipelago, Vos. 2–8. E. J. Brill Ltd., Publishers, Leyden, Holland.

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