SOME NOTES ON RECENT AND PRE- AND PROTOHISTORIC FISHING GEAR FROM NORTHWESTERN EUROPE

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CONTENTS

1. INTRODUCTION

2. RECENT FISHING GEAR AND FISHING TECHNIQUES
   2.1. A few recent fishing techniques not requiring the use of any fishing gear
   2.2. Fishing methods using actively operated fishing gear
   2.3. Passively-operating fishing gear
   2.4. Auxiliary fishing equipment

3. ARCHAEOLOGICAL FINDS OF FISHING GEAR
   3.1. The method of approach
   3.2. The fish-spear
   3.3. The gorge
   3.4. The fish-hook
   3.5. The weir
   3.6. The wickerwork fish-trap
   3.7. The fishing net

4. SUMMARY AND CONCLUSIONS

5. ACKNOWLEDGEMENTS

6. NOTES

7. REFERENCES

8. KEYWORDS

1. INTRODUCTION

Objects are sometimes found that are interpreted by the archaeologist as fishing gear or parts there of. For various reasons finds of items of fishing gear are very rare in direct relation to the remains of their victims. In recent years large quantities of fish remains have been retrieved with more precise excavation methods, but the fishing gear with which these fish were caught are often absent or are unrecognizable as such. Sometimes the investigation of fish remains provides data from which it can be deduced what kind of fishing gear may have been used. Ethnographical sources can also be of use in providing relevant data. Such sources can only be made use of, however, on a certain condition. The natural environment described in the ethnographical source concerned must be more or less equivalent to the natural environment ascertained for the prehistoric settlement. From a combination of archaeological, pedological, botanical, zoological and ethnographical data it is then permissible to attempt reconstructions of prehistoric fishing gear.

The first part of this article deals with a number of fishing methods and types of fishing gear known from ethnographical sources. Much of this information has been obtained from Sirelius: *Über die Sperrfischerei bei den Finnisch-Ugrischen Völkern* (1906) and *Die Volkskultur Finnlands. Jagd und Fischerei* (1934). In these works the fishing tackle and fishing techniques used by the Lapps, Woguls, Ostjaks and Syrjäns are described in detail. The last three of these peoples live immediately east of the Ural Mountains along the rivers that flow into the Ob basin. The aquatic environment in this region is freshwater and contains a standing population of *i.a.* pike, perch, burbot and members of the carp family (Cyprinidae) and a migrant population mainly consisting of whitefishes (Coregonidae). This ichthyofauna is comparable to that of the freshwater environment of Northwestern Europe.

The second part of this article deals with a variety of pre- and protohistoric fishing gear from Northwestern Europe.

2. RECENT FISHING GEAR AND FISHING TECHNIQUES

A characteristic feature of primitive cultures is that social organization, food acquisition, medicine and religion have not become isolated elements of cultural identity. No differentiation of these elements has taken place. Even in present-day developed societies it is still possible to trace remnants of cultural traditions that remind us of more primitive societies. According to Van Doorn (1971), in Western Europe this is still valid to a limited extent for inland and sea fishery, notably with regard to the following points.

a. The trade and its associated jargon are handed down from father to son; there is no official occupational training.

b. The fisherman is dependent on the natural breeding patterns of the fish.

c. The equipment handed down and the working methods remain the same, with a few exceptions.

d. There is little contact between the fisherman and other trades. The fisherman makes his own equipment. He carves his knitting-needles out of wood, makes his own nets and weaves his own wickerwork fish-traps.

e. Forms of taboo are very abundant among fisher-folk and sailors.

f. Because automatization and mechanization play hardly any role in freshwater fishery, the terminology of the freshwater fisherman includes many words that have undergone little or no differentiation. Thus there exists in this terminology *e.g.* a close relation between bird and fish nomenclature.

In non-agrarian societies of the past and present, gathering, hunting and fishing are essentially the only means of existence. There is no great distinction between these three. It could be said that hunting and fishing are methods of gathering that require the use of tools.

An evolution in fishery technique is evident, from fishing for individual fish to catching fish *en masse*. Thus we see the development of fishing gear from those forms in which one fish can be caught at a time, to those forms in which many fish can be caught simultaneously. As for fishing methods, a correspon-

ding distinction can be made between active and passive fishing. What I mean by active fishing is that the fisherman searches for the fish or lures it towards himself and then tries to catch it. With passive fishing the fisherman only has to collect the fish that have become caught in his traps or nets. Those types of fishing gear with which only one fish at a time can be caught generally involve active fishing, while those types of gear designed to catch many fish simultaneously involve passive fishing, although it is not always easy to make a sharp distinction between these two types of gear.

2.1. A few recent fishing techniques not requiring the use of any fishing gear

These techniques are very simple, and often give good results. The use of such techniques by prehistoric fishermen will not have left any traces for the archaeologist to discover. Nevertheless I shall briefly describe some of these fishing techniques.

2.1.1. *Catching fish with one's bare hands*

Many fish, even the swift and elusive trout, can be caught with one's bare hands. With this method one must be able to see or feel the fish.

2.1.2. *Stunning fish with a stick or cudgel*

A fish that can be seen in shallow water can be struck dead with a stick or cudgel. The Syrjäns had a certain method of fishing that was practised in the autumn. When ice forms over a surface of water, the oxygen distribution in the water changes and the fish come up to just under the ice. They are visible through the thin ice if there is no covering layer of snow. A blow is struck on the ice immediately above the fish by means of a stone, attached to a wooden haft. The pressure wave generated in this way stuns the fish. Since thin ice cannot take the weight of an adult man, boys practised this method of fishing (Sirelius, 1934).

2.1.3. *Catching fish by making the water turbid*

In small pools with a muddy bottom the fisherman stirs up the silty substratum with a stick, so that the water becomes turbid. The fish thus suffer a shortage of oxygen, float up to the surface and can be lifted out of the water.

2.1.4. *Poisoning*

Of all known fishing methods fishing with the aid of poison is the most effective. After being poisoned almost all fish come to the surface, more or less in a state of torpor, and from there they can be lifted out of the water. In Asia and South America many fish poisons are known to fishermen. Rotenone, which is prepared from the roots of plants of the genus *Derris,* is used at the present time in biological research concerned with fishery. This poison is effective at very low concentrations (0.5 l per 1,000,000 l water) and is harmless to people. Formerly poisons were also used in the Netherlands. Such poisons were freely available and among Dutch fishermen were known as *koggelbonen* (Van Doorn, 1971). Also in ancient times in Europe various poisons derived from plants were used in catching fish. An extract of the flowers of the great mullein was used by the Greeks. The Romans used the juice of cyclamens (Muus & Dahlstrøm, 1968).

2.2. Fishing methods using actively operated fishing gear

With these methods specially made equipment is used by the fisherman who is an active participant in the process of catching fish. The types of gear include the stick fitted with a hook, the rod with a bob, the stick with a noose, the fish-spear (fish harpoon, leister), the gorge, and the fish-hook. A number of these are in evidence in various archaeological contexts.

2.2.1. *The stick with hook or gaff*

A bent nail is fixed to a stick. A piece of bait is put on the nail. The baited stick is held in the water until the fisherman feels a fish biting. Then he suddenly flings up the stick with the fish on it out of the water (Barthel, 1977). The fisherman can also use a non-baited stick. When he sees his prey, he carefully shoves the stick with hook under the fish and drags the fish out on to dry land. This is the way in which the Kwakiutl, who lived on the coast of British Columbia, caught salmon when these fish swam up the rivers *en masse* (Forde, 1934). This method was also used in winter by the Woguls to catch burbot at night with the aid of artificial light (Sirelius, 1934).

2.2.2. *The rod with a bob*

The fisherman threads together a number of worms from end to end on a string and makes a clew out of them. This clew of worms, or bob as it is called, is hung on a string, that is fixed to the end of a rod measuring about 1 m in length. With the aid of a piece of string a stone is attached to the lower surface of the bob (fig. 1). The weighted bob is let down into the water as far as the bottom. It is then repeatedly raised a few decimetres and allowed to sink again. The worms and the movement of the bait serve to attract eels. These bite into the bob. The fisherman feels this and lifts the line with the eel attached carefully out of the water. This method of fishing is carried out at night.

2.2.3. *The stick with a noose*

With this method a noose of copper wire or other material, attached to the end of a stick, was carefully put into the water around the body of a fish spotted by the fisherman. Then the noose was suddenly pulled tight an the fish was flung on to dry land. This method was used in the Netherlands to catch pike. A few remains of pieces of wood from a peat-bog near Oberdorla (East Germany), dating from Roman times, have been interpreted by Barthel (1977) as including a stick with a hook and a stick used for fishing with a noose. Together with the latter the remains of a noose of horse-hair were found.

2.2.4. *The fish-spear*

The basic form of this kind of fishing gear is a long straight wooden stick with a forked extremity. In the recent past the Lapps used this kind of fishing gear to catch arctic charr (Sirelius, 1934).

Elsewhere we find fish-spears with separate points (prongs). These prongs are often serrated or barbed on one or both edges. They are made out of bone or metal and are fixed to the wooden shaft by means of cord. The most highly developed metal fish-spears have a socket into which the wooden shaft is fitted. Figure 2 shows a number of examples of recent fish-spears.

There are also fish-spears with detachable prongs. When a fish is hit the prong comes loose from the shaft, but remains connected to it, at the end of a long line. We then call the fish-spear a fish-harpoon and the prong the harpoon-point.

Fish are also caught by means of bows and arrows. The fishing arrow that was used by the Ostjaks and Woguls consisted of a long shaft without any feathers and with a heavy double-pointed arrow-head (Sirelius, 1934).

Fishing with a fish-spear (fish-harpoon, fishing arrow) is a well-known practice almost all over the world. The fish-spear is used in places where the water is clear. When the fisherman sees his prey, he tries to spike it with his fish-spear or to shoot it using his bow and arrow. These techniques require a certain skill, as the fish is situated in a different spot in the water to where it appears to be, on account of diffraction. A correction therefore has to be made by the fisherman.

If the fisherman with his fish-spear wishes to exploit a local population of non-migratory fish, he will have to search for his prey. A freshwater, non-migratory fish that is eminently suitable for catching with the aid of a fish-spear is the pike. As these large predators frequent shallow water close to the bank or shore, either when spawning or when lying in wait, motionless, for their prey, they easily fall victim to the fisherman armed with his spear. As this species is attracted to light, it

can also be speared at night using artificial light (Sirelius, 1934). Pike can be caught all the year round. For the fisherman with his spear they are most vulnerable, however, from the beginning of their breeding season (February) until late in the autumn. When the water temperature drops they search for deeper water. When the water is frozen over, they can be speared through blow-holes in the ice.

Also other species of freshwater, non-migratory fish (*e.g.* bream) can be speared when they are spawning in shallow water close to the bank or shore.

If the fisherman with his fish-spear is exploiting a migratory population, there is no need for him to search for his prey. He simply waits at a suitable spot until the fish swim past. Fish species that fall into this category include salmon and sturgeon. The large salmon arrive from the sea at the mouths of rivers and swim upstream together in large numbers in order to spawn. Then the water of clear rivers looks red on account of the great number of salmon in their spawning colour. The clearly visible, large fish thus form an easy prey for the fisherman with his spear.

Also sturgeon can be caught using fish-spears. In the Fraser, a river in British Columbia, fishermen used to harpoon sturgeon from their canoes (Lord, quoted by Clark, 1948).

Inhabitants of the basins of southward flowing rivers in the Urals also used to harpoon sturgeon. This took place in winter, when the rivers were frozen over. A large number of fishermen together smashed holes in the ice, and tried to harpoon the sturgeon that had been startled by the noise. When the fishermen had fished part of the river in this way, they went further downstream and repeated their performance (Mohr, 1952).

Also in the Netherlands the fish-spear is known to have been used. Its use is a thing of the past, however, as it is now forbidden by law. It was used formerly for catching flounders and eels.

The flounder occurs abundantly in the Wadden Sea. When this fish is startled its escape path in the water is marked by clouds of disturbed bottom-sediment. From these clouds of sediment the fisherman is able to locate his prey, and spike it with his fish-spear. The fisherman could also simply stand on top of the fish, so as to hold it down, and remove it from under his foot. This method is called *bottrappen* in Dutch (literally: flounder-treading).

The fish-spear that was used in the Netherlands for catching eels is known as an *aalschaar* or *elger* in Dutch, equivalent to the English term eel-spear (fig. 3). The fisherman stood on the bank or in a small boat and thrust the eel-spear haphazardly into the mud. On lifting the spear out of the water he could see whether any eels had been caught between the prongs.

2.2.5. *The gorge*

The gorge is a short stick-like object, cylindrical in the middle and pointed at both ends. It may be made of wood, bone or iron. Gorges come in varying sizes. They may be only a few centimetres long, or as much as 10-15 centimetres. In the middle of the gorge (at its centre of gravity) a line is attached. To prevent the line from slipping off, a groove, or a few shallow grooves or a notch may be cut in the surface of the gorge (fig. 4). The line is thrown into the water with the gorge hidden inside some kind of bait. If the fisherman feels a fish biting, he gives the fish time to swallow the bait completely. Then the fisherman pulls hard on the line so as to make it taut. In this way the gorge is pulled into a position perpendicular to the line and thus becomes stuck in the throat of the fish.

The line with gorge can also be used for passive fishing. The fisherman fastens the loose end of the line on to something and goes away. When a fish swallows the baited gorge and swims away, the line is pulled taut and the gorge similarly becomes stuck in the throat of the fish.

The size of the gorge, the strength of the line and the kind of bait used are determining factors for the species of fish that may be caught.

Partly because of its behaviour and the shape of its snout, the pike is a very suitable species of fish for catching with the aid of a gorge. The gorge is then baited with a small

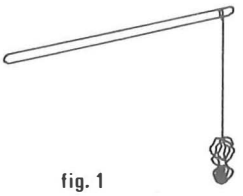

fig. 1

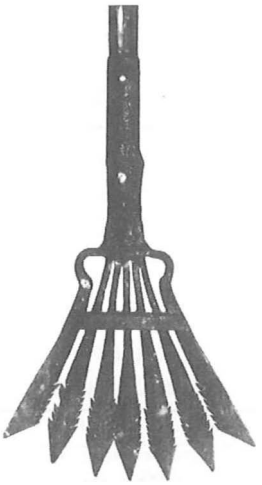

fig. 3

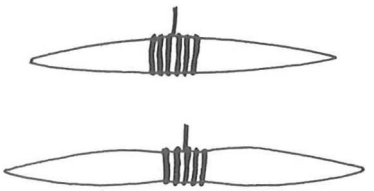

fig. 4

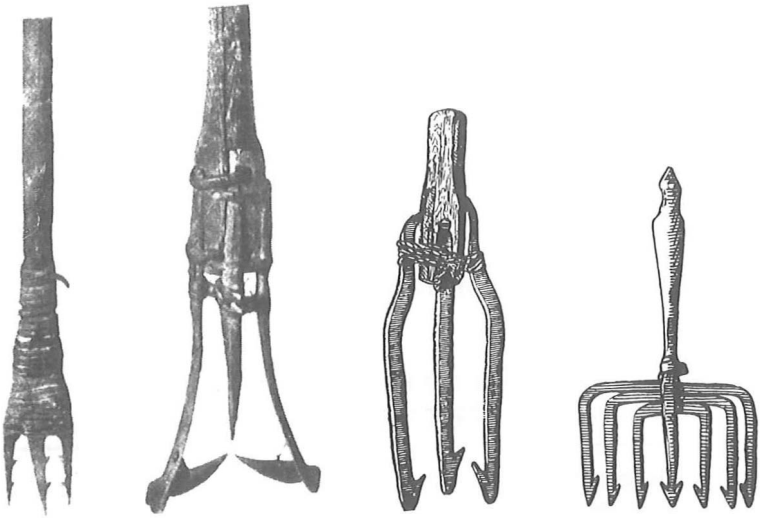

fig. 2

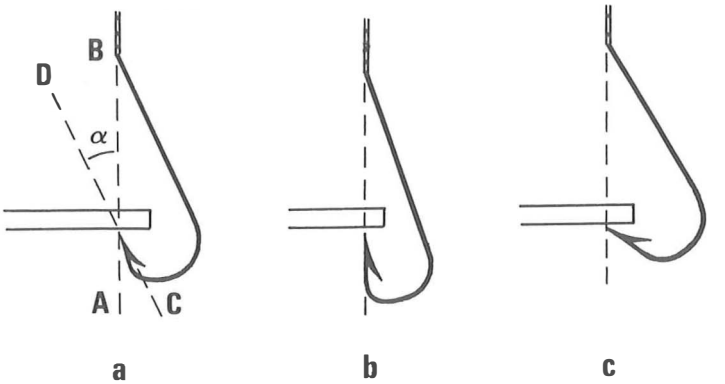

fig. 5

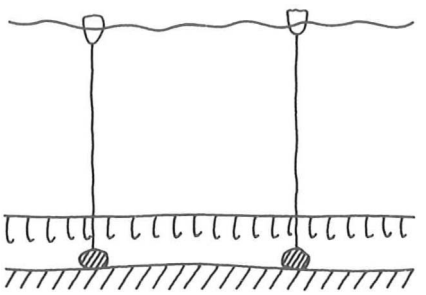

fig. 6

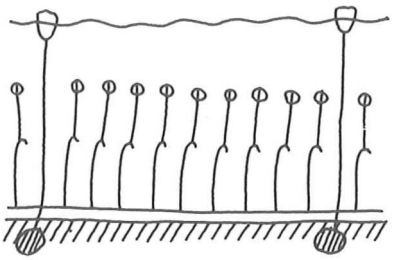

fig. 7

fish. The fish used as bait is partly slit open along the ventral surface, and the fisherman inserts the gorge into this aperture.

Gorges are in fact used for a variety of purposes. Until recently gorges were used to catch wildfowl on Lake Constance (Clark, 1948). Also Sirelius (1934) mentions the use of gorges in catching waterfowl. At the same time he states that elsewhere in the world gorges are used to catch crocodiles.

2.2.6. *The fish-hook*

If we talk about a fish-hook, then this piece of equipment must consist of three distinguishable elements. These are: the hook-shaft, the hook-bend and the hook-point.

The hook-shaft is the more or less straight part of the hook to which a line is attached. At the end of the hook-shaft there is usually some kind of modification for the attachment of the line. This may be in the form of a thickening of the shaft, a hole, one or more transverse notches in the shaft or one or more grooves cut into the shaft and running round it. The hook-shaft passes into the hook-bend, that may be regularly curved or angular. The hook-bend passes into the hook-point. This is more or less parallel to the hook-shaft. The hook-point is shorter than the hook-shaft and has a pointed extremity, that can penetrate the body of the fish. This extremity may be fitted with a barb to prevent the fish escaping.

For all types of fish-hook it is important that they have a good penetrating capacity, *i.e.* when in use the hook-point must point in the right direction for it to be able to penetrate the fish easily. At the same time the hook must be of the optimal shape, so as to minimize any chance of the fish escaping. This brings us to the concept of 'angle of grip' (Lekholm, 1951). If we let a line with a fish-hook hang vertically, then we see that the hook-shaft hangs more or less as an extension of the line. In such a case the line must be attached to the extremity of the hook-shaft.

If we now place the hook with its point against a hard object (the roof of the mouth of the fish) and pull on the line, we see that the hook takes up a different position. This position is characterized by an imaginary line running from the hook-point to the point of attachment of the line to the hook-shaft. We call this the line of pull (A-B). A second imaginary line is formed by the longitudinal axis of the hook-point (the line C-D). The two imaginary lines A-B and C-D form an angle with each other. This angle is called the angle of grip (fig. 5a). To obtain optimal penetration, the direction of the hook-point C-D should coincide with the line of pull A-B (fig. 5b). With a fish-hook of this kind, 'hooking' a fish is not very easy. The hook opening (the distance between the hook-point and the hook-shaft measured perpendicular to the hook-shaft) is small. On the other hand, the hook does meet the requirement that the chance of the fish escaping is slight. The hook 'holds' well.

If the hook-point is bent away slightly from the hook-shaft, then hooking a fish will be easier. The hook opening is then bigger (fig. 5c). On the other hand 'holding' the fish will be a problem, as the line of pull is a different one to that where the point of the hook becomes embedded. Then there is a chance that the fisherman will pull the hook out of the mouth of the fish. To prevent this the hook-point is provided with a barb.

A good fish-hook will therefore have to be a compromise between one that 'hooks' well and one that 'holds' well. Borne, cited by Lekholm (1951) estimated an optimal 'angle of grip' of 10°. Present-day steel hooks with a barb have angles of grip of 10° to 30°. With steel hooks the 'angle of grip' can be modified by making the hook-shaft longer or shorter, by slightly bending the hook-point or by altering the curvature. A relationship evidently exists between the characteristic features of a particular steel hook and the species of fish that can be caught with it. A combination of data, based on experience, of Biscoff, cited by Lekholm (1951), and data of Lekholm (1951) provides us with the information on

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Fig. 1. The rod with a bob.
Fig. 2. Examples of fish-spears (after Sirelius, 1934): a, b. Greenland; c. Russia; d. Finland.
Fig. 3. The eel-spear (after De Groot & Schaap, 1973).
Fig. 4. The gorge (schematic).
Fig. 5. The fish-hook and its mode of operation (schematic).
Fig. 6. The *hoekwant* (schematic).
Fig. 7. Ledger-line for catching sturgeon (schematic).

Table 1. Relationship between the size and hook opening of steel fish-hooks and the species of fish that can be caught with them

Fish species	Estimated maximum length of the fish (cm)	Estimated maximum weight of the fish (kg)	Total length of the hook (mm)	Hook opening (mm)
Bleak	20	0.04	up to 10	3-5
Roach	40	1	15	4-5
Rudd	45	1.5	18-22	?
Whitefish (houting)	50	2	25	5-9
Bream	80	9	22-28	5-6
Tench	70	8	22-28	6
Perch	50	3.5	28-30	5-8
Eel	100	4.5	28-35	?
Pike	130	28	30-80	7-23
Cod	150	40	30-70	?
Salmon	150	36	up to 110	7-23
Tunny	300	300	100-160	?

steel hooks presented in table 1.

From the table it follows that small fish cannot be caught with large hooks. In general we can say that the fisherman uses small hooks and thin lines to catch smaller kinds of fish and large hooks and thick lines to catch larger fish. At the present time steel hooks are used almost exclusively. This applies to fishing activities on the European mainland, that are for the most part carried out by amateurs as recreation. In commercial fishery at sea, lines with hooks are sometimes used because fishing with nets may not be possible for various reasons.

Until recently, in the Netherlands, fishermen both of inland waters and at sea worked with ledger-lines. These were called *beug* or *hoek-want* in Dutch. They consisted of very long lines with at certain intervals shorter transverse lines, that each carried one baited iron hook. At the same time floats and weights were attached (fig. 6). The *hoekwant* was cast in such a way that it came to lie more or less on the bottom. In inland waters eels were caught in this way. At sea the species mainly caught in this way were cod and haddock.

Along the coasts of the Black Sea, the Caspian Sea and in the rivers that debouch into them fishermen use ledger-lines to catch sturgeon. These ledger-lines are comparable to the *hoekwant*. There are two important differences however in the way in which the ledger-lines are set up. In the hook-bend of the non-baited hooks extra side-lines are affixed, each with a float. Consequently the side-lines take up a vertical position in the water (fig. 7). The main line lies on the bottom. The distance between two successive hooks is 20-30 cm. The sturgeon, which swims close to the bottom in its journey upstream, has to pass through the side-lines and thus may get caught on a hook (Mohr, 1952).

2.2.6.1. *Primitive fish-hooks*

Sirelius (1934) gives ethnological descriptions of some fish-hooks made of wood and bone that were used by the Finns, Woguls and Ostjaks. On the basis of the different forms in use Sirelius was able to establish a series showing different stages of development (fig. 8).

In hook a he sees a double-pointed wooden gorge with a pointed side-piece. The line is attached at the point where the main shaft and the side-piece meet. Hook b already has the shape of a true fish-hook. However, the line is still attached at the point where the main shaft and the side-piece meet (in the hook-bend). Hook c has the same shape as hook b, except that the line is attached in the middle of the hook-shaft. At this point a notch has been made on the inner side of the hook-shaft. (Also hook b has a notch here, though it is not clear why). The final result of the shifting of the point of attachment of the line is to be seen in hook d.

The hooks illustrated all have a total length of 8-9 cm. They are all cut from the tough wood of juniper, heather, honeysuckle and (sometimes) birch. At the same time we see that the hook-bend is wound around with cord. The fisherman knows from experience that the hooks made out of a single piece of wood (or bone) break easily in the hook-bend. Therefore he makes composite hooks, that consist of two separate components, a hook-shaft and a hook-point. If a fish is hooked that is too heavy, then it is possible that the hook-point will break off. The fisherman then still has the hook-shaft. He only has to make a new hook-point.

The Woguls and the Ostjaks used the fish-hooks exclusively as passively-operating fishing gear in the first place for catching pike,

also for large perch. The hook, baited with a small fish, was put in the water on a line with a large float. The tip of the line was made of a strip of leather and the main line of split roots of pine (fig. 9).

2.3. Passively-operating fishing gear

In the preceding section we have already become acquainted with a passively-operating kind of fishing gear, the ledger-line. With this fishing gear, however, only one individual can be caught per hook. Moreover the hooks have to be baited again every time. This is not very effective and other kinds of fishing gear have been developed that enable fishermen to catch many fish at the same time. These kinds of passively-operating fishing gear are: the weir, the fish-surround, the wickerwork fish-basket and the fishing net.

2.3.1. *The weir*

The weir is a kind of barrier or obstruction that leads fish to a spot where they can be easily caught and taken out of the water. The kind of construction material used depends on the sediment of the river-bed, lake bed or sea bottom (whether consisting of rock, gravel, sand or clay) and the construction materials available in the local environment. Thus weirs may be made of stones, felled trees, posts, sticks, bunches of twigs or woven screens of laths, bamboo, *etc.*

In stagnant or sluggishly flowing water the weir is always used in combination with a more elaborate kind of passively-operating fishing gear. On the other hand the weir itself can function as a kind of passively-operating fishing gear in places where there is a strong current or where there are great diurnal differences in water level. In the former case the fisherman will have to use a splashing stick (2.4.1.).

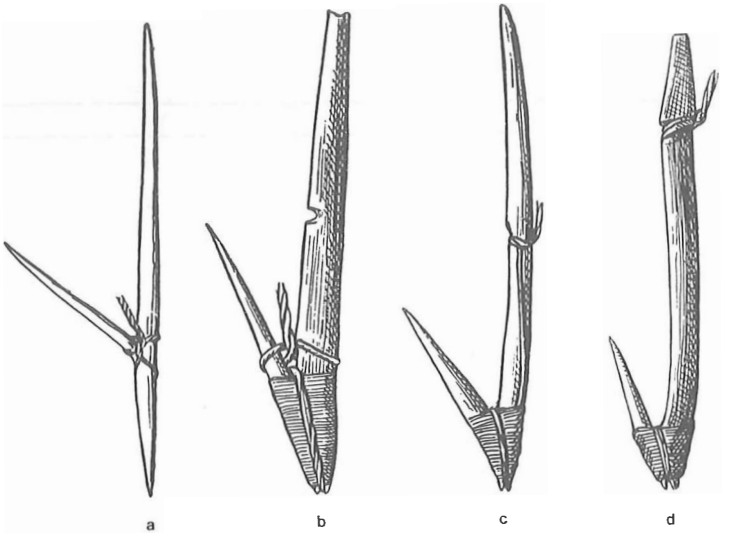
Sirelius (1906) described how the Ostjaks and the Woguls were still using the weir in its most primitive form at the beginning of this century (fig. 10). A few hundred metres upstream from the weir a fisherman uses a splashing stick to drive the fish in the direction of the weir. The fish that have collected up against the weir are taken out of the water by a second fisherman with the aid of a dip-net or stick with a hook. Fish regularly caught in this way include pike, perch and members of the carp family. This method of fishing must be carried out by at least two people, because the fish only stay close to the weir when someone continually splashes about further upstream. This is therefore not a true kind of passively-operating fishing gear.

Sirelius also described the passively-operating weir in its most simple form as used by these same ethnic groups. This is called *läl täm* in those parts. A wooden weir is built transverse to the direction of the stream flow. At the same time, slightly further upstream from this weir two barriers are built, that point diagonally towards the weir. In this way a funnel construction (throat) is the result, with a chamber behind it serving to collect the fish (fig. 11). The fish are driven into the chamber with the aid of a splashing stick, the throat opening is closed with a post or screen and the fisherman takes the fish out of the water using a dip-net or stick with a hook. This method of fishing is carried out by one person.

Another primitive kind of passively-operating weir is to be found in the Département du Var (France). In a swiftly flowing stream a V-shaped weir of stones is built. The apex of the weir points downstream. In the apex itself an opening is left, in which is placed a bunch of twigs weighted down with stones (fig. 12). The fish present upstream of the weir are driven towards the weir by means of splashing the water-surface with a splashing stick. At the weir itself the increased strength of the current forces the fish into the bunch of twigs where they become caught up and killed. The bunch of twigs is now lifted out of the water and the fish caught up in it are removed.

2.3.1.1. *The development of the weir*

It is possible that natural barriers could have served as an example for the construction of an artificial weir. Natural barriers are to be found in places where the water level fluctuates. This occurs *e.g.* in places where rivers overflow their banks or along coastlines with a large difference between the low and high tide marks (*e.g.* the coast of Bretagne). As the water rises the fish come close to the coast



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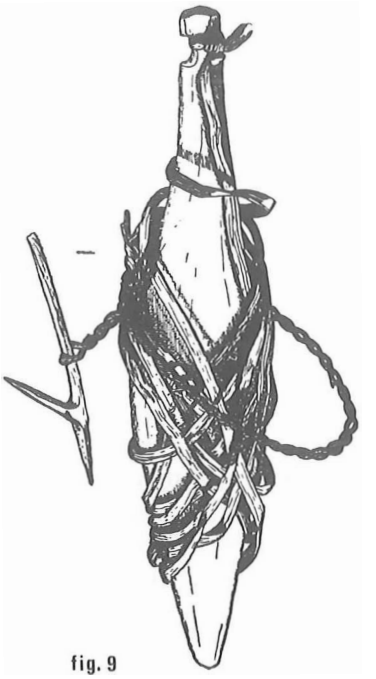

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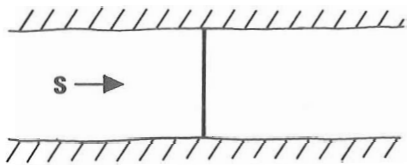

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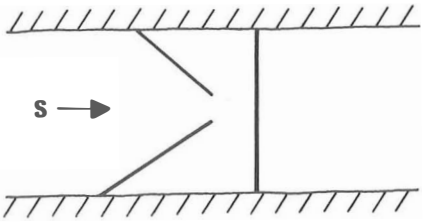

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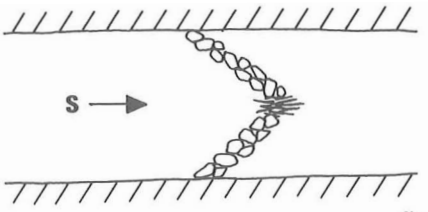

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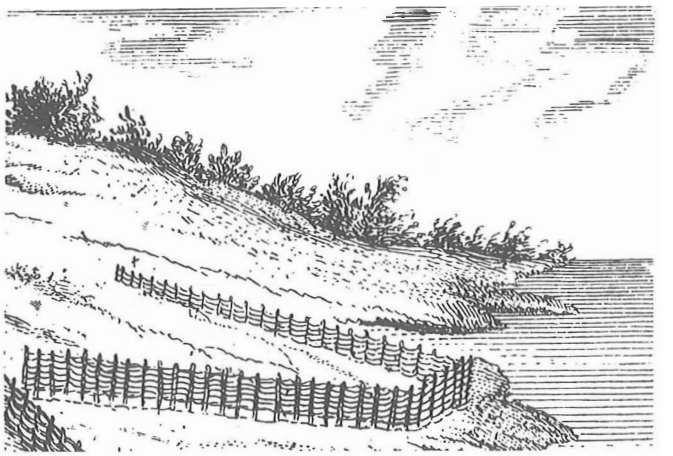

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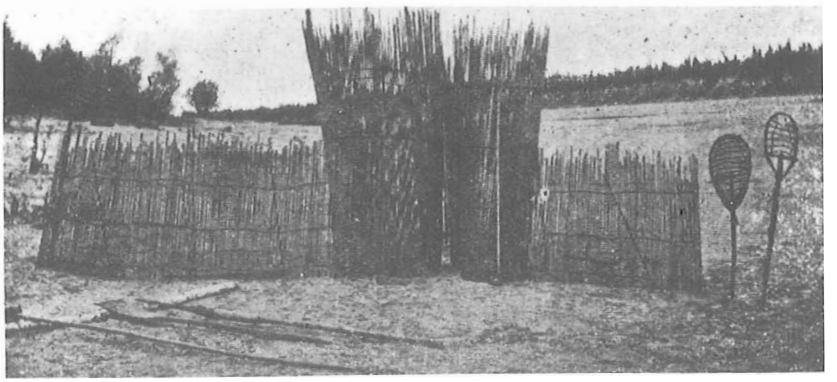

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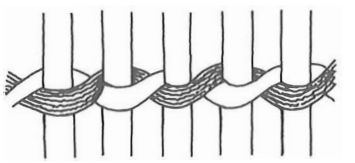


fig. 15

to search for food, and as the water goes down they swim back again. In places where there is a natural barrier, however, there is a chance that some fish will not be able to swim back in time. They stay behind in pools or become stranded and thus become an easy prey for animals or for man.

Obviously the fisherman will make use of such situations, and will extend natural barriers with large stones and pieces of wood so as to construct effective passively-operating fishing gear. In places along the sea coast where no natural barriers occur, wooden weirs are built that are V-shaped or in the form of an arc. With weirs shaped like this the fish are prevented from escaping as the water goes down. We find examples of such weirs on the coasts of Thailand, India and Madagascar. They also occur in Western Europe, namely in France along the coast of the Atlantic Ocean (fig. 13), and in Germany on the Baltic coast near Schleswig. Here such a weir is known as a *gaard* (Sirelius, 1906).

2.3.2. *The fish-surround (German: Fischzaun)*

Obviously in wide rivers and lakes there is no point in building a weir or *läl täm*. The collection chamber would be far too big and it would be impossible to take all the fish out of it. Therefore the chamber is made smaller so as to form a 'fish-surround', which is more or less round in shape. The two sides of the weir both project into the chamber (fig. 14).

As the fish will remain in the chamber for some time, they will try to find all possible hiding places. The use of lath screens can solve this problem, as the laths are bound together so tightly that no escape is possible. At the same time the fishing gear can quickly be lifted out of the water in the event of a storm or floods. Thus Finnish fishermen build their fish-surrounds out of lath screens. These screens consist of pieces of pinewood, that are sharpened at one end. The pieces of wood are bound together with birch twigs or straw using the *Zwirnbindung* (fig. 15). Cord is also made out of strips of lime or willow bast twined together.

When the fish-surround and the weir are to be put in position the screens are driven into the bottom of the lake or river. Then the fisherman drives in heavier posts so as to give extra support to the screens.

2.3.2.1. *The development of the fish-surround*

In contrast to the passively-operating weir, the fish-surround is also suitable for use in stagnant and sluggishly flowing water. It can catch fish swimming both upstream and downstream. Combinations of the fish-surround with the elements of a weir and the development of the fish-surround itself have resulted in very complicated fishing gear. A few examples, taken from Sirelius (1906), illustrate this (fig. 16).

a. When the water in the middle of a river or lake is too deep to build a fish-surround, the fisherman builds the fish-surround close to the bank or shore (fig. 16a). The throat opens towards the bank. Immediately in front of the throat, along its midline, a weir element is placed at right angles to the bank. At the same time the bank itself serves as a weir. With this construction the fish can come into the surround from two sides.

b. If the fisherman expects the fish to come from a certain direction, then he places the fish-surround with the throat opening in this direction (fig. 16b). Here too two weir elements and the bank lead the fish into the fish-surround.

c. Small, shallow rivers and lakes can be exploited by placing across their entire width a combination of a number of fish-surrounds and weirs (fig. 16c). The throat openings of the fish-surrounds face in opposite directions alternately, so that fish can become trapped from both sides.

d. In the previous example each fish-sur-

Fig. 8. Development of the fish-hook based on examples from Finland and Russia (after Sirelius, 1934).
Fig. 9. Wooden fish-hook with line and float (Ostjaks) (after Sirelius, 1934).
Fig. 10. The weir. S direction of flow of the river.
Fig. 11. The *läl täm* (after Sirelius, 1906).
Fig. 12. V-shaped stone weir with bunch of twigs (after Sirelius, 1906).
Fig. 13. Weir on the coast of the Atlantic Ocean in France (after Sirelius, 1906).
Fig. 14. Primitive fish-surround with weir construction (Woguls) (after Sirelius, 1906).
Fig. 15. Method of binding screens and wickerwork fish-traps, using the *Zwirnbindung*.

round has to be emptied individually by the fisherman. This has led to the joining together of the fish-surrounds to form one single fish-surround. To facilitate emptying the fish-surround, the fisherman can build a small collection chamber on to the fish-surround. This collection chamber is also fitted with a throat (fig. 16d).

e. An interesting variation is the spiral fish-surround of Anjala (Finland) (fig. 16e). In this structure, which is made out of lath-screens, duck not infrequently get trapped. On account of the spiral shape they can no longer find the way out. Also the screens are placed so close together that the birds can no longer fly upwards.

The fish-surrounds with their weirs are also often placed in rows, one behind the other (fig. 17).

From historical sources and recent data it is evident that the fish-surround occurs widely in Asia and Eastern Europe (Russia, Estonia, Poland and Hungary). In Western Europe on the other hand it is only found in Sweden, Finland (except for the region where the Lapps live), Yugoslavia and Italy (in the Po delta). On the basis of this distribution and the etymology of this fishing apparatus Sirelius (1906) comes to the conclusion that the fish-surround came to Northern Europe from a south-eastern region of origin, via river-courses and lakes.

It is a matter of some doubt, however, whether this distribution pattern is correct. In the past, in shallow places along the Dutch coast a kind of fishing gear was used that on account of its shape is strongly reminiscent of the fish-surround. This kind of fishing gear, known as a *kom* (literally: bowl), consisted of a long weir element that led the fish through a throat-shaped opening into a semicircular collection chamber. The underside of this collection chamber was closed off with a horizontal net. The vertical part was also made of network. The whole contraption was suspended by means of ropes from vertical posts.

2.3.2.2. *The use and duration of the fish-surround (and weirs)*

The fish-surround is built as early as possible in the spring. This is done preferably at the onset of the thaw, when the ice can still be trodden. It is easier to build a fish-surround from the ice than from a boat, and at the same time fish can be caught earlier. There is a risk, however, that the fish-surround may be destroyed by ice-flows.

As far as the catch is concerned the best results are obtained in spring and in the autumn. At the end of the autumn the fish-surround is taken out of the water, dried and put away. The cord used to bind the laths together has often rotted away by this time. The laths are often in sufficiently good condition to last another year, but many fishermen make a new fish-surround and use the old laths as firewood.[1] In Finland the fish-surround is used to catch pike, perch, bream, roach, crucian carp, burbot, (whitefishes) and eel.

The way in which the fisherman takes the fish out of the fish-surround is described vividly by Sirelius (1906) in the following passage:

> Der fischzaunfang wird in Finland nirgends als berufsfischerei getrieben. In den meisten fällen beschränkt er sich auf die beschaffung der zukost für den hausbedarf. Es ist daher natürlich, dass in voller arbeitskraft stehende leute ihre zeit nicht auf diese fangart verwenden, wenn sie auch bei der schwierigsten aufgabe, der errichtung des fischzauns, mit hand anlegen. Das visitieren wird gern den alten männern und kräftigen knaben, wenn solche im hause sind, übertragen. In fischreichen zeiten wird es mitunter sogar zweimal am tage vorgenommen, wird aber die beute geringer, beschränkt man auch das visitieren allmählich, bis es zuletzt ganz eingestellt wird. Gewöhnlich sieht man früh am morgen nach den fanggeräten. Der betreffende mann nimmt einen fischzaunhamen und einen rindenranzen oder korb mit, in welchem er die fische nach hause transportiert. Gern versieht er sich, wenn er die wahl hat, mit einem kleinen boot, bestenfalls mit einem nachen und wrickt es zu seinem fanggerät. Am ziel angelangt, steuert er sein fahrzeug zuerst an das grasufer und scheucht die fische durch trampen gegen den fischzaun zu. Dann rudert er an die leitwand des fischzauns und kommt, indem er beiderseits im wasser stört, schliesslich zur einkehlung des fanggeräts. Diese verschliesst er ve
>
> treibt die fische aus dem vorhof in die kammern. Nachdem er auch die einkehlungen der letzteren versperrt hat, nimmt er schliesslich den hamen zur hand. Er drückt diesen am einen ende der kammer auf den grund und hebt ihn erst am anderen ende empor. So kommen alle fische auf einmal herauf. Nachdem er eine kammer oder einen fischzaun untersucht hat, nimmt er die verschlüsse der einkehlungen weg und begiebt sich nach den anderen kammern oder fischzäunen, um bei ihnen sein glück zu versuchen. Ausser fischen steigen als beute manchmal krebse auf, die vermutlich ein in dem fischzaun

verendeter fisch in die gefangenschaft gelockt hat. Es ist auch nicht selten, dass sich eine ente, gewöhnlich ein von fischen lebender taucher, in den fischzaun verirrt. Durch die einkehlung kann sie sich nicht zurückfinden, und die kammer ist gewöhnlich so eng, dass sie beim versuch zu fliegen mit den flügeln an die wände schlägt. Durch mannichfache misslungene anstrengungen ermüdet, muss sie notgedrungen das schicksal der fische und krebse teilen.

2.3.3. *The wickerwork fish-trap*

This kind of fishing gear generally consists of a long funnel made of wickers plaited together, of willow or some other kind of wood that is similarly pliant. The wide opening of this funnel where the fish enter is called the mouth. This is often formed by a hoop. This word implies that the mouth is circular. However, there are also fish-traps with oval, semicircular, square or rectangular mouth openings. The external wall of the fish-trap is referred to here as the outer casing. The narrow, hindmost part of the outer casing is called the tail. Two main types of wicker fish-traps can be distinguished, namely the fish-trap without throat (German: *Trompetenreuse*) and the fish-trap with throat (Sirelius, 1906) (fig. 18). The throat (Dutch: *inkeling, inkel, enkel*) consists of a small wicker funnel that is inserted in the big funnel.

2.3.3.1. *The fish-trap without throat or trumpet fish-trap*

This is a funnel-shaped wickerwork fish-trap which does not have a special throat. The trumpet fish-trap is mostly used in combination with a weir in places where the water current is very strong. It is placed in the water with its wide opening facing against the current. The fish that enter the trap are forced by the water pressure into the narrow part (the tail) of the funnel, where they become stuck fast. Consequently the fish are unable to turn around and swim away. Sometimes there is a so-called fish-hole in the tail of the trumpet fish-trap. The fish that have been caught can be removed from the trap through this hole. When the fish-trap is in use the fish-hole is sealed off with a wooden plug, or a bunch of twigs, or the wickers of the outer casing are tied together at the tail end with a piece of cord. In principle most kinds of fish can be caught with the trumpet fish-trap. Fish-traps of this kind are placed in swiftly flowing streams and rivers, and in places where there is temporarily a strong water current *e.g.* as a result of heavy rainfall, or a thaw, or tidal action. In England a kind of trumpet fish-trap is actually used for catching flatfish.

Figure 19 shows a trumpet fish-trap from Finland. The total length of this trap is 1.6 m. The first hoop is made of the thin stem of a fir tree, the outer casing is made out of fir branches split lengthwise and the cord used for binding consists of fir roots.

An interesting kind of trumpet fish-trap is known from the estuary of the Severn, that opens out into the Bristol Channel between England and Wales (fig. 20). This so-called salmon putcher is 1.7 m long and the largest opening measures 53 cm in diameter. The salmon putchers are put in position, with their largest opening facing downstream, in rows and fixed above and below on to wooden constructions. In the estuary there is a big difference in water level between low and high tide. Moreover, the water that rises with the incoming tide is very turbid. Consequently the salmon swimming upstream do not see the fish-trap, and become caught inside it. In a state of 'panic' the fish tries to escape through the narrow opening. In the attempt the fish jerks itself so forcefully that it becomes stuck fast, and cannot be released by even the strongest current of the ebb tide.

In the salmon putcher only one fish can be caught at a time. This is in contrast to the normal trumpet fish-traps, which can catch several fish at a time.

2.3.3.1.1. *The development of the trumpet fish-trap.* Sirelius (1906) presumes that this kind of fish-trap is derived from the bunch of twigs weighted with stones, which is placed in the opening of the V-shaped weir (2.3.1.). Evidently it is not very easy to lift a bunch of twigs, containing fish, out of the water. There would thus have been an incentive to develop a light-weight and portable kind of fishing gear, with which the catch could be lifted out of the water all at once. Thus Sirelius sees the prototype of the trumpet fish-trap in a kind of fishing gear used in the Département du Var (France). Here, in addition to the V-shaped weir with a bunch of twigs, a V-shaped

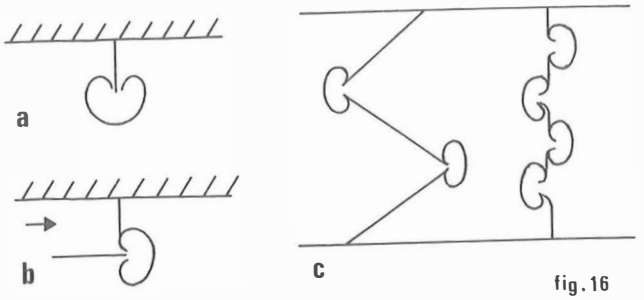


fig. 16

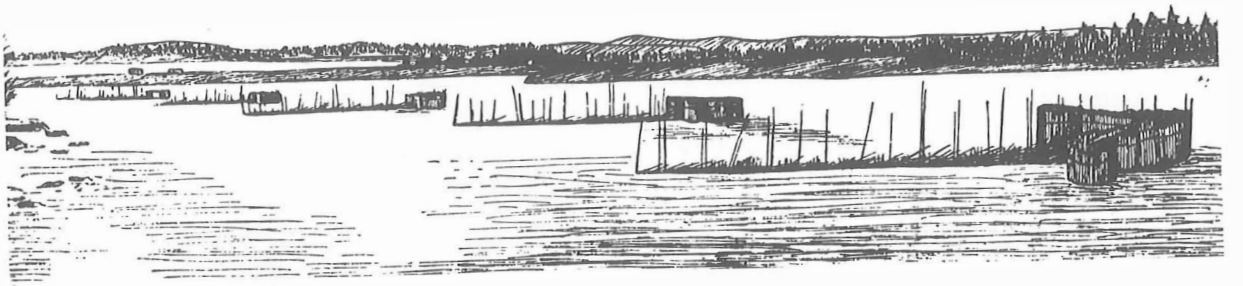
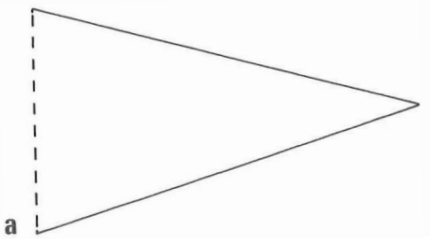
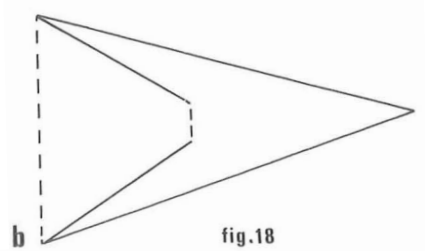


fig. 17





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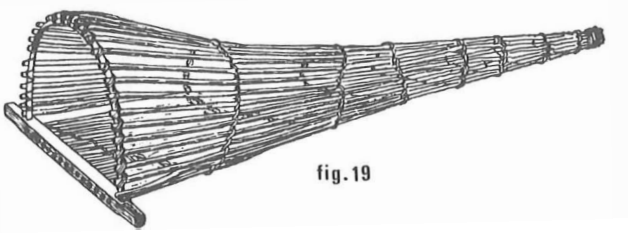

fig. 19

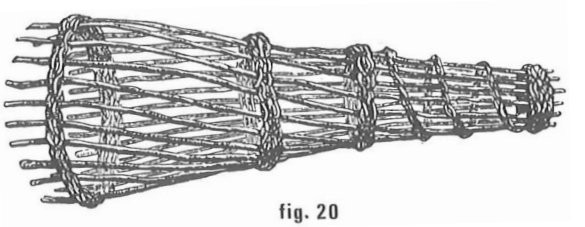

fig. 20

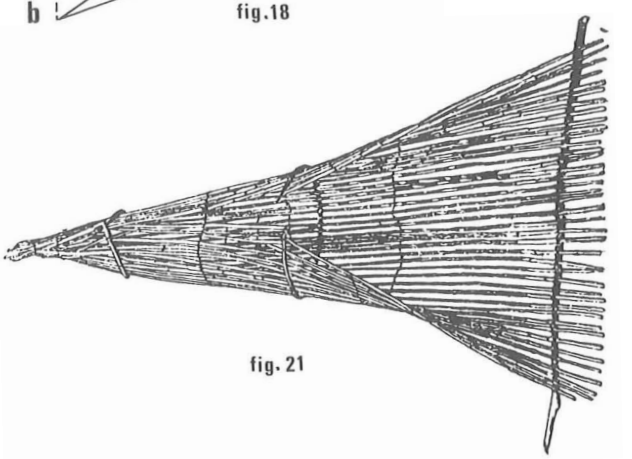

fig. 21

fig. 22

weir with two bundles of reed is used. These bundles of reeds, that are held together by strips of lime bast, are joined together at one end. When the fishing gear is in use there is a bunch of twigs between the two bundles.

A further development of the trumpet fish-trap would be the type of fishing gear that comes from the Département d'Aude (France) (fig. 21). With this kind of gear the hindmost part, where the fish become trapped, is already closed in the form of a funnel. The foremost part is still open, however.

2.3.3.2. *The fish-trap with throat*

In sluggishly flowing and stagnant waters the trumpet fish-trap cannot be used. Because the water pressure is too low, the fish can swim freely in and out of the trap. To prevent this the fisherman makes use of the fish-trap with throat.

2.3.3.2.1. *The weaving technique used for fish-traps with throat.* The fish-traps with throat can be made in two different ways, as regards weaving technique. On the basis of the weaving technique used we can distinguish between the so-called light fish-trap and the closely woven fish-trap (German: *Korbreuse*). The former owes its name to the fact that the wickerwork has an open structure. As a result of this much light can penetrate the fish-trap, in contrast to the closely woven fish-trap. With the light fish-trap the outer casing and the throat are formed mainly of wickers that run in the longitudinal direction of the trap. These wickers run more or less parallel to one another. The distance between adjacent wickers is usually 0.5 tot 1.5 cm.[2] The wickers are connected to one another at regular intervals by means of cord. This binding is done using the *Zwirnbindung* technique. The cord forms the so-called cross-strips. The mutual distance between these cross-strips is usually 6 to 10 cm. They can run around the fish-trap in the form of circular or spiral bands. Figure 22 gives an example of a light fish-trap with two throats, that is used for catching eels. It is made out of laths of pine wood. The cross-strips are made out of pine roots. These have been divested of their bast layer and tanned in boiling soda water with oak- and beech-bark (Peesch, 1966).

The closely woven fish-trap also has wickers running in the longitudinal direction of the fish-trap. The distance between adjacent wickers is greater than in the light fish-trap, however, for the outer casing is largely formed by the cross-strips (fig. 23). These cross-strips are also made out of wickers. They are woven close to one another by means of the *Leinwandbindung* technique (Vogt, 1937). Sirelius (1906) finds these closely woven fish-traps only among the Magyars and related peoples. They are used for catching very small kinds of fish. Thus in the north of Yugoslavia small cyprinids are caught with a closely woven fish-trap (fig. 24). To lure the fish inside the trap, the throat opening is rubbed over with bread.

2.3.3.2.2. *Weaving methods for fish-traps and the kinds of wood used.* The fish-traps can be woven out of different kinds of wood. In Finland they are often made out of willow wickers. For this purpose wickers are used that are one year old, that are gathered in the autumn or at the end of the winter. Here fish-traps are also made out of the wood of fir, pine and juniper. For cross-strips are used: roots of fir, pine and juniper, strips of bast of birch, willow and lime or sometimes flax. Closely woven fish-traps are also sometimes made out of wood shavings. In the Netherlands the fish-traps known as the *prikkorf* (lamprey-basket), the *aalkorf* and the *aalkubbe* (both eel-baskets) were woven exclusively out of willow wands. These were also wickers of one year of age. Usually the basket-maker used unpeeled wickers for the hoop of the mouth opening. He then used peeled ('white') wickers for the outer casing of the *aalkorf* that was used mainly in salt and brackish water (a so-

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Fig. 16. Various forms of fish-surround (after Sirelius, 1906).
Fig. 17. Fish-surrounds in Finland (after Sirelius, 1906).
Fig. 18. The fish-trap (schematic):
a. fish-trap without internal funnel; b. fish-trap with internal funnel.
Fig. 19. Trumpet fish-trap with semicircular mouth opening from Finland (after Sirelius, 1906).
Fig. 20. The salmon putcher (after Sirelius, 1906).
Fig. 21. Trumpet fish-trap from France (after Sirelius, 1906).
Fig. 22. Eel-trap from Lunow (Germany) (after Peesch, 1966).

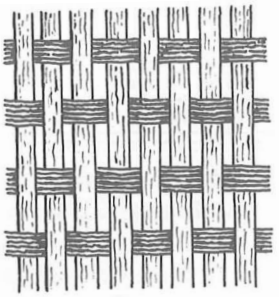
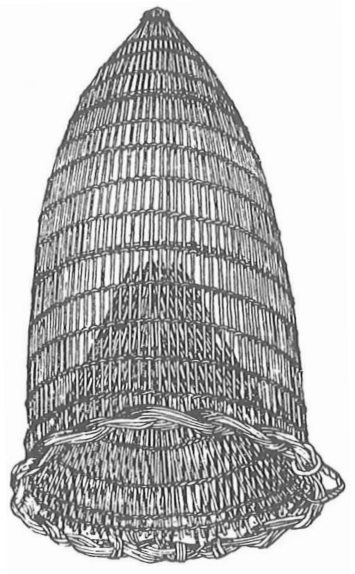


fig. 23

fig. 24



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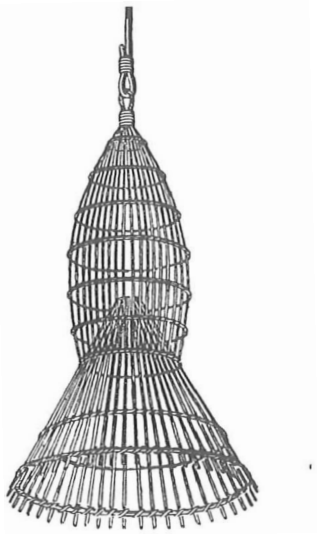

b

fig. 25

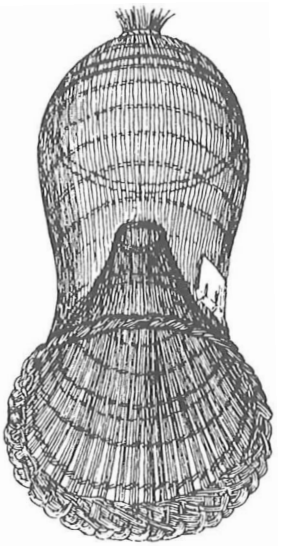

fig. 26

called white basket). Unpeeled ('green') wickers were used to weave the so-called dark basket (Dorleijn, 1977) So far as I have been able to ascertain all recent Dutch fish-traps are light fish-traps. The terms *prikkorf* and *aalkorf* do not mean that we are concerned with closely woven fish-traps.

The basket-maker can begin weaving a light fish-trap in different ways. The basket-makers of Lunow (Germany) begin by weaving the tail end. The throat is woven separately and is later inserted in the outer casing (Peesch, 1966). Other basket-makers begin by weaving the first hoop (Van Doorn, 1971; Michelsen, 1952) or by drawing together into a circle the ends of the first hoop, if it is made out of one twig (Sirelius, 1906). The throat is woven on to this first hoop. The basket-maker then weaves the wickers of the outer casing on to the first hoop. In this way a fish-trap is produced, in which the outer casing completely encloses the throat (fig. 25a). It is also possible to weave the outer-casing wickers on to a cross-strip of the throat. Then a fish-trap is produced in which the throat projects slightly out of the outer casing (fig. 25b). A transitional form between the fish-trap with a built-in throat and the fish-trap with the throat sticking out of the outer casing is to be seen in figure 26. The outer-casing wickers are woven on to the first hoop. At the level of the middle of the throat the outer casing becomes narrower, and behind this level it becomes wider again. To strengthen the wickerwork of the outer casing extra hoops are sometimes fitted. To give the fish-trap its funnel shape, the basket-maker weaves the cross-strips not around every outer-casing wicker, but around every pair of these wickers. He does this at regular intervals. Thus towards the tail the outer-casing wickers come to lie increasingly closer together. The basket-maker can also make the outer casing (and the throat) narrower by cutting away regularly an outer-casing wicker. A combination of these two methods is also known to occur.

The opening through which the fisherman removes the fish from the trap is often made by the basket-maker at the end of the tail. This fish-hole is closed off when the trap is in use by means of a wooden plug, a woven lid or a bunch of straw; alternatively the outer-casing wickers may be tied together with a tough binding, that can be undone. There are also fish-traps that have a fish-hole in the outer casing. The opening is sealed off with a woven or solid wooden flap. One of the many fish-traps of the Syrjäns has no true fish-hole. In this particular case the outer casing is not woven concentrically around the throat, and the space that is thus created between them is used as a fish-hole. When this fish-trap is in use the pole to which it is attached covers this opening.

The dimensions of the fish-traps (particularly the light fish-traps) are variable. In Germany (Lunow) the eel-baskets are 120 and 150 cm long and the lamprey baskets 100 cm. There are also so-called *Wehrrüsen* (fish-traps that are used in combination with a weir). These measure 5-6 m in length and have a mouth opening of 1-1.5 m (Peesch, 1966). For a number of Finnish fish-traps Sirelius (1906) mentions lengths of between 100 and 130 cm and mouth openings between 100 and 130 cm and mouth openings between 35 and 60 cm. The Dutch fish-traps also varied in size. The *prikkorf* was 50-100 cm long, and measured 20-30 cm in diameter. This fish-basket had a cylindrical outer casing, and two throats (the so-called *hoedje* and *petje* — the little hat and the little cap). The basket was used for catching river lampreys and smelt. So far I have not been able to find any measurements for the eel-baskets. Van Doorn (1971) mentions only the use of the eel-basket with two throats and two wings that were woven on to the first hoop (fig. 27), the *welie* (a large eel-basket), the *vleugelkorf* (literally: winged basket, an eel-basket with one weir element), the *waas* (an eel-basket especially suitable for use in strong currents), a *Friese korf* (literally: Frisian basket, a short basket with two wings) and the *kachelkorf* (literally: stove basket, an eel-basket without wings, in the shape of a pot-bellied stove).

Fig. 23. Method of weaving fish-traps, using the *Leinwandbindung*.

Fig. 24. Closely woven fish-trap from Batrovci (Yugoslavia). Photo: B.A.I., Groningen.

Fig. 25. Placing of the throat: a) fish-trap with built-in throat (Finland); b) fish-trap with throat sticking out of the outer casing (Russia) (after Sirelius, 1906).

Fig. 26. Fish-trap with built-in throat and narrowed outer-casing (Sweden) (after Sirelius, 1906).

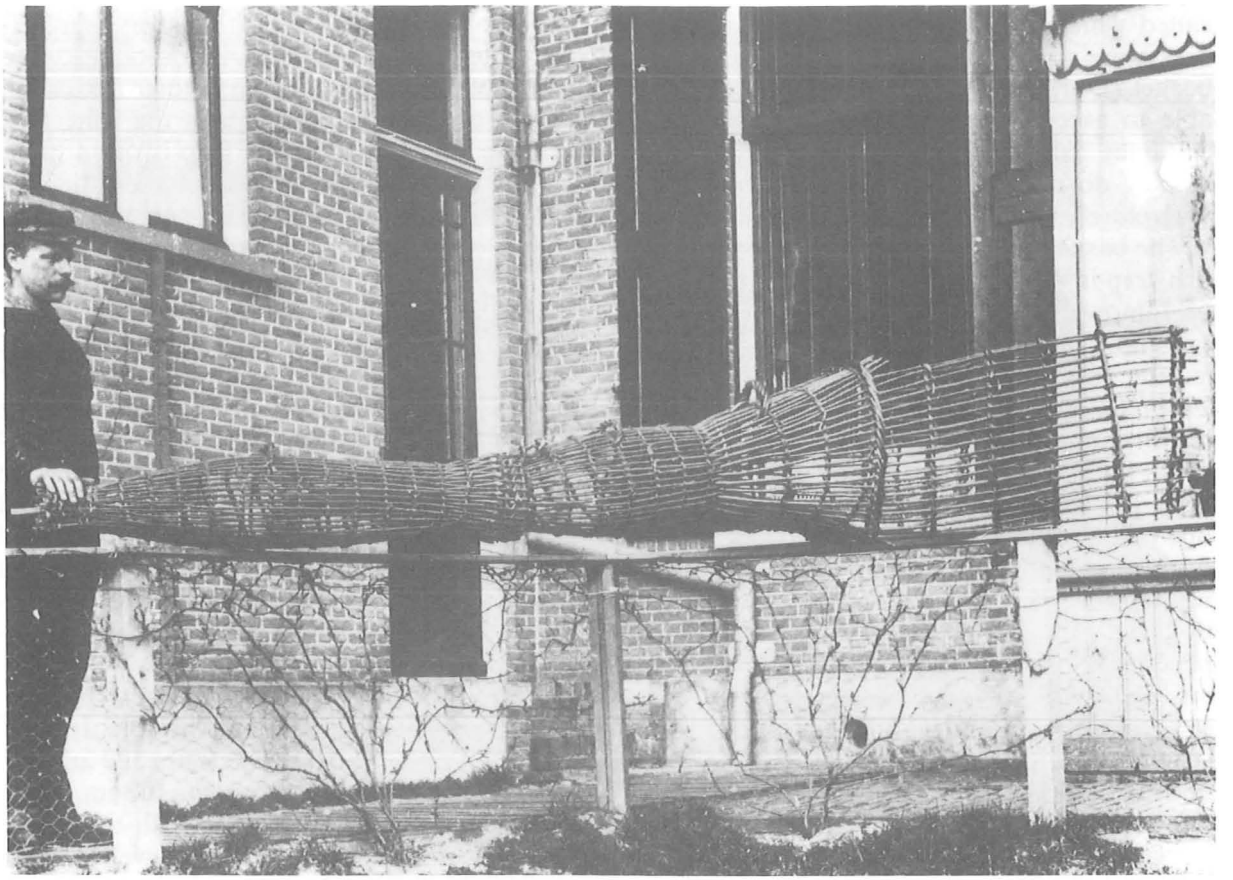

fig. 27

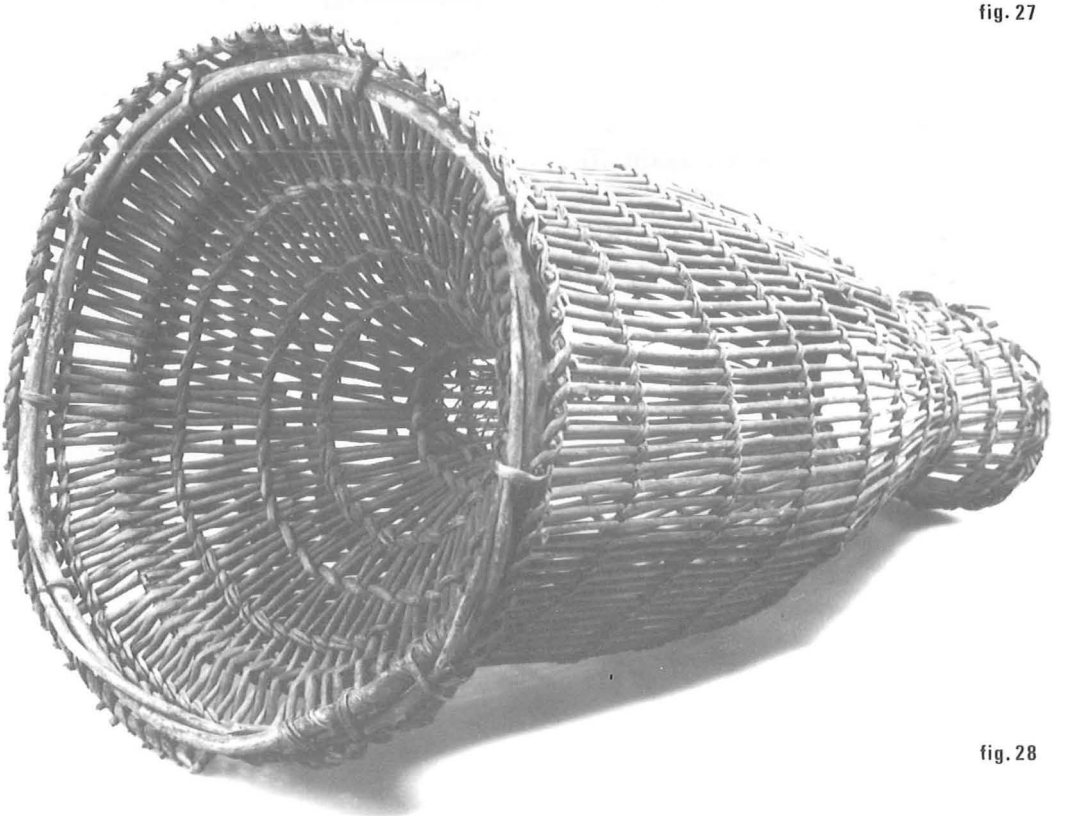

fig. 28

The Dutch *aalkubbe* (a special kind of eel-basket or eel-pot) is a bell-shaped trap measuring 50-60 cm in length. At the rear opening of the throat a silk net (called an *inkeltje*) is attached, that is fastened to the tail with a piece of cord (called an *enkelsnoertje*). The fish-hole is situated at the end of the tail and is closed off by means of a wooden plug. The space between the peeled outer-casing wickers measures 0.5 cm and the space between the cross-strips 4.5 cm. These cross-strips are woven in a spiral around the outer casing. The diameter of the rear opening of the throat measures 5 cm (fig. 28).

2.3.3.2.3. *Fishing with a trap and the kinds of fish caught in it.* To fish effectively with fish-traps (and other fishing gear), the fisherman must have a broad knowledge of the habits of the different kinds of fish. This means that he must know his fishing waters (with regard to depth, current, substratum, *etc.*). In addition insight into weather conditions and familiarity with his equipment are important. On the basis of this knowledge he sets out his fishing gear.[3]

The larger fish-traps are placed in combination with a weir. These can be very large permanent weirs. The fish-trap is then lowered into the weir and lifted out of it with the aid of a vertical gate construction (fig. 29).

In the Netherlands this kind of fishing is known as *weervisserij* (literally: weir fishing). It involves the use of a V-shaped weir, almost 1 km long, with a fish-trap made of yarn to catch herring and anchovy and the *zalmsteek* (a row of fish-traps) to catch salmon.

In addition fish-traps are used in combination with loose (transportable) weir elements. The fish-trap is then often anchored to a post, that has a central position in front of the mouth opening. Also the tail can be attached to another post with a piece of cord. Sometimes the tail is weighted with a stone. Fish-traps may also be put down in the water completely weighted with stones.

In the Netherlands, in the big rivers a number of lamprey-baskets or eel-baskets were placed next to one another in the water on a steel wire or thick rope (a so-called *weel* or *kubbenlijn*) (Van Doorn, 1971). In the former Zuiderzee many eels were caught with the *aalkubbe*. The position of this *kubbe* in the water is quite different to that of other fish-traps, *i.e.* it is vertical instead of horizontal. The baited *kubbe* is weighted with stones and is hung on a cord from a stick stuck at a slight angle into the bottom. This is done in such a way that the mouth hoop just touches the bottom. The position of the *kubbe* on the ground can be altered by placing the stick at a steeper or less steep angle accordingly. During cold weather the eel moves down deeper and then the hoop has to rest on the bottom. During warm weather the *kubbe* may be lifted up a little higher (Dorleijn, 1977).

The wicker fish-traps are not very durable. According to Sirelius (1906) the Finnish fish-traps are worn out after a few years. According to Dorleijn (1977) the *aalkubbe* that was used in the Zuiderzee lasted for two years.

In principle almost any kind of fish can be caught with a fish-trap. For technical reasons this is not done, however, and for many kinds of fish no special fish-traps are made. Such fish are caught with nets or lines. So far I have not found any special fish-traps in Western Europe for catching the larger kinds of fish such as sturgeon and catfish. This can be simply explained: large (predatory) fish are rare compared to other, smaller kinds of fish. A special fish-trap for large fish would provide too low a yield. Moreover smaller kinds of fish can easily swim in and out of such a fish-trap. We thus find fish-traps for catching those kinds of fish that are present in large numbers in the waters concerned. These are nearly always kinds of fish that are not very big compared to sturgeon and catfish. When the fisherman uses a fish-trap in combination with a weir or a fish-trap with wings, he does not need to use any bait. The *aalkubbe* and the *prikkorf* are baited, however. In the Netherlands the freshwater fisherman used the fish-trap to catch the following kinds of fish: eel, perch, members of the carp family, pike, ruffe, smelt and river lampreys. When a migrant species of fish was temporarily present in freshwater (*e.g.* salmon, sea trout, houting,

Fig. 27. Eel-basket with two throats and two wings, from the Netherlands (after De Groot & Schaap, 1973).
Fig. 28. *Aalkubbe* (wooden plug missing) from the Netherlands. Photo: C.F.D., Groningen.

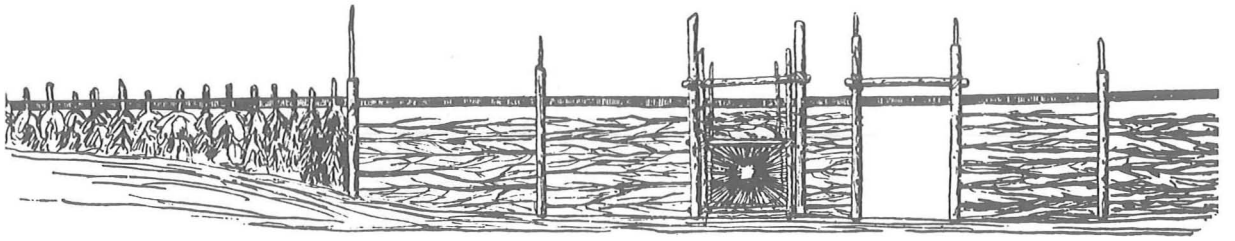

fig. 29

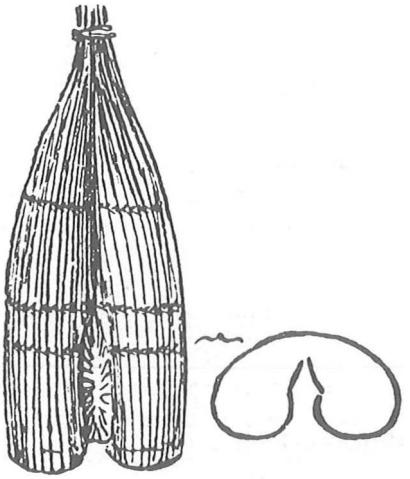

fig. 30

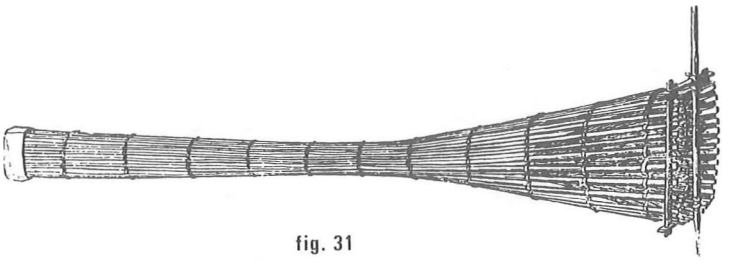

fig. 31

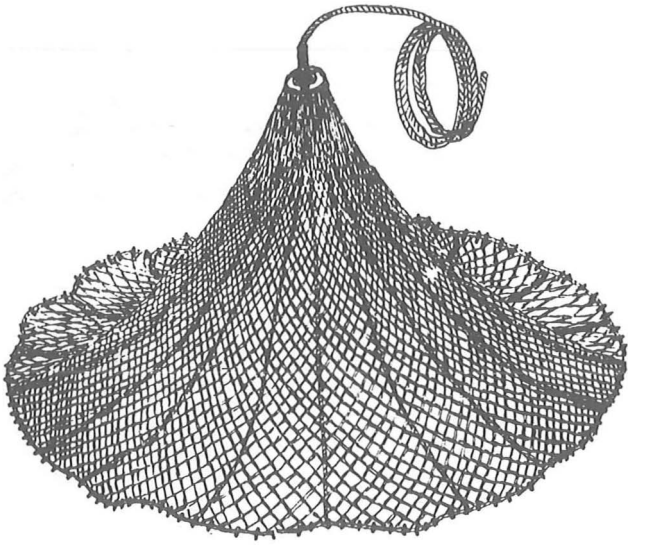

fig. 33

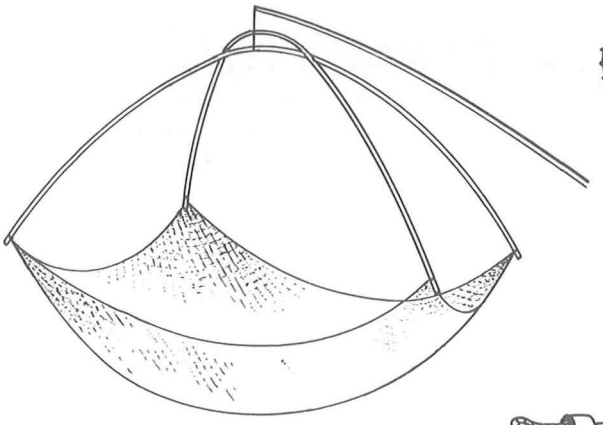

fig. 32

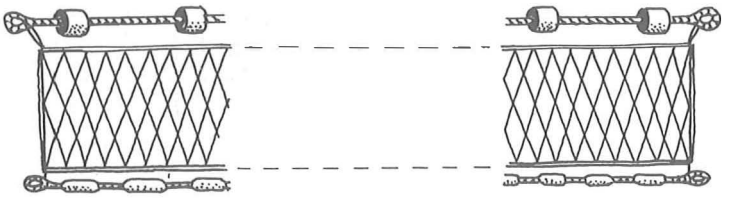

fig. 34

twaite shed and allis shed), these were fished too. In brackish/salt water herring and anchovy were caught. The herring fishery with fish-traps on the Frisian Wad (the tidal shallows) yielded a supplementary catch including flounder, gurnard, sole, codling and ray (Van der Molen, 1976).

2.3.3.2.4. *The development of the fish-trap with throat.* On the one hand Sirelius (1906) regards the fish-trap with throat as a further development of the fish-surround, on the other hand he regards it as a further development of the trumpet fish-trap.

It is evident that fish-surrounds placed in sandy and muddy bottoms are not completely escape-proof. Fish can dig them selves into the substratum and in this way escape under the barrier. Because there is no roof present, birds of prey visit the fish-surround. Also strong sunlight can have a damaging effect on the fish. In the event of sudden flooding the fish-surround may disappear under the water thus enabling the fish to escape. Moreover, there are obvious difficulties involved in emptying a fish-surround of its catch, on account of its necessary situation in deep water. A transitional form between the fish-surround and the fish-trap with throat is seen by Sirelius (1906) in a fish-surround from Southeast Asia (fig. 30). This fishing gear has a base, and the top ends of the fencing are tied together. The contraption is placed vertically in the water, however. Figure 31 shows a fish-trap with throat that is used by the Syrjäns. This trap can be regarded as a further developed form of trumpet fish-trap, since it has an especially long and narrow tail.[4] The trap is made out of willow wickers. The cross-strips are roots of fir. The mouth-opening is square.

In addition to the above-mentioned fish-trap the Syrjäns also use a trap that consists of a loose throat and a loose outer casing. This throat is inserted in the outer casing. This kind of fishing gear can also be regarded as a transitional form between the trumpet fish-trap and the fish-trap with fixed throat. The most developed fish-traps are those with an outer casing and throat made entirely out of cording (2.3.4.4.).

Fig. 29. Weir with two fish-trap openings (Syrjäns) (after Sirelius, 1906).
Fig. 30. Fish-surround from Siam (after Sirelius, 1906).
Fig. 31. Fish-trap with a long narrow tail (Syrjäns) (after Sirelius, 1906).
Fig. 32. The square net.
Fig. 33. The cast-net (after Živković, 1956).
Fig. 34. The drift-net.

2.3.4. *The fishing net*

The final stage in the development of the fishing gear is the fishing net. This consists entirely of cords that are knotted together in such a way that a meshwork is produced with diamond-shaped openings. The cording of recent fishing nets is made out of hemp, cotton, nylon or other synthetic fibres. Sirelius (1906) mentions that in Finland also willow bast was used formerly. Fishing with nets is in almost all respects more advantageous than fishing with lines, weirs and wickerwork fish-traps. The fishing net is less conspicuous, so the fish are caught more easily in it. Once fish are trapped in a net they become confused in the meshwork and are hardly able to escape. Moreover fishing nets are easy to handle and take up little space when they are stored away.

On the basis of their shape fishing nets can be divided into four groups, namely the square net, the round net, the rectangular net and the bag-shaped net.

2.3.4.1. *The square net*

This net is suspended by its corners from two flexible sticks placed crosswise. At the point where the sticks cross a cord is fastened, and the other end of this cord is attached to the end of a long stick. This kind of fishing gear is called a square net (Dutch: *kruisnet* or *totebel*) (fig. 32). The net has a closely spaced meshwork, and is let down horizontally into the water, until it comes to lie on the bottom. The fisherman may place a bait on the net, but this is not essential. When the water is turbid, the fisherman raises the net haphazard. If the water is clear, then he actively goes in search of fish. Then, whenever a fish swims above the net, the net is lifted up. The dimensions of square nets vary. Those that are operated by hand measure c.4 m². If the

fisherman is fishing from a boat, he uses a bigger net (*e.g.* 25 m²). Such a net would be mechanically operated (Van Doorn, 1971).

2.3.4.2. *The round net*
This circular fishing net has a diameter of about 4 m. The periphery of the network is strengthened with a thick rope, to which lead weights are attached. At the centre-point of the net there is a small opening, in which a cow's horn or a ring made of horn is fixed to protect the network. Passing through this ring are a number of ropes (Dutch: *pezen*), that are attached to the periphery of the net at regular intervals (fig. 33). This kind of fishing gear is known as a cast-net. The fisherman stands in a boat or wades into the water and throws this net as far outspread as possible on to the surface of the water. On account of the lead weights the net sinks rapidly to the bottom and covers the fish there present. By pulling up the ropes that run through the central hole the fisherman is able to trap the fish inside the net, which is then pulled out of the water.

Van Doorn (1971) states that the cast-net is derived from the *stulpmand.* This is a basket without a base. With this device the fisherman stands motionless in shallow water and waits until a fish or a shoal of fish comes along. As soon as the prey comes within reach, he quickly thrusts the basket down over the fish and can easily remove the fish from the basket.

Barthel (1977) mentions the find of a *stulpmand* dating from Roman times in Oberdorla.

2.3.4.3. *The rectangular net*
This fishing net is a rectangular network, of which the two long sides are attached to strong ropes (the top and bottom ropes). The dimensions of this kind of fishing gear are very variable, and depend on the waters that are to be fished with it. Smaller specimens measure *e.g.* 10 m in length and 1 m in height; others may be as much as several hundreds of metres long and ten or more metres high. The rectangular net is always placed vertically in the water. This can be done in two ways: either the net is suspended on vertical posts that are driven into the lake, river or sea bottom (a standing net) or the net is used as a so-called drift-net. In the latter case, to the upper rope are attached floats made of wood, cork or synthetic material and to the lower rope weights made of stone, lead or some other heavy material.[5] It is clearly obvious that rectangular nets are derived from the weir. Figure 34 shows the simplest form of drift-net, that is still widely used. From this basic kind of drift-net other kinds have been developed that are more effective. I will not go into this matter in any further detail. An important point is that the use of a boat is nearly always necessary for fishing with rectangular nets.

2.3.4.4. *The bag-shaped net*
This kind of fishing gear consists of a network funnel that is held open by means of a number of wooden or metal hoops. In this funnel a number of constrictions are present. To lead the fish towards the trap one or two network wings are attached to the first hoop (fig. 35). These network fish-traps are attached to posts and placed in shallow water in lakes, rivers and along the coast.

The wickerwork fish-trap stood as a model for the development of the bag-shaped net. This in turn gave rise to the development of the drag-net or trawl. Seeing that this kind of fishery involves such a high degree of development of the fishing boat and fishing techniques, however, I will not go into any further detail on this matter.

2.4. Auxiliary fishing equipment

In the actual process of catching fish only a few items of auxiliary equipment are used. These are: the splashing stick (Dutch: *plonsstok,* German: *Trampe*), the gaff (German: *Schlaghaken*) and the scoop-net or dip-net (Dutch: *haam* or *schepnet*). At the same time one could regard the boat and the live-box as auxiliary fishing equipment. In view of the fact that terms like scoop-net and boat need no further description, I shall not devote any attention to them here.

2.4.1. *The splashing stick*

This is a long wooden stick with a small flat wooden disc at one end. There are also splashing sticks that have a hollow wooden disc, a hollowed-out gnarled piece of wood or a

piece of leather (Sirelius, 1906). To alarm the fish and to drive them towards the fishing gear noise is made in the water. The fisherman can do this by merely hitting the water surface with an ordinary stick. It is evident that the splashing stick results in a more rapid and effective flight of the fish, however, as it produces a noise of greater resonance.

A species of fish that does not flee from the noise, but rather is attracted by it, is the European catfish. The predatory fish is only active at night. In order to make the fish active in the daytime, the fisherman makes use of the splashing stick. In Yugoslavia a wooden or iron stick c. 40 cm long is used for this purpose. At the end of this a hollowed-out disc, c. 5 cm in diameter, is attached (fig. 36). With this splashing stick the water is struck obliquely from above. This is done very regularly (c. 20 strokes per minute), and in this way a resonant singing noise is produced, that carries a long way. According to Ristić (1977) this sound imitates the noise that is made when a large catfish snaps up its prey. Impelled by their insatiable appetite the catfish swim towards the source of the noise. Here they are caught with a strong line and large baited hook, which the fisherman moves up and down in the water. As it is difficult to haul in large catfish from the riverbank or shore, this kind of fishing is only done from a boat.

2.4.2. *The gaff*

The gaff consists of a long wooden stick with a large iron hook at one end. The hook is sometimes barbed. It is attached to the stick by means of thread (fig. 37). With the aid of the gaff the fisherman removes from the water the larger fish that have swum into the passively-operating fishing gear. I have also mentioned the gaff as an actively operated kind of fishing gear under 2.2.1. Among the people living around Lake Ladoga a similar gaff is used for catching seals (Sirelius, 1934).

In the Netherlands, those who fish in rivers are familiar with specific types of gaff, namely the *steurhaak* and *zalmhaak* (literally: sturgeon hook and salmon hook). The sturgeon hook is a large crescent-shaped hook that is thrust into a sturgeon when it threatens to escape from the net. The salmon hook is used in catching salmon and is usually slightly smaller than the sturgeon hook (Van Doorn, 1971). Van der Molen (1976) mentions the use of a gaff in the *hoekwant* fishery. The fishery museum in Moddergat (Friesland) possesses a finely decorated iron hook that was used in bringing in large cod.

2.4.3. *The live-box*

This is a square or rectangular wooden container with a lid. In the bottom and in the lower part of the sides small holes are present, so that water can flow in and out of the container. The live-box provides a means of keeping alive fish that have been caught, and also of transporting them alive.

In the Netherlands large wickerwork trailing baskets were used for transporting river lampreys from Arnhem to Vlaardingen. These baskets were secured alongside the fishing boat (Lobregt & Van Os, 1977). A fixed live-box in a fishing boat is known in Dutch as a *beun* or *bun*. In Yugoslavia wooden live-boxes are used that are in the shape of small boats c. 1 m long. These are pulled along by means of a rope attached to the fishing boat.

During excavations of Early Medieval Dorestad (Wijk bij Duurstede), a rectangular oaken frame was found in the bed of the Rhine, dating from Carolingian times. This frame had a bottom made of a wickerwork of willow wands, while in the frame there were holes that had been bored into it, in which remains of the side-walls were still present. The object has been interpreted as the remains of a live-box (Van Es, 1974; Casparie & Swarts, 1978).

3. ARCHAEOLOGICAL FINDS OF FISHING GEAR

In the article 'The development of fishing in prehistoric Europe' (Clark, 1948), detailed information is given about the ways in which prehistoric man in Europe exploited the natural fish populations as a source of food, and about the kinds of fish that were certainly or probably caught. After this survey had been published, in the field of archaeology hardly any more attention was devoted to this subject.

Recent research has shown, however, that

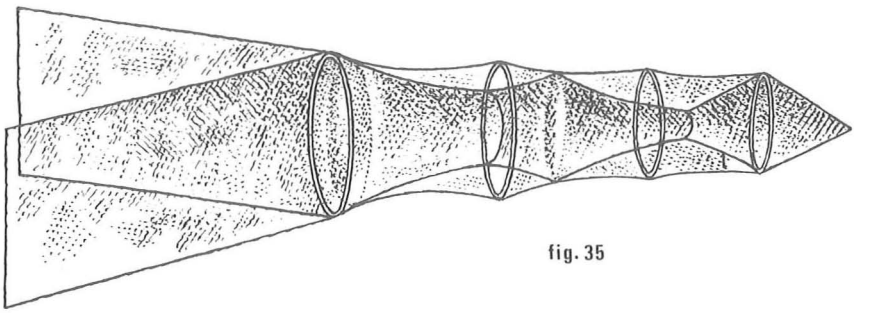

fig. 35

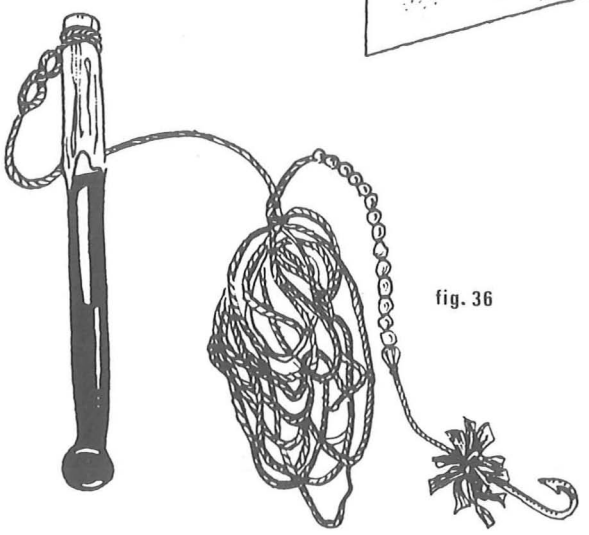

fig. 36

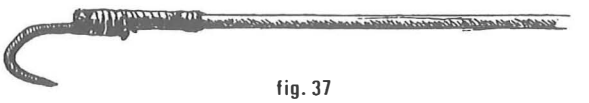

fig. 37

fig. 38

some assumptions made in that article were premature, and therefore stand in need of readjustment.

3.1. The method of approach

In looking for references to pre- and protohistoric fishing gear in the archaeological literature I have had to restrict myself in many ways. For example, I have not attempted to make an inventory of the non-independently operating types of fishing gear. That would be a very time-consuming task, as there are many scattered references to such finds in the literature. Rather, I have limited myself to a few brief remarks on fish-spear prongs and gorges, and also to the description of six bone fish-hooks from the Netherlands, in consideration of their effectiveness from a theoretical viewpoint.

With regard to the independently operating fishing gear I have not made any special effort to look for references to archaeological finds of weirs, fish-surrounds and fishing nets. Finds of weirs and fishing nets are well known. On the other hand, so far I have not come across any finds of fish-surrounds. Emphasis is laid, however, on the inventorization of Mesolithic and Neolithic wickerwork fish-traps and fragments thereof from the Netherlands, Northern Germany, Denmark and Sweden. In addition, with regard to these finds attention is devoted to the plaiting method used and the degree of regularity in the wickerwork, as far as can be ascertained. Also in a number of cases a reconstruction is attempted of the fish-trap or fragment in order to gain some idea of the possible type.

Figure 38 indicates the sites of the various types of pre- and protohistoric fishing gear from the Netherlands, as mentioned in the text.

Fig. 35. Network fish-trap with two wings.
Fig. 36. Splashing stick for activating catfish (Yugoslavia) (after Živković, 1956).
Fig. 37. The gaff (after Sirelius, 1934).
Fig. 38. The Netherlands at the present time, showing the findspots of the various types of pre- and protohistoric fishing gear: 1. Rotterdam-Europoort; 2. Vlaardingen; 3. Rotterdam-Bergschenhoek; 4. Molenaarsgraaf; 5. Olst; 6. Spoolde; 7. Noordoostpolder; 8. *terpen* area; 9. Emmererfscheidenveen; 10. Utrecht; 11. Dorestad (Wijk bij Duurstede).

3.2. The fish-spear

In prehistoric assemblages since the Upper Palaeolithic, objects evidently occur that strongly resemble the loose prongs of recent fish-spears. These are long (c. 15 cm) narrow points that have a number of small barbs on one long edge. They are made out of bone or antler, and are called leister prongs or barbed points. These barbed points are found especially in those countries around the southern part of the North Sea, the North Sea itself and countries around the Baltic Sea, as isolated finds in old lake-bottom sediments. Barbed points have also been found in excavations of Mesolithic (Maglemose) settlements in Denmark. In these settlements fish remains were also found. Among these remains those of pike evidently predominate, or at least occur regularly (Degerbøl, 1945). Also the find of a pike skeleton in the close vicinity of a barbed point (Indreko, 1948) makes it probable that the barbed points were for catching fish.

On the basis of this evidence Clark (1948) stated: 'Evidently, from the rarity of remains of other species, we have to do with a specialized pike fishery. In summer this was mainly carried on by spears as the fish lay quiet in still, shallow water'. That this statement is too one-sided and may lead to wrong conclusions is clear if we look at the Late Preboreal settlement of Star Carr. Partly on the basis of the absence of pike remains (no fish remains were found at all) Clark (1954) concludes that the settlement cannot have been inhabited in the summer. However, besides the fact that pike can be caught just as well in winter, Wheeler (1978a) comes to the conclusion, on the basis of biological and palaeogeographical factors, that pike could not have been present at the time in the lake next to which Star Carr was situated. The data that have been obtained from the material of the Danish Maglemose settlements are not applicable *a priori* to contemporary settlements elsewhere. Many barbed points were indeed present at Star Carr. Despite the absence of fish remains, in my opinion these barbed points could certainly have been used for

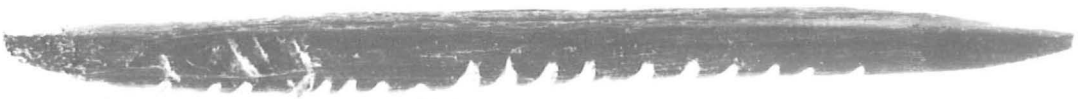

fig. 39

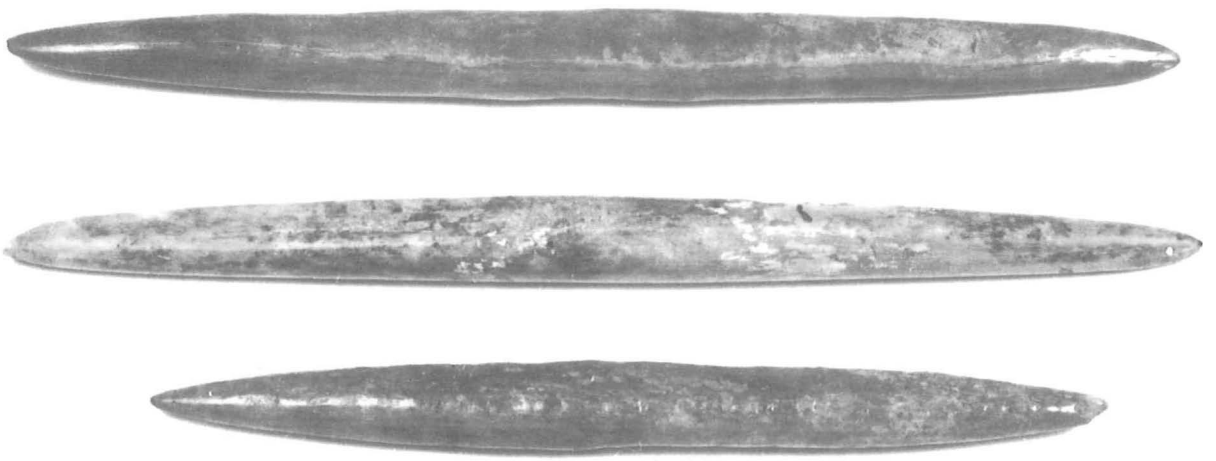

fig. 40

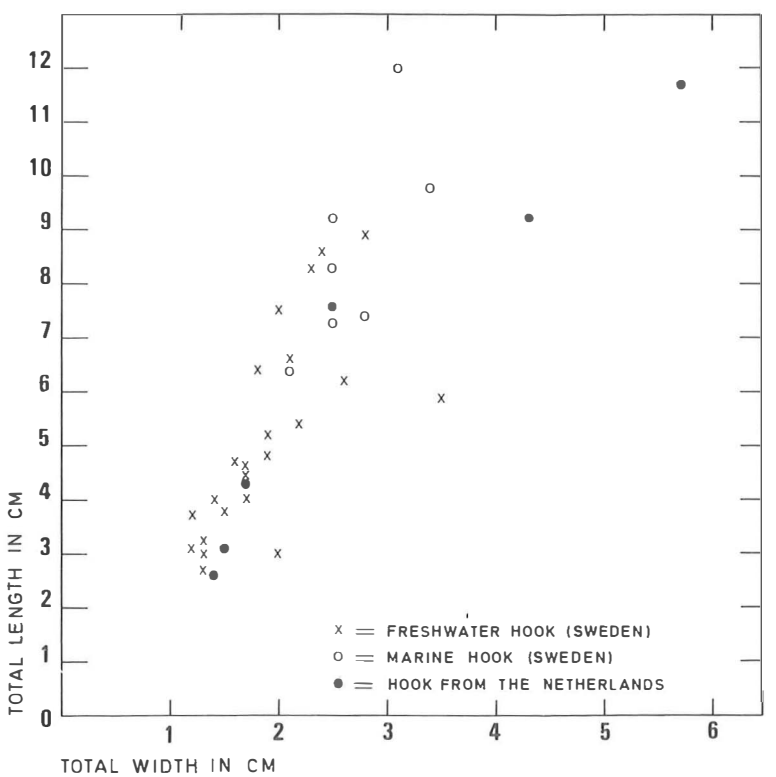

fig. 41

catching fish, namely fish of the salmon family. On the basis of the biology and the distribution of salmonids it is well possible that there existed a standing population of arctic charr or a migrant population of salmon and sea-trout in the Late Preboreal lake. However, for physiological and chemical reasons the chances of remains of salmonids becoming fossilized are very slight (Lepiksaar, 1975; Wheeler, 1978b). Also cultural factors can be responsible for decreasing the likelihood of preservation of salmonid remains. For example, it is known that certain North American Indian tribes prepare the salmon they catch by splitting them lengthwise, drying them and then pounding them into fish-meal (Casteel, 1976). It will thus be clear that salmonid fish processed in this way will leave no or hardly any remains.

In Neolithic and later periods it is evident that the finds of barbed points decrease. This may be, on the one hand, the result of the development of better fishing gear and, on the other hand, due to the transition from hunting, fishing and food-collecting to agriculture and stockbreeding. Fish-spears remain in use, however. The Greeks and Romans used the fish-spear, as is evident from frequently occurring illustrations in pictorial art. This does not mean that for the Greeks and Romans this was the most important kind of fishing gear. The fish-spear is rather the kind of tackle used by those who fish for pleasure, and as such emphasizes the element of sport.

3.2.1. *Barbed points from the Netherlands*

Also from the Netherlands a number of barbed points are known. One of these comes from Emmererfscheidenveen (fig. 39). On the basis of the data of Clark (1936), the object is dated by Louwe Kooijmans (1970/1971) in the Preboreal or Early Boreal. About 10 barbed points have been found as a result of sand-dredging operations at Europoort, Rotterdam. They probably come from a deposit that is dated in the very beginning of the Boreal (Louwe Kooijmans, 1970/1971, 1976). Some of these barbed points are very small (c. 5 cm) in comparison with barbed points from other sites. Despite their small size, that these objects functioned as fish-spear prongs is not impossible in my opinion.

3.3. The gorge

Bone objects interpreted as gorges are known from as early a context as Upper Palaeolithic sites in France (Sirelius, 1934; Clark, 1948). Reinerth (1926) illustrates two objects from a Swiss Neolithic lake-shore settlement which he interprets as gorges. The larger specimen measures 11.2 cm in length and 1.2 cm in diameter; the smaller one is 3.9 cm long and 0.4 cm in diameter. Barthel (1977) mentions a number of bone gorges dating from Neolithic, Roman and Early Medieval times from Thüringen. The author also mentions that the constriction in the middle of the gorge is not necessary. This became evident to him as a result of experiments with gorges.

3.3.1. *Gorges in the Netherlands*

In the Netherlands many bone artifacts resembling gorges have been found in the *terpen* of Friesland and Groningen (fig. 40). Most of them have not been dated, however. Similar objects are also known from the Early Medieval town of Dorestad. Some Dutch authors think that these objects were used in spinning, while others leave the question open as to what function they may have had. Roes (1963) describes a number of these objects yet she does not attribute any function to them, but says 'not all the rods need have served the same purpose for there are many different types among them'.

In my opinion it is possible that a number of the double-pointed short bone rods that have been found in the Netherlands were used as gorges. In the middle of some of these rods a number of notches or a small hole can be

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Fig. 39. Barbed point from Emmererfscheidenveen. Photo: R.M.O., Leiden.

Fig. 40. Double-pointed bone rods from the Dutch *terpen* area. Photo: C.F.D., Groningen.

Fig. 41. The relationship between length and width of bone fish-hooks from Southern Sweden (after Lekholm, 1951) and the Netherlands.

seen. These notches could serve as a distinguishing mark for the fisherman, while at the same time they would prevent the line from slipping off the rod.

3.4. The fish-hook

The oldest fish-hooks that we find in Northwestern Europe date from the Boreal-Mesolithic. These fish-hooks measure up to several centimetres in length and have no barb. They are made out of a single piece of bone or antler. Bone fish-hooks with a barb and combination hooks with separate hook-shaft and hook-point appear in Northwestern Europe at the end of the Neolithic. Soon afterwards metal fish-hooks make their appearance (approximately in the Late Bronze Age) (Clark, 1948). Nevertheless bone fish-hooks both with and without a barb continue to remain in use (see *e.g.* Solberg, 1909). Until recently fisherfolk who had little or no contact with technologically advanced cultures still used bone and wooden fish-hooks. Consequently it is obvious that an isolated find of a bone or metal fish-hook is difficult to date.

Lekholm (1951) studied 40 bone fish-hooks from Southern Sweden. Of these 29 had been found in freshwater deposits and 11 in marine deposits. None of the hooks were dated. From an examination of the complete specimens it was evident that the hooks from the freshwater deposits were generally smaller than those from the marine deposits (fig. 41). Also the hook opening was evidently bigger with increasing length of the hook-shaft. In addition the grip angles were measured. These varied from —25° to 65°, though most of the hooks had a grip angle of between 30° and 40°. This range corresponds fairly well with the grip angles of modern steel hooks.

3.4.1. *Bone fish-hooks from the Netherlands; description*

Louwe Kooijmans (1974) mentions six bone fish-hooks from the Netherlands. Three of these were found together with a tool made of red-deer antler and a few flint artefacts in grave II at Molenaarsgraaf in the Ablasserwaard. The grave dates from the Bell Beaker period. These three hooks I shall refer to from here on as hook a, hook b and hook c. In addition to these, three isolated finds of fish-hooks are known, to which I shall refer as hooks d, e and f.

Hook a is a bone hook (maximum length 4.3 cm) without a barb (fig. 42a). At the top of the hook-shaft there is a small thickening or knobble. Below this knobble a groove appears to be present, that runs around the hook-shaft. In the hook-bend one can still see part of the perforation that determined the shape of the hook-bend.

Hook b is a bone hook (3.1 cm long) without a barb (fig. 42b). There is no knobble present to prevent the line from sliding off. However, the diameter of the hook-shaft does increase towards the top. With this hook, too, part of the perforation is visible.

Hook c is a bone hook (2.6 cm long) without a barb (fig. 42c). No provision has been made to prevent the line from slipping off. With this hook, too, part of the perforation is still visible in the hook-bend.

Hook d measures 7.6 cm in length and is made out of antler (fig. 42d).[6] It was found in the River IJssel at Olst. This is a hook with a barb. Around the hook-shaft there runs only a single groove, and not several grooves as mentioned in the description given by Louwe Kooijmans (1974).

Hook e measures 9.2 cm in length and is made out of antler (fig. 42e).[7] It was found at some time around 1950 in the Zwolse Vaart in the Noordoostpolder (Van der Heide, 1972). The hook has a barb. Just below the top of the hook-shaft there are three notches present on both the inner and outer side. These notches have been cut in such a way that they alternate with respect to one another. This implies that the line was attached to the hook-shaft spirally. The cross-sections of the hook-shaft, the hook-bend and the hook-point are more or less round.

Hook f measures 11.7 cm in length and is made out of antler (fig. 42f).[8] It was found in 1948 on the Frisian side of the Noordoostpolder (Boeles, 1951). The hook has a barb and the top of the hook-shaft consists of a large rectangular knobble. In cross-section the hook-shaft is rectangular and the hook-point round. The inner side of the hook-bend is more or less flat, while the outer side is rounded.

About 1.5 cm away from the knobble of the hook, on one side of the hook-shaft a shaliow transverse groove is present, measuring about 2 cm in breadth.

3.4.2. *Measurements*

The various measurements and grip angles of the hooks a-f are given in table 2. They are taken according to figure 43.[9]

Two different grip angles were determined. Grip angle A is the angle between the imaginary line through the axis of the hook-point and the imaginary line from the hook-point to where in my opinion the line was attached, namely below the knobble or around the groove situated nearest the top. I have also assumed that the line was attached to the outer side of the hook-shaft, facing away from the hook-point.

Grip angle B is the angle between the imaginary line through the axis of the hook-point and the imaginary line from the hook-point to that part of the top of the hook-shaft situated closest to the hook-point (Lekkolm, 1951).

3.4.3. *Conclusions*

On the basis of the data presented in table 2, that have been included to some extent in figure 41, we can draw a few conclusions.

On the basis of their measurements the hooks a, b and c fit well in the group of freshwater fish-hooks from Sweden. This is in agreement with their place of origin, which was situated in a former freshwater tidal delta. Hook d could have been used for fishing in either freshwater or the sea. The findspot suggests rather that it was used in freshwater. On the basis of their measurements it seems that hooks e and f were intended for use in the sea.

On ethological and anatomical grounds, *e.g.* the way in which fish of a particular species bite, the position of the mouth of fish of a particular species, *etc.*, the data of table 2 can also be compared with those of table 1. It would then appear that hooks a-d could only be used for catching pike, salmon and European catfish. This last-mentioned species, which does not appear in table 1, is fished for with a hook that is of the same size as or larger than those used for catching pike and salmon. Remains of large European catfish have been shown to occur regularly in pre- and protohistoric settlements in the catchment area of the Maas, Rhine and IJssel (Brinkhuizen, 1979a). The hooks e and f could have been used for catching cod and other large species of marine fish. On the basis of the size of its grip angles it would seem impossible to catch a fish with hook c: the fish would very readily get hooked, but could just as easily escape. Moreover no provision has been made to prevent the line from slipping off the hook-shaft. This could mean that the hook was specially made to serve as a grave gift for the dead, and that it was never used for catching fish.

Table 2. The measurements and grip angles of the fish-hooks a-f

	Length (mm)	Width (mm)	Hook opening (mm)	Angle of grip (°) A	B
Hook a	43	17	13	57	45
Hook b	31	15	10	48	33
Hook c	26	14	11	63	62
Hook d	76	25	16	55	32
Hook e	92	43	24	46	36
Hook f	117	57	28	42	28

It is difficult to assign a date to the undated hooks d, e and f. Metz (1975) dates hook d in the Mesolithic. On the basis of the presence of a barb we should date the hook, according to Clark (1948), in the Late Neolithic or thereafter.

Hook e shows traces of working on the inner side of the hook-bend and the hook-shaft. Clason (pers. comm.) deduces from the nature of these traces that the hook was made with the aid of flint tools. On the basis of this a dating in the Late Neolithic or Early Bronze Age would seem justifiable. Traces of inhabitation dating from this period have been found in the region concerned. Although the exact findspot of the hook is not known, we know that the local aquatic environment was a freshwater one formerly. In that case the hook must have been used for catching freshwater fish, quite possibly European catfish.

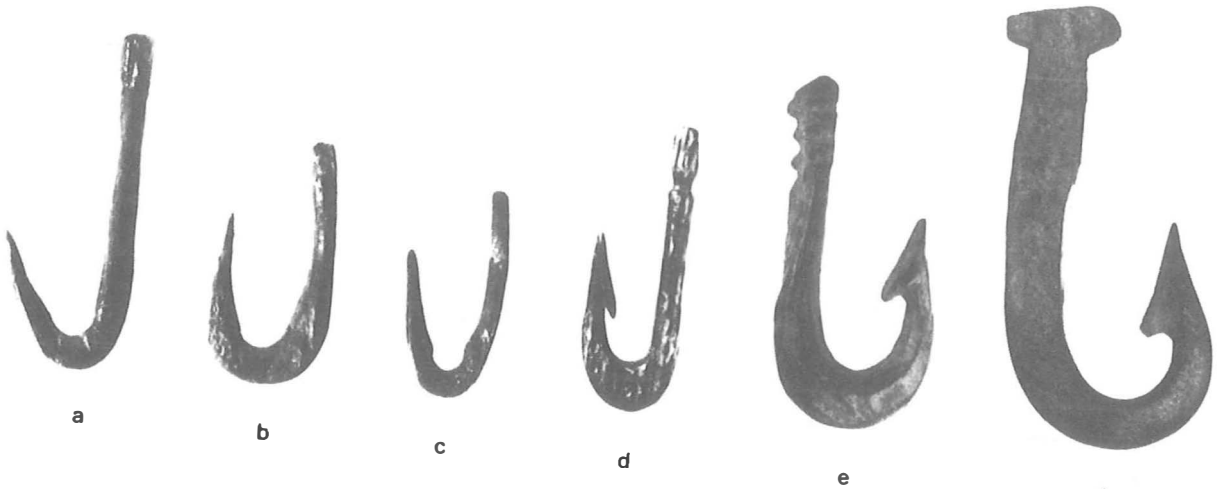


fig. 42

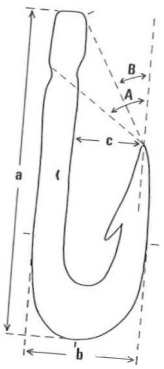


fig. 43

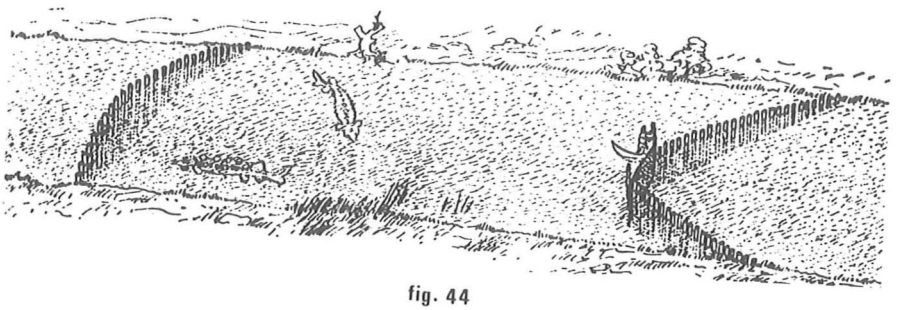


fig. 44

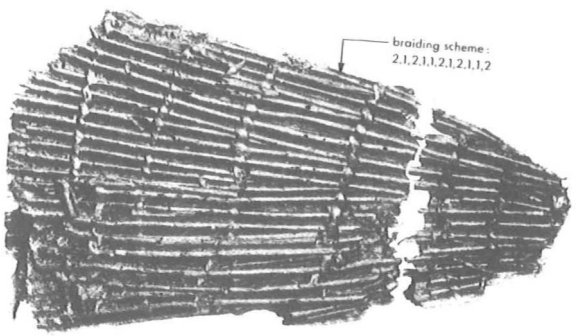


fig. 45

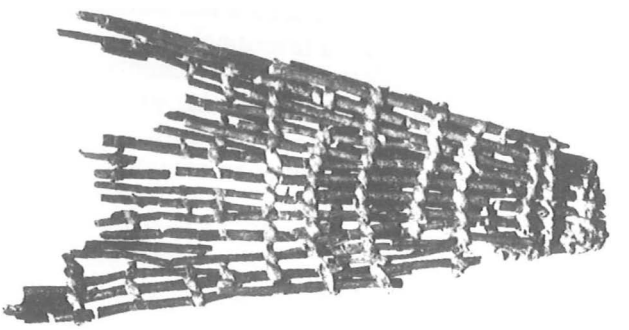


fig. 46

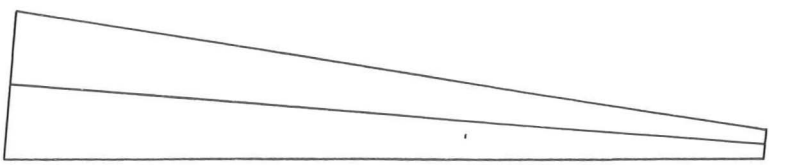


fig. 47

Van der Heide (1955) dates hook f, on the basis of isolated finds in the vicinity, in the Late Neolithic or in the Early Bronze Age. Although this dating cannot be rejected, it is my impression that the hook dates from a younger period. This is suggested by its shape and the way in which the hook-bend and hook-shaft are neatly finished off. The size of the hook indicates that it was used for sea fishing. On the basis of the assumption that in the Netherlands the first seaworthy fishing boats were built only in Roman times, the hook can perhaps better be dated between the beginning of the Christian Era and the Early Middle Ages. Seeing that the environment in the vicinity of the findspot was a freshwater or brackish one, the hook must have been lost from a fishing boat on its way to or from the sea. Because of its size, it is also possible that the hook was attached to a stick and used as a gaff.

3.5. The weir

If the water conditions were suitable, prehistoric fisherfolk would certainly have made use of weirs. However, archaeological finds of weirs or fragments thereof are rare. There are various reasons to account for this (3.6).

3.5.1. *Archaeological finds of fish-weirs outside the Netherlands*

Clark (1948) mentions the find from Kyrkslätt (Finland) of a row of vertical posts, about 13.5 m long, with horizontally lying branches. This framework must almost certainly have been part of a weir. In Høyland (Western Norway) a similar weir was found in the channel of a silted-up stream, that once connected two small lakes. The sediment in which the find was present was dated by means of pollen analysis to the period of transition from Stone Age to Bronze Age in Norway. Becker (1941) describes a fragment of a wattle screen from Svinninge Velje (Holbaek district, Sjaelland, Denmark). The find was made in a marine deposit, dating from the Atlantic (zone VIIb according to a palynological investigation by Troels-Smith). The fragment, which measured 65 x 50 cm, was made out of parallel wickers connected to one another by means of twisted strips according to the *Zwirnbindung* technique. The wickers were lime twigs and the strips were of lime bast. In the immediate vicinity of the fragment some 20 or so pointed stakes were found. These stakes, which measured 3-5 cm in diameter, had been driven into the bottom in a row. Becker interprets the whole construction as a weir, that led the fish towards a fish-trap. In my opinion this is not necessarily so. The find-spot once formed part of the Lammefjord and with the tidal movement of water in this locality the weir could have functioned as an independently operating kind of fishing gear (a so-called *gaard*: 2.3.1.1.). Becker (1941) also describes the find of a wickerwork fish-trap from a peat-bog at Magleby Long (Sorø district, Sjaelland, Denmark). At a distance of 2-3 m from the fish-trap a fragment of a screen was found. This did not have any cross-strips, but the wickers were most probably clamped between obliquely standing sticks. It is clear that we are concerned here with a fish-trap with a weir.

3.5.2. *Fish-weirs in the Netherlands*

Up to the present time no finds have been made of clearly recognizable weirs. During the excavation of the Neolithic settlement in Vlaardingen, in the tidal creek that ran alongside the settlement many wooden posts were found. Boddeke (1971) interprets these as the remains of a weir for catching sturgeon. When the water was rising the sturgeon would first pass a V-shaped weir with a throat opening and then come up against a solid barrier of posts.

Fig. 42. Fish-hooks made of bone or antler, from the Netherlands: a, b and c. Molenaarsgraaf (after Louwe Kooijmans, 1974); d. Olst (photo: R.M.O., Leiden); e, f. Noordoostpolder (photo: C.F.D., Groningen).
Fig. 43. Measurements of the fish-hook. a length; b width; c hook opening; A, B grip angles.
Fig. 44. Reconstruction of the enclosure for catching sturgeon at Vlaardingen (after Boddeke, 1971).
Fig. 45. Layer 2 of the fish-trap fragment from Nidløse (after Becker, 1941).
Fig. 46. Fish-trap fragment from Magleby Long (after Becker, 1941).
Fig. 47. Median cross-section of the reconstructed fish-trap fragment from Fjellenstrup.

Before the tide turned the throat opening was sealed off, so that the sturgeon could no longer escape down to the sea. At low water the sturgeon could then be simply removed from the enclosure (fig. 44). In this method we see the principle of the *lältäm* (2.3.1.).

During the excavation remains were also found of a net with a mesh-width of 24 cm. Among these remains a dermal scute of sturgeon was present. Van Iterson Scholten (1977) is of the opinion that this net was used to seal off the throat opening of the weir. The net from Vlaardingen could also be a net for transporting heavy objects, like a sturgeon. To my mind the use of the *lältäm* in Vlaardingen is a reasonable supposition. Detailed examination of the excavation ground-plans, that so far have only partly been published, may provide more information on this matter. In a photograph published by Van Iterson Scholten (1977) a row of posts is visible that is strongly reminiscent of a weir.

In Spoolde, during the investigation of a site where objects made of antler had been found, a gully was cut into which probably dates from the Bell Beaker period. At the bottom of the gully filling a number of roughly hewn wooden posts were present (Van der Heide, 1962). It is possible that these posts were used for the attachment of fish-traps or nets; alternatively they may have formed part of a weir.

At Molenaarsgraaf in the Ablasserwaard, the excavation was carried out of a settlement dating from the period of transition from the Neolithic to the Bronze Age (Early Bell Beaker/Barbed Wire Beaker). In the stream channel that ran alongside the settlement, a number of pointed wooden posts were found. Some of these were still standing vertically, others were leaning at an angle as a result of the pressure of water flowing through the channel. The excavation plan of the stream channel does not show any systematic distribution of the posts. Louwe Kooijmans (1974) presumes that nets or fish-traps were attached to the posts. Alternatively these posts could be regarded as the remains of a weir.

In the Netherlands weirs were used for fishing in the Middle Ages. An 11th century copy of the list of property belonging to the church of St. Martin in Utrecht mentions seven fish weirs in Muiden (Blok, 1974). Whether we are concerned here with the use of a weir as an independently operating kind of fishing gear either by itself or in combination with a fish-trap is not clear. The latter alternative seems to me more likely.

3.6. The wickerwork fish-trap

The find of a wickerwork fish-trap or a fragment of such a trap can be regarded as a very rare find indeed. This becomes clear if we look at the conditions under which a wickerwork fish-trap has to function. Fish-traps are set in shallow water in places where fish are abundant. In such places the water is eutrophic and thus rich in oxygen. Fish-traps are subject to rapid oxidation. Moreover it is evident that *e.g.* the wickerwork of an eel-basket disintegrates as a result of the exertions of the eels trapped inside in their attempt to escape. After a couple of years the trap is worn out and is then thrown away or burnt. In view of the local conditions (a eutrophic environment), the chances of the trap ending up in an environment with good preservation conditions are extremely small. This occurs only if the trap becomes rapidly covered by a sediment or if the oxygen content of the water suddenly decreases drastically. Also it is evident that a fish-trap or fragment thereof that has ended up in an environment with good preservation conditions becomes as soft as butter in the course of time. Before the trap is recognized as such, it has therefore often been partly dug away. Nevertheless a number of fish-traps or fragments of traps have been found and recovered. Also in a number of cases fish remains have been found in the immediate vicinity, that may originate from fish that were caught with the aid of these traps.

3.6.1. *Archaeological finds of wickerwork fish-traps from Denmark*

Fish-trap fragment, found in 1905 in the Amosen at Nidløse, Holbaek district, Sjaelland. This find is described by Becker (1941). The fragment dates from the Early Atlantic (zone VIIa according to the zonation of Knut Jessen). It measures 52 by 38 cm and consists of two layers of wickerwork. The wickers

measure 0.5-0.7 cm in thickness and are made of birch twigs. The space between the wickers measures at most 0.9 cm. The cross-strips are made of split pine roots. The distance between the cross-strips, that hold the wickers together by means of the *Zwirnbindung,* measures 4-8.5 cm.

In the wickerwork of one layer the wickers run almost parallel. In the other layer, however, the wickers converge towards one another and a few wickers have been cut away with some degree of regularity (fig. 45: see arrow). On the basis of this difference Becker concludes that layer 2 is part of the throat. Layer 1 is then part of the outer casing at the level of the throat. The find is thus part of a light fish-trap with throat.

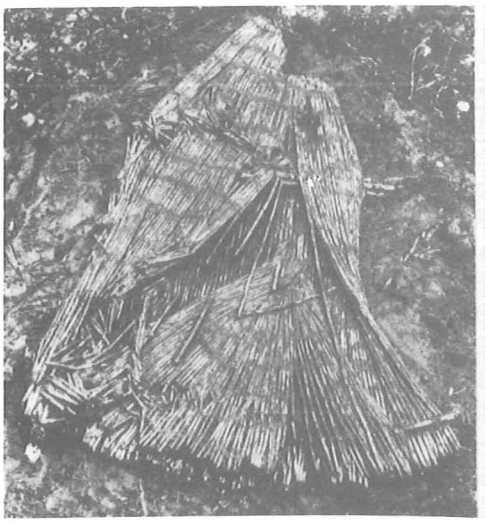
Fish-trap fragment that was found in 1940 in the Magleby Long, Sorø district, Sjaelland. This find is described by Becker (1941). With some reservation the fragment can be dated to the beginning of the Subboreal (zone VIII according to the zonation of Knut Jessen). The fragment consists of a flattened funnel (fig. 46). The wide end of this measures 18 cm; the width at the narrow end is 5.5 cm. The total length of the fragment is 34.5 cm. The wickers measure 0.4-0.6 cm in thickness and are made of lime twigs. These are attached to one another with twisted lime-bast cross-strips by means of a *Zwirnbindung*. To some extent the cross-strips run in a spiral around the funnel. The distance between cross-strips is 3.5 cm at most. The top of the cone is closed off by a double cross-strip. The funnel has been made narrower by cutting away wickers. In the funnel a stone c. 7 cm in diameter was found. At some distance from the fish-trap fragment the remains of a weir were found (3.5.1.). Becker interprets the find as the tail-end of a fish-trap, which was placed in the water weighted with stones. It is not possible to ascertain whether a throat structure was present. In making a reconstruction of the tail-end, I noticed that the wide end of the funnel measured c. 11 cm in diameter. The other end of the funnel is tied together so as to make it shut. Therefore the tail-end must have been very narrow. It is thus well possible that the fragment is the tail-end of a trumpet fish-trap. It could also be a transition form between a trumpet fish-trap and a fish-trap with throat, *i.e.* the long narrow fish-trap with throat.

Fish-trap fragment, found in 1940 during turfcutting operations in Fjellenstrup near Gilleleje, Sjaelland. Before the fish-trap was recognized as such, 1-1.5 m of it had already been dug away. The find is described by Becker (1943) and has been dated by Iversen, on the basis of pollen analysis, in the Middle Atlantic. From the geological investigation it became evident that the fish-trap lay in the bank zone of a former small island. This small island was situated in the narrow fjord that connected the Søborg Lake with the Kattegat in the Early Atlantic. The excavated fragment has a total length of 2.95 m. The maximum width is 90 cm. The width at the end of the tail is 20 cm. The wickers of the wickerwork measure 0.3-0.6 cm in thickness and are peeled. The distance between adjacent wickers is at most 0.7 cm. The twisted cross-strips are made of twigs, split lengthwise. The space between the cross-strips measures 5.5-6.5 cm. To give extra strength to the outer casing there are sometimes two or three cross-strips close together. The entire structure is plaited together by means of the *Zwirnbindung* method. The wickers of the tail-end are tied together with a piece of cord, which could be undone.

In the tail a small stone is present. From that part of the fish-trap that had been dug away a few remains were retrieved. These consisted of two layers of wickerwork, which differed from each other. In one layer the wickers run parallel to one another (the wickers of the outer casing); in the other layer the wickers converge towards each other (the throat wickers). Also peat was found containing three layers of wickerwork. On the basis of this Becker interprets the find as a fish-trap with throat measuring c. 4 m in length.

If we estimate the diameter of the wide part of the excavated fragment, this comes to c. 60 cm. The tail of the funnel is bound together to make it shut. From the reconstruction it is therefore clear that the fish-trap was very narrow (fig. 47). In my opinion we are here also concerned with the transition form between a trumpet fish-trap and a fish-trap with throat, *i.e.* the long narrow fish-trap with throat.

Fish-trap fragment, found in 1968 during the excavation of a coastal settlement dating from Early Atlantic times at Villingebaek, Sjaelland. Kapel (1969) mentions the find, but



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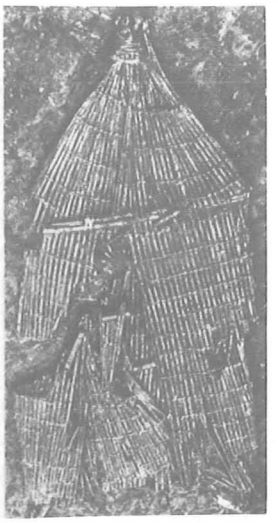

b

fig. 48

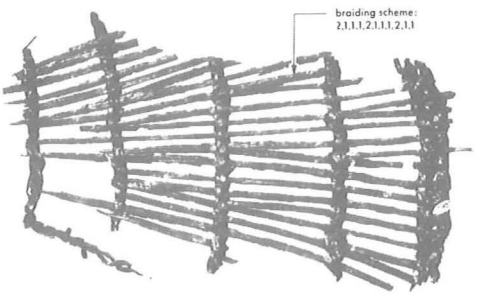

fig. 49

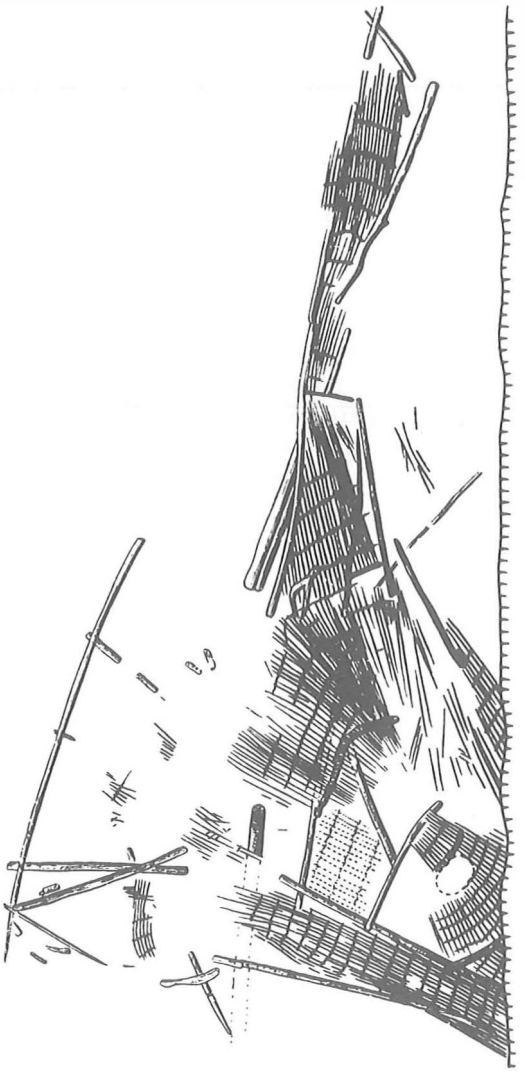

fig. 50

fig. 51

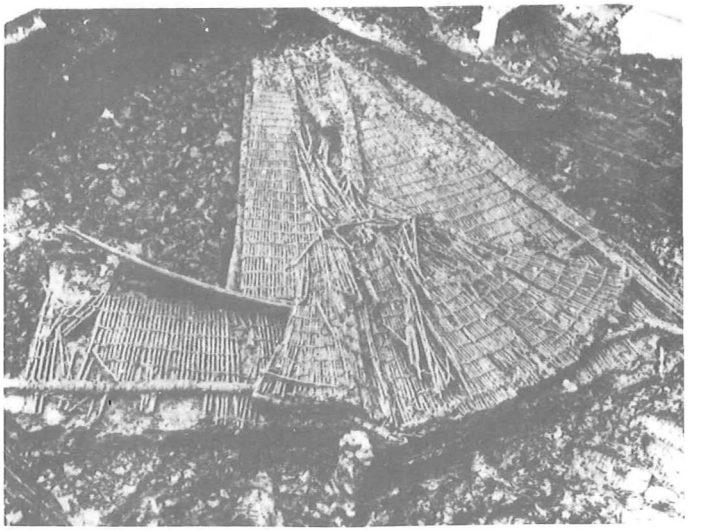

fig. 52

gives no description of it. He interprets the fragment as being the throat of a fish-trap. From the photos accompanying his article it can be deduced that the wickers are most probably peeled. They converge towards one another and are joined together with cross-strips according to the *Zwirnbindung* technique. Here too the wickerwork has been made to become narrower by the cutting away of wickers. The distance between the cross-strips becomes smaller towards the narrow end. At least two layers of wickerwork are visible. Whether the fragment is the throat or the tail of a fish-trap will only become clear when the entire structure has been finally prepared.

In the course of the excavation fish remains were found. These come from spurdog, cod and pike (identification U.Møhl).

Two fish-traps and fish-trap fragments, found in 1946 in Lille Knapstrup, Holbaek district, Sjaelland. The find was made in the course of turf-digging operations in a peat-bog and has only been published in a short communication in a Danish journal (Becker, 1946). The find consisted of two almost complete fish-traps with throat. These lay c. 2.5 m apart. Moreover about 6 m away from these fish-traps the fragments of five or six other traps were found. Together with one of the fragments pieces of cord were found, as well as stones around which cord had been wound. It is clear that this fish-trap was formerly anchored with the aid of stones. The find is provisionally estimated to date from the Atlantic period.

Clark (1965) illustrates the two almost complete specimens from Lille Knapstrup. The findspot that he mentions is however incorrect.

Figure 48a shows a short, light fish-trap with throat. The trap has two hoops, namely one where the wickers of the outer casing meet those of the throat, and one halfway down the outer casing behind the throat.

Figure 48b shows a light fish-trap with throat too. This specimen also has a hoop halfway down the outer casing. The wickers of the outer casing are tied together at the end of the tail with a piece of cord, which could be loosened. The tail is fairly wide. This implies too that the specimen is not a trumpet fish-trap.

Fish-trap fragments, found at Koster Vig (to be more correct: Sprove), Damsholte, Praestrø district, Møn. The find consists of 12 fragments of one or more fish-traps. No further information is available, as the fragments were found in the course of turf-digging operations. They are kept in the National Museum in Copenhagen where their classification number is A 39570-81.[10]
Mathiassen (1948) mentions this find, about which no more publications have appeared as far as I am aware.

Mathiassen (1948) mentions the find of a fish-trap at Svinnige Velje. In his publication he refers to Becker (1941). The latter author, however, interprets the find as a fragment of a weir (3.5.1.).

3.6.2. *Archaeological finds of wickerwork fish-traps from Sweden*

Fish-trap fragment, found in 1952 in Jonstorp, parish of Jonstorp, Schonen. The find is described by Petersson & Olausson (1952). The fragment was found, when a well was being dug, at a depth of 6.3 m below the surface in a marine sandy gyttja, that dates from the Atlantic (probably an older phase of zone V_s according to the zonation of Tage Nilsson). The fragment measures maximally 10 by 20 cm and consists of two layers of wickerwork. In one layer the wickers converge towards one another and wickers have been cut away with some degree of regularity (fig. 49: see arrow). In the wickerwork of the other layer the wickers run parallel and with a certain degree of regularity two adjacent wickers are enclosed within a single loop of a cross-strip (a 'double wicker'). The working scheme followed in this layer is: 1 double wicker, 2 single wickers, 1 double wicker, 3 single wickers, 1 double wicker, 2 single wickers, 1 double wicker, 3

Fig. 48. The two complete fish-traps from Lille Knapstrup, Holbaek, Sjaelland (after Clark, 1965).
Fig. 49. Fish-trap fragment from Jonstorp (after Petersson & Olausson, 1952).
Fig. 50. Fish-trap from the Schlüsbeker Moor (after Sprockhoff, 1953).
Fig. 51. Closely woven fish-trap from Oberdorla (after Barthel, 1977).
Fig. 52. Fish-trap C from Rotterdam-Bergschenhoek (after Sarfatij, 1978).

single wickers, *etc.* On the basis of these differences the authors conclude that one layer is a fragment of the throat structure and the other part of the outer casing. The wickers used are unpeeled birch twigs. As a result of the pressure exerted by the overlying sediment they have been deformed into wickers 0.1 cm thick and 0.3-0.4 cm wide. The cross-strips consist of peeled willow twigs split lengthwise. The space between the wickers is at most 0.7 cm. The distance between the cross-strips, that hold the wickers together by means of the *Zwirnbindung*, is 3.5-5 cm. Also a double cross-strip is present, consisting of two closely adjacent single cross-strips (fig. 49: the cross-strips on the extreme right). We also know of one species of fish that was caught with this fish-trap. Between the two layers of wickerwork some fish remains were present, namely those of a c. 45 cm long cod (identification O. Nybelin/J. Lepiksaar).

Fish-trap fragments, found together in 1951 in the course of turf-digging activities in the Nebbe mosse, parish of Östra Vemmerlöv, Schonen. The find is described by Stjernquist, Nilsson & Nybelin (1953). It dates from the Late Atlantic (the younger part of zone V_s according to the zonation of Tage Nilsson). The fish-trap is made of willow twigs split lengthwise. The connecting elements consist of twisted cross-strips of a different species of willow that hold the structure together by means of the *Zwirnbindung* technique. The space between the wickers measures c. 0.6 cm and between the cross-strips c. 4 cm. It cannot be ascertained from which part of the fish-trap the fragments originate. That the fragments do indeed come from a fish-trap and not a weir is clear from a fragment, in which a narrowing of the wickerwork is visible.

Petersson & Olausson (1952) also mention the following unpublished fish-trap fragments from Sweden:

Fish-trap fragment, found in 1946 in the Nebbe mosse, parish of Östra Vemmerlöv, Schonen.

Fish-trap fragment, found in 1947 in Häljarp, parish of Tofta, Schonen.

Fish-trap fragment, found in 1951 in the Store mosse, Sösdala, parish of Norra Mellby, Schonen.

3.6.3. *Archaeological finds of wickerwork fish-traps from Northern Germany*

Fish-traps, found in Lake Dümmer. Petersson & Olausson (1952) mention this find, with reference to the publication of Reinerth (1939). In the latter a broad description is given of the results of the excavation of a settlement of the Funnel-Beaker Culture (Dümmer-Lembruch). There is mention of finds made of fish remains, from pike and perch, but not of any fish-traps. On the other hand, Dürr (1962), who was excavation technician for Reinerth, does indeed mention two fish-traps in combination with two weirs for this site. In contrast to Reinerth's publication, Dürr states that the settlement was occupied twice, namely in the Neolithic and in the Iron Age. He sees indications of inhabitation during the Iron Age in the presence of bones of domesticated horses. Also Reinerth mentions that bones were found of both domesticated and wild horses. As neither author gives any measurements of these bones, we are unable to verify whether or not the horses were indeed domesticated. In addition Dürr points out that an Iron Age pot was found. This pot is currently regarded as a Late Havelte pot of the Funnel-Beaker Culture (Bakker & Van der Waals, 1969). Another indication of inhabitation during the Iron Age is given by the find of a pointed stake from the vicinity of the weir. This stake is said to have been cut by a metal axe. However, in my opinion the find of a single stake cut with a metal axe gives no decisive proof of inhabitation in the Iron Age. Dürr sees the most convincing argument for multi-period inhabitation in the presence of the fish-traps. If the Neolithic settlement is contemporaneous with the fish-traps, then it follows from the location of the fish-traps and weirs that these stood on dry land. This means that the fish-traps cannot have been contemporaneous with the Neolithic settlement. They must therefore be older or younger than the settlement. A dating in the Iron Age is possible, but on the basis of the above-mentioned arguments not imperative.

Fish-trap fragment, found in the Priestermoor near Duvensee, Kreis Herzogtum Lauenburg. This fragment is said to date from the Mesolithic (Schwabedissen, 1949). No further details of this find have been published.

Fish-trap, found in 1952 during turf-digging operations in the Schlüsbeker Moor, Gem. Moorsee, Kreis Plon. Sprockhoff (1953) gives a brief description of this find and an outline sketch of its position in situ (fig. 50). From a palynological investigation it is evident that the fish-trap dates from the Early Atlantic. The fish-trap, which was originally fastened to posts, was found as a 10-12 cm thick layer of wickerwork. This wickerwork consisted of willow wickers c. 0.5 cm thick, which had been carefully attached to one another by means of cross-strips made of bast. The distance between the wickers measured just 0.5 cm and that between the cross-strips about 5 cm. At the same time the author states that the funnel structure, which was at least 2 m long and had a mouth opening about 1.5 m across, can clearly be distinguished from the tube-shaped end of the fish-trap which was almost 2.5 m long.

From the outline sketch of the fish-trap in situ it is not clear to me where Sprockhoff made these observations. On the basis of the drawing I myself am inclined to regard this find as a light fish-trap with or without a throat, which was fixed to posts, in combination with two weir sections (wickerwork screens). A closer study of this find will provide more details. In addition Sprockhoff mentions the find of a second fish-trap, which was found 12.5 m away from the first one, lying undisturbed in the peat. The remains of a third specimen were found that same year elsewhere in the peat.

Also in Southeastern Germany wickerwork fish-traps and fragments thereof have been found. Thus in the peat-bog near Oberdorla (Thüringen) many specimens came to light in the course of excavations. These dated from Roman times (Barthel, 1977). They had all been plaited from willow twigs. Among the specimens found there was only one light fish-trap, which had no throat. All the other fish-traps (about 20 specimens) were fish-traps with throat. The wickerwork of these fish-traps had been made according to the *Leinwandbindung* technique (fig. 51). In a number of these fish-traps stones were still present, that had served as weights. One fish-trap still contained fish remains, namely of a pike.

3.6.4. *Archaeological finds of wickerwork fish-traps from the Netherlands*

Fish-traps, found in 1978 at Rotterdam-Bergschenhoek during the excavation of a small 'extraction camp', situated on a small 'peat island' measuring 10 m² in area and only 30-35 cm in thickness. The group of finds dates from the Late Atlantic (5415 ± 60 BP: GrN 7764). The finds consist of a few sherds, three pieces of flint, a few bone tools, faunal remains and worked wood, including the fish-traps. Three almost complete fish-traps were found as well as a fragment of a fourth. Together with a few large planks this fragment formed the basal part of one of the layers added to the peat island to make it higher. The three other fish-traps lay in the surrounding clay. In addition, scattered among the find-bearing layers were a few fragments of wickerwork, that may have come from the fish-traps. Louwe Kooijmans, who carried out the excavation, presents a brief report on this group of finds in Sarfatij (1978).[11] No special study of the fish-traps has appeared as yet. Evidently all of them were light fish-traps. Their wickerwork thus consists of wickers held in place by cross-strips by means of the *Zwirnbindung*. From one of the fish-traps it can be deduced that the cross-strips were plaited around the wickers as separate 'hoops'. At the spot where the 'hoop' closes, the cross-strip passes diagonally out of line so as to commence the next 'hoop'.

The three complete fish-traps are about 1.50 m long. Two of them are provided with a throat. The third one is throatless, however. This implies that it is a trumpet fish-trap. If we look at one of the fish-traps with throat (fig. 52), however, then we see the remains of the two hoops it contained. These hoops have been broken or came loose as a result of the tension within the wickerwork. When the hoops sprung loose part of the outer casing came loose with them, though not the throat. This could indicate that the throat was fastened to the outer casing in only a few places. It is also possible that the throat was a separate element which was inserted into the outer casing. If this theory is correct, then the fish-trap without throat could be a trumpet fish-

trap or a separate outer casing. Further study of the fish-traps and their attempted reconstruction will probably provide the right answer.[12]

During the excavation sieving was carried out, and many fish remains were thus found. These come from pike, perch, ruff, eel, members of the carp family and European catfish.

Fish-trap fragments, found at Vlaardingen during the archaeological investigation (1959-1961) of the settlement of the Vlaardingen Culture (4330 ± 60 BP: GrN 2303; 4330 ± 100 BP: GrN 2487). The find is described by Van Iterson Scholten (1977). It consists of two fragments, namely a hoop with remains of wickerwork and a small fragment of wickerwork, that may come from the former. The wickerwork consists of slightly converging wickers, held together with cross-strips by means of the *Zwirnbindung*. The cross-strips are made of bands of twisted bast and measure 0.3 cm in diameter. The distance between the wickers is at most 0.7 cm. About the hoop the author says: 'The weel fragment consisted of an outer hoop of two or three pieces of wood, between which the side bars were clamped. The outer hoop was wound around with strips of bast 8 mm wide. In situ, the outer hoop measured 56 x 68 cm and the circumference was 193.7 cm, which, after reconstruction, resulted in a mouth diameter of 62 cm' and further on 'on account of its shape this fragment is probably the internal funnel of a weel, but in the absence of other fragments no further reconstruction can be attempted'.

If this interpretation is correct, then somewhere on the fragment there should still be remains present of the area of attachment between the wickerwork of the outer casing and that of the throat. The most obvious place for this is the hoop. Here no remains are present however. It is also possible that the attachment area of the outer casing lay in that central part of the throat that has been destroyed. To find out whether this may have been the case, it is necessary to make a reconstruction. For this purpose we have to consider the technique that was applied to make the wickerwork narrower. This narrowing begins from the fourth cross-strip. Here we see the so-called double wickers, like those of the fish-trap fragment from Jonstorp. The plaiting system that was followed is: 1 double wicker, 2 single wickers, 1 double wicker, 2 single wickers, *etc.* These double wickers are coloured black in figure 53. The double wickers run as far as the eighth cross-strip, after which they can be traced no further. The eighth cross-strip lies more or less concentrically within the hoop. The distance between the two is about 15 cm. The number of wickers that are plaited on to the hoop amounts to c. 200 and the number of wickers of the eighth cross-strip to c. 150 (the double wicker is counted as one wicker). The ratio is thus 4:3. The estimated diameter of the hoop is about 62 cm. From this diameter and the estimated ratio it follows that the diameter of the eighth cross-strip must have been about 46.5 cm. On the basis of this data a reconstruction can now be made. From this reconstruction it follows that it must have been possible for the outer casing to be plaited to the throat. The fragment could thus be part of a short fish-trap with throat (fig. 54a). As we do not know how the narrowing continued after the eighth cross-strip, there still remain three other possibilities. If the fragment did not become any narrower, then it would have been a trumpet fish-trap (fig. 54b). Alternatively the fragment may be an isolated throat, that was placed inside a separate outer casing (fig. 54c). The reverse is also possible: the fragment may be an isolated outer casing, inside which a separate throat was inserted (fig. 54d).

The construction of the hoop is strange. Generally, for a hoop a single long thick wicker was used. The hoop of this fragment consists of two or three pieces of wood. In my opinion this indicates that the hoop became weakened or broken in the course of use. By the addition of elements to provide extra strength this problem was overcome. This also explains the fact that the wickers in the NW-quadrant of the hoop are clamped between the hoop and the strengthening elements. Elsewhere around the hoop this is not the case.

During the excavation of the settlement fish remains were found, which could be identified as remains of sturgeon, thin-lipped grey mullet and pike (Brinkhuizen, 1979b). Sturgeon was certainly not caught with this fish-trap (3.5.2.).

Fish-trap found in 1971 during the excavation of a former bed of the river Rhine in Utrecht (Van Regteren Altena & Sarfatij, 1973). The find dates from the second half

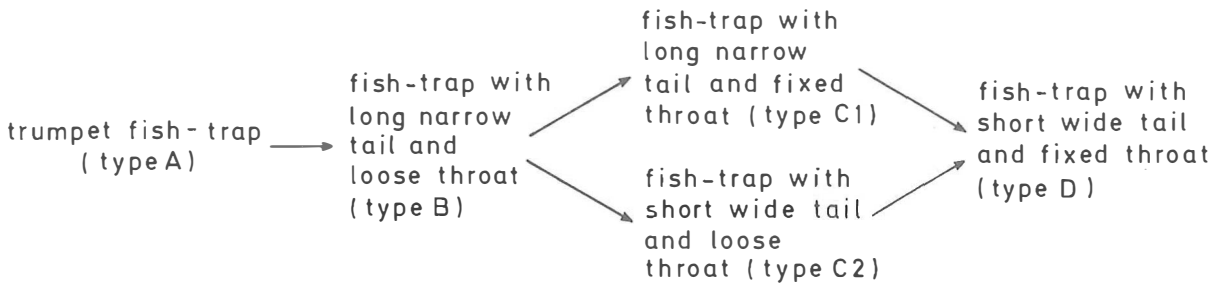

Fig. 56. Type classification of fish-traps.

of the first century A.D. (1880 ± 35 BP: GrN 6633). It was fitted with a throat and measured 95 cm in length. The wickerwork of willow twigs had been made according to the *Leinwandbindung* technique. Between the wickerwork of the throat and outer casing a number of stones and a clay net sinker which had served as weights were present (fig. 55). The fish-trap strongly resembles the closely woven fish-traps from Oberdorla.

Two fish-traps found in 1975 during the excavation of the Early Medieval harbour complex in the Kromme Rhine riverbed at Dorestad (Wijk bij Duurstede). Both fish-traps were approximately 3.5 m long and plaited according to the *Zwirnbindung* technique. One fish-trap was fitted with a throat. Due to the difficult excavation conditions (rising groundwater) this observation could not be made on the second one. The two fish-traps will be published in another article in the near future.

3.6.5. *A few remarks concerning the prehistoric wickerwork fish-traps*

3.6.5.1. *The typology*

If we wish to ascribe a wickerwork fish-trap to a particular type, then first of all a typology must be established. A sentence such as 'a fish-trap made of wickers and cross-strips of the type well known from South Scandinavia' (Glasbergen *et al.*, 1966) is of little value as so far no typology has been established for fish-traps. To arrive at a typology, we must first return to the trumpet fish-trap. Sirelius (1906) proposes that this fish-trap developed via some intermediate forms into the fish-trap with fixed throat.[13] On the basis of some intermediate forms known to us from ethnographical studies we are confronted with the typological series given in figure 56.

On the basis of this typology we can now classify the prehistoric fish-traps (table 3). As the finds usually consist of fragments, for any particular case we cannot determine the exact type.

Thus in the table for each fish-trap the different possibilities are indicated. The fish-traps are listed not according to site location, but in order of age.

From table 3 a few conclusions can be drawn. The Lille Knapstrup fish-traps (type C2 or D) date in all probability from the Atlantic period. The Magleby Long fish-trap (type A, B or C1) dates from the beginning of the Subboreal. From this it follows that on the Danish island of Sjaelland a more primitive type was in use at a later time than a more highly developed type. If we now consider the fish-traps found in Northwest Europe as one group, then it is clear that the Lille Knapstrup fish-traps are typologically comparable with the Bergschenhoek fish-traps C and F. Also the latter are some 500 years older and as regards type more highly developed than the Magleby Long fish-trap.[14] This implies that we cannot link the typological series to the archaeological time-scale that has been established for Northwestern Europe. In other words: the typology is only descriptive and has no chronological significance. This can be explained from the ethnological data. In Finland, France and England, up until recently the trumpet fish-trap (type A) and the fish-trap with fixed throat (type D) were both in use at the same time. Which type of fish-trap was used depended on the speed of

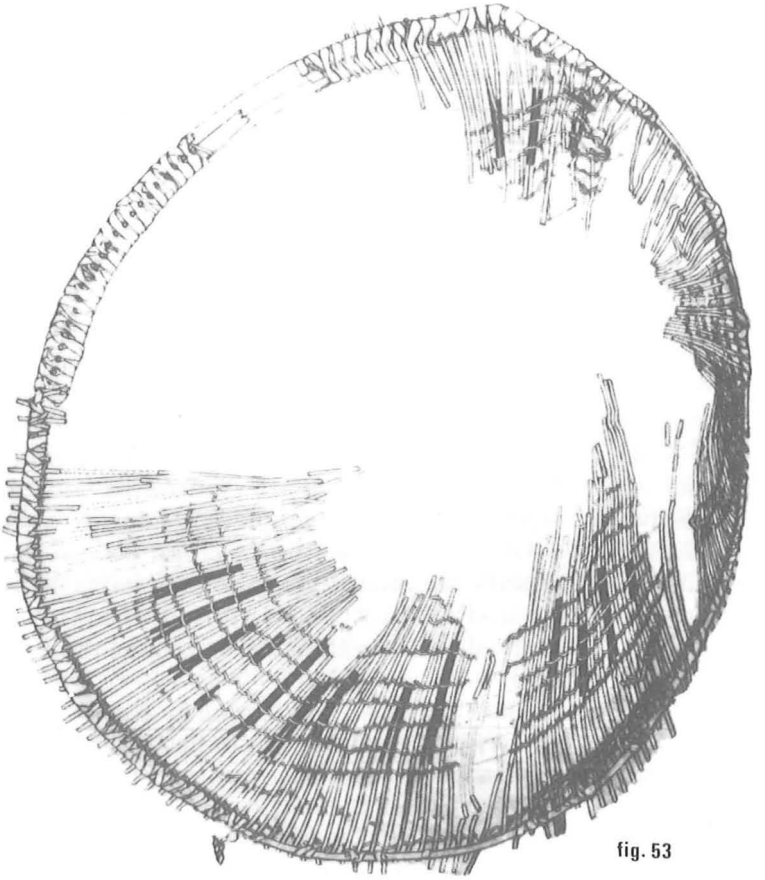

fig. 53

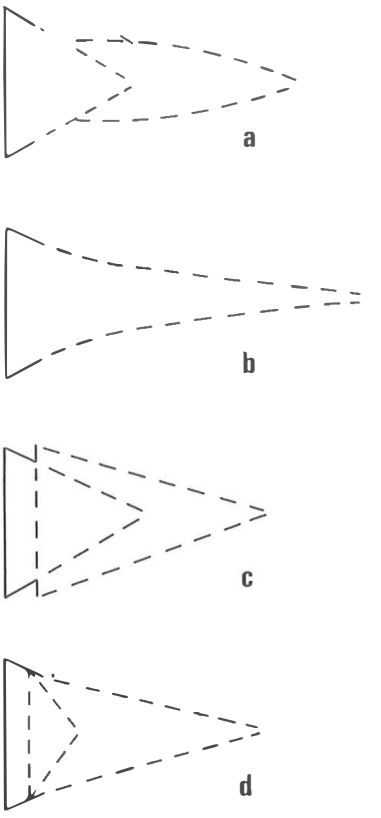

fig. 54

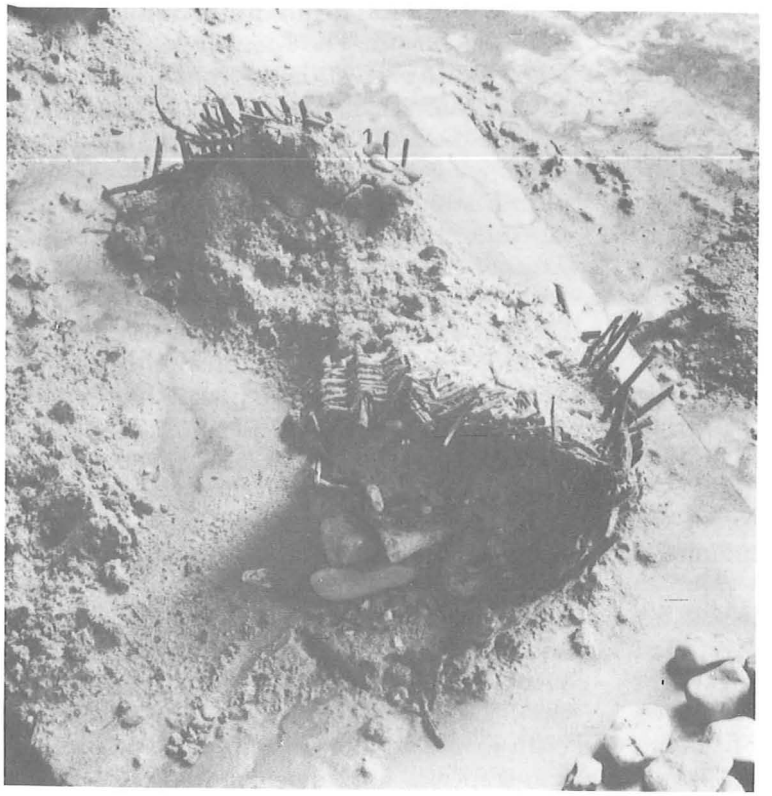

fig. 55

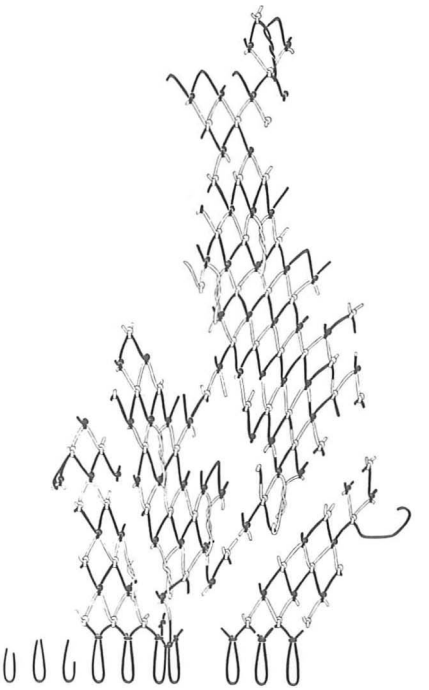

fig. 57

flow of the water. The Woguls, Ostjaks and Syrjäns even had the types A, C1, C2 and D. On the basis of this evidence it is reasonable to assume that in prehistoric times too the various types of fish-trap in any particular region could have been used alongside one another at the same time.

3.6.5.2. *The origin of the wickerwork fish-traps*

The Nidløse fish-trap, which dates from the Early Atlantic, already possesses a loose/fixed throat and the wickerwork is regularly plaited. This high degree of precision indicates that the fish-traps had undergone development already before the Atlantic. Where this development took place and when it began cannot be said at present. In principle the area of origin could have been any locality where fish were present and from which the necessary construction materials could have been obtained. As regards the Upper Palaeolithic reindeer hunters, who lived in Northwest Europe near the periphery of the ice sheet, we can almost certainly say that they were not familiar with wickerwork fish-traps. In the environment in which they lived the necessary construction materials were lacking at that time. It is true that fish lived in the rivers and lakes that were present near the edge of the ice-sheet, namely cold-resistant freshwater and migratory fish. These may have been caught using *e.g.* the fish-spear and perhaps nets made of strips of leather knotted together. In the course of the climatic amelioration and the accompanying changes in flora and fauna the reindeer hunters were gradually forced to switch over from hunting reindeer to hunting wild boar, red deer, roe deer, elk, aurochs and birds. In addition their means of subsistence included fishing and fruit-collecting. It is obvious to assume that fishing was done in the long familiar way, namely using the fish-spear and fishing nets. Finds of fish-spear barbs and parts of drift-nets (3.2 and 3.7) are known from the Early Mesolithic of Northwest Europe. The first wickerwork fish-traps found here date from the Middle Mesolithic. They are, however, already in an advanced stage of development. There are two possible explanations for this. If the development of the fish-trap did take place in Northwest Europe, then this occurred fairly rapidly. The alternative explanation is that the fish-trap developed elsewhere and was introduced into Denmark at a far-advanced stage of development. This development could have taken place *e.g.* in the Late Palaeolithic in the interior or on the coasts of Southern Europe. The construction materials were available there and the fish fauna was presumably the same as that present today. Which of the two explanations is correct cannot be ascertained, also on account of the lack of finds. From Rosenlund (1976) it is evident that in Denmark the number of fish species that could be identified among the bone material from Early Atlantic settlements shows a sharp increase with respect to those from older settlements. This could indicate the introduction of a more effective means of catching fish, but it is more likely that this increase in fish species is due to the fact that the colonisation of the Danish waters had almost been completed at the Boreal-Atlantic boundary.

Table 3. Classification of the prehistoric wickerwork fish-traps found in Northwest Europe

Fish-traps	Type					
	A	B	C1	C2	D	Dating
Nidløse		●	●	●	●	Early Atlantic
Villingebaek	●	●	●	●	●	Early Atlantic
Schlüsbeker Moor	●	●	●	●		Early Atlantic
Fjellenstrup		●	●			Middle Atlantic
Jonstorp		●	●	●	●	Middle Atlantic
Bergschenhoek fish-trap C				●	●	Late Atlantic
Bergschenhoek fish-trap F				●	●	Late Atlantic
Bergschenhoek fish-trap B	●			●		Late Atlantic
Lille Knapstrup				●	●	Atlantic
Lille Knapstrup				●	●	Atlantic
Magleby Long	●	●	●			Early Subboreal
Vlaardingen	●	●	●	●	●	Early Subboreal

Fig. 53. Vlaardingen, cutting 17, in situ drawing of the weel by S. Hoek, I.P.P. (after Van Iterson Scholten, 1977). The double wickers are shown in black.

Fig. 54. The four possibilities for the reconstruction of the fish-trap from Vlaardingen.

Fig. 55. Closely woven fish-trap from Utrecht. Photo: Foto Dienst Gemeente Utrecht.

Fig. 57. Drawing of the unfolded net I from the Nebbe mosse (after Stjernquist *et al.*, 1953).

3.6.5.3. *The plaiting technique and the materials used*

All the Mesolithic and Neolithic fish-traps found in Denmark, Sweden, Northern Germany and the Netherlands are light fish-traps. The wickerwork of these fish-traps was without exception plaited using the *Zwirnbindung* technique. The material used for the wickerwork varies. For the wickers of the outer casing and the throat, twigs of lime, willow and birch were taken. The cross-strips were made of twisted bands of willow and lime bast, longitudinally split willow wickers and pine roots. All these materials are the same as those which were used until recently in Finland.

3.6.5.4. *The catch*

In view of the skill with which the prehistoric fish-traps were plaited, it is certain that these were by no means inferior, in terms of efficiency, to their recent counterparts. On the analogy of recent wickerwork fish-traps some authors regard the prehistoric ones as intended for catching eels. That this is by no means necessarily so is shown by the Jonstorp fish-trap, which was used in a marine environment. In this fish-trap remains of cod were present. The fish remains that were found with the Bergschenhoek fish-traps do not only come from eels, but also from various other species of fish. This is not unusual, for as a general rule a fish-trap is not selective as to its catch. Almost all fishes and crustaceans that are smaller in diameter than the diameter of the rearmost throat opening can be trapped inside.[15] Once inside the trap generally only those fish which are smaller in diameter than the space between the wickers of the outer casing can escape. One fish species that could have been caught with prehistoric traps is the herring. Clark (1948) states:

> A point to emphasize is that, apart from a few rib-bones from Sölager in Denmark, remains of herring are conspicuously absent from the prehistoric settlements of Europe. The herring fishery is notoriously subject to great local fluctuations, but such can hardly be held to account for the absence of herring-bones from so many regions over so lengthy a period. The absence of a fish, which to-day is caught in larger numbers than any other, from early settlements in the whole region from the Baltic to the west coast of Norway and northern Britain, and extending from the Stone Age to the Early Iron Age, can only mean that the fishery was not developed during the prehistoric period.

However, in putting forward this theory the author has disregarded the possibility that certain fish species may be considerably underrepresented in the faunal remains. For this is evidently the case with species of fish having a skeleton rich in fat. These species include: fish belonging to the salmon family, to the herring family, to the mackerel family and to flatfish (Lepiksaar, 1975). That herring were indeed caught is shown by the excavated herring remains from a Middle Neolithic settlement at Korsnäs, Grödinge, Södermanland, Sweden. From a refuse pit, measuring 2 m x 0.6-0.7 m and at least 0.3 m in depth, an earth sample weighing 2,375 grammes was taken. This sample was found to contain, in addition to several hundred remains of pike, perch, eel and whitefish, at least 21,000 remains of herrings (Aaris-Sørensen, 1978).

3.7. The fishing net

The oldest fishing net known to us dates from the Early Boreal. The remains of this net were found in 1913 at Korpilahti in the neighbourhood of Antrea. This place lies to the west of Lake Ladoga in what was formerly Finnish territory. The find is mentioned by *i.a.* Clark (1948, 1965, 1975), Stjernquist *et al.* (1953), Welinder (1969) and Van Iterson Scholten (1977). Eighteen flat, more or less oval floats of pine bark were found, each perforated at one end. Below several of these floats remains of the net were still present. The cord from which this net had been made consisted of two strips of willow bast twisted together. Close by these floats lay 31 unworked fist-sized stones. The find is interpreted as the remains of a seine,[16] that must have measured 27-30 m in length and 1.3-1.5 m in height.

In addition to this fishing net Van Iterson Scholten (1977) also mentions the find of a Mesolithic fishing net from Vuoksenranta. Ayrapää (1950) shows a photo of this find. However, this is the same as the illustration given by Clark (1975) of the net from Korpilahti. Also from the texts and references of the two authors it is clear that one and the

same fishing net is concerned here. Thus one Mesolithic fishing net is known from Finland and this is mentioned in the literature as the fishing net from Korpilahti, Vuoksenranta or Antrea.

Another find of part of a drift-net is a disc-shaped float of pine bark from the Bare mosse (Sweden). From a pollen-analytical investigation it has been established that this float dates from an early stage of the Boreal (Welinder, 1969). Thus it is contemporary with the drift-net from Antrea.

Indreko (1948) describes the find of a fragment of a flat oval float of pine bark from Siivertsi (Estonia). An unworked fist-sized stone with cord remains from the same region is interpreted as a weight for a fishing net. The finds have been dated by pollen analysis to the Boreal/Atlantic transition.

From Northwest Europe net fragments dating from younger periods are also known. Schwabedissen (1957, 1957/1958) mentions the find of an almost complete fishing net from Rüde 2 (Förstermoor, Kr. Schleswig), a settlement of the Ertebølle/Ellerbek period. The author says that the net consists of triangular and diamond-shaped meshwork, the cord being knotted with so-called *Fischer- oder Weberknoten.*[17] From a peat-bog near Ordrup (Denmark) a fragment of an unknotted net is known, dating from the Neolithic (Clark, 1965). Dating from the same period are a number of net fragments from the Nebbe mosse, parish of Östra Vemmerlöv, Schonen, Sweden. This find has been excellently described by Stjernquist, Nilsson & Nybelin (1953). The fragments were found to have come from three different nets. It was possible to study two of these (fragments I and II) in detail. Thus the material used could be identified (lime bast), and the mesh-width (net I: 4-5 cm; net II: 5-6 cm) and the type of knot (net I: *Pfahlbau* knot; net II: another type) could be ascertained. From the position of the knots in the two fragments it was evident that net I had been made in the round and net II not. In addition net I showed some particular features from which it was clear that this had been part of the tail of a bag-shaped net (fig. 57). In view of the small size of the remaining fragment (c. 30 x 50 cm), however, the overall shape of the net cannot be ascertained. On the basis of comparison of data provided by these nets with data from recent Swedish lime-bast fishing nets it seems not unlikely to the authors that the recent ones are directly descended from their prehistoric predecessors. As to the kinds of fish caught by net I, among the netting a number of bones of tench were found (estimated length of the fish: 50 cm), as well as a caudal vertebra of a pike (estimated length of the fish: 50 cm) and scales of a roach.

4. SUMMARY AND CONCLUSIONS

In the first part of this article a number of fishing methods and types of fishing gear known from ethnographical sources are described. Three principal fishing methods can be distinguished:

a. Fishing without the use of any fishing gear; such as catching fish with one's bare hands, stunning fish with a stick, catching fish by making the water turbid, and poisoning. The last two mentioned methods are more or less unselective with regard to the fish species and their sizes, and fish are caught *en masse.*

b. Fishing by means of actively operated fishing gear. The types of gear include the gaff, the rod with a bob, the stick with a noose, the fish-spear, the line with a gorge and the line with a fish-hook. When the fisherman is fishing with one of these types, he searches for the fish, or lures it towards himself, and tries to catch it. The method can be time-consuming and is more or less selective with regard to the species and the size of the fish. Usually one fish is caught at a time. Determining factors are *e.g.* the clearness of the water, the size of the gorge/fish-hook, the strength of the line and the kind of bait.

c. Fishing by means of passively-operating fishing gear. The kinds of fishing gear are: the weir, the fish-surround, the wickerwork fish-trap and the fishing net. When the fisherman uses these he only has to collect the fish which have become trapped.

The weir itself can function in places where there is a strong current or great diurnal differences in water level. In stagnant or slowly flowing water it is always used in combination with the fish-surround, fish-trap or fishing net. These combinations have resulted in very large and complicated complexes of fishing gear.

The duration of these complexes depends on the construction materials used. Those parts made of wickers, roots or strips of bast (the screens, collection chambers, fish-traps and fishing nets) are worn out after a couple of years. Heavier vertical wooden posts to which these contraptions are fastened last longer.

In regard to the wickerwork fish-traps two main types can be distinguished: the trap without internal funnel, or trumpet fish-trap, and the trap with internal funnel. Which of the two is used depends on the speed of flow of the water.

A further division of the fish-traps with internal funnel can be made on the basis of the weaving technique used. In regard to this we distinguish the light fish-trap, which is woven according to the *Zwirnbindung*, and the closely woven fish-trap, which is woven according to the *Leinwandbindung*. The latter is mainly used for catching very small kinds of fish.

In general a fish-trap or fishing net is not selective as to the catch. However, the plaiting technique used, the diameter of the rearmost throat opening, the mesh-size of the net, the kind of bait and the position of the fishing gear in the water can influence the fish species and sizes caught.

The most highly developed fishing gear is the fishing net, and on the basis of its shape four groups can be distinguished: the square net, the round net, the rectangular net and the bag-shaped net.

In the actual process of catching fish, the fisherman sometimes uses a few items of auxiliary fishing equipment. These are: the splashing stick, the gaff, the scoop-net, the live-box and the boat.

In the second part of this article a few general comments are made on the pre- and protohistoric actively operated fishing gear, the bone and antler fish-spear prongs, gorges and fish-hooks. Six fish-hooks from the Netherlands are described and considered from a theoretical viewpoint with regard to their effectiveness and the possible fish species that could have been caught with them.

In regard to the passively-operating fishing gear, some comments are made on the finds of prehistoric weirs and fishing nets. Finds of fish-surrounds are conspicuously absent in the archaeological record. Emphasis is laid on the pre- and protohistoric wickerwork fish-traps from the Netherlands, Northern Germany, Denmark and Sweden.

On the basis of the ethnographically known types of wickerwork fish-traps a simple type classification for the prehistoric wickerwork fish-traps has been made. The few Mesolithic and Neolithic wickerwork fish-traps found fit into this typology. However, from the datings of these traps it is clear that the established typology is only descriptive and has no chronological significance.

The most striking conclusion concerning the prehistoric wickerwork fish-traps found in Northwestern Europe is that their overall shape, the plaiting technique and the materials used were the same as those which have been used until recently. In view of this, it is certain that the prehistoric wickerwork fish-traps were very efficient and could have trapped nearly all the fish species which were living at that time. It is also clear that they were used both in a freshwater and in a marine environment.

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Postscript

The present article was concluded at the end of September 1979. Since that date no fewer than two bone fish-hooks and more than 200 barbed points or fragments thereof have been

recovered from the Rotterdam-Europoort sand dredging works (pers. comm. L. Verhart, R.M.O.). Also a fish-trap possibly dating from 200-100 B.C. was found during the excavation of *terp* 100 in the Uitgeesterbroekpolder near Uitgeest (pers. comm. A. van Gijn, I.P.P.).

6. NOTES

1. In the Netherlands, however, it is known that the screen of a *zalmsteek* (= a row of posts with hurdles in between that salmon swim up against, before being driven into fish-traps) rotted away already halfway through the summer and then had to be replaced by a new one (Van Doorn, 1971).

2. This distance is dependent on the size of fish that the fisherman wants to catch in his trap.

3. Fish-traps can also be used for fishing in winter. The Syrjäns cut a long trench in the ice, in which a weir of young evergreen trees is constructed. At the place of the fish-trap an even bigger hole is made. When fishing is in progress the fisherman must ensure that this hole does not freeze over. An already existing weir can also be used in this way (Sirelius, 1906).

4. Fish-traps may also be provided with a long tail because the fisherman expects a lot of fish and does not wish to pick up his catch immediately.

5. Until recently the Finns used flat oval wooden floats. As weights for nets they used *i.a.* oblong stones wrapped in birch bast (Sirelius, 1906).

6. Collection Rijksmuseum van Oudheden, R.M.O. d 1928/12.1.

7. Collection Rijksmuseum voor de IJsselmeerpolders, without inventory number. The hook is made out of red-deer antler (pers. comm. Dr. A.T. Clason and Dr. W. Prummel, B.A.I.).

8. Collection Fries Museum, F.M. 240/1. Boeles (1951) says that the hook is made of (whale?) bone. According to Van der Heide (1955) the hook is made of whalebone. However, in a more recent publication (Van der Heide, 1972) the whalebone has changed into 'probably antler of elk'. On the basis of closer investigation it is evident that the hook is made of antler. The raw material was most probably the antler of an elk although a large antler of red deer cannot be excluded (pers. comm. Dr. A.T. Clason and Dr. W. Prummel, B.A.I.).

9. The length measurements of the hooks a-d are taken from Louwe Kooijmans (1974). Their width, hook opening and grip angles were estimated from illustrations.

10. This information was kindly given to me by P.O. Nielsen, assistant curator of the First Department of the National Museum in Copenhagen.

11. The find is erroneously mentioned in the Archaeologische kroniek van Zuid-Holland for the year 1977.

12. In particular the diameter of the hindmost throat opening must be noted. This opening determines the size of fishes able to swim inside.

13. Also Sirelius (1906) does not exclude the possibility that the fish-trap with throat is derived from the fish-surround.

14. Becker (1941) ascribes the Magleby Long fish-trap to the Funnel-Beaker Culture.

15. Only the *aalkubbe* (2.3.3.2.3.) that was baited with herring roe, worms, *etc.* caught exclusively eels. The diameter of the rearmost throat opening (5 cm) and the deviating position of the trap in the water were determining factors for this.

16. Seine = a drift-net, one end of which is taken out from the shore and subsequently hauled in again on land so that the net encompasses a wide arc. The net is hauled in from both ends, so that the fish enclosed within the net are driven ashore in a heap.

17. There are at least five different known types of knots (Van Iterson Scholten, 1977).

7. REFERENCES

Aaris-Sørensen, K., 1978. *Knoglematerialet fra den mellemneolitiske boplads ved Korsnäs, Grödinge socken, Södermanland* (Riksantikvarieämbetet och Statens Historiska Museer Rapport 8). Stockholm.

Ayrapää, A., 1950. Die ältesten steinzeitlichen Funde aus Finland. *Acta Archaeologica* 21, pp. 1-43.

Bakker, J.A. & J.D. van der Waals, 1969. Denekamp-Angelslo. Cremations, collared flasks and a corded ware sherd in Dutch final TRB contexts. In: G. Daniel & P. Kjaerum (eds.), *Megalithic graves and ritual. Papers presented at the III Atlantic Colloquium, Moesgard 1969.* København, pp. 17-50.

Barthel, H.J., 1977. Die Germanische Binnenfischerei im Gebiet des See- und Moorheiligtums von Oberdorla. *Alt-Thüringen* 14, pp. 148-185.

Becker, C.J., 1941. Fund af ruser fra Danmarks stenalder. *Aarbøger for Nordisk Oldkyndighed og Historie,* pp. 131-149.

Becker, C.J., 1943. Et 6000-aarigt fiskeredskab. *Fra det gamle Gilleleje*, pp. 70-87.

Becker, C.J., 1946. Stenalderens ruser var konstrueret som nutidens. *Salomonsen Leksikon- Tidsskrift* 10, pp. 1118-1120.

Blok, D.P., 1974. *De Franken in Nederland.* Bussum.

Boeles, P.C.J.A., 1951. *Friesland tot de elfde eeuw.* 2nd ed. 's-Gravenhage.

Boddeke, R., 1971. *Vissen & vissen.* Amsterdam.

Brinkhuizen, D.C., 1979a. On the finds of European catfish (*Siluris glanis* L.) in the Netherlands. In: M. Kubasiewicz (ed.), *Archaeozoology I. Proceedings of the IIIrd International Archaeozoological Conference held 23-26th April 1978.* Szczecin, pp. 256-261.

Brinkhuizen, D.C., 1979b. Preliminary notes on fish remains from archaeological sites in the Netherlands. *Palaeohistoria* 21, pp. 83-90.

Casparie, W.A. & J.E.J. Swarts, 1978. Hout. *Spiegel Historiael* 13, pp. 267-281.

Casteel, R.W., 1976. *Fish remains in archaeology and paleo-environmental studies.* New York.

Clark, J.G.D., 1936. *The Mesolithic settlement of Northern Europe.* Cambridge.

Clark, J.G.D., 1948. The development of fishing in prehistoric Europe. *The Antiquaries Journal* 28, pp. 45-85.

Clark, J.G.D., 1954. *Excavations at Star Carr.* Cambridge.

Clark, J.G.D., 1965. *Prehistoric Europe, the economic basis.* 2nd ed. London.

Clark, J.G.D., 1975. *The earlier stone age settlement of Scandinavia.* Cambridge.

Degerbøl, M., 1945. Subfossile fisk fra kvartaertiden i Danmark. *Vidensk. Medd. fra Dansk Naturh. Foren.* 108, pp. 103-160.

Doorn, T.H. van, 1971. *Terminologie van de riviervissers in Nederland.* Assen.

Dorleijn, P., 1977. *Geen moed vist ook.* Bussum.

Dürr, H.W.A., 1962. Zur Ausgrabung an der Hunte bei Dümmerlohausen 1938/39. Unpubl. man.

Es, W.A. van, 1974. Vis uit Dorestad voor mijnheer Calkoen. *Westerheem* 23, pp. 89-94.

Forde, D.C., 1934. *Habitat, economy and society.* London.

Glasbergen, W. *et al.*, 1966. De Neolithische nederzettingen te Vlaardingen (Z.H.). In: W. Glasbergen & W. Groenman-van Waateringe (eds.), *In het voetspoor van A.E. van Giffen.* Amsterdam, pp. 41-65.

Groot, S.J. de & S. Schaap, 1973. *De Nederlandse visserij rond 1900.* Amsterdam.

Heide, G.D. van der, 1955. Archaeological investigations on new land. *Antiquity and Survival* 2, pp. 93-122.

Heide, G.D. van der, 1962. Een bijzondere bodemvondst in Overijssel. *Verslagen en Mededelingen van de Vereniging tot beoefening van Overijsselsch Regt en Geschiedenis* 77, pp. 21-35.

Heide, G.D. van der, 1972. *Graven naar het verleden.* Utrecht.

Indreko, R., 1948. *Die mittlere Steinzeit in Estland* (= Küngl. Vitt. Hist. och Antik. Akad. Handl.). Stockholm.

Iterson Scholten, F.R. van, 1977. Rope and fishing tackle. In: B.L. van Beek, R.W. Brandt & W. Groenman-van Wateringe (eds.), *Ex Horreo.* Amsterdam, pp. 135-143.

Kapel, H., 1969. En boplads fra tidlig- atlantisk tid ved Villingebaek. *Fra Nationalmuseets Arbejdsmark*, pp. 85-94.

Lekholm, C.G., 1951. A technical study of some Scanian bone fish-hooks. *Meddelanden från Lunds Universitets Historiska Museum*, pp. 123-143.

Lepiksaar, J., 1975. Über die Tierknochenfunde aus den mitteralterlichen Siedlungen Südschwedens. In: A.T. Clason (ed.), *Archaeozoological studies. Papers of the Archaeozoological Conference 1974, Groningen.* Amsterdam, pp. 230-239.

Lobregt, P. & J. van Os, 1977. *De laatste riviervissers.* Zutphen.

Louwe Kooijmans, L.P., 1970/1971. Mesolithic bone and antler implements from the North Sea and from the Netherlands. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek* 20-21, pp. 27-73.

Louwe Kooijmans, L.P., 1974. *The Rhine-Meuse delta. Four studies on its prehistoric occupation and Holocene geology.* Leiden.

Louwe Kooijmans, L.P., 1976. Local developments in a borderland. *Oudheidkundige Mededelingen uit het Rijksmuseum van Oudheden te Leiden* 57, pp. 227-297.

Mathiassen, T., 1948. *Danske Oldsager I. Aeldre Stenalder.* København.

Metz, W.H., 1975. *Pre- en protohistorie in Veluws museum 'Nairac' te Barneveld.* Barneveld.

Michelsen, P., 1952. Risflettede ålekuber, *Fra Nationalmuseets Arbejdsmark*, pp. 91-100.

Mohr, E., 1952. *Der Stör.* Leipzig.

Molen, S.J. van der, 1976. *Vissers van wad en gat.* Leeuwarden.

Muus, B.J. & P. Dahlstrøm, 1968. *Zoetwatervissengids.* Translated and edited by R. Boddeke. Amsterdam/Brussel.

Peesch, A., 1966. *Holzgerät in seinen Urformen.* Berlin.

Petersson, M. & E. Olausson, 1952. Eine mesolitische Fischreuse aus Jonstorp, Schonen. *Meddelanden från Lunds Universitets Historiska Museum*, pp. 141-157.

Regteren Altena, H.H. van & H. Sarfatij, 1973. Waarnemingen in de bouwput van V. & D. Achter Clarenburg. *Maandblad Oud Utrecht* 46, pp. 68-70.

Reinerth, H., 1926. *Die jüngere Steinzeit der Schweiz.* Augsburg.

Reinerth, H., 1939. Ein Dorf der Grossteingräberleute. *Germanen-Erbe* 4, pp. 226-242.

Ristić, M., 1977. *Ribe i ribolov u slatkim vodama.* Beograd.

Roes, A., 1963. *Bone and antler objects from the Frisian terp-mounds.* Haarlem.

Rosenlund, K., 1976. *Catalogue of subfossil Danish vertebrates, fishes.* København.

Sarfatij, H., 1978. Archeologische kroniek van Zuid-Holland over 1977. *Holland* 10, pp. 297-312.

Schwabedissen, H., 1949. Die Bedeutung der Moorarchäologie für die Urgeschichtsforschung. *Offa* 8, pp. 46-74.

Schwabedissen, H., 1957. Ausgrabung mesolithisch/neolithischer Wohnplätze im Satruper Moor, Kr. Schleswig. *Germania* 35, pp. 371-373.

Schwabedissen, H., 1957/1958. Die Ausgrabungen im Satruper Moor. *Offa* 16, pp. 5-28.

Sirelius, U.T., 1906. *Über die Sperrfischerei bei den Finnisch-Ugrischen Völkern.* Helsingfors.

Sirelius, U.T., 1934. *Die Volkskultur Finnlands I. Jagd und Fischerei.* Berlin/Leipzig.

Solberg, O., 1909. *Eisenzeitfunde aus Ostfinmarken* (= Videnskabs-Selskabets Skrifter II. Hist.-Filos. Klasse 7). Christiania.

Sprockhoff, E., 1953. Fischreuse aus dem Schlüsbeker Moor. *Germania* 31, pp. 229-230.

Stjernquist, B., T. Nilsson & O. Nybelin, 1953. Some stone age fishing tackle from Scania. *Meddelanden från Lunds Universitets Historiska Museum*, pp. 123-148.

Vogt, E., 1937. *Geflechte und Gewebe der Steinzeit.* Basel.

Welinder, S., 1969. Ett barkflöte från Bare mosse. *Fornvännen* 64, pp. 37-38.

Wheeler, A., 1978a. Why were there no fish remains at Star Carr? *Journal of Archaeological Science* 5, pp. 85-89.

Wheeler, A., 1978b. Problems of identification and interpretation of archaeological fish remains. In: D.R. Brothwell, K.D. Thomas & J. Clutton-Brock (eds.), *Research problems in Zooarchaeology* (= Occasional publication). London, pp. 69-75.

Živković, O., 1956. Ribolov i ribarske sprave na Tamišu. *Rad Vojvodjanskih Muzeja* 5, pp. 194-204.

8. KEYWORDS

The Netherlands, Germany, Denmark, Sweden, Europe, prehistory, protohistory, recent, ethnography, archaeology, zoology, fishing technique, fishing gear, fish-trap, type classification.