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Reconstructing a Prehistoric Fish Trap

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Fish traps, still in use all over the world today for catching fish and crustaceans, have been used by mankind at least since the Mesolithic period. Their shape at that time is quite well-established, suggesting that they may have originated even earlier (Bulten et al, 2002: 108). This type of fish trap is made up of two elements: the funnel and the main trap body (or pot). The funnel is placed in the opening of the trap, pointing inwards to guide the fish into the trap and prevent their exit.

Introduction

> “Little has been published so far on the processing of bast fibres and the textile techniques they were used for. In the archaeological literature, technical terms relating to bast fibres and in particular to interlacing and cording techniques, are often used in a confused and confusing manner. A clearer understanding of the structures, techniques and terminology would help archaeologists better understand the finds and their evolution.

The conical fish trap with a funnel entry is used mainly in standing waters, slow streams and tidal areas.Fish traps without a funnel can be used where a strong current prevents the fish from swimming out again, but in slow-moving water, the funnel is indispensable to block the way out and keep the fish penned (Brinkhuizen, 1983:8-53).

A live reconstruction of a camp of the hunting, fishing and gathering peoples of the Mesolithic period exists in the Archeon (Alphen aan den Rijn, the Netherlands), and one of the important objects for understanding their way of life in the wetlands of the Low Countries is the wicker fish trap.Several finds of fish traps in the Netherlands have been documented, of which the best-known is from the excavation led by Louwe Kooijmans at Bergschenhoek in 1978 (Kooimans *et al*. 2005), which brought to light remnants of four fish traps. The site, and thus the fish traps, have been dated by the ceramic finds to the middle Neolithic, about 4200 BC.One of the wattle fish traps was conserved and is now on display at the Dutch National Museum of Antiquities (RMO) in Leiden.

Being so well preserved, the fish traps of Bergschenhoek are prime subjects for a full-scale reconstruction that will approach the original as closely as possible.In the 1980's, archaeologists estimated that such a fish trap would take at least a day to complete (Bloemers *et al*. 1981:42).Actually building such an object can reveal much, both about the production process and about the skills and knowledge of the people who made the original. The reconstruction project therefore addresses the following questions:

- What more can archaeological finds tell us about the shape and construction of wattle fish traps in the late Mesolithic and early Neolithic periods?
- Which techniques and materials were used in the production of fish traps at that time?
- How much time does it take to build one fish trap?
- How much material does it take to build one fish trap?

This article will first review the fish traps found in the Netherlands since the excavation at Bergschenhoek, with emphasis on the materials and techniques used to make them. We will then present the setup of the reconstruction, based on a detailed analysis of the original find.Finally, on the basis of both the data from the literature and the actual reconstruction, we will describe the complex process of gathering the raw materials and processing them, building the fish trap, and using and maintaining it. This article does not address the question of the specific shapes of fish traps meant to catch particular kinds of fish.

Prehistoric fish traps from the Netherlands

Several prehistoric fish traps have been found in the Netherlands. An overview of these can be found in Out (2008). The sites mentioned in this article are shown in Figure 1(Out, 2008).

Bergschenhoek

The Bergschenhoek excavation brought to light the remnants of a small winter camp (See Figure 2) from about 4200 BC.It has been interpreted as a temporary winter camp, set in a swampy region of sweet to slightly brackish lakes, used repeatedly, over a period of possibly several decades, as a base for hunting and fishing.In this marshy place, an old fish trap was used to firm up the boggy soil, reeds were regularly added to raise the ground level, a discarded dugout canoe served as flooring; the fireplace too was regularly maintained. The excavation turned up remains of fish and birds and also bones from, among others, a small dog. Bits of corded fibre, both fine and thick, were preserved embedded in clay, and are evidence for the use of rope and cordage (Louwe Kooijmans *et al.* 2005: 268).

The most remarkable finds from this site are the three more or less complete wattle fish traps (See Figures 3 and 4) and fragments of several others (Louwe Kooijmans*et al.* 2005: 268). It also yielded old rootstocks of *Cornus sanguinea* (common dogwood), though these were not preserved by the excavators (Louwe Kooijmans, personal communication 2013).

The fish trap from Bergschenhoek shown in Figure 3 is made of *Cornus sanguinea* and has a length of 170 cm and a diameter of 70 cm (Bloemers*et al.* 1981: 42). The stakes are held together with fibres twined[1] into a two-ply cord, each stake being secured in a turn of the cord. The extremely regular workmanship suggests that this is the work of an experienced and skilled maker. The fibres are vegetal, but have not been precisely identified. The outside of the fish trap is aligned straight towards the tip, suggesting that its shape was a cone with a round mouth. The tip itself is not visible (observations by the author, 2013).

An examination of the fish trap was made in 2013 to document constructional details and to measure and count different components. On the main body of the trap, 124 stakes are visible, forming one half of the body. This suggests that the entire circumference would be 248 stakes.

The funnel which is on the top of the main body has some holes, little folds and movable stakes. Altogether with the lengthwise fold it makes itimpossible to determine the exact number of stakes of the main body of the trap with absolute certainty. The funnel is made of 218 stakes. Its half-circumference at the mouth is 96 cm, which yields a total circumference of 192 cm and a diameter of 61 cm. The main trap body was held in shape by two hoops placed about 30 cm apart in the mouth of the cone. The funnel was held open by a single hoop set in the mouth.Of the rows of twined cord securing the stakes, 34 are visible on the body and 13 in the funnel.

Some interesting constructional details are indicated in Figure 5. On top of the funnel, the start of the twined binding is clearly visible (red arrow). The funnel appears today as a double layer of wicker (blue arrows), recognizable as a conical structure folded in two and flattened. The hoops are held in place with a cross-stitch lashing (yellow arrow). The second hoop of the trap body is lying under some of the stakes forming the body, which indicates that the body, too, is now a double layer formed from a collapsed cone (green arrow).

The twined binding is most easily observed on the top layer of the funnel (See Figures 5 and 6). The jump from one row of binding to the next, in particular, is clearly visible.One binding row is carried all the way around the circumference, securing each of the stakes; where it comes back to its starting point, it catches the first three to five stakes of the row a second time. The fibres are then twined into plain cord, not catching any stakes, for a short distance; this cord is angled across the stakes to the starting-point of the next row. This new starting-point is situated three to five stakes back (to the left) from the last bound stake, and as far up as the desired distance between the two binding rows. This distance is larger at the mouth than at the tip, that is, the binding rows are farther apart near the opening. This technique of "jumping" from one row to the next by means of a short section of plain cord ensures that the rows of binding are always at right angles to the stakes.Catching a few stakes twice before jumping to the next row adds stability to the whole length of the structure, from mouth to tip. This method of changing rows is clearly visible on the funnel; Figure 7 illustrates the indications found on the main body of the trap to show that the same technique was used here.

The fish trap was made by someone working from left to right: the starting point of the binding is visible on the funnel, and so is the direction of the twined binding. The worker has laid a bundle of fibres (technically called "strand") around the left side of the first stake, and the first twists of the cord are laid to the right of this starting point. The circumference of the trap body diminishes towards the tip. In Figure 6, the coloured lines marking the stakes show the method of decreasing: the red dotted stake disappears after four rows of binding. The white spots in the figure indicate where two stakes have been secured together in a single turn of the binding cord. The stakes themselves taper off towards the tip and the cord which binds them also grow slightly narrower.

For the second fish trap from Bergschenhoek, a drawing (See Figure 4) is available for examination. The published description states that towards the tip, the maker has often secured two stakes together into a single turn of the cord to narrow the cone (Bloemers *et al.* 1981: 42-43). The same publication describes the cord as being made of rushes. However, experimental work by this author in 2013 casts serious doubts on the use of rushes for building a fish trap. In the experiment, cordage of this type made from rushes was already weakened to the point of falling apart under the least strain after only three weeks in water. The published drawing shows that this fish trap was of the same type as the previous one, with a conical shape and an entry funnel. Three hoops are illustrated, two in the main trap body and one in the funnel. The drawing shows 16 binding rows on the trap body, growing closer together towards the tip, and six on the funnel. The number of stakes in the drawing is about 160.

Hogevaart

The fish traps excavated at the Hogevaart site are dated to about 4200 BC (See Figure 8).All are made from *Salix* spec. (willow) (Bulten*et al.*, 2002:117). These fish traps were found at the foot of fishing weirs, pointing to the combined use of traps and weirs. The hoops inside these traps are made, like those from Bergschenhoek, by bending a single shoot into a circle. Figure 8 shows that in the Hogevaart fish trap, the hoop was held in place with lashings set at more or less regular intervals and wrapped six to eight times around the stakes. Remnants of twined binding securing the stakes were also found. Van Rijn and Kooistra (1997:10) describe this as follows: "*The cord used to plait the fish trap consisted of two strands of two or three layers of bark, twined to right and twisted into each other to the left. The diameter of the rope was about 1.2 cm, and seven twists were counted on a seven cm distance.*" The bast used was not identified precisely.

The excavation report mentions the recurring cutting of shoots from stools of willows and alders, to provide wood for the weirs and fish traps. The stakes for this fish trap were cut in autumn (Hogenstijn and Peeters, 2001: 40). Near all the weirs, remnants of cordage of the type used in making fish traps were found; it may have been used to fasten the trap to the weir (Van Rijn, Kooistra, 1997: 2).

Hardinxveld-Giessendam De Bruin (See Figure 9)

This excavation brought to light traces of dwellings built on a high sandy riverbank in a marshy region about 5100 BC. The post holes and hollows indicate intensive use of the site.Finds include four canoe paddles, a 5.5 m long dug-out canoe made from a lime tree, several fragments of other canoes, split wood and shavings and some tools (Louwe Kooijmans*et al.* 2005:183). The finds also include the tip of a conical wattle fish trap. The stakes are *Cornus sanguinea*, (Out, 2008).

A photograph of this find (See Figure 9) shows the stakes lying quite far apart and a thicker spot is visible on one of the binding rows.When the stakes are secured with twined pairs of osiers[2] (willow shoots), such a slight bulge forms wherever an osier ends and a new one is added; the twined osiers are bulkier than a cord twined of fibres and hold the stakes farther apart. The photo also shows that the binding rows are closer together at the open end and that the structure there looks more like wickerwork.

Vlaardingen (See Figure 10)

The Vlaardingen site is dated to 2900–2600 BC. Remnants of a fish trap, probably the funnel part, were found here in a tidal creek. The material is *Cornus sanguinea*, (Out, 2008). There are also indications that a V-shaped fishing weir existed at this location.Other finds include remnants of knotted nets, presumably fishnets, comparable to finds from Bodensee, (Germany (Van Iterson Scholten, 1977:139). Like the net fragments from Friesack (Cunliff, 1994), they are made of bast fibres.

The stakes can be counted on one half of this fish trap funnel; a total of 110. The other half has been disturbed but the total number of stakes would have been close to 220. Some 15 rows of binding are visible, with an estimated four to six centimetres between the rows. The twining which secured the rows is clearly visible, and the cross-stitch lashing securing the hoop, made from a single shoot, can also be discerned.

Emmeloord

The archaeological site Emmeloord J97 is a rich source of fish traps and weirs, about which much has been published (Bulten*et al.* 2002). The site is dated to 3370–1500 BC.A total of 44 fish traps and fragments of fish traps were excavated here, as well as 10 fishing weirs.Several of the fish traps were completely intact.Most of the fish traps date to the Bell-Beaker culture; the oldest, numbered 1 and 2, have been dated to about 3300 BC, in the Swifterbant period (Bulten*et al.*, 2002:126; Van Rijn, 2002:72).

Fish trap 1 (3340–2920 BC) is complete except for a part of the tip.It is described as "triangular" (See Figure 49, model I). Part of the funnel can be identified and it can be seen that there had been two hoops set inside the opening. On the visible half of the trap body, 60 stakes were visible, with 30 rows of binding. The hoop at one end is described as made of two branch sections and at the other, of a number of twigs into which the stakes of the body were caught (Bulten*et al.*, 2002:44-45).

Fish trap 2 is also described as "triangular" (Bulten*et al.*, 2002:44). The two pieces found are the tip and the opening of the trap body. The tip is described as composed of about 50 willow stakes bound with 11 "strands of rope", with 14 "strands" binding the opening over a distance of one metre (Bulten*et al.*, 2002:45). The excavator notes that two or three of the strands are diagonal, but it is not clear whether this refers to row-shift diagonal cords as seen on the fish trap from Bergschenhoek. Two hoops are described in the opening, with about 15 cm between them and the hoop branches partly held together with a plaited rope (Bulten*et al.*, 2002:46).

The other fish traps from Emmeloord are dated later, but as they are well documented, some general data about them are included below.

These fish traps are described as "rectangular" (See Figure 11) and "fish-shaped" and the authors speculate that the rectangular ones may be older than the fish-shaped ones (Bulten *et al.*, 2002:42) (See Figure 49, models III and IV). Both types are described as having a conical mouth, but with the body of the trap rectangular in one and elongated and rounded in the other, with the tip shaped the same in both. The rectangular fish traps are longer (180–200 cm) than the fish-shaped ones (120–150 cm) (Bulten*et al.*, 2002: 41-42). The authors think it probable that the change of the shape from rectangular to fish-shape may have been motivated by the larger capacity of the trap body (Bulten*et al.*, 2002: 42). A conical entry funnel is set in the mouth of these traps, which has a diameter of about 70 cm (Van Rijn, 2002:67). Figure 11 shows one of the rectangular fish traps, with its conical funnel clearly visible on top.

Most of these traps are made from one- and two-year old osiers of *Salix* spec. or *Corylus* spec. (hazel), normally using a single species per trap (Van Rijn, 2002:70). The willow species are probably mostly *Salix alba* (white willow) and *Salix fragilis* (crack willow). It seems likely that these were the dominant species in the scrub along the riverbank (Van Rijn, 2002:74).A total of 24 fish traps are made from unpeeled one- and two-year old osiers of *Corylus* spec.Another16 fish traps are made from unpeeled one- and two-year old osiers of *Salix* spec.In the other traps, the stakes are a mixture of osiers from *Salix* spec. and *Corylus* spec., and in a single case some osiers from *Viburnum opulus* (guelder rose, also known as water elder) and *Betula* spec. (birch) (Van Rijn, 2002:72); like the others, these are one or two years old.It is also worth noting find number 473, which is a simple bundle of stakes without any particular structure. The spectrum of osiers used shows that some trees, both willow and dogwood, were managed according to a specific system, with pollarding or coppicing cycles of one and/or two years, in order to produce the desired materials for wickerwork (Van Rijn, 2002).

The funnels are all conical, 40–60 cm long and 20–40 cm in diameter. The hoops and twigs used in the funnels are smaller than those in the body of the trap. The excavators note the jagged edge of the opening through which the fish swam into the body of the trap (Bulten 2002:42). The osiers used to make the funnel and at the transition from the funnel to the body, seem to have a smaller diameter (about four mm) than those of the trap body (about 5–6 mm.) (Van Rijn, 2002:67).

The cords securing the stakes, often of bast fibres, are made by twining together two or three thin strips of bark, but it remains difficult to identify the bast species precisely; the distance between the rows of cord is usually between six and ten cm (Van Rijn, 2002: 67).Some fish traps have been reinforced with several ropes worked diagonally into the structure; the mesh is approximately the same in all traps, being equal to the thickness of the cord used in the making, which is usually 3–5 mm. (Bulten *et al.*, 2002: 41).

The hoops fixed inside the trap to hold it open are made of three- and four-year old shoots, often *Quercus* spec. (oak), but also *Salix* spec., *Fraxinus excelsior* (ash) (Van der Heijden and Hamburg, 2002: 42), *Alnus glutinosa/incana* (alder), *Betula* spec. and *Viburnum opulus* (Van der Heijden and Hamburg, 2002:55). The first hoop is set in the opening, with the second fairly close behind it, while the third, and, depending on the size of the trap, the fourth, are set farther back. The hoops are secured to the body or the funnel by lashing, usually with a cross-stitch catching the hoop and one stake (Bulten *et al.*, 42). The hoops set in these traps are of three types. The simplest is a single shoot, about 2 cm in thickness, which is bent in a circle. The second type is a shoot which has been split and which is reassembled in lashing, so that the stakes pass between the two splits (See Figure 37). The third is a variation on the second, where one of the splits is replaced by a number of thin twigs (Bulten *et al.*, 2002:43).

All these fish traps are made in open wickerwork by the same method, in which the stakes are laid lengthwise and the rope binding runs at right angles, with each stake in turn caught in a turn of the rope (Van Rijn, 2002:67). The number of stakes is made to decrease towards the tip of both the funnel and the body of the trap, by first catching two stakes together in one turn of the rope and then letting only one of them continue towards the tip (Bulten *et al.* 2002:41). The authors use the term "twijnbinding" for these traps, which might be translated as "wickerwork" (Bulten, 2002:41). However, in the normal basketry technique, this means that stakes are being added continuously during the work, while in the case of these fish traps, the stakes are laid in place and secured by the first row of the binding, after which they stay as they are while the binding is worked around them.

Prehistoric fish traps in Europe

Prehistoric fish traps finds are numerous in Europe, as shown in the overview in Bulten *et al.* (2002). Reviewing them here goes beyond the scope of this article, but one at least deserves mention: the fish trap found at Holbaek, Denmark, dated to 4000–6000 BC, shown in Figure 12. It has a clearly defined tip and the photograph clearly shows that the four last binding rows on the trap body taper off all the stakes to the tip.(Compare with model II in figure 49) The material of the binding, either cord or osiers, is not identifiable.

Results from comparable finds

Materials for the stakes

In the fish traps from Hardinxveld-Giessendam, De Bruin, Bergschenhoek and Vlaardingen, the stakes are *Cornus sanguinea*(Out, 2008).

In the fish traps from Hogevaart and most of the fragments from Emmeloord, the stakes are *Salix* spec. (Out, 2008:10).

The natural range of Cornus sanguinea may influence the choice of material (Out, 2008).

To use wattles cut from Cornus sanguinea, they must be freshly cut, since, unlike willow, they cannot be soaked to give them pliancy (Mellgren, 2011:121).

The growth of the willow

> "*When a tree is cut down or fallen, but the root system remains intact, the stool or the rootstock will sprout new shoots, which grow very fast.*
> *The full-grown root system provides plenty of water and nutrients for a large number of shoots to grow close together. Competing for light, the shoots branch little or not at all and grow straight up, resulting in smooth straight branches.*
> *This regeneration from a mature rootstock, when used systematically and intensively in one stand of trees, gives a quick yield of long smooth poles or shoots with hardly any lateral branchings.*" (Van Rijn and Kooistra, 1997:4-5)

To construct a wattle fish trap, one needs a large quantity of material, beginning with numerous long smooth stakes.Collecting these in natural scrub or woodland is labour-intensive and the yield is poor.Good material for wickerwork is best produced by fast growth from a mature stool or pollard.

The results from the Emmeloord site support the hypothesis that both Salix spec. and Corylus spec. were managed for specific ends (Rijn, 2002:75). The Hogevaart site also contributes evidence supporting regular harvesting of wattle (Van Rijn and Kooistra, 2001: 15).

At the Bergschenhoek site, the excavators encountered a gnarled rootstock which may also be suggestive of this (pers. comm. Louwe Kooimans), other indications for the way in which the stakes were collected are rare.

Most of the wattles used for the wickerwork were cut in winter, as indeed such materials still are today.

The rootstock or stool remains healthier if the wood is cut during the season when sap flow is at its lowest, that is, in winter (Rijn, 2002:75).

The materials for binding cords and ropes

There is no good accepted method for identifying bast fibres (Van Rijn, 2002:57-58). This makes it hard to identify exactly which plants yielded the bast fibres used to bind the fish traps from the Dutch archaeological sites discussed above. Other finds in which bast fibres were used, such as ropes and nets, where the identification of the fibres was successful, will be used to get an idea of the raw materials used to make ropes and cord.

The use of bast fibres for nets, such as the Vlaardingen find, is documented on several Mesolithic and Neolithic sites.

In finds from Friesack (Germany, 7000–4000 BC), plant fibres were used to make nets in needlebinding (Coles, 1989:93). In Korpilahti (Finland, 8000–4000 BC), fragments of nets were found which are probably made from *Salix* spec. In Ladoga, (Estonia, 4000-3000 BC) fragments of nets were found which were made from the bark of *Tilia* spec. (Coles and Coles, 1989)). In Antrea (Finland, 9000–4000 BC), fragments of tree bark were found together with net floats made of birch bark and sinkers made of pierced stones (Clark, 1977:98). The technique used for the nets, called needlebinding, creates loops, such as for example in the net from Ordrup Mose, Denmark, in Figure 14.

In Tybrind Vig, Denmark, fragments of braid have been found, made of willow bark, 8 cm long and 1 cm thick (Andersen,1986:68).

Based on these finds, it may be stated that the bark of *Salix* and *Tilia* (lime tree, also known as linden or basswood) is suitable and was used to supply fibres for rope making. Other tree barks yielding usable fibres are *Populus* (poplar), *Quercus* and *Ulmus* (elm) (Korber-Grohne, 1977).

In the case of the fish trap from Hardinxveld-Giessendam de Bruin, it is unclear whether bast fibres or osiers were use to bind the stakes. The use of osiers to bind a fish trap has been documented on the Mesolithic site of Noyen-sur-Seine (France, 7000 BC). The fragment of a fish trap found here had a length of 36 cm and was bound with osiers, as can be seen in Figure 13.

Describing the treatment of bark, Van Rijn, van der Heijden & Hamburg (2001:40) write: *"The fresh bark was ripped off the tree in wide strips, either lengthwise or spirally. These were cut into narrower strips, which were first soaked in water for a long time, then pounded to make the material as pliable as possible."*

The German experimenter Anne Reichert has published her results on the processing of bast fibres from the bark of many different trees and on the reconstructions of twined textiles. She has obtained good results with the bark of Tilia tree and *Quercus*, but also with *Ulmus*, *Populus*, *Fraximus* (maple), *Prumus* (cherry), *Pinus* (spruce) and *Salix* spec.(Reichert, 2007). The bark of the lime tree can be harvested from May to October (Reichert, 2005) and worked fresh.

The use of bast fibres from the bark of willows and lime trees as raw material for cordage has continued in Scandinavia and Finland well into the 20th century (Van Iterson Scholten, 1977).

The author has obtained fibres for experiments by pulling off, in strips, part of the bark of a lime tree. Some of the layers from the inside of the bark (cambium) can be processed for fibre; when the bark is fresh, it can be stripped off the inside, layer by layer, as in Figure 15. After the strips of bark have dried, they can be soaked in water for several weeks to soften the layers. The layers of cambium can then be pulled off. The soaking takes two to eight weeks depending on the thickness and kind of bark.When processed fresh, the bark of the lime tree gives off the same lovely smell as the tree; in contrast, to be used after it has been dried, the bark needs soaking/retting, which stinks.

Technique

Examining the fish traps, one sees that all are made of stakes caught in a twined binding. The published sources, however, give widely varying descriptions of the technique:

- "*stakes held together in a rope without knots*" (Bergschenhoek, Louwe Kooijmanset al., 2005:269)
- "*knotted all around with a Zwirnbindung*" (Emmeloord, Bultenet al. 2002:117)
- "*Rope was used for plaiting the fish trap*" (Hogevaart,Van Rijn and Kooistra, 1997:10)
- "*The twigs are tied to each other with rope*" (Emmeloord, Van Rijn, 2002:40)
- "*The fish traps are made in an open plaiting method (zwirnbindung), where the wall of the trap is formed of stakes set lengthwise, connected at regular intervals by a cord or by a thin twisted osier tied around each lengthwise stake with ropes*" (Hogevaart, Van Rijn and Kooistra,1997:7).

These descriptions and the use of such terms as weaving, knotting and pleating, show how difficult it is to explain this technique without a specialised vocabulary. None of them are, in fact, technically adequate. But then, the very term "weaving a basket" is a metaphoric use of the verb "to weave".
In this article, the following definitions are used. *Interlacing* is any way of working elements, either stakes or fibres, *across* each other to form a structure with a significant surface–by weaving or plaiting, but also needle binding and sprang (both loop techniques), and even knots–as long as the elements cross and/or reverse direction in a regular pattern. *Weaving* is done with a large number of elements; they are separated into two distinct systems which cross at (approximately) right angles; they do not reverse direction. *Pleating* is done with three or more elements; they form a single system, they do cross each other and they do reverse direction. A *knot* is made in at least one element, which does reverse direction and crosses at any angle.
Unlike all the previous, *twining* or *cording* are not forms of interlacing. The elements (usually

two or three) do not cross each other and do not reverse direction. Instead, a twist in one direction is added to each element and the elements are then twisted together in the other direction; the twist and counter-twist lock and stabilise the structure. Thus, each of two strips of bark may be twisted clockwise, then both strips twined around each counter clockwise to form a *two-ply cord*. The term cord is here reserved for two-ply products, whereas rope is more general and can be used for braided as well as corded products.

The above definitions all apply primarily to textiles, but most are also valid in basketry; the fish traps are not textiles, though their descriptions sound as if they were.
Basketry, or wickerwork, is structurally similar to textile, the essential difference being that some at least of its elements are rigid, where a textile is floppy. Some basketry is woven or even sewn, but most involves some form of plaiting (angle of crossings about 60 degrees) or twining/cording (stakes and binding crossing at about 90 degrees).
The technique used to make the fish traps will be discussed below ("*Twisting, twining and binding*").

Describing the technique is confusing unless the proper technical terms are used. To quote Van Rijn and Kooistra (1997:10):

> *"The cord used to plait the fish trap consisted of two strands of two or three layers of bark, twined to right and twisted into each other to the left."*

This is as confused as it is confusing, in fact the terms seem to have been reversed, since the proper technical meaning of "twining" is letting two twisted strands curl around each other in the direction opposite to their twist. That is, two or three strips of bark may be twisted to the right (S twist), then one such twisted strand may be laid across another to the left (Z twined) to form a cord (see also below "*Twisting, twining and binding*").

The shapes of the fish traps

The fish traps from Bergschenhoek are conical. From Emmeloord, fish traps 1 and 2 are described as "triangular", others are called "rectangular" and "fish-shaped" (Bulten *et al.*, 2002:41). In Figure 49 different models of fish traps are drawn.

In the "rectangular" and "fish-shaped" traps, the body is shaped and supported by three or four hoops, of which one is set near the tip; a feature not seen in the other finds.

The fish traps found in Hogevaart and in Hardinxveld-Giessendam De Bruin are difficult to characterize where shape is concerned. As for the funnel from Vlaardingen, its shape is a cone, like all the entry funnels.

Relationship between traps and weirs

At the Emmeloord site, the fish traps were found near some fishing weirs, but with no physical connection, since in the intact part of the weir, no holes were found behind which the traps might have been set. But as only part of the weir was found, it is not impossible that there were in fact holes in the missing part (Bulten*et al.*, 2002:55).On the other hand, at the Hogevaart site, the fish traps were found in position below the weirs.

Weirs and traps are still used today to catch fish. The fishing weirs in Figure 16 are built of stones.

In the waters of the Bergsche Diep near Bergen op Zoom (See Figures 17 and 18), the fishing methods have hardly changed since prehistoric times, except that the boats are aluminium and the fish traps are made of nylon.

The author visited these fishing weirs in 2013 and spoke with the fishermen, whose information was very illuminating. The Bergsche Diep is a tidal waterway where the difference between high and low tide can be as much 4 or 5 m. The traps are set to catch anchovies, but many different kinds of fish turn up in them. In spring, when the water starts to warm up, the fish swim up to the coast seeking warmer shallows and cross the poles of the weir on the flood tide; coming back on the ebb, they get caught in the weir.

The weir is V-shaped, built of poles set upright in the water a little distance apart but closer together at the tip of the V. Each of the two legs of the weir is almost a kilometre in length (See Figure 17). The distance between the poles is such that the fish could pass between them perfectly well in still water, but the wind and waves cause vibrations in the poles and in the water and these trick the fish into perceiving the line of poles as a closed barrier, which they will follow docilely into the tip of the V.

At the tip of the weir, a gap about 150 cm wide is left open. Beyond it, the poles are set upright in a heart-shape, with nets tied between. The fish trap (of the fyke net type) is set at the open tip of this heart-shaped enclosure (See Figure 17)

The fish follow the line of the weir, cross the gap and are held back by the nets in the heart-shaped enclosure.

At low tide, the fishermen come to see what the enclosure holds, and from it, the fish can be chased into the fish trap.

The fishermen venture out at low tide to work on the construction of the weir. During the author's visit, they were securing the nets on the upper part of the heart-shaped enclosure (See Figure 18), the lower part being already equipped. They work until the tide rises too high and come back at the next low tide to continue the work.

This visit to a working fishery using weirs and fish traps has made clear many things about the fishing methods and the operation of the weir. Combining archaeology and practical research–fishing methods in this case–leads to very useful insights.

Twisting, twining and binding

Twisting and twining are the two steps of making a cord from any kind of fibre.

Twisting is adding twist to loose fibres to form them into a strand or yarn. Twining is twisting two formed yarns around each other. The twist can be to the left (Z twist) or the right (S twist), as shown in figure 19. The fibres twisted in one direction to form the strands, will be twined in the other direction, locking the structure together.Cordage and ropes can be made of a great many different materials.

Figure 20 illustrates cords made from bast fibres from a lime tree, bast fibres from willow, horsehair, nettle *(Urtica)* and sedge (Carex).

The oldest cordage fragments on record date back to the Palaeolithic.

At the French site of Lascaux for example, a fragment of rope has been found and dated to 15000 BC. It is probably made from bast fibres from tree bark, 30 cm long and 6 to 8 mm tick. Three Z-twisted strands have been corded together to form a three-ply S-twined rope (Glory 1959: 149-150).

Two-dimensional textiles are made by catching, in each turn of the cord, a new bundle of fibres or a rope, set at right angles to the cord (See Figure 21). In the middle Neolithic, this is the prime production process for creating two-dimensional textiles (Rast-Eicher, 1993:18). Some of the most famous examples are the knife sheath and grass cloak belonging to Ötzi (Spindler, 1993).

The fish traps are not textiles, but the binding is the same: the turns of the cords enclose the rigid stakes rather than fibres or yarn, thus the trap is rigid rather than floppy and basketry rather than textile.

Twined textiles

Prehistoric textiles made by twining have been found in Switzerland (See Figures 22 and 23), in Germany and in other places.At the Hornstaad/Hörle 1 site (Germany, about 3900 BC), the fibres have been also been found unprocessed, as bundles of raw material (Müller, 1993: 28). The same excavation has brought to light finds of textiles with rows of binding twined extremely close together, up to 8 threads per cm (See Figure 24). Such textiles have also been found double-layered and of subsequently, larger dimensions (Vogt, 1937). Bast fibres were made into textiles not only by twining, but by needlebinding, tabby weave and wrapping techniques. The Mozartstrasse site (Swiss) has yielded textiles made from oak bark bast fibre in tabby weave, with four threads per cm from S/S spun threads of 1.5 mm (Rast-Eicher, 1993:21). The Zürich-Mythenquai site (Swiss) has yielded textiles of lime tree bast fibre in tabby weave with seven threads per cm from S/S spun threads of 0,8 mm (Muller 1993:21). These examples demonstrate the use of bast fibres from the bark of oak and lime tree to make textiles and other objects.

The reconstruction of the fish trap

The reconstruction was made using a variety of materials: willow bark obtained from a modern coppice as well as bark harvested by hand from willows and lime trees.

The material from the modern coppice had been peeled off the shoots mechanically and was delivered is tangled heaps, but it proved extremely suitable for twining cords.

For a small section at the tip of the reconstruction, lime tree bast fibres have been used to twine the cord. This shows clearly in Figure 35, as it is much lighter than the rest.

Stripping and using willow bark

Willow shoots can be peeled only in spring, when the sap rises in the limbs of the tree, as this loosens the bark slightly from the wood.

In a modern willow coppice, the shoots are cut in winter and stored in enough water for them to put out roots in spring and start making leaves. This is the point where they are stripped. The bast fibres of a one-year old willow shoot are fine: 1 to 4 mm. Peeling the bark off the shoot causes the bark to split in strips of varying width. The whole length of the bark is then divided into three or four strands (See Figure 25). Older shoots yield a thicker fibre, suitable for heavier work.Once stripped, the shoots are dried (See Figure 26). In this way, the crop of shoots is processed in spring and can be stored to last all year. The dry bark only needs a little wetting in water to become pliable and usable.

The funnel was made using fibres from willow shoots barked by hand. This is done with a hand-brake, a tool from traditional basketry. The bark is stripped off by the pressure from the iron on the shoot as it is pulled through (See Figures 27 and 28). Stripping the bark can also be done with two pieces of wood, which press the sides of the shoot.

Making the body of the trap

The cord binding the stakes is lengthened by adding in more fibres as the strands are used up in the turns. Adding fibres regularly ensures an even thickness of the cord. The yarn is made at the same time as it is being twined into the cord holding the stakes, which means that the length that needs to be pulled around and under the stakes is limited. This is far easier than working with two pre-spun yarns, since the whole length of each yarn would have to be pulled between the stakes at each turn.In the whole construction, the strands of fibres are always twisted in the S direction. First the strands are each given an S twist, then one strand is pulled under the next stake, the other laid over the stake and across the first strand The two strands are then twined together in the Z direction to lock the "embrace" around the stake.

At the start of the first row (red arrow on Figure 5), the strand is laid around the first stake and the cord is worked towards the right from there (See Figure 29).

The stakes are laid into the first row, to the number required for the diameter of the trap (See Figure 30).

The last stake is then secured to the first (See Figure 31) and the first three to five stakes are caught a second time.For the "jump" to the next row of binding, the strands are then twined into plain cord, not catching any stakes, for a short distance; this cord is angled upwards and to the left, across three to five stakes to the starting point of the new row. This ensures that each row starts straight above the previous one (See Figure 33). Figure 32 shows a detail from the fish trap from Bergschenhoek on the left and the reconstruction on the right.

The binding rows of the trap body are about 8 to 9 cm apart near the mouth, and about 3 cm apart at the tip.A total of 34 rows of binding are visible on the trap body.

Constructing the body of the trap takes a great deal of time.Binding the first few rows took two to two and a half hours.As the circumference of the trap body diminishes towards the tip, the work goes faster.

To narrow the trap towards the tip, the process of decreasing was started in the 15th binding row. To decrease, two stakes were caught in the same turn of the cord, and one of them was cut off.In the next binding row, five to eight stakes were paired for decreasing. This number was increased towards the tip.At the tip of the trap, just a few stakes were left; a cord was wrapped around them a few times to finish off the tip (See Figure 35).

The count on the original fish trap (see "*Prehistoric fish traps from the Netherlands – Bergschenhoek*") was 240 stakes in total. However, the reconstruction reached a diameter of 240 cm, which is the diameter calculated for the original, with only 167 stakes. To avoid making the trap too big, the decision was made to build the reconstruction with 167 stakes.

A difference of a very few millimetres in the thickness of the stakes or cord are enough to cause such a deviation.

The structure that is created at this stage is stiff lengthways (See Figures 33 and 34), but can be rolled up across the stakes, which protects the work for transport and storage.While under construction, the structure lies more or less flat, in two superposed layers, just like several of the finds.

A fish trap of similar construction bound with osiers rather than cord would be rigid in both directions: it would take and keep its three-dimensional shape as soon as the first few rows were bound.

Setting the hoops

Once the body of the trap was finished, the two hoops were set inside it. This is the stage where the trap becomes a three-dimensional, round, stiff object (See Figure 36).

Each hoop is a single shoot bent into a circle.For the reconstruction's hoops, shoots from different trees were used. The second hoop is made from a two-year old hazelnut shoot, just as in the original from Bergschenhoek. The hoops holding open the mouth of the trap body and the funnel are made from three- to four-year old willow shoot, as in the finds from Emmeloord-J97. The hoops were supplied by "De Koperen Knop", a museum in Hardinxveld-Giessendam.

The hoop construction from the find at Emmeloord-J97, with the stakes caught between the two halves of the split hoop, is extremely strong (See Figure 37).

The hoops are secured with a cross stitch lashing, as in the Bergschenhoek original. The lashing that will hold the hoop is started around one stake; the cord is then pulled outside between the stakes and the cross stitch can be finished (See Figure 38). The strand or bundle of fibres has to be pulled in and out between the stakes for each lashing, which is made difficult because the stakes are bound quite closely together.

If the cross of the lashing is made on the outside, the inside looks different.Figure 39 shows details of the inside and the outside. The outside of the original from Bergschenhoek, with cross stitches, is shown top left (photo RMO 2013). Below is the inside of the cross stitches of an original from Emmeloord (photo museum Schokland 2013). The pattern of both is strikingly similar to the result of the reconstruction shown on the right.

To make the cross stitch lashings, it was easiest to work with a length of cord of about 1 m to 1.5 m.A total of about 25 m of cord was needed to set one hoop into the reconstruction (50 m for both hoops), which comes to about 15 to 17 cm per cross stitch. It took about 20 minutes to makes ten cross stitch lashings, while setting one hoop took about five and a half hours.

Both hoops are necessarily set within arm's reach, since the arm must reach them from inside to push the cord back out between the stakes.

If a third hoop is to be set in, as in the Emmeloord finds, this would probably be done at an earlier stage, before completing the tip.

Making the funnel

On the funnel of the Bergschenhoek original, 13 rows of binding are visible. The reconstruction was made with 14 rows. The length of the original funnel is about 60 cm (See Figure 41), but the dimensions of the mouth are not quite clear. The distance between the binding rows is about 5 cm at the mouth, somewhat less towards the tip.

Since the funnel is, of course, shorter than the body which it must fit inside, its diameter needed to decrease faster. The decreases on the funnel were therefore started earlier and closer together than on the body (See Figure 40). In the second binding row, every sixth and seventh stake was paired, with the seventh stake cut off in the third row. This method of decreasing was applied until the eighth row.In row eight, each fifth and sixth stake was paired, with the sixth stake cut off in row nine.In row ten, each fourth and fifth stake was paired, with the fifth stake cut off in row eleven.In row twelve, each third and fourth stake was paired, with the fourth cut off in row thirteen, to reach the desired diameter for the open tip of the funnel through which the fish swim into the trap.

In Figure 32, the detail of the fish trap from Bergschenhoek on the left, and from the reconstruction on the right, clearly show their identical construction.Figure 42 shows two stakes being bound together in one row and one of them cut off in the next.Figure 43 illustrates a detail of the hoop and bindings of the funnel.Figures 44 and 45, taken at the reconstructed Mesolithic camp at the Archeon, show the hoop being set in place.

Fastening and ropes

The finds give no evidence for the attachment of the funnel inside the trap body.

On the reconstruction, ropes were attached at six points around the mouth (See Figure 46). These ropes can be passed between the stakes of the body, behind the hoop, to fasten the funnel inside the body and loosened to take the fish out of the trap.On one of the Emmeloord finds, the excavators report relatively thick braided ropes at the mouth and tip, "*to open the body of the trap or to fasten the trap to a pole set in the water*" (Bulten*et al.*, 2002: 45). The reconstruction was equipped with two braided ropes, 4 cm thick and 2 m long, at the mouth and tip of the body, to secure it to poles set up in the water (See Figure 47).

Results of the reconstruction

Figures 46 and 48 show the entire reconstructed fish trap. The body of the trap is 170 cm long and 76 cm across the mouth. The entry funnel is 60 cm long and 63 cm across the mouth. The opening at the funnel tip, where the fish pass into the trap, is 13 to 15 cm across. In general, the size of this opening depends on the kind of fish one wants to catch. In the reconstruction, the size was based on data from a fisherman from Bergen op Zoom who uses the fishing weir there.

	140	355		170 metre		598	
Finds	part	shape	material	amount of stakes	amount of bindings	hoops	
Bergschenhoek fish trap 1	body	conical	Cornus sanguinea	245	34	2	30 cm distance
	funnel	conical	Cornus sanguinea	218	13	1	
Bergschenhoek fish trap 2	body	conical	Cornus sanguinea			2	
	funnel	conical	Cornus sanguinea			1	
Hogevaart	not clear		Salix spec.			1	
Vlaardingen	funnel	conical	Cornus sanguinea	220	15	1	
HG de Bruin			Cornus sanguinea				
Emmeloord fish trap 1	body	conical		120	30	2	15 cm distance
	funnel	conical					
Emmeloord fish trap 2	tip of the body		Salix spec.	100	11		
	part of mouth body				14		

TABLE 1. RESULTS OF RECONSTRUCTION THE FISH TRAP, EVA IJSVELD 2013

The reconstruction work gives an idea of the time necessary to make a fish trap (See Table 1). This is of course only a rough estimated. Though the author is an experienced craftswoman, familiar with both the techniques and the materials involved, there is no doubt that someone who regularly builds fish traps could do the work significantly faster. The quantities of materials and the duration of the work for the different parts of the reconstruction are summarized in table 1.

The materials for the stakes

No less than 355 straight stakes, 180 cm long, were needed to build the fish trap. The original from Bergschenhoek is made with stakes from *Cornus sanguinea*, but this is not easily available.

Van Rijn and Kooistra (2002:13) mention that gathering dogwood stakes in the wild is very time-consuming. Present-day coppices normally do not include dogwood. *Salix* on the other hand is widely available, and as described in "Results from comparable finds", prehistoric fish traps were made with willow stakes as well as dogwood. Therefore *Salix* stakes were chosen to build the reconstruction.

The materials for the binding

The material used for binding the stakes of the original Bergschenhoek fish trap has not been precisely identified. For the reconstruction, three different binding materials were used: willow bark obtained from a modern coppice, as well as bark harvested by hand from willows and lime trees. The mechanically stripped willow bark was very convenient as stock material, but it does of course not reflect the prehistoric processing. The experiment showed that binding with the mechanically stripped bark was more time-consuming than with manually harvested material. The fibres yielded by the manually stripped willow bark were longer and of better quality than those from the mechanically stripped bark. The fibres from the bark of the lime tree are easily worked into extremely fine and strong twined binding, which is not surprising considering their suitability for making fine twined textiles. Compared to willow bark however, it takes a lot more work to loosen enough fibres from the inside of the lime tree bark for a large stock of fibre. Lime bark bast fibres can be stored for years before use. The fibres from the bark of one- or two-year old willow shoots are thicker than those from lime and extremely suitable for binding the stakes of a fish trap. In general, all three types of fibre gave good results on the reconstruction.

Stripping the bark

The hand-brake can be used in two ways to peel the bark off the shoots. One way is to pull through the entire shoot, bark and all, for a smooth and shiny fibre. The other way (See Figure 25) is to pull the shoot through in such a way as to catch the bark behind the iron, where it forms a wad that can be smoothed out to release the crushed and softened bast.

Table 1 gives the number of one-year old willow shoots that need to be stripped to yield enough bark for binding the stakes and braiding the ropes of the fish trap. The calculation is based on the number of hanks of bark needed for each thickness and on the length of the rope used in the reconstruction. In total, the reconstruction needed the bark from nearly 600 one- or two-year old willow shoots, leaving 600 clean white willow shoots ready for use. This is almost a reversal of the modern situation, where willow shoots are peeled for use in basketry and the bark discarded. Three bundles of shoots were used for the reconstruction. Each bundle held 250 to 300 shoots, 170 cm long. They were obtained from a modern coppice. These three bundles were used up entirely, yielding stakes, binding fibre and ropes.

The binding technique

The fish trap is constructed by securing the stakes in a twined cord made from two strands of willow bark, S-twisted and Z-twined. The rows of binding were worked to the right from the starting point. As the bark cord is very pliable, the work in progress lay flat. While working the binding, it became clear that twining the cord from two strands of fibre was feasible, but doing the same with two ready-made yarns or ropes was not (see "*Making the body of the trap*"), as it would have taken an impractical length of rope, or several lengths knotted together.

The tip

At the tip, where the reconstruction ends, the shoots are quite thin (3 mm) and rather fragile-looking compared with the finds from Emmeloord and Denmark (See Figure 12). A stronger shoot could have been used. The willow shoots used are 180 cm in length, and at the tip of the fish trap (170 cm), they have tapered off into a very thin twig. It is possible that the shoots of *Cornus sanguinea* taper off less strongly.

Towards the tip, the body of the reconstructed trap tended to crease, indicating that the diameter was too large. When a hoop was put inside the body, near the tip, as in the finds from Emmeloord (See Figure 49, model II), it was found that the creases smoothed out when the hoop was set about 40 cm above the tip. The creases could be prevented if, in building the trap, the number of stakes were decreased earlier and faster. It is possible that fish traps from a later date were made with the extra hoop to smooth out such creases, increasing the volume of the trap body at the same time.

The hoops

The simplest way of making a hoop is to take a fresh two- or three-year old shoot and bend it into a circle. Securing the hoops with cross stitch lashings took much more time and materials than expected at the start.

Once the hoops are in place, the fish trap is suddenly completely rigid. To prevent the hoop slipping off the stakes, it is set between the first and the second row of binding. The result looks strikingly like the prehistoric originals (See Figure 39).

The funnel

The hoops must be set into the body of the trap before measuring its mouth to determine the size necessary for the entry funnel. The conical shape of the funnel is made by systematic decreases in the number of stakes. The binding on the funnel was made entirely from hand-stripped willow bark.

Some authors have supposed that the fish traps were opened at the tip to take out the fish, as is done to modern nylon fyke nets. With these wattle fish traps, this is out of the question. Instead, the funnel was tied in the mouth of the trap body with six ends of 0.5 cm thick rope, and could be untied to empty it.

The ropes

One of the fish traps found in Emmeloord ("*Prehistoric fish traps from the Netherlands – Emmeloord*") still had some braided rope attached to the mouth and tip. Such ropes of braided strands of bark are very strong and when wet, they are pliable enough to be easily knotted and tied to a pole.

Conclusion

The study of this type of find is of great benefit when an experienced craftsperson's knowledge and skills are combined with the archaeological data.

The reconstruction work gives an idea of the time necessary to make a fish trap, which runs to several weeks. It also became clear that willow bark is a good material for the binding cord. The fibres swell when the fish trap is immersed in water, and the structure becomes very stable and stiff. The use of bast fibres from willow bark for making ropes is documented in the Mesolithic period (see "*materials for binding cords and ropes*). Bark from one-year old shoots has the right strength and thickness for the corded binding and to make the ropes. The bark needs no processing and can be stockpiled in fair quantities. The stripping leaves large numbers of clean white willow shoots, an ideal material for basketry.

The bark must be peeled in spring, but it is possible to stockpile it to last all year. The cutting of the shoots of *Salix* or *Cornus sanguinea* is best done in winter. *Salix* can be either worked at once, or dried and stored, then soaked when wanted. *Cornus sanguinea* can only be used fresh (see "*Materials for the stakes")*; unlike willow, once the shoots have dried, they cannot be made pliable again by soaking. Large numbers of the desired kind of shoots can be produced if rootstocks or stools are regularly coppiced or pollarded(see "*The growth of the willow"*). This kind of woodland management is not proved, but a rootstock found at Bergschenhoek can be an indication that it was practiced.

A certain logic may be conjectured in the evolution of the shape of the prehistoric fish traps. The conical traps would be the oldest, evolving into the rectangular and later into the fish-shaped traps (See Figure 49). Working with dried materials, the conical shape is easy to achieve, since the stakes remain straight. For a fish-shaped trap, the stakes need to be bent more. Such a model is easier to make with fresh or soaked stakes, which are more pliable.

Little has been published so far on the processing of bast fibres and the textile techniques they were used for. In the archaeological literature, technical terms relating to bast fibres and in particular to interlacing and cording techniques, are often used in a confused and confusing manner. A clearer understanding of the structures, techniques and terminology would help archaeologists better understand the finds and their evolution.

Looking back on the reconstruction

During the research and the practical reconstruction work, many choices had to be made.

For the twined binding joining the stakes, several types of bark were used. The mechanically stripped willow bark was convenient, but of course not representative, while the fibres took longer to work than manually striped kind; this has been taken into account in the calculation of the time needed to construct the trap body.

The original Bergschenhoek fish trap was made using stakes from *Cornus sanguinea*, while *Salix* was used for the reconstruction. This difference in material has had no impact on the time needed for construction.

Creases caused near the point by excess width can be smoothed out by setting a third hoop, which also increases the volume inside the trap body (*compare figure 49 form I and II)(see, "Results of the reconstruction, the tip*")

Future Research

Bast fibres are an important material in prehistory and there is much research still to be done. Making reconstructions of archaeological finds and using them experimentally, can yield rich results. Some work has been done, but very little has been published on this subject. Both wicker and textiles using bast fibres are interesting subjects which invite further research.

The subject of the fish traps is far from exhausted. For instance, it can be very interesting to investigate the construction methods for rectangular and fish-shaped models. Another interesting point would be to try working with *Cornus sanguinea* and investigate differences in tapering, stiffness and lifespan of the shoots.

In September 2014, students of TNO Delft , Netherlands will be investigating the strength of handmade ropes made out of different natural materials with pulling tests. It will be organised by Arend Schwab, TNO, Delft and Eva IJsveld .

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1 Twisting is adding twist to loose fibres to form them into a strand or yarn. Twining is twisting two formed yarns around each other.

2 Twining pairs of osiers around the stakes to secure them, with a certain distance, both between the stakes and the osiers, is a classic basketry technique to make baskets with a very open structure. It was and is much used for fish traps.

Keywords fishing

Country the Netherlands

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FIG 1. MAP FISHTRAPS IN NETHERLANDS, OUT 2008

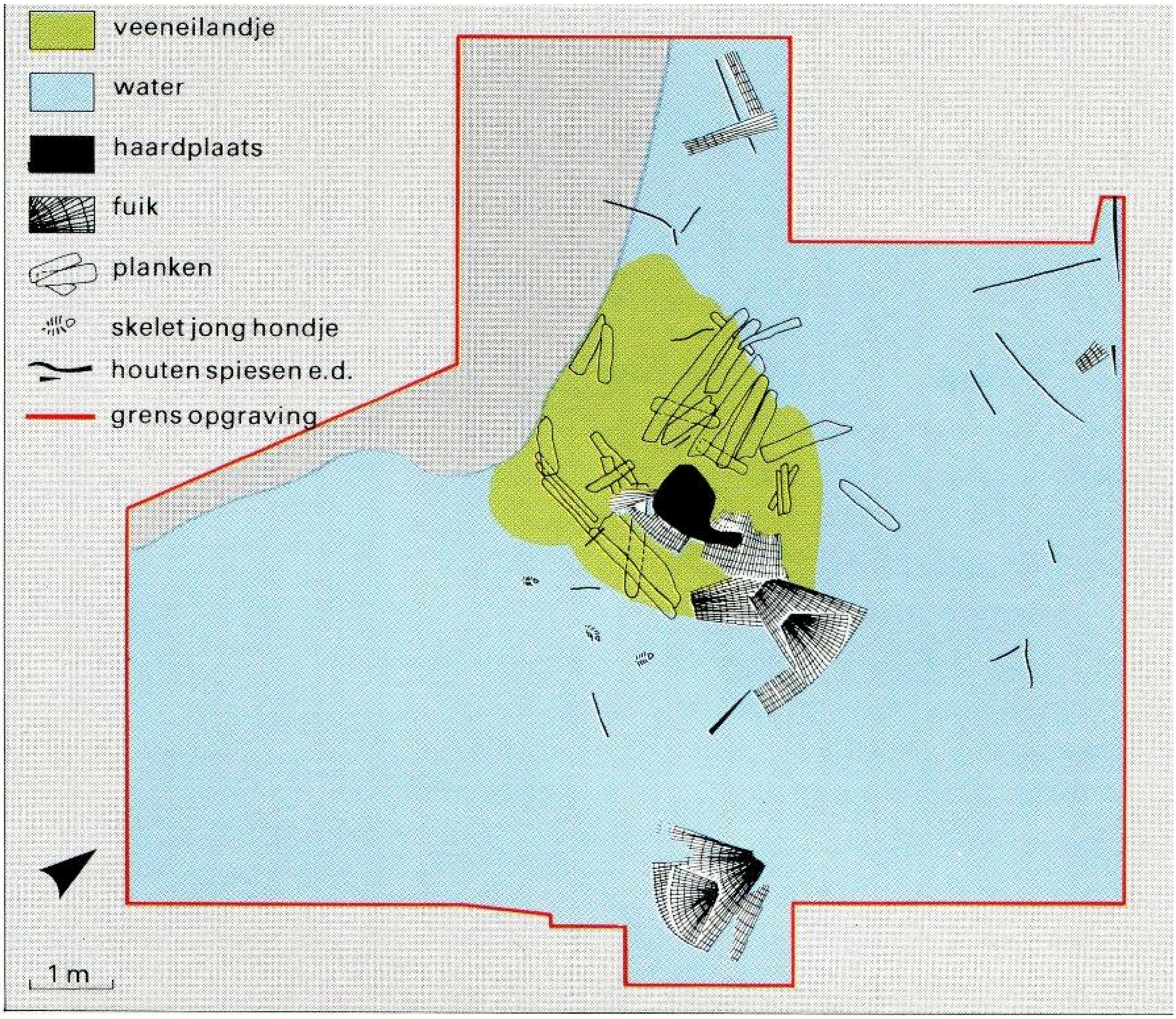


FIG 2. MAP OF CAMP BERGSCHEHOEK , BLOEMERS 1981

FIG 3. FISHTRAP 1 BERGSCHENHOEK, KOOIJMANS 2005

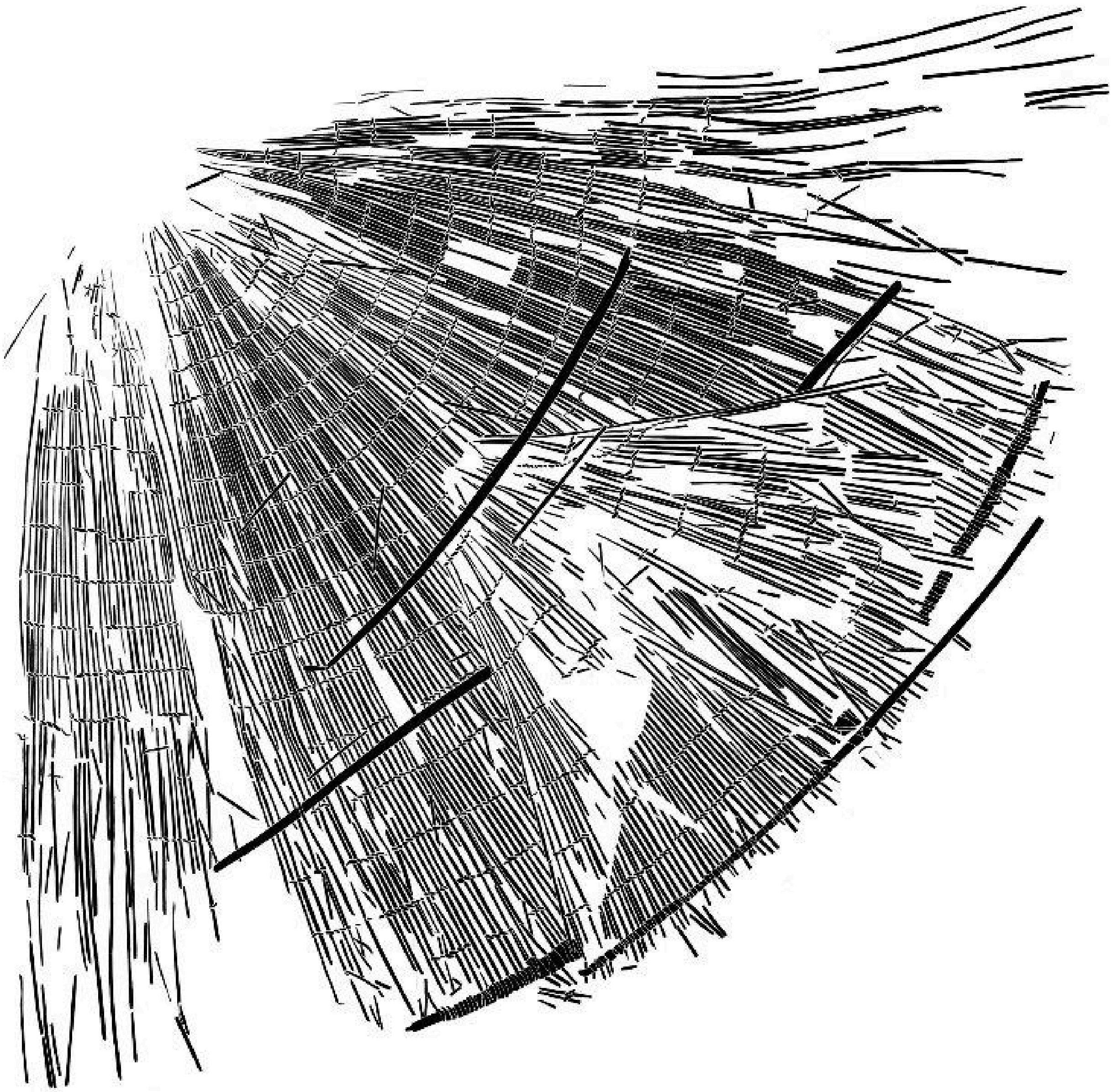
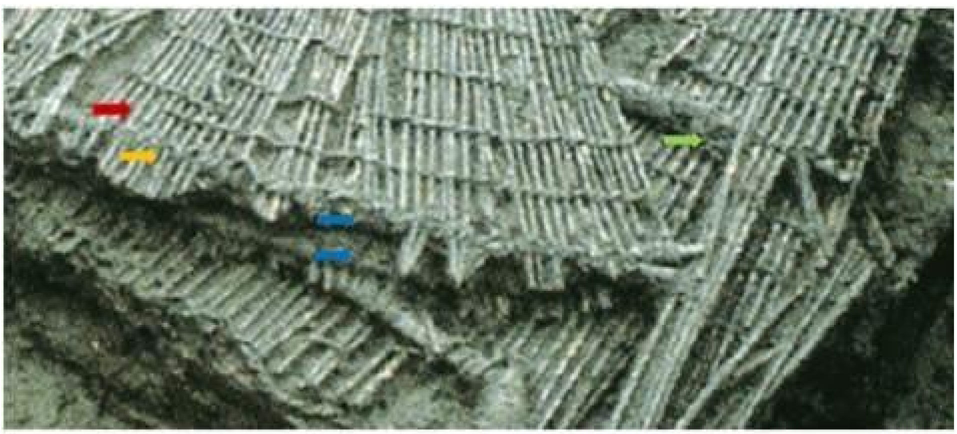


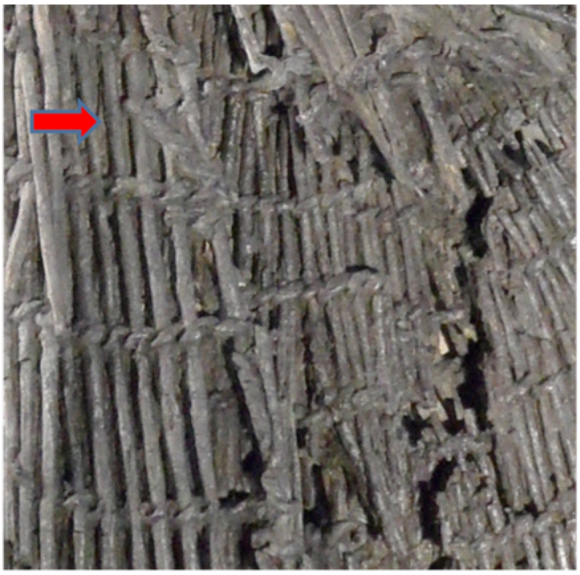
FIG 4. DRAWING FISHTRAP 2 BERGSCHENHOEK , LOUWE KOOIMANS



- (red arrow) the start of the bindings
- (blue arrow) a double layer stakes at the mouth of the funnel indicating a collapsed cone.
- (yellow arrow) the hoops are fastened with cross-stich lashing
- (green arrow) second hoop is lying under some stakes indicating that the body is a double layer

FIG 5. BERGSCHENHOEK ANALYSED, EVA IJSVELD

FIG 6. FUNNEL ANALYSED, EVA IJSVELD



Details of places on the body of the fish trap where there is an indication of the same technique for jumping to the next row as on the funnel.

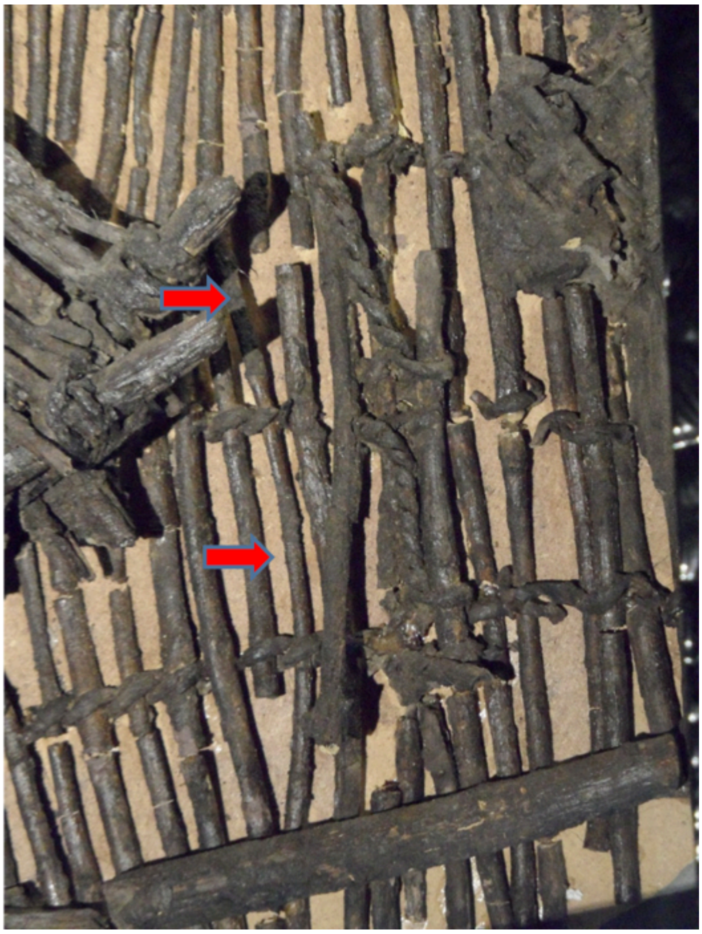


FIG 7. ANALYSED BINDING ON THE BODY OF FISH TRAP, EVA IJSVELD

FIG 8. HOGEVAART FISHTRAP, DR.J.H.M. PEETERS

FIG 9. FISHTRAP HG DE BRUIN

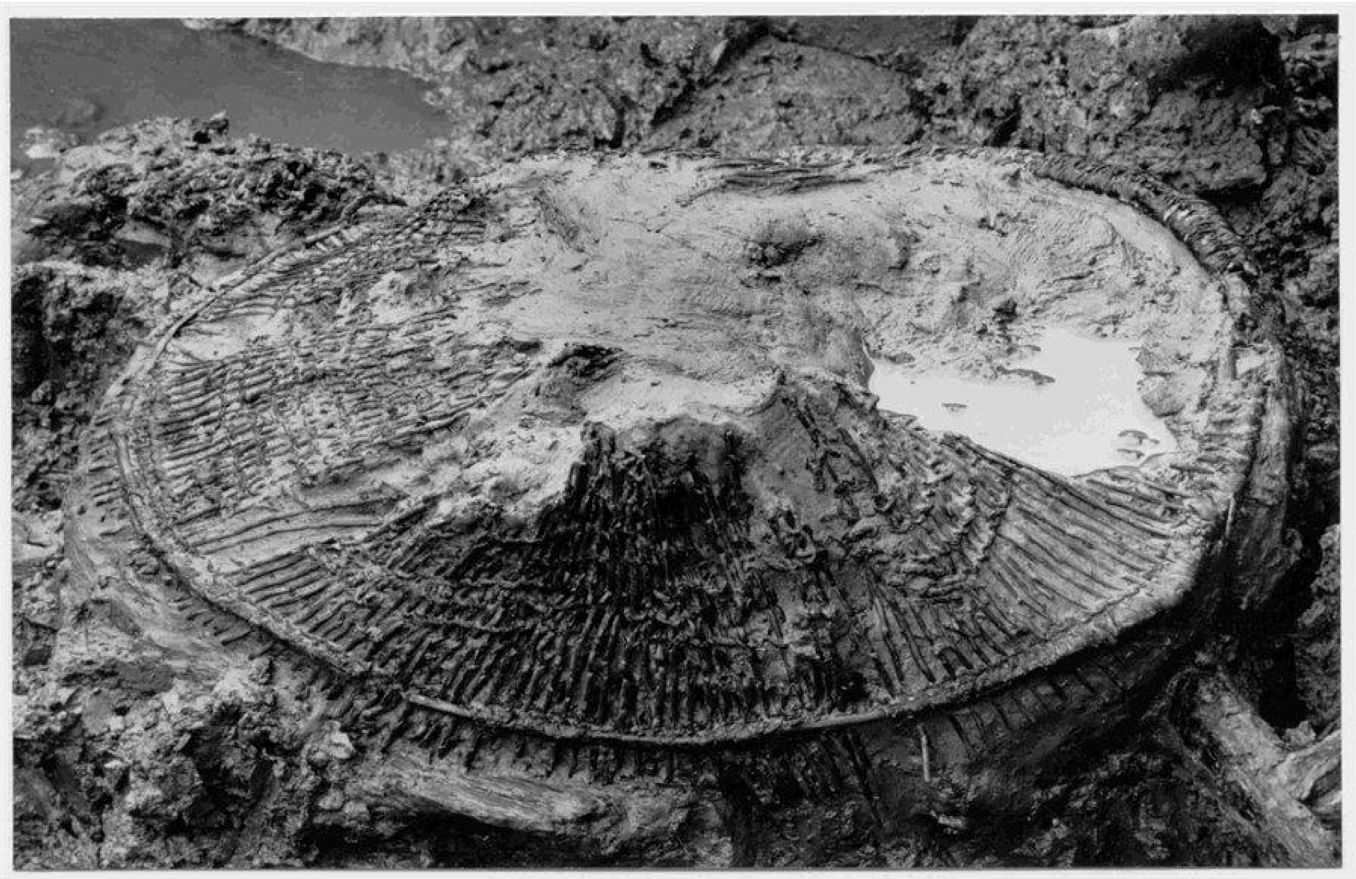


FIG 10. VLAARDINGEN FUNNEL, CORRIE BAKELS 2005

FIG 11. EMMELOORD, RECTANGULAR FISHTRAP. ADC RAPPORT 2002.

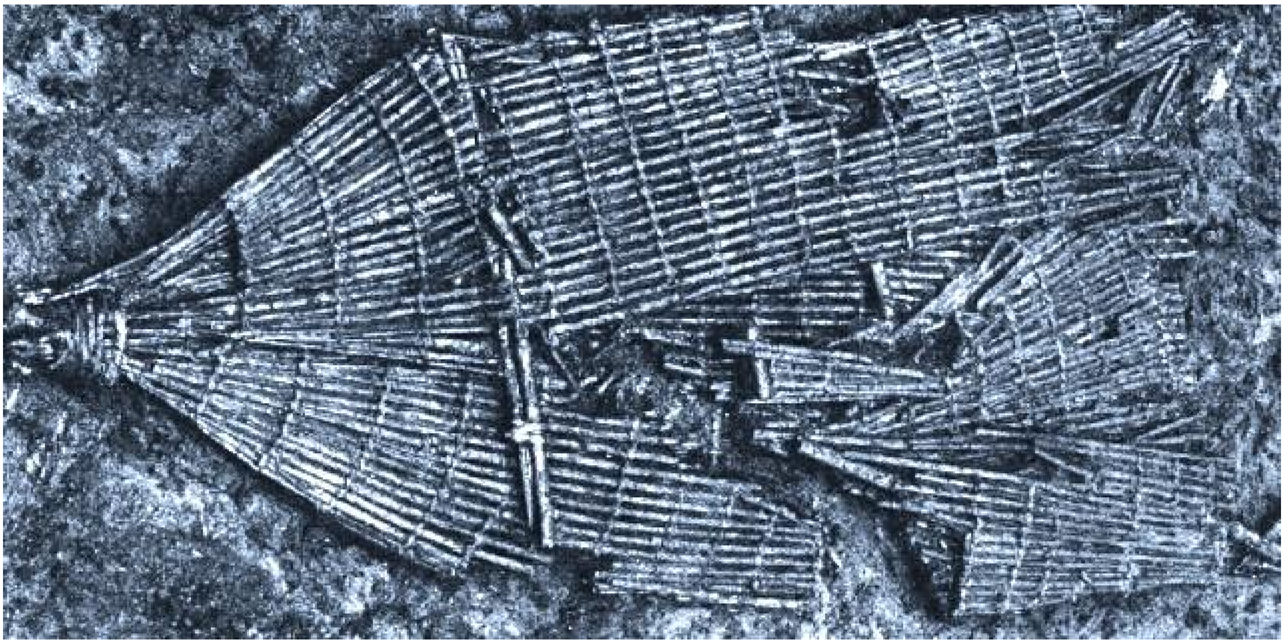


FIG 12. FISHTRAP HOLBAEK DENMARK

FIG 13. NOYEN SUR SEINE FRANCE

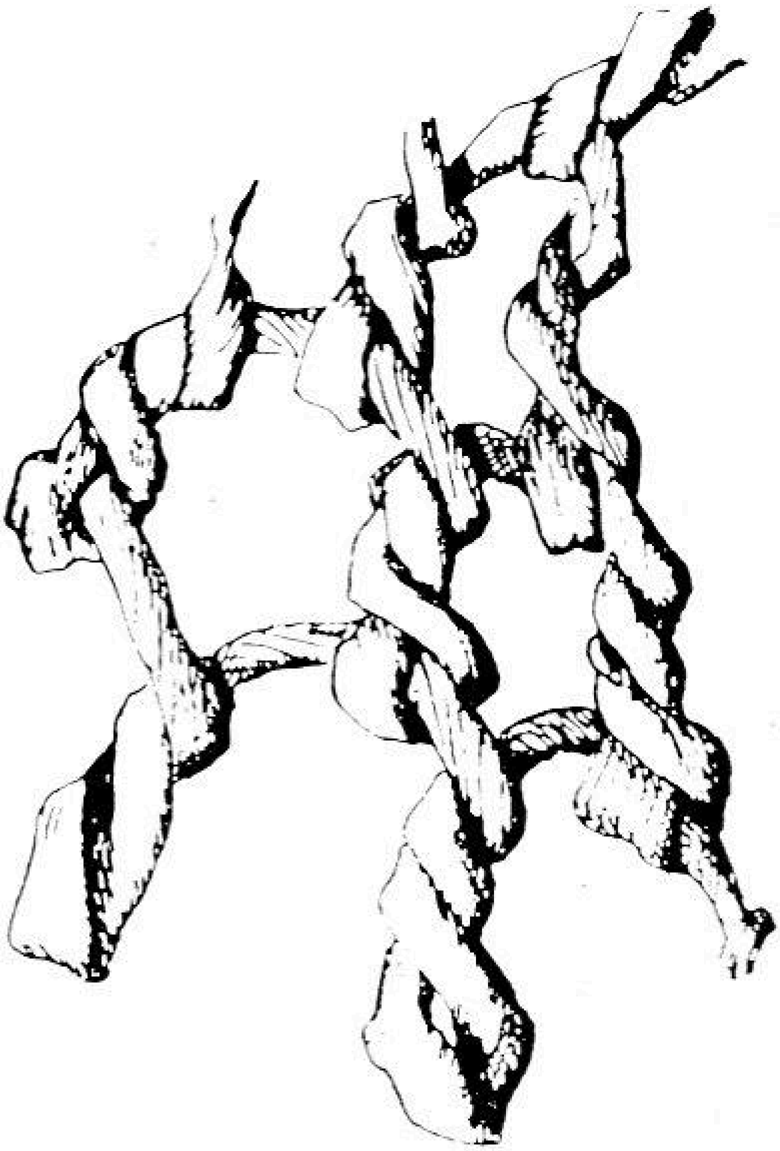


FIG 14. NEOLITHIC BARK NET ORDRUP MOSE DENMARK, HALD 1980

FIG 15. PEELING LAYERS OF LIMEBARK, HEMSLOJDEN 1995

FIG 16. FISHING WEIRS IVERNES SCHOTLAND

FIG 17. FISHING WEIRS BERGEN OP ZOOM NETHERLANDS, PHOTO EVA IJSVELD 2013

FIG 18. FISHING WEIRS BERGEN OP ZOOM, PHOTO EVA IJSVELD 2013

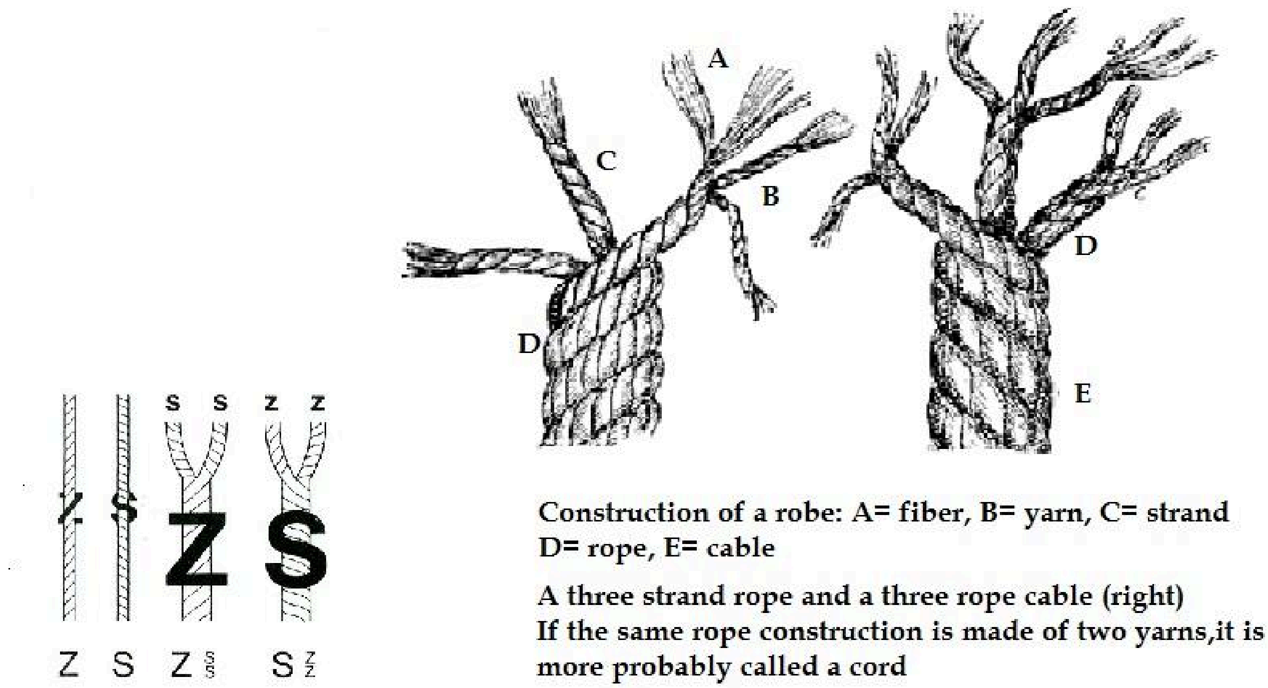


FIG 19. LEFT: TWISTING AND TWINING , GLEBA 2012. RIGHT: HTTPWWW.GUTENBERG.ORGEBOOKS13510

FIG 20. ROPE FROM TOP DOWN: LIME BARK, WILLOW, HORSEHAIR ,STINGING NETTLE AND GRASS, PHOTO EVA IJSVELD

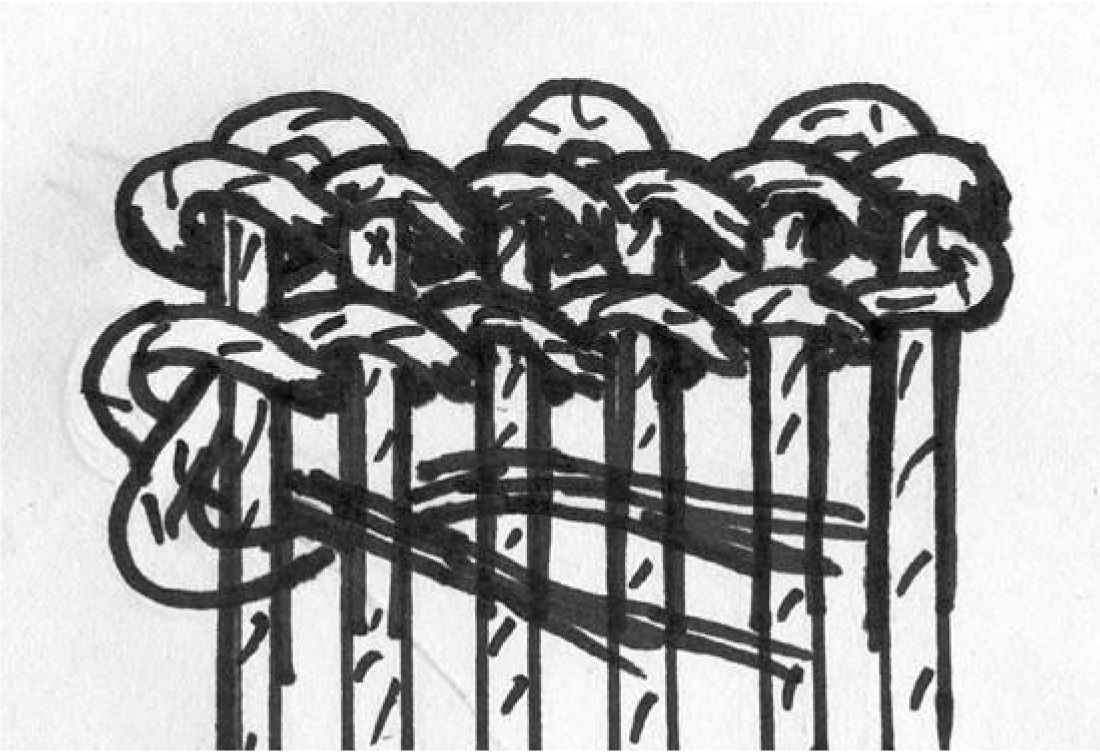


FIG 21. DRAWING OF TWINED TEXTILE, DRAWING EVA IJSVELD

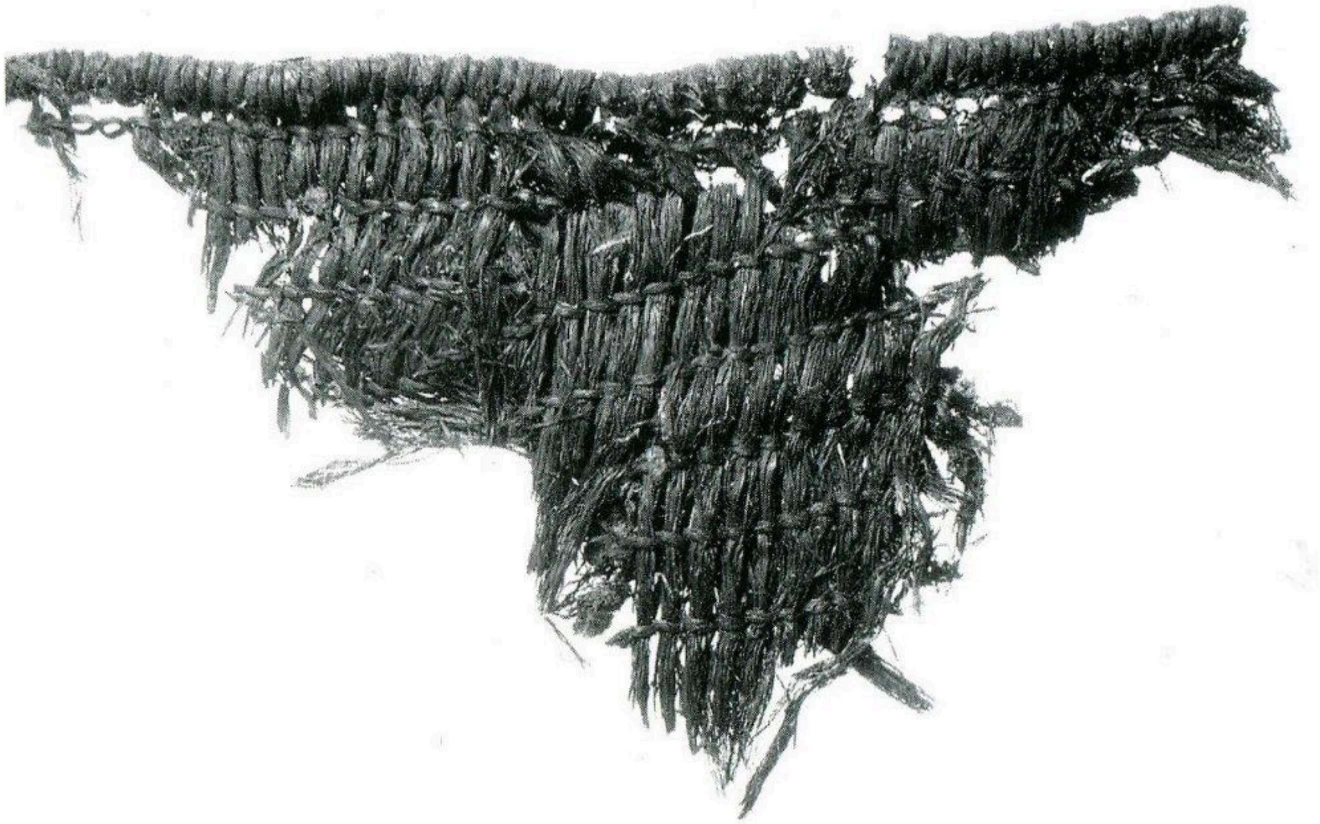


FIG 22. TWINED TEXTILE EGOLZWIL ZWITSERLAND, MÉDARD 2012

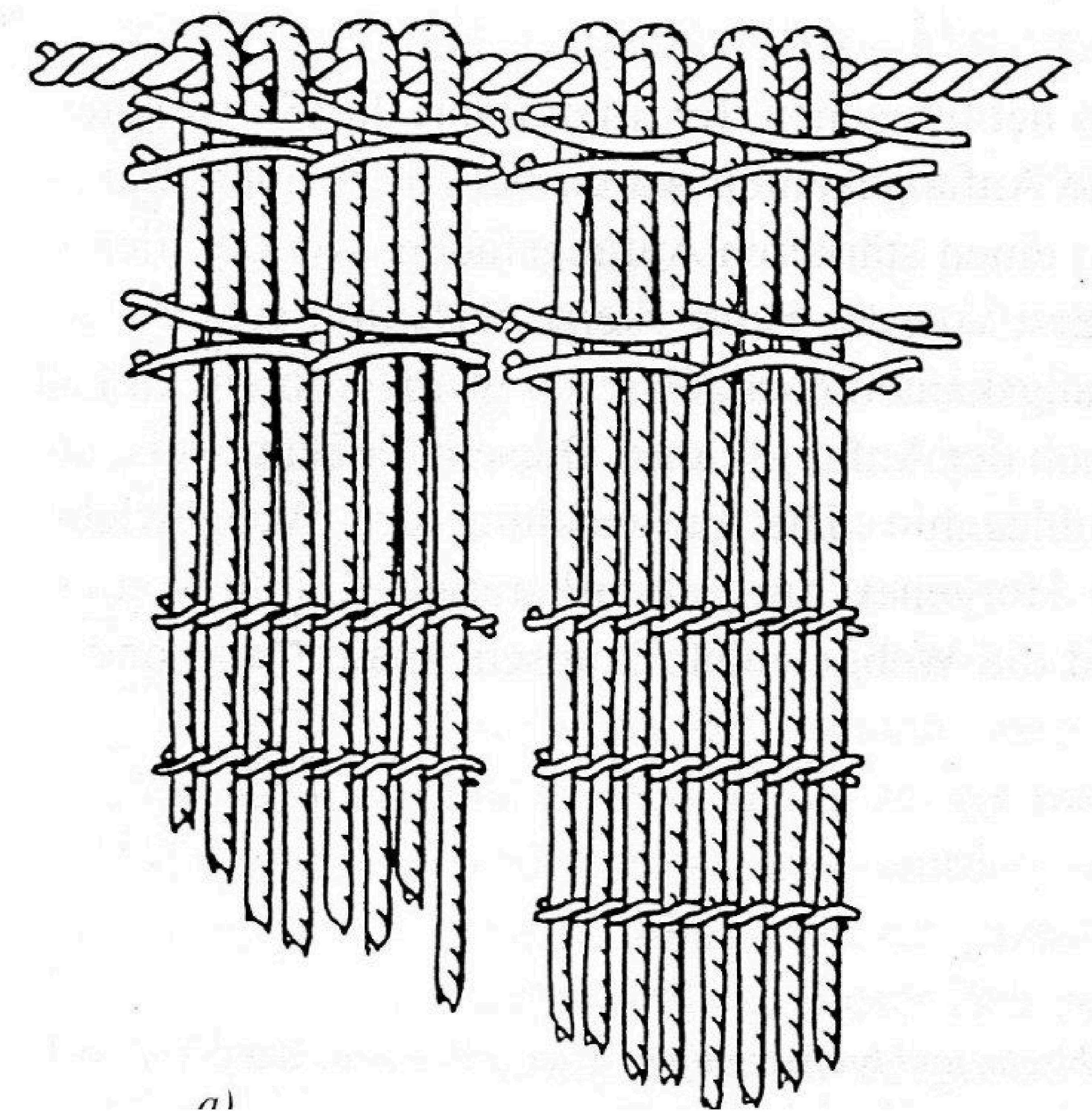


FIG 23. TWINED TEXTILE ZURICH MOZARTSTRASSE, RAST-EICHER 1993

FIG 24. TWINED TEXTILE HORNSTAAD HORLE, A. FELDTKELLER 1998

FIG 25. THREE STRANDS OF BARK FIBER, PHOTO EVA IJSVELD 2013.

FIG 26. DRYING OF THE BARK, PHOTO EVA IJSVELD

FIG 27. PEELING THE BARK IN ARCHEON, PHOTO ANONYMUS

FIG 28. PEELING THE BARK, PHOTO ANONYMUS

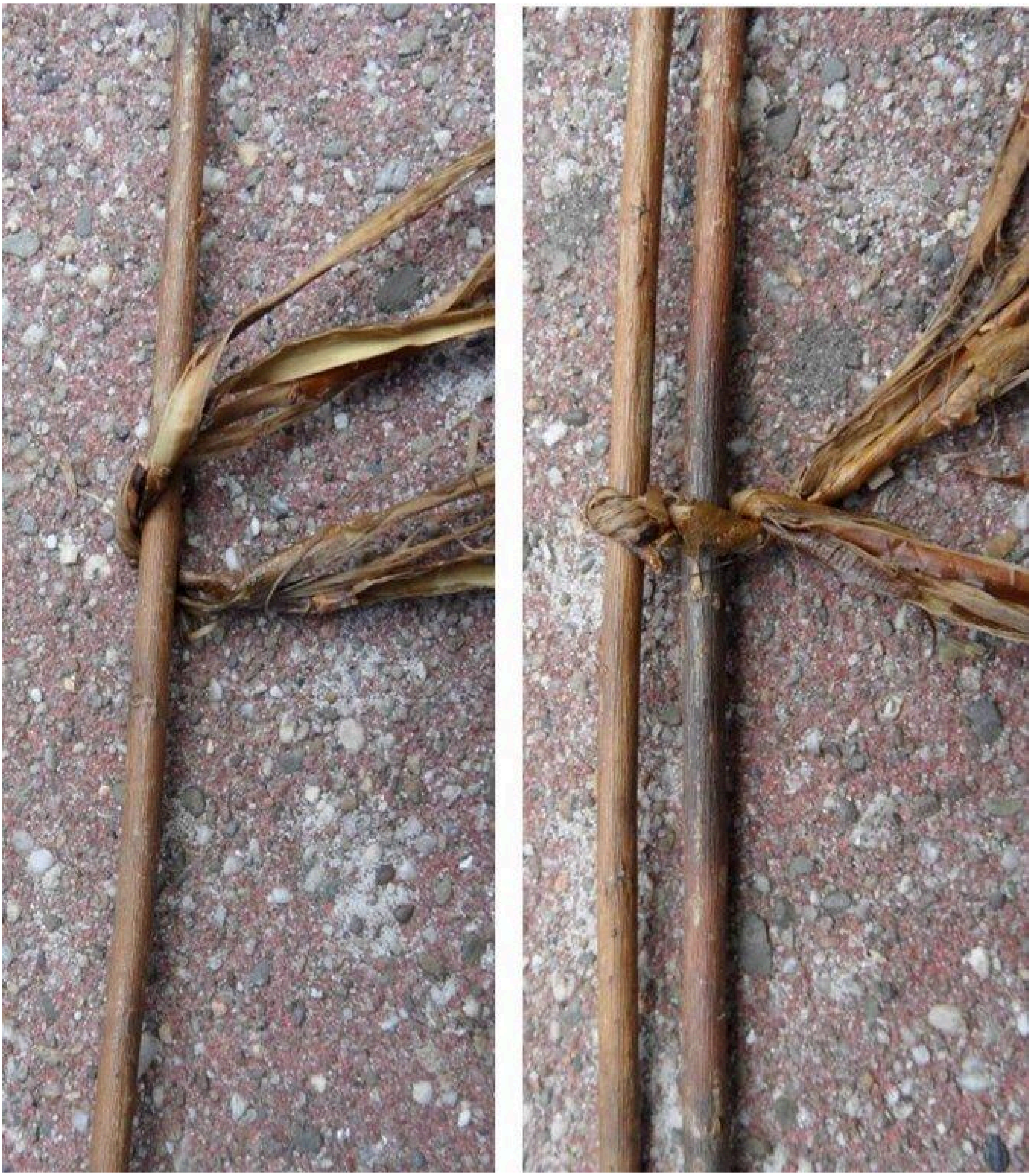


FIG 29. START OF THE BINDING, PHOTO EVA IJSVELD

FIG 30. FIRST ROW OF BINDINGS, PHOTO EVA IJSVELD

FIG 31. FIRST STAKE ATTACHED TO THE LAST ONE, PHOTO EVA IJSVELD

FIG 32. LEFT THE ORIGINAL FINDING ,ON THE RIGHT THE RECONSTRUCTION, PHOTO EVA IJSVELD

FIG 33. THE BODY OF THE FISH TRAP, STILL FLAT WHILE WORKING ON IT, PHOTO EVA IJSVELD

FIG 34. MAKING OF THE BODY OF THE FISHTRAP, PHOTO HANS SPLINTER

FIG 35. TIP OF THE FISHTRAP, PHOTO EVA IJSVELD

FIG 36. LOOKING IN THE BODY OF THE FISH TRAP WITH THE HOOPS, PHOTO EVA IJSVELD

FIG 37. HOOPS AS IN EMMELOORD FINDINGS, PHOTO EVA IJSVELD

FIG 38. CROSS-STICH LASHING, PHOTO EVA IJSVELD

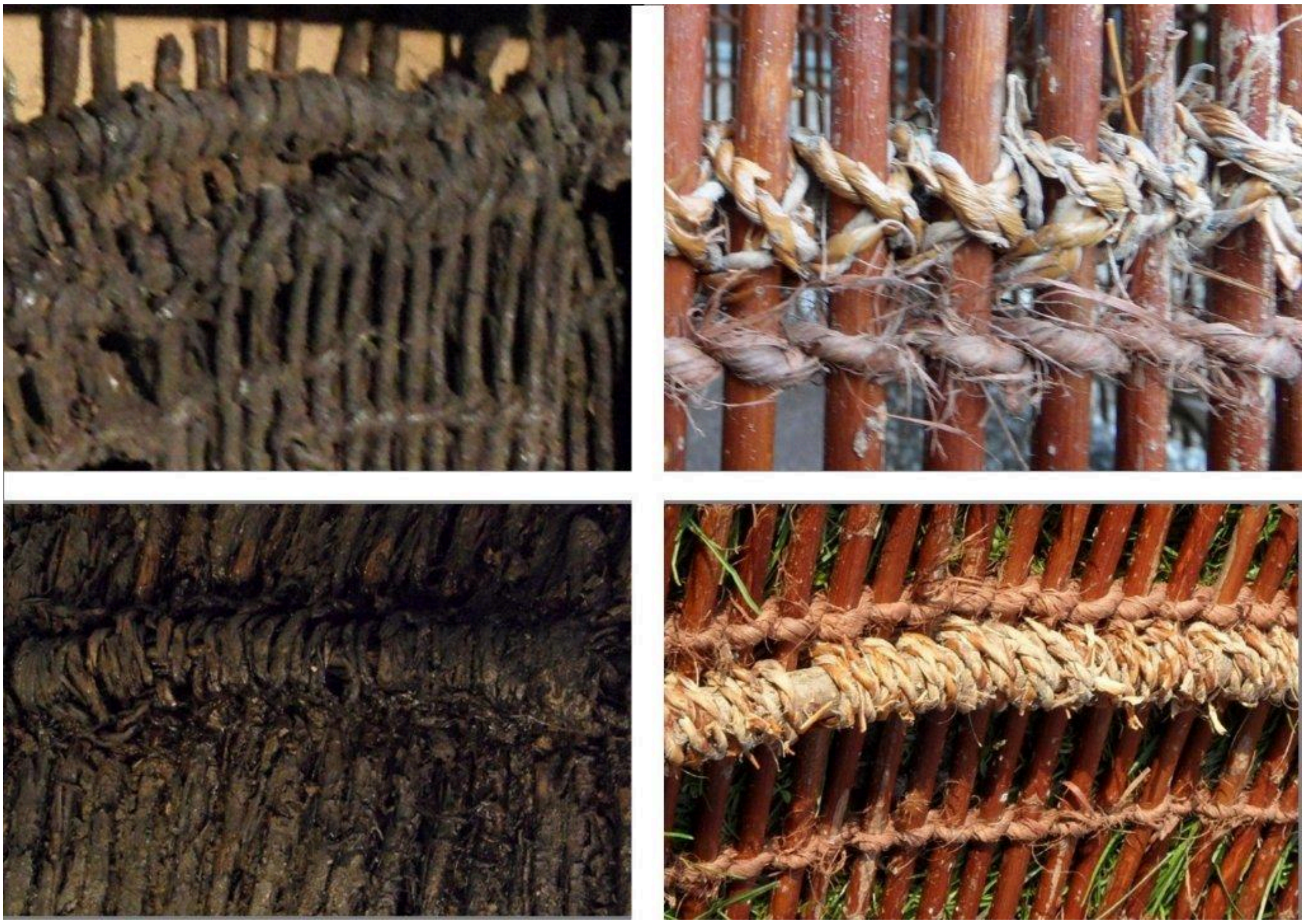


FIG 39. CROSS-STICH LEFT FINDINGS, RIGHT RECONSTRUCTION ,ABOVE OUTSIDE ,UNDER INSIDE, PHOTO EVA IJSVELD

FIG 40. FUNNEL, PHOTO EVA IJSVELD

FIG 41. FUNNEL, PHOTO EVA IJSVELD

FIG 42. DECREASE IN FUNNEL, PHOTO EVA IJSVELD

FIG 43. FUNNEL DETAIL, PHOTO EVA IJSVELD

FIG 44. WORKING ON PLACING THE HOOPS IN ARCHEON, PHOTO HANS SPLINTER

FIG 45. ARCHEON EVA IJSVELD AND THE RECONSTRUCTION, PHOTO HANS SPLINTER

FIG 46. FUNNEL IN THE BODY, PHOTO EVA IJSVELD

FIG 47. PLAITED ROPE, PHOTO EVA IJSVELD

FIG 48. FISH TRAP WITH FUNNEL INSIDE, EVA IJSVELD

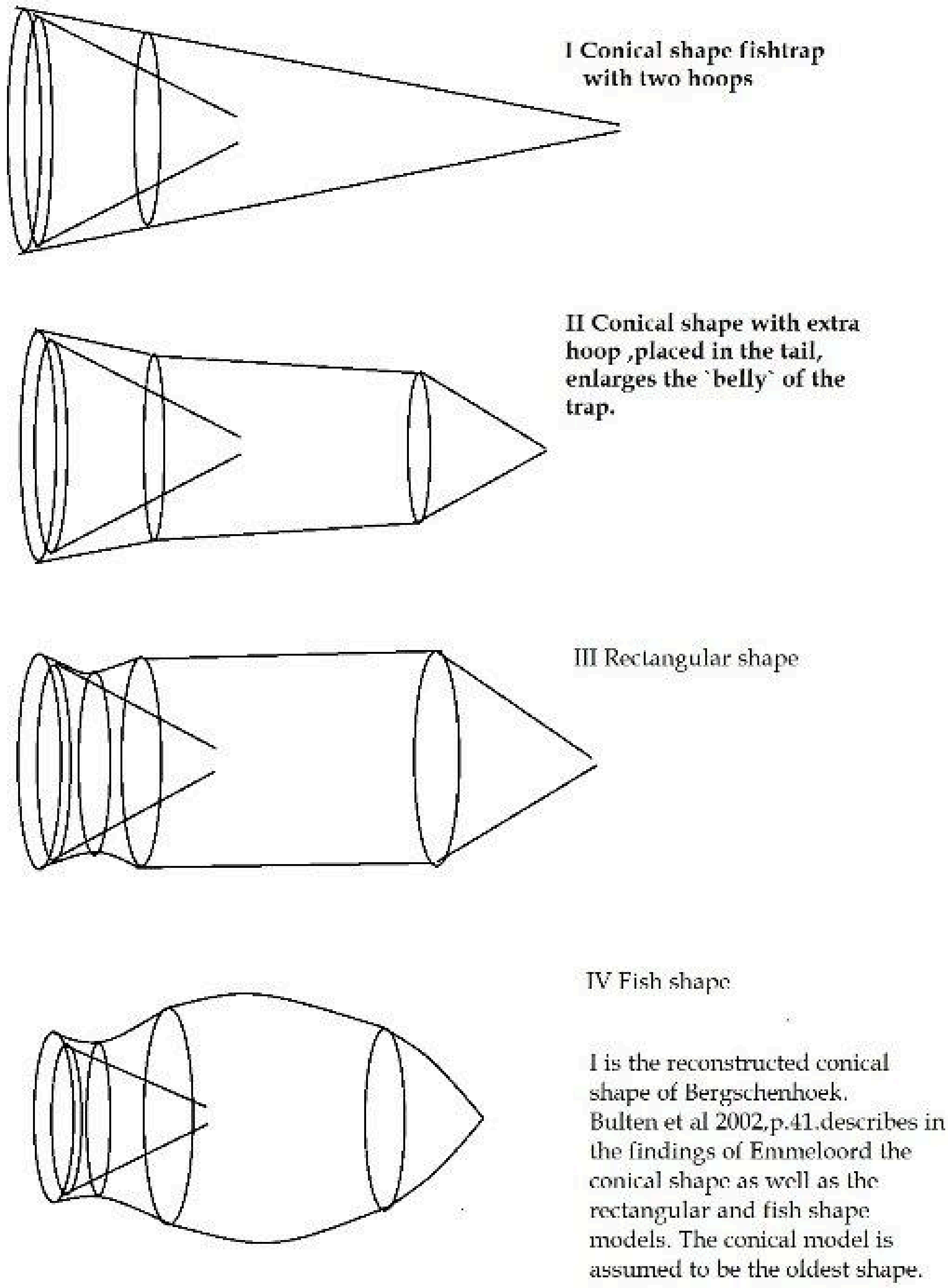


FIG 49. SHAPES OF FISHTRAPS, DRAWINGS EVA IJSVELD