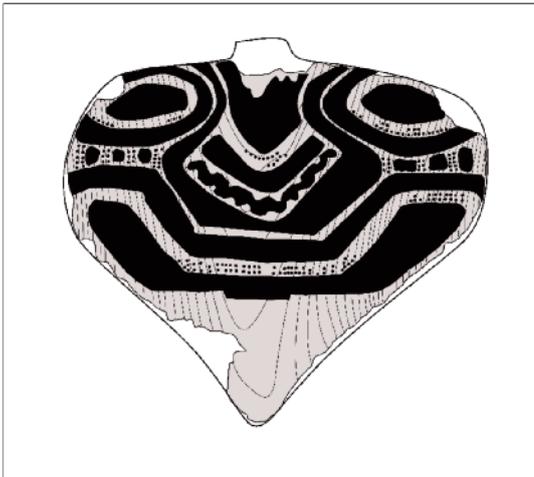




WHY ARE CANOE PADDLES THE SHAPE THEY ARE?

Around 5000 years ago, a Stone Age community lived on the reedy fringes of a lake at what is now Tybrind Vig (pronounced Too-brin Vee) in Denmark. They chipped canoes out of logs and carved paddles so they could venture out onto the lake to catch the big fish that lived out there. Their village was eventually abandoned as the post ice age water level rose, inundating their houses and the possessions they left behind.

The site lay unsuspected under the waters until discovered accidentally by amateur divers in 1957. In the late 1970s, as part of a more systematic exploration, archaeologists started bringing wooden artefacts to the surface. Divers had already found canoes and all manner of fishing equipment, but one flat, muddy object caused particular interest. A hush fell over the onlookers as dark sediment was gently washed away, revealing a beautiful, leaf-like shape ornately relief-carved and stained with black pigment. This was one of the most elaborate Stone Age canoe paddles yet found.



The paddles found at Tybrind Vig were difficult to make and not particularly efficient at propelling a canoe. Why was this shape chosen? Redrawn from Acta Archaeologica, vol. 5;87

Although carved at a time when canoe travel was still in its infancy, and when day-to-day survival surely took precedent over aesthetics, this paddle was beautifully symmetrical, intricately decorated and certainly not the simplest shape that would propel a boat. Its design, and that of other paddles made hundreds or thousands of years ago can tell us something about how the business of canoe propulsion was perceived by our ancestors. The whole story of the original inspiration behind paddle blade design might be all-but impossible to decipher now, but tantalising glimpses remain of why canoe paddles are shaped the way they are.

Near the dawn of canoe use, ancient paddlemakers were unfettered by precedent. They created paddle designs from pure functionality tempered by their emotional relationship to the world around them. If we sit down and start to make a new paddle today, we are to a great extent blinded by what has gone before. When we look at ancient paddles such as those from Tybrind Vig, we have the clearest window on the evolution of the design process.

Northern Europe is fairly rich in finds of prehistoric paddles, and I will concentrate on the origins of paddle designs in this region because they are the most familiar to me. However, the ideas emerging are likely to be relevant to paddles originating North America and elsewhere.

Any shape will do

If you compare canoe paddles from around the world, you are bound to be struck by the sheer variety of blade shapes. This variation suggests that any link between shape and efficiency is a loose one. Surely, if shape was all-important, the most efficient one would have been discovered long ago, and would now predominate. “Scientific” tests support the idea that the outline shape of a paddle blade is not the most important factor in efficiency. John Winter, the canoe designer, set up a test rig in which a variety of paddle-shaped boards were pulled through a water tank. John measured the time it took for each “paddle” to traverse a set distance. In theory, the more ef-

fective the shape as a paddle, the slower it moved. No clear trend emerged; almost any shape of paddle worked tolerably well. I did a similar set of experiment with 1:5 scale paddles of the same surface area shaped like beaver-tails, ottertails and Sugar Islands, with the same result. There was no significant difference in the water-grabbing ability between the various shapes.

So it seems that the shapes of canoe paddle blades have not evolved by selection of the most efficient configuration. However, there were a number of forces at work during the construction of prehistoric paddles, such that the efforts of the ancient paddlemakers were not random, giving paddles that, for the most part, are in fact not too dissimilar to those we use today.

Physical forces that shape a paddle

The shapes of paddles may vary, but they do so within certain limits. These overall limits are broadly set by a well-known range of physical factors that were as real when paddle shapes were first evolving as they are today:

The width of material available. With stone tools it is much more difficult to fell a large tree than a small one. This would provide a powerful incentive in Stone Age times to make paddles with narrow blades. The dimensions of trees decrease as we near the tree line, so peoples living in northern latitudes again might make mainly slim paddles. However, in some locations, as in the Amazonian forest, trees with buttress roots provide a relatively accessible source of wide timber, even when using primitive tools. Wide paddles are common in such regions.

Depth of water. Canoeing predominantly in shallow water leads to the preference for shorter, wider blades. These give reasonable pulling power but minimise the depth to which the paddler needs to submerge the blade, so reduce the risk of damaged by impact on the river bed. Longer blades are more suitable for deeper water.

Optimal pulling power. Paddles with small (low surface area) blades are relatively ineffective at propelling your canoe against the flow of a river, or against a headwind. Paddles with very large surface areas can become very tiring to use. An analysis of around fifty native paddle designs from around the world showed an average surface area of around 114 sq.in., with rather little variation around this figure (see: *100 Canoe Paddle Designs*). This probably reflects a balance between pulling power and availability/ease of working of suitable wood. Recreational paddlers prefer somewhat larger blades.

Survival of the user. A sharply pointed tip extends the use of a paddle by making it into a passable spear, useful in hunting, and in self-defence or aggression. A relatively narrow tip to the blade also reduces the splash when your paddle enters the water, enabling you to keep as silent as possible whilst canoeing to avoid spooking prey or alerting enemies to your presence. When paddling just for fun, canoeists usually choose a wider, more rounded tip.

Symmetry. In order to preform smoothly, a paddle blade needs to be symmetrical (equal pulling power) either side of the shaft so it doesn't rotate in the hands when in use.

So the majority of traditional canoe paddles are rather narrow, around 114 sq.in. in surface area, relatively pointy and symmetrical in outline. Although broadly set by physical laws, these constraints still leave considerable scope for the paddle designer.



Most native paddles are symmetrical, narrow, rather pointed and of relatively low surface area. A replica of a paddle of the Emerillon people of the 1950s, French Guiana

Function is never enough

Humans are rarely content with the mere utilitarian; the artist in us needs little encouragement. Canoe paddles are no exception to the rule that we have always woven more than just function into the things we make.

The great majority of canoe paddles have symmetrically shaped blades, and as we have seen there is a good physical reason for this. But this isn't the whole story. Humans seem hard-wired to find symmetrical objects beautiful, and so worth spending extra effort to create. Great care has clearly been taken to ensure symmetry in most of the paddles found at archaeological sites, and in more recent paddles made in traditional societies. And of course this doesn't just apply to canoe paddles; symmetry is apparent in some of the most ancient human artefacts— flint arrow heads, polished stone axes and jewellery. According to Darwin's theory, this love of symmetry must have survival value, although people have struggled to explain just what this might be.

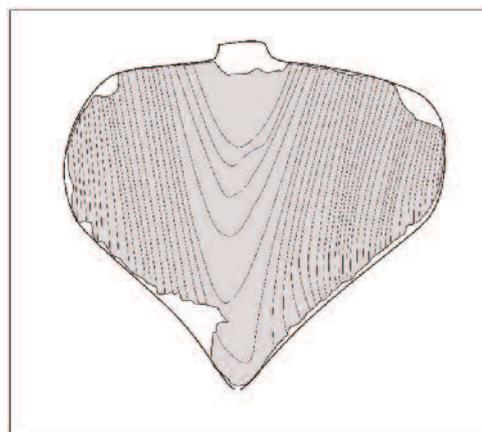
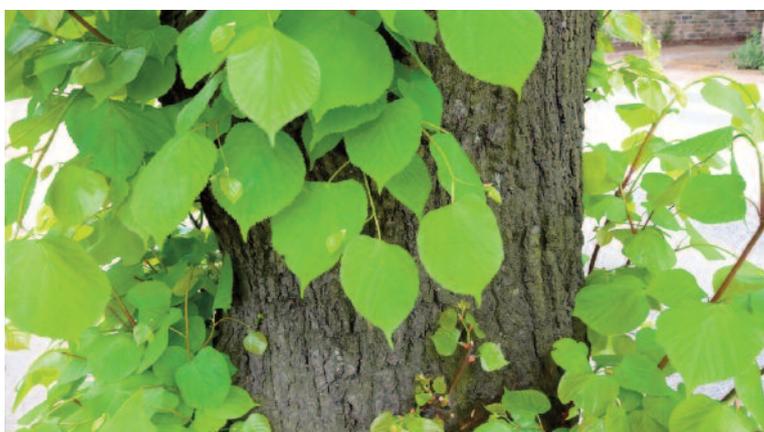
But symmetry alone is not enough. An oblong board on a stick may be symmetrical, and may function pretty well to propel a canoe; but you won't see many paddles shaped like this. Blade design has never been simply a matter of getting the same amount of area each side of the shaft. Some symmetrical shapes are clearly more attractive than others, and it is a daunting task to understand why we come to find certain shapes beautiful and desirable. We can get some clues about possible influences on our ancestor's creativity by imagining their world, especially the shapes around them from which they may have drawn inspiration. It is not unreasonable to imagine that our visual preferences were moulded to some extent by the symmetrical forms we saw about us in the primeval forest. It may not be a coincidence that paddles are often leaf-, seed- or petal-shaped.

Sympathetic magic

Apart from simply choosing shapes that they found appealing for their paddles, there might be deeper, symbolic reasons for Stone Age paddlemakers choosing shapes that resemble certain leaves and seeds. To understand their choice, we might also need to think about their feelings towards the tree species upon which they depended for raw materials for the canoes and paddles that were so important for their livelihoods.

At the Danish archaeological site mentioned at the start of this article, many of the paddles uncovered are heart-shaped. Almost all were made from ash, and were considerably wider than the majority of ancient paddles found elsewhere. Wide (around 30cm) blades would not have been the easiest type to carve in ancient times because of the need to harvest bigger trees, and because wide flat surfaces are much more difficult to shape than narrow, domed ones. If you have ever tried shaping wood with stone or bone tools you can begin to appreciate the size of this task. The paddlemakers at Tybrind Vig didn't choose the easy option. Even more paradoxically, these wide designs are not particularly effective as paddles; they tend to cause cavitation (pull air into the water) when used at higher stroke rates. The expenditure of such effort for making wide, relatively unwieldy paddles, then decorating them intricately must surely have had some perceived advantage.

Interestingly, these heart-shaped paddles resemble the shape of the leaves of the lime tree, the source of the timber of choice for making canoes in prehistoric Europe. It was selected because it is soft and relatively easy to work, and dries out without splitting. In Europe, the lime was our Mesolithic ancestors' Canoe Tree; the paddle shapes of the people at Tybrind Vig, deliberately or not, were symbolic of canoe travel. But, the paddles themselves



The leaves of the European lime compared with the shape of paddles found in Tybrind Vig, Denmark. This paddle shape might have venerated the role of the lime tree as the source of the timber of choice for dugout canoes.

(like most surviving paddles from prehistoric Europe) were carved in ash wood, most likely because soft limewood is not ideal for the rough life of a paddle blade.

Whatever the reason behind the heart-shaped paddles at Tybrind vig, it was purely a local thing. They are not typical of Stone Age paddles found in Europe generally; most are slimmer and resemble the more familiar paddle shape of today. However, heart-shape paddles have also been found at several other sites in the general area of Tybrind Vig, evidence of a local group of peoples sharing the same beliefs or fashion.

By far the most common paddlemaking wood in Europe from the Stone Age onwards was ash. This wood was (and is) also widely used in North America. Tantalisingly, the samaras of ash are possibly one of the most paddle-like shapes in Nature. Might some ancient people have chosen to incorporate an emblem of the “parent” tree into their paddles? How fitting that the tree to which they most often went for material was bedecked for most of the year with bunches of tiny canoe paddles. Symbolism was clearly a fact of life back then; it runs deeply through ancient ritual and art.

And we still incorporate symbolism in some of the things we make, a nod to the origin of the design. One example is the “pointing hand” type signposts once popular, which carry the memory of helpful bystanders pointing out the way.

Perhaps the most familiar prototypes for canoe paddle design, at least going by the names of today’s classic models, are the tails of beavers or otters. Beavers do have very paddle-like tails, otters less so. But although beavers use their tails in swimming, it is unlikely that the first paddlers saw in this structure the direct answer to how to propel their canoes, and so join the beavers out on the lake. Beavers paddle primarily with their feet and bring their tails into play mainly as a rudder. The tail is much more in evidence to the onlooker as a prop when the animal is standing upright on land. Nonetheless, some North American Eastern Woodland designs of the Mi’kmaq and Maliseet are very beaver tail-like in shape, as is one of the oldest paddles yet found (7000 BC), unearthed at Ulkestrup Lyng in Denmark. It is at least possible that these paddles embodied for the maker some essence of the freedom of water travel as symbolised by the beaver.



A replica of an 8000-year-old paddle found at an archaeological site in Lithuania. Ancient European paddles were almost always made from ash wood, and this design may have been inspired by the paddle-shaped seeds of the tree



Beavers’ tails (left) may have influenced the design of some paddles, such as this replica of a 9000-year-old paddle found at Ulkestrup Lyng in Denmark (right). But it might have been the beaver’s freedom of movement on the water rather than its method of propulsion that was the inspiration.

The shape of wear and tear

About thirty years ago I bought a general household scraper, of the type used for stripping paint and wallpaper. It has been a trusted companion on all the repainting and redecoration jobs we have done around the house ever since. With constant use, the corners of the blade have worn to beautiful curves, the one corner being an almost perfect mirror image of the other. The wear-curves produced look very like those at the tip of a typical beavertail blade. This raises the idea that the “beavertail” paddle blade tip is actually self-generating (given long enough); it may be a shape inherent in the very nature of wooden things. The shape might have been adopted by ancient paddlemakers because angular tips “evolved” to this shape anyway by abrasion on rocky river beds.



The once angular corners of a scraper worn into curves by constant use. Such a curve is echoed at the tip of a paddle blade. Such a “pre-worn” shape is more resistant to further abrasion damage.

The physics of wear processes is an active area of scientific research, with the serious aim of minimising wear in engines and structures by machining parts at the outset to the shape they will eventually wear down to. Ancient paddlemakers might have been fully aware of this and so carved their paddle tips to the pre-worn outline to reduce the chance of splitting on impact with rocks. The shapes of wear also often appeal on aesthetic grounds as they are frequently rather beautiful— like water-worn river stones, or pebbles on the beach. Cabinetmakers sometimes reproduce wear-curves on the edges of their creations for aesthetic effect.

A guiding hand

When our Stone Age ancestors set out to make a paddle they could have simply set to work carving, following some design in their minds eye. Alternatively, they might have used some type of template to mark out the shape. It is possible that the “templates” or design aids available to the primitive paddlemaker played some part in the evolution of the paddle blade shapes which are familiar to us today.

To draw a curve, primitive paddlemakers could have taken a flexible withy and drawn around it with a piece of charcoal from the fire, very much as we would use a wooden batten today. Straight, flexible new shoots cut from a tree naturally taper, and when bent form the compound curves that we see in canoe paddle blades, especially at the tip. The desired curve of the withy can be stabilised by tying off with cord, and the “template” thus formed can be used to create symmetry by scribing one side of the design, then flipping over to create the other. Using such a template could *dictate* paddle design to some extent; it hard not to produce a beavertail shape using this method.

We will probably never know for sure whether prehistoric paddlemakers drew around flexed sticks to design their paddle blades, because of the ephemeral nature of these devices, but the concept of a template has a long history— from birchbark canoe builders using bark templates to create the repeated designs etched onto their hulls, right back to early cave-painters drawing around their hands.

The most obvious template for drawing around to give a paddle design is another paddle. Quite apart from reproducing a particular shape, the edges of paddle blades also make excellent “French curves” for piecing together curvilinear outlines related to the original to a greater or lesser degree. Using the paddles of others as templates is a powerful force for the conservation of a particular design within a group. It is usually the case that paddle designs within a particular tribal group are similar, but may vary from those of more distant neighbours.



A flexible withy forms a paddle-like compound curve when held in tension with a cord. This could have been a handy design aid in the primeval forest.

The paddles that turn up at ancient archaeological sites were crafted in an era close to the dawn of canoeing, carved to designs embodying a pure response to the physical and conceptual world surrounding the maker. We can only guess at the subtle forces that may have guided paddlemakers' hands as they painstakingly split and pared away at their wood. It is plausible that some paddlemakers were inspired by the shapes of nature they saw around them, maybe with a special reverence for the particular types of tree that benevolently provided material for making canoes and paddles. Others might have been influenced by the appealing shapes emerging when wooden implements wore down with use, and by the beautiful curves expressed in the flexing of a withy. Today, our paddles make only swirls and ripples in the water, but a Stone Age paddle likely stirred up all manner of images and associations for its user, related to the world around them and their struggle for existence.

Whether primal paddlemakers actually were influenced by all, or any, of these factors, we may never know. But what is certain is that making a paddle with stone tools was a sufficiently demanding task that the end product would have been highly valued and treated with respect. It may be significant here that at the majority of archaeological sites where both dugouts and paddles have been found, the paddles were made at an earlier date than the canoes. One interpretation of this observation is that paddles were carefully preserved and continued to be used from generation to generation. Paddles originally made to propel earlier skin-and-frame canoes may have outlived these vessels because the latter, being made of highly perishable materials, simply did not survive. It was only later, when technology had advanced sufficiently to allow bigger trees to be felled and hollowed out that the more enduring dugout canoes came into being, and it is these that we uncover today.

Regardless of how our ancestors got inspiration for their paddle designs, I feel sure that they would have shared with us the delight in what at times seems like a magical process—the transformation of a crude slab of wood into a thing of beauty with one's bare hands.

Graham Warren

Book cited: *100 Canoe Paddles Designs*. Raven Rock Books. U.K. 2014.