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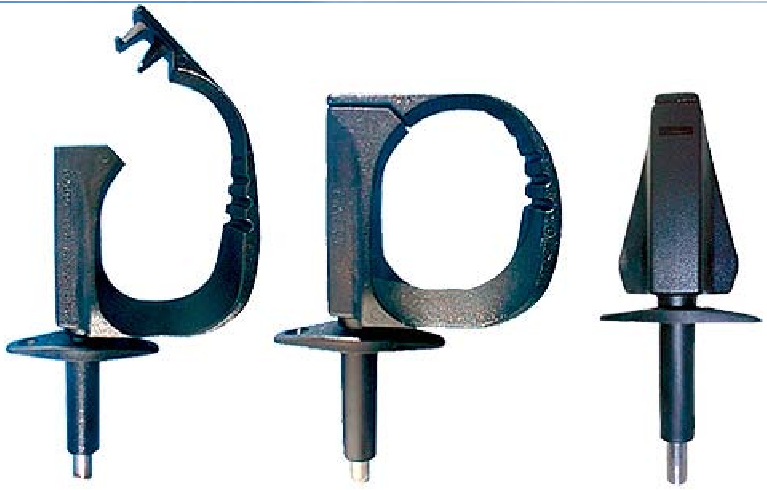
By Australian boat builder John Murray inventor of the Gaco Oarlock.

Gaco Oarlocks, Revolutionary Design!

Friction Free!
Light smooth and easy to use, the GACO rowlock snaps onto the oar for safety's sake. The rowlock of the future costs a little bit more but saves in the long run. It employs hardened 316 SS and black polypropelene for a low friction bearing which will not corrode or wear. Lighter and kinder to oars and gunwales, it's carefully angled shape eliminates the tearing effect of ordinary rowlocks on your rowboat and facilitates the stroke. Forget the struggle with your rowboat and snap onto your oar for an unbeatable rowing experience.

"I have discovered the GACO oar-locks. Though they couldn't be described as traditional in appearance, I have found them to be light, strong, and moderately priced. In addition, they make no noise whatsoever. I am not affiliated with GACO."

(Letter to the editor Wooden Boat magazine, October 2005)



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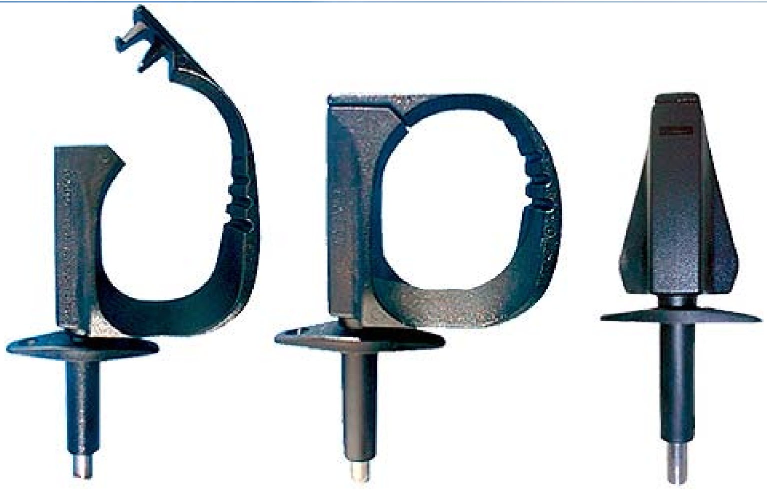

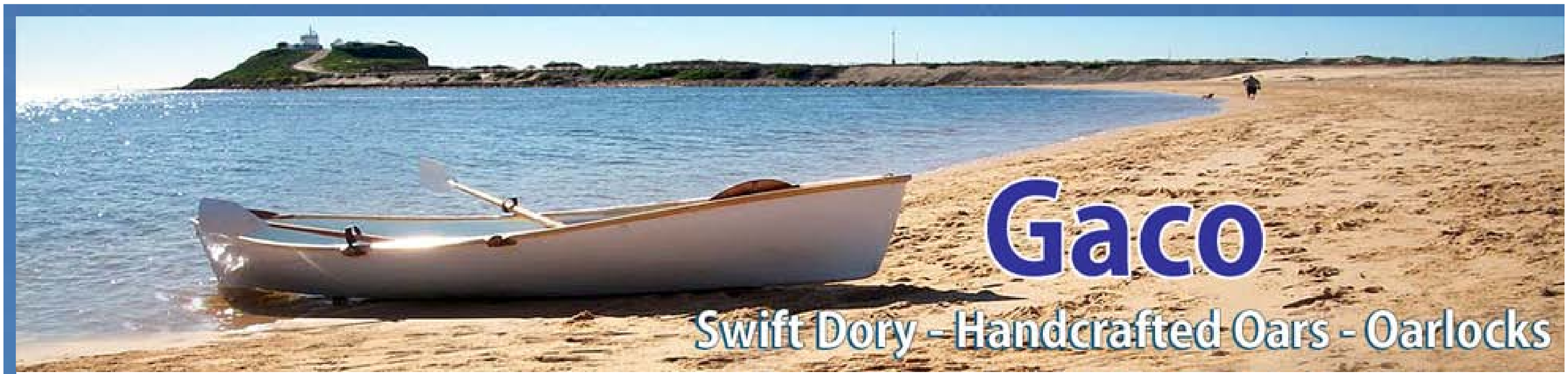

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The Gaco Oarlock (for Rowboat Owners)

"I have a set of your oar-locks already and love them. They do what you said they do and they have remained wabble and squeak free for a couple of years and probably 800 miles. Thank you."
(David Bridges, Rhode Island)

"I have to say that the Gaco oarlock assembly is not only unique, but a delight to use. I have in the past used various systems but none have been so trouble free or kind to the oars as Gaco."
(Garry McPhail, Ontario Canada)

Best Oarlocks on the market.

Kit contains:
2 Oarlocks + 2 sockets + adaptor sleeves for existing sockets & fitting instructions.
(Most common size adaptor sleeves supplied but other sizes available on request.)




To fit oars up to 2 1/4 inch (56mm) diameter.

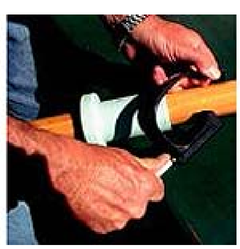
Why it works so well:

Ordinary rowlocks develop friction and wear because of the uneven pressure where the pin rotates in the socket. In the GACO rowlock the pin does not rotate in the socket. Up and down movement of the oar is accommodated by the carefully angled shape. The two features above are employed in the design of rowlocks fitted to racing sculls now available for your rowboat.

1. Light, strong and won't corrode.
2. Much lower friction in both horizontal and vertical planes.
3. Will not wear out.
4. Less wear on the oars and gunwhales.
5. Snaps onto the oar so rowlocks can t be lost.
6. Does not develop slop with time.
7. Quiet and elegant.
8. User friendly, magic to use.

Fitting the Rowlock to the oars of your rowboat:

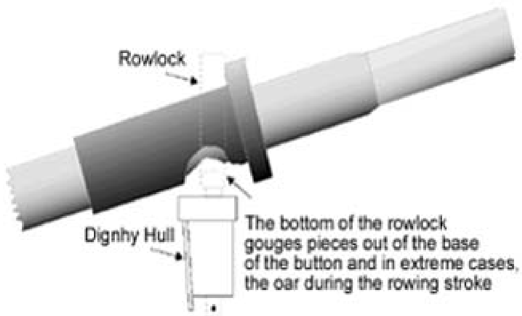
1. Lay the oars alongside each other so that the blades are together. Open the gate of the rowlock by pressing a screw driver into the bottom of the slot at the front top of the rowlock.
2. Pull the gate open and slip the rowlock over the shaft of the oar.
3. Press the clip on the end of the gate shut. Repeat these steps with the second rowlock.
   The rowlocks must be mounted so that the arrows on top are pointing towards each other.
   (See picture 4)
4. You now have a port and starboard oar. They will function much better if they are mounted so that arrow on the top of the rowlock is facing the bow when rowing. NB: If your rowlock sleeves have lugs on them you will need to cut them off with a knife (a simple task).

Fitting the socket to the gunwale.

The socket has a 10 mm internal diameter and a 5/8 (16mm) outside diameter, and should fit most socket holes. For high sided boats the rowlocks will work more efficiently if they are angled outwards. If no suitable hole exists drill a 5/8 hole in the gunwale. and insert the socket and secure with 3/4"(20mm) by 10 gauge screws. The rowlock set includes 7/16"(11mm) adapter sleeves for current sockets while other sizes are available on request.

How the conventional design damages the oar.



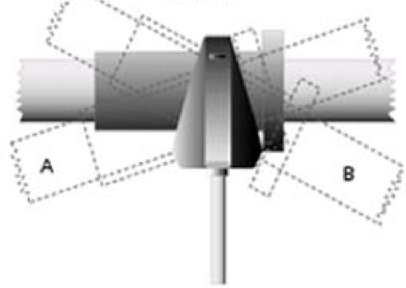


Figure 1

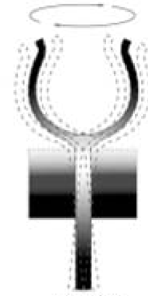


Figure 2

How the Gaco design avoids wear problems.

The GACO snap-on Rowlock makes it easier to row well! It's as simple as that. The GACO snap-on Rowlock allows the oar move up and down easily, and its unique shape encourages the oar to sit at the best angle to achieve an efficient rowing stroke. (See Fig.1)

The plastic head of the rowlock rotates around the metal pin which remains stationery in the gunwale. This eliminates wear in the socket holes and is virtually friction free, making it easier to row.

Conventional rowlocks rotate in the gunwale causing wear, often causing the hole to become oval and creating that familiar clunk slap noise when rowing the boat. (See Fig.2)

The GACO snap-on Rowlock head is made of polypropylene, a material that is very strong, UV resistant and extremely light.

The pin is 316 Stainless Steel. It will not corrode or wear and is the benchmark for metals used in a salt water environment. It is 40-50% stronger than conventional rowlocks.

Contact: mail@gacooarlocks.com Or Fax: (02) 9456 7150 (Trade Enquiries Welcome)

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The Swift Dory Recreational Rowboat

Introduction to Rowboat

The "Swift Dory Rowboat" is a swift rowing dory which is a delight to row. It is probably the fastest one man rowboat available for recreational use. It is being offered with two rowing positions and a rudder so that it can be rowed in a variety of ways and with considerable ease. Apart from the elegant and efficient design, the ergonomics of rowing are very refined. In fact the GACO rowlock was developed as part of this refinement.

Gaco Rowboat Design History

The Swift Dory hull shape has evolved over a period of a hundred years or more. It is based on the Adirondack Guide boat and drawn up by the American Halsey Herreshoff in 1947. It was refined by the famous small boat designer John Gardner to increase its seaworthiness. The Swift dory row boat has been further refined and adapted for fibreglass construction. Dories are a kind of rowing boat with a flat bottom originally designed to fit inside each other for use on fishing schooners. The flat bottom of the rowboat is a design feature particularly suited to speed as it permits of a narrow hull with adequate stability. Herreshoff described the hull as "falling between the fragile racing scull and the heavy ill shaped row boat of several hundred pounds". The hull is 5.5 m (17ft.) long 1.2 metres wide and weighs 51kg. Rowed with vigour it will travel at 6 knots and can easily do 5.

Applications for use of the Swift Dory Rowboat

There are many examples of the Swift Dory in use as commuter rowboats on Dangar Island where their ease of rowing, room and sea-worthiness is fully appreciated. They have been employed partly as a green solution to dangerous, noisy and smelly "tinnies". Recreational applications, however, are also an attraction and they are used for picnics, exploration and exercise. The Swift Dory row boat is capable of carrying up to six people but is designed to carry between one and four.

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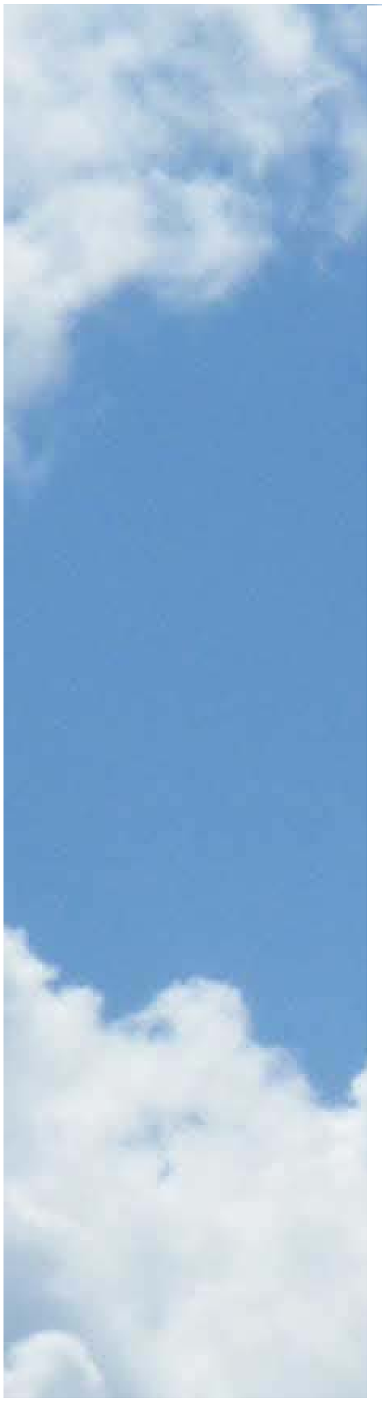
Gaco Oars

Handmade by Australian Boat Builder John Murray

The shaft is fitted to the Gaco oarlock to hold the blade vertically to the water. Leather or rubber protectors are not necessary for the oar with the Gaco and the increased resulting diameter at the rowlock aids stiffness and strength. The blades are a composite of fibreglass and coremat for strength and light weight. The shape is compound to increase strength and grip on the water.



The handles are turned to the ideal shape for a comfortable grip. The shafts are engineered for aesthetics and low outboard weight. This makes it easier to lift in and out of the water and to change direction on the strokes. The rudder is operated from lanyards inside the hull.

Download plans for making Oars here

There are three basic rowing options:

1. Single rower where the dory is steered by use of oars. **2.** Rower in the front seat and passenger lounging and steering from the rear. **3.** Rowers in the middle and front seats with passenger lounging and steering from the rear. Rowers may be equipped with a pair of oars or one oar each.

Selling Gaco Oars direct to the public:
We have been able to keep the price for a pair of oars down to $220 including GST.

If you are interested in a pair of handmade oars that you will keep for a lifetime my email address is:
mail@gacooarlocks.com

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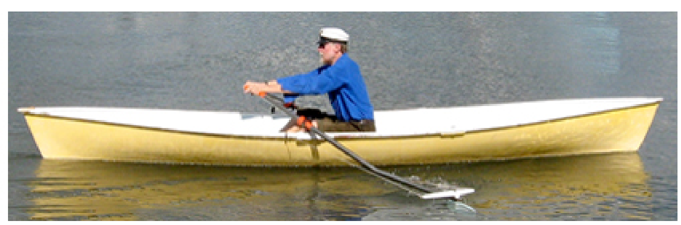
The Swift Dory Recreational Rowboat

Rowboat Construction

The rowboats hulls are made of vinyl ester resin (stronger and lighter than polyester) reinforced with glass fibre and finished on the inside with polyurethane paint. The seats or the rowboat form fibreglass air tanks for strength, buoyancy and stiffness. There is plentiful use of varnished cedar for gun-whales, front and rear back rests and gussets. There is also an adjustable cedar foot-stretcher to brace your feet against when rowing. The dory row boat is provided with a sturdy snag free rudder which does not interfere with beaching. The rudder is operated by lanyards from the passenger seat. The overall impression is of elegance, swiftness, and comfort. The rowboat is sufficiently light that two people can easily carry it or lift it onto the roof of a car for transport.

Rowboat Specifications

Length	5.25 metres(17ft)
Width	1.2 metres
Weight	33kg(79ibs)
Top Speed	5.5 knots
Cruising Speed	4.5 knots



Contact Rowboat Sales

By selling Swift Dory Rowboats direct to the public we have been able to keep the price for the dory including oars down to $3800 including GST.

If you are interested in a Swift Dory Row boat my contact details are:

John Murray
Mobile: 0419 606 832
Office: (02) 9456 1150
Fax: (02) 9456 7150
mail@gacooarlocks.com

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Gaco Swift Dory

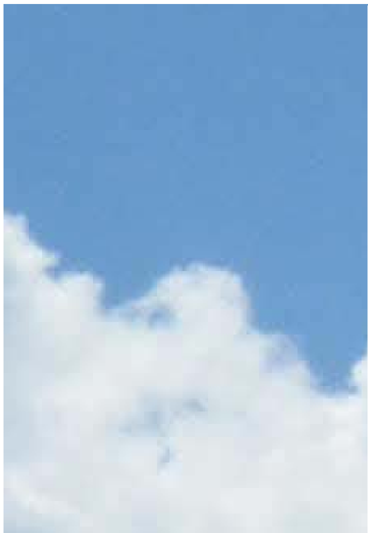
Gaco oarlocks

Dangar Dory Derby Day Part 1

Gaco Gated Oarlocks

Dangar Dory Derby Day Part 2

John Murray on another adventure.



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Gaco Oarlocks available here

Fisheries Supply
Marine Supplies Since 1928

"Born to Row" by John Murray

Not quite, at the age of five I struggled to paddle a canoe made by my Dad from the wing tank of a WW2 fighter plane. Not long after I found myself straining to row clinker hire boats on the promise that I would bail them free of water. Often the water would flow in faster than I could bail it out, and sometimes we rowed into waters where man-eating sharks were still devouring people (Middle Harbour in Port Jackson). One poor fellow from the Mediterranean was warned not to dive in and was taken the instant he hit the water. Then, in the sea scouts I struggled with heavy hardwood oars to row whaleboats. Really! Were whaleboats so heavy and clumsy? Apparently so, it was just as hard to row the replica whale boat to re-enact the trip of Captain Arthur Phillip 8 miles up the Hawkesbury river for the Australian bicentennial in 1988 (these were not the proper super light weight whaleboats used to chase whales).

Later I demurred to row a surfboat because of a bad back but when pressed into service was delighted to find my bad back cured. I had the experience of coasting into the beach trailing oars on a wave that a surfboard would find far too shallow to catch. Then, on to the purposeful rowing of a dinghy as I sailed around the world. Now here was a boat I could row easily if not at a great speed. On one occasion I rowed the damn thing 5 miles to a reef off Tagula Is. in New Guinea, where I had been shipwrecked, for a spot of spear fishing. I had to turn back when a huge shark cruised by, as I was about to enter the water.

These days I am consumed with the desire to have the perfect recreational rowing boat. I discovered the Herreshoff rowboat and have made about 30 for the islanders to commute from Dangar Island in the Hawkebury River to the mainland. They seem to me to be as close to the perfect rowboat as you can get. I have seen a young mother gaily row in a large chop, daughters and all disappearing from view as each swell passed by. The image had all the charm of a Homer Winslow painting. All of this is not only good for the soul but also the environment.

But a few things bothered me. The boat was great but the oars and oarlocks were not up to standard. After studying racing oarlocks I spent a couple of years incorporating their best features into the design of the Gaco oarlock.

Then the oars needed attention. I still had my fathers oar made in the 1950's. They were beautifully made and showed attention to the structural properties of wood. For instance the tension side of the loom was thinner than the compression side (wood is twice as strong in compression as in tension). However, the taper in most of these old oars did not seem to be as extreme as engineering considerations allowed (that is, drawing the taper from 2 ¼" at the oarlock to an imaginary width of zero at the end of the oar blade). As well most of the oars I had used required an annoyingly firm grip to stop them rotating as they pulled against and up the round oarlock. Now, one unintended consequence of the Gaco was that its broad flat plastic bearing area obviated the need for a leather or plastic oar protection. As well the shape of the oarlock allowed a modified D-section oar to hold the blade vertical in the rowing stroke. The larger section oar at the oarlock meant it was now stiffer. The loom was made by judicious use of circular saw and router bits ranging from ½" to 1" radius. I might add that it was necessary to purchase a variable speed router for the large diameter bits. The only decent Oregon without knots I could buy was from a recycled timber yard. These lengths of 4" by 2" had probably been seasoning for 50 years or so in the roof of a suburban house.

What to do about the blade? At first I considered using veneers but soon realized it could only be curved in one direction. So now it is made after much experimentation from fiberglass using, 10 oz. woven roving on the tension side, 4mm coremat and 1 ½" oz chopped strand mat on the compression side. (chopped strand mat is superior in compression).

The blades are finished off with white polyurethane paint and the looms are varnished to give the oars an aesthetic appeal. They are much more pleasant to use as they are lighter outboard and the blades have an efficient grip on the water. The most pleasant surprise is the constant angle the blades keep, vertical to the water, without any effort on my part.

I have had the opportunity to observe the dynamics of rowing with my crew of eight galley slaves in the surfboat. It took some time to train them to take long slow strokes, but when we were headed by the wind, they reverted to quicker shorter strokes. Much more energy was used during the shorter strokes as the momentum of the oar and rower’s body has to be changed more often and more violently. You can actually feel the wasted effort as you push on the oar at the beginning of the return stroke. However this extra effort is partly compensated for by the fact that the middle part of the oar stroke is the most efficient as it is pushing the water straight back. At the beginning and end of the stroke the water is pushed both back and sideways. The short quick strokes have the extra advantage of keeping the momentum of the boat going against the headwind.

Much effort is often made to put weight onto the inboard end of the oar, to reduce the effort of raising and lowering the oar in and out of the water. Sometimes this is done by leaving inboard part of the oar a square heavy section or alternately lead weights are incorporated near the handle. Both these solutions add to the effort required to change the momentum of the oar at the beginning and end of the stroke. Seeing as we have so little horsepower to row with, a better solution offers itself. This involves reducing the weight of the outboard part of the oar. So far I have done this by engineering the appropriate taper into the loom, and keeping the blade as light as possible.

I have noticed that experienced rowers take long slow strokes in calm conditions. For long distance rowing this works best. However, it is best to vary the length of the rowing stroke over time as this brings different muscles into use. The end result of a nice long row is a good sleep and wonderfully strong stomach and back muscles. To say nothing of how the quiet contemplation of nature lifts the spirits and abolishes depression.

The materials to make each oar cost less than $30 and the oars are certainly more aesthetic than the carbon fibre oars which cost over $500. Then there is the added difficulty of making the bought oars fit the oarlock. So in the meantime I am very happy with the present product and still have room for refinement. Now I am very close to the goal of owning the perfect rowing combination. What a pleasure it is to gently pull the boat through the water in such an efficient manner that you can go on and on indefinitely.

The Turbo Oar

Attacked for failing to discover a light filament after 1000 tries Thomas Edison famously replied; "But now I know 1000 materials that don't work." I'm in a similar boat. I have tried two known oar theories, and have now come up with a third which works, but may not be the complete answer.

The simplest theory according to William of Ockham of Ockham's razor fame is most likely the correct one. In this case it happens to be; "To every action there is an equal and opposite reaction." (Newton's third law). That is, as the oar blade pushes on the water the water pushes back. This theory has been elaborated in a scientific paper that excited me some years ago; 'The force from the blade on the water is generally normal (at right angles) to the blade surface at all times. The only exceptions to this are at the catch and the release. This force can be broken down into the following two components: 1) parallel to the direction of the boat, and 2) lateral to the direction of the boat. The lateral force does not contribute to the forward motion of the boat. Between 70 and 110 degrees, the oar's angle with the boat's direction provides the greatest forward force on the boat. Ideally the rower's force should be highest when the oar is in this position." (Virginia Technical Institute, Mechanical Engineering, Tidwell 1998)

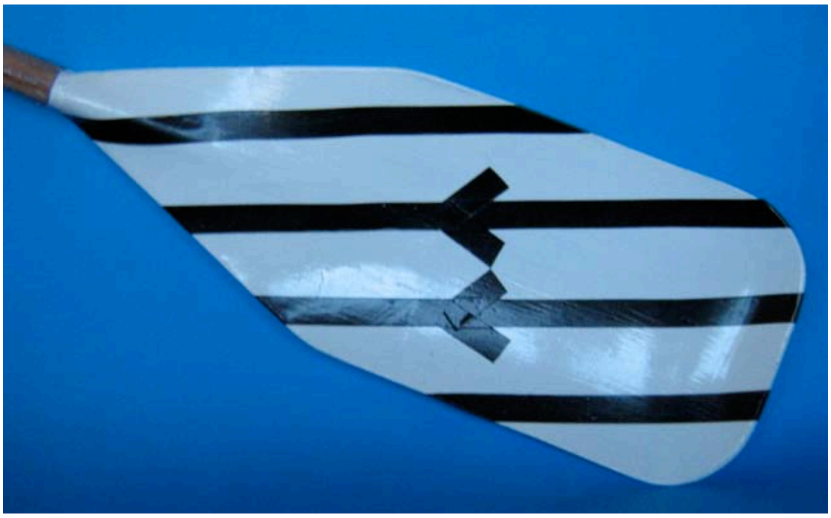
Well: "The lateral force does not contribute to the forward motion of the boat." It seemed logical, so I made an oar that is always at right angles to the boat to eliminate the lateral (sideways) force.
The articulated oar blade (Take in photo A)

The blade swivels at right angles to travel. Its angle is controlled by a lanyard attached to the gunwale.

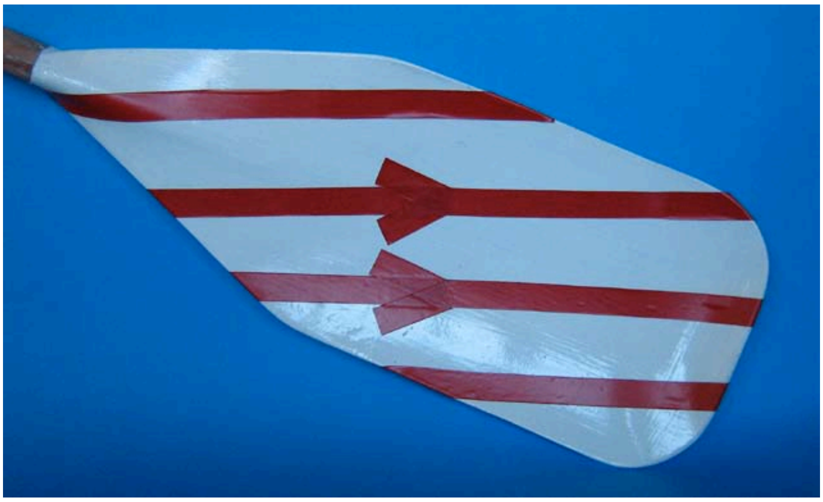
A failed experiment

What a disappointment! It was very easy to pull at the catch and release and not very efficient mid stroke. However it was a bit like going nowhere and moved the boat less than a conventional oar. I dumped the project, but gradually figured out why it didn't work. Of course, at the catch the blade was going two-thirds sideways, and only one-third aft. Although it was easy to pull, two-thirds of my action was being wasted. How then was the conventional oar so much more effective at other than right angles, when most of its energy was being wasted because "the lateral force does not contribute to the forward motion of the boat?" I have come to the following conclusions about this, especially for low load conditions.

1. For a well designed curved blade on a boat in motion, the water will flow over the blade at the catch, as the boat moves forward, in the same way as the wind blows over a sail and drives a boat to windward. As a matter of interest the area of a normal oar blade is equivalent to a wind-sail of 70 m2 or 760 square feet when the difference in density between air and water, is taken into account.

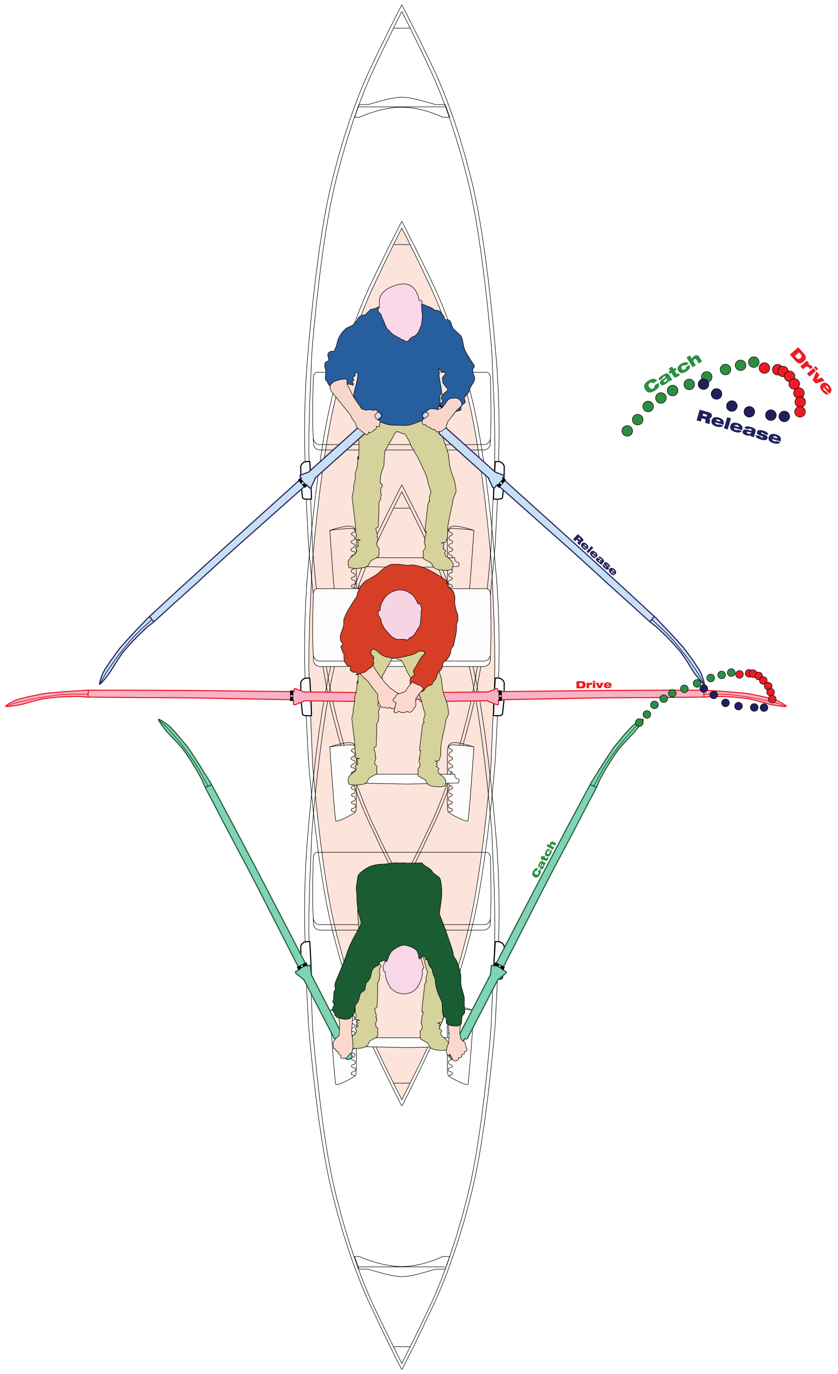


At the catch the motion of the boat induces the water flow as shown.
The angle of flow over the blade corresponds to the angle of the oar in the water.



At the release the reverse occurs.

This does not apply to a boat getting under way as the blade will stall. This explains why starting strokes are short and close to right angles with the boat. Further readings on “Hydrodynamic lift” in relation to rowing confirm my conclusion. They disclose the counterintuitive fact that the oar moves forward in the water by around 4 inches (10 cm.) during the rowing stroke. The following diagram based on actual photos taken during a rowing stroke, illustrates this.



The rowing strake color.

The above diagram shows the rower at the three stages of the same stroke (the catch is the start, the drive is the middle, the release is the final part). The dots represent the position of the blade in the water about every 5 degrees of stroke. Notice especially that that the blade has sailed forward in the water. This "sailing" occurs for 60 degrees of catch and release while stalling or moving back in the water occurs for 40 degrees of drive. It must be borne in mind that even a flat blade will appear to sail forward at the catch because of the forward motion of the boat. The aim is to make a blade that will sail better. (Data from "Hydrodynamic Lift in the rowing strike." Ken Young, University of Washington, 5 June 1997)

1. The lateral motion of the oar will now induce the water to flow over the blade rearward creating a forward thrust in return.

2. Greater efficiency is offered at the catch, as the oar is moving sideways into clean water. The parallel to this is the greater efficiency of a sailing boat on a reach (catch) than a run (drive).
3. When the oar is at right angles to the boat it loses energy through slippage. This slippage amounts to about 30% at the tip, which travels furthest. This argues for a shorter wider blade, but for reasons of balance, and clearance on the return stroke, this is not practical beyond a certain point.

Years ago I was interested to observe the native use of canoes on the remote island Tagula in New Guinea, where I had been shipwrecked. Although they had efficient paddles they would always use a pole to propel the canoes when the water was shallow enough.
The pole had no slippage of cvourse, and gave close to 100% efficiency (in contrast to estimated efficiencies of 70%-80% for racing oars and probably less for their paddles). They would allow their weight to fall backwards off the canoe while poling and push themselves upright, at the last, in the most skillful manner.

Excited about the interesting and counterintuitive theory of the sailing oar, I made a prototype oar that is shaped more like a sail to improve its performance. The leading edge is curved aft at 45 degrees to the line of the shaft and the blade is curved length ways and sideways to encourage non turbulent flow.

Testing with a hose showed the water attaching much better to the rear of the prototype.

The water does not attach to the rear of a more conventional blade.


The water attaches to the rear of the prototype for at least part of its length.

Now for the acid test, how would it work? Had I wasted my time again? I chose a calm day to test the oar down on the Hawkesbury River and opposed the prototype “sailing oar” against a more conventional blade of the same area, in which the blade curves evenly through 15 degrees. The test had to be done under calm conditions. If the boat was carefully rowed with equal force on each oar, prototype one side, it should turn away from the prototype if more efficient, and towards it if less efficient. After twenty careful test runs, eyes closed, eyes open, the dory consistently turned away from the prototype. It was even more effective when a long catch was used. The feel at the catch is of a quite refined performance, with a pull propelling the boat further than expected.
Sometimes the laws of physics work against you. In this case not so, the prototype is very much stiffer because of its more compound shape. This enables a lighter blade that has the important effect of reducing outboard weight where such a reduction will have most effect.
Where to from here? Well of course even more radical shapes are to be tested until the shape becomes too extreme. **End of part 1**

Oar Theory Part 2.

Thanks to Francis Herreshoff and John Gardiner, the Herreshoff rowing boat we build is as close to perfection as it can get. However the rowlocks available were most unsatisfactory so I set about inventing, designing and manufacturing the Gaco rowlock. Still, there were the oars. If they were not heavy and clumsy they had poorly shaped blades. Enquiries at a racing oar manufacturer indicated a cost of over five hundred and fifty dollars and no guarantee that a satisfactory rowlock would suit them. So I have spent about a decade on and off investigating how oars work in the water and the best way to build them. A novel and simple way of shaping a stiffer and lighter shaft is described separately (the isosceles trapezoid shaft). In the following article I will describe a third theory of how an oar works. Part one described two theories and my investigations of them. Part two describes my investigation into a third and novel theory proposed by a chemical engineer. Part two also describes my final preferred design and its performance under racing conditions. A proper understanding of how oars work should inform oar selection and improve the rowing stroke.

The Turbo Oar

After engaging in an informal consultation with a friend of mine, I have felt obliged to test a new oar theory. Col Putt is a chartered chemical engineer who now teaches at Sydney University. He has been fitted with so many titanium joints that he insists upon expiry that his body be taken to the scrap merchant. Upon visiting him in hospital where he was being fitted with another metal joint I gave him a draft of my article on the sailing oar. A few days later he called back with an oar theory he was excited about, related to the mechanism of a centrifugal pump. A centrifugal pump has an inlet at its central hub and rotating vanes propel the water in a circular motion where the centrifugal force sends it through an outlet at the circumference. According to this theory "The oar acts to project a jet of water away from the centre of rotation, in this case the oarlock. The curved end of the blade impels the water in a more effective direction for propulsion through most of the stroke." This analysis bears thinking about especially when designing the blade.

In discussion with Col, I suggested that I should increase the angle, between blade tip and shaft, to 55%. "No" said Col "try 60%." So I set to work and through some unexplained error ended up with an even more extreme angle change of 65%. The image below shows the blade shape and illustrates the anticipated, centrifugally driven, flow of the water during the stroke.

The Turbo oar blade A65. (Number refers to angle between blade tip and shaft)

Tests were carried out on the three different types of blade, the reaction blade (A15) the sailing blade (A45) and the turbo blade (A65). The comparison tests were carefully carried out in waters unaffected by currents or wind. The oars were opposed to each other in tests repeated till results were consistent.
Summary of results:
Full stroke: The turbo blade was superior to both blades. In order to determine why and where it was superior, tests were then carried out comparing the blades at the catch, drive and release.

Catch: The sailing and turbo blades were superior to the reaction blade. The sailing and turbo blades were equal to each other.

Drive and Release: All types of blade were equal at the drive and release.

Conclusion: The order of blade performance was as follows;

1. Turbo blade.
2. Sailing blade
3. Reaction blade.

It is interesting that the sailing blade is equal to the turbo blade when the different phases of the stroke are tested separately. However the turbo blade is very definitely superior for the full stroke. This result seems to support the centrifugal effect of the water where, “the oar acts to project a jet of water away from the centre of rotation.” It is probable that breaking up and testing the stroke at its component parts prevents the turbo blade establishing a consistent flow of water along the blade. The action of redirecting the water aft, results in a forward reaction on the blade that increases its efficiency.

It helps to reconsider what is happening in the stroke. It must be remembered that the oar blade is changing the direction in which it pushes the water by about 90% during the stroke. That is, it pushes the water in one direction and then changes its direction, but the water it has been pushing continues in the previous direction and thus slips off the end of the oar. We are really talking about Newton’s first law (“A body continues in its direction and speed of motion unless acted on by an external force.”) rather than centrifugal force.

The enhanced sailing blade. One last test.

It is well known that wings and sails get their most lift from the low pressure side. To enhance this lift every effort is made to prevent eddies forming as the fluid flows around the wing or sail. Since my “sailing” blade had a sharp leading edge, eddies could detract from the smooth flow over the blade. Consequently I made a blade with a nicely rounded and faired leading edge, fully expecting it to have an improved performance.

The enhanced sailing oar.

Repeated tests indicated that the enhanced oar was slightly inferior to the unfaired sailing oar. It appeared that the turbo effect was more effective than the sailing effect. The unfaired blade allowed a cleaner exit of the water off the end of oar, while the faired blade caused eddies to form at the tip thereby obstructing the clean flow of water. Exit of the water off the blade is more important than entry onto it.

The Acid test.

Easter Sunday each year, all and sundry have a rowing race around Dangar Island on the Hawkesbury River in boats considered suitable for safe, island commuting. They must be able to carry three people in reasonable comfort and safety. The motto for the Dangar Dory Darby Day is “No smelly engines, just smelly people”. The most numerous rowboat is the Herreshoff rowboat. Now here was the place to test out the new oars.
I have to confess at this stage that I was trying to use a combination of tactics, technique and technology to compensate for my aging body in this race. A second turbo oar was made to pair the existing one and the pair was tried on the river. They seemed to exert such a grip on the water that my arms felt like they were pulling out of their sockets. Some would argue at this point for bendy oars but I preferred to change the mechanical advantage. Stops were put in place to increase the inboard to outboard ratio from 26% to 30%. Now the handles overlapped on the rowing stroke so the bottom spacer of one Gaco oarlock was trimmed off to lower one oar and facilitate overlapping. With some practice the overlap proved easy and enabled a longer efficient stoke that was quite comfortable and very satisfying.

Incidentally the oar acts as a first order lever even though science teachers will correctly say that the load is at the gunwale and the fulcrum (pivot) at the blade water interface making it a second class lever. This would be so if the rower were to be standing outside the boat and pushing whilst himself stationary. For instance imagine the oar completely outboard with the handle at the oarlock. For a rower, the boat would not move but a person standing in the sand and pushing on the handle there would be no problem. However for calculation purposes the oarlock is the fulcrum and the blade water interface the load. Thus if the oar is say 25% inboard then the blade (which is three times as far outboard) will travel three times as far as the oar handle. Thus the rower will move the boat about three times as far but with about one-third the force. Although we consider rowing boats slow, a well designed craft will travel at about twice walking speed. We have to view the function of the oar as moving the water past the boat rather than the boat through the water. If the turbo blade has less slippage, the rower may improve the force by moving the handle further inboard without losing any motion. In other words what is lost by having to move the handle further is more than gained by the greater efficiency of the oar blade. In practise it enabled me to conserve energy for the seventeen minute race, by achieving the same performance with less effort.

Technique: the resistance of a displacement craft through the water is proportional to the square of the speed. To go twice as fast requires four times the power, so it is best to keep the speed as constant as possible. This means as quick a recovery as possible and a good effort at the catch. At the catch the boat has slowed because the oars have not been driving for a period, and the rower’s body has suddenly stopped moving aft, thereby acting as a brake. There is a temptation at the drive to pull harder and this can result in acceleration into a high resistance zone, with the stern squatting and the bow rising, with not much increase in speed. This energy is best expended at the catch and to a lesser extent at the release. As general rule it is best to use the same force through the whole stroke. As well, and this is an argument for overlapping oars, a long stroke is more efficient because energy is wasted changing the direction of movement of the body and oars at the ends of the stroke. That is, the fewer strokes the less energy is wasted. Small amounts of energy may also be conserved by relaxing the arms and body during the recovery stroke and by gripping the oars correctly. When D-shaped shafts are used, the effort required to hold the blade vertical in the water is obviated. Now the handle can be gripped simply by hooking the fingers around the handle.

Over the years we have had some rowers who train enthusiastically for this race, and there is somewhat of an atmosphere conveyed by some lines from an Australian bush poem

“There was movement at the station, for the word has passed around
That the Colt from old Regret had got away

And had joined the wild bush horses – he was worth a thousand pounds
So all the cracks had gathered for the fray."

No quarter is given in the race and starters age from eight to eighty. The only stipulation is that the island must be circumnavigated. Tides can encourage tactics like rowing under wharves and across reefs. One year several boats found themselves stranded on oyster strewn reefs. As they tore the bottom out of their boats and their feet I thought I could hear mutterings of "Oh well! It's all part of the rich tapestry of life."

The race record around the 1.46 nm island is held by Rodney Bryson who smoked around the island at an average speed of 5.56 knots which is the theoretical top speed of the 15'9'' waterline craft (top speed in knots for displacement craft = 1.4 times the square root of waterline length in feet)

The starters range from eight to eighty. Rodney, the race record holder, lines up with a future champ for the start.

As usual I missed the inside running by involving myself in the running of the races, organising boats etc. As I carefully manoeuvred under the first wharf for a short cut, Admiral Nelson came charging through and rammed me into the piles losing me some time, thanks Admiral! Then came the long slog across the south side of the island overtaking some of the sluggards. Then around the west side of the island where I gradually overtook Rodney and Jonathan who have both been keen competitors and former winners. Was it the oars? Or was it fitness? Then down the north side of the island to come fourth.

Asher celebrates his win.

What a fantastic result, three young fellas were ahead of me. First came Asher Ashford (aged 18) in a race record speed of 5.57 knots. He was followed by David Tilley (aged 29, 5.49knots) Peter Miller (aged 42, 5.39knots) and myself John Murray (aged 70, 5.26 knots). Rodney Bryson came fifth (aged 46, 5.19 knots) and down the pack a future champ Luka Dahl (aged 8, 3.11 knots).

The sniffer dog does the rounds, checking for illegal drug use.

After the race Rodney rowed my boat to test a front view mirror I had fitted to my boat. He came back so impressed with the oars that he determined to make a new pair for himself.

Contemplating defeat by the new generation.

Rodney related that when he was front runner and record holder in the past, that he used to carry the dory on his car all the time, and any chance for a training run took it. It is worth noting that Rodney made his record using oars that looked somewhat like clubs, fitness trumps all. Of course all other things being equal a decent set of oars will trump a poor set.

Colin has reviewed this paper and comments that he once watched some fellas rowing at Halfslo in Norway around 1973. As he observed these fellows confidently rowing away from the upside of a 200 foot waterfall, he was surprised to observe that they were using long saplings as oars. The ends were quite whippy and had no blades at all. So there you go! There really is more than one way to skin a cat. Colin introduced himself to these Vikings whose names were William and Harold Hardarse. He concluded they were aptly named as the seats comprised two branches whose natural shape fitted the sides of the boats such as knees might and must have been hard on the butt. I have learned that the Vikings employed oars and seats described above, though they would flatten the rear side of the sapling where it entered the water.

These Vikings couldn't catch us so there was no pillage and slaughter. Image 14 RST

And in second place, one time vegetarian islander David Tilley

There are many factors affecting performance but youth and fitness must be the most important. It is pleasing to see that size and strength do not seem to favour larger people. The lighter weight of the smaller person lowers the resistance of the boat in the water. Even more pleasing for us, is to see the young people getting involved and showing us older folks a clean pair of heels. There is a wonderful sense of community and sportsmanship involved with the day and no apparent generation gap. Asher is keen to get his own boat so he, his dad and I, will be building two boats where he will not only acquire a boat but the boatbuilding skills needed to make one.

As far as the oars are concerned it seems all three theories apply to their efficiency in the following order: Action and reaction> Centrifugal effect > Sailing effect. Various readings imply that the efficiency of the racing oar is between 70% and 80%. I expect that the turbo oar has a considerable efficiency increase over some of the commercially available oars, and may well be an improvement on the racing oar.

As far as the rowing race is concerned, the young fellas have shown their mettle so I will have to "…take kindly the counsel of the years and gracefully surrender the things of youth." (Desiderata)

POSTSCRIP: One year on (2012) and Asher and his sister have teamed with me to build Swift dories (Herreshoff rowboats) for themselves.

Blue for boys and pink for girls. Asher's sister Rosie adds artwork to her boat.

For some months Asher trialled the Sailing oars against the Turbo oats. He came down decisively in favour of the Turbo oars and bought a pair from me. He subsequently won the race decisively and broke the race record by 15 seconds in a year that the race was slow (30 seconds slower for me) because of the tides.

His time was equivalent to a speed of 5.65 knots which is a remarkable achievement, no doubt attributable also to his youth, fitness and determination.

John Murray comes from down under and has invented and manufactures the Gaco oarlock. He has been rowing for longer than he cares to admit. He has built his own trimaran and sailed it around the world. He spent a year of his time sailing up and down the US east coast where he enjoyed the kindness, courtesy, and eccentricities of the American people. He has worked as an Industrial Chemist, science teacher, boat charterer and in the copper mines at Bougainville.

A Properly Engineered Rowlock

When the character played by Jack Palance in the movie “City Slickers” was asked the secret of his contentment, he raised his finger and replied; “One thing, just one thing!” Well I am no genius, but I have obsessed for over a decade with one thing, how do oars and oarlocks work and how can their function be improved.

A lifetime of rowing had left me dissatisfied with the oarlocks I had been using. Some broke, some bent, most wore out the oar, all wore out the socket and pin, some were easily lost and most were heavy. In time many rusted and after some use the rowing strokes were accompanied by a clunk, clunk removing all chance of stealth. To insert the oarlock into the socket it often had to be returned from the blade end by raising the oar till the oarlock came crashing down to the button (oarstop).

It is interesting to consider the degrees of freedom an oarlock must impart to an oar.

It must allow the oar to:

1. Move in a horizontal plane.
2. Move in a vertical plane.
3. Rotate.
4. Be withdrawn.
5. Be removed from the gunwale.

The excessive wear on the socket and upper part of the pin is easily seen as an engineering fault. The pin rotates in the socket, which becomes the bearing. The problem is that the pin exerts an uneven and excessive pressure at the top of the socket, so wear is concentrated there and to a lesser extent at the bottom of the pin and socket.

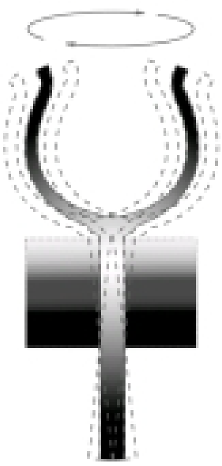


Figure 2

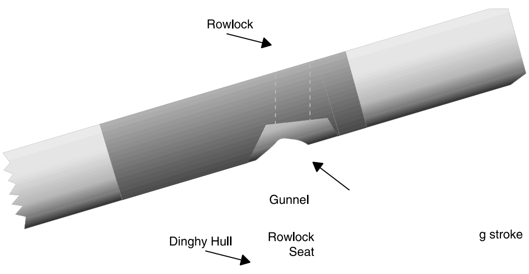
This problem is solved by designing an oarlock that rotates on the pin with the pin remaining fixed in the socket. You may wonder why this issue has not been addressed in the past.

In the middle of the last century, it was my habit as a child to bail out the hire boats at the local boatshed and as a reward take one for a row. One particular type of oarlock stuck in my memory as it was mounted on a fixed post and was of a D-shape. I have managed to track some down at a maritime collection in Tasmania. In the little hamlet of Tinderbox, Ross Burnett has a collection of clinker rowing boats, oars and oarlocks. He has kindly allowed me to photograph some oarlocks that are of the type I have mentioned and were manufactured by a company associated with Kopsens in Sydney. The inverted V section is a casting that is bolted to the top plank and a bronze or steel bolt passes through the horn and screws into the top of the V-section. It must be noted that the bolt does not rotate and the bronze oarlock rotates around the bolt or pin. Often the bolt was steel and if properly maintained, was also greased, a messy process if applied to an oarlock that is routinely removed. Consequently the oarlock followed the action of the oar nicely and was less inclined to walk up the oar and press against the button.

A Traditional well engineered oarlock

This oarlock was fine for hire boats as it was strong, resisted wear and could not be lost. However for modern skiffs it could cause damage to itself and the deck whilst upending the craft for storage, and, would be inclined to gouge the side of any yacht that it pulled alongside.

There is another aspect of oarlock design that is not properly understood. Much of the wear on an oar appears on the underside instead of the back of the shaft where it bears on the oarlock. During the stroke the oar is lowered into the water and the top of the button bears against the top of the oarlock. The bottom of the shaft is then dragged across the bottom of the oarlock, persistently wearing it away. The diagram below illustrates this process.



Below is an extraordinary and most beautiful design of oarlock. This was dredged up in St.Nazaire in France and the photographs and details passed on by a Dutchman Mr Cor En Leen. He and his colleagues are inclined to think it was a gun-holder but there are too many features distinguishing it as an oarlock. Some may argue that it was for a sweep but I suspect that a sweep or a gun holder for that matter, would have its pin in the centre.

"There are more things in Heaven and Earth, Horatio, than are dreamt of..."

This oarlock deals with the vertical friction and wear very effectively. It weighs over four pounds, has a ¾" pin and will accommodate a three inch diameter oar which happens to be about the size of a whaleboat oar. Notice how the oar can only be fitted and extracted at the blade end and is thus less likely to be lost (This did not stop some cursed soul losing this oarlock overboard). However a simpler way of resolving this wear problem has been has already been in use.

I had naively headed out to a racing skiff manufacturer on the Parramatta River, called Sargent and Burton. This, in my quest for a decent oarlock for the Herreshoff rowboats I was making. Much to my disappointment I found that they were the wrong diameter, were quite expensive and were designed to slip over a post bolted to the outrigger. So I adopted the general principal and began hand making them out of high-density polyethylene and stainless. These worked well and are still in use today 20 years later, but they were a lot of work and missed some features.

Careful study of the racing oarlock revealed a mystifying profile that eventually showed itself as a cunning way to obviate the friction cause by vertical motion. After making some wooden mock ups I perfected the ideal profile for an oarlock. The diagram below illustrates how this works. I discovered that the widest part of the profile should coincide with the bottom of the oar in the oarlock, a fine point that the racing oarlock seemed to have missed. The oar had to pivot over a triangular profile at the bottom of the oarlock (indicated by the dotted lines).

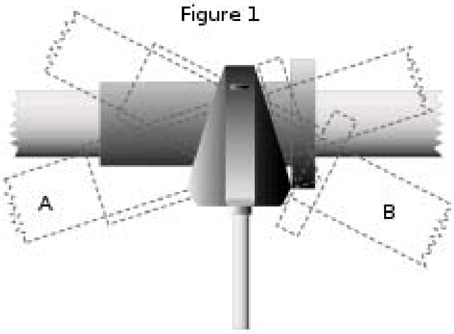


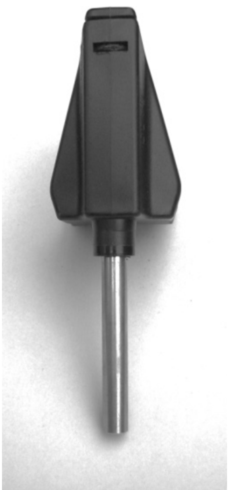
Figure 1

This is not the only way of solving this problem. I have never seen it practised or recommended, but I strongly suspect that it can be obviated by a 15-degree outward angle (or whatever angle the oar makes on the rowing stroke) on a conventional oarlock. If this seems a bit extreme any outward angle will help.

Motivated by the desire to manufacture something useful I engaged an Industrial Designer to draw up a Cad- Cam (Computer Aided Design-Computer Aided Manufacture) model employing the features mentioned above. Over a period of a year and in consultation with a Mechanical Engineer, a Chemical Engineer, an Industrial Arts teacher and the Industrial designer we came up with the final model oarlock and socket to be made in the same mould. Significant contributions by this loosely knit team enabled the use of a catch that not only captured the oar but also the pin.

The rest of the process was quite mind blowing. It took place in several stages:

1. An exact replica of the CAD was cut out of graphite using a CNC (Computer Numeric Control) lathe.
2. This was then immersed in kerosene above metal slab that was to become the mould.
3. An electric field was created between the graphite replica and its exact shape was etched into the mould.
4. A trial run was completed with two plastics, nylon and polypropylene. The nylon proved unsatisfactory as it was too stiff and changed its properties markedly when wet.



This may sound simple but many costly and troubling problems were overcome before getting to market. However the oarlock has lived up to, and in some respects exceeded expectations.

Some have argued that the pin would revolve in the socket. However the oarlock chooses the bearing surface with the least friction and revolves around the upper part of the pin. Inspecting the pin after some use confirms this fact.

The 10mm (slight larger than 3/8”) hardened 316 stainless steel pin and plastic body enable a much lighter oarlock. We have found on the surfboat that one man to an oar will not bend the pin and none have worn one out yet after 10 years of regular use.

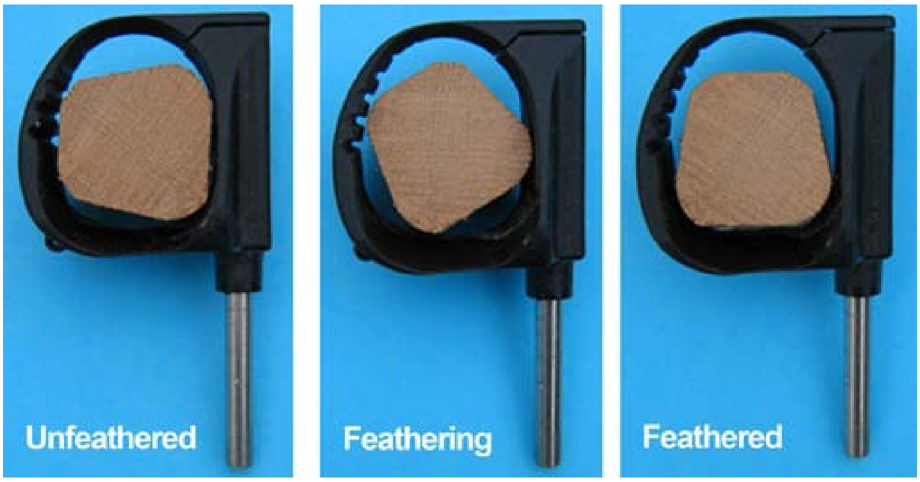
Oh! Some customers wanted to use their existing sockets so an interference fit sleeve was developed for 7/16” and 1/2" sockets.

Some unanticipated bonuses have revealed themselves. For instance it is possible to easily shape the oarlock to fit particular designs of oars. As well being plastic the oar holder is much kinder to oars.

I had now begun reading articles on oar theory, and this had piqued my interest especially as some theories seemed contradictory. This has led me to a prolonged experimentation down wrong alleyways till I have come up with some very interesting conclusions, and, an oar design that seems to be quite superior to the current paradigm.

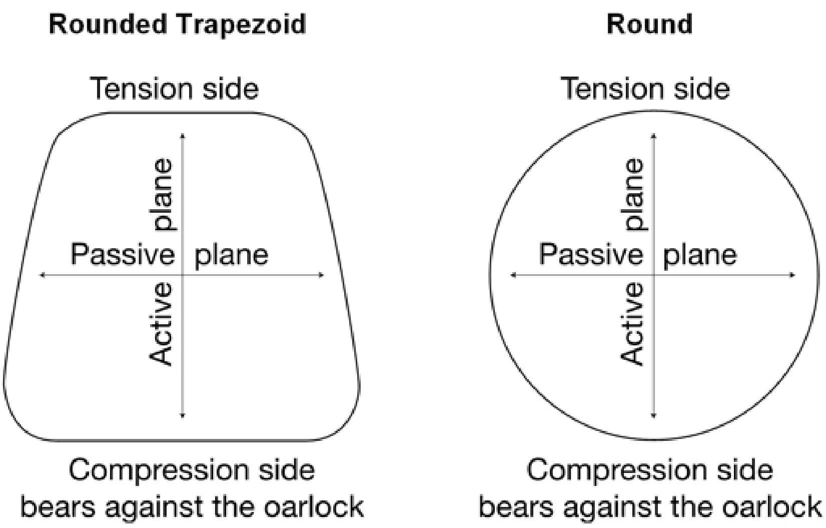
Lighter & Stronger Oar Shaft

It is more by accident than design I have arrived at an efficient and radical way of making a stiff, light shaft. The cross sectional shape goes by the rather awkward name of "isosceles trapezoid" (an isosceles triangle with the apex cut off). It was while I was playing around with different shapes that I was surprised to find that such a shape could rotate in the oarlock, as well as provide a flat section to match the D-shape oarlock. Since it had many other advantages I have been making oars using this shape.



Considerations: Most oarlocks are designed for a round less than two-inch diameter shaft. When the leather protector is added, the shaft is reduced to 1 7/8". Some fittings reduce it to 1 ¾" at the oarlock and this dictates the dimensions of the rest of the oar for a given length. Most properly designed oars will have approximately the same volume. Hence they need a light strong timber. Expensive and hard to get, Sitka Spruce, is generally selected as the ideal choice.

Active and passive planes: the plane of the oar vertical to the water (passive plane) only needs to be strong enough to lift the blade in and out of the water, while that parallel to the water (active plane) needs to be strong and stiff to resist bending and breakage of the oar. The passive plane of a round oar is wastefully stiff. There is no reason why a heavier timber cannot be made thinner in the passive plane as long as it is still functional.



Note that the trapezoid cross section has substantial material on the tension side and even more on the compression side to compensate for the lesser compressive strength of wood. By contrast the round cross section has a minimum amount of material where it is most needed and a maximum where it is least needed.

Stiffness: It takes energy to bend an oar and this energy will be imperfectly returned at the end of the stroke when it is not as useful.

I may have an argument on my hands about this as one enthusiast has told me; "The oars on my Adirondack guide boat have quite a bit of spring in them. The builder says that's intentional." In order to resolve these contrary positions, the argument should be taken to a logical conclusion. So: Consider an oar made of stiff rubber that bends considerably. It is obvious that it would be quite ineffective. Now make it of stiffer and stiffer materials. It will become progressively more effective. The logical conclusion is that a perfectly stiff oar will be most effective.

A 10% increase in thickness of the active plane will yield a 20% increase in stiffness. Both the amount of material, and, the distance between the compression and tension side of the active plane affect stiffness. This explains the two to one ratio. Only the amount of material in the passive plane affects stiffness, so, its thickness affects stiffness on a one to one basis. This means that a 1/8" increase in the active plane will allow a ¼" decrease in the passive plane, producing a lighter oar that is just as stiff.

Balance: the oar should be as light as possible especially at the outboard end.

Energy can be wasted in the following ways due to poor balance:

1. For each stroke the oar reverses direction twice. Since the speed of motion at the blade end is greatest, then its weight will require the greatest effort to reverse direction (it will also slow the boat as the rower is effectively pushing back on the oarlock). The weight of the handle has less effect, as its speed is one third of the blade.
2. For each stroke the oar must be raised in and out of the water. The more balanced the oar is over the oarlock and the lighter it is, the less effort will be required to overcome inertia and weight. Extra weight in the handle helps balance the oar, but increases inertia. A sufficiently light oar will almost balance with the weight of the hand and arm holding it.

It is remarkable how much easier it is to feather a lighter oar, probably because of its lower inertia, and, friction at the oarlock. After all, the wrist twisting muscles are much weaker than the major muscles used in rowing.

Utility: Oarlocks made for racing sculls are designed for the utmost efficiency. They have a plastic oar holding body on a stainless pin (the Gaco is modeled on this principal) for low friction. The shaft at the oarlock employs a D-shape fitting to marry to the D-shape of the racing oarlock. This has the important function of holding the oar blade vertical to the water with little effort from the rower. The D-shape also makes for a stronger and stiffer oar. Most recreational oars and oarlocks do not have this feature.

An old catalog from Wilcox Crittendon (pp76-81 of "Boats Oars and Rowing" by R.D. Culler) shows 26 kinds of oarlocks and yet only one, called Victoria pattern is designed to accommodate a D-shape cross section oar. However I am old enough to remember hire boats, when most fishing was done from row boats, which had bronze D-shape oarlocks on steel posts and I still have an oar made in the fifties which has a flat section on the back, a kind of modified D-section.

All is not lost as the Douglas oarlock and the Gaco are designed to accommodate the D-shape oar. The Gaco has a plastic oar holding body that is easy on the oar especially if it is protected at the oarlock with fiberglass (which also improves stiffness and strength).

Oar design: Racing oars these days are made of round carbon fiber, tapered hollow shafts with a meat cleaver carbon fibre sandwich blade (shaped somewhat like a meat cleaver and angled to parallel in the water on the rowing stroke). They can be ugly especially at the bolt on D-section adapter to the oarlock, and the black carbon fibre does not appeal. For reasons of simplicity, availability, cost and aesthetics, the shaft is best made of timber and the blade carbon fibre. A carbon fiber blade allows for the efficient complex shape needed. The shaft can be varnished and the blade painted white, thus retaining traditional aesthetics.

Characteristics of timber: The following facts about wood characteristics are taken into consideration in the design:

1. Tension strength along the grain is approximately twice compressive strength.
2. There is a reasonable correlation between density and strength.
3. Strength across the grain is only about 4% of the strength along to the grain.

Length of oar: This should be 1.9 times the distance between the oarlocks. The inboard part of the oar should be 26% of the length of the oar.

Cross section: The following cross sectional shapes have been considered.

1. Round: for strength this is close to the worst shape. It is thinnest at top and bottom where it needs maximum compressive and tensile strength. In the neutral middle where very little strength is needed it is thickest. Good shape for flag poles but not much else.
2. Oval: Better than round but confined to a round shape at the oarlock, and has similar negative characteristics as round.
3. Hollow: Difficult to make and inclined to fail. I well remember the hollow Oregon and Spruce spas failing on other skiffs while us poorer kids with the solid Oregon masts and steel (not duralumin) centreboards went on and on, part way down the pack of course, without any problems.
4. Isosceles Trapezoid with rounded edges: by a process of deduction and trial and error I have selected this shape for the following reasons.
   a) It allows design to accommodate the difference in tensile and compressive strength. The weaker compression side is wider than the tension side.
   b) There is more width and strength at the top and bottom of the active plane where it is needed.
   c) It facilitates feathering.
   d) The flat section on the wider compressive side behaves like a D-section oar and holds the blade in the correct vertical position with little effort from the rower.

e) The thickness of the oar in the passive plane can be reduced to cut weight.
f) It is easy to cut with a circular saw with very little waste.
g) It employs as a starting blank the very common four by two.
h) For a given weight it is stronger and stiffer.

Timbers: Number one clear Douglas Fir (Also called Oregon) seems readily available in recycled timber yards but elsewhere is rubbish and full of knots. I have also, with a bit of luck, been able to secure a reasonable quantity of Western Red Cedar at the same yard. Not only is this timber often of good quality, it is generally cut to a very generous 4” by 2” so that its dressed size can be 4” by 2”. Is it not a wonderful thing to save forests by using timber that has possibly served structurally for perhaps 50 years and turn it into something beautiful and functional?

I purchased Sitka Spruce, rare in Australia, which had been imported to renovate a Tiger Moth. Surian a type of cedar was available at a local exotic timber yard.

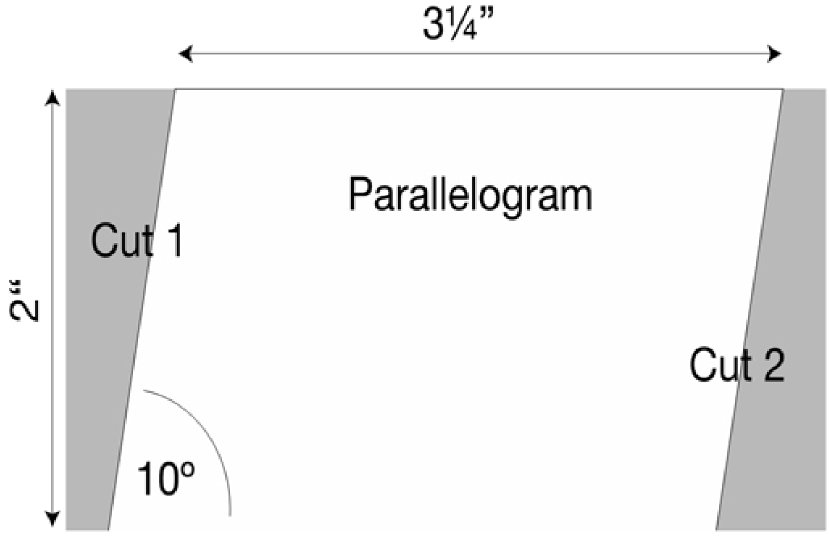
Some guide to their use is given below. The figure in brackets is the density relative to water. Bear in mind that these are only timbers I have used and there must be numerous others. It is reasonably easy to research timber properties on the Internet these days if in doubt.

1. Oregon (0.55 but varies): Cheapest and most readily available but must be carefully selected to avoid knots. A bit on the heavy side but made reasonable in weight by keeping the passive side slender. I might add that a slender passive side makes the pair of oars wonderfully easy to carry with one hand. Planing and routing must be done with the grain to avoid slivers of timber shattering off (the rotary action of a power plane tends to minimize this problem). The grain looks attractive when varnished.
2. Sitka Spruce (0.45): Most expensive and difficult to acquire. It is light and easy to work. Finishes to a beautiful cream colour when varnished.
3. Surian (0.41): Reasonably expensive but fairly available. It is light and easy to work but soft. Finishes to a beautiful red colour.
4. Western Red Cedar (0.35): lightest, must work with the grain to avoid splintering. It is quite pretty with a nice grain when varnished. This is my timber of choice for the shaft as it is available, very light and modestly priced.

Making the shaft from 4”x 2” timber.

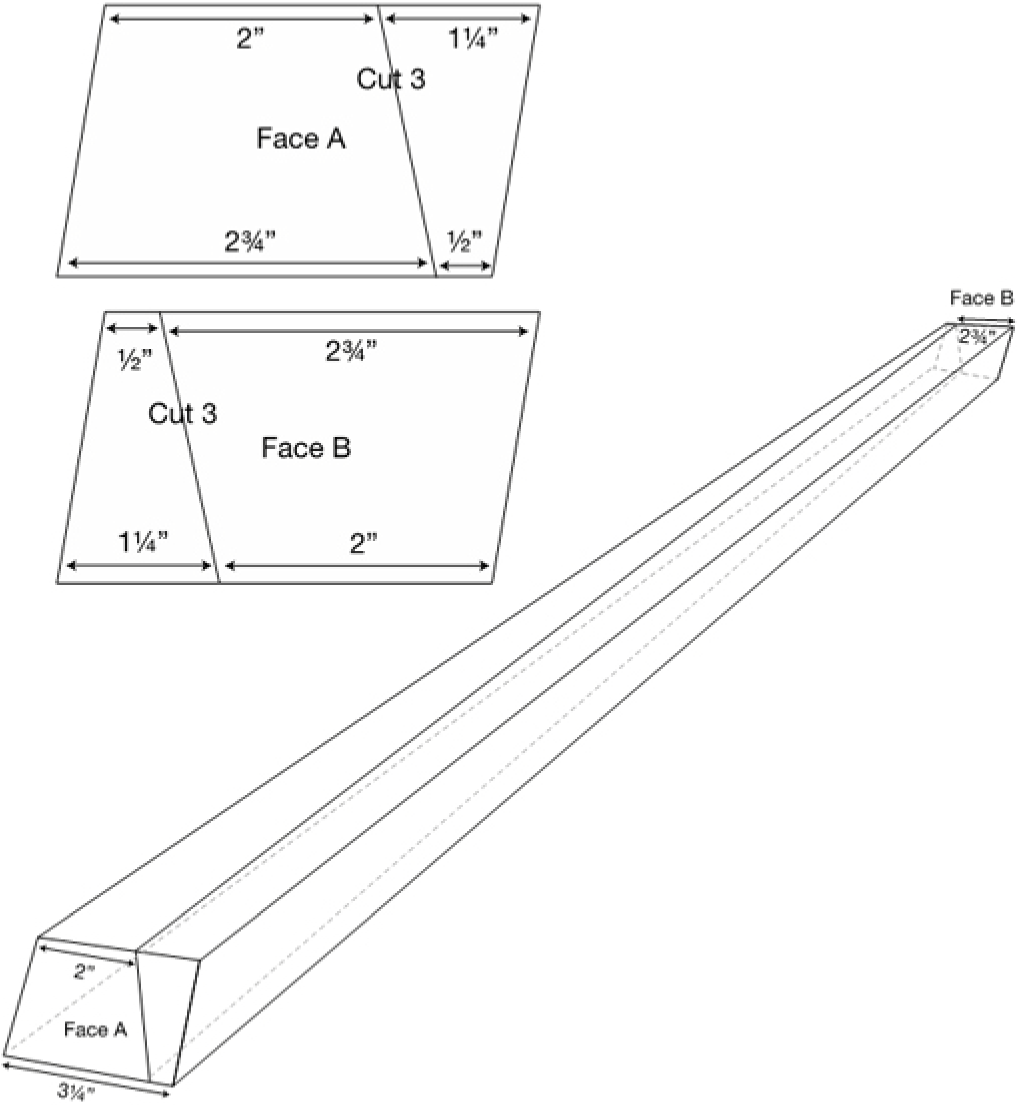
The passive plane of the shaft shaft must be tapered towards the blade to take into account the diminishing stress, which is at a maximum at the oarlock. The dimensions for cutting take this into account as well as allowing for width of cut and planing. The cutting can be achieved with three passes of the hand held circular saw.

The diagram shows the first two cuts to form the parallelogram from the four by two length of timber.



1. The four by two is first cut to a length one foot (30 cm.) less than the overall length of the oar. The remaining foot will be made up from the blade.
2. The circular saw blade is set to an angle of 10 degrees and the timber is cut down each side (aided by the saw guide) to a parallelogram shape whose major dimension is 3 1/4” (80mm). Leave the saw set to the same angle for the third cut.
3. Carefully mark the longitudinal cut by stretching masking tape along the timber. Use the dimensions shown in the diagram. This cut is easier to make with a hand held circular saw than a table saw. (**Note:**For long oars it is possible to increase the dimension by cutting a larger parallelogram and altering the dimensions somewhat. However the dimensions given are more than adequate for oars up to 8 feet long.)
4. Plane the resulting blanks to equal size and weight. After checking stiffness you may elect to trim the passive side to suit yourself. The only stipulation is they must be able to rotate in the oarlock and of course not be too flexible or weak.
5. Taper the front of the shaft from 8” (20cm.) from the tip to zero where it is going to attach to the blade
6. Rounding the shafts: the back- side of the shaft should be rounded to a radius of approximately ¾” (19mm.) near the oarlock area. Make sure a flat area remains to marry the oarlock. Diminish the radius going further down the shaft. A half-inch radius is adequate on the front. This shaping can be done by combination of plane and sanding. Make sure the rounding allows the oar to rotate in the oarlock with about 1/8” to spare.(**NB.** Do not round the last 8”(20cm.) of the back of the shaft where the blade is to be attached)
7. The handle can be cut with a handsaw or careful application of circular and hand saw. Finish off with sanding disk and hand sanding. It is best made 5” (150mm) long, 1 1/8” (28mm) where it meets the shaft and 1 ½”(37mm) at the end of the oar. Reduce the dimensions for smaller hands.
8. Apply a layer of fibreglass around the oarlock area for the Gaco and attach ¾” wedges front and back as an oar stop

9. The blade: Can be home made or bought (Gaco is one source). It is best attached to the back of the shaft with one screw and epoxy bog. Now knock the blade into alignment and allow the glue to set.
10. Fill in around the shaft attachment with epoxy and micro balloons and fibreglass over this.
11. Finish by filling, sanding, and painting. Ordinary enamels and undercoats are adequate, but two part polyurethane is better.



NOTE WELL: Make absolutely sure that the blade is at an opposite angle to the angle of the parallel sides for this cut.

My short career as a paint chemist indicated that epoxy should not be used as a varnish because of its poor UV resistance. Ignorant of this, some of the locals have been successfully priming with epoxy. I have followed suit, thinning a little with acetone if necessary. It seems to stiffen and harden the oar. I have to presume that the subsequent coats of varnish with their included UV inhibitors have obviated the problem of solar degradation.

Final tweaking: the Gaco oarlock can be matched to the oar using a round backed rasp. Merely sharpen the internal radius in the plastic oar holding body to fit any discrepancy. Rub candlewax onto the oar where it meets the oarlock to facilitate feathering. Also make sure your oarlock sockets are high enough so that the blade is at the surface when you are pulling the oar at chest level.

An appreciation of the finer points of rowing combined with refined rowing equipment yields a satisfying and healthy experience. The rowing stroke can be savoured, unimpeded by clumsy and inefficient rowing gear. This will encourage a more constant use of an exercise yielding healthy mind and body. We might call it Zen and the art of row boating.

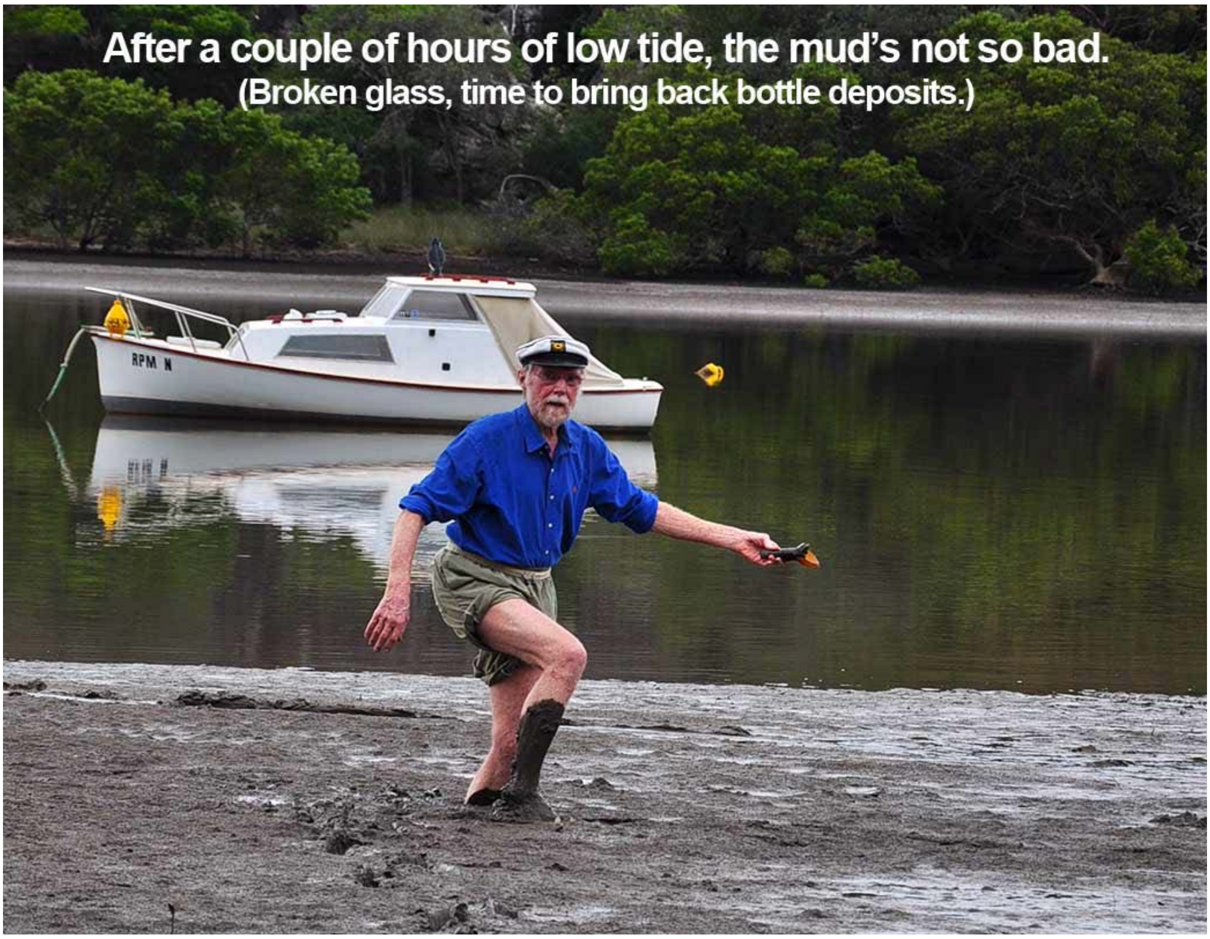
Mudskipper

Eccentric people live on average three years longer than conformists, or so it is said. I suppose there is a stress in conformity that has a subtle effect on health. This may be of some comfort to me when I paddle out to my putt putt in the odd looking mud skipper.

When the Waterways Authority booted my motor boat, from its comfortable life on a running line to a mooring, I had a problem. Down the end of Baden Powell road at Brooklyn is a gravel boat ramp leading to a waterway appropriately called the Gut. I say appropriately, as, at anything below half tide one staggers from the water, through glutinous mud and silt, to get to the ramp. This was where my boat was to be moored.


The "Brunkenkunjekrub" at its new mooring.

I have already made the mistake of attempting to swim ashore from my new mooring. Unfortunately it happened to be low tide. All went well, until I got to the mud. My leg managed to drive its way so far into the mud that a tremendous suction resisted all further movement. The only option available was to plant the other foot in front, lean down hard and hope the other would release. After about twenty seconds the rear foot released suddenly from my sneaker and the mud, and I was face down with the front foot more firmly planted than ever. After a few goes at this, I managed to change to a crawl with my shins providing resistance to sinking at the rear and the container with my possessions floating the front half of my body. About ten minutes later I managed to make it to the gravel ramp covered in mud from head to foot. A lady in a nearby house observed this, regarded my appearance, and walked inside in disgust. I thought she might at least do the humane thing and hose me down, but no, such an incompetent wretch had got his just desserts.



I had seen something similar to this happen at English harbour in Antigua. A yachtie had staggered drunkenly out of the Admiral's inn to return to his yacht. Unfortunately Admiral Nelson had built a stone lined pit for seasoning masts across his path, and it was now heavily silted up. I arrived to find this chap had stumbled into the pit in the dark, and, was repeatedly falling face down into the black mud. There was a variation on this theme as he would occasionally and creatively fall sideways and even backwards so that his body was very evenly covered in the black stinking silt. He had a much more appreciative audience than I, as a group of dark skinned locals were holding their stomachs in mirth. I got the feeling they thought him a jolly fine chap. The victim eventually managed to climb out, almost invisibly black in the night. I last saw him stagger off into the dark muttering volubly to himself. For some people this is not a joke. For instance a rather heavy chap needed three people to rescue him from the mud in the gut, and a drunk friend of mine thought he was going to die on a cold winters night after he became stuck in the silt ("Stuck in the Mud") trying to retrieve his dinghy.

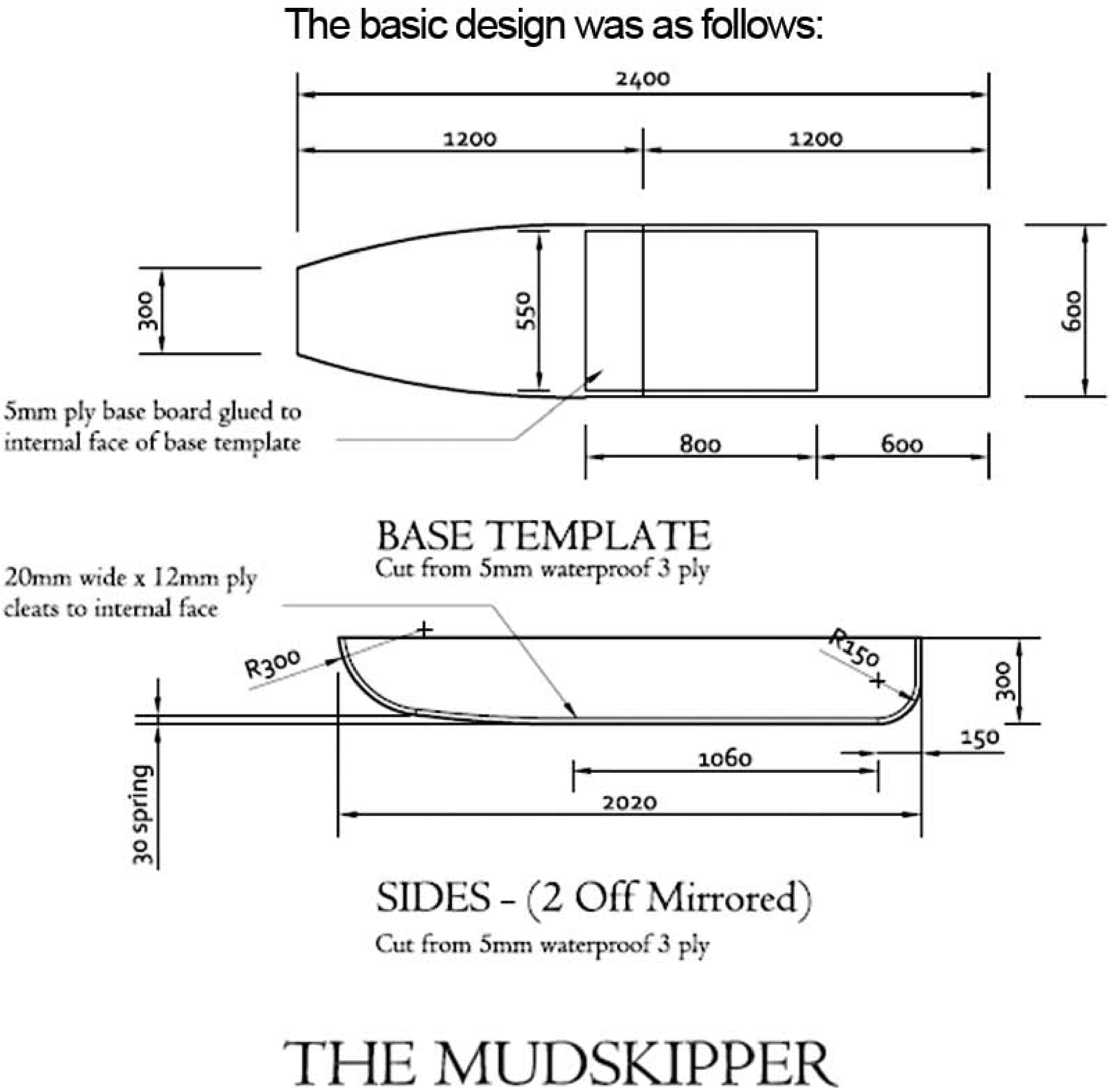
This was all food for thought. I had been spoilt. Now I had to acquire a tender. My Herreshoff rowboat was too big and valuable to use. A dinghy was a hassle to acquire and carry. It also needed oars, which would have to be secured against theft. A canoe needed a paddle and had to be acquired somehow. Aiding my thought process was a small canoe that I had hand paddled as an emergency tender on my trimaran. I had been thinking about a design like this for some time. An old mate "Moo" had observed once, that building a boat is ninety five percent thought and five percent action. Following this principle I spent the next month mulling over the basic requirements leading to its design.

Not far from the ramp sheltered under a forest of large malaleukas and resting on a fence lay twenty mouldy tenders. I must find a spot among these. So I lay down the following parameters:

1. Must be small, light, and easily carried by one person.
2. Designed to load one person up to 100 Kg. (220 lbs.)
3. About two meters (2’7”) long and use one sheet of 8’x4’ ply.
4. Wide enough to be stable and carry a load but not too wide to hand paddle.
5. Flat bottom to skid over the mud and be stable when loading.

The design I set my sights on would be made out of three sixteenths ply, two meters long and be half a meter wide. But would it have enough buoyancy? This calculation thanks to the metric system I was able to do in my head. A litre is a cube with 10cm. (4”) sides and each litre of water weighs one kilogram. The bottom area of the tender was to be 2m or 20dm (dm. is a decimetre or 10 cm.) by 0.5m or 5dm. Thus the bottom area would be 100 square dm (20dm x5dm). So if the tender were depressed 1dm. or four inches in the water it would displace 100 litres and support 100 kg. This seemed OK so off I went to buy a lump of waterproof 8’ x 4’ three ply 3/16” plywood.

The beauty and simplicity of this project would be that it dispensed with frames, stringers, seats, oarlocks and paddles. The front of the tender would be barge like with the ply curving up to the bow and the same happening but more severely at the stern. The grain of the ply needed to run across the hull for stiffness and allow for easy bending at the ends. This meant cutting across the sheet and joining with butt strap in the middle. This join would provide extra stiffness at the sit. After some examination of shoulder widths and arm lengths I decided that the bottom of the tender could be 60cm. (2 ft.) wide. The sides of the craft sloped in at an angle of 10 degrees so that they would not interfere with the stroke. However I have found that the natural position of the arms during the stroke do not necessitate the slope. The following design uses vertical sides to slightly improve ease of manufacture, buoyancy and stability.

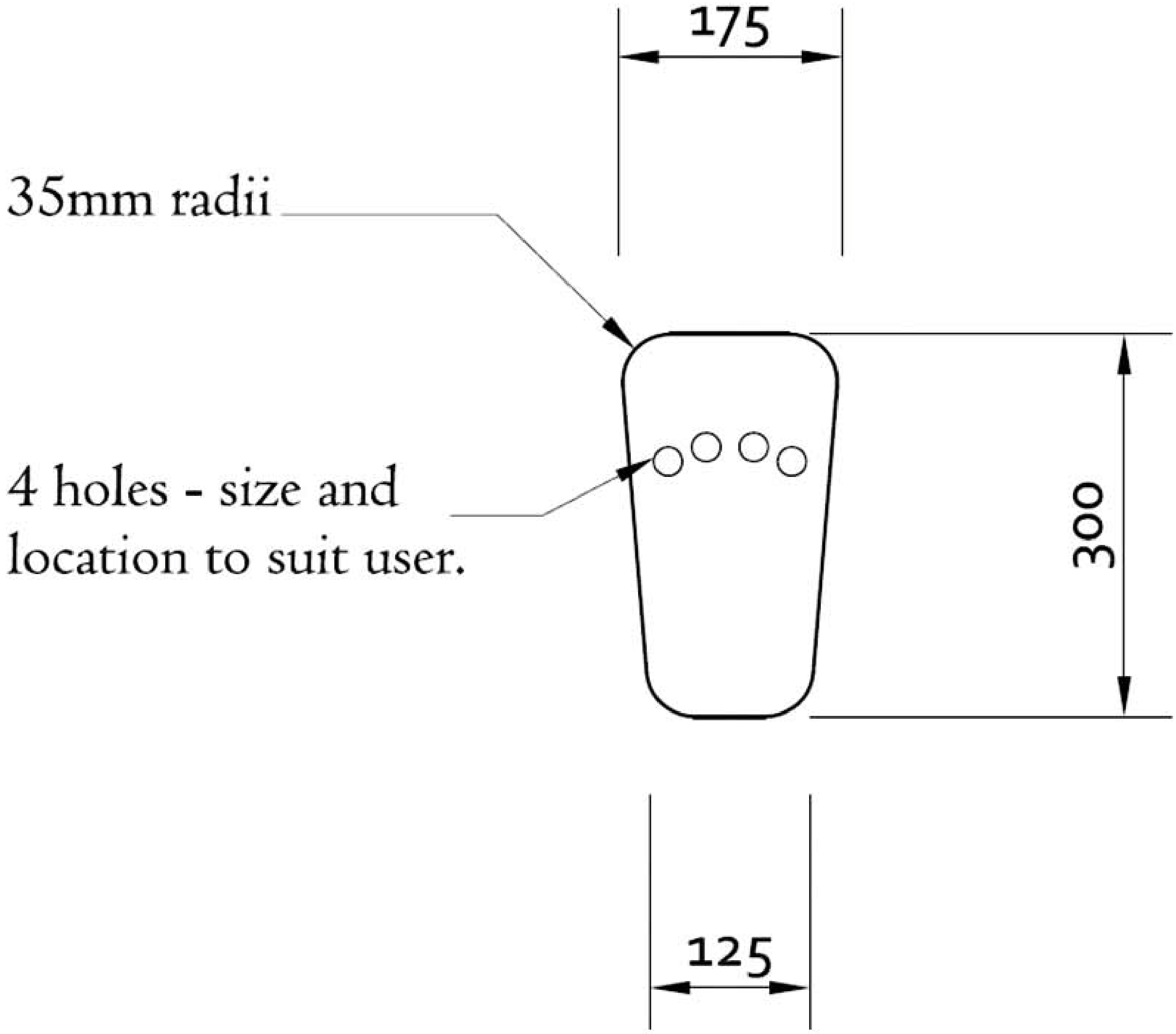


So the craft was duly constructed. This was simply a matter of:

1. Cutting the ply to the correct dimensions, making sure the grain ran across the beam and making sure the grain was vertical in the sides.
2. Joining the two four foot bottom sections together with glue and butt straps and repeating this process with the two side sections.

3. Nailing and gluing 20 mm. cleats to the side sheets. Using ½" ply where the curved sections occur.
4. Attaching the sides at the appropriate point of the bottom with glue and screw.
5. Bending and attaching at the ends. This was aided by a loop of rope around the length of the hull. Clamps were used at the end till the glue set.
6. Finishing off by attaching 20 mm. gunwhales and gussets around the top of the hull
7. Fibreglassing using vinylester resin and light fibreglass cloth.

The craft was now put to the test. Yes, it was light enough to easily carry at nine kilograms and it was adequately stable, but, hand paddling was a bit inefficient so a set of hand paddles was made. Using two fingers in the paddles seemed to work quite well. A small fin was bolted to the rear side for directional stability but it made little difference. Directional stability was OK probably aided by the slab sides depressed into the water.



With a water line length of two meters, a displacement speed of 3.3 knots could be expected so very little power was need to utilise this. Some skill was needed to get into my little putt putt but a larger boat allows for the paddler to pull himself up quite easily. And yes, I was asking the same question, is it seaworthy? Well it did survive the kilometre paddle to Dangar Is. and back braving the power boat washes and all the curious boating commuters who insisted on inspecting the strange craft. One lady towered over me, whilst asking me what I was up to. How do you explain that, in one sentence?

Now for the mud test. If successful I would no longer have to worry about the tide when going for a run. It was quite an expanse of mud to negotiate. Getting in was easy. Then with the fists pressing down and back off we went. Sandy mud is a bit sticky, so I altered course for the wetter and siltier mud and off we skidded down to the river’s edge.

So far, many outings have been successfully concluded, the only problem being cleaning up, which has been effected by having a gallon of water on hand. It is a one man craft so the "Brunkenkunjekrub" must be fired up and guests picked up at the public wharf at Kangaroo point, or at the ramp on high tide. To tell the truth, I have become very fond of my little craft which fits into my concept of minimalism. So there you go, what do I call it? "Bathtub" or "Mudskipper". No! now I've got it, from now on it is to be called "Minimal". In fact I'm so pleased with it, I think I will make sure its name goes on the stern.

The Wreck of the Brunkenkunjekrub.

I am often asked where I got the name for my wonderful single cylinder, hand start putt putt. Here follows the poem as recited to me by my friend who is known as the Count of no account. I have not been able to find the source of this poem but have seen it elsewhere with one verse missing.

The brundub thunder snarched above
The swissling biferous sea
While drimble mugfrubs boofkuntunked
And swunglers klunked in glee.

Twas the brunkenkunjekrub
That shoddled in the blast
The mugfrubs fierce had blooked the screw
And swanglekranked the mast.

The fleeded few that held the deck
Were streely wheeled with fright
For, Oh! The fearful Swankterbosh
Came squirdling through the night.

They saw the unktersspronks at play
Their souls in horror shrunk
The unktersrponk, the swankterbosh
The hootlejumptebunk.

And as the stykled ship went down
The swankterbosh drew nigh
And morgled them by twos and threes
A glumbious way to die.

He slorpelgised the lot
And then the hootlejuptebunk
Came at him with a stirkrous yell
And horched him with a krunk.

It takes some time to learn and I would sometimes recite it to kids when I was on playground duty as a science teacher. After one recital a young girl asked me; "What was that about Mr. Murray?" I was so amused I did not respond. Damn! I should have, the young lady was revealing the beauty of her unpretentious innocence.

Stuck in the Mud

Some years ago it almost seems like another lifetime now – I lived in a boatshed on the southern beach of Dangar Island on the Hawkesbury River. I had a dory in which I used to row back and forth across the river to Brooklyn. It was a great way to start and end the day, except when the tide was low, when getting ashore through the mud was a dirty, difficult business. It was annoying, but if you had told me it would one day put my life in jeopardy I would have laughed.

One cold but fine winter afternoon, I decided to stop at the Angler's Rest Hotel and have a couple of beers after work. There would be no difficulty rowing across the river afterwards in these conditions I reasoned, and you never knew who you might meet at the pub. As hoped, I met a few friends and enjoyed their conversation and three or four beers. I wasn't drunk by any means but perhaps not entirely sober either when I finally left the pub.

It was a beautiful night. A big yellow moon had risen over the hill and the sky was full of stars. I gazed at them, remembering nights at sea and dreaming of future voyages. I inhaled the crisp air, and the natural beauty soothed my melancholy. I remember being pleased with my decision to stop by the pub.

When I got down to the river, however, I discovered that it was low tide, and I had to wade out through the mud to my dinghy. I quickly sank into the black ooze, it was almost up to my knees after a few steps, and I found it difficult to extract my feet as I lurched towards the dinghy. I may not have been blind drunk but I was doing a good imitation, staggering from side to side. Just as I came alongside the dory, I lost my balance and fell backwards into the mud.

I tried to get up but the mud held me down like a giant suction cup. With considerable effort, I broke free, lurching to my feet, but my heavy jumper was now considerably heavier, caked as it was in mud, and I immediately lost my balance again, falling on my face this time. I was now plastered in black, stinking mud front and back, from head to foot, mummified in the stuff, which made the task of getting to my feet even harder. Again and again I struggled free, only to fall immediately. By this time my clothing was soaking wet and the intense cold had begun to numb my limbs. There was no way I could regain my balance.

Nearby, I could see a light in the residence above the marina. I called out, but my voice sounded feeble in the winter air. Nobody was listening. The tide, I noticed, was coming in. I began to fear that I was going to drown there, ignominiously, caked in mud like a bloody hippopotamus, unless I succumbed to hypothermia first. Then something in me rebelled. Drawing on some primitive strength, I hurled myself up, making no attempt to stand, only to travel in the direction of the dory. Talk about slapstick comedy! I flopped around like Charlie Chaplin, repeatedly landing on my face in the mud, but each time a little closer to the dory. It took several attempts but at last I landed in the boat. Saved!

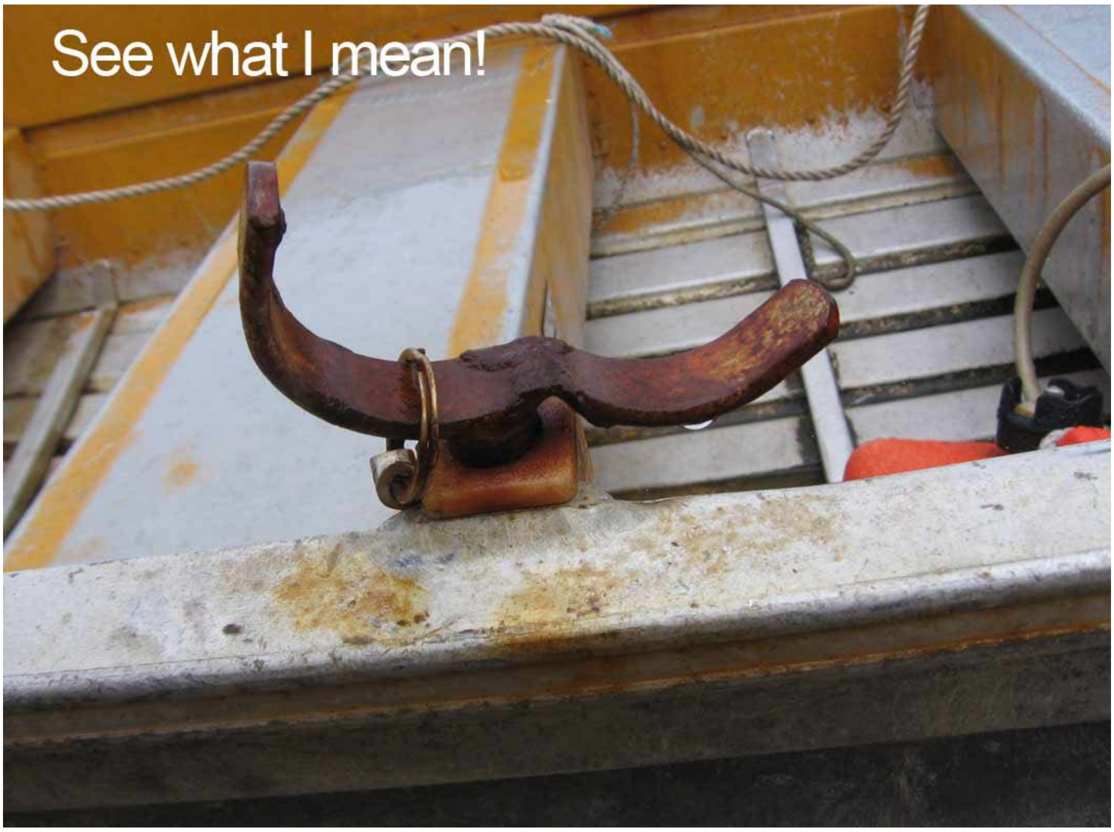
I lay there for ages. Time didn't matter now. I was hyperventilating, out of control, my ribcage racked with convulsions, but something inside me was calm, detached. When my breath returned to normal, I pulled up my anchor and rowed home. The night was transcendental - the tide was well and truly in now, the moon high in the sky, a cold, white orb, and the river like a sheet of black satin.

I could have rowed all night, filled with the joy of being alive. The next morning every joint in my body ached and I spent the next two days in bed. I did not touch a drink for several years.

From Graham Cox's unpublished memoir.

Oarlocks

A lifetime of rowing has left me dissatisfied with the oarlocks I have been using. Some broke, some bent, most wore out the oar, all wore out the socket and pin, some were easily lost and most were heavy. In time many rusted and after some use, the excessive wear caused two clunks with each stroke. To insert the oarlock into the socket it often had to be returned from the blade end by raising the oar till the oarlock came crashing down to the button (oarstop).



It is interesting to consider the degrees of freedom an oarlock must allow an oar. The oar must be able to:

1. Move in a horizontal plane.
2. Move in a vertical plane.
3. Rotate.
4. Be withdrawn.
5. Be removed from the gunwale.

The clunking rowlock: The excessive wear on the socket and upper part of the pin is easily seen as an engineering fault. The pin rotates in the socket, which becomes the bearing. The problem is that the pin exerts an uneven and excessive pressure at the top of the socket, so wear is concentrated there and to a lesser extent at the bottom of the pin and socket. Before long the oarlock clunks backwards and forwards with each stroke.

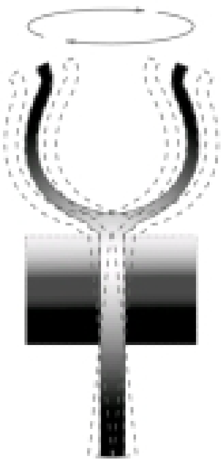


Figure 2

This problem is solved by designing an oarlock that rotates on the pin with the pin remaining fixed in the socket. You may wonder why this issue has not been addressed in the past.
In the middle of the last century, it was my habit as a child to bail out the hire boats at the local boatshed and as a reward take one for a row. One particular type of oarlock stuck in my memory as it was mounted on a fixed post and was of a D-shape. I have managed to track some down at a maritime collection in Tasmania. In the little hamlet of Tinderbox, Ross Burnett has a collection of clinker rowing boats, oars and oarlocks including the type described. A company associated with Kopsens in Sydney used to make these. It has a bolt around which the bronze horn rotates and the wear is evenly distributed on the bearing surfaces. Often the bolt was steel and if properly maintained, was also greased. Too bad if not, as rust would quickly foul things up.

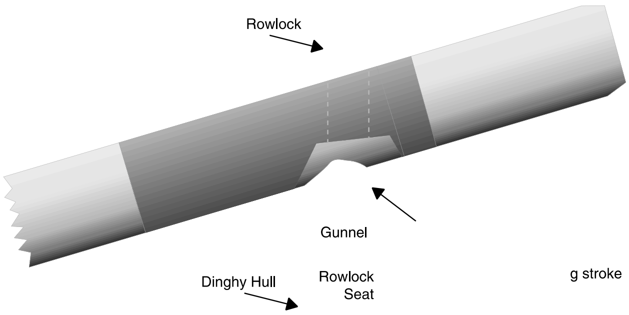
A Traditional well engineered oarlock

This oarlock was fine for hire boats as it was strong, resisted wear and could not be lost. However for modern skiffs it could cause damage to itself and the deck whilst upending the craft, and would be inclined to gouge the side of any yacht that it pulled alongside. Another variant of this has been supplied from a boatshed belonging to an old water access house on the Hawkesbury River. Shown below, this rugged design weighs just over one kilogram (2 ¼ pounds). Rowers designed this in the first half of the twentieth century to solve the problem of rowlock wear on boats used for transport rather than as a tender. Bearings work best when one surface is softer and bronze on bronze can become squeaky if not greased as would often be the case.

A more rugged design of oarlock.

Assembled oarlock is squeaky without grease.

Oar wear: There is another aspect of oarlock design that is not properly understood. Much of the wear on an oar appears on the underside instead of the back of the shaft where it bears on the oarlock. As the blade is lowered into the water during the stroke the top of the button bears against the top of the oarlock. The bottom of the shaft is then dragged across the bottom of the oarlock, persistently wearing it away. The diagram below illustrates this process.



Below is an extraordinary and beautiful design of oarlock. This was dredged up in St.Nazaire in France and the photographs and details passed on by a Dutchman Mr. Cor En Leen. He and his colleagues are inclined to think it was a gun-holder but there are too many features distinguishing it as an oarlock. Some may argue that it was for a sweep but I suspect that a sweep or a gunholder for that matter, would have its pin in the centre.

“There are more things in Heaven and Earth, Horatio, than are dreamt of ...”
This oarlock deals with the vertical friction and wear very effectively. It weighs two kilograms (over four pounds) has a ¾” pin. It will accommodate a three inch diameter oar which happens to be about the size of a whale-boat oar. Notice how the oar can only be fitted and extracted at the blade end and is thus less likely to be lost, but this did not stop some cursed soul losing this oarlock overboard. However a simpler way of resolving this wear problem has already been in use.

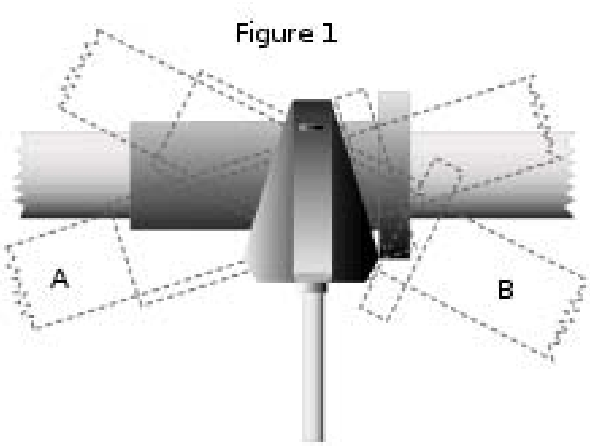
Racing scull oarlock.

In my quest for a better design I began investigating use of the racing oarlock. Much to my disappointment I found that they were the wrong diameter, were quite expensive and were designed to slip over a post bolted to the outrigger. However the general principal on which the bearing functioned was much superior from the point of wear and friction. Thus I found myself making a variant that could be used on the Herreshoff rowboats that I make. These worked well and are still in use today 20 years later, but they were a lot of work and missed some features.

Hand made oarlock after 20 years of use. (The plastic rotates around the pin so the pin does not move in the socket.)

Careful study of the racing oarlock revealed a profile that eliminated the friction cause by vertical motion. This lead me to make some wooden mock ups to perfect the ideal profile. The diagram below illustrates how this works. I discovered that the widest part of the profile should coincide with the bottom of the oar in the oarlock, a fine point that the racing oarlock seemed to have missed. The oar had to pivot over a triangular profile at the bottom of the oarlock.

Figure 1



This is not the only way of solving this problem. I have never seen it practised, but I suspect that an outward angle equal to the angle the oar makes with the water (about 150) on a conventional oarlock would solve the problem. If this seems a bit extreme any outward angle will help.

Astonishing technology: I engaged an Industrial Designer to draw up a Cad- Cam (Computer Aided Design-Computer Aided Manufacture) model employing the features mentioned above. Over a period of a year of experiment and in consultation with a Mechanical Engineer and the Industrial designer we came up with the final model oarlock. Significant contributions by this loosely knit team enabled the use of a catch that not only captured the oar but also the pin.

The rest of the process was astonishing. It took place in several stages.
An exact replica of the CAD was cut out of graphite using a CNC (Computer Numeric Control) lathe.

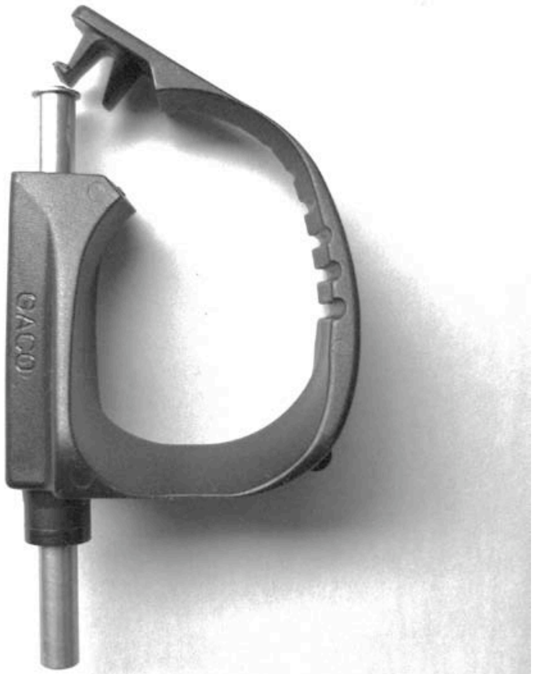
This was then immersed in kerosene above metal slab that was to become the mould.
An electric field was created between the graphite replica and its exact shape was etched into the mould.

A trial run was completed with two plastics, nylon and polypropylene. The nylon proved unsatisfactory as it was too stiff and changed its properties markedly when wet.

This may sound simple but many costly and troubling problems were overcome before getting to market. However the oarlock has lived up to, and in some respects exceeded expectations.

Some have argued that the pin would revolve in the socket. However the oarlock chooses the bearing surface with the least friction and revolves around the upper part of the pin. Inspecting the pin after some use confirms this fact.

Socket worn down but not out after 5 years of use (The down wear can be obviated with a stainless washer)



The 10mm (slight larger than 3/8”) hardened 316 stainless steel pin and plastic body enable a much lighter oarlock. We have found on the surfboat that even when one man is on an oar it will not bend the pin. None, including those hand made, have worn one out after 20 years of regular use.

Oh! Some customers wanted to use their existing sockets so an interference fit sleeve was developed for 7/16" and 1/2" sockets.

Some unanticipated bonuses have revealed themselves. For instance it is possible to rasp the oarlock to fit particular designs of oars. Also being plastic the oar-holder is much kinder to oars and the oarlock is significantly lighter than all other oarlocks except the all plastic models.

The oarlocks have been on the market for eight years now and are being sold in the US, Australia and New Zealand. Individuals have ordered them from the UK and Sweden. Website reviews have generally complimentary of their silence, and the ease with which they work. One bloke even gave up using his outboard in favour of rowing. Being a bit of a greenie, that is one result I endorse.

Now that this task was complete I took it upon myself the job of making a better oar since those available were either specific for racing craft and expensive, or designed for cheapness.

Postscript: A customer in the UK has tried thole pins in the 18 foot gig he had built by Chris Rees. Traditional as they are he found the Gaco very much better "perfect" as he described them

Gig by Chris Rees

Jeff's daughter and grandchild try the new rowlock.

MUDSKIPPER TENDER

by JOHN MURRAY

Eccentric people live on average three years longer than conformists, or so it is said. I suppose there is a stress in conformity that has a subtle effect on health. This may be of some comfort to me when I paddle out to my putt putt in the odd looking mud skipper.

When the Waterways Authority booted my motor boat from its comfortable life on a running line to a mooring, I had a problem. Down the end of Baden Powell Road at Brooklyn is a gravel boat ramp leading to a waterway appropriately called the Gut. I say appropriately, as, at anything below half tide one staggers from the water, through glutinous mud and silt, to get to the ramp. This was where my boat was to be moored.

I have already made the mistake of attempting to swim ashore from my new mooring. Unfortunately it happened to be low tide. All went well, until I got to the mud. My leg managed to drive its way so

The *Brunkenkunjekrub* at its new mooring. (main pic top)
After a couple of hours of low tide, the mud's not so bad (broken glass, time to bring back bottle deposits) (above)

The author at the dinghy rack.

There was a variation on this theme as he would occasionally and creatively fall sideways and even backwards so that his body was very evenly covered in the black, stinking silt. He had a much more appreciative audience than I, as a group of locals were holding their stomachs in mirth. I got the feeling they thought him a jolly fine chap. The victim eventually managed to climb out, almost invisibly black in the night. I last saw him stagger off into the dark muttering volubly to himself. For some people this is not a joke. For instance a rather heavy chap needed three people to rescue him from the mud in the gut, and a drunk friend of mine thought he was going to die on a cold winter's night after he became stuck in the silt trying to retrieve his dinghy.

This was all food for thought. I had been spoilt. Now I had to acquire a tender.

My Herreshoff rowboat was too big and valuable to use. A dinghy was a hassle to acquire and carry. It also needed oars, which would have to be secured against theft.

far into the mud that a tremendous suction resisted all further movement. The only option available was to plant the other foot in front, lean down hard and hope the other would release. After about 20 seconds the rear foot released suddenly from my sneaker and the mud, and I was face down with the front foot more firmly planted than ever. After a few goes at this, I managed to change to a crawl with my shins providing resistance to sinking at the rear and the container with my possessions floating the front half of my body. About 10 minutes later I managed to make it to the gravel ramp covered in mud from head to foot. A lady in a nearby house observed this, regarded my appearance, and walked inside in disgust. I thought she might at least do the humane thing and hose me down, but no, such an incompetent wretch had got his just desserts.

I had seen something similar to this happen at English harbour in Antigua. A yachtie had staggered drunkenly out of the Admiral's Inn to return to his yacht.

Unfortunately Admiral Nelson had built a stone lined pit for seasoning masts across his path, and it was now heavily silted up. I arrived to find this chap had stumbled into the pit in the dark, and, was repeatedly falling face down into the black mud.

A canoe needed a paddle and had to be acquired somehow. Aiding my thought process was a small canoe that I had hand paddled as an emergency tender on my trimaran. I had been thinking about a design like this for some time. An old mate 'Moo' had observed once, that building a boat is 95% thought and five percent action. Following this principle I spent the next month mulling over the basic requirements leading to its design.

Not far from the ramp sheltered under a forest of large malaleukas and resting on a fence lay 20 mouldy tenders. I must find a spot among these. So I lay down the following parameters:

1. Must be small, light, and easily carried by one person.
2. Designed to load one person up to 100kg. (220*lbs*)
3. About two metres (2'7") long and use one sheet of 8' x 4' ply.
4. Wide enough to be stable and carry a load but not too wide to hand paddle.
5. Flat bottom to skid over the mud and be stable when loading.

The design I set my sights on would be made out of 3/16" ply, two metres long and be half a metre wide. But would it have enough buoyancy? This calculation thanks to the metric system I was able to do in my head. A litre is a cube with 10cm. (4") sides and each litre of water weighs one kilogram. The bottom area of the tender was to be 2m or 20dm (dm is a decimeter or 10cm) by 0.5m or 5dm.

Thus the bottom area would be 100 square dm (20dm x5dm). So if the tender were depressed 1dm. or four inches in the water it would displace 100 litres and support 100 kg. This seemed okay so off I went to buy a lump of waterproof 8' x 4' three ply 3/16" plywood.

A final slide down to the river.

The beauty and simplicity of this project would be that it dispensed with frames, stringers, seats, oarlocks and paddles. The front of the tender would be barge like with the ply curving up to the bow and the same happening but more severely at the stern. The grain of the ply needed to run across the hull for stiffness and allow for easy bending at the ends. This meant cutting across the sheet and joining with butt strap in the middle. This join would provide extra stiffness at the sit.

After some examination of shoulder widths and arm lengths I decided that the bottom of the tender could be 60cm (2ft) wide. The sides of the craft sloped in at an angle of 10° so that they would not interfere with the stroke. However I have found that the natural position of the arms during the stroke do not necessitate the slope. The following design uses vertical sides to slightly improve ease of manufacture, buoyancy and stability.

Ready to go. (top)
Off the mud. (above)

The building process described applies to the design drawings that follow.

So the craft was duly constructed. This was simply a matter of:

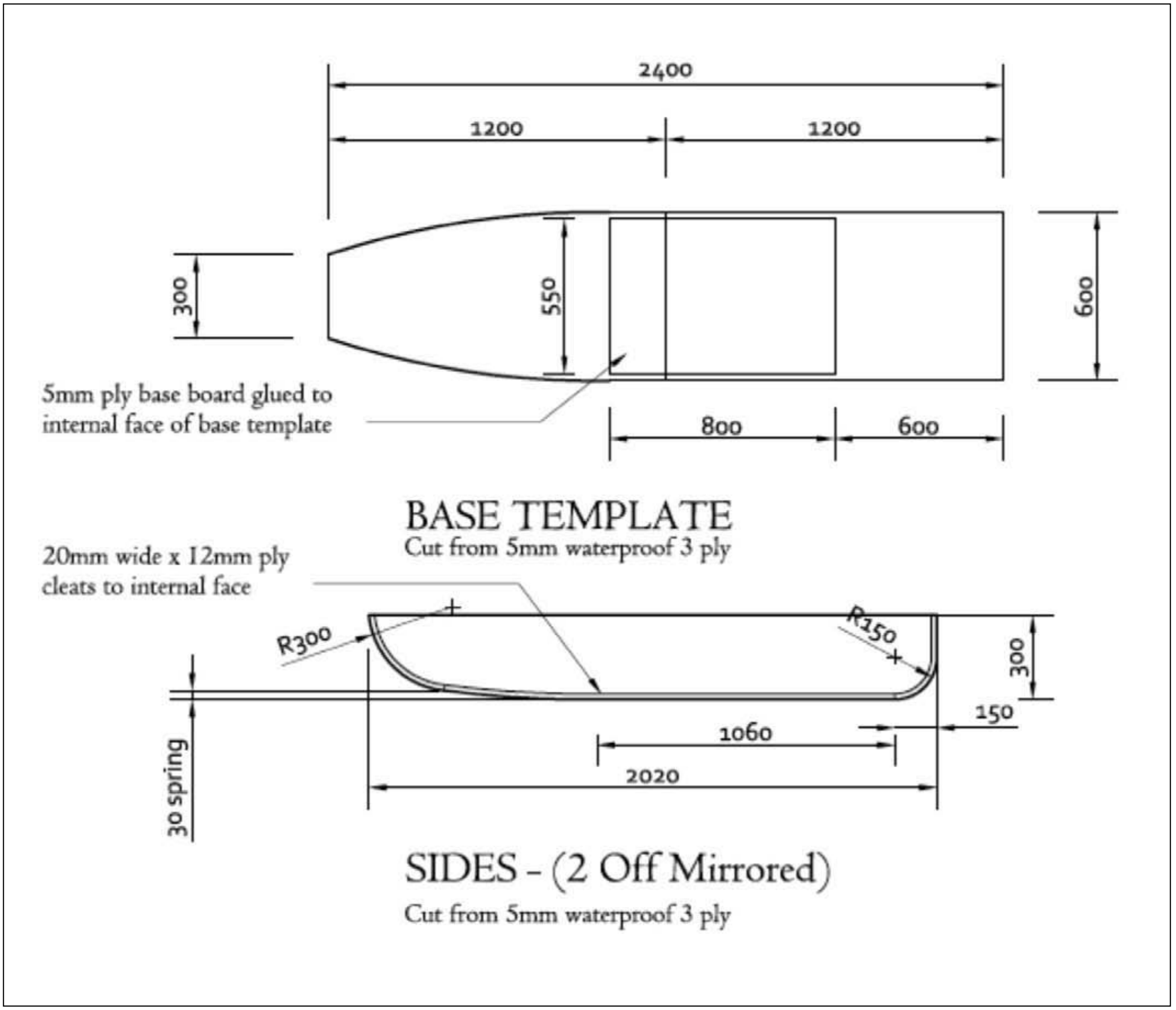
1. Cutting the ply to the correct dimensions, making sure the grain ran across the beam and making sure the grain was vertical in the sides.
2. Joining the two four foot bottom sections together with glue and butt straps and repeating this process with the two side sections.
3. Nailing and gluing 20mm cleats to the side sheets. Using 1/2" ply where the curved sections occur.
4. Attaching the sides at the appropriate point of the bottom with glue and screw.
5. Bending and attaching at the ends. This was aided by a loop of rope around the length of the hull. Clamps were used at the end till the glue set.
6. Finishing off by attaching 20mm gunwales and gussets around the top of the hull
7. Fibreglassing using vinylester resin and light fibreglass cloth.

The craft was now put to the test. Yes, it was light enough to easily carry at nine kilograms and it was adequately stable, but, hand paddling was a bit inefficient so a set of hand paddles was made. Using two fingers in the paddles seemed to work quite well. A small fin was bolted to the rear side for directional stability but it made little difference. Directional stability was okay probably aided by the slab sides depressed into the water.

With a water line length of two metres, a displacement speed of 3.3kts could be expected so very little power was need to utilise this. Some skill was needed to get into my little putt putt but a larger boat allows for the paddler to pull himself up quite easily. And yes, I was asking the same question, is it seaworthy? Well it did survive the kilometre paddle to Dangar Island and back braving the power boat washes and all the curious boating commuters who insisted on inspecting the strange craft.

One lady towered over me, whilst asking me what I was up to. How do you explain that, in one sentence?

Now for the mud test. If successful I would no longer have to worry about the tide when going for a run. It was quite an expanse of mud to negotiate. Getting in was easy. Then with the fists pressing down and back off we went. Sandy mud is a bit sticky, so I altered course for the wetter and siltier mud and off we skidded down to the rivers edge.



So far, many outings have been successfully concluded, the only problem being cleaning up, which has been effected by having a gallon of water on hand. It is a one man craft so the *Brunkenkunjekrub* must be fired up and guests picked up at the public wharf at Kangaroo point, or at the ramp on high tide. To tell the truth, I have become very fond of my little craft which fits into my concept of minimalism.

So there you go, what do I call it? *Bathtub* or *Mudskipper.* No! Now I've got it, from now on it is to be called *Minimal.* In fact I'm so pleased with it, I think I will make sure its name goes on the stern.

The Wreck of the Brunkenkenjekrub

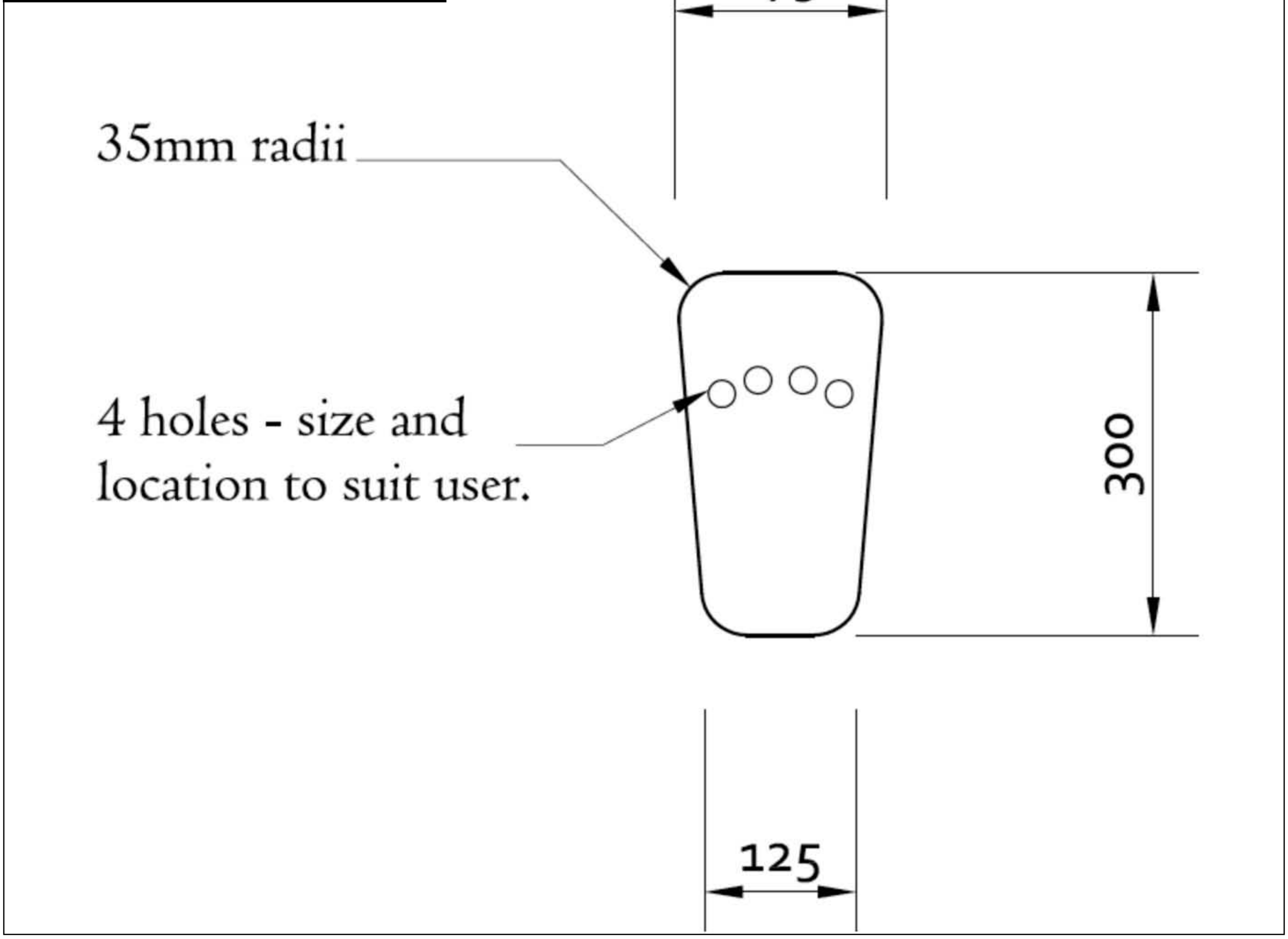
I am often asked where I got the name for my wonderful single cylinder, hand start putt putt. Here follows the poem as recited to me by my friend who is known as the Count of no Account. I have not been able to find the source of this poem but have seen it elsewhere with one verse missing.

The brundub thunder snarched above
The swissling biferous sea
While drimble mugfrubs boofkuntunked
And swunglers klunked in glee.

Twas the brunkenkunjekrub
That shoddled in the blast
The mugfrub fierce had blooked the screw
And swanglekranked the mast.

The fleeded few that held the deck
Were streely wheeled with fright
For, Oh! The fearful Swankterbosh
Came squirdling through the night.

HAND PADDLE DESIGNS



They saw the unktersspronks at play
Their souls in horror shrunk
The unktersrponk, the swankterbosh
The hootlejumptebunk.

And as the stykled ship went down
The swankterbosh drew nigh
And morgled them by twos and threes
A glumbious way to die.

He slorpelgised the lot
And then the hootlejuptebunk
Came at him with a stirkrous yell
And horched him with a krunk.

It takes some time to learn and I would sometimes recite it to kids when I was on playground duty as a science teacher. After one recital a young girl asked me; "What was that about Mr Murray?". I was so amused, I did not respond. Damn! I should have, she was being innocently unpretentious.

John Murray built his yacht *Unbound* and circumnavigated the world between 1969 and 1975. He has worked as an industrial chemist and science teacher. He has invented and manufactures the Gaco gated rowlock(www.gacooarlocks.com)
and also makes oars and rowing boats. He lives near, and boats in the beautiful Hawkesbury river near Sydney.

home | gaco oarlock | dory history | gaco oars | swift dory | video | sales/contact

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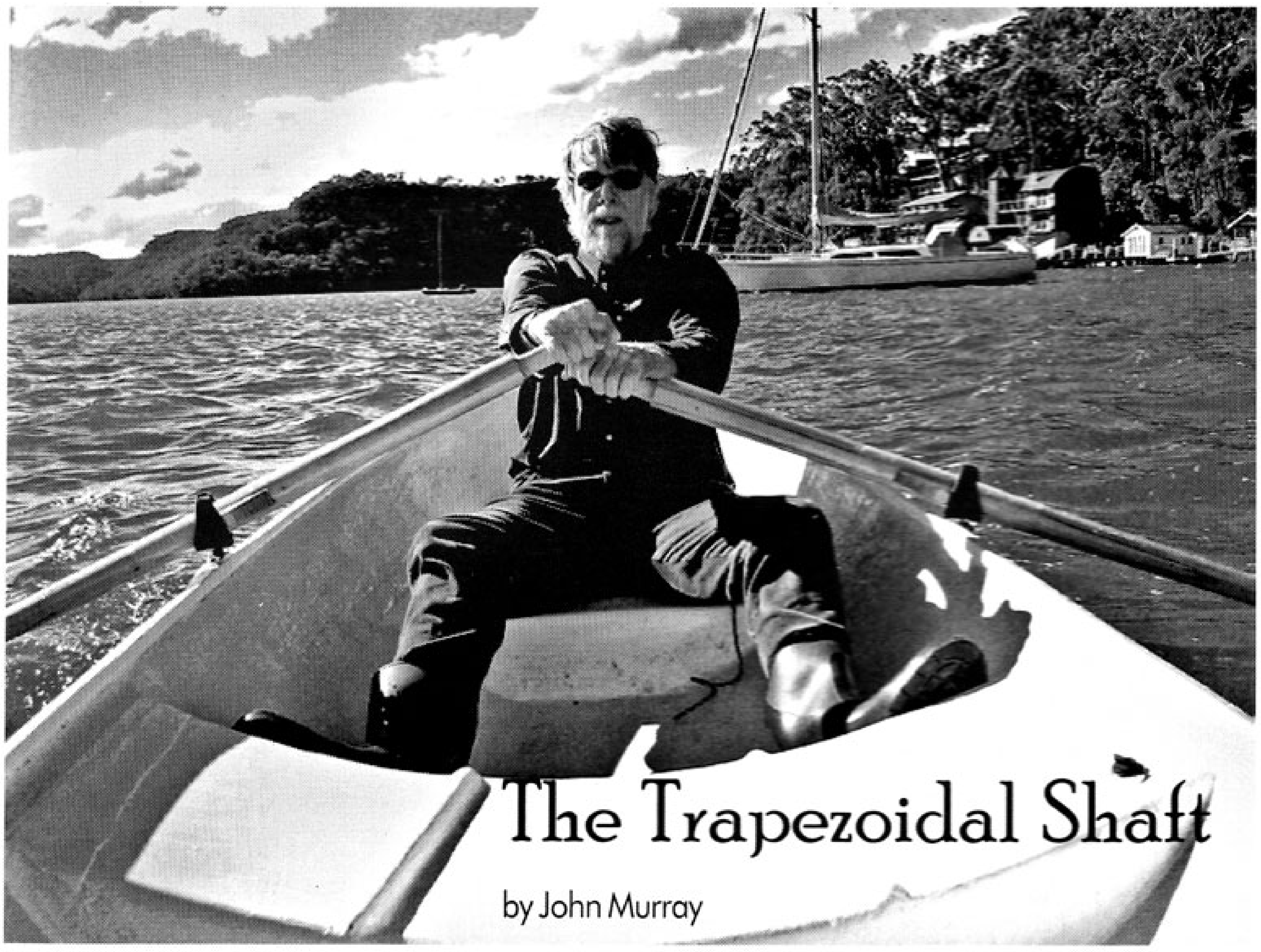


Photo of John Murray, at the oars, by John Weiss.

The Trapezoidal Shaft

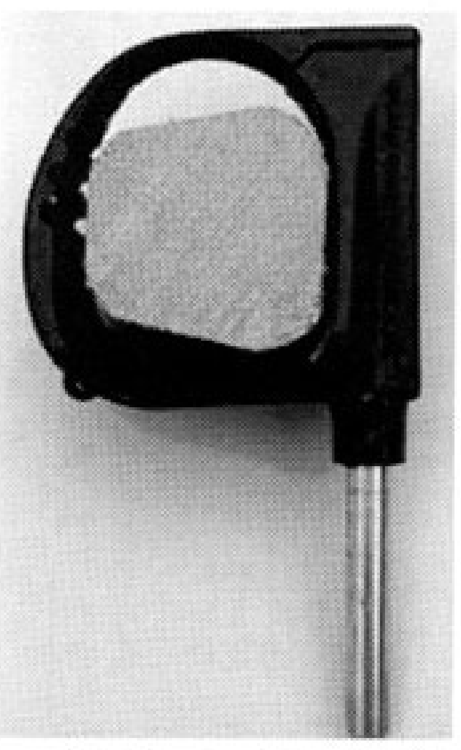
by John Murray

Part II in a Series on Oars: It is more by accident than design that I have arrived at an efficient and radical way of making a stiff, light shaft. The cross sectional shape goes by the rather awkward name of "isosceles trapezoid" (an isosceles triangle with the apex cut off). It was while I was playing around with different shapes that I was surprised to find that such a shape could rotate in the oarlock, as well as provide a flat section to match the D-shape of the oarlock (see photos below). Since it had many other advantages I have been making oars using this shape.

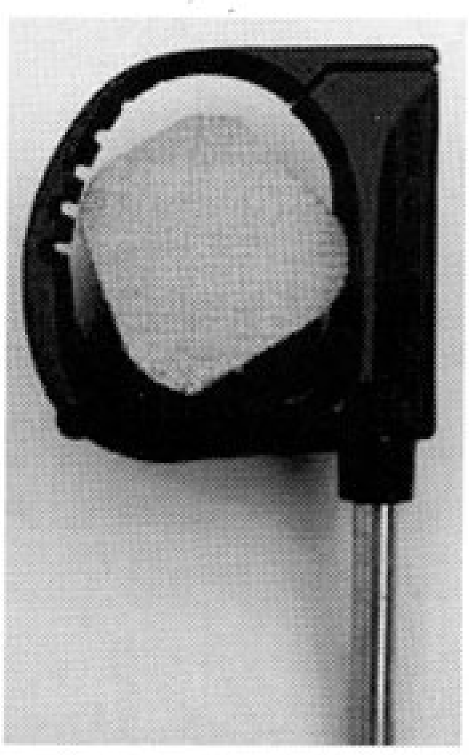
Considerations: Most oarlocks are designed for a round, less-than-two-inch diameter shaft. When the leather protector is added, the shaft is reduced to 1 7/8". Some fittings reduce it to to 1 ¾" at the oarlock and this dictates the dimensions of the rest of the oar for a given length. Most properly designed oars will have approximately the same volume. Hence they need a light strong timber. Expensive and hard to get, Sitka Spruce is generally selected as the ideal choice

Active and passive planes: the plane of the oar vertical to the water (passive plane) only needs to be strong enough to lift the blade in and out of the water, while that parallel to the water (active plane) needs to be strong and stiff to resist bending and breakage of the oar. The passive plane of a round oar is wastefully stiff. There is no reason why a heavier timber cannot be made thinner in the passive plane as long as it is still functional (see above right).

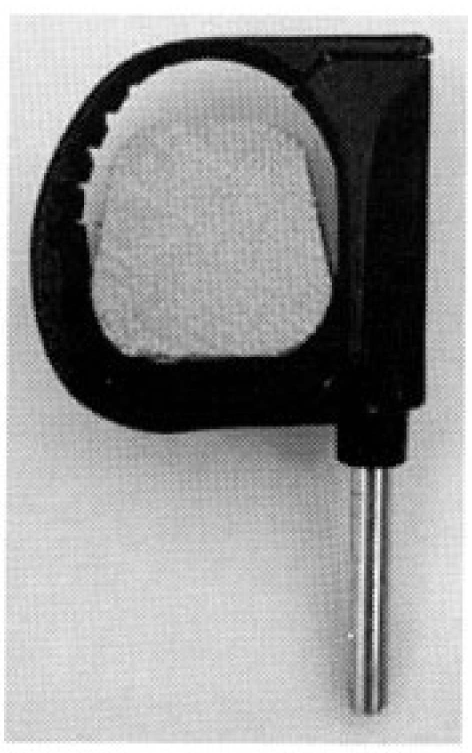
Note that the trapezoid cross section has substantial material on the tension side and even more on the compression side to compensate for the lesser compressive strength of wood. By contrast the round cross section has a minimum amount of material where it is most needed and a maximum where it is least needed.



Unfeathered



Feathering



Feathered

Stiffness: It takes energy to bend an oar and this energy will be imperfectly returned at the end of the stroke when it is not as useful.

I may have an argument on my hands about this, as one enthusiast has told me: "The oars on my Adirondack guide boat have quite a bit of spring in them. The builder says that's intentional." In order to resolve these contrary positions, the argument should be taken to a logical conclusion. So: consider an oar made of stiff rubber that bends considerably. It is obvious that it would be quite ineffective. Now make it of stiffer and stiffer materials. It will become progressively more effective. The logical conclusion is that a perfectly stiff oar will be most effective.

A 10% increase in thickness of the active plane will yield a 20% increase in stiffness. Both the amount of material, and the distance between the compression and tension side of the active plane affect stiffness. This explains the two-to-one ratio. Only the amount of material in the passive plane affects stiffness in the active plane, so its thickness affects stiffness on a one-to-one basis. This means that a 1/8" increase in the active plane will allow a 1/4" decrease in the passive plane, producing a lighter oar that is just as stiff.

Balance: the oar should be as light as possible especially at the outboard end. Energy can be wasted in the following ways due to poor balance:

1. For each stroke the oar reverses direction twice. Since the speed of motion at the blade end is greatest, then its weight will require the greatest effort to reverse direction (it will also slow the boat as the rower is effectively pushing back on the oarlock). The weight of the handle has less effect as its speed is one third of the blade.
2. For each stroke the oar must be raised in

continued on next page

Trapezoidal Shaft, cont'd.

> and out of the water. The more balanced the oar is over the oarlock and the lighter it is, the less effort will be required to overcome inertia and weight. Extra weight in the handle helps balance the oar, but increases inertia. A sufficiently light oar will almost balance with the weight of the hand and arm holding it.

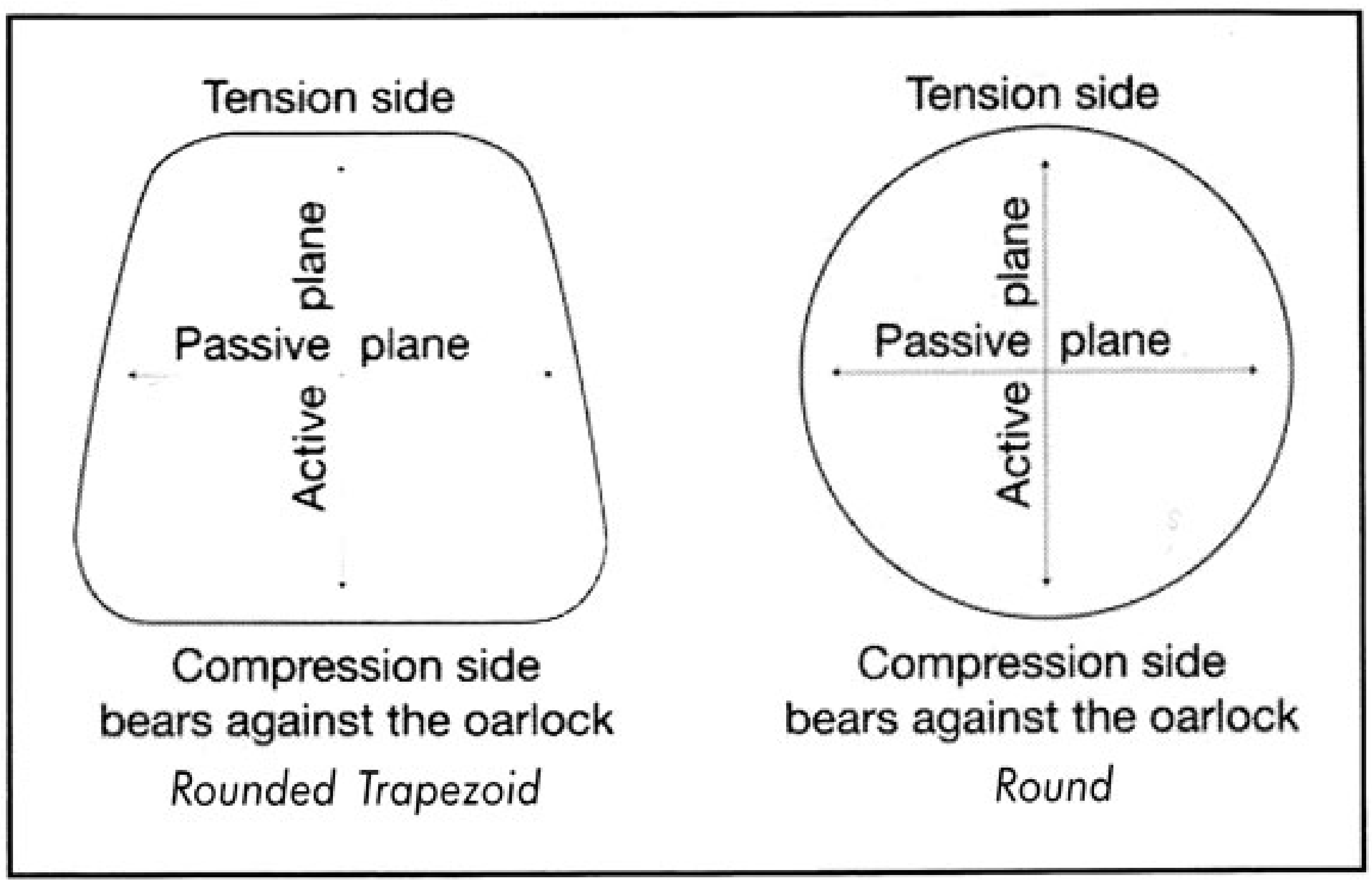
It is remarkable how much easier it is to feather a lighter oar, probably because of its lower inertia, and friction at the oarlock. After all, the wrist twisting muscles are much weaker than the major muscles used in rowing.

Utility: Oarlocks made for racing sculls are designed for the utmost efficiency. They have a plastic oar holding body on a stainless pin (the Gaco is modeled on this principal) for low friction. The shaft at the oarlock employs a D-shape fitting to marry to the D-shape of the racing oarlock. This has the important function of holding the oar blade vertical to the water with little effort from the rower. The D-shape also makes for a stronger and stiffer oar. Most recreational oars and oarlocks do not have this feature.

An old catalog from Wilcox Crittendon (pp76-81 of *Boats, Oars and Rowing* by R.D. Culler) shows 26 kinds of oarlocks and yet only one, called Victoria pattern, is designed to accommodate a D-shape cross section oar. However I am old enough to remember hire boats, when most fishing was done from row boats, which had bronze D-shape oarlocks on steel posts and I still have an oar, made in the fifties, which has a flat section on the back, a kind of modified D-section.

All is not lost as the Douglas oarlock and the Gaco are designed to accommodate the D-shape oar. The Gaco has a plastic oarholding body that is easy on the oar especially if it is protected at the oarlock with fiberglass (which also improves stiffness and strength).

Oar design: Racing oars these days are made of round carbon fibre, tapered hollow shafts with a meat-cleaver carbon fibre sandwich blade (shaped somewhat like a meat cleaver and angled to parallel in the water on the rowing stroke). They can be ugly — especially at the bolt-on D-section adapter to the oarlock — and the black carbon fibre does not appeal. For reasons of simplicity, availability, cost and aesthetics, the shaft is best made of timber and the blade, carbon fibre. A carbon fiber blade allows for the efficient complex shape needed. The shaft can be varnished and the blade painted white, thus retaining traditional aesthetics.



Characteristics of timber: The following facts about wood characteristics are taken into consideration in the design:

1. **Tension strength along the grain is approximately twice compressive strength.**
2. There is a reasonable correlation between density and strength.
3. Strength across the grain is only about 4% of the strength along to the grain.

Length of oar: This should be 1.9 times the distance between oarlocks. The inboard part of the oar should be 26% of the oar length.

Cross section: The following cross sectional shapes have been considered.

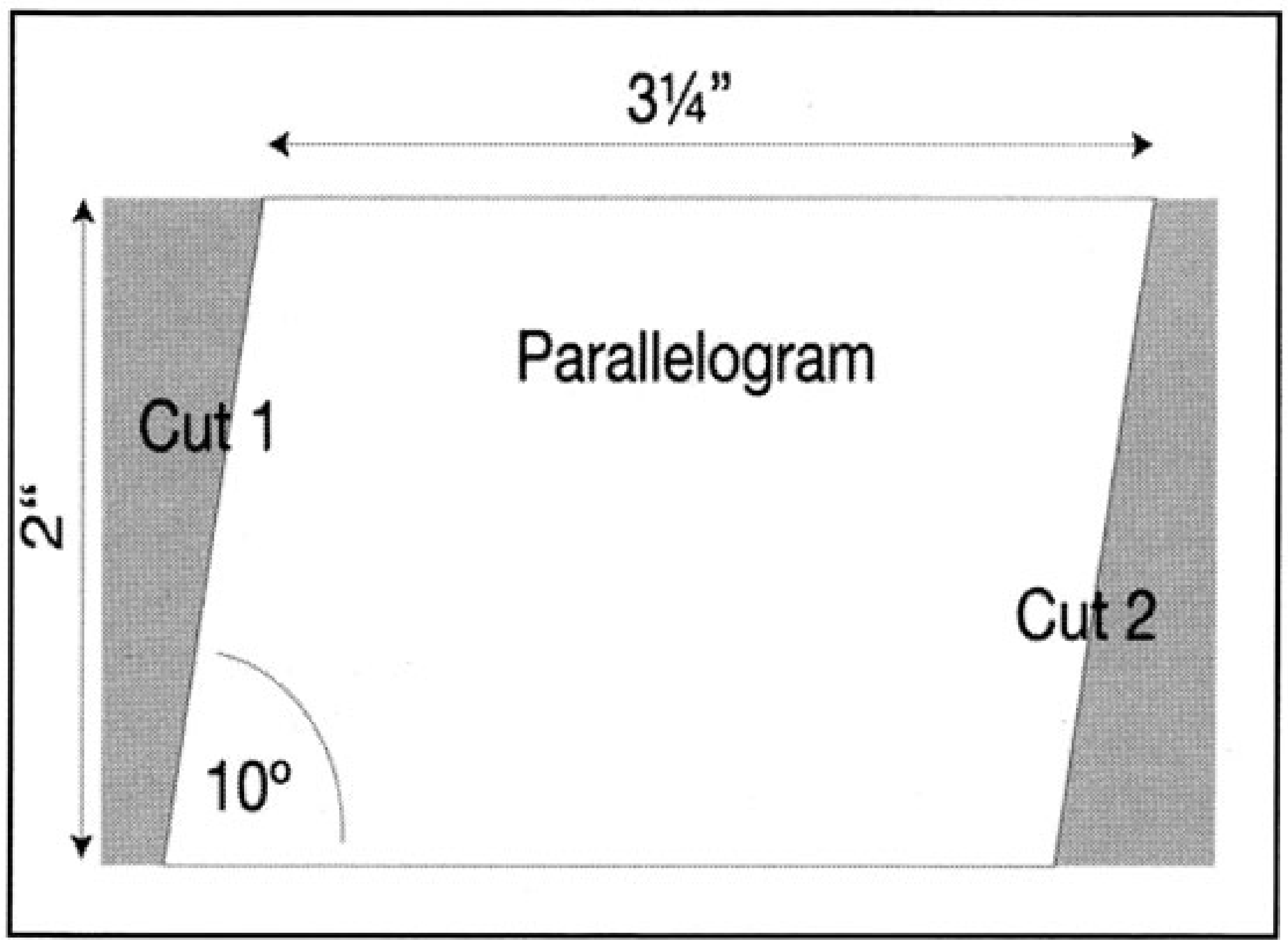
1. ***Round:*** for strength this is close to the worst shape. It is thinnest at top and bottom, where it needs maximum compressive and tensile strength. In the neutral middle, where very little strength is needed, it is thickest. Good shape for flag poles, but not much else.
2. ***Oval:*** Better than round but confined to a round shape at the oarlock, and has similar negative characteristics as round.
3. ***Hollow:*** Difficult to make and inclined to fail. I well remember the hollow Oregon and Spruce spars failing on other skiffs, while us poorer kids with solid Oregon masts and steel (not duralumin) centreboards went on and on, part way down the pack of course, without any problems.
4. ***Isosceles Trapezoid*** with rounded edges: by a process of deduction and trial and error I have selected this shape for the following reasons.
    a. It allows design to accommodate the difference in tensile and compressive strength. The weaker compression side is wider than the tension side.
    b. There is more width and strength at the top and bottom of the active plane where it is needed.
    c. It facilitates feathering.
    d. The flat section on the wider compressive side behaves like a D-section oar and holds the blade in the correct vertical position with little effort from the rower.
    e. The thickness of the oar in the passive plane can be reduced to cut weight.
    f. It is easy to cut with a circular saw with very little waste.
    g. It employs, as a starting blank, the very common four-by-two.
    h. For a given weight, it is stronger and stiffer.

Timbers: Number one clear Douglas Fir (Called "Oregon" in Oz) seems readily available in recycled timber yards but elsewhere is rubbish and full of knots. I have also, with a bit of luck, been able to secure a reasonable quantity of Western Red Cedar at the same yard. Not only is this timber often of good quality, it is generally cut to a very generous 4" by 2" so that its dressed size can be 4" by 2". Is it not a wonderful thing to save forests by using timber, that has possibly served structurally for perhaps 50 years, and turn it into something beautiful and functional?

I purchased Sitka Spruce, rare in Australia, which had been imported to renovate a Tiger Moth. Surian, a type of cedar, was available at a local exotic timber yard.

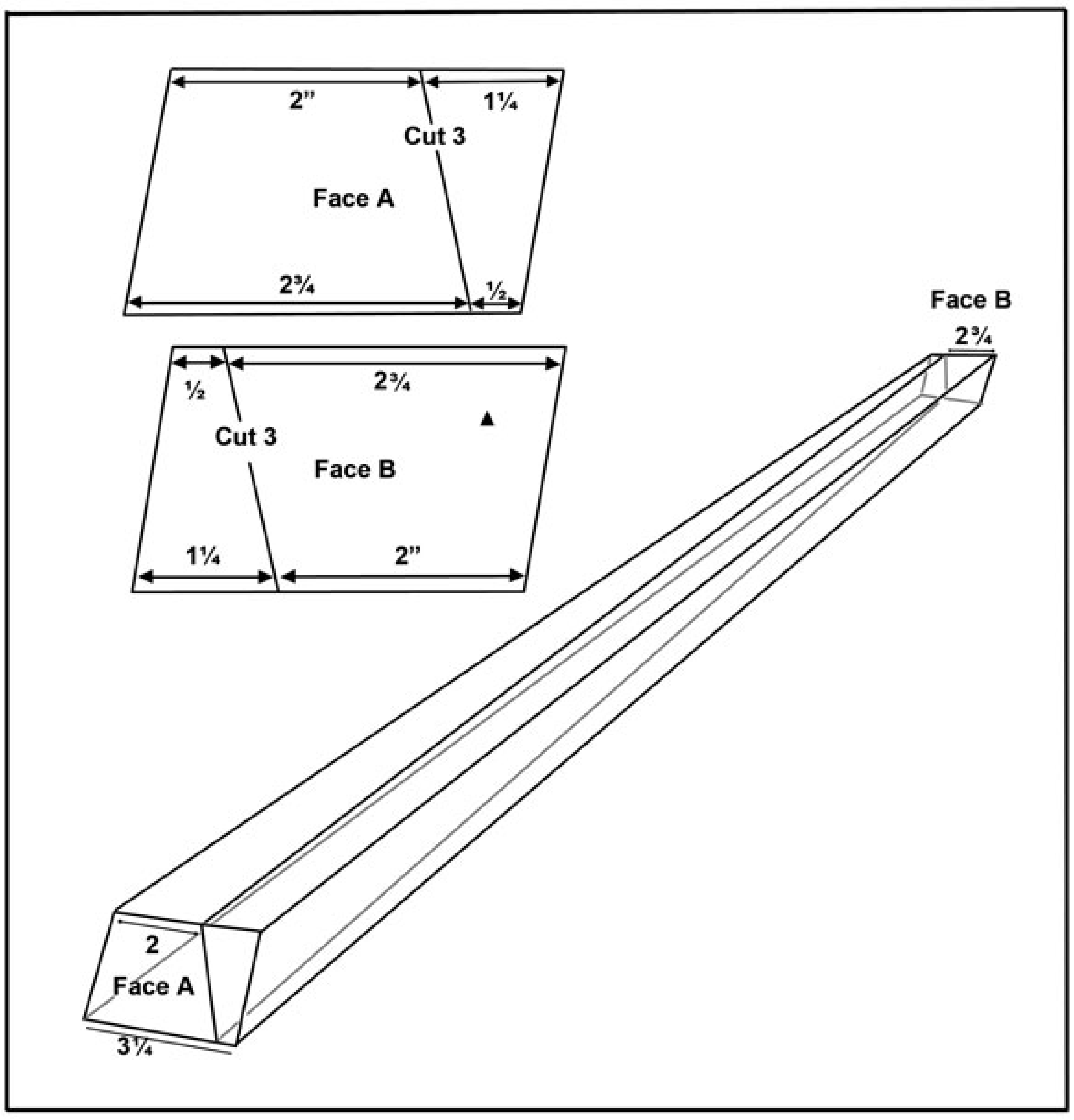
Some guide to their use is given below. The figure in brackets is the density relative to water. Bear in mind that these are only timbers I have used and there must be numerous others. It is reasonably easy to research timber properties on the internet these days, if in doubt.

1. **Oregon (0.55 but varies):** Cheapest and most readily available but must be carefully selected to avoid knots. A bit on the heavy side but made reasonable in weight by keeping the passive side slender. I might add that a slender passive side makes the pair of oars wonderfully easy to carry with one hand. Planing and routing must be done with the grain to avoid slivers of timber shattering off (the rotary action of a power plane tends to minimize this problem). The grain looks attractive when varnished.
2. **Sitka Spruce (0.45):** Most expensive and difficult to acquire. It is light and easy to work. Finishes to a beautiful cream colour when varnished.
3. **Surian (0.41):** Reasonably expensive but fairly available. It is light and easy to work but soft. Finishes to a beautiful red colour.
4. **Western Red Cedar (0.35):** lightest, must work with the grain to avoid splintering. It is quite pretty with a nice grain when varnished. This is my timber of choice for the shaft as it is available, very light and modestly priced.



Making the shaft from 4"x 2" timber: The passive plane of the shaft shaft must be tapered towards the blade to take into account the diminishing stress, which is at a maximum at the oarlock. The dimensions for cutting take this into account, as well as allowing for width of cut and planing. The cutting can be achieved with three passes of a hand-held circular saw.

1. The four-by-two is first cut to a length one foot (30 cm.) less than the overall length of the oar. The remaining foot will be made up from the blade.
2. The circular saw blade is set to an angle of 10 degrees and the timber is cut down each side (aided by the saw guide) to a parallelogram shape whose major dimension is 3 1/4" (80mm.) Leave the saw set to the same angle for the third cut.



The diagram, at left, shows the first two cuts to form the parallelogram from the four-by-two length of timber.

3. Carefully mark the longitudinal cut by stretching masking tape along the timber. Use the dimensions shown in the diagram, above. This cut is easier to make with a hand held circular saw than a table saw. Note: For long oars it is possible to increase the dimension by cutting a larger parallelogram and altering the dimensions somewhat. However the dimensions given are more than adequate for oars up to eight feet long.

   Note Well: Make absolutely sure that the blade is at an ***opposite*** angle to the angle of the parallel sides for this cut.
4. Plane the resulting blanks to equal size and weight. After checking stiffness you may elect to trim the passive side to suit yourself. The only stipulation is they must be able to rotate in the oarlock and of course not be too flexible or weak.
5. Taper the front of the shaft from 8" (20cm.) from the tip to zero where it is going to attach to the blade.

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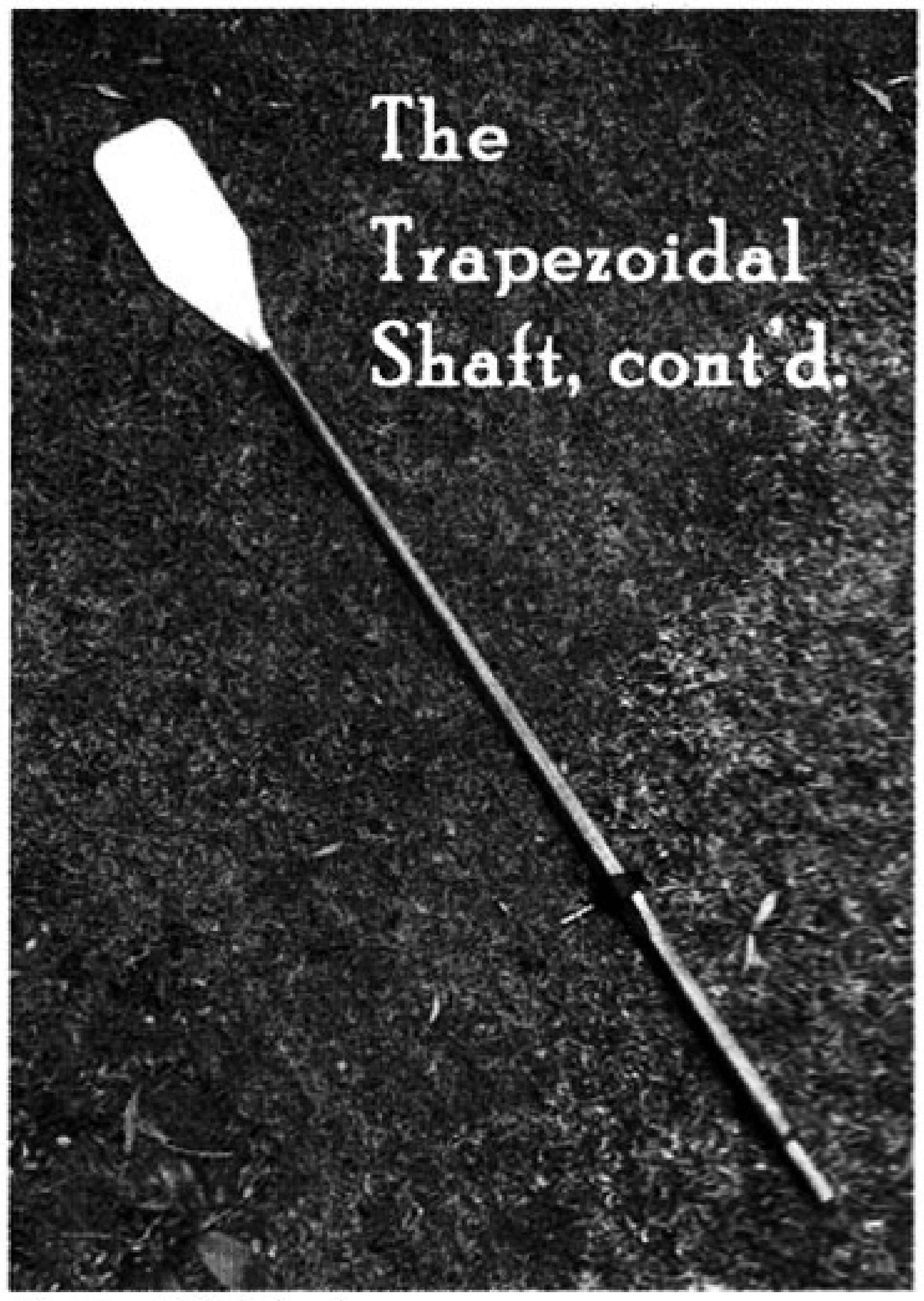

Photo of finished oar.

6. Rounding the shafts: the back-side of the shaft should be rounded to a radius of approximately 3/4" (19mm.) near the oarlock area. Make sure a flat area remains to marry the oarlock. Diminish the radius going further down the shaft. A half-inch radius is adequate on the front. This shaping can be done by combination of plane and sanding. Make sure the rounding allows the oar to rotate in the oarlock with about 1/8" to spare.

   N.B. Do not round the last 8"(20cm.) of the back of the shaft where the blade is to be attached.

7. The handle can be cut with a hand saw or careful application of circular and hand saw. Finish off with sanding disk and hand sanding. It is best made 5" (150mm) long, 1 1/8" (28mm) where it meets the shaft and 1 1/2"(37mm) at the end of the oar. Reduce the dimensions for smaller hands.

8. Apply a layer of fibreglass around the oarlock area for the Gaco and attach 3/4" wedges front and back as an oar stop.

9. The blade: Can be home made or bought (Gaco is one source). It is best attached to the back of the shaft with one screw and epoxy bog. Now, knock the blade into alignment and allow the glue to set.

10. Fill in around the shaft attachment with epoxy and microballoons and fibreglass over this.

11. Finish by filling, sanding, and painting. Ordinary enamels and undercoats are adequate; two-part polyurethane is better.

My short career as a paint chemist indicated that epoxy should not be used as a varnish because of its poor UV resistance. Ignorant of this, some of the locals have been successfully priming with epoxy. I have followed suit, thinning a little with acetone if necessary. It seems to stiffen and harden the oar. I have to presume that the subsequent coats of varnish with their included UV inhibitors have obviated the problem of solar degradation.