: AMATEUR YACHT RESEARCH SOCIETY
HERMITAGE, NEWBURY, BERKSHIRE.

CATAMARAN DESIGN

A.Y.R.S. PUBLICATION No. 15

JUMPAHEAD

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(Founded June, 1955)

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October 1957

EDITORIAL

This publication deals exclusively with the double hulled craft. It doesn't seem worth while any more to try to give " Catamaran " its original meaning and, in future A.Y.R.S. publications, will be used for the equal hulled craft. " Outrigger " or " Trimaran " will be used for the unequal hulled type. However, it must still be remembered that the Indians and other people will still call their outriggers " Catamarans " as they have done for many centuries.

An attempt has been made here to give the main principles of catamaran design, so far as these are known. No doubt, some of the conceptions are controversial and articles giving other points of view will be welcome for future publications.

We are lucky to have an article by Arthur Piver of San Francisco on his elegant catamaran, as he has had a lot of experience with both catamarans and trimarans and has made excellent examples of both.

This study is not complete. We still need to know the relative performance of :

1. Catamarans with sections of a right angle at the keel.
2. Catamarans with symmetrical sections of a deep ellipse resembling those of *Manu Kai*.
3. Catamarans with semi-circular sections and a bow overhang like that of *Gemini*.

Relative Speeds.

It is yet to be shown that any small catamaran anywhere is faster than the Prout *Shearwater III*. Bob Harris' *Ocelot* beat one *Shearwater III* in Long Island Sound in a strong wind, though the smaller craft was faster in light going. Bill O'Brien's *Jumpahead* is similar in speed reaching and running but was slower to windward in the races this year (1957). Twin C.B.s and more racing experience might make the craft more similar. The Australian *Yvonne*, being 20 feet long, may have similar speeds to a *Shearwater III* in strong winds but is likely to be slower when the winds are light. To my knowledge, no contact has been made between the two as yet.

Arthur Piver's *Pi-Cat* should be similar or faster than *Shearwater* because she is longer and of the same basic design.

All the other designs in this publication will be slower than *Shearwater III*. Naturally, the shorter craft will be slower but they have to be beamier to carry their load and thus begin to lose the slim hulls which give the catamaran its speed.

The majority of yachts built nowadays, some of them costing many thousands of pounds, have not had even the most rudimentary tank test done on a model first. Indeed, not many yacht designers have even the simplest testing apparatus of their own. This may have been the normal practice in the past but, in my opinion, no yachtsman should *ever* have a yacht built *in future* unless a model has been made and compared with a model of a comparable nature in a test tank of at least the quality of that described in our publication No. 12, *Amateur Research*. Such a tank could be made for such a small sum of money that it would be a very reasonable thing to ask.

This matter has been brought to my attention recently because of the numbers of people who have asked *me* to design catamarans for them. Now, though I have designed *Gemini*, which is described in this publication, and it goes well, I have never thought of becoming a *professional* yacht designer, even of catamarans, because I would like to know *exactly the quality* of the craft I am asking people to build. I could only find this out by some test and this I have not yet done. I consider that, to take money from people for a design " because it looks right " is prehistoric behaviour and people should demand much more from yacht designers than that, nowadays. The best yacht designs have always been the result of testing and the best yacht designers have always done tests. We should insist that this become the usual custom, rather than the exception.

Professor Ata Nutku of Istanbul, Turkey is prepared to test catamaran models sent to him. Details of the size of models can be got from the Editor.

THE LONDON BOAT SHOW

A Stand has again been taken for the next London Boat Show. This year, exhibits will be full scale as far as possible. Our stand will show (1) a non-commercial catamaran, (2) the A.Y.R.S. catamaran with Melagasy floats and hydrofoils, (3) one or two " Wingsails " and (4) Dr. Davies' canoe *Swan of Arden*, to show the possibilities of " Developed plywood " design. Will any members with devices, models or full scale craft which would be suitable for showing, please get in touch with the Editor. Our space is very limited but we would like to put on the best show pessible. It would be nice to have the " Wing " foresail, which is shown on Page 25 of WINGSAILS, on the catamaran instead of its jib. If anyone would like to make this for us, the dimensions can be got from the Editor. It is simply a matter of making an elliptical shape with batten pockets every 18 inches. No bolt ropes would be necessary and the cloth used need not be expensive.

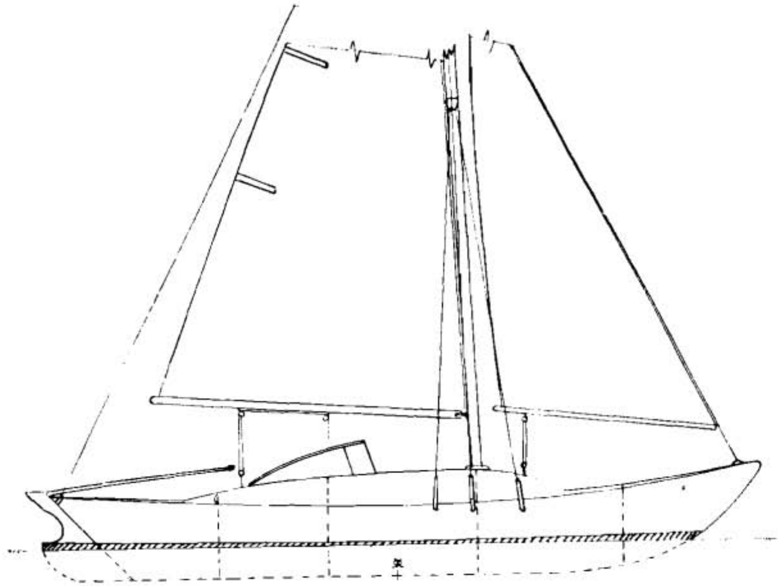
We will again need to have people on the Stand to keep the public talking and interested in our work. The Boat Show runs from January 1st to the 11th, of which I can only manage to be there the first four days. Mrs. Morwood, will however, be on the Stand the rest of the time, and given some relief, will doubtless manage in her usual capable manner.

THE MODERN CATAMARANS

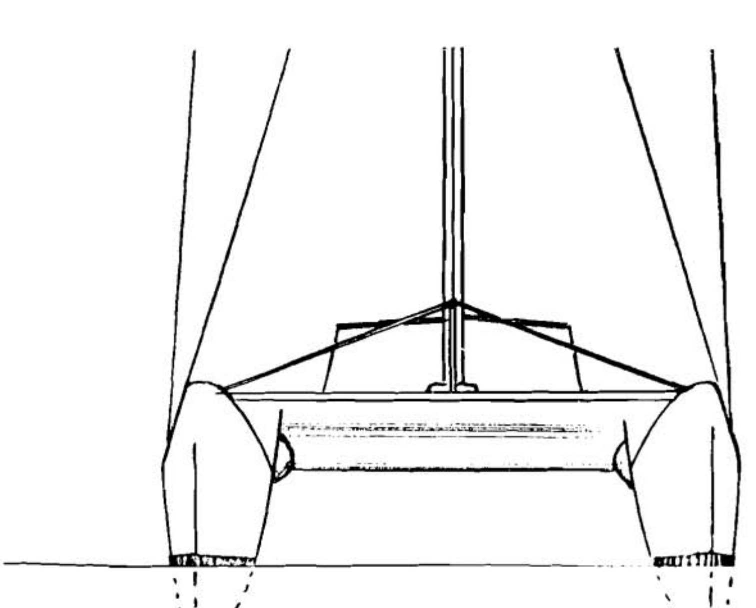
It is very obvious that all modern catamarans owe their design and existence to *Manu Kai*, designed by Woody Brown and made by him and Alfred Kumalai in Hawaii after the last war. This wonderful craft is described in our publication AMERICAN CATAMARANS from which the two drawings have been taken. Starting with this design, the relationship of many modern catamarans will be studied.

Manu Kai

The basic idea of *Manu Kai* was to produce lateral resistance from the hulls themselves so as to avoid having a centreboard or fin keel to prevent leeway. To achieve this, the hulls were asymmetrical with the flatter sides on the outside so that when sailing at an angle of heel, the lee hull should produce a force acting to windward. The windward hull would be less immersed and hence have less effect in producing a force in the opposite direction.



" Manu Kai "



" Manu Kai "

It might be wondered how such a concept could arise in the mind of any naval architect, amateur or professional, steeped, as we all are, in the traditions of Western European boat building and ideas. The clue lies in the shape of the section which is exactly that of the large native Micronesian " Proas " some 60 feet long so ably described by Hornell in his book " THE CANOES OF OCEANIA " published by the Bishop Museum in Honolulu which specialises in Polynesian and Pacific Island culture. To me, it seems very obvious that these Micronesian craft were studied in great detail before *Manu Kai* was designed. The large Polynesian war canoes so ably described by Captain Cook most likely had semi-circular sections, in common with all Polynesian canoes and outriggers of which we know. The only place in the world where the concept of asymmetrical hulls ever existed was in Micronesia and to a lesser extent in Melanesia.

Manu Kai was thus the fusion of the Micronesian and Polynesian cultures as far as the shape was concerned, combined with American and Western European constructional methods. One feature which resulted was the canoe stern of the Micronesian original which is to be found in very many of the modern catamarans designed with *Manu Kai* in mind.

The Creger Catamarans

Creger's main idea was to produce easily constructed catamarans by the use of plywood sheets but of the same basic shape as the successful *Manu Kai.* He also used asymmetrical hulls and canoe sterns but, though his craft were often fast on a reach in the larger sizes, the deep box-like sections did not slip through the water like *Manu Kai* and, I suspect, often produced eddies around the chines which must have slowed them tremendously.

The Tchetchet Hulls

These hulls, which Victor Tchetchet uses in his Trimarans also take origin from *Manu Kai*, via the *Lear Cat*, but they are of much less depth than those of the latter. In fact, they are roughly half square in shape, which is a form with relatively little wetted surface which explains the speeds of 18 knots which have been achieved. There must be some eddying around the chines which will slow the craft in light winds but this is obviously of much less importance than in the *Lear Cat* as Victor's Trimarans have a good performance in light winds.

Ocelot

This craft by Bob Harris again took its origin from *Manu Kai* via the *Lear Cat* and *Naramatac*, a catamaran with asymmetrical hulls and deep chines also designed by Bob Harris, described in OUTRIGGED CRAFT. *Ocelot* has hulls of symmetrical section but rather deeper than a semi-circle and she also has the canoe stern of her great original. Twin centreboards and rudders are used and, from experiments recently carried out by Roland Prout, this would appear to be of advantage. *Ocelot* has been timed at 20 knots.

The Piver Hulls

Arthur Piver, of San Francisco, has been designing and making various multihulled craft of elegant appearance and performance for some years. His large hulls are all designed with a semi-circular underwater section where they are strip planked. Plywood is used above water. He also uses the canoe stern.

The Yvonne Cat

Again taking origin directly from *Manu Kai*, this craft, designed by the Cunninghams in Australia, is a hard chine type of excellent performance but, as compared to the *Lear Cat* and the Tchetchet hulls, the chines are carried much higher and the midship section is that found in chine dinghys. The chines are just below the L.W.L. amidships and come above it fore and aft. It has the canoe stern of *Manu Kai*, a single central centreboard and twin rudders. The main speed of the craft, which has been measured at 18 knots, is due not only to the design but also to the light weight and the length of 20 feet, though this would be equivalent to a couple of feet less, if a transom were to be used.

The Shearwater Hulls

As described in detail in No. 6, OUTRIGGED CRAFT, the first *Shearwater* hull was a paddling Kayak hull built up with plywood sheet. The section was almost a semi-circle and had a transom stern. This hull was then made into a catamaran through the influence of *Manu Kai* by Roland Prout. Because there was not enough lateral resistance, a centreboard was necessary and this was put down from the bridge between the hulls in the centreline of the craft. A single central rudder was used.

Shearwaters II and *III* are from the same mould. They are similar in design to *Shearwater I*. The underwater section is now ever, a true semi-circle and there is more fullness in the ends because *Shearwater I* tended to dig her lee bow in and not to rise to waves fast enough. In essence, *Shearwater* has a shape very similar to that of a destroyer hull and, as such, it is to be expected that it will be the fastest shape possible, at least for the lower speed range, i.e., below 10 knots and it has yet to be shown that any other shape is faster in the higher speed range.

The British Catamaran Hulls

As could be expected, the success of the Prout *Shearwater* started British designers producing hard chine plywood catamarans of similar shape. In 1955, David Jeffrey produced the first British catamaran with a long flat run capable of planing. According to Jeffrey, however, she never did plane, though she could do her 14 knots. The profile shape was similar to that of a hard chine launch and its length made coming about difficult. Greater rocker on the keel would have made this easier but would have made her even less likely to plane.

Jumpahead

The hulls of this catamaran obviously take origin from the planing dinghy *Daring*, also designed by Bill O'Brien and described in detail in publication No. 8 DINGHY DESIGN. With the chines above the waterline all their length and a flat run leading to an almost flat transom, the *Jumpahead* slips easily through the water with only slightly greater wetted surface than the *Shearwater*. The *Jumpahead* may ,plane, if driven fast enough, and it has the shape to do so, but the question of catamaran planing will be discussed in a separate article.

Gemini

This is a catamaran I designed for a Folkestone yachtsman for construction in fibreglass. It puts about quickly and goes fast but doesn't appear to me to be as fast as the *Shearwaters*. We have, however, been using home-made sails of only 145 square feet. This craft is similar to the *Jumpahead* but has considerably more fullness forward and more V to the transom. The chines are above the waterline.

The Catamanner

This is a catamaran of the "Split-boat" type, with asymmetrical hulls and rather more wetted surface than with other designs.

Designed by E. J. Manners, it does not fit in with the contemporary trend in catamaran design. Speeds comparable with those of *Shearwater III* are not claimed for it but, apparently, it puts about and handles satisfactorily.

THE MIDSHIP SECTION

Eleven midships sections are shown in the diagram. On the whole, they show a tendency to reduce wetted surface in the more recent designs by having a shape approaching a semi-circle, the notable exceptions being Bob Harris' *Ocelot* and the *Yvonne Cat*. *Jumpahead* by Bill O'Brien and *Gemini* have a section with a near right angle at the keel which is not far away from the minimum wetted surface.

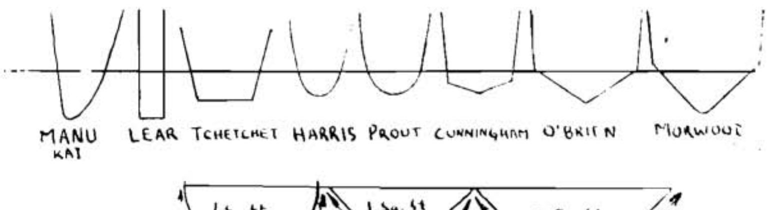


FIG. 1. *Midship Sections.*

Deep underwater chines have also ceased to be used except by Victor Tchetchet in his Trimarans. The modern chine catamarans have the chine very near to the water line.

It has also been shown that a centreboard is a far better way of getting lateral resistance then deep, asymmetrical hulls and these are being less used.

The three lowest sections are instructive. All are drawn to include an area of 1 square foot. The semi-circle has a wetted perimeter of 2.5 feet, the triangle with a right angle below has a wetted perimeter of 2.83 feet and the third shape, which is also a right angled triangle with the point rounded off, has a wetted perimeter of 2.6 feet. These figures show that the triangle has 13.2% more wetted distance, and the rounded triangle 4% more distance than the semi-circle. If, therefore, wetted surface is of the greatest importance to catamaran speed, little is lost by having these shapes over a semi-circle. The rounded triangle could be of great use when designing large cruising catamaran because most of the hull could be made from plywood sheet and even the bottom rounded part could be made from plywood " planks " laid either carvel or clinker (lap strake) without any significant loss of speed.

The Turkish Tank Tests

As far as these concern us, it appears from these tests that the semi-circle is the best at low speeds. At a $\frac{V}{\sqrt{L}} = 1$, where V is the speed in knots and L, the length in feet, a deep triangle has less resistance which it maintains till $\frac{V}{\sqrt{L}}$ 1.2 when the semi-circle again is better. This is due to the triangle having no hump in its resistance curve while the semi-circle has one. Above the speed of $\frac{V}{\sqrt{L}}$ 1.5 what is called a "Catamaran" hull has far less resistance than a semi-circle. It is presumed that the shape tested was rather like that of *Manu Kai*, because the only interpretation of this result is that the narrow hulls with fine entrances do not produce big surface waves, causing less disturbance and less resistance. In addition to this, the interference of waves of each hull at certain speeds reduces the total wave making resistance.

We are indebted to Professor Ata Nutku of Istanbul for this work and for checking on my interpretation of it.

SUMMARY

It would appear from all our information that the semi-circular hull section is likely to be the fastest for all round sailing. The rounded triangle should be about as good. A section with a right angled triangle will be about 6% slower in light winds but probably no worse in strong ones. In really strong winds, however, a deep V section with a rounded off point should be fastest.

THE " SEWER " SECTION

Roland Prout has conclusively shown that catamaran hulls of a semicircular underwater section are very fast and will put about as well as a normal dinghy. In my opinion, it is the best shape for any small catamaran whose crew by sitting out to windward can equalise the weight on each hull, except in very strong winds.

Large and heavy catamarans, however, cannot be sailed with an equal weight on each hull because the crew cannot sit them up. The lee hull then displaces more water than the weather hull and is no longer semicircular in section under water. The weather hull rises and may just give drag from its wetted surface without giving any worth while buoyancy.

There is a certain shape which was, I believe, invented by the ancient Romans for their sewers which is designed to produce the least possible wetted surface for varying amounts of water flowing in it. This is an egg shape with the smaller curve downwards. Modern sewers of this shape have a width to height of 2 to 3. Catamarans could well be made with hulls of this section and this would result in less wetted surface when they were heeled and only increase the wetted surface on a level keel by a very small amount. It is not, of course, possible to say with certainty that such sections would definitely be an improvement but it is a matter which could well be considered in the design of a large cruising catamaran.

Having been given this idea by one of our members, I asked Roland Prout what he thought of it on the evening before the Cross Channel Dinghy Race when, it will be remembered, his hulls showed such a startling superiority over the dinghys. His comment was "What you say may be alright but *will a drain plane* ?"

CAN A CATAMARAN PLANE ?

From all the evidence at my disposal I have come to the conclusion that catamarans *never* plane. They simply go through the water and leave a groove after them when they have passed. David Jeffrey has made the best shape of catamaran for planing of which I know and states quite definitely that he did *not* plane even at 14 knots. In *Gemini*, high speeds of the order of 18 or so knots have been obtained with the inside bow waves sluicing across the craft in a solid sheet of water and again planing did not occur. If these two hard chine, flat floored craft do not plane, a *Shearwater* certainly cannot. Additional evidence comes from tank tests of destroyer hulls which so much resemble *Shearwater*. Again, there is no planing.

There are, however, certain things which a catamaran does at speed which are very similar to planing. Firstly, she tends to lift her bows up and depress her stern. This is simply due to the fact that the under surface of the hull is a fair curve and the water in which it is sliding also has the same curve. Thus, by pushing the craft along in this curved groove, the bow will lift and the stern go down. Secondly, the whole craft gives the impression of being lifted bodily up. This is due to the fact that the bow wave is overrun by the speed of the craft and it is raised by flotation in its own bow wave.

True planing is due to the dynamic lift caused by particles of water hitting the underside of the hull, lifting it up so that it rides at a higher level than when it is stationary. Dynamic lift must certainly occur at the bows of the chined catamarans, but owing to the low ratio of beam to length, not enough lift will occur along the whole length of the craft to constitute true planing at the speeds which have been achieved so far.

HULL " FINENESS "

Perhaps our greatest ignorance about catamaran hulls is to do with their " Fineness." We do not know the best ratio of length to beam. Neither do we know the optimum " Prismatic coefficient." Both of these can be found by the long process of trial and error at full scale or much more cheaply and quickly by testing models.

The Prismatic Coefficient

This is a figure which gives us an idea of how full the ends of a yacht are for a given maximum section. It is arrived at by multiplying the area of the maximum section by the waterline length. This gives us a volume, and the ratio of the volume of water displaced by the boat to this volume is the prismatic coefficient.

When the prismatic coefficient is high, the ends of the boat are full and the light wind performance will be good because the wetted surface will be less for a given displacement. When the prismatic coefficient is low, the ends of the boat will be fine and, though light wind performance may be less good, the strong wind performance may be better.

Shearwater III has full ends with a prismatic coefficient of 0.68. *Ocelot*, with fine ends has a prismatic coefficient of 0.57. These two designs seem of equal merit to me. The fact that, in a trial between the two, *Shearwater III* was faster in light winds, while *Ocelot* was faster in strong winds, is exactly what could be expected from these coefficient figures.

" FLYING " A HULL

" Flying " a hull is amusing and even exciting. However, in catamarans such as *Shearwater*, Bob Harris' *Ocelot* and many others, this put too much displacement on the lee hull and the craft is slower than when the displacement is more equally spread between the hulls.

However, in *Jumpahead* and *Gemini*, when one hull lifts off the water, the speed increases, instead of falling. The reason for this is hard to produce but it may be that the forward overhang gives a greater overall sailing length with the same fine entry as when they are on both hulls. When other catamarans dig their hulls in, the entry becomes much more bluff.

When sailing on one hull, the transom becomes more deeply immersed in *Shearwater*. In the two above craft, the flat floor aft might keep the stern raised and the transom from sinking so deeply.

CATAMARAN SPEED

Almost without exception, the top speeds which have been measured reliably for well designed catamarans and trimarans have proved to be between four and five times the square root of the waterline length. This again is further evidence that catamarans do not plane because hulls like those of *Manu Kai* certainly will not plane. If any catamarans *did* plane, their top speeds would be greater than those of those which did not.

Slim hulls and hulls with a V section should be tried to see if they have a higher top speed than the semi-circular sectioned hulls. Below $\sqrt{L}$ knots, the semi-circle will, of course, be the best and the only problem, therefore, which is left is to find out if another shape will be better at speeds in excess of this.

MANOEUVREABILITY

Catamaran manoeuvreability depends as in other craft on the underwater profile. However, they always need to be sailed the whole time from one tack to the other not only because they are relatively lighter than other boats but also because the hull shape is such that it has good directional stability and tries to run a straight course at all times.

It is essential, therefore, to sweep the keel line of the profile up to the waterline both forward and aft and to provide a centre board or two centreboards around which the craft can pivot. Both the Prout *Shearwater* and *Gemini* are much harder to put about without the board than with it.

Catamarans with asymmetrical hulls such as *Manu Kai* and the *Lear Cat* are harder to put about than craft with symmetrical hulls. Long straight sides also make manoeuvreing difficult which is probably the reason why catamarans of the " Split boat " type have a poor reputation for putting about.

It appears to make little difference what shape the keel line is as long as it comes to the waterline fore and aft. It can be elliptical in shape as in the *Shearwater* or with an almost straight line from a deepest part forward of midships as in *Gemini* and still manoeuvre well. The position of the centre of buoyancy also can be put where convenient so as to balance the weight of the crew and craft. If it is far forward, as in *Gemini*, the crew must sit forward in light winds but come aft for high speeds.

CATAMARAN WETNESS

It is almost axiomatic that a fast craft will be wet and a catamaran is no exception. However, the catamaran has one aspect here not possessed by other boats. That is that the weather bow wave of the lee hull can rise up and produce a jet of water of large dimensions directly on the crew on the weather side. This is decidedly uncomfortable.

Spray deflectors, such as are used with speed boats are now being fitted to the Prout *Shearwater* and are helpful. They consist of a batten of triangular cross section with a horizontal lower surface. Water being scooped up by the bow hits the batten and is shot outwards and does not rise high enough to come aboard. It has been shown by Professor Ata Nutku that these spray deflectors give increased resistance in the test tank but in practice, this is probably more than made up by the lesser water carried in the cockpit.

It is also possible to deck in the whole forward part of the craft between the hulls but this appears to trap air and to slow the catamaran very much. However, by studying the air flow forward, it should be possible to design a fore deck between the hulls which does not obstruct the air flow but still keeps the water down.

CATAMARAN STERNS

Manu Kai had a canoe stern. I believe that this was simply because she took her origin from the Micronesian canoe more than from the Polynesian outriggers or large war canoes which often had counters. All the craft which owe their origin to *Manu Kai* directly seem to have copied her canoe stern, except for the English catamarans which have the Europeanised Kayak transom stern of the Prout *Shearwater*. It is therefore worth while considering which stern is likely to be the best.

The canoe stern has the advantage of being streamlined and hence has less wind resistance than a transom. It is usually more attractive to the average yachtsman than the transom because it conforms more to most people's conception of a yacht. However, it is a waste of boat because, for example, a canoe sterned catamaran with fine lines of 20 feet overall length could be shortened to somewhere about 17 feet in length by using a transom and still have the same performance. In my opinion, the extra expense and weight of the stern is not likely to be worth while.

BRIDGE DECK DESIGN

The strains between the hulls of catamarans have not to my knowledge been fully worked out. However, without doubt the greatest strain leading to failure in the bridge deck would be a twisting strain between the hulls where one bow is lifted by a wave when the stern of the other hull is also on a wave crest. Strains from the hulls pressing together or apart are, I think, much less.

The separation between the hulls can be achieved by a sheet of plywood firmly glued and screwed to both hulls. At the bows, a cross beam is necessary to stand the compression strain of the wire span for the forestay and to support the bows apart and in torsion. At the aft end of the cockpit plywood, another beam such as a 4″ by a 1″ set on edge will also deal with these strains and also be able to take an outboard motor, if required, though this may not be a good place to have one because air can be sucked down to it from the surface. It has been found preferable in *Gemini* to put the outboard on one of the transoms, even though it meant cutting into the deck.

As already mentioned, the torsion strains are most important. They are best taken by a tube or " box girder " stretched across the craft and, to come as near this as possible, many catamaran designs curl up one or both ends of the plywood sheet to form a part of a tube. Then, by curling plywood over the top, there is a structure capable of taking the torsion strains involved. The *Yvonne Cat*, however, takes these strains by two girders which are X shaped in plan view laid across the craft and this is also satisfactory. In the plywood version of *Gemini*, the torsion strains are taken by a cross girder with an isosceles triangle for its section. This torsion structure, of whatever shape, is also given the job of supporting the mast at its centre.

CATAMARAN SEAWORTHINESS

When the long slim hulls of a catamaran meet a wave, they are supremely unconcerned. They simply go straight on and cut through it. This again is evidence that catamarans don't plane because, if they were getting dynamic lift from the water, they would be stopped by a wave ; or at least have to jump over it. They suffer neither indignity. However, when they have penetrated far enough into a wave, buoyancy gets to work, unless they are too slim and deep, and they bob up like corks, thus once again achieving their designed state of surface travel.

This behaviour of catamaran hulls (of good design) means that their motion to small waves is less than that of a beamier boat.

In larger waves, the catamaran will take the main contour of the wave which is a surprisingly gentle slope, even in soundings, and it is found that on the deep seas, the motion of a catamaran is very easy indeed, compared to conventional keeled yachts. The reason for this is that a catamaran will only take the slope of the wave whereas a keeled boat will have a pendulum movement which will often cause it to heel at twice and even more times the angles of slope of the waves. For example, a keeled boat running down the trades will often indulge in the tactic of "Rhythmic rolling" where the frequency of the yacht's roll corresponds to the period of the waves. This cannot happen to a catamaran.

Summary

A catamaran will have far less motion and be far safer at sea than a conventional boat of the same size. As regards safety, this point is arguable in the case of cruising catamarans which can be capsized and one must keep an open mind about them till we have more information.

CATAMARAN CAPSIZES

Light catamarans can all be capsized. We have an interesting account of one capsize later on in this publication which was not righted but, usually, a light catamaran like *Shearwater III* can be righted by her crew should she be allowed to tip up. According to Jack Blundell, capsizes fall into two types :

1. With the board lowered.
2. Without the dagger board.

In the case of No. 1, as the mast hits the water, the helmsman should slide over the hull onto the board, immediately. This will often stop the craft from turning further and halt it with the mast just below the horizontal. The crew should then free all the sheets and hand the jib sheet to the helmsman. The helmsman should then lean outwards, using the sheet to hold by, while, at the same time, the crew lifts up the mast as much as he can. As soon as the mast and sail leave the water and the catamaran is just past the point of balance, ready to plop back right way up, the helmsman must duck under the upper hull *forward* so that it doesn't hit him as it falls. He will then be between the bows when she is right way up.

In the case of No. 2 without the board and completely upside down, there is no great hurry. Again the sheets should be freed and the jib sheet brought up. Helmsman and crew should then get right forward on the lee hull or the hull which is lowest in the water. Both should then stand up and lean out using the sheets. The mast will gradually lift and as it does so, the person further aft should move aft to the after end of the cockpit. Again, when the craft is just past the point of balance, both helmsman and crew must drop off fore and aft of the bridge, between the hulls.

THE PI-CAT CATAMARAN

by Arthur Piver, Mill Valley, California

Length :	20′	Width of hulls :	15″
Beam :	7′ 11½″	Weight :	600 lbs.
Draft :	8″	Sail Area :	200

The ideas which led to the building of the *Pi-Cat* began accumulating just after I assembled a *Lear Cat* kit about four years ago, and were an attempt to overcome what I felt were some deficiencies in the commercial design.

The *Lear Cat* is a much maligned boat, in my estimation, as the one I had was very fast indeed, and was then easily the best performing boat on San Francisco Bay, and could beat anything of any size off the wind, and on the wind could outpace any similar sized craft, including such vaunted types as the International 14 and the Hornet, except in light weather. However, other *Lears* hereabouts were far inferior in performance, a fact I cannot explain, although I did change the design somewhat by eliminating a good deal of the fore and aft rocker on the keel at the time of assembly.

The *Lear* had a tendency to bury the lee bow when driven hard, and as a matter of fact I sailed it completely under water on a half dozen occasions. It was quite a sensation, but was more inconvenient than hazardous, as the boat showed no tendency to capsize when fully immersed ; but on releasing the sheet it would back out of the water, and was all ready to go once again.

It came about quite well, after I discovered that in a strong blow it was necessary to move the crew weight forward, as otherwise the

The 20′ catamaran Pi-Cat, designed by Arthur Piver, Mill Valley, California

boat would squat just before coming into the eye of the wind, and under these conditions it would not respond. Also, if there were more than three persons aboard, the craft was just dead in the water, unless it were blowing a young gale.

I also spent quite a bit of time aboard a 20′ catamaran commercially manufactured over here, which had the worst hobby horsing habits I ever saw in a boat. This craft, although it manoeuvred well otherwise, spent most of the time just bobbing up and down in a most annoying manner. If it would come to a single large wave, for instance, it would pitch its bows so high that the after-decks were actually under water, and after the wave had passed it would continue hobby horsing along, in ever diminishing steps.

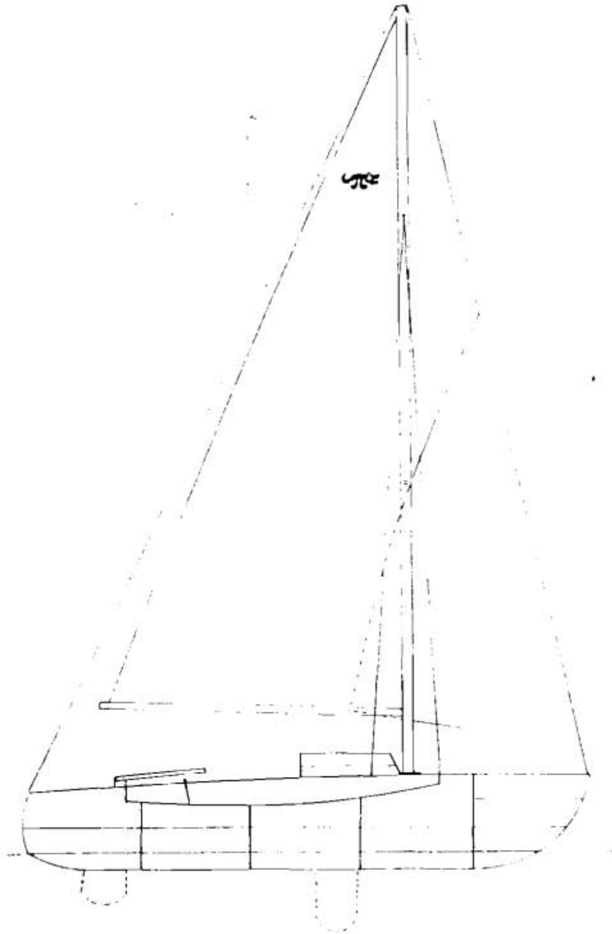


FIG. 2. *Arthur Piver's " Pi-Cat."*

And so, from the foregoing experiences, I had three major tasks in my own design — keeping the bow from burying, better light weather performance, and the elimination of hobby horsing tendencies. The light weather performance dictated light over-all weight and less wetted surface, while the only way I could think of reducing the hobby horsing was to have no fore and aft rocker. This latter step also gave more buoyancy forward, which did indeed eliminate the bow burying.

Being my first design, and not being sure of my centers, I devised a track arrangement between the hulls, so that the single centerboard, which was fastened to a stout aluminium pipe, could move fore and aft. The original idea was to have a trim tab arrangement in the cockpit so that the board could be moved easily, but I never did get around to completing it, as the board proved insecurely mounted on the pipe, and indeed it twisted almost like a pretzel, even though composed of $\frac{3}{4}''$ ply. This lead to fastening it more securely through the center section, but at least I had discovered the best point for balance.

Incidentally, here is an area for more research, for I believe that a readily moveable board would be a distinct advantage for a catamaran, as we have discovered that the best way to come about in this type is to sail it around, and the application of the rudder too soon in the manoeuvre will kill the turn in sloppy conditions. In other words, when the boat is close-hauled and it is desired to come about, the rudder is released while the trim tab is actuated to give the craft a strong weather helm. When the boat reaches the point where wind begins to spill out of the sails, then the rudder is applied to continue the turn at a steady rate. Incidentally, we always pull the boom nearly amidships as the boat approaches the eye of the wind, maintaining drive as long as possible. When the rudder is finally applied, we find that the angle should be increased as the speed diminishes, although never more than 45 degrees.

Although the single center board seemed to provide sufficient lateral plane, I later replaced it by a board in each hull, and to my surprise discovered that although their combined area equalled that of the former single board, they were markedly more efficient. This phenomena was later explained by an article in an A.Y.R.S. publication, regarding tip losses.

The hulls are semi-circular below the chines, with the full chine-beam carried relatively far forward to provide sufficient buoyancy so that the bows will not bury. The over-all beam chosen is just below the maximum for trailering on our highways. Construction is largely of $\frac{1}{4}''$ plywood, with the sections below the chines of $\frac{1}{2}''$ square strip-planked spruce, covered with one layer of medium-weight fibreglass to just above the chines.

Performance was even more than I had hoped for, far exceeding that of the *Lear*, especially in light airs. The mast head rig was chosen so that an especially large genoa could be carried in light going, and this sail, which is made of spinnaker cloth and contains about 140′ area, pulls the boat along in an almost unbelievable manner. Of course a mast head rig calls for backstays, which are not otherwise required. Also, an overlapping jib means the chain plates must be further inboard for on-wind sheeting ; thus increasing mast loading somewhat.

Maximum speed was somewhere between 18 and 20 statute miles. Not having radar facilities, it has been found difficult to accurately judge speed, although we now use two speedometers, one of the pitot-head type, and another a dip-stick arrangement.

As this boat was built four years ago, I have since decided on a number of changes, and have found that my ideas largely coincide with those of the Prout Brothers.

First of all, the semi-circular bottoms are a must for light weather performance and manoeuvreability. Moving the rig aft a foot or so turns the bow-diving movement into a heeling one which is taken care of by the boat's natural stability. Twin boards are superior in performance, although they must adversely affect the turning somewhat, and of course when housed in the hulls present additional problems.

In the *Pi-Cat* the sides of the hulls are parallel above the chine as an aid to simplicity of construction, but now I believe they should be vee'd to reduce wetted area and build buoyancy faster as the lee hull is immersed. The veeing of the hulls above the waterline would also tend to offset the loss of buoyancy caused by adding rocker fore and aft, as although in *Pi-Cat* there was no rocker, and it still manoeuvred well, some rocker will undoubtedly aid turning.

As a matter of fact, outside of public reluctance in general, I believe that the chief handicap to the catamaran type is the lack of manoeuvreability, and although a sailor with a good sense of feel will have no trouble, even under extreme conditions, the average skipper simply does not have what it takes.

For instance, we have here on San Francisco Bay about eight or ten catamarans, and although two of them are ones I have owned and which I know come about easily, still almost all now have outboard motors prominently attached to their sterns — a most disheartening sight.

THE YVONNE CAT

L.O.A. :	20′	Draught :	6″
L.W.L. :	14′ 6″	Sail Area :	190 sq. ft.
Beam O.A. :	7′ 4″	Weight :	
Beam, hull	1′ 5½″		

This catamaran was designed by C. H. and L. N. Cunningham of Victoria, Australia as a series of modifications of a hard chine catamaran with box shaped sections till it became the elegant craft shown in the drawings. All this was carried out full scale and started in 1952 and the craft took its final shape in 1953. For the Cunninghams, this was the only way to develop their craft because they had

Two Yvonne Catamarans.

so little to go on when they started. Their development had to be carried out almost from the same point as the other catamaran pioneers.

The first catamaran with box shaped sections was well rockered on the keel to allow of easy manoeuvreability, had symmetrical sections, a canoe stern, a central centreboard and balanced rudders. It was very fast in smooth water but in rougher water, the fore and aft stability was not enough and the rudders lifted clear at times and the flat floors pounded. As a result the bows were extended two feet, lifted and flared, a false V-bottom was added from the bow to amidships and the rudders were enlarged. This cured all the faults of the previous

An Yvonne " Flying A Hull."

design and all the present *Yvonne* 20 catamaran owners feel that they have a very satisfactory craft. To day there are 10 *Yvonne* 20 catamarans registered in Victoria, with 87 sets of plans sold all over the world.

Performance. The *Yvonne* 20 has sailed over a mile distance at an average speed of 18 m.p.h. In bursts, a speed of 20 m.p.h. has been exceeded. Over a distance of 21 miles in very rough conditions, 15 m.p.h. was averaged on a broad reach. It will be noted that these speeds are almost identical with those of the Prout *Shearwater*, *Ocelot* and others.

Design Features. As compared with contemporary British and American catamaran design, the main features of the *Yvonne* 20 are:

1. The forward overhangs.
2. The taking of the torsion strains between the hulls by two crossed girders instead of the rolled plywood system of most designs.
3. The ingenious centreboard design, which allows the board to come up below the cockpit when it is up.

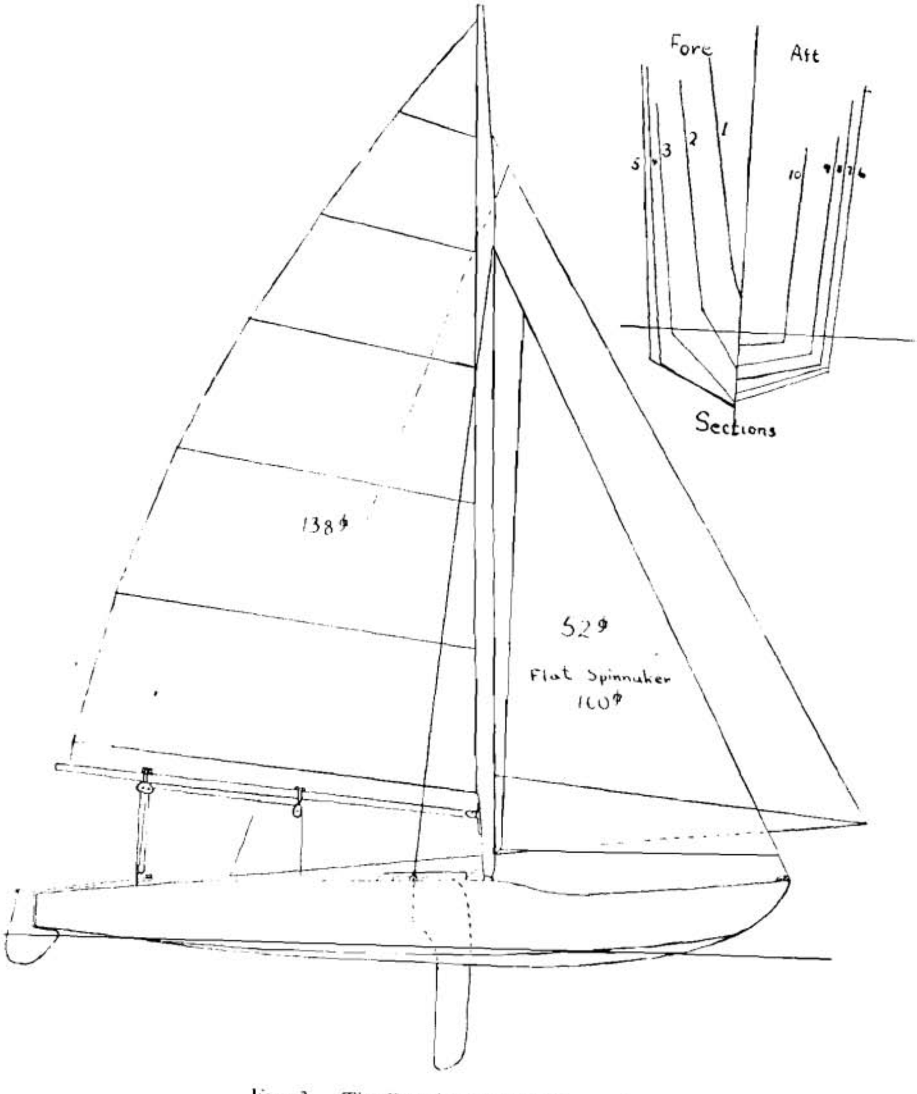


FIG. 3. *The Cunningham's "Yvonne."*

Summary. The Cunninghams have produced a catamaran which is very fast on all courses, manoeuvres well, is fully seaworthy in hard winds and big seas and is suitable for amateur building.

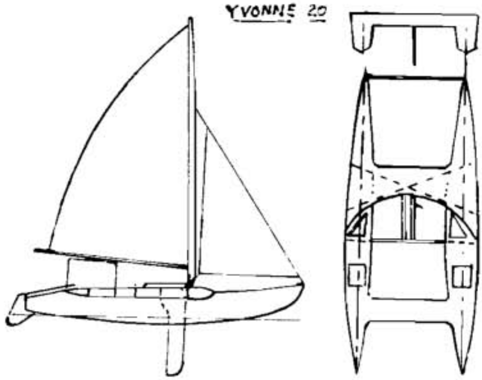


FIG. 4. *Yvonne—Note X Girders.*

THE QUICK CAT

L.O.A. :	16′ 0″	Draught :	4″ ex-C.B.
L.W.L. :	13′ 0″	Sail Area :	126 sq. ft.
Beam O.A. :	6′ 3″	Weight :	190 lbs.
Beam, hull :	1′ $3\frac{1}{4}$″		

This catamaran, also designed by C. H. and L. N. Cunningham, has box shaped sections but, due to its light weight, it is very fast, only being 6% to 7% slower than the *Yvonne* 20. There are only three frames in each hull so construction is very simple. Again, the torsional strains are taken by two crossed beams and the mast, which is farther forward than in catamarans which use a jib, is on a structural member which also supports the plate case, at its fore end.

Performance. The *Quick Cat* is faster than the *Finn* dinghy and 12 square meter sharpies on all courses. It can be righted easily by one person, if it capsizes.

Design Features. Apparently, the box section of this catamaran are of little hindrance to it and the performance is good. However,

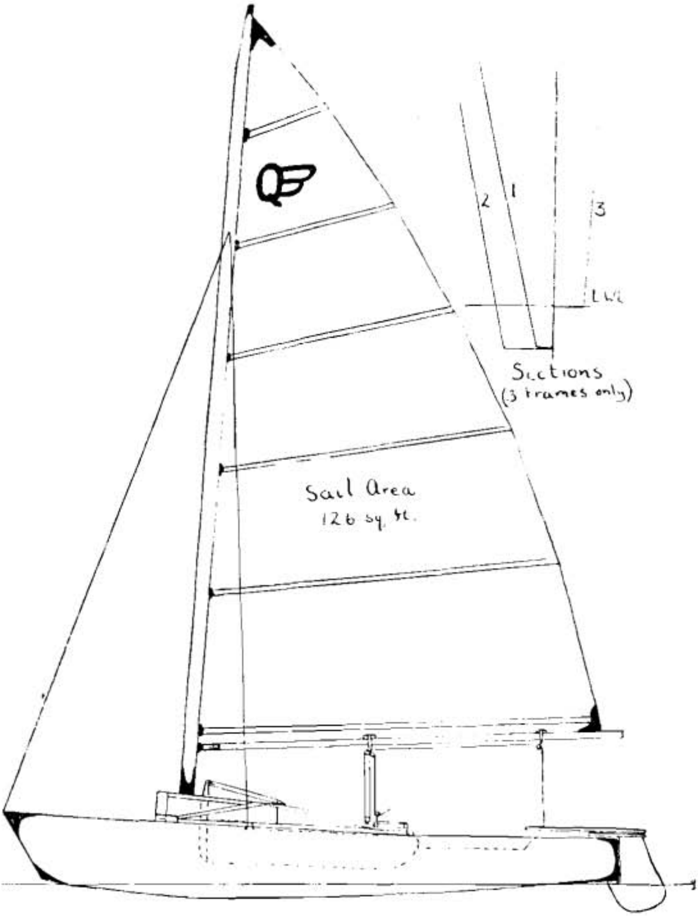


FIG. 5. *The Quick Cat.*

it must pound in anything of a seaway. The single sail is, I think, an excellent feature for catamarans and could be more widely adopted. It is doubtless due to *not* having a jib that this catamaran goes so well to windward.

JUMPAHEAD

L.O.A. :	16'	Min. Weight (Stripped) 200 lb.
Beam :	7' 6"	
		Max. Sail area: 167 sq. ft.

Designer Bill O'Brien.

This excellent design was produced by Bill O'Brien as a result of seeing *Shearwater II* sail in 1955 and talking to Roland Prout and myself at Weston, Southampton. In essence each hull is a modification of his 14' chine dinghy *Daring*, described in publication No.

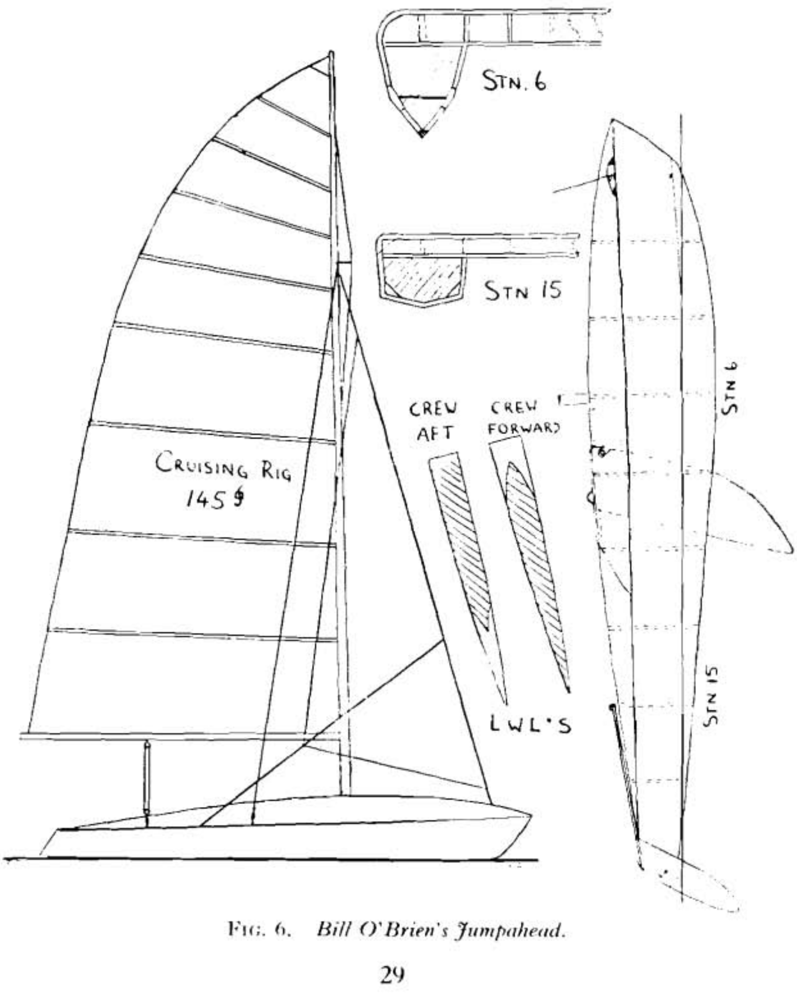


FIG. 6. *Bill O'Brien's Jumpahead.*

8. This produced deep chested hulls with an unusual amount of rocker, a hollow entry and planing run, changing to a dead flat transom.

Light Winds

In light airs, the crew moves well forward to lift the transom clear of the water to reduce wetted surface. Sailing *Jumpahead* at Lymington this year, Richard Creagh Osborne won a four hour drifting race against a 505.

To Windward

Jumpahead gives of her best at 40° to the apparent wind with the sheets well in. She goes to the windward well by luffing to each gust which makes the lee hull bite deeper, and for cruising the centre board can be dispensed with.

Putting About

With practice this can be done in 5 seconds, but, as with other catamarans, the technique is different to that used with dinghies. The jib should be held in hard until it is on the point of "backing" but definitely not "aback." It is then changed over and sheeted in fast on the other side so that it is drawing her forward. Catamarans are generally light craft and, on coming up into the wind with a large sail area, the flogging sail and the seas tend to drive the craft backwards so the sails must be kept drawing to the last possible moment. A wrong impression is also given by the change in speed when putting about. A dinghy slows down from about 6 knots to 2 or 3 knots whereas a "cat" may be doing 10 or 12 knots and slows down to the same speed as the dinghy when putting about.

Flying a Hull

When sailing single handed with *Jumpahead*, hardening the sheets and lifting one hull about a foot off the water in a 12 knot wind *increases* the speed from 15 knots to 17-18 knots. This is due to decreased wetted surface of the weather hull, whilst maintaining sufficient dynamic lift on the lee hull.

Speeds

The highest speed recorded by the *Smith* speedometer, carrying 167 sq. ft. is 19 knots, in 2 ft. seas, crew sitting inboard. Ideal conditions, i.e., strong wind and smooth water, are eagerly awaited.

There are some objections to catamarans put forward by people, which Bill O'Brien would like me to state, with his answers :

1. *The catamaran cannot be easily trailed*

A *Jumpahead* has been trailed thousands of miles on an A.S.T. designed trailer.

2. *Takes up too much room*

A *Jumpahead* may be hung on the wall or placed on its side, the "shores" being the girders going right through it. The space needed is 16′ by 2′ and it could often be put at the side of a garage or hung from its roof.

3. *Lying at moorings*

As safe as a cruiser, having the self draining cockpit.

4. *Cannot be stopped quickly*

A *Jumpahead* can be stopped in 10 ft. from 15 or 16 knots by pushing the helm down. Similar action in a dinghy would result in a capsize. The catamaran will then lay "hove-to" with jib flapping and the mainsail well in and cleated. The rudders would be reversed. Bill says: "I have stayed hove-to in the Solent in a 25 knot wind with biggish seas (wind against tide) to light a cigarette and, on other occasions, I have sat on a starting line, waiting for the gun." When the rudders are centralised and the jib pulled in, she actually jumps forward to full speed in a few feet. Full planing seems to be achieved around 19 knots.

THE ROE CAT

L.O.A. :	14′ 0″	Weight, stripped :	210 lbs.
Beam O.A. :	6′ 6″	Sail Area	154 sq. ft.

Designer : Bill O'Brien.

This catamaran was designed for an A.Y.R.S. member, Mr. D. Roe, of Ceylon, for the special circumstances of trailing and handling in which he is placed.

It obviously is very similar to *Jumpahead* and should have a very similar performance, though possibly not so fast. In the present state of our knowledge, the speed is impossible to predict. However, the handling and manoeuvreing qualities will be quite as good as the larger craft.

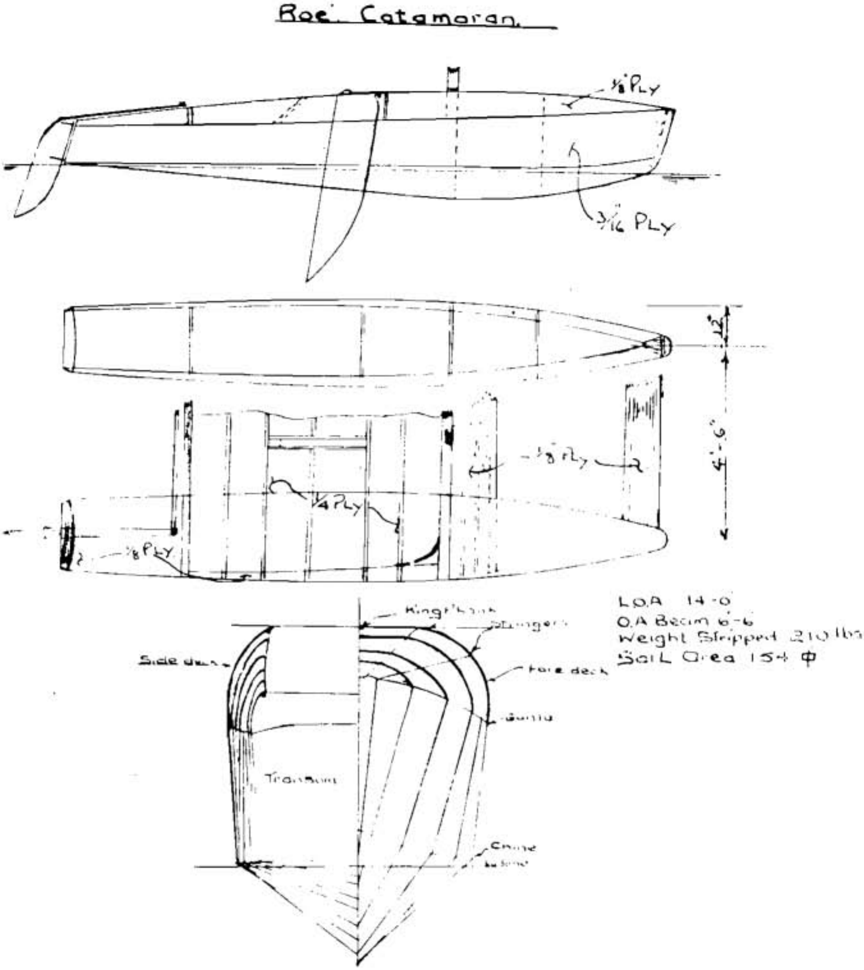


FIG. 7. *Bill O'Brien's "Roe Cat."*

12 FT. "RIVER" CATAMARAN

L.O.A. :	12′ 0″	Displacement :	520 lbs.
Beam, O.A. :	6′ 0″	Sail Area :	120 sq. ft.

Designer : Bill O'Brien

This is a still smaller catamaran of the same series. At these small sizes, the hulls have to be wider and deeper with the result that we are beginning to lose the main speed factor of the catamaran, i.e., the slim hulls. However, this craft should still have a good speed and compare very favourably with the dinghies.

Plans

At the moment, plans of neither the *Roe Cat* nor the *River Cat* are available for sale. Bill O'Brien feels that prototypes should be made and their performance noted before this is done. In the A.Y.R.S. we strongly agree with him.

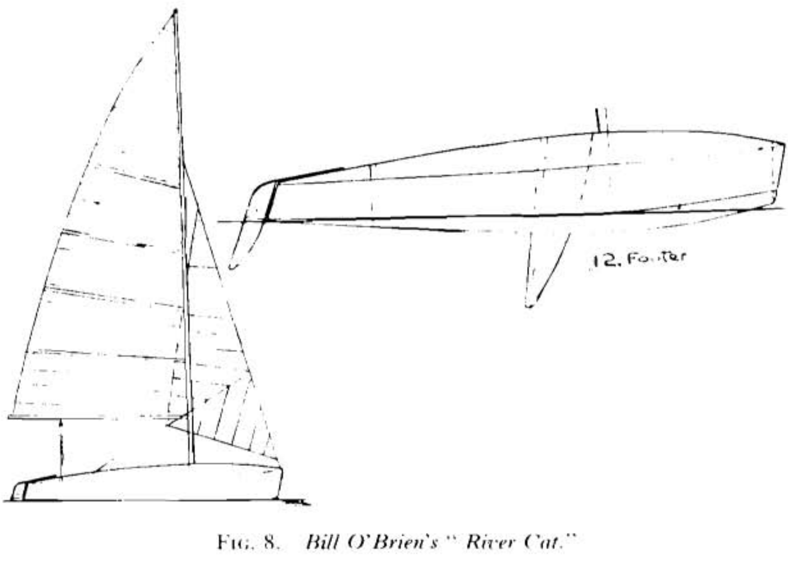


FIG. 8. *Bill O'Brien's "River Cat."*

GEMINI

L.O.A. :	16′ 6″	Hull beam, O.A.:	2′ 3″
L.W.L. :	15′ 0″	Hull beam, W.L.:	2′ 0″
Beam, O.A. :	7′ 6″	Weight :	350 lbs.
Sail Area :	145 sq. ft.	Construction :	Fibreglass and Plywood.

Owner and builder : Norman Naish. Hull Design : John Morwood.
Bridge Design : Roland Prout.

Gemini is the result of the special conditions existing at Folkestone where boats have to be launched from a concrete jetty, generally with a bit of sea running. Plywood hulls, unless fitted with a metal runner would soon be chafed so Norman Naish decided to use fibreglass.

(*Photograph by Fullers, Folkestone*)

Gemini.

The Layout

The general layout and dimensions are those of the Prout *Shearwater III* as is the bridge design.

Hull Design

The hull has a long flat run with easy twisting of the bottom plywood. The chines are on the waterline and the keel line is rockered to the waterline fore and aft. The overhang forward is to preserve an easy entrance and to prevent the bow burying when flying a hull.

Performance

The top speed appears to be the usual 18 knots. "Flying a hull" appears to increase speed, rather than slowing her down. The light weather performance, on the other hand, is only about com-

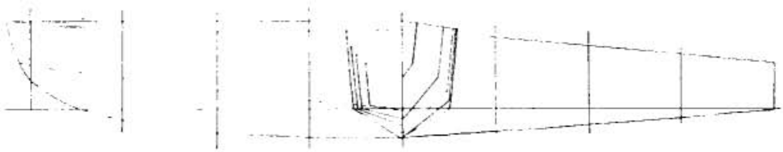


FIG. 9. *Lines and Sections of Gemini.*

parable with the dinghys which may be due (1) to the smaller sail area as compared with *Shearwater III* (160 sq. ft.) or *Jumpahead* (167 sq. ft.); (2) the greater weight, which is due to the fibreglass construction; (3) the fact that the sails were home made, though they sit very well indeed, and (4) there is more wetted surface than with a *Shearwater III*.

Manoeuvreing

Putting about is quick, easy and certain, if she is "sailed" from tack to tack as described by Arthur Piver. She then takes about a second more time than a *Firefly* dinghy. Putting about is very difficult indeed without the centreboard, though it can be done. In fact, the centreboard is hardly needed for windward sailing though it must be used for putting about.

Planing

I have never seen *Gemini* plane, though she has the shape to do so. Even at 13 or 14 knots, the bow does not lift and she runs on her designed waterline. In the design, the bow sections are full but I think that even fuller bow sections would be needed for easy planing, which must start at about 12 knots to be of any use to a catamaran.

Summary

A chine catamaran is described which is suitable for home building and which has a satisfactory performance. A *Shearwater III* will be sailing from Folkestone this month with a full rig and, by exchanging sails, it is hoped that full comparable performance data will be obtained.

Plans

Plans for building *Gemini* will not be sold as it is felt that *Jumpahead* will cater for the needs of people for this type of craft. However, one set of plans are available should anyone want to use them. It would be interesting to see how a light plywood version would go in relation to both *Jumpahead* and *Shearwater III*.

The female mould from which the first craft was built is still available should anyone want to build *Gemini* in fibreglass.

THE 14 FT. CATAMANNER

L.O.A. :	14′	Beam, hull	2′
L.W.L. :	13′ 6″	Weight from	$2\frac{1}{2}$ cwt.
Beam, O.A. :	7″	Sail area :	100 sq. ft.

This Catamaran, designed by one of our vice-presidents, Erick J. Manners, is a Prov. Patent and Regd. Design of semi "split-boat" type, with the flatter edges outwards as they should be. Due to the asymmetrical hulls very little extra lateral resistance is needed for peak performance, and, for ordinary use, a centreboard can be dispensed with. She will then work to windward in very shallow water.

Construction

This craft has been specifically designed for easy amateur construction of marine plywood, with no difficult wood work. The hulls have six watertight compartments.

Performance

The overall performance of the 14′ Family *Catamanner* compares favourably with conventional dinghies of similar size, though there is no intention of its being as fast as, say, the Prout *Shearwater*. Apart from its availability for amateurs to construct from scratch, the other principal features of the 14′ Family *Catamanner* are greater safety, ease of handling, dryness and comfort than are found in orthodox light craft.

As regards coming about, anyone proficient in this manoeuvre in an ordinary sailing craft can turn the 14′ Catamanner as easily, although, it is readily admitted, not quite so rapidly, but this is common to all catamarans. For witnessed test purposes the *Catamanner* has

The Catamanner.

been turned within five or six feet, after heading direct for the shelving rocky stone wall of a lee shore. She came about readily every time and there was never the slightest danger.

Summary

The 14′ *Catamanner* is a cheap, easily constructed family catamaran with a cockpit large enough to camp in. She is not as fast as the pure racing types of larger size but provides the comforts of dryness and raised seating.

Cost

Materials for the 14′ *Catamanner* should be bought for about £75 including sails.

Plans

The plans and instructions for building consist of sixteen large sheets, containing over a hundred detailed step-by-step drawings. They may be obtained from E. J. Manners, 93, Ridgeway, Westcliff-on-Sea, Essex. Price 50/-.

THE 18 FT. 6 IN. HIGH SPEED CATAMANNER

A larger version of the 14′ *Catamanner* is now being built by Twin Hulls Ltd. to E. J. Manners' design.

AN INFLATABLE CATAMARAN
by
TOM LANCASHIRE

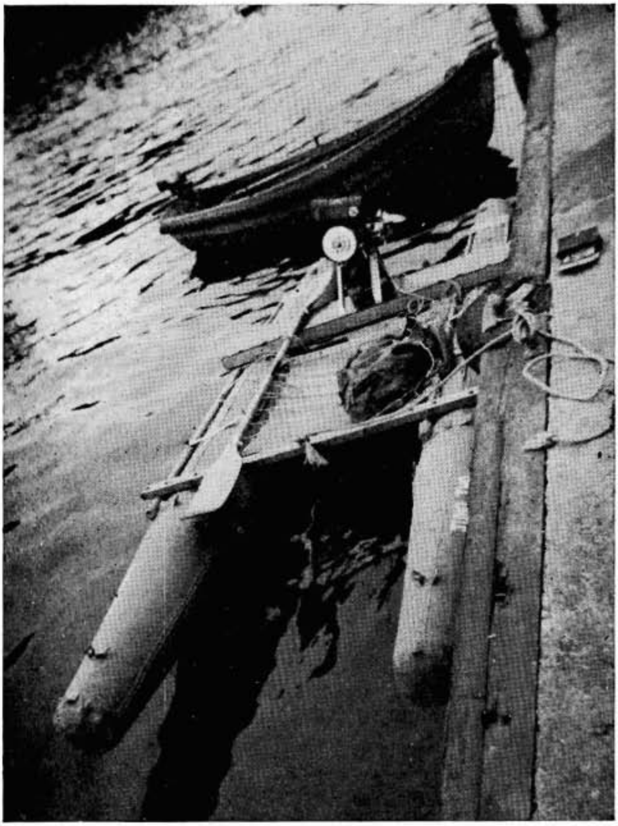
This craft is an experiment towards a light, easily stored, transported and launched sailing catamaran. So far, it has only been used with paddles and an outboard motor on the Thames. It consists of two light inflatable floats 14′ long by 15″ in diameter, joined by a light wood, aluminium and canvas framework. Each float consists of two separate parts (1) a rubberised fabric lining, and (2) a heavy canvas outer cover. When collapsed, both of these can be rolled up into a bundle about two feet long by fifteen inches in diameter. The total weight of the craft is 50 to 60 lbs. without motor.

The Linings

Each lining is divided by a partition into two equal compartments which have to be inflated separately. The linings can be used on their own without the outer covers but, of course, they will not stand such rough treatment as the combined inner and outer. They are designed to take an internal pressure of two pounds per square inch, when they are surprisingly rigid. Much less pressure can be used in calm water. They weigh about 6 lbs. and were made by Elliott Equipment, Ltd., Llympia, S. Wales.

The Outers

The outer covers are heavy green flax canvas, liberally supplied with attachment points for the framework. They weigh about 9 lbs each and were made by C. Nielson and Sons of Kingston.



Tom Lancashire's Inflatable Catamaran.

The Framework

The framework is made up of four aluminium tubes, each 6′ long, running fore and aft, two over each float. They are clamped to two transverse members (1) a strong built-up beam aft, and (2) a $2\frac{1}{2}''$ by $1\frac{1}{2}''$ spruce member forward. Four wooden poles, 1″ in diameter extend aft from the tubes to help spread the load on the floats. The strength of the framework is in the built up beam. It is not very rigid at present and for use in choppy water, it will be made either more flexible or stronger.

Assembly

The assembly sequence is as follows :

1. Place the aluminium tubes in position in the clamps on the transverse members and tighten the clamp bolts.
2. Insert the wooden extension poles in the aft ends of the tubes.
3. Lace on the canvas sling.
4. Inflate the floats.
5. Position the floats under the tubes and lash in place. The forward ends of the tubes fit into pockets on the floats. A single lashing is used round the aft end of each tube.

Inflation

A vacuum cleaner gives the quickest inflation of the floats but if one is not available, an ex-Air Force large dinghy bellows will do. It then takes about a quarter of an hour to inflate all four compartments. One pair of lungs takes a bit longer. After being left inflated for several weeks on one occasion, the floats of my craft still had enough pressure to be used without topping up.

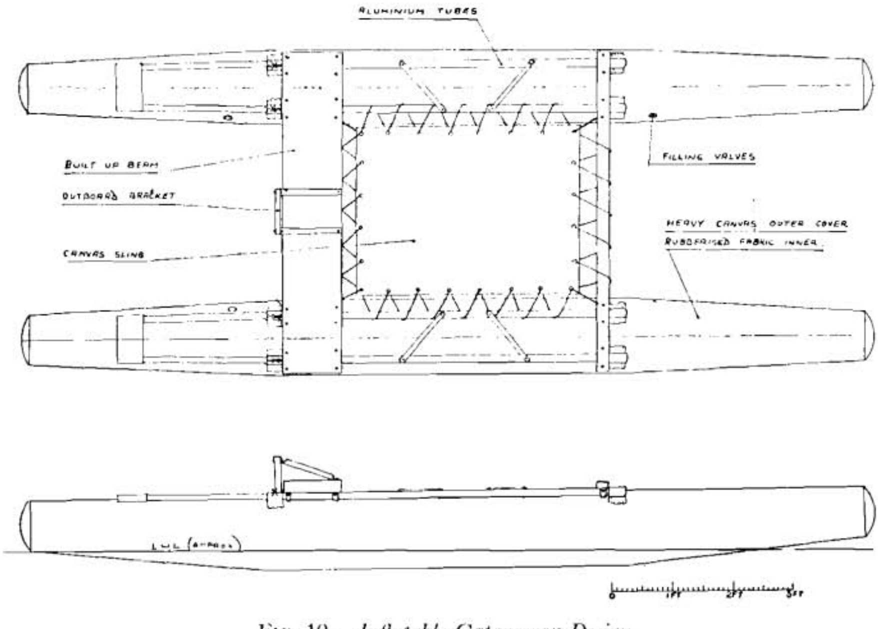


FIG. 10. *Inflatable Catamaran Design.*

Motor

The outboard motor used is a Seagull Super 40 ($1\frac{1}{2}$-$2\frac{1}{2}$ h.p.). At half throttle with one up, it gives a speed of 5 to 6 m.p.h. At higher throttle openings, the speed increases but cavitation of the propellor produces periodic jerking of the whole craft. An attempt will be made to cure this later on.

Sails

The modifications for sailing have not been quite settled yet but they will probably include :—

1. A short mast stepped at the centre of the craft.
2. Extending the framework further aft.
3. Lee boards pivoted in a cross tube.
4. A single rudder on an extension of the framework.

Materials

In America, Goodyear make "Airmat," a double surfaced inflatable rubberised nylon material which can be used for structures. The two surfaces are joined by thousands of close pitched nylon fibres and, when inflated, it can stand high air pressures. Goodyears say "It makes like a beam." It sounds excellent for an all-pneumatic catamaran and possibly for cantilever aerofoil sails. Messrs. Frankenstein & Sons, Victoria Rubber Works, Manchester 10 can supply a nylon fabric proofed with "Neoprene." This is said to be an improvement on rubberised cotton fabric in respect of :—

(a) Resistance to oils.
(b) Resistance to sunlight.
(c) Ageing.
(d) Wear and tear.
(e) Strength to weight ratio.

A CATAMARAN CAPSIZE

by

OWEN DUMPLETON

The "Cat" was lying alongside the lee side of Rochester Cruising Club pontoon. We had been doing the various odd jobs which are always needed in a new boat and now it was time to go home. Timber for the rubbing bands was aboard and lashed down and all sorts of gear had been stowed in the hulls. My buoy was on the windward side of the pontoon and the wind was force four. I had no motor. The ebb tide was running at 2 to 3 knots with the wind.

Hazel, my crew, decided that it was too rough to sail but I put my faith in the man who told me that a *Shearwater* had never been known to capsize and I got under way alone.

I set the close reefed main only and all went well until I was in mid stream. The wind then suddenly dropped away to force 1 and I was carried down stream towards Rochester bridge where the tide runs at 3 to 4 knots. I rounded up and dropped anchor but the water was quite deep and I lost a lot more weather way before it held.

The wind continued light so, after tidying up and waiting a few minutes, I set the whole main sail and the jib and got under way again. At first, she held her own against the strong tide close hauled but, just as I was beginning to think I would make the slack water on the Castle side, there came a sudden squall and though I was holding both sheets and let them fly at once, the weather hull rose slowly but relentlessly despite my full weight on the weather side deck until I was dropped into the middle of the mainsail. There was no perceptible pause as the mast hit the water and the *Shearwater* turned right over without interruption till the mast touched bottom at some 12′ and there I was, swimming below what had been the weather hull with the two hatch covers, a paddle and my tool box floating close by.

My first thought was "Stay by the ship — she is your best lifeboat" — always the best thing to do. Then I started to consider how best to minimise the damage. I caught the paddle and bent on the end of the main sheet. Then I cast off the jib sheets. I tried to reach the side stays to let go the mast but one side was too deep and the other was too high. Soon, however, we were carried into deeper water and I was able to reach the shackles. Fortunately, I had my shifting spanner on a lanyard so the shackles came adrift quite easily and the mast floated up alongside. Next, I let go the main halliard at the peak and hauled down the sail from the tack. The sail and boom then came clear so I left them and let go the jib sheets at the clew and the jib halliard at the head.

About this time, I noticed a white motor boat coming downstream and assumed I would be taken in tow so I redoubled my efforts to clear the gear ready for towage. I was trying to untangle enough anchor warp to tow by and, when I looked up, the motor boat had passed on.

By this time, the tide had carried me downstream opposite Strood pier. A tug was coming up river quite slowly so I stood up on the bridge and waved. Once I was sure that they had seen me, I slid back into the water where it was warmer out of the wind and continued sorting out the gear. The tug came alongside and lowered a line. I got most of the main sail on " deck " — really the underside of the bridge, but the clew was still fast on the sheet so the boom would only come level with the gunwale. However, I took a turn round the tack with a jib sheet to hold it alongside the hull. I gave a sharp push to the centreplate and it shot down out of its case and bobbed up between the bows, where I caught it and brought it aboard and laid it on the bundled up mainsail to hold it down.

I made fast a rope from the tug to my forward cross-beam and another to a bight of the main sheet. The skipper rang " slow ahead " and the cat towed quite nicely alongside. I climbed up for a word of thanks to the skipper and we soon arrived alongside Strood pier where four strong tugboat men soon had one bow up onto the pier and were able to throw it right side up.

The catamaran suffered no damage except for the end of a diamond stay which pulled out through its ferrule. However, I lost both hatch covers and my tool box. Other gear remained in the hulls. The tool box was only lost because I had left it directly under the hatch. Another time, I would give higher priority to the rescue of loose floating objects.

Comment

Very few *Shearwater* capsizes are known at the time of writing. This one occurred in such a strong squall that every boat sailing in that part of the Medway also capsized. Another one took place in the Mistral during an offshore cruise in the Mediterranean. In both cases, there was only one person in the boat.

1. To a motor boat, an upside down catamaran may not look to be in trouble.
2. When sailing a very light catamaran with one person only, should there be strong breezes about which can start and stop as happened here, it is better to sail without the jib. There is far more side force when the jib is set than without it. In a quick emergency such as this, the jib sheet may not run out soon enough and may have been the factor causing this capsize.
3. Save your floating gear first thing.
4. Make a habit to stow things so that nothing is directly under the hatches, which should be fastened or hinged to their coomings or held by lanyards.

Printed in Great Britain by F. J. PARSONS LTD., London, Folkestone and Hastings.