TRIMARANS AND OUTRIGGERS

A.Y.R.S. PUBLICATION No 16

Arthur Piver's 12′ fibreglass Trimaran with solid plastic foam floats

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EDITORIAL

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This publication is called TRIMARANS as a tribute to Victor Tchetchet, the Commodore of the International Multihull Boat Racing Association who really was the person to introduce this kind of craft to Western peoples. The subtitle OUTRIGGERS is to include the ddlightful little Micronesian canoe made by A. E. Bierberg in Denmark and a modern Polynesian canoe from Rarotonga which is included so that the type will not be forgotten.

The main article is written by Walter Bloemhard, the President of the American A.Y.R.S. and deals first with the design features of catamarans as exemplified by *Ocelot*, most of which are also applicable to trimarans. When dealing with trimarans, however, he is in great difficulty because of an extraordinary craft in Long Island Sound, Francis Dealy's *Flamingo*, which appears to be the fastest craft afloat IN SPITE OF HAVING BOX-LIKE SECTIONS AND SPRUNG CROSS BEAM CONNECTIVES. The first of these two design features seems to make any catamaran slow (if not very slow) and the second appears to offend the susceptibilities of the modern yacht engineer and naval architect. Yet *Flamingo* can beat Bob Harris' *Ocelot* both in moderate and strong winds.

The conclusion is obvious. Either, Walter Bloemhard, Bob Harris and many other people are wrong and a half square box makes the ideal section for a craft *or* the proportions of *Flamingo* are such that she can overcome the disadvantages of her shape by the trimaran configuration relative to such a fine catamaran as *Ocelot*, which, it will be remembered beat at least one *Shearwater III* in a strong wind. Should we be right and a semi-circular or deep U hull midship section be the fastest, trimarans or Indonesian canoes capable of some very startling speeds are possible.

Walter Bloemhard's article is logically followed by that of Arthur Piver of San Francisco who has built a trimaran weighing only 300 lbs. which can be driven at 20 miles per hour by 130 square feet of sail. This craft has semi-circular under water sections and engineered cross beams of spruce and plywood. A *Shearwater III* has sailed alongside *Evaine*, the 12 meter which is being used as a guide to the British challenger for the *America's* Cup, for as long as 15 minutes in a fairly strong wind. Perhaps the *Rocket* with a full suit of sails might be able to beat the yacht which is eventually chosen to be the Defender. I shouldn't be surprised.

At present, we have collected a good many further articles on catamarans and outriggers which will all be published sometime. I hope that all the kind people who have sent these in, especially those in New Zealand, will not become too impatient before their articles appear. I feel that we should not have too many publications on these new craft one after the other, interesting as they are. Sails and sail rigs and many other things also need to be examined to keep the interest of ALL our members in the picture.

As usual, there are some omissions in this publication. Donald Robertson's outrigger was partially described in No. 8. I have not described it in greater detail here because Donald feels that the catamaran is the better configuration. Nor were his floats of the best design. The craft was beautifully made, however, and must have been a " near miss." I must confess that I made contact with another English outrigger of very good design and construction this year but lost contact. However, the greatest omission is an account of the Italian outriggers of the Marquis Marcello d'Andrea an account of which was given in the U.S. magazine *Motor Boating* of February, 1957. Contact with him has not been made as yet and I should be grateful if our Italian members would do this for us. The Marquis has made many catamarans and trimarans and prefers the trimaran for speed and comfort and insists that the trimaran is safer for offshore sailing, because of the lesser strains in the cross beams. His large trimaran is 32′ 6″ long, has a round bottomed hull and planing floats like those of Arthur Piver's *Rocket* or *Jehu* and has repeatedly done 22 knots with an easy sea motion, running smoothly while fishing boats and conventional yachts are taking white water all over them.

It is worth noting that Victor Tchetchet, Arthur Piver and the Marquis d'Andrea have all had a good deal of both catamaran and trimaran experience and now all prefer the trimaran. The reasons for this preference as given by them seem to vary widely. The reasons for my preference are that the trimaran is cheaper, lighter and it is easier to transport.

Walter Bloemhard's statements about the " Apparent Wind Barrier " should be noted because they indicate that a high speed sailing boat needs the greatest possible " Thrust to Side force " ratio from its sails. It is because of this that Ice yachts, which can travel at three times the speed of the wind, no longer use a jib and rake the mast aft much more than any yacht.

CATAMARANS AND TRIMARANS

by

WALTER J. BLOEMHARD, President A.Y.R.S.-A.S.

Introduction

Some five years ago, I picked up a book in the library of the Institute of Navigation and Aeronautics in Rotterdam, Holland, in which the famous theoretician Dr. Weinblum discussed the limitations on performance of surface-, subsurface- and above surface craft. Automatically, my thoughts went back to pre-war days and Indonesia, where I had seen the *Proa Soppe* from Macassar fly past at speeds well in excess of 11 knots, the rate of the harbour launch which carried us to and from the island of Samalona on Sunday swimming excursions. I wondered what speeds could be attained in a modern version of the type, if these relatively crude but certainly elegant and nimble dugouts already moved the way they did.

Three years later, I went to the U.S.A. with a vivid picture of high speed sailing in my mind and firmly resolved to do something to make the dream come true. I was elated therefore when I came to meet Bob Harris, a really enthused catamaran supporter, handy with tools and moreover a well-trained yacht designer who for five years had been working in the office of Sparkman and Stephens, cradle of so many winning boats. Pretty soon, I found myself at his side diligently breaking the bottom out of his *Naramatac*, an undistinguished edition of *Manu Kai*, his first catamaran design. We never completed the work of streamlining the undersides of *Naramatac*, as meanwhile construction of the new *Ocelot* had started.

Ocelot.

As *Ocelot's* shape developed on the drawing board, I grew more and more expectant of her performance. The basic concept underlying the craft certainly seemed to be in the right vein, while it did good to see Bob and his partner Ned Mullen tackle the many problems of her construction and arrangement of gear with flair and understanding.

Bob Harris' *Ocelot*

The Design

With the light displacement planned, a displacement-length ratio of 1.6 was to be realised. The sail area-wetted surface ratio would be 4. A fine shape was indicated at a " Prismatic Coefficient " of 0.53. Both the centre of buoyancy and the centre of flotation were well forward which I hold to be good for light going. This opinion can be defended on theoretical grounds of flow but practical results have repeatedly pointed the other way. The transverse metacentric height would be about 30 feet.

The best points of all, however, about the design were the nicely shaped round-bottomed hulls, the only logical form for catamarans. I do not care how dogmatic this sounds. Not only does one get the least wetted surface per volume with semi-circular form, but induced drag is also lower. A wedge shape is better in this respect than a square bottom which has two sharp corners causing eddy formation. A semi-circular shape is good but it seems desirable to stabilise the flow pattern by employing a somewhat deeper section of a more oval form.

The ends of the boat were properly upturned and, with an efficient sail plan, deep centreplates and twin rudders — all retractable of course — the plans had what it takes to make *Ocelot* " look right."

In *Ocelot*, several long needed departures from standing design practices have been made, resulting in a craft which is no longer a derivation from the native proas, but a truly modern small boat. For one thing, the fixation of chine bottoms has been broken. Then also, the notion that some flexibility is needed to take care of torsional strains set up between the two hulls has been replaced by modern design practice, with high loading, lightness and rigidity, critical limits and compromised efficiencies. In this respect, it would be fair to say that the Herreshoff catamarans were entirely proper in their time but it seems unwise to continue the same philosophy in the contemporary era.

There seemed to be every reason then to expect exceptional speeds under all conditions, including light winds, and on all courses. The boat could, moreover, be expected to manoeuvre well enough to satisfy even the keen day sailor, used to sailing in modern, quick-spinning dinghies. All these expectations have been fully met in practice and I have yet to see a *conventional* type of craft, big or small, planing or displacing which exceeds *Ocelot's* performance on any course and in any wind strength down to Beaufort I. *Ocelot's* ghosting ability is quite a delight but there is no doubt that she can be further improved on this point, though not very much. It is a matter for experiment to find out how much prismatic coefficients can be raised to improve light wind performance without unduly impairing maximum speed. I would not say that *Ocelot* is invincible and am sure that each and every one of the modern planing dinghies will be difficult to take in very light winds. On the basis of past experience, however, we feel sure that no conventional boat would at any time walk away very easily from her, to say the least.

With *Ocelot's* design data in hand, I set to work on a speed estimate. The implication was that she would do 20 knots under favourable conditions and 20 knots she did make on a timed run across Northport Harbour on a day when the wind was nothing more than moderate (possibly force 4 to 5). There were four people aboard. The calculations used were more a work of art than an exact process owing to the lack of data on both hull resistances and reaching sail forces and thus are not suitable for presentation here. However, the diagram was arranged, as is customary for airplanes, with a curve of thrust required and a curve of thrust available on the bases of boat's speed and true wind speed for the conditions of broad reaching and weather hull out. We feel that *Ocelot* can still do a little better, possibly 22 knows or so as she has not been sailed in high winds yet and the crew has seldom been more than two.

Relative Performance.

From all reports, it would seem that Prout's *Shearwater III* is in a class with *Ocelot*. In fact, one of these boats proved to be quite a match for her in a recent try-out in light going. The bigger boat gave somewhat better speed in a breeze, however.

The one boat which, so far, has shown *Ocelot's* helmsman her triple sterns is Francis Dealy's trimaran *Flamingo*, an admirably proportioned sailing machine, considerably longer than *Ocelot* and capable of tsememdous speeds. However, the light weather performance of this boat could be improved and, on account of this, I would say that a good, modern prototype for trimarans is still lacking.

Handling.

Ocelot is very well bred and remains nicely in hand all the time. Her designer complained that the fibreglass covering had added too much weight but I am of the opinion that the extra weight adds to the docile nature of the boat and to the steadiness of her motion under all conditions. It also adds to the stability but, of course, a boat of this type should be in the light class, generally speaking.

The twin centreboards are a big advantage. They can be adjusted so as to cover the range from some lee helm to hard weather helm, via perfect balance. This matter of balance in a catamaran is one of the major design problems and needs to be given a fresh look. I am definitely against a single surface piercing centreplate as such an arrangement must lead to a very appreciable increase in wave resistance and resonance effects at speed. I of course recognise the advantage of simple construction and the reduction in the chance of leaks. These hulls are rather inaccessible on the inside and once leaks occur, there is scarcely an end to the misery, as has been experienced over here.

One of the objections constantly raised against catamarans is their poor manoeuvrability. In *Ocelot* however, there is never a moment's doubt whether the boat will come about, even in light airs. Certainly, she will swing more stately than a dinghy, but she will do it single-mindedly, in one broad sweep and it never becomes strictly necessary to back the jib but of course doing so shortens the overall time, as it would do in any other boat. Response to slight alterations of the rudder angle is instant and it is entirely possible to manage gusty weather with the sheets untouched most of the time.

In general, it does not seem detrimental to manoeuvrability to space catamaran hulls wider apart. On the contrary, placing them closer together seems to impair turning ability more, strange as this may seem. For reasons of stability, resonance etc. one wants the hulls as far apart as possible but a practical limitation is set up by stress considerations. An overall length to beam ratio of 2 to 1 seems to be a neat compromise and I would not recommend anything narrower.

Wave Interference.

Wave interference becomes serious at a speed of $1.4\sqrt{\text{L.W.L.}}$ and exists up to around $2.5\sqrt{\text{L.W.L.}}$ We recognise its great importance in the medium speed range, especially for power boats and motor sailers (for which the catamaran form is ideally suited) when they operate within the critical limits. This problem is not solved at the moment but we are hard at work finding ways to overcome it and we are confident that practical solutions will be found in time.

Summary.

Ocelot certainly fulfills the promise of the catamaran type with her docile behaviour and superior speeds in light and strong winds relative to conventional boats of all kinds and sizes. It would be most unfair to base criticism of the type on any specimen of lesser performance. It could therefore well serve, with the Prout *Shearwater*, as a prototype for further development, especially also with regard to her construction, which was well conceived and expertly done. I heartily agree with the ambition of her designer to establish a class.

In conclusion I should like to state that *Ocelot* represents a victory of concept rather than a mere development and it is precisely for the encouragement of such results that the A.Y.R.S. has come into being.

CATAMARANS AND THE YACHTING PUBLIC

Crewing for Bob and Ned, I spend many a time on *Ocelot* during the 1956 season. We met and gave chase to all kinds of daysailers and yachts. We passed Star boats (reputed ghosters) without effort in light zephyrs which would not even allow the mainsheet to run out through the blocks by itself and the sail to take a decent curvature. We held our own against the so much bigger Atlantic class boat, running downwind under the same conditions. We outpointed Sixes in fluky winds, going a good deal faster at the same time. We went off on races with the last of the starting guns with big flotillas of all sorts of boats going over the courses ahead of us to come in on the first gun to finish.

It makes no sense, however, to boast of these facts, as acceptance of the catamaran is a matter of adjustment on the part of the public and the officials and it is also awaiting the fiat of our leading naval architects. These are processes which cannot be hastened by brash claims and a loud mouth. We will just have to reappear, time and time again. Recognition will come, suddenly and " en masse " and I feel quite sure the time is not very far off. A very interesting development will then be seen to take place, one that will inevitably lead to a complete overhaul of concept-matters in sailing yacht design.

In the meantime, it is hoped that yacht clubs will have the wisdom to provide for separate multihulled classes in their racing programmes, rather than expand their handicap classes, because if the newer and faster catamarans and trimarans must compete in handicap classes, no rule existing at the moment will prevent extreme embarrassment on the side of other participants. The controversy resulting from such a situation would do nobody any good. I salute the Honolulu race committee for having made the right decision in barring catamarans from competition, giving a timed start in place. We feel sure that this year's unspoiled demonstration of *Aikane's* ability in the Honolulu race will not fail to have good effects.

CATAMARAN DESIGN

The example of *Ocelot* has been given to show the many features which go to make up a good catamaran design. Other features which should be considered are found in publication No. 15 CATAMARAN DESIGN. In this section, however, I wish to put some things about catamaran and trimaran hull design which have been tried and not found to be successful. This is done, not in the spirit of finding fault with honest efforts by enthused amateurs, but as an exchange of ideas and experience in the hope that costly mistakes can be avoided in the future. We should also recognise the fact that at this stage in the development of multihulled craft, each bad example that is put out will do a lot of harm.

Planing.

Contrary to some deceiving theories about catamarans, the natural tendency for these displacement vessels is to dig in at speed, rather than to climb on top of the water and plane. Attempts to design catamarans to plane on flat bottoms are against the basic concept and have invariably resulted in low efficiencies and bad overall performance. Of course, it is not at all impossible to make them plane and at good speeds for that matter. All I say is that it would be less than best and that it will spoil the performance in light and medium winds. The argument that a V-bottom or flat bottom makes for easy construction does not hold much weight, if we consider what can be done with modern plastic materials.

Asymmetrical Hulls.

Another fallacy often met is to give the hulls a wing profile shape, so as to increase the lateral force production of the lee hull. The difficulty with notions coming down to us from the aircraft field is that they are seldom tailored to suit our needs. A sail is a different thing from a wing and so is the underwater part of a sailboat. The sooner we forget about planing catamarans and wing profiles for the pontoons, the better off we will be. This may seem a little harsh to say but then a fanciful notion can only be cracked by a heavy stone.

Ballast.

Ballasted catamarans have also appeared. This is so much against the whole idea of a light, form-stable craft that we will have no difficulty discarding it. If ballast is to be used (to increase end-stability, perhaps) then it should at least be water ballast, which can be readily disposed of.

THE TRIMARANS

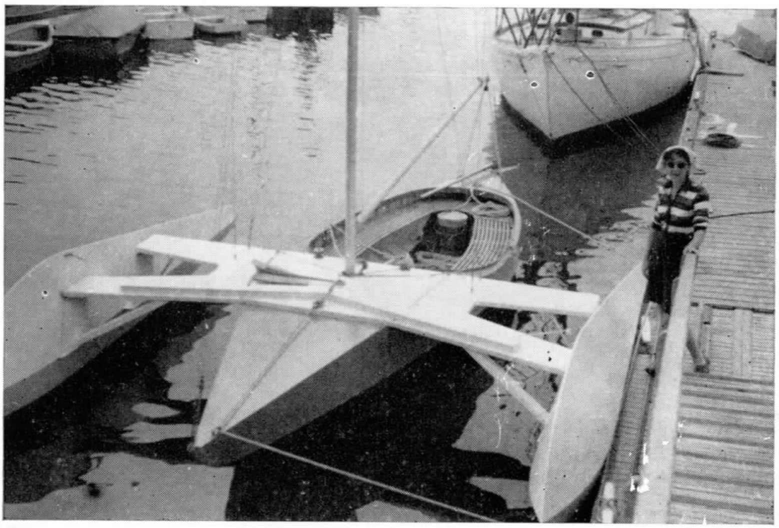
Commodore Victor Tchetchet

Naturally, in time I crossed paths with the granddaddy of the Long Island Sound multihull clique, Commodore Victor Tchetchet, widely known as a tireless promoter of multihulled craft and builder of numerous trimarans. Commodore Tchetchet is a great amateur to whom we all owe a debt of gratitude for his ceaseless efforts in furthering the cause of multihulled craft. He is also a born artist, as witness the painting and many other works of art in his home at Kings Point, L.I., and his designs look the part.

I have not yet had the pleasure to sail his *Egg Nog*, although I have encountered her on several occasions, allowing me to evaluate her performance. This most graceful and stylish of all multihulled boats in the area seems to run very stably, manoeuvre well and is a beautiful sight for a man with a sense of poetry. However, her speed is not as high as *Ocelot's* and *Flamingo's*, which I suspect is due to minor imperfections in the design of pontoons and sterns. The flat bottom has very little camber towards the ends and is well immersed, which I believe is a happy circumstance as it may well keep the boat from planing at a big loss in eddymaking and spray resistance. *Egg Nog* gives a good account of herself against conventional boats and finished second behind *Ocelot* in the Bayside Y.C. Regatta in 1956. Her seating arrangement is worth noting as it eliminates splash and makes a cosy cockpit.

Trident

Dave Clewitt's boat *Trident* reportedly caused quite a stir at Larchmont when she came out there in handicap races. I have not seen the boat myself so I cannot comment on her performance or construction. From the photographs, however, it would seem that we have here an attempt to compromise the " Long boat " just so far that she will have sufficient form stability in light winds and at the moorings, the outriggers coming into action only when the breeze freshens. The idea is very much worth while and I have been occupied



Dave Clewitt's *Trident*

with it myself for some time. I cannot, however, admire the general form of the Clewitt outrigger floats as they must have an excessive amount of wetted surface per volume of displacement. On the other hand, their relative length is excellent for high speeds. It is to be hoped that some constructive work will be done on this form.

We should realise that the catamarans and trimarans of length to beam ratios around 15 : 1, as developed here will never give the same compact arrangements and internal room of the single huller of L/B = 3 to 3.5 : 1, whether light or heavy. They provide wonderful deck space on the other hand. If a craft can be developed which combines the internal room of the single huller with the major advantage of all well-conceived catamarans and trimarans, viz. inherent stability without ballast, it will, I think find a big following. Such designers as Bolger and Gardner, Hunt and others who have experimented with longish forms could very well find a logical extension of their thinking in the trimaran configuration. It does not matter whether stability is obtained by static or dynamic means, as long as we can get away from the brutal design method of ballasting. One of my favourite sayings is that, if we were to ask a competent engineer, who had not received a formal training in yacht design and initiation in traditional ways, to design us a fast, livable cruiser, he would probably never hit on the idea of ballast. This " invention of shipwrights " has been carried to an extent where it has become an insult to the man of elegant ways.

FLAMINGO

L.O.A. 26′ 0″	Beam O.A. 12′ 6″
D.W.L. 25′ 6″	Sail Area 280 sq. ft.

Designer : Victor Tchetchet

I first saw *Flamingo* when coming away from the Bayside Y.C. race. I had been sailing in *Ocelot* with Ned Mullen, a pilot and sailor of pushbutton accuracy, and he had taken a lead which was an object lesson in itself. *Flamingo* was just one day in the water and not in the race. She caught up with us and passed by at a speed which threw me in dumbfounded astonishment and next in despair. However, we made it a race home to Huntington Harbour, some 30 miles off.

Flamingo, with her bright red hull, white pontoons, tall rig and lively crew, looked very gay in the diffused sunlight and she surely

Francis Dealy's *Flamingo*

dashed along. In the light fluky wind that followed, however, she slowed down sufficiently for us to catch up. It was clear enough that she was no match for *Ocelot* whenever the wind died down. She would tack downwind at quite some speed but still would not shorten the distance to *Ocelot* who is best sailed on a straight course.

Next, Francis Dealy invited me to sail in *Flamingo* during the Manhassat Bay Y.C. Regatta. Before starting the race, we reached back and forth behind the line, showing off our speed. The wind was good. I estimated it at between 15 and 20 knots. *Flamingo* paced along fiercely and everybody seemed to enjoy the sight. Sailing like this can only be compared with a ride on an Arab stallion (I have never done that myself but I have seen it done, many a time).

I have never gone as fast in a sailing boat. The quick, sharp turns, the jerky accelerations causing you to tumble back if it caught you unawares, the speed of action required. The fun of holding the boat in check on the spot by trimming the sheets to allow some slow-poke his way ; next a padding motion or two with the rudder and within a ten-count, you would cut under his counter, break through his lee and then there would be the spray again and the whistling in the rigging. It all added up to one big bundle of joy. I hate to call out speeds when you have to guess. *Flamingo* has a pitot tube but the meter was reading erratically at the time so it was not reliable but I am sure that the speed must have been well over 20 knots at times and not far under it as a mean, when reaching.

Going into the race, we ran into what you might call the " Apparent wind barrier " (It is a logical expression since by now every branch of locomotion has its " Barrier "). We were moving so fast that, although the sails were sheeted in as hard as possible, they would not bundle up the wind and so we had to bear off to keep them full, which raised the speed even more so that we had to turn off again. In the end the course required was something like 6 points off the true wind, as indicated by the streaks on the surface of the sea, which at that time was beginning to break out in " white horses." Due to a badly timed start, Commodore Tchetcher had given us the advantage of some 50 yards of height to windward. At the end of the first tack, possibly a mile or so, we had lost all that and actually had fallen way down on her course : but the tremendous speed through the water made up for it. *Egg Nog*, of course, sailing much slower, held on high to the wind.

Since this race, *Flamingo* has been improved a lot. She is in the water again this year (1957) winning races among which were the handicap class races at Larchmont. Also going, is *Sheer Coincidence*, another Tchetchet design, at present in the hands of Francis Dealy. The boat is equal in length to *Flamingo* but carries somewhat more sail and, according to Francis, is a delightful boat, very fast in a breeze.

Sails

Flamingo has a mainsail which is positively a work of art. The sail was cut by Hard Inc. with a deep draft, yet shaped so as to flatten considerably when stretched along the foot and luff ropes and strapped down. In light winds, the sail is very efficient. However, I think that these high speed vessels are better off with very flat cut sails and suitable headsails of light weight. Or else, the mainsail should be battened from luff to leach as is the practice with iceboats. *Ocelot*, with a much flatter main does not seem to feel the effect of the apparent wind drawing farther forward at speed, but then I have not sailed *Ocelot* at really high speeds to windward yet.

The Main Hull

Flamingo's main hull seems longer than strictly necessary on considerations of sail base. In that way, wetted area is added. On the other hand, the lower displacement-length ratio gives better speed in a blow. However, I think one does best to restrict length to the minimum required for an all-inboard rig. This, of course, presupposes a design procedure which starts off with a weight estimate and so on to wetted surface, sail area, stability and form.

Both the main hull and the floats have flat bottoms and hard chines, which for reasons given before I must definitely consider a major mistake. True enough, dinghies are hard chined but they are required to plane, which a catamaran or trimaran should never be. Even so, most of the modern dinghies have round bilges.

The Floats

The after endings of *Flamingo's* pontoons were at first rounded off, where they should have terminated in a sharp edge. Consequently, going at speed, a high pressure spout, a foot or so in height occurred. If this looked amazing, it did not look right and the ends were tapered last winter.

The centre of lateral pressure on the leeside of the pontoons is far forward. This first became clear to me while watching the models in the Webbs Institute towing tank, though it is to be expected from a study of pressure diagrams for plane surfaces, such as have been published many times. Some thought and observation expended in the study of the leebow wave system might provide useful clues as to the longitudinal position of the pontoons in relation to the main hull. However, as Bob Harris pointed out in his article, one should always give proper thought to the position of the C.B. of the pontoons of a trimaran when heeled, on considerations other than wavemaking. It might be noted here that the pontoons, being shorter than the main hull, will have a higher speed-length ratio and consequently will have a higher residuary drag for the same displacement-length ratio. I disagree with the notion that any noticeable venturi action would be set up between the pontoons of a trimaran, at usual displacements and drafts and spacings as needed for stability.

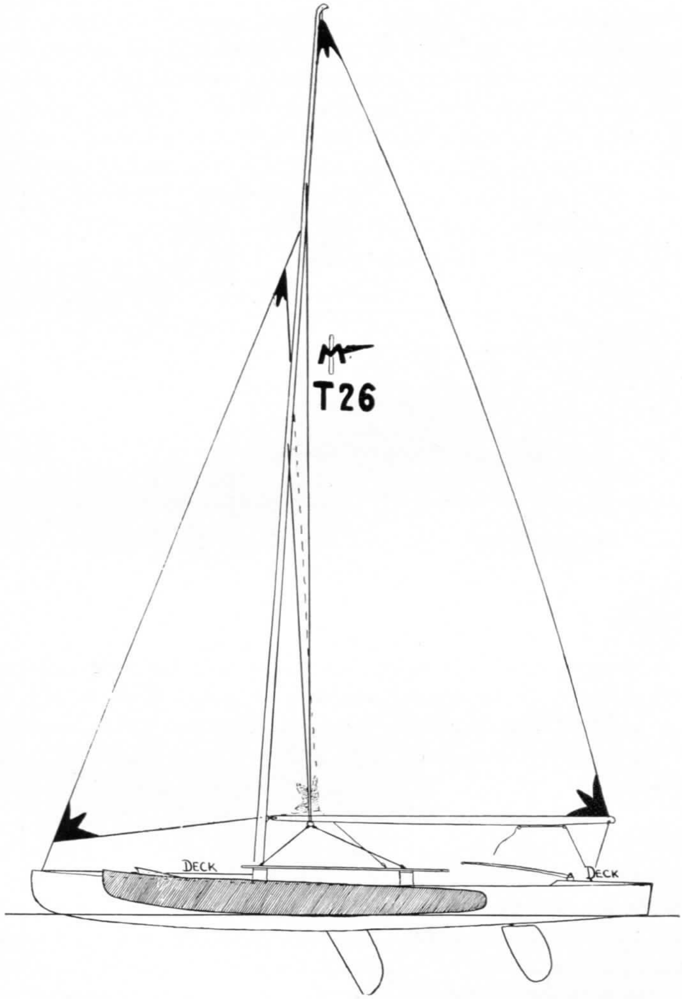


Fig. 1. Profile of *Flamingo*

The Cross Beams

The two cross bars tying the hulls together consist of two flat arches meeting at the ends, strutted in between and fastened to the hull and floats by strong hinge joints. There is considerable vibration in these members under shock load and my feeling is that they might give some day. I would feel much better if the cross members were integral with the hull, internally webbed and plated with stressed skin. With cross members constructed as separate units, connections of the airplane type could be considered which would need to be well engineered to stand the stress Experimenters could well keep the picture in mind of the capsize and crash which would occur following the collapse of a trimaran's cross members. The stability in the main hull is entirely negligable and there would not even be a split second in which to make an emergency move.

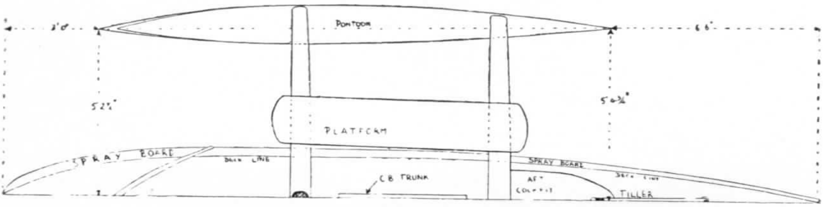


FIG 2. *Flamingo*, half hull and one float. Note: slight " toe-in " of float

The Rudder

Flamingo's rudder is slung underneath the hull, very efficient of course, but throwing the advantage or shallow draft to the birds. Once, I forgot this fact and ended an otherwise splendid shuttling manoeuvre alongside a dock, high and dry on a mudbank ; such a shame.

Handling

Contrary to the docile nature of *Ocelot*, *Flamingo* is full of caprices and it would take a long time before one could get the best out of her. Part of her behaviour may have resulted from an unbalanced disposition of areas but the matter of balance in these craft has not been studied sufficiently, so far. There can be no doubt, of course, that once the pecularities of the type are defined, balance can be obtained.

Summary

With *Flamingo*, we certainly have a well visualised trimaran, although she is far from perfect yet. Basically, she seems to be alright and I would advise anyone contemplating the design and construction of an experimental trimaran to take a good long look at her proportions. The boat has plenty of reserve buoyancy in her high floats, which is very well seen. The main hull also has high freeboard and moreover a broad rail which is very nice to sit on and keeps down a lot of spray. In my opinion, she is of light build. She is a very nice job, considering that she is amateur work. I am sure she would make a sensational craft, much more spectacular than the smaller *Ocelot*, if she were rebuilt with a round bottom and either a single centreplate as she has now or wedge shaped pontoons. At present *Flamingo* carries no genoa, but surely a genoa of generous dimensions would add miles to her speed.

A 30 foot trimaran would be able to go 25 knots in a 20 knot breeze, I believe but more important still, it would go just as fast or faster than any other boat in light winds and manoeuvre well. There is no reason in the world why the windward performance should not be excellent. With a cockpit arrangement of *Egg Nog's* type complemented with canvas dodgers perhaps, you would have an ideal day sailer or camping cruiser. A small ice box, a sanitary bucket and some locker space could be easily provided. A boat like this would be far superior to any other type in sustaining high speeds at sea. *Flamingo* has far less tendency to pitch than *Ocelot*, which is due, I think, to her long length of main hull. In fact, in this respect, she is entirely comparable to and even better than conventional boats.

Catamarans vs. Trimarans

I cannot see any decided advantage for either the catamaran or trimaran. Both have, in my opinion, about the same potentiality for speed and about the same gross overall value as boats suitable for racing and cruising. But of course there are secondary differences in such matters as ultimate stability, balance, comfort, stress requirements, handling, sea keeping ability, interference effects etc., etc. It would be extremely unwise to create controversies over these differences at this stage ofthe game for as yet, neither the trimaran nor the catamaran carry the popular vote and none of the arguments in favour of one type or the other carry enough weight to put the other on a sidetrack. I regret very much that enthusiasm sometimes lead people to contrary inferences.

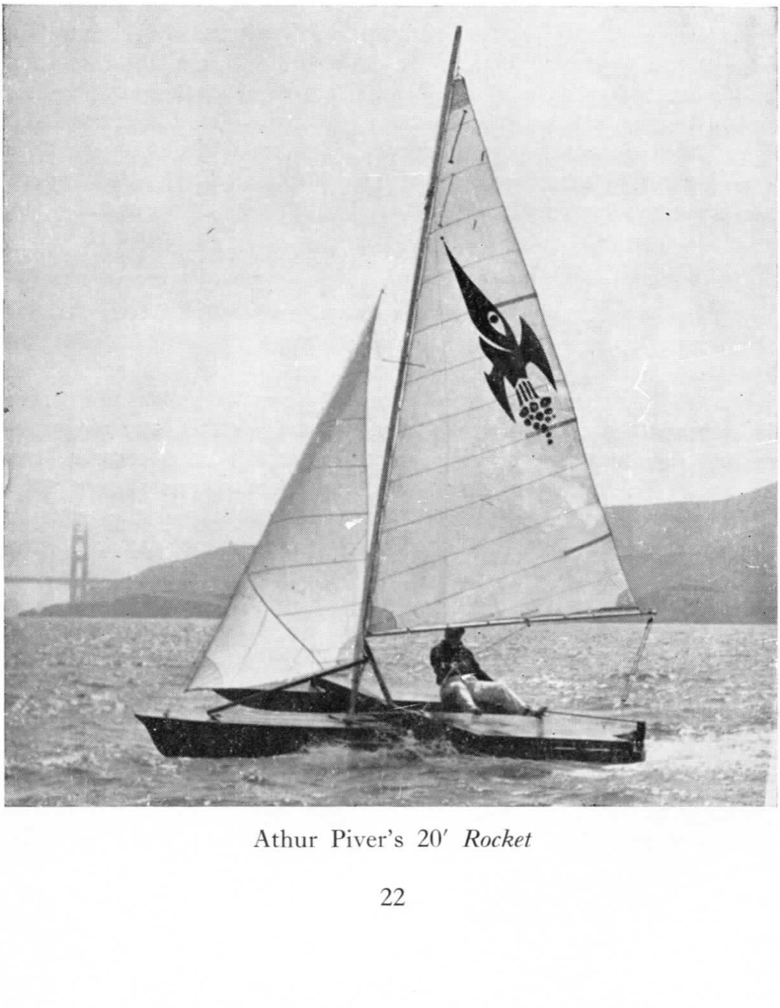
Both catamarans and trimarans are unballasted craft of high form stability displacing long, finely shaped bodies. Both are capable of carrying a lot of sail in relation to their wetted surface and displacement, allowing them to accelerate to great speeds. There you have it. A most exciting development lies ahead of us and all the yachting fraternity, a development which will set new dates in the history of sail. Let us get at it.

THE ROCKET TRIMARAN

by ARTHUR PIVER, Mill Valley, California

L.O.A. 20′	L.W.L., 19′
Beam, O.A., 10′	Beam, main hull, 25″
Draft, 6″	Weight, 300 lbs.
Floats 12′ by 1′ by 9″	Sail Area, 130 sq. ft.

The 20′ Rocket is the sixth multi-hull boat I have owned ; two were catamarans, one a single-outrigger type, and the last three trimarans. All of these craft have been considered good performers, and in each case a new one was built more as a challenge for a better craft, after the existing one was completely proven.



Athur Piver's 20′ *Rocket*

The last trimaran is very similar to its immediate ancestor, the first Rocket, with the only difference being a slightly fatter main hull, tending toward the boat-shape rather than the canoe configuration, and the elimination of a formerly depressed central cockpit area. The trend toward the boat-shaped hull is a search for a more manoeuverable form—for I consider the lack of manoeuverability the chief drawback of the multi-hull type. As pointed out in the article on the *Pi-Cat* catamaran, the experienced sailor with a good sense of " feel " will have no trouble in manoeuvering (coming about) with a multi-hull, even under extreme conditions, but the average skipper simply does not have what it takes, and it is a great blow to a man with a well-developed respect for his own ability when a boat will not perform according to his expectations. Of course, it is only reasonable that a different type of boat should require a different type of handling, but the average sailor will invariably blame the craft, and not himself. And so, the search for a more manoeuverable multi-hull.

The underwater shape of the *Rocket* is almost semi-circular in cross section, with a 6″ draft and a 20″ width at the chines amidships. Floats are attached so that in the static position both floats are several inches out of the water — this means that the pivot point when turning comes at the central rounded portion of the main hull, while the floats are balanced out of water to reduce drag. A very definite advantage of having both floats out of water in the static position is that in going to windward in a chop with the lee float in the water, the weather float is well up in the air, ensuring a much drier ride for the crew perched over it. As a matter of fact, these boats are a good deal drier than the conventional boat at conventional boat speeds — it is only when you exceed 12 to 14 mph that the spray begins flying.

The original sunken section at the cockpit, which was self-bailing through the dagger-board case, was eliminated largely because of the difficulty of keeping water from shooting up the case and filling the cockpit and adding unnecessary weight when travelling at high rates of speed. The tops of the side cockpit decks are now 7″ above the level of the deck of the main hull, and this furnishes a convenient area between the decks to stow gear etc., which was the original reason for the sunken cockpit section.

The boat is constructed largely of $\frac{1}{4}$″ plywood, while the section below the chines with its compound curves is made of $\frac{1}{2}$″ square spruce strips, covered to above the chine by fibreglass. The cross beams are 2 x 4 fir.

There have been questions as to why the floats are of square box section. There is a lift/drag problem involved, but the principal reason was for simplicity of construction. The floats have no frames or stringers, being constructed of $\frac{1}{4}''$ play with glue strips in the corners. It is considerably easier to build a box compared to a boat, and in the case of the *Rocket* you are building one boat and two boxes — lots simpler than building three boats ! In light and moderate airs the weight of the crew to windward will keep the floats out of water, and when the wind increases to the point where the lee float touches, the boat will be going at such a high rate of speed the lift will be dynamic from the planing shape.

The actual size of floats for an intended outrigger is an interesting question, but in general I believe that a good rule of thumb is to have enough buoyancy in one float to support the weight of the normal crew.

The *Rocket* was originally designed to carry 200′ of sail, but performed so well with a 130′ set borrowed from a dinghy that the smaller rig was retained. An overlapping jib was originally carried, but the nuisance of a wet jib sheet being constantly on the deck led to the mounting of the jib club, with a self-tending sheet. It will be noted that the forward end of the jib club is pivoted well behind the tack of the sail, which causes the sheet to pull the clew aft as well as down, approximating the usual lead of the loose-footed sail, generally considered more efficient.

The boat performs very well, indeed, being particularly fast in light airs with good manoeuverability. In our usual summer winds of from 25 to 30 miles per hour, we will reach speeds between 15 and 20 mph.

Many people want to know the differences between the catamaran and the trimaran types. The only advantage of the catamaran over the trimaran, at least in my experience, is greater available space for storage, which may be an advantage more apparent than real. My last catamaran, which seemed very large and stately compared with the Rocket of the same length, should have had some advantage, for it weighed twice as much (600 pounds), cost twice as much, and took considerably longer to construct. In addition, the trimaran with a 10′ beam is more stable than the catamaran, which had a width of 8′. The trimaran is more manoeuverable and faster in light airs, even though it had considerably less sail area than the catamaran (130′ v. 200′). Speaking of comfort, the *Rocket* is decked over between the cross beams, giving a cockpit area 6′ long by 10′ wide — most comfortable, although the catamaran had a cuddy forward of the cockpit where two people could get out of the rain.

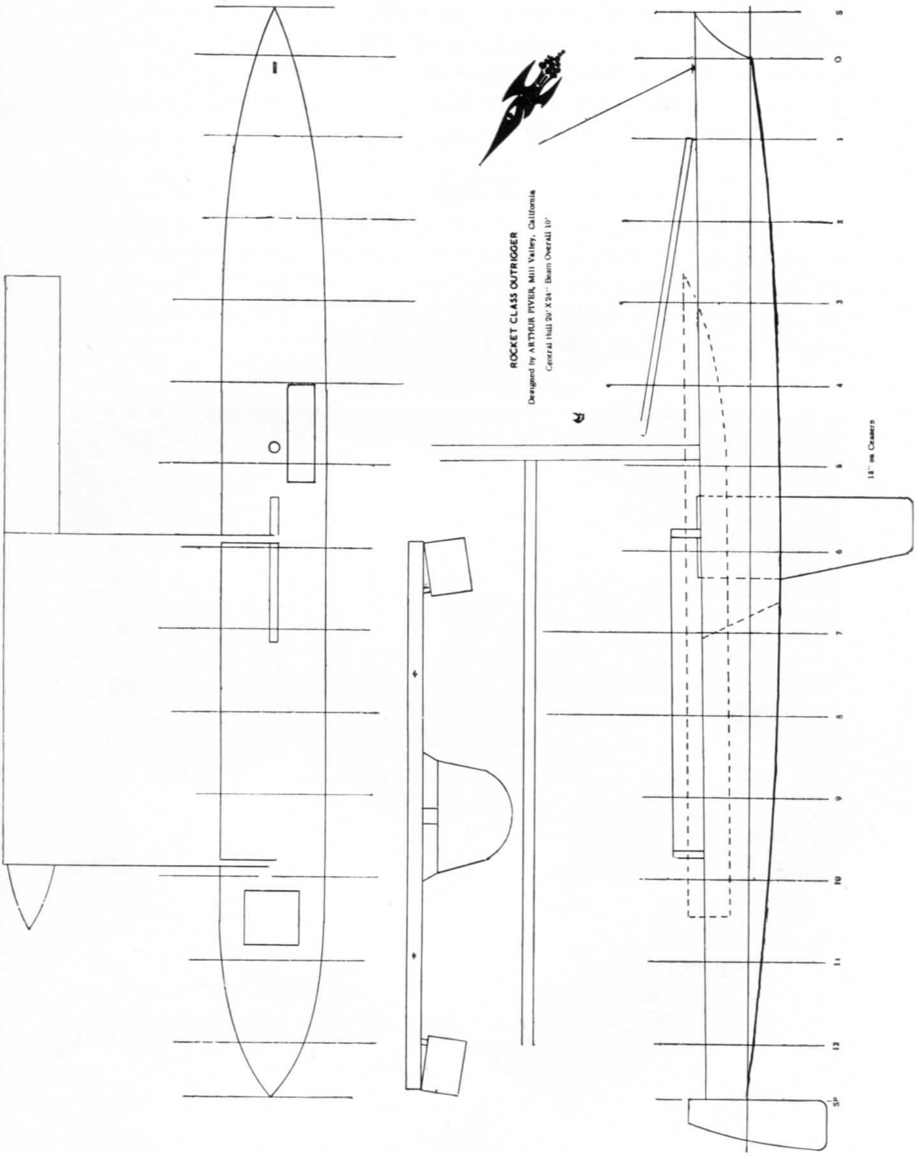


FIG. 3. Arthur Piver's *Rocket*

Perhaps I over-emphasize manoeuverability, having spent considerable time in a responsive dinghy, but it seems to me the catamaran is penalized in this respect by its own shape. Here you have two long, narrow hulls which resist turning by their very nature, and when you do turn them, the pivot point is between the hulls, which must be twisted in the water, rather than having one smooth surface on which to pivot.

JEHU, 1957

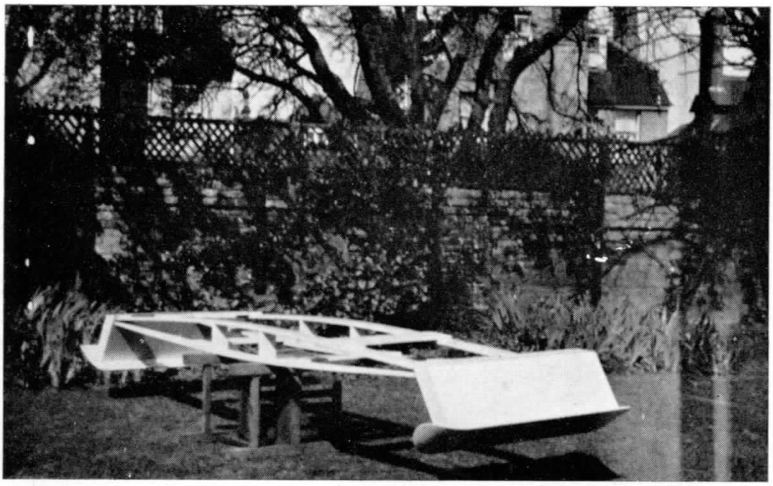
This year, Sandy Waterson has rigged up the A.Y.R.S. catamaran in the Melagasy version of the Indonesian configuration. Commercial surfboards manufactured by Thamsply Ltd. and kindly presented to the A.Y.R.S. were mounted at the ends of a Tchetchet-style cross beam system 12 feet wide. The connectives between the board and

Jehu with Melagasy floats

cross beam were boxed in enough to give about 60 lbs. of buoyancy on each side. Sandy also redecked the main hull and moved the tiller forward by cross bars and lines, all most cleverly and neatly done.

The Design

Jehu's main hull is from the *Shearwater II* mould and has a *Shearwater* rudder. The mast and sails carry about 100 sq. ft. of



Jehu's Outrigger beam

canvas. The surf boards (4′ by 1′), with upturned bows, were screwed and glued to the connectives on the cross beams without any angle of attack but they were given 30° of slope out (dihedral). The whole outrigger system was then mounted on the hull with 10° of slope from the horizontal to give the surf boards that angle of attack to the water.

Performance

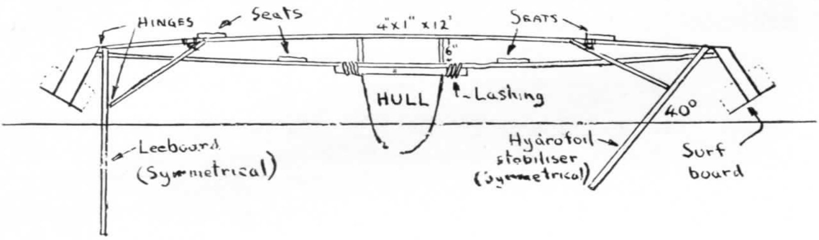
It was quite obvious when we started to sail that we had hit an excellent configuration. The cross beams produced a very comfortable armchair for the person producing counterpoise and it was very easy to balance the craft so that only the after part of the inside edge of the lee surf board was touching the water. In strong winds, the surf boards produced good planing lift and made sitting the craft up unnecessary for stability but it added to the speed. Again, the Tchetchet cross beams were found useful as another comfortable seat again appeared further outboard.

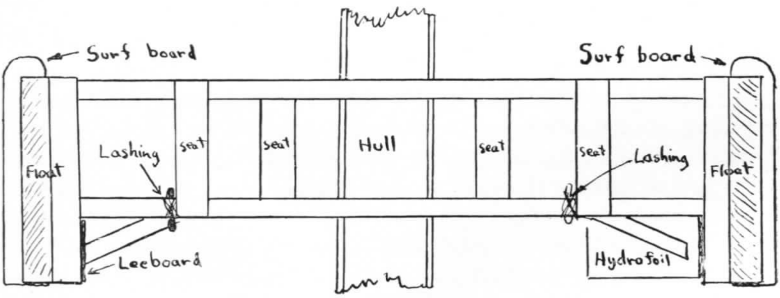
Handling

Handling was very simple indeed. The main sheet could be tied at all times because of the enormous stability given by the 13 foot of beam, leaving only the jib sheet and the tiller to attend when putting about. It seemed that the fore and aft trim was satisfactory with a single person on the outrigger beam, though we have never been able to drive her to the limit. Sitting forward of the mast was very convenient as one was completely clear of the boom — an unusual and very pleasant thing.

Faults

At first, when we had no centreboard, putting about was difficult. Lee boards were then fitted on each float and putting about became as easy as with a catamaran. The only minor fault still left is that the, surf boards are only boxed in for their middle 4 inches. As a result the water flow is able to get on top of the boards to produce extra wetted surface and an uneven water flow. The whole of the tops of the surf boards should have been boxed as shown dotted in the diagram.





FIGS. 4 and 5. *Jehu's* outrigger and hydrofoils

Summary

The Melagasy outrigger configuration with Tchetchet-style beam mounted on a *Shearwater II* hull makes a delightful craft to sail. It is essentially a single hander, though we often filled it with five or six children. It can quickly be taken apart into its two main pieces and easily transported on the roof of a car. The total weight is about 150 lbs. It is unfortunate that Sandy Watson was not at home for most of the summer and I, of course, have little time for practical sailing. Thus, *Jehu* has not been well enough tested but, in our seven or eight outings, she was a beauty.

JEHU'S HYDROFOILS.

When fitting the lee boards to *Jehu*, the only logical way of having them retractable was to hinge them and retract them *inwards*. Hinged struts held them in position, either up or down. It was, of course, quickly seen that if they were angled in at the Baker angle of 40°, they would function as hydrofoil stabilisers. We soon tried them as such and, to our delight, we found that the surf boards could be completely lifted off the water by the angled-in lee board. This occurred at a relatively low speed ; about 4 knots. At speeds greater than 5 knots no sitting out was necessary and the craft sailed close hauled very nearly with the crew placed just as they wished and the surf board raised off the water.

Summary

Jehu's leeboards, when angled-in at 40° from the horizontal, appeared to function as excellent hydrofoil stabilisers. It is too early to say if there are any snags in this but there did not appear to be any. We certainly need more experience.

TRIMARAN DESIGN

by

JOHN MORWOOD

The Main Hull

The main hull of the Indonesian configuration does not alter its displacement as much as does a catamaran hull. When sailing the light racing version, one tries as far as possible to keep the lee float from digging into the water by sitting out farther as the wind pressure increases. This means that one uses the floats as stabilisers, while trying to sail only on the main hull. Therefore, the main hull need only be designed to give the least resistance to motion at *one L.W.L.* only.

Design Features

The main design features of these slim hulls are dealt with adequately by Walter Bloemhard in this publication and in No. 15 CATAMARAN DESIGN. However, as a result of only having to design to *One L.W.L.*, the *Sewer Section* (which was first suggested to me as a design feature by R. R. A. Bratt) need not be used as a means of keeping the wetted surface down, though it may be a good section for low resistance at speed. The midships section may therefore be (1) a semi-circle, (2) a deep U or (3) a right angled V, with the angle rounded of.

The Floats

There are three main alternatives here any one of which could be best. (1) a variable displacement float with a *Sewer Section* and fore and aft lines like those of the main hull. (2) a box section with a rounded-off right angled V below as described by Ivan Morris in No. 6, OUTRIGGED CRAFT. The box should *not* be asymmetrical as in that design and the aft end should be nearly as large as the midships section to prevent squatting at speed. (3) Surf boards 4′ by 1′ in size, angled out at 30° and set at an angle of attack to the water flow as described in the article of *Jehu*, 1957. Above the surf boards, there would be buoyancy for static stability. All these three types would need a C.B. in the main hull, or, less efficienty, twin leeboards on the floats.

The principle of simple, buoyant outrigger floats is self evident from our catamaran studies. The fact that *Planing* surfaces can also be used depends on the fact that the loading on the floats is very much less than on a main catamaran hull. However, if one is going to have a *Planing* float, it must be one with a flat under surface and a good deal of beam, and not one with the same narrow proportions as the main hull such as are used in *Egg Nog* and *Flamingo*. A commercial surf board meets this in the size we want and appears to work perfectly well on *Jehy*. The angle of 30° of slope out is that of the Melagasy floats (Madagascar). However, though it worked well, it produced a good deal of fuss forward and 40° might have been better. I cannot be sure of this, though.

HYDROFOIL STABILISERS

I think that people have been frightened to use hydrofoils so far because they have felt that they must go the whole way at once and rise right off the water. This is, of course, a fascinating concept but we should not try to get there in one leap. The people who have tried it recently have all failed simply because, if one makes a craft for rising out of the water, there cannot be the development of the foils themselves which comes from sailing for pleasure with a mechanism which works. If we had a whole fleet of racing craft which used hydrofoil stabilisers, in only one or two years we would have the hydrofoils improved to such an extent that we would have our flying foil craft.

The logical method to try for this development is to fit hydrofoil stabilisers to either the *Hornet* or *International Canoe* both of which would allow their use for racing, as outriggers are not barred. Because the cost of the foils would be so small, it is unlikely that the rule makers would immediately ban their use as would happen, of course, if they were an improvement and expensive.

Hydrofoil stabilisers could also be added to the Melagasy Indonesian canoe by tilting the surf board at 40° and having a dagger slot just above it and below the buoyancy. Or the *Jehu* system can be used, which is easier to retract, if heavier and needing more beam.

Summary

Hydrofoil stabilisers should be developed and used in such craft as the *Hornet*, *International Canoe* or with the Melagasy surf boards on a catamaran type hull. This would very soon develop hydrofoils to the stage where an all-hydrofoil craft would be possible. I am glad to say that Reg Briggs, of Folkestone, is now carrying out a series of foil tests on a *Fleetwind* dinghy which already have shown that heeling can be abolished by hydrofoils. The most successful foils will, I hope, be at the Boat Show for inspection.

A CATAMARAN OR TRIMARAN HULL DESIGN

by

DEREK W. NORFOLK

The suggested form of a catamaran or trimaran hull as shown in the illustration would, I think, be the logical development from the designs I have seen so far.

The main difficulty with these long slim hulls is that the design has to be suitable for a greater range of speed than can be obtained from the normal dinghy. When the speed is low, the wetted surface is an all important, which indicates a semi-circular under water section. When the speed is high, the speed boat and planing type of hull would probably be an advantage For the best all round performance therefore, a compromise has to be arrived at.

The hull, to attain a good speed, has to be long and narrow so the wide, flat stern sections of the normal dinghy, which are mainly responsible for making a hull plane, are gone. However, higher

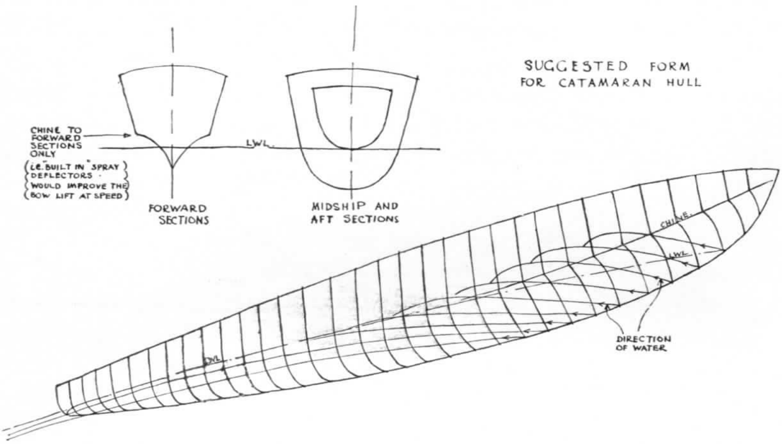


FIG. 6. Derek Norfolk's suggested hull design

speeds might be obtained if the bow is made to lift as far as possible by other means. These are : (1) lifting sections in the bow, (2) moving the sail plan farther aft and (3) keeping the centre of the sail low to reduce the overturning moment.

The sketched lines only deal with the hull, where an attempt has been made to introduce lifting sections and spray deflectors as a part of the design and not added as an afterthought. These lifting sections will only operate at speed, when they are required and be out of the water at low speed.

The construction of the hull would involve moulded ply to the lower half only, terminated with an internal stringer with ply sheet from the stringer to the gunwale.

THE BIERBERG EXPERIMENTS IN MICRONESIAN CANOES

FIG. 7

In publication No. 6 OUTRIGGED CRAFT, some calculations were given which indicated that the Micronesian canoe is theoretically capable of greater speeds than either the catamaran or Indonesian canoe. However, it does not seem to be a type of craft which appeals easily to yachtsmen and very few have been built in recent times. Its lack of appeal is largely due, I think, to the unusual way in which it must be sailed from one tack to the other. But there is nothing really difficult in sailing this craft and, indeed, from our personal experience it is rather pleasant once one has got used to the different reactions. We have neglected it for the moment but it is very nice to find experiments going successfully ahead in Denmark with this type. Perhaps, they have not come anywhere near to a final conclusion but, at present, a fine workmanlike craft has appeared which it would be a pleasure to sail.

Since 1950, A. E. Bierberg of Skovbrynet 23, Kgs. Lyngby, Denmark, our Scandinavian Correspondent, has been taking an interest in and has been making useful Micronesian-type outrigger craft. His interest in these craft started from the desire to stabilise his keel-less Canadian canoe so that he could sail it without risk of capsizing. But, in order to do this, he has turned his interest to the native craft in the Pacific and has not only studied Haddon and Hornell's classic books but has also corresponded with the Ethnological museums throughout the world. As a result, his interest has taken the practical form of adapting craft and materials with which *we* are all familiar to the Micronesian pattern, thus creating "*Aloha*."

Aloha—A Modern Single Outrigger

The Hull. The Canadian canoe used was of the ordinary type, 5 meters long, 0.9 m. wide, 0.35 m. in depth, of course symmetrical in section and also, as in the Micronesian canoe, identical fore and aft. A Norfolk punt (shaped like a Viking "Longboat" but only about 15′ long) would be just as good and moreover would have the rowlock holes to which the cross beams could be tied.

A. E. Bierberg's *Aloha*

The Cross Beams. Three poles about 2.5 meters long by 5 cm. in diameter were lashed by strings in a Spanish windlass across the gunwales. They are thus easy to rig and unrig. They project to one side about 2 meters and the outrigger float was attached to the free ends by means of suitable stanchions.

The Float. *Aloha's* float was made from half of a wing tank of an aeroplane. It was of aluminium with a wooden deck, about 2 m. long and weighing 35 kgm. (77 lbs.). It was very light when floating and planing along the water surface. An impregnated spruce pole 15 cm. by 15 cm. and 3 m. long made into a boat shape would give the same weight and would be equally suitable and easier to get. To counteract a sudden gust from the lee side, which could drive

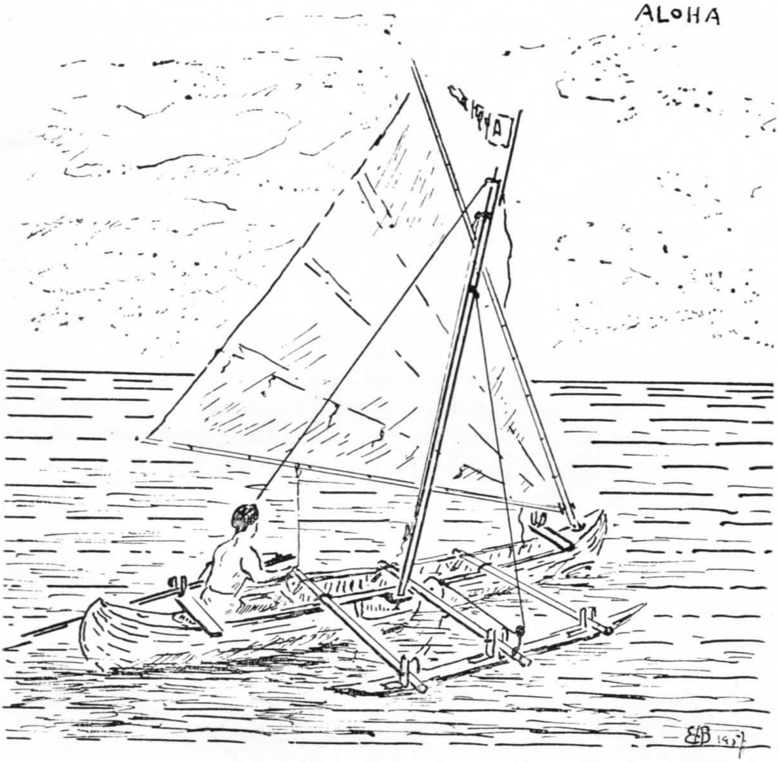


FIG. 8. A Micronesian Canoe

the float under and thus cause a capsize, pieces of cork or buoyant material could be attached to the top of the float to increase buoyancy.

The Stays. There are three stays to the mast. One stay runs from the masthead to the outrigger at its centre. The other two stays consist of one rope which runs from the masthead to one end of the hull, around a block there and on to the other end of the hull where it again passes through a block and back to the masthead. The running stays allow the mast to lean towards whichever end of the craft is the bow and stops hold it in position.

Steering. Steering of the craft is by paddle or by one long oar which can be placed in a rowlock at either end of the canoe. Detachable rudders are used by some Gilbertese islanders, and of course, drop rudders such as are described in publication No. 4 OUT-RIGGERS could also be used.

The Sail. The photograph and drawing show the lateen sail of Oceanic pattern, isosceles with the apex as the tack, which sits very well indeed. It has 5 sq. m. of canvas (50 sq. ft.) and is rigged from a mast of the Oceanic pattern amidship to windward which can tilt towards whichever end is to be the bow. The lower end of the yard fits into a socket in each end of the canoe.

Leeboards. Mr. Bierberg uses two leeboards on the lee side to gain extra lateral resistance. They are, of course, at equal distances from midships. He also uses a galvanised iron sheet 2 mm. thick on the windward side which is hung on to a bolt and can be lowered to work on either tack. Doubtless, these three boards could be replaced by one board whose athwartships position would need to be found. It would be amidships, of course.

Changing Tack. As a counterweight, the float of the single outrigger must always be kept to windward. When changing tack, therefore, the procedure is as follows : The sheet is let fly and the

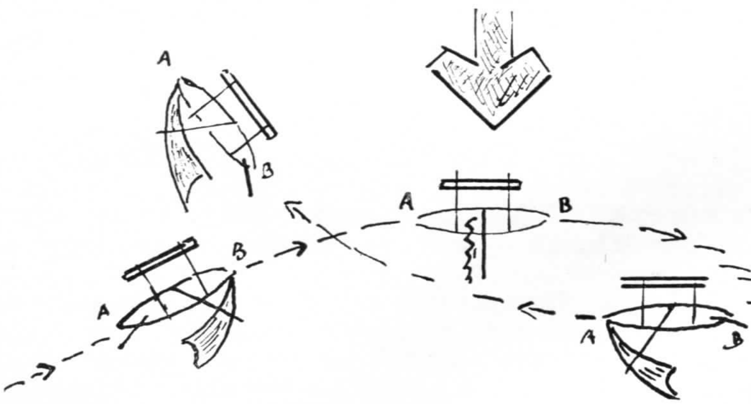


FIG. 9. Micronesian Canoe, changing tack

boat is brought to a standstill. Then the tack of the sail is carried from what was the bow to the other end of the craft and the lower end of the yard is dropped into the socket there. The steering oar is then taken from one end of the craft to the other, the sheet is pulled in and the craft sails off in the opposite direction to that which it was sailing before. All this may seem to be a cumbersome way of changing tack as compared to putting about through the wind but, in practice, it can be done fairly quickly and easily. Naturally, it would make tacking up a narrow river difficult but, on the sea, long tacks are possible and the time taken changing tack would not greatly affect a voyage.

Summary. *Aloha* is a Micronesian type canoe *converted* from an ordinary Canadian canoe *at very little expense*. This example has been followed by several other owners of these canoes in Denmark and could well be done elsewhere, especially in Norfolk in England, where the traditional small boat is suitable. Such experiments are practical and that is certainly what the A.Y.R.S. wants of its members. This craft is a lagoon boat. However, *Aloha* has sailed many miles around the Danish Islands.

A. E. Bierberg, in order to make people familiar with these boats has produced a *Toy* Micronesian sailing canoe 40 cm. long with an asymmetrical hull which is now being manufactured and sold in Denmark in the hope that it will produce adults who appreciate the principle.

A POLYNESIAN CANOE

The Polynesian canoe has only one float but, as compared with the Micronesian type, it has a fixed bow and stern and always travels in one direction. The float is thus sometimes to windward and sometimes to leeward and the crew go out on the outrigger beam to counterbalance the wind force on either tack. The beam projects somewhat on the side opposite to the outrigger to allow of this.

Polynesian type canoes have never seemed to capture the fancy of Americans or Western Europeans and I have only heard of one of them ever being used and it was paddled, not sailed. We have no details of it but fortunately, Milton D. McDonald of the Rarotonga Sailing Club is a member of the A.Y.R.S. and has sent the following details of their craft and sailing waters :

"The lagoon on which we sail is shallow, say an average depth of 8 feet. There are many coral heads reaching to within inches of the surface and breaking through at low water, so that our course, limited as it is, is hazardous. Conditions of flat calm prevail for the greater part of the year and we call it rough (within the lagoon) if waves of 18 inches are raised.

" Boats of any description were welcomed in the Sailing Club when it was founded in 1940 and the variety was wide. In the main, however, canoes of the dug-out type with a hollow outrigger, likewise dug-out but decked and watertight, were most common. In time these, being made of soft wood, rotted and a more hardy replacement was needed. Suitable trees of the proportions required for an 18 footer could no longer be easily found or bought so Mr. Ronald Powell (originally from Ramsgate), was asked to design a canoe to suit the prevailing conditions. *Ron Tiki* was the first design named jointly after the designer and *Kon Tiki*, the balsa raft for, in comparison to other canoes, this one seemed barge-like. It was built in 1947 and is still with us, acting as a prototype for five others being built at present.

RON TIKI

L.O.A.	18′ 0″	*Outrigger float*	
L.W.L.	15′ 9″		
Beam :	2′ 9″	L.O.A.	12′ 9″
Draught :	1′ 3″	Beam :	1′ 0″
Sail Area :	160 sq. ft.	Depth	9″

"The designer envisaged a canoe which could also be used for fishing in the open waters beyond the encircling reef and allowed high freeboard. *Ron Tiki*, like all our other sailing canoes, has a

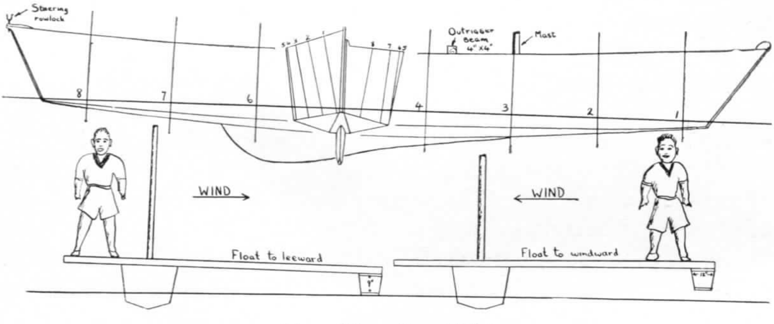


Fig. 10. *Ron Tiki*

false deadwood keel which is easy to build but provision was also made for a centreboard case.

"The profile and sections are as in the diagram. She is planked with 3/10th inch plywood with a false bottom of ½″ kauri which is a necessity with so much coral to contend with. Steering is by a wide bladed oar in a rowlock on the sternpost.

The Outrigger. "Construction of the outrigger float is of $\frac{3}{4}''$ timber top and bottom with plywood sides. It is completely water-tight with a calculated buoyancy of 210 lbs. It is lashed to the end of the tapered cross beam about 15′ long, whose greatest measurement is 4″ by 4″ where it lashed athwart the main hull to project about 3′ on the other side. The after end of the outrigger float is lashed to a supple pole which allows the float to work in the waves, thus following Tahitian and Southern Polynesian practice.

The Mast and Sails. "The mast is stepped on deck and is solid or otherwise at the discretion of the owner. It is supported by three stays and carries 160 sq. ft. of sail in the rough proportions of 120 in the mainsail, 40 in the jib.

"The first of the new canoes for this season has a double skin, the inner diagonal being of very light cedar, the outer $\frac{1}{4}''$ kauri. This boat will have a centreboard and a solid outrigger made from local native timber as light as balsa. To obtain the proper dimensions, logs of 4 or 5 inches diameter — as near straight as possible — were selected, buzzed square, then dowelled. A final adzing faired the shape.

Speed. "At times, *Ron Tiki* has put on such a burst of speed that she has passed me in my *Moth* like a destroyer doing power trials. On checking the Club records, I find that *Ron Tiki* holds the record for the fastest time when she did a $4\frac{1}{2}$ mile course with windward, leeward and reaching legs at an average of 7.25 knots in a strong and steady breeze. For normal sailing, one could not hope for much better than that. While racing, the canoe is manned by skipper and jib hand."

CORRESPONDENCE

Sir,

The paragraph in No. 15 CAN A CATAMARAN PLANE ? interested me a lot. I should think there is no reason why catamarans should not plane. *Pirate*, a hard chined sharpie starts planing at about 7-8 knots. The reason why we do not see catamarans planing might be :

(a) Their hulls are not proportioned to suit planing by their narrow beam in relation to their length.

(b) Their sail area to weight ratio is short of the necessary limit for planing.

(c) The longitudinal centre of buoyancy is not in the ideal position.

(d) The wetted surface per ton displacement $\left(\frac{S}{\Delta^{2/3}}\right)$ is higher than for a normal single hull.

The statement in the paragraph "Flying a Hull" that "when one hull is lifted out of water in *Gemini*, speed increases, instead of falling" proves that each individual hull bottom, when loaded to higher pressures behaves more efficiently. Your *Gemini* lines are those of a planing hull except in L/B ratios. Therefore, shorter hulled catamarans are worth testing. Also forms with inner sides of each hull kept straight (like a split hull).

Yours sincerely,

PROF. ATA NUTKU.

Sir,

The paragraph in No. 15 CATAMARAN DESIGN on prismatic coefficients is absolute iconoclasm, casting down every cherished idea of our textbooks with a resounding crash. Personally, I cannot believe that catamarans are an exception to all other craft in this matter, which is a very important function of wave making but not so important as regards wetted surface. It seems to me that your fallacy lies in stressing the influence of p.c. on wetted surface and neglecting completely its undoubted influence on wave making at the higher speeds.

The better performance in strong winds of *Ocelet* with p.c. 0.57 against *Shearwater III* with p.c. 0.68, which you quote in support of a low p.c. for fast work is beguiling, but I suspect that the real reason lies in the simple fact that *Ocelot* is the bigger and more powerful boat and thus has a slightly higher ultimate speed. Length still plays some part, though I myself believe a very small part in the comparative performance of these fast catamarans at high speeds. *Ocelot* is certainly quite a few feet longer and more powerful than little *Shearwater*.

In support of my plea for high prismatic coefficients for high speeds let me refer you to Skene's "Elements of Yacht Design," Chapter XV on Resistance and the paragraph therein on Wave Making Resistance. There is also the graph of Fig. 124, showing optimum p.c. 0.51 for speed $0.7\sqrt{L}$ and optimum p.c. 0.67 for the higher speed $2\sqrt{L}$. This graph is for a particular craft but the general increase of p.c. necessary for higher speeds hold good for all craft, if the textbooks are correct.

Cdr. G. H. GANDY, R.N.

Editorial comment. Commander Gandy's point is, of course, correct for most craft. The top speeds of ordinary boats are achieved when they create the longest possible wave and a full bow throws off the bow wave farther forward and a full stern collects "push" from the farthest aft stern wave. Therefore, a boat with full ends will go faster up to a speed of $2\sqrt{L}$. However, a catamaran going at $5\sqrt{L}$ does not create the same wave system as a conventional boat. The main difference, as I see it, is that almost all of the " push ' from the stern wave is lost. One therefore has to design a hull which will cut through the water as easily as possible forward and only bring in the stern enough to collect the small amount of " push " which is available. Fining the stern must not be overdone because catamarans with very fine sterns tend to squat in the water and sink by the stern. Both the need for a fine entry and a slightly broader stern have been shown by Prof. Ata Nutku in the test tank.

Commander Gandy's reply :

	Destroyer hull	*Shearwater* one hull	*Shearwater* two hulls
Designed efficient speeds	1.4 to $2.4\sqrt{L}$	3 to $4\sqrt{L}$	3 to $4\sqrt{L}$
Length to immersed beam ratio	9 to 10	15	$7\frac{1}{2}$
Loaded displacement ratio	40 to 60	25	49
Prismatic coefficient	0.63 to 0.66	0.68	0.68
Half bow entry angle (static trim)	7° to 9°	13° about	13° about

The p.c. of the destroyer 0.65 is high but, because the after end is abruptly cut off and it is fuller than forward, the destroyer has a very fine bow entry ; in fact, she has been given the entry of a longer craft yet the p.c. has been kept high as it should be for high speeds.

To have a high p.c., yet still retain a fine bow entry, the centre of buoyancy cannot be forward of amidships unless an unusual craft with a deep narrow forefoot and bow overhang is required. The form of *Shearwater III* with a cut off transom, high p.c. of 0.68, yet with a reasonably fine forward entry has quite a similarity to the destroyer type. *Shearwater's* centre of buoyancy, although slightly aft of amidships is not as far aft as that of the destroyer so *Shearwater's* bow entry is not as fine.

Ocelot, on the other hand, is of entirely different form with fine endings at both bow and stern, with bow overhang and with centre of buoyancy well forward of amidships. In spite of this forward placing of the C.B., the designer, by deepening the hull somewhat, has got the bow half angle of entry down to about 9° (incidentally, the stern waterline exists at the same angle !). By fining both ends in this way, one cannot expect to get an optimum high speed p.c. and in fact the designer of *Ocelot* has managed very cleverly to get it up as high as 0.57 which best suits medium but not high speeds.

No one factor of ship design can be fairly considered by itself, being inter-related with a surprisingly large number of others. This is what makes design still somewhat of an art except in a few stereotyped cases. On the hulls as I see them, *Shearwater* has a greater speed potential in terms of $\frac{V}{\sqrt{L}}$ than has *Ocelot* and although *Ocelot* won in strong winds, I doubt very much whether *Shearwater* was beaten on the basis of $\frac{V}{\sqrt{L}}$. There are many other important things which come into such a match besides p.c. and I also have a feeling that the helmsman of *Ocelot* was somewhat more experienced, though this is just guesswork.

Cdr. G. H. GANDY.

Editorial reply : The "Prismatic Coefficient" is a mathematical concept and is liable to give a false picture in some respects. For example, if *Ocelot's* stern were cut off by about four feet (where it is very fine), her p.c. would be increased to a much higher figure and

I do not believe her performance would be greatly different. On the whole, I think that Commander Gandy and I both agree that these hulls should have fine entries and broader sterns for greater speeds. However, I must admit that the paragraph in No. 15 should have been better expressed and I am grateful to Commander Gandy for taking up the point.

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