AMERICAN CATAMARANS

A.Y.R.S. PUBLICATION No. 10

BOB HARRIS' "OCELOT"

CONTENTS

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EDITORIAL. December, 1957

We are lucky in this publication to get some details of the early, but post war, American Catamarans and Outrigged craft written by our able secretary in the U.S., Bob Harris. The Catamaran, *Ocelot*, which he designed and sailed this year is a fine craft capable of 20 knots. One can trace in these pages the development of the various constructional details which have made the latest catamarans the elegant and seaworthy craft they undobtedly are. Nearly every one of the early craft had some larger or smaller fault which later designs are learning to avoid as the type develops. This is quite natural because the craft which are described here are the trials of a new principle for us and it would indeed be extraordinary if they were perfect from the start.

This American development is a natural process of trial and error among many people who were looking for the best method of using a principle. It can be compared with the development of his catamaran by Roland Prout, described in *Outrigged Craft*, where he already had almost perfect hulls and was looking for the best way of attaching them together as a sailing craft. I feel sure that the *Shearwater* of Roland Prout was greatly helped in its development by all this American work, much of it resulting in craft whose performance was not exceptional.

The photograph of Waikiki Surf is printed by the courtesy of the Editor of " Yachts and Yachting."

AMERICAN CATAMARANS

Introduction

If you mentioned the word " Catamaran " or even more " Outrigger " to the most knowing yachtsman in American, right away he sees a bunch of South Sea islanders numbly perched on the bamboo outriggers of a dugout canoe racing through the jade-green breakers in a headlong plunge for the beach. He thinks too, of the bamboo and lashings that keep their crude dugouts from capsizing. No wonder our yachtsmen shy away from such creations and it is one of the purposes of this publication to present a more balanced picture of these craft and present them not as they have been but as they are, developing into extremely fast and seaworthy ships.

Although the names by which multihulled craft are becoming more widely known may leave much to be desired, they have at least a legitimate origin like " Catamaran " from the Tamil dialect of India meaning *katu* (tie) and *maram* (tree) or have been coined with a suggestion of three hulls like Tchetchet's " Trimaran " which he uses for the Indonesian type canoe.

In spite of the fact that multihulled craft have received such little attention from sailors, builders and designers, there is enough interest on the part of amateurs to bring about a high degree of development. Certainly, not all of the progress to date has been made by amateurs. Herreshoff, for instance, lent his professional efforts to the development of catamarans and if his designs did not arouse more interest at the time, it was not for any lack of ingenuity, for his configurations were each a wonder of engineering. The lack of interest in the Herreshoff catamarans can be explained by the fact that it was a time when the single hulled craft still demanded many improvements, a time when power craft were beginning to take the spotlight and the time when great fortunes were being made amidst the industrial beginnings of a very large country.

MANU KAI

L.O.A. 40′ 0″	Displacement 3,000 lbs.
D.W.L. 31′ 6″	V/L (Speed length ratio) 5
Beam, O.A. 13′ 0″	Vmax. 28 knots.
Beam, each hull D.W.L. 1′ 9″	Planking 3/8 Fir Plywood
Draft 1′ 9″	Sail area/weight, 167 sq. ft./lb..
Sail Area 500 sq. ft.	Righting moment 21,400 to 25,000 ft. lb.

Heeling moment (20 knot wind)
15,000 ft. lb.

From Hawaii shortly after World War II came the most important development in multihulled craft since Herreshoff when Woody Brown, a former glider pilot, carried his light aircraft flying experience into the design of *Manu Kai*. Together with Alfred Kumalai, a skilled boat builder, the hulls, which had before been lashed to the ends of bamboo logs were now rigidly connected with trussed beams not unlike those of wooden aeroplanes (see Fig. 1A). Following good engineering practices combined with native skill, Brown and Kumalai were able to keep the weight down to $1\frac{1}{2}$ short tons (of 2,000

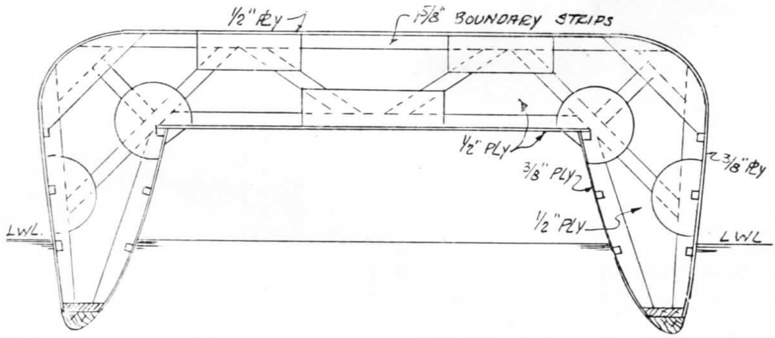


FIG. 1A. "MANU KAI"

lbs.) which, on a 40 foot length, is truly remarkable. Consider that the average 40 foot length overall hull will displace between $7\frac{1}{2}$ and 9 short tons, 27 to 30 per cent of which is needed just to keep it upright.

Manu Kai's beam of 13′ 0″, with each hull nearly straight outside with flare and curvature on the inside might cause some water venturi, since it was indicated from tests made by Peter Joubert of the University of Melbourne, Australia on catamaran hulls at M.I.T. this past summer that, unless the distance between the hulls exceeded one half the length of the waterline, there would be some interaction. However, Mr. Joubert did not qualify his statement as to speed or hull form tested and, from experience, it would seem that this effect on *Manu Kai* would be extremely small. For example, my own 25 foot *Naramatac*, which has a beam of 8′ 3″ and waterline length of 22′ 0″ giving a beam to length ratio of .375 produced no noticeable venturi. *Manu Kai's* length to beam ratio is .357. The effect of venturi at the narrowest point between the hulls would be to lower the water pressure and cause some flow from the outsides, resulting in a wave formation which, at high speeds, would crest and form a

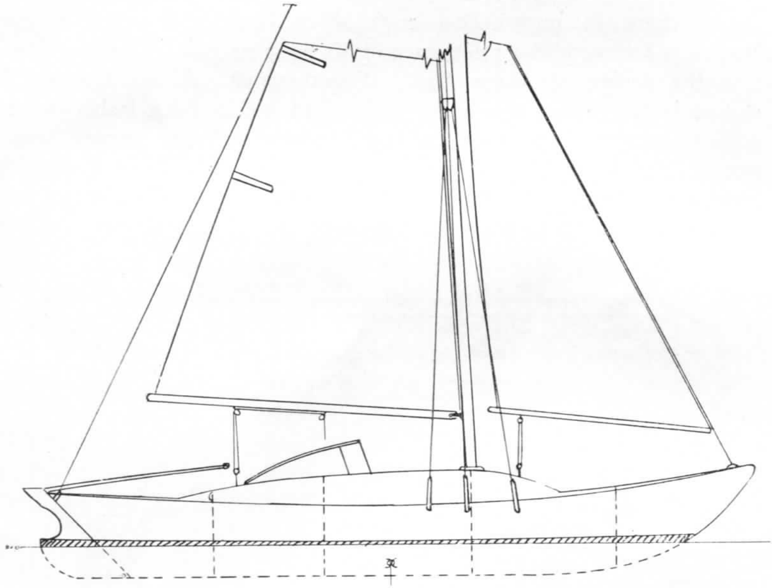


FIG 1B. "MANU KAI"

rooster tail. The net result would be loss of some energy given up to eddy making and thus more drag.

Manu Kai's above water profile has in it all of the grace and beauty of the sea bird for which it was named, but her long straight keel, ending with its deepest point at the sternpost, makes her slow in stays. Although the lateral plane is needed since she has no centreboards, it could well have been concentrated further forward by cutting away the deadwood aft and deepening her forward. If balance could not be maintained by this, centreboards would not have been out of place, even on an ocean going catamaran like her.

As a displacement form, *Manu Kai's* beam to length ratio (of each hull) of 1 to 18 is excellent for high speed which can be maintained in the trade winds around Hawaii, but with these same proportions in Long Island Sound for instance, she would be a dead duck. The wetted surface could be reduced by decreasing this ratio and this would improve her light weather speed and thus her all round performance, especially if her total bean and the sail area were increased.

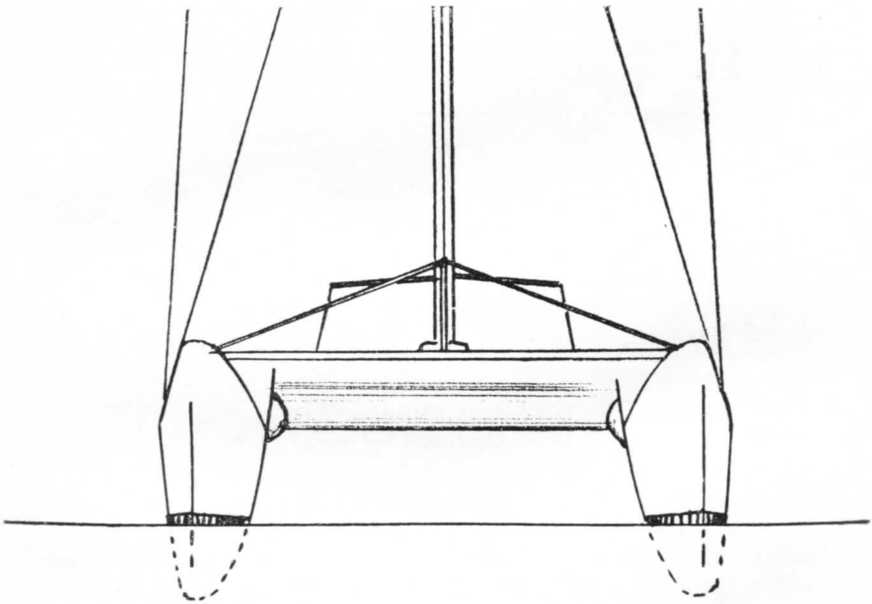


FIG. 1C. " MANU KAI "

In concluding about this fine craft, she sails in Hawaii where she is operated in areas of high winds and therefore makes high speeds. Her fine form is probably paying dividends. This reminds us that the best designs are still a result of good compromise to suit the expected conditions. Still, there are very few places in the world like the Molokai Channel.

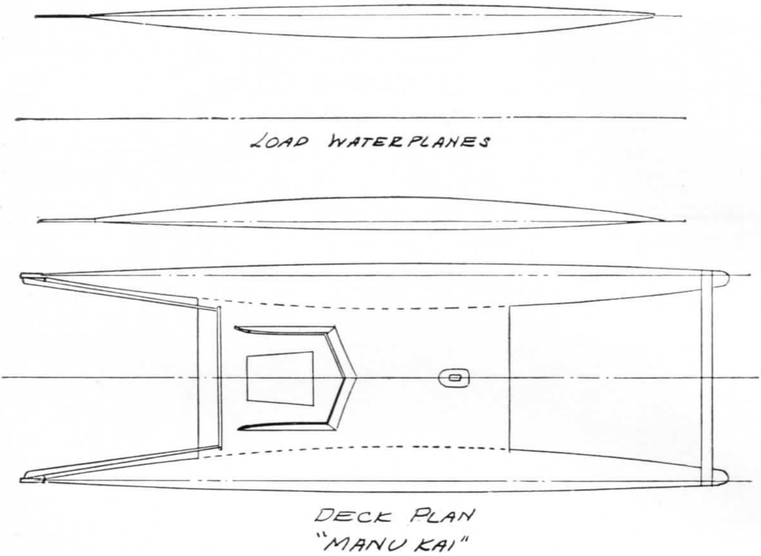


FIG. 1D

THE LEAR CAT

L.O.A. 16′ 0″
Beam, O.A. 7′ 6″
D.W.L. 13′ 1″
Draft 13″

Beam, each hull on D.W.L. 7″
Displacement 500 lbs.
Sail Area 150 sq. ft.
Sail Area/Weight .30

Construction $\frac{1}{4}$″ plywood

Perhaps the next most important development of multihulled craft came from the American West Coast. Creger, a man of many talents and industries, had taken up the designing of a 16′ catamaran called the *Lear Cat*. With flat bottoms, low hull length to beam ratio, heavy construction and small sail area, the *Lear Cat* was a poor performer on any point of sailing. Single hulled boats of her own length and even smaller would pass her by time and again. She may have been capable of reasonably good speeds on a reach but this was not evident at the hands of those I have seen sailing her. During the first *One of a Kind* race series held by the Seawanhaka Corinthian Yacht Club at Oyster Bay in 1950, she tailed the fleet of 28 boats. Other race results have been similar. In the Bayside Yacht Club races of 1956, she was behind the other boats on the first day of racing

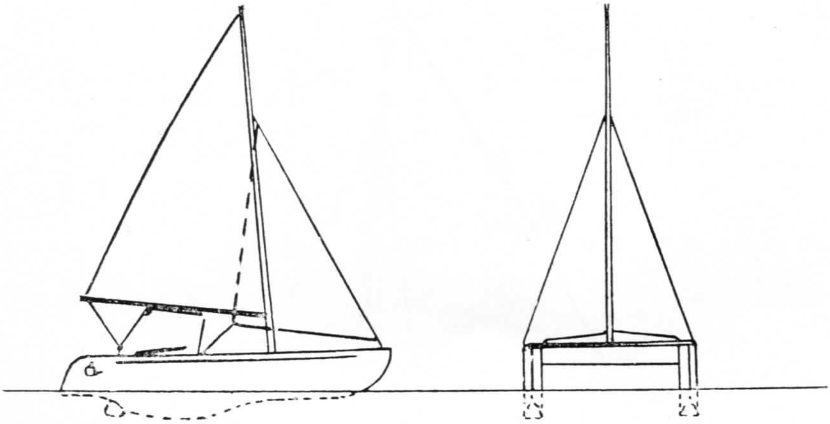


FIG. 2. "LEAR CAT"

while the other multihulled craft, *Ocelot*, *Egg Nog and Flamingo* had gone around the course so fast that they were not noticed by the other racers who figured that only the *Lear Cat* was racing.

The *Lear Cat* was thus no flyer but it had all the other virtues of the catamaran, stability, easy motion and a good platform for picnics and fishing. This craft helped catamarans in two ways. Firstly, she showed off the virtues of the catamaran in all other ways then speed and, secondly, the publicity which was involved in her marketing brought the type to the notice of many yachtsmen. Her slow speed also brought the successful catamarans into greater relief, and probably made them more acceptable to yachtsmen.

THE SABRE CAT

L.O.A. 18′ 0″	Displacement 400 lbs.
D.W.L. 15′ 1″	Sail Area 185 sq. ft.
Beam, O.A. 7′ 6″	Sail Area/Weight .463
Draft 1′ 5″	

The *Lear Cat* was followed by the *Sabre Cat*, also designed by Creger, an 18′ length overall sloop rigged catamaran of the same general characteristics as the *Lear Cat*. Her performance is similar to the earlier craft but the top speed is a bit more. She is no match for the better single hullers going to weather, manoeuvring or in light weather.

Fig. 3. " Sabre Cat "

THE CREGER 32

L.O.A. 32′ 0″
Beam, O.A. 12′ 0″
Draft 2′ 6″
Displacement 8,000 lbs.

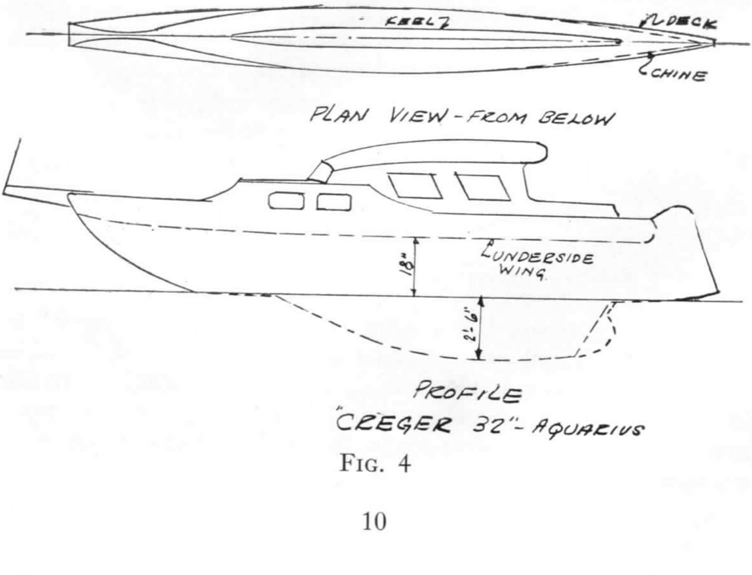
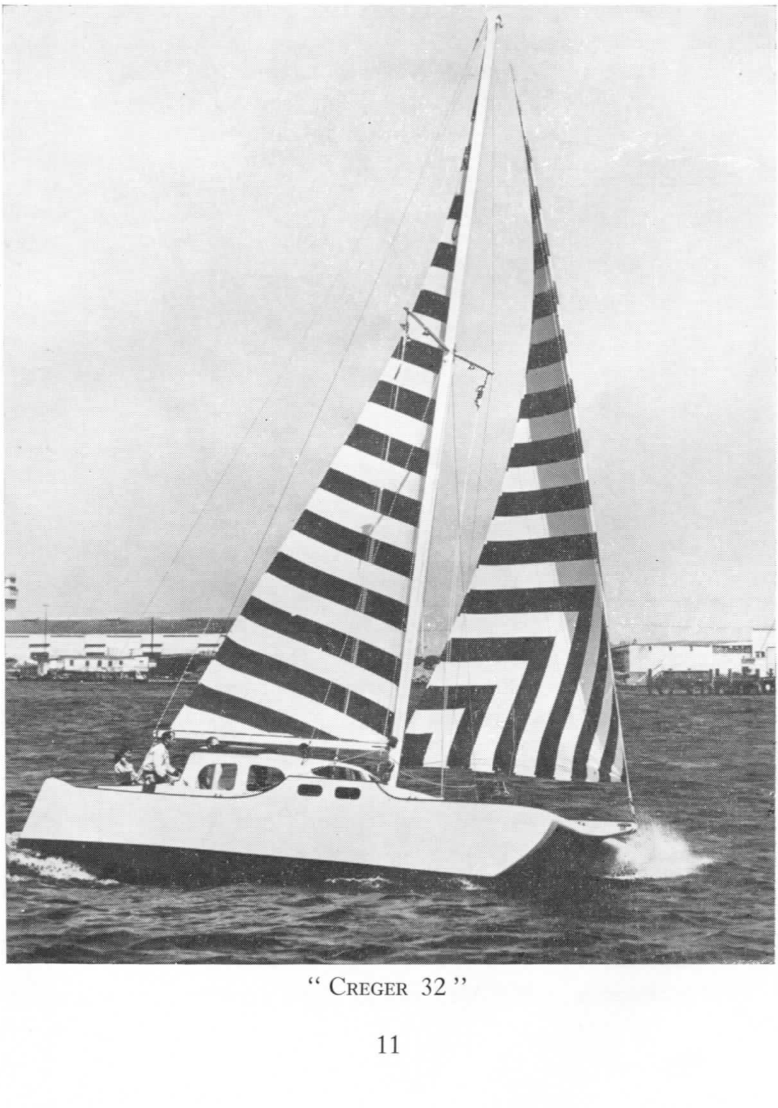


Fig. 4

This craft by Creger is similar to the *Sabre Cat* but 32 feet overall. She carries 1,100 pounds of ballast in each fin and has room for 900 lbs. of water ballast as well. None of the three owners has used the water ballast but it would help her stability. This last summer, it was reported that she capsized on the Great Lakes while attempting to carry 700 sq. feet of sail in a fresh breeze.



" Creger 32 "

WILD WIND

L.O.A. 35′ 0″ Beam 12′ 6″
D.W.L. 30′ 0″ Displacement 8,500 lbs.

This craft was designed by Creger for Dan Brown of San Diego, California. It is reported by Bill Mehaffey of Oak Park, Illinois that her performance is much better than the Creger 32. Her outsides are flat and the insides are symmetrically shaped fore and aft. She has provision for water ballast in one tank in each hull and Bill says

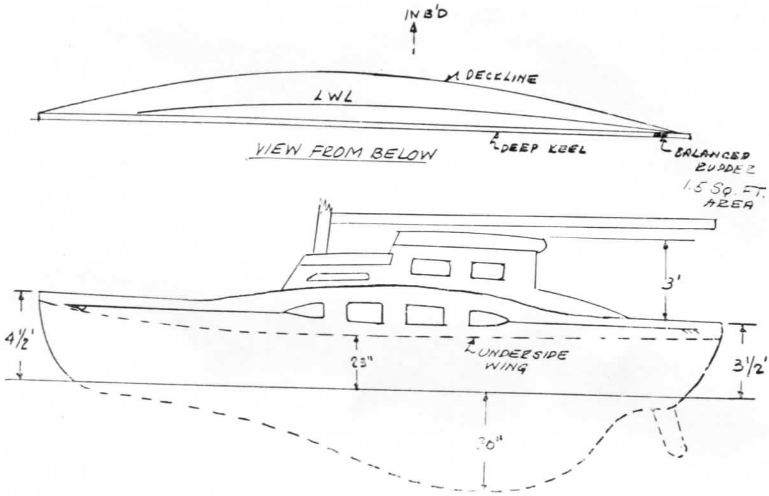


FIG. 5. "WILD WIND"

she can capsize without the water ballast, but with it, she will have her rig ripped off before she goes over. She has frequently beaten 10 meter conventional craft in a 30 knot breeze and she will beat many racing boats of conventional type in moderate to heavy winds. She is easy to beat in light airs, however.

SEA WITCH

L.O.A. 30′ 0″ Draft 2′ 6″
D.W.L. 25′ 0″ Displacement, 6,500 lbs.
Beam 12′ 0″

This design is by Bill Mehaffey to whom I am much indebted for

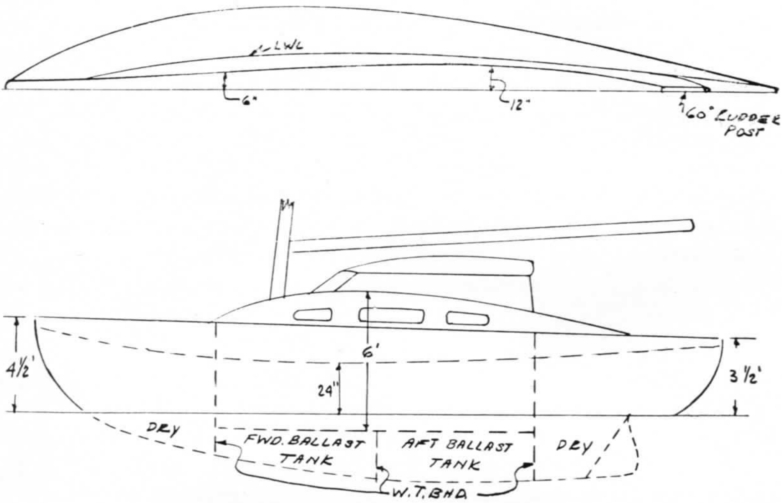


FIG. 6. "SEA WITCH"

the sketches of *Aquarius* and *Wild Wind*. The outsides of *Sea Witch* will be flat and the insides curved, having a modified N.9 hydrofoil at a 15° angle of heel waterline. She carries up to 2,000 lbs. of water ballast in two tanks in each hull. The hull weight will be 4,500 lbs., giving him 1,000 lbs. of trimming ballast in each hull to set her on the L.W.L. It is his intention to use the water ballast to produce or restrict her heel to 15°, the best running line. Her scantlings call for 2 x 4 inch ribs, $\frac{3}{4}''$ by $1\frac{1}{2}''$ spruce stringers, on 12″ centres and planking will be $\frac{3}{8}''$ plywood with fibreglass over all outside surfaces with extra strengthening, at the underside of the wing and hulls.

EVALUATION OF THE CREGER TYPE CATAMARANS

These boats, like the larger Creger types and now this one by Mehaffey, represent a compromise which seems to rob the catamaran of her true virtue. The idea of a catamaran, as I see it, is to spread the displacement out to the beam ends where its effect as a righting arm will be as great, if not greater, than that of a single hulled boat with its great lump of ballast at the bottom, thus allowing the hull form to be independent of the stability or nearly so. By doing this, the designer has the opportunity of designing a faster, lighter craft which resembles the single hulled boat in appearance and handling. It is also the idea of a catamaran (and here I agree with Herreshoff) that it is a light boat, the primary purpose of which is to go fast. When you start weighing them down with ballast to make up for what they lack in beam, it is, to say the least, a sacrilege. The designer must keep his hulls from breaking apart with the required beam and cause them to manoeuvre well. Otherwise he is losing the whole value of the catamaran principle.

OTHER CATAMARANS

H. Morton Jones of Miami, Florida is the instigator of several catamaran designs in the Creger style ranging in length from 12 to 55 feet, some sail, and some power. Most notable of these designs is one he calls the *Little Fish*. This craft is 38 feet overall, 22″ draft and will go along about 12 knots under sail or under power. Victor Tchetchet has sailed in this craft in calm water and says she is very comfortable and roomy. Jones is also building or has in his stock line 12′, 16′, 20′, 26′, 35′, 45′, 55′, 38′ catamarans, all of which are of the flat bottom type with very little rocker and twin rudders. There are no centreboards.

The Custom Hydrocraft Co., of San Diego, California is another outfit which is doing its best to defeat the prejudice against catamarans. Their main product is the *Sea Cat* whose dimensions are : L.O.A. 16′ 0″, D.W.L. 15′ 6″, Beam O.A. 7′ 6″, Draft 4″, Displacement 288 lbs., Sail Area 170 sq. ft., Construction $\frac{1}{4}$″ plywood. They are also building an outboard powered catamaran of 12′ L.O.A., Beam 6′, weighing 220 lbs. Outboard power recommended is from $7\frac{1}{2}$ to 16 H.P.

Space does not permit drawings and pictures of all of the various types of catamarans being built in America but from time to time I shall submit to the A.Y.R.S. pictures and drawings of the several sizes and kinds which are being produced or are popular in the U.S.

All of the people whose designs have been published here and those who are trying to establish the catamaran must be congratulated for they are pioneering and, in the long run, advancing the very thing for which the A.Y.R.S. stands — better boats at smaller prices. Speed and manoeuvrability of some types are not very great as yet but as the demand for catamarans grows and more people become interested and see the possibilities of the type, better examples of the breed will appear.

THE TRIMARANS

In spite of all of the engineering proof and practical experience that can be tossed around in favour of rounded or elliptical bottoms for these fine shapes, there are and always will be those people who will divert to the forms more easily produced. Up to now, this has meant the use of deeply chined hulls, but perhaps the perfection of mouldable materials for even the least skilful of builders will put an end to these hard chines with the production of far better boats.

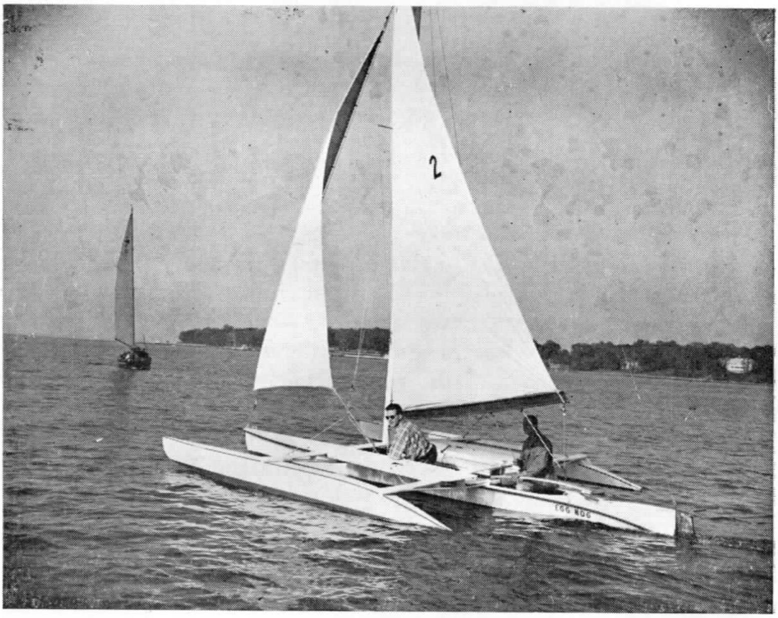
Victor Tchetchet, who has probably designed and built more trimarans than anyone in the world except the Indonesians, is an advocate of the flat bottom. He entered T26, a 26 foot trimaran, in the 1950 *One of a Kind* series, finishing 21st. Reaching on the days when the wind was moderate to heavy, she would do better than all of the other boats, attaining speeds up to 15 knots but she would not go to weather as well as the single hullers. A sloppy sea running during the fading easterly seemed to rob her sails of wind due to excessive transverse motion. It is to be noted that the pontoons, being flat and in the static position out of water by several inches, will roll uncomfortably even at the mooring, fetching up with a slap on each pontoon alternately. Her poor light weather performance can be accounted for partially due to this movement which shakes the wind out of her sails but of probably greater importance are the flat bottoms which give her excessive wetted area. It would appear also that her beam to length ratio of 1 to 25 could be safely reduced to 1 to 18 or 17 or conversely 1.4 to 25. This, with round bottoms would probably give her the least resistance.

The poor windward performance could have been due to poor sails as I noticed they were not good aerofoils, the draft being too far aft. Another possibly may be the result of the trimaran's configuration. Forgetting balance for the moment, let us first consider the float to leeward. (It is virtually impossible to keep the lee float out of the water by balancing weights to weather). With this float in, there will be an overall shift of centre of pressure to leeward and slightly forward since the C.P. of the float is forward of the C.P. of the hull. Since there is no shift of the centre of gravity, the boat will lie further askew in the water with a higher resultant drag. Also, the proximity of the lee float to the main hull at certain speeds will cause some water venturi, a lessening pressure to leeward and thus less windward lift. Combine these effects with the certain added wetted area of the float to leeward plus its couple tending to turn the boat away from the wind, plus its induced drag and one may begin to appreciate why she will not do well to windward.

EGG NOG

L.O.A. 22′ 0″	Sail Area 230 sq. ft.
D.W.L. 21′ 0″	Displacement 500 lbs.
Beam, O.A. 13′ 0″	Length of floats 16′ 0″
Beam D.W.L. 12′ 6″	Beam of floats 1′ 0″
Draft 1′ 2″	Depth of floats 8″

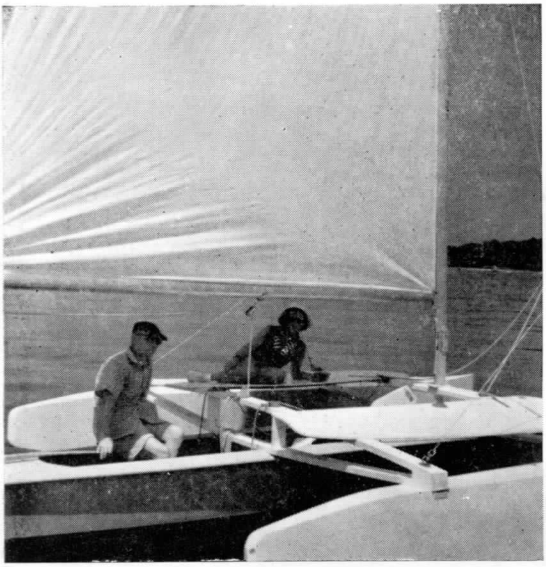
This is a later design by Tchetchet on the same general plan as T 26 described above and possesses all of the same characteristics as that craft. It is somewhat faster in light airs due to a lighter construction in part and in part to better sails. She was the best of the multihulled boats during the summer of 1955.



FLAMINGO

L.O.A. 26′ 0″	Draft 6″
D.W.L. 25′ 6″	Displacement 700 lbs.
Beam, O.A. 12′ 6″	Sail Area 280 sq. ft.
Beam Main Hull O.A. 3′ 0″	Length of floats 16′ 0″
Beam, mainhull D.W.L. 1′ 4″	Beam of floats 1′ 0″

Bud Dealy's new trimaran *Flamingo* was launched this summer in time for the Bayside Yacht Club regatta and proved to be much faster than *Egg Nog* on all points of sailing. *Flamingo* is 26 feet overall and of the same configuration as *Egg Nog*. She has excellent gear and sails, is well built though a trifle on the heavy side but has a blunt entrance which I suspect puts up an unnecessary anount of fuss. She has more freeboard than Tchetchet's boat and is therefore dryer and more comfortable. The pontoons are relatively deeper in section, too, though relatively the same in length to the main hull. They sit on the water in the static condition but this does not prevent her



" FLAMINGO "

transverse slapping from float to float in a real slop when the weather is moderating. Good buoyancy in these pontoons allows her to stand up to her canvas better than *Egg Nog* which buries her lee float at times. The pontoons, like the main hull have a blunt entrance producing the same fuss.

The weather float of a trimaran is a parasite giving only useless drag from its weight and exposure to the wind forces. It is also a nuisance to have to be careful of it when coming alongside to prevent it being damaged. The shrouds can be placed far outboard on the structure connecting the pontoons which will give a smaller mast compression but they then prevent the use of overlapping jibs.

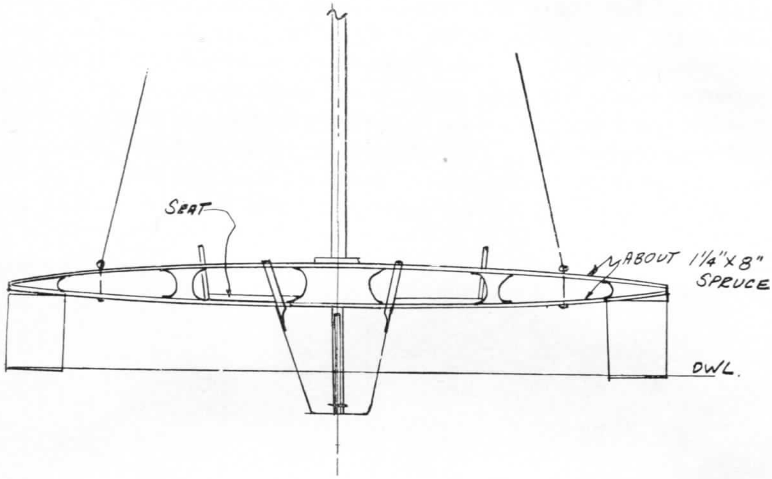


FIG. 7. " FLAMINGO "

The general scheme of connecting the floats to the main hull as used by Tchetchet and Dealy is to arch two planks on the flat and put stiffeners in to keep the arch. In turn, these are strapped to the

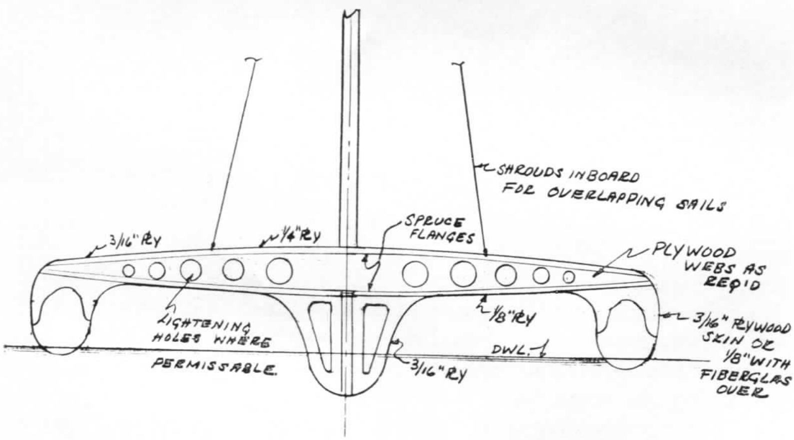


FIG. 7A

floats or pontoons and to the main hull. In this way, all the parts lie exposed to water and wind forces and must surely cause a lot of drag. Fig. 7 shows this scheme and Fig. 7A illustrates how the writer feels that the trimaran configuration should be handled for least resistance, greatest possible strength for the weight and be more modern in appearance. The thing we have to do is to get away from that " native " look, if we are going to get people into these fast sailers.

In summing up the case for the trimaran, it seems to me that there is a way to get around the disadvantage of the types I have described here and, when that is done, I am not at all sure that it will not be one of the finest sailers going. Certainly, we owe much to Victor Tchetchet for his ground work on these fleet craft and for the knowledge of their construction and performance which will be indispensable for future design.

OCELOT

L.O.A. 20′ 6″	Wetted area with boards and rudders 68 sq. ft.
D.W.L. 17′ 6″	C. of Effort .415 D.W.L.
Beam, O.A. 10′ 0″	C. of L.R. with C.B. .415
Beam, Hull 2′ 0″	C. of L. R. No C.B. .25 to .35 D.W.L.
Beam, Hull on W.L. 1′ 2″	C. of L.R. with C.B. no rudder .407 D.W.L.
Displacement (inc. one of crew) 709 lbs.	
Sail Area (100 % fore triangle) 268 sq. ft.	Righting moment (RMmax.) 6,600 ft. lbs.
	Sail Area/Wetted area ratio 3.96 (Used $\triangle$ to D.W.L.)

Sail area to weight ratio .38

The disadvantages of the original form of T-26 later carried into *Egg Nog* and *Flamingo* were not apparent when racing against *Naramatac*, (a 25 foot flat bottom catamaran designed and built by the writer) and certain of the single hulled boats. They showed up sharply when the smaller *Ocelot* left them behind at the Bayside Yacht Club Regatta this past season (1956). Of the above dimensions, she was excellently built by Ned Mullen. Designed by the writer.

The best estimated speed of *Ocelot* is 20 knots, which gives her a $V/\sqrt{L}$ ratio of 5. The best recorded speed is 15 knots giving a $V/\sqrt{L}$ of 3.5. We did not have the Navy's radar out there the day we went 20 knots but we did time our course across Northport Harbour in smooth water.

Ocelot seems to have three distinct humps in her speed curve. These occur at 6, 12 to 14 and 20 knots. Perhaps, the most remarkable thing about the speed is the small amount of effort needed to get

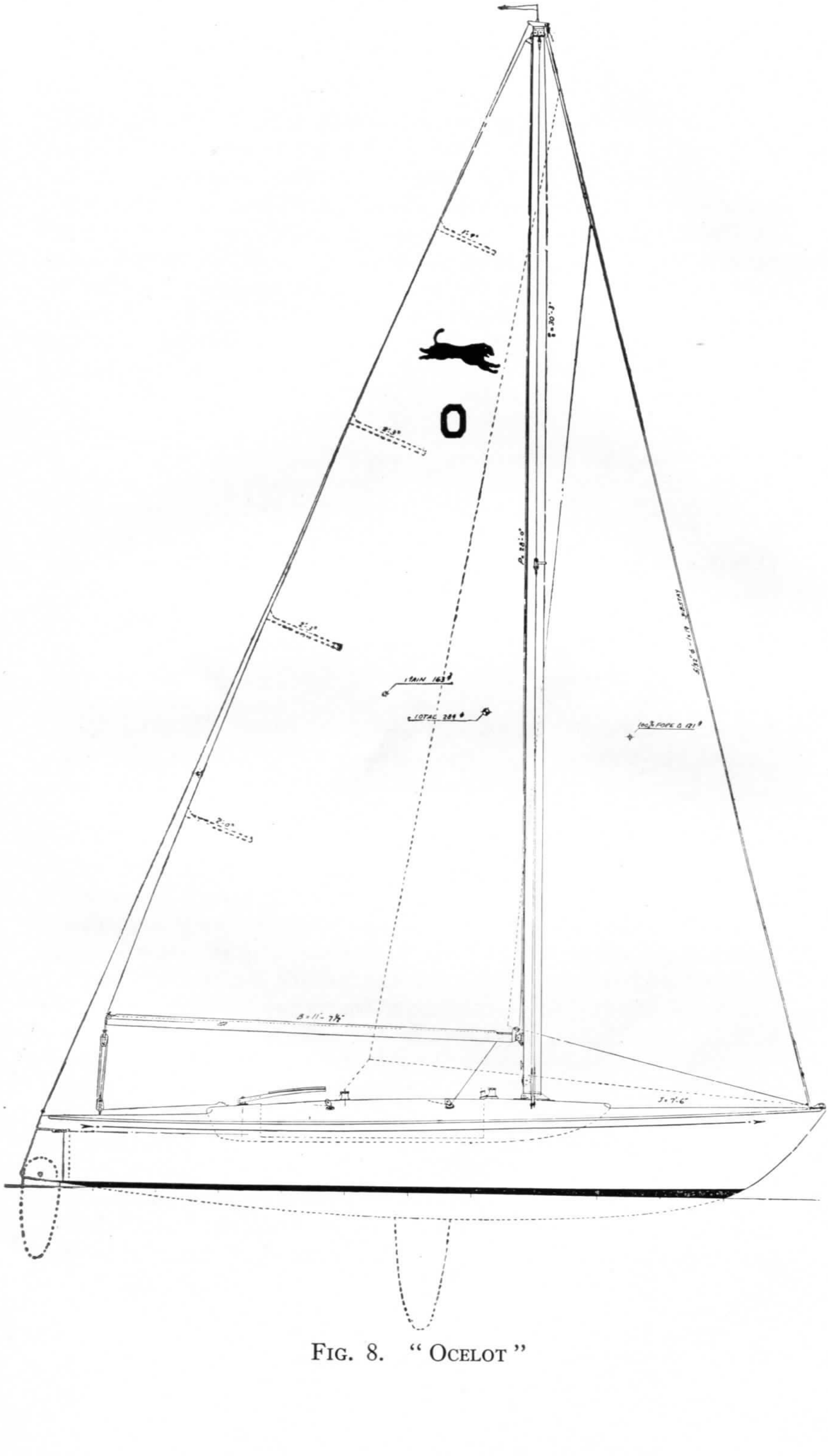
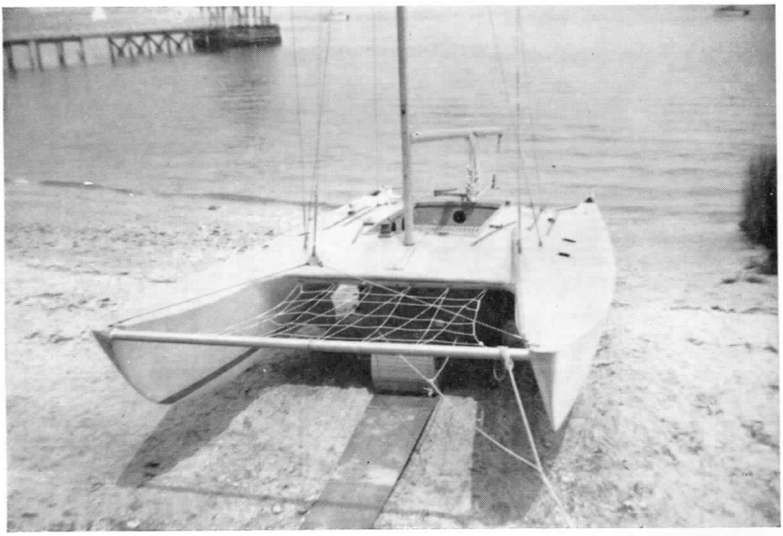


FIG. 8. "OCELOT"

her up to the 12 to 14 knot region. Much more relative effort is required to push her over that hump than over the 6 knot hump. I even doubt whether the hump at 6 knots would be very noticeable on a drawn curve of resistance versus speed.

CONSTRUCTION

Ocelot is made of plywood sheet $\frac{3}{16}''$ thick. There are deep plywood web frames, some of which are $\frac{3}{16}''$, and some $\frac{1}{8}''$ thick, with longitudinal spruce stringers to complete what is known as the *Isherwood* system of framing. Had we planned at the outset to cover the boat with fibreglass, we would have gone to $\frac{1}{8}''$ planking and used a slightly different framing system. The fibreglass uesd was a very heavy cloth from a former job impregnated with an " Epoxy " resin.



" OCELOT "

We found that the best way to apply the resin and cloth was first to staple the cloth to the overturned hull and then apply the epoxy resin and smooth out a squeegee (a rubber blade used for window cleaning). This makes a fine type of construction and one I would recommend any time. The plywood should be only thick enough to give the shape and the cloth used should be very light so as not to absorb too much resin. The epoxy is excellent to work, smooths up like a car body finish and is tougher than nails. The heavy cloth we used and the great absorption of resin ran our weight up by 50 lbs. more than we figured.

As it was, we put too much reliance on the glass around the opening of the centreboard slot. The pressure and working of the boards eventually broke out the resined glass and a leak developed. We sailed for about a mile with the starboard hull full of water ! Towards the end of the season, she had soaked up so much water that she was down to the datum water line without anybody on board.

BALANCE

The designed balance was maintained in the final product. It was decided at the outset that she should develop a normal weather helm with the boards up so that she could sail in shoal water without them. With one board almost fully down, she balanced right out and needs no more lateral area to really get to windward. The weather board is used to keep the drag on the weather side. A very definite lee helm is produced by lowering the opposite board.

The boards are operated by two wires led over a system of blocks. A turnbuckle at the side of the cockpit can be slid fore and aft to raise or lower them. This system requires a watertight gland at the C.B. pins which is difficult to reach and maintain. Next time, we will use levers inside the boxes which reach to the decks so that the pins may be completely enclosed in their bearings.

The rudders were arranged with cables so that they could be positively operated in either direction. This is a bit fancy and a simple shear pin would be almost as good.

The cockpit floor is an open grating. It is fine for draining off water but we found that water would slop up through it from under the wing just as easily so we had eventually to make a canvas cover for it. Several good drain holes slanted aft (with a smooth underside to prevent resistance when the water hits there) would be much better.

THE LINES

Either one designs a vessel for one particular service and takes what comes after that or, the design has to be the best compromise for all round services. We decided that *Ocelot* should be the best all round configuration by compromise that we could think of so that, as a future class boat she could be sailed anywhere in the world under any circumstances. It would appear that we have just that. The most important feature is that she can be sailed efficiently without the centreboards. This allows the use of thousands of square miles

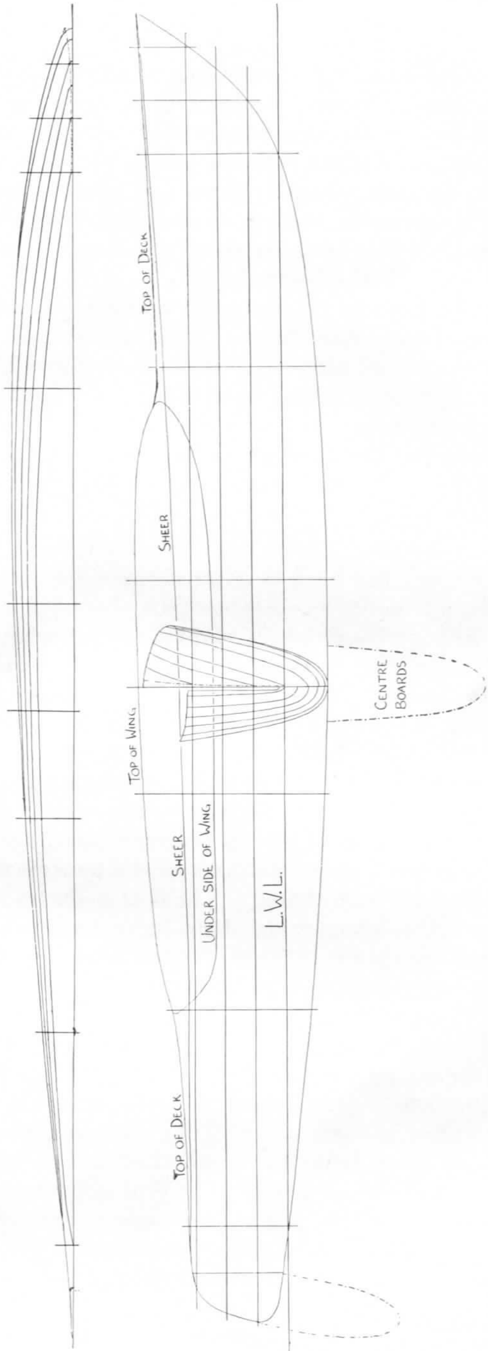


Fig. 9. Lines of Ocelot

of shoal bay water along our eastern and southern coasts where the depth is one foot or more. Realising full well that semicircular sections would give us the minimum wetted area, we sacrified some area for a better lateral plane with the boards up. The extra depth, when placed in the right position, would also improve her manoeuvrability. This compromise worked, as she will come about without backing the jib when no boards are down and is only a fraction slower than a single hull with the board down.

There is not a doubt in my mind that we sacrified some top speed by compromising these lines. We have attempted to make up for this in a generous sail plan which we carry easily with a big beam. We think that is is about right, too. To wit, we have a day sailer which will fetch a mark on any course about twice as fast as the normal single hull, including the dinghys, do this with more comfort at all times, in shoal water, in rough water or just plain drifting.

THE PROA

Very little work has been done in this country on proas. We have never seen any sailing in these waters.

A proa, designed by Ralph M. Munroe about whom and about whose boat I am unable to get any information except from a sail plan in the *Rudder Sail Boat Clan Book* (1944) was launched about 1898. This boat is about 30 feet overall, 2′ 6″ beam, Sail area 240 sq. ft. The draft with the boards up is negligible. She is fitted with a lateen rig which, on changing tack, is shifted so that the tack becomes the peak and the peak the tack. The rudder and sheet are shifted from stern to bowl. The boat does not actually cross the wind but turns off the wind, stops and sails off backwards after the sail, sheet and rudder have been shifted. The float is always to windward.

The main hull is symmetrical about its centreline. It is double ended with good overhangs and has a flat bottom dory style of midsection. It is interesting to note that the outrigger float is round bottomed and is .40 of the length of the main hull.

To me, the proa is a dinghy with a permanent hiking board and it seems that, if for one moment one does not hike far enough out on the outrigger, she will be over. To say the least, it would take a great deal of manoeuvring to come about. The outrigger, always being to windward makes more sense for speed than the trimaran with an outrigger in the water at all times. The proa is probably potentially the fastest type of long fine arrow displacement type craft available under sail. The problems involved in changing tacks, and the constant danger of capsize will prevent large scale development of this type.

RACING CLASSES OF MULTIHULLED BOATS

In view of the fact that there is yet a great deal of development and experimenting to be done on the outrigger types, I cannot express strong enough feelings towards what we call a development class. Using the catamaran as an example, suppose we assume that waterline length, beam and displacement are controlled to keep any development within reasonable bounds, then I am sure that an equitable rating may be given out on the basis of a simple formula. Although we are now proposing to build six or eight identical *Ocelots* this winter as the formation of our first catamaran class, we will certainly admit other boats to the class which fall within these limitations, study their relative performances and attempt to proportion their speeds. It will still be the skill of the sailor with which we shall be concerned, but the best boat for all round racing stands a better chance of being built with the limitations imposed than for any fixed class. The length limit would seem over-restrictive but this is suggested to keep competitors within sight of each other and make the race more interesting.

The beam limitation is, of course, for overall beam and would be imposed to avoid coming up with a design which would not manoeuvre.

I shall soon propose an international development class rule covering boats up to the longest now in existence so that, if we should have an opportunity to have a race of such a character, all may enter. In the meantime, the *One of a Kind* rule, which has worked out well for boats of widely different form and size might be applied. This rule is stated in brief form as :

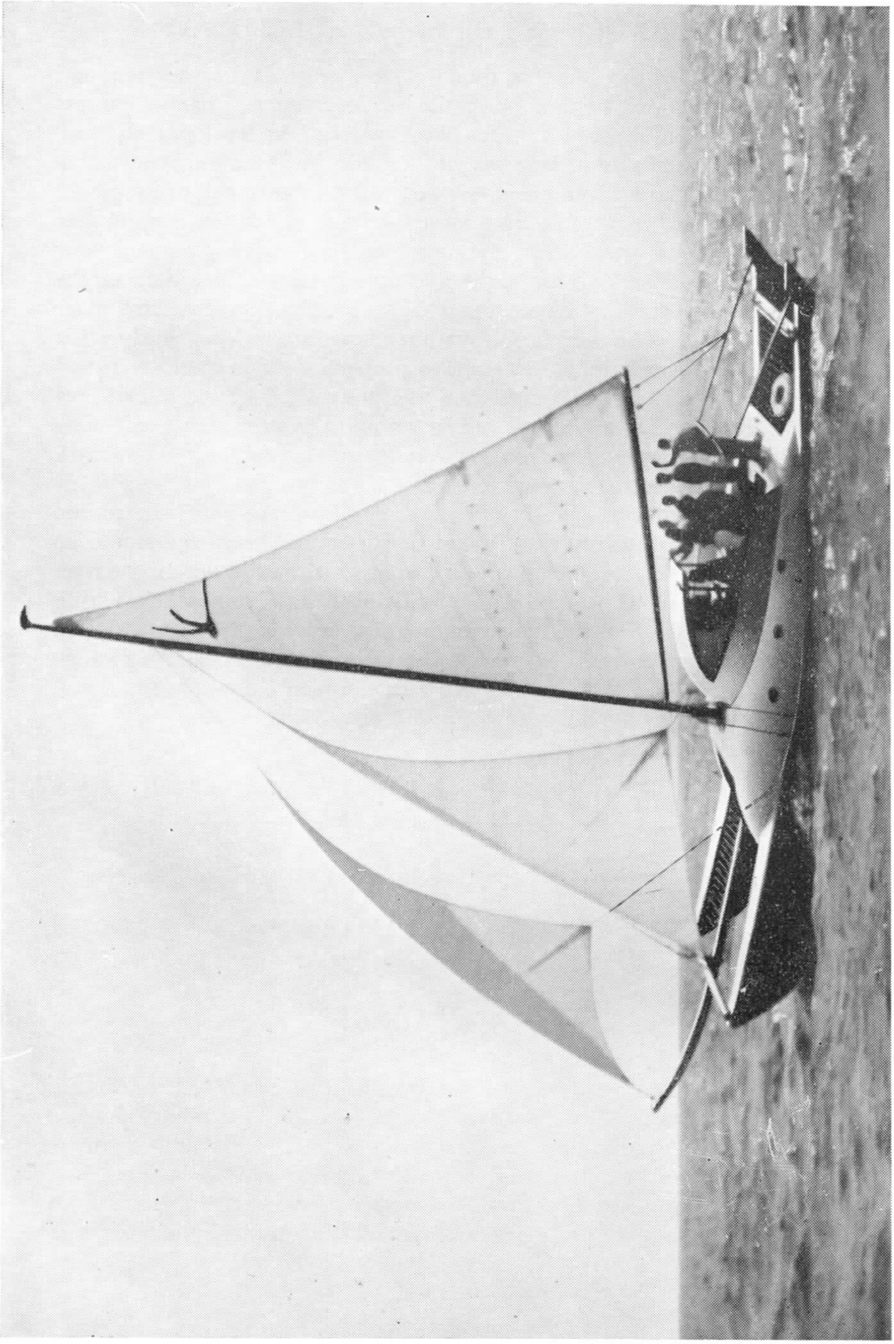
$$R = \text{Rating} = \frac{L + 1.3 \times \sqrt{SA}}{2} \quad \text{where } L = \frac{LOA + .7\ DWL}{2}$$

CRUISING CATAMARANS

WAIKIKI SURF

L.O.A. 40′ 0″	Sail Area 1,050 sq. ft.
Beam, O.A. 13′	Displacement, 3,000 lbs.

This amazing craft was launched on June 5th, 1955 in Hawaii and came like a fresh breeze in the design, building and sailing of ocean going cruising catamarans. Designed and made by Woody Brown, who produced the *Manu Kai*, described earlier, and Rudy Choi, she is similar in construction and dimensions to the earlier craft but of better shape, according to Brown. After being launched, she set sail



from Honolulu on June 10th and arrived in Santa Monica 15 days and 12 hours later, an average of 180 miles a day for 2,700 nautical miles. They tried to enter her for the trans Pacific race from Los Angeles to Hawaii. Her entry was not allowed but she sailed with the fleet of yachts and would have won the race on corrected time by many hours even after having had to reduce speed for a crack in the port wing section which they feared was a full failure. It turned out to be a minor local fault which took two days and less than $100 to fix.

Her participation in this event is significant on three counts. Firstly, the general configuration was proved suitable for ocean racing. Secondly, the boat proved herself faster than the largest single hulled craft with which she completed, five at least of which were over 70′ in length. Thirdly, race committees everywhere will now have a yardstick on which to figure handicaps for future catamaran entries. They will now be able to come up with a suitable factor allowing for their light weight and sail carrying ability and proportion their speeds to those of the single hulled boats. Nor will they have any excuse for not letting future contestants enter. Her passage did, however, show up the need for controlled speed at all times. For this, better sail handling techniques and gadgets are in order.

From the article which appeared in the April, 1956, issue of *Yachting* called *Pacific Passage by Catamaran*, Rudy Choi says, "There is more room in her twin hulls and wing bridge than a casual observer would surmise. Because she is streamlined everywhere, there is an illusion of inadequate living space. Actually, all hands were comfortable both above and below during the trip across.

In my 25 foot catamaran *Naramatac*, had she the same good proportions as *Ocelot*, we would have been able to fit two berths in the hull and, with some redesign in the wing, create a bridge area sufficient to house a galley, chart table, navigational instruments, all with a dog house over it. There are few 25 footers which can boast this kind of accommodation or even come anywhere near it. Not only that but to have all of this you would sacrifice very little in performance, being able to get out at approximately twice the speed of the single huller on all points. It is also worth pointing out that the entire watch can be put in one hull so that the comings and goings of the opposite watch will not disturb them. The galley being in the wing will not interrupt those sleeping below. There is also the advantage of having more complete privacy for two parties on long voyages, which under certain circumstances, would prevent many a social disaster.

Later in the *Yachting* article, Mr. Choi says, " For the entire six hours, *Waikiki Surf's* indicator never dropped below 15 m.p.h. In that thick blackness, fresh wind and driving rain, we hurtled along for the wildest ride in our experience, and sometimes shot up past 25 m.p.h." These figures and those put down in the article by Mr. Choi indicate that a catamaran, properly designed for cruising and racing, has a potential speed three times that of the corresponding single huller and that this speed is a great asset. For the first time in the history of sailing yachts, one is able to step on the gas, so to speak and go like blazes (as in your car) or you can ease up on her and cruise as slowly as you wish. The watchword becomes versatility. Versatility beyond the dreams of sailors only a short span of 10 years ago. What is required to complete this picture are better sail handling techniques. Like the gas pedal in one's car, the power must be applied to the spirited catamaran with the same ease. So, it behoves those interested in seeing these vessels reach their zenith to work diligently at their power plants — the sails.

About the only advance in sail handling technique in the past 100 years is the roller reefing boom. In the roaring seaway with a high wind, this is still a tough operation and the usual set up does not offer enough mechanical advantage to really horse it in smartly. No one would be so foolish as to say that they could come up with a radically new system overnight but I am sure that better techniques can be evolved, given good concentration and a feel for the problems.

One of the more obscure advantages of the catamaran is the fact that these long lean forms may be driven under low power at good speed. Today, the auxiliary power plant is playing an ever increasing role and the dividing line between the motor sailer and the auxiliary is becoming less noticeable. A pair of 20 h.p. outboard engines on a *Manu Kai* sized catamaran gets her along at 14 knots. Driven at the same speed, the single huller would have water over the transom and the power plant to drive her at this speed would be equal in weight to 1/5th the weight of the boat, if she could be driven at that speed at all.

An objection which some of the present day architects and sailors have to the cruising catamarans is its lack of ultimate stability. They are justified in thinking so of the catamarans in existence today but, with very little more beam and alterations in hull design, these same boats can be made to stand up to the heaviest gales and sea forces. There can be no compromise with stability. A capsize far out at sea is certain disaster and to avoid it in the catamaran without adding ballast calls for a generous beam. This means a heavier interconnecting structure and a slower reaction in stays, but the added weight is better than the uncertainty of having less beam. There is, however, a limit to the beam and even within this limit, there might be an uncomfortable snap roll in a beam sea.

HYDROFOILS

It is too early in the game to evaluate the use of hydrofoils on power boats, let alone sailers, but one thing seems to be emerging from what work has been done. Firstly, it is apparent that, in order to be efficient, they must be used at high speeds. Secondly, they are not a great deal more efficient than good planing forms except in rough water. This second fact is important, however, because the bane of sustained high speeds on the water is the sea. If big payloads can be carried through thick and thin, then the hydrofoils are justified, even though the foils themselves displace a good bit of the payload.

For sailing boats, I believe that, with hydrofoils, they will be able to attain their maximum speeds because it has been shown that the Lift/Drag ratio (L/D) is higher for the hydrofoil boat and for this reason, more weight can be lifted for the same horse power. If you can lift a boat clear of the water, in this way getting rid of wetted area and wave making resistance, the forward speed will be better.

The big drawback to the use of hydrofoils on a sailing boat is the fact that it takes considerable speed to get it up on the foils and it takes a sustained breeze to keep it there. Anyone who sails is well acquainted with the vagaries of the wind and will at once realise the difficulty of staying on the foils. Therefore, unless the foils can be easily retracted and extended, their use for a good all round racer is precluded. There will be very few times when a sailboat will be able to make maximum use of the foils, and, in the meantime, their weight must be carried about and they will surely be a strain on the arrangement of a good racer.

Since a sail boat lays askew in the water when going to windward or reaching, a low aspect ratio foil would cause serious wave and eddy making. High aspect ratio foils are therefore called for and these are more difficult to make and to stow or retract, though the loads will be small in the small light sailing hulls such as the Prout catamarans and the lighter planing dinghys. The catamaran or trimaran seem to offer the best possibility of retracting high aspect ratio foils because of their good beam.

Surface piercing foils seem to be best for a sail boat. This type requires a good deadrise or dihedral and some sweep back to avoid air entrainment. Their advantage lies in their ability to rise out of the

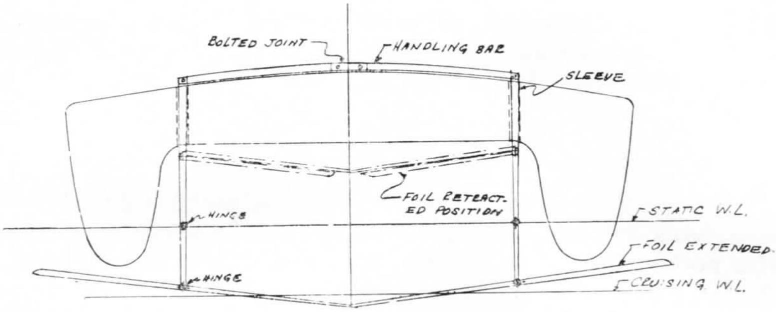


FIG 10A

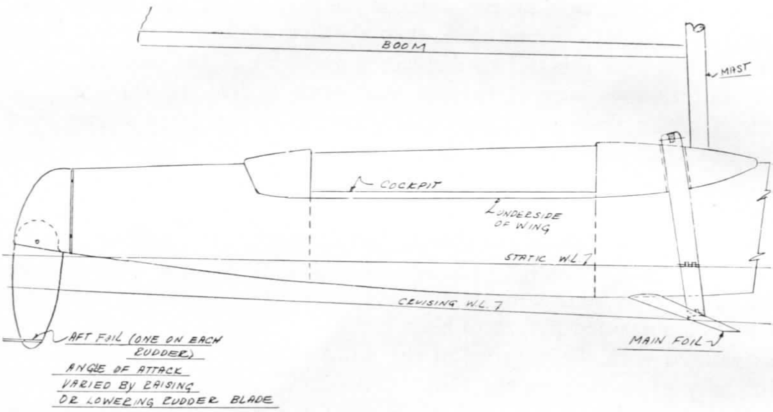


FIG. 10B

water as the pressures increase, thus reducing their drag. The lee foil is also able to take up the side force more evenly and with less drag than a fully submerged foil. Such a foil is indeed difficult to retract but in Fig. 10, I have sketched a possibility for the catamaran which seems to lend itself better than other types for retracting since, as is shown in the sketch, the foils stow completely out of sight and out of water under the wing. As soon as time permits, we will try out this foil configuration and give a detailed report on it.

CONCLUSIONS

One of the objects of the *Amateur Yacht Research Society* is to produce a safe, comfortable, fast and cheap cruising boat. Multihulled types are at once ancient and modern, having gone through several stages of development. It is only since World War II that we have had the materials at hand to transform the rickety, spidery connecting systems into streamlined, functional, wholesome entities. We can only hope that those in this country engaged in the design and building of multihulled boats (and there are many I have not even mentioned here) will pause with the Society from time to time to take a fresh look through their own efforts in model testing and experiments for the purpose of making better use of these materials. In spite of their ancient heritage, these boats are in an infant stage of development but there is every indication that the object of the A.Y.R.S., stated above, will find resolution in these crafts.

Towards this end, we must take our hats off to John Morwood for his tireless efforts to awaken some of the latent talent in this country. Even before I assumed the Secretaryship of the American A.Y.R.S., the first publications had stirred up a deal of interest and controversy. There are thousands of societies in the U.S. and most of them have to be split up into several districts and those into divisions and, in turn into local chapters, simply because distances are so great, let alone the number of members. The way it stands here is that there is tremendous interest in the A.Y.R.S. but it is so widespread that we will be lucky to have half a dozen people at a meeting out of the five or six hundred people who have enquired about us during the last six months.

The new *Ocelot* class is being formed of the six or eight boats we hope will be built this winter. The interest aroused by the A.Y.R.S. has done much toward its development and, looking in retrospect, it was based on the experimental work of men like *Herreshoff*, *Brown*, *Prout*, *Tchetchet*, *Locke*, *Barkla*, *Creger* and a host of others.

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