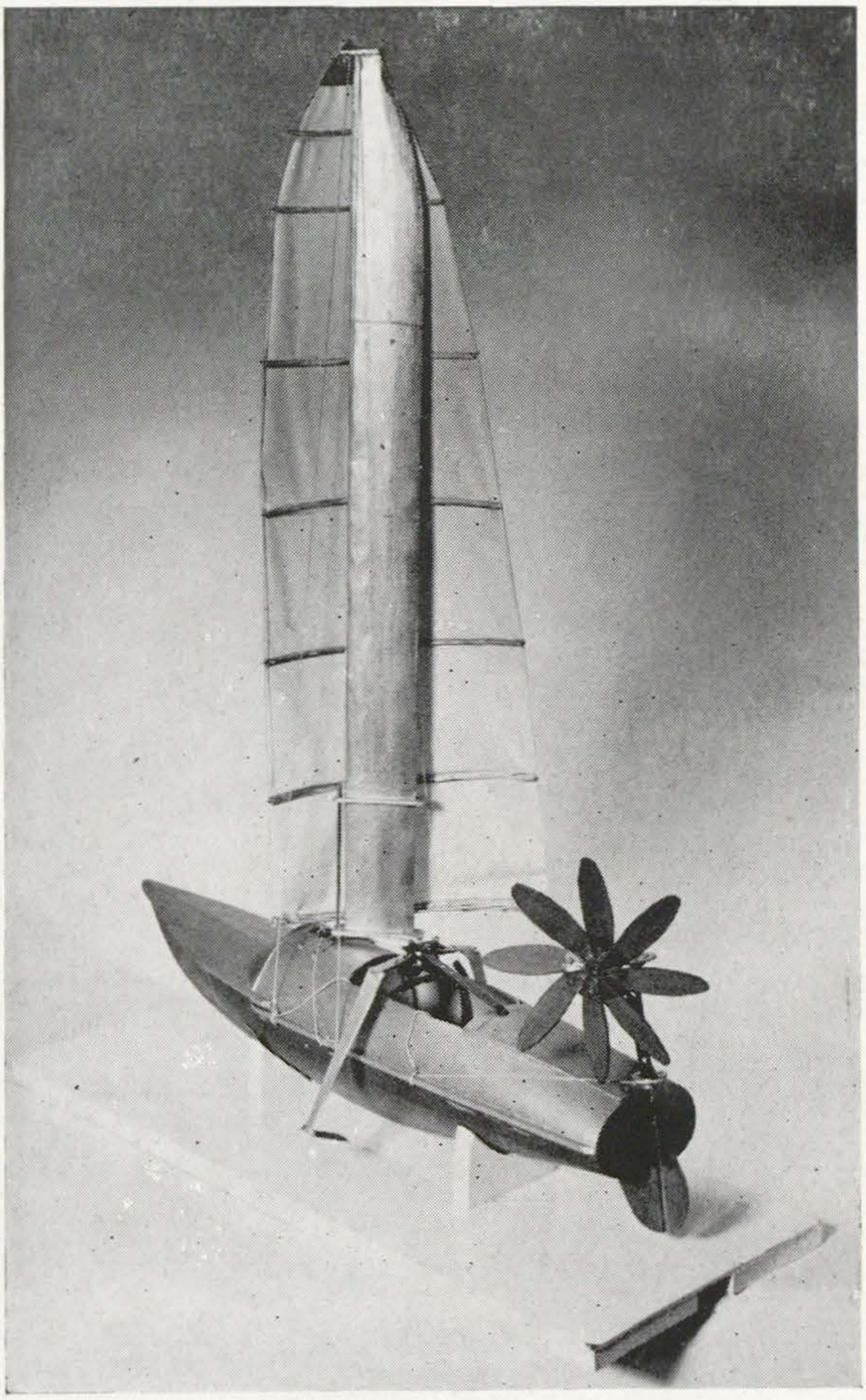
A.Y.R.S. YACHTS

A.Y.R.S. PUBLICATION No. 44



Model of PELORUS JACK

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(Founded June, 1955)

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EDITORIAL

July, 1963

It is with great pleasure to me that this publication is produced, because in it we are able to show what I consider to be the greatest and probably the last "breakthroughs" to be achieved in sailing craft. With a boat like the *Rysa* design, or possibly the Micronesian Hydrofoil, sailing speeds should be the greatest which will ever be achieved while with *Pelorus Jack*, a type of cruising boat is shown which should be the cheapest, most seaworthy and fastest sailing boat which ever crossed an ocean. None of these boats have yet been built, of course, but from the models and the vast amount of information we have, I feel quite sure that their promise of value will be fulfilled.

This publication not only shows these craft which may become the conventional boats of the future but it also justifies the premis on which the A.Y.R.S. was founded which was that one has only to gather together the yacht experimenters and give them a forum in which to express their views and yacht development will leap forward.

These last eight years with the A.Y.R.S. have seen more development in sails and sailing boats than all the thousands of years which have preceded them. The next decade will, I feel sure, see new types of sailing boats on the water sailing at greater speeds than ever before after which boat development may well again become static. We may count ourselves lucky to be living in this era and to have taken part in this development.

The Hindus have a theory of "Cyclical change" in which development proceeds in a circle to come back almost to its starting point. At the conclusion, however, things are not quite what they were before. Perhaps the yacht development which we have watched over these years shows this process in that the single hulled boat gave way to the catamaran, which has now found a rival in the trimaran and may soon be in competition with the hydrofoil stabilised craft. We may therefore eventually find ourselves back again with single hulled craft but with hydrofoils.

We in the A.Y.R.S. have now the opportunity to take up the work of our members and to make it practical in exciting new boats which are likely to behave as no boats before them have ever done (possibly the most exciting part).

This brings me to the final point. I feel that in this publication my contribution to the A.Y.R.S. is about completed. I find myself getting less and less enthusiastic about catamarans and trimarans and also feeling that the time has come for me to build and sail a boat myself. It has been my life long ambition to sail across an ocean (or three) and, though this may in fact be impossible, at least I want to do the nearest thing possible and that is to own a boat which would do the trip I set my heart on so many years ago. In addition, I have two pieces of medical research which I started many years ago and want to finish. One is a matter of working out the mechanics of the human nervous system and the other is to sort out the behaviour patterns of babies. In order to study these matters (and others) I would like the editing and publishing side of the A.Y.R.S. to be taken over by other people. Neither is very difficult but they tie one's thoughts down too closely, for my liking, to yachts.

Self Steering. This publication (No. 13) is now once more in print. It has been extensively revised and brought up to date by Tom Herbert, the original author and we now include an article by the celebrated French yachtsman, J. J. Herbulot on self steering gears and two articles by Frits Fenger, one on twin spinnakers, and one entitled "The Weather Twin," which apparently allows a boat to be self steering on any course without any gears.

The A.Y.R.S. Test Tank. Our laminar flow test tank is at present in store, though ready for work. If any member wishes to borrow it for research, will he please write to the Hon. Sec.

We hope to have our Open Annual Meeting at Weir Wood Reservoir near Forest Row, Sussex on October 5th and 6th 1963. As there is a limitation of 15 boats, will members wishing to attend kindly contact the Hon. Sec. to make final arrangements.

THE FUTURE ROLE OF THE A.Y.R.S.

BY MAJOR GENERAL H. J. PARHAM

The future role of the A.Y.R.S. is, I understand, under discussion. It is very important to know where, and why, we are going.

My own views are, to me at least, quite clear. As I see it, we sailors have one absolutely priceless possession . . . we have an occupation or pastime in which there is still full scope for the amateur. This is unique in the modern world. To spoil this would be a disaster of the first magnitude. There is no other activity left which has this remarkable quality.

Motoring and motor cycling had it in the early days and so, for a few brief years had aviation. Up to 1914, a gifted and determined amateur with the right qualities could, by living hard and working very hard, hope to take the air in a machine of his own design and construction. World War I largely finished that but the birth of the gliding movement in Germany (brought about partly because they were forbidden to make powered aircraft) showed the amateur at the very height of his achievement. These men, working against almost unbelievable difficulties, brought motorless flight to the world.

All of this is "History." Yet it has a deep lesson for us. This lesson is that there are, and always will be, a small number of people with energy and with enquiring minds who will pursue activities which interest them and which they believe to be worth while. These people will do this regardless of all difficulties; indeed difficulties encourage rather than daunt them.

It is this select band that the A.Y.R.S. should serve—not with financial help but with encouragement, by acting as a clearing house for information, as a bond of fellowship, and as a means of suggesting new lines of thought.

The brilliant and original conception behind the A.Y.R.S. was dead right and should be adhered to.

It does not matter in the least whether the thing grows in size. The modern idea that because a thing is bigger it must be better is a delusion. There are in the world only a limited number of the right sort of amateurs and it is no good diluting this select band by enlarging the scope of the A.Y.R.S. to bring in other kinds of sailors. Which brings me to the next point. The average yachtsman finds all the reading he needs in the yachting periodicals, which contain accounts of races and cruises with, now and again, a technical article. The A.Y.R.S. member is, by and large, interested mainly in the latter. I would suggest that all the resources of the A.Y.R.S. are concentrated on providing adequate material for the A.Y.R.S. Journal and that this should include reprints of some of the best of the technical or semi-technical articles from the Yachting Press . . . of all countries where the A.Y.R.S. has members.

I am utterly opposed to the giving of grants to University or Trade Research programmes. The former are apt to be unrelated to the hard facts of wind and water and the latter should be paid for by those who have to *buy* their boats, rather than design and make them themselves. Let us also beware of being sucked into the whirlpool of International Contests. These are all very well in their way but should be paid for by those sponsors who, for a variety of reasons, see fit to back them.

As to the provision of special research equipment (wind tunnels, tanks etc.), I would have none of it. The very world-wide diversity of Amateur Research precludes the full use of such gear and its design and maintenance puts an impossible burden on the staff of the A.Y.R.S. which should be an affair *run by amateurs for amateurs*, i.e., by people "speaking the same language." You may say this makes the task of the amateur designer/builder harder. I would counter this by saying that a mass of data, mainly aeronautical, exists only a fraction of which has been applied to sails, masts and hulls.

The gifted amateur, with a touch of the artist about him (for boat design *is* an art) and with the right qualities of determination and adventure will not be put off by the lack of research facilities and has a real chance of keeping up with and even outdistancing the professional designers.

Finally, we come back, inevitably, to the human side of it all. A thing is only worth doing so long as it is *fun* to do. To the man who loves the sea and the wind and is fascinated by the interplay of those two on the hull and the sail, there is an endless vista of enjoyment stretching far out ahead to his old age. These happy souls are to be found all over the world and can be kept in touch with each other by such a thing as the A.Y.R.S. . . . and only by it. They are not the kind to come running to others for financial help; they are too independent for that and realise that the hard way is usually the best. They would not want the A.Y.R.S. to finance them, even if it could.

Neville Shute, as usual, has something relevant to say: "Most of my adult life; perhaps all the worth while part of it, has been spent in messing about with aeroplanes." Kenneth Graham said much the same thing about boats and I agree with him. Yet for a fleeting period in the world's history I think that aeroplanes ran boats very close for sheer enjoyment . . . that halcyon period started about 1910 and was in full flower when I was a young man. It died with the second war when aeroplanes became too costly and too complex for individuals to build or even operate. I count myself lucky that my youth and my young manhood coincided with that fleeting period and that I had a part in it."

Our boats need never become too complex . . . so let us count our blessings.

Norden House,
Corfe Castle,
Wareham,
Dorset.

March 17/63

Dear Morwood,

Regarding your letter of the 12th March, calling for my opinion on the A.Y.R.S.

I feel that the A.Y.R.S. is doing splendidly as it is, and the reason for the extraordinary growth to world wide fame is because of the policy you have adopted, which encourages enthusiasts to say what they think and are interested in. These sort of people have a wide, refreshing outlook, and because it is an amateur organisation, they are not afraid to air their views, or of getting up against the so called professional technical expert and being made to look silly. They try what interests them rather than what will sell well.

Furthermore, the amateur is not tied to secrecy, as in the case of the average professional research worker, employed by a firm drawing its money from customers afraid of someone stealing a march on them.

I feel that if the A.Y.R.S. collects cash for the Universities, it will get terribly involved, for it will have to support all Universities, and it may quite soon lose its own peculiar identity.

I believe the A.Y.R.S. should carry on as it is doing for the present and until, circumstances may alter. It should work in with the University of Southampton where yacht research is carried out in the exchange of knowledge from time to time, and every year the A.Y.R.S. journal should have a summary, published by *yourself*, of the professional research, and the University research, that is released. This summary would be given with comments on how the A.Y.R.S. work has fitted in with it, and how certain lines could be investigated by A.Y.R.S. Members to fill gaps. You are a Member of the Advisory Committee, and are fully in touch with results published.

Yours sincerely,

CLAUDE BOWDEN.

P.S. I would like to add, that I think the A.Y.R.S. journals stimulate people to further work. I know of one operation that is going on at the moment, entirely stimulated by an article on testing boat performance that was published in the A.Y.R.S. Journal.

THE THEORETICAL YACHT

BY JOHN MORWOOD

The theoretical yacht consists only of a semi-elliptical sail in the air attached to a semi-elliptical centreboard in the water. No means of support, stability of concession to working on both tacks is present. This combination can be expected to sail at about 10° from the apparent wind, which is likely to be the sum of the drag angles of the sail and centreboard (see A.Y.R.S. No. 41, "The Course Theorem").

The Sail. For aerodynamic reasons, the "loading" along the span of an aerofoil or hydrofoil should be of a semi-elliptical distribution. Departure from this causes losses which can be as great as 10 per cent. for a triangular plan form. It is therefore the greatest economy of sail area to distribute it in a semi-elliptical plan form with the same shape of section all along the span. The aspect ratio (or the ratio of the span to the average fore and aft chord) should be 3 : 1, if the foot of the sail is in contact with the sea surface. This is equivalent to an aspect ratio of a complete aerofoil in free air of 6 : 1, which is the minimum useful ratio. Higher aspect ratios give greater efficiency in lesser drag angles but the heeling moment is greater. The formula $\frac{\text{Span}^2}{\text{Area}}$ is a handy way of taking the ratio of the span to the average fore and aft chord. There must, of course, be no twist in the aerofoil.

The drag angle is the angle whose tangent is $\frac{\text{drag}}{\text{lift}}$

The Chord Section. We are not quite sure of the best section. For the Theoretical Yacht, it is probably a thick aerofoil but we can short-circuit our examination by allowing that our aerofoil must work equally well on both tacks. When we do this and consider weight, a thin sail is likely to be best. For thin sails, a parabolic section is likely to be best for low drag angles but, as the sail will often be used at high angles of attack and even "Stalled," an arc of a circle may be better. It would seem that the maximum flow should be about 1 in 7, i.e., the greatest distance between the sail and the chord line should be 1/7th of the chord. Apparently, this is true for "soft" sails as well as for fully battened ones but they are much harder to sail with. *Hellcat* used a fully battened mainsail of 1 in 4 flow which seems excessive but she sailed well.

The Centreboard. Everything which holds for the sail, holds for the centreboard, except that the need for sailing on either tack makes the section symmetrical, made up of two parabolic curves with a sharpish leading edge and maximum thickness about 1/3rd of the chord from the leading edge. The ideal thickness-to-chord ratio is 1 in 12. The ratio of sail area to centreboard area is about 35 : 1 for fast dinghies and catamarans and it falls as low as 25 : 1 for low aspect ratio keel boats and boats with less efficient sail plans.

Summary. The essential factors in "The Theoretical Yacht" are (1) an "ideal sail and (2) an "ideal" centreboard. Our yachts would indeed consist merely of those two things if we did not have a preference for them to float on the surface of the water in an upright manner. In order for this to be met we need (a) Support and (b) Stability, both of which detract from the ideal state of the theoretical yacht.

Support

Support can be achieved in three different ways (ignoring stability):

1. Surface-piercing buoyancy as in conventional craft of all types.
2. Submarine buoyancy, where the buoyancy is *below* the surface.
3. Hydrofoils, where the lift is *dynamic* from the water flowing over and under the hydrofoil.

1. *Surface-piercing buoyancy.* In light winds, nearly all the resistance to motion comes from surface friction. One would therefore tend to think that the best possible hull shape for very light winds would be a hemisphere, which could be drawn out to give elliptical lines for stronger winds. However, such shapes tend to give the water vertical or athwartships flow at the stern and this results in eddying and extra drag. In fact, it seems probable that the best hull shape for very light winds is half a streamlined shape of circular underwater section throughout.

In stronger winds, it has been shown by Edmond Bruce and others that the position of greatest sectional area needs to move aft for greatest efficiency and a transom begins to be of value.

In very strong winds, the catamaran hull shape which we have studied so extensively in the A.Y.R.S. comes into its own. Here, the grestest sectional area is slightly aft of amidships; the greatest section when carrying the load is a semicircle; the run is flat, straightish and shallow and ends in a fairly wide transom. The prismatic coefficient is low. Up to a speed of $4\sqrt{L}$ the lift to drag ratio is very good.

2. *Submarine Buoyancy.* This has yet to be used in practice. It would be a simple streamlined shape at all speeds, connected by a streamlined strut to the above water structure. This principle is likely to produce little in the way of surface waves and hence have less resistance even than the catamaran type of hull. Edmond Bruce has obtained some very good figures in his test tank for such shapes.

3. *Hydrofoils.* These are of two generic types as regards function; (a) Stabilisers and (b) Lifters, and three types as regards structure; (a) The Hook system, (b) The "Sliding" foil (the common type) and

(c) The "Ladder" foil type. The place of hydrofoils in the boating scene is not finally settled. The lifting hydrofoils only seem to have their value in the speed range of 20 to 40 knots. Below 15 knots, the catamaran or outrigger craft is probably better while between 15 and 20 knots both are about equal.

The unknown factor is the value of hydrofoil stabilisers which can work at 5 knots and they might produce a craft which is better than an outrigger or catamaran in the speed range of 5 to 15 knots.

It is my guess that the ultimate in sailing efficiency will be obtained by a narrow hull stabilised by small floats or very modest ballast for speeds below 5 knots. Hydrofoil stabilisers will most efficiently extend the speed range to 15 to 20 knots while the addition of a third hydrofoil will produce a lifting hydrofoil craft for speeds up to 40 knots.

The same speed ranges can also be covered by sliding hydrofoils allied to the Micronesian canoe in a slightly more elegant fashion. This craft will be described later.

Stability

Stability to counteract the heeling moment produced by the side force of the sails and the windward forced on the centreboard is produced in the following ways :

1. Shifting the crew weight to windward.

2. Using ballast at the bottom of a fin keel. This moves to windward on heeling.

3. Using a hull form whose centre of buoyancy moves to leeward on heeling.

4. Using multple hulles, e.g., catamaran or trimaran. This is another way of shifting the centre of buoyancy to leeward on heeling.

5. Hydrofoil stabilisers.

1. *Shifting the Crew Weight to Windward.* This is good practice in any boat but it is the main source of stability in canoes and dinghies. It varies from a simple crew movement to the use of sliding seats and trapexes.

2. *Ballasted Keel.* This method is frequently described by A.Y.R.S. members as "obsolete". It is expensive, reduces speed, accommodation and the durability of the structure while making the craft harder to work and navigate. Its only virtue, they say, is that it will right a craft which has turned upside down. Not to be too dogmatic, however, ballast is a very economic form of stability when the yacht is not sailing or at speeds below $\frac{1}{2}\sqrt{L}$.

3. *The Moveable Centre of Buoyancy on Heeling.* The movement is usually small and weight movement by the crew or ballast keel is necessary.

4. *Multihulls.* The movement of the centre of buoyancy is much greater than with the previous type of stability and, in larger craft, neither crew movement nor ballast is needed.

5. *Hydrofoil Stabilisers.* These are theoretically ideal. For ideal stability, all the lift should be to leeward and all the weight should be to windward. Hydrofoil stabilisers provide this better than any other system, the nearest being the Micronesian canoe.

Summary. Starting off from the "Theoretical Yacht," we accept a number of features which detract from the ideal for reasons of practicability. These features are (1) ability to work on both tacks, (2) support and (3) stability.

APPLYING THE THEORY

There are many ways of converting the "Theoretical Yacht" into a practical sailing machine. Some are in constant use. Some are being developed by A.Y.R.S. members. Some which show the greatest promise have yet to be tried.

The Object of Yacht Design. A yacht is a vehicle which carries things around on water. The object of a yacht design will firstly be to determine just what is to be carried. The yacht may carry :

1. Nothing at all as in model yachts.
2. A one or two man crew sitting on its top as in the catamarans.
3. The crew sitting inside a well as in trimarans, dinghies, etc.
4. The crew plus overnight camping accommodation.
5. The crew plus accommodation for extended cruising.
6. The crew plus accommodation for a world cruise.

Once the cargo to be carried has been determined from the above list, a prospective owner becomes concerned with some other factors as follows :

1. *Speed.* This is increased by length, sail area and lightness.
2. *Cost.* Increased by weight, sail area and accommodation.
3. *Accommodation.* Increased by size in all dimensions.
4. *Difficulty of working.* Increased by size, sail area and weight.
5. *Durability of the structure.* Increased by cost and workmanship.
6. *Beauty.* This is entirely subjective. In yachts, curves are preferred to straight lines, possibly because the sea itself is displayed in curves.

Of this list, one gets value in amenities for every item except weight and A.Y.R.S. members have concentrated on the reduction of weight as their first and foremost target.

Having now studied the features of yachts which interest us, let us examine the yachts which exist at present to see how they are to be evaluated in relation to the "Theoretical Yacht." In many of them will be found the heavy hand of either tradition or the rating rules working to keep them slow and inefficient.

The International Canoe

This is the nearest approach to the "Theoretical Yacht" now in existence. An efficient sloop rig surmounts what is nearly a catamaran hull and an efficient centreboard is used, though there is a tendency to increase the aspect ratio beyond the 3 : 1 ratio. Stability is from the weight of the single man crew on the end of a sliding seat. Improvements banned by the rules are as follows :

1. The use of a transom stern. Tradition decrees that a canoe has a sharp stern and the name of the Class uses the word "Canoe." A transom would be faster.

2. The rig. An efficient sloop rig is used but it is likely that a "cat" rig of *Finn* pattern would be faster. Or an A.Y.R.S. sail could be used.

3. Minimum beam. In order to give these canoes some stability of hull shape, a minimum beam has been decreed. This makes for good class racing because without it, the helmsman's full attention can be taken up in keeping the boat upright.

The A.Y.R.S. Version of The International Canoe. We must begin by using the sail and centreboard of the "Theoretical Yacht." Support will naturally come from a single catamaran type hull similar to Don Robertson's *Freedom* (shown later). Stability will come from small hydrofoils rigidly fixed to the ends of a cross beam which is mounted at its centre by a universal joint to the main hull. A single handle gives the appropriate angle of attack, on both tacks. Without any doubt whatever, this design will give the fastest possible sailing boat at speeds below 15 knots. The course to windward will be as close as possible, especially if the deck is rounded and the crew is put in a cockpit to avoid windage. This same craft, with both hydrofoils in the water (though possibly with differential action) and a Hook hydrofoil forward could be the hydrofoil craft which we have been looking for.

RYSA

(An Experimental Hydrofoil Yacht)

L.O.A. 25 ft.	Depth 3 ft. 9 ins.
L.W.L. 24 ft. 6 ins.	Displ. 800 lbs.
Beam 3 ft.	Sail Area 200 sq. ft.

Designer : John Morwood, Woodacres, Hythe.

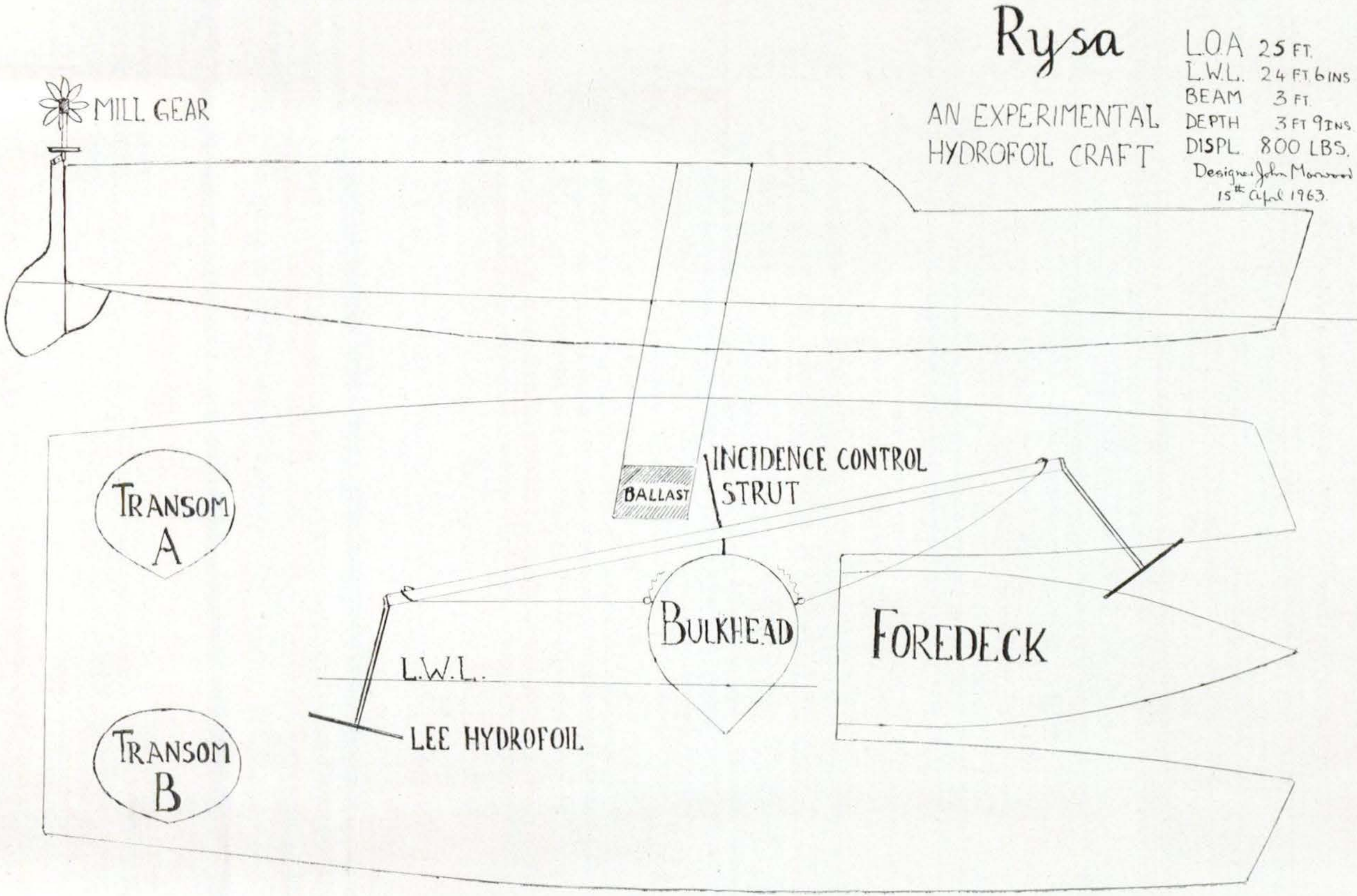
Rysa is a design which shows the fastest possible configuration of a sailing yacht. The version shown is a daysailing and camping cruising yacht, though the headroom at 3 *feet* is a bit spartan for most people. However, without the ballast and rudder skeg, she would be faster than any catamaran or trimaran in existence.

The Hull. At the lower side of the design is an outline looking like the profiles of two yachts laid on their sides joined together like Siamese twins. If this outline is cut from a sheet of plywood 26 feet long by 10 feet wide, it can be bent around a shape shown as the "Bulkhead" and, being held together at the keel, the shape shown as the "Transom" can be fitted in at the stern, the "Foredeck" can be fitted on with deckbeams and one has a single narrow hull whose profile is shown at the top of the plan. Transom A has less wetted surface than Transom B,

The Centreboard. This projects 4 feet six inches below the hull and is 1 foot six inches in chord, giving an aspect ratio of 3 : 1. In the version shown, the centreboard is ballasted which seems the best way to use ballast to me because, when the board is down, extra stability is needed. However, the amount of ballast used is only enough to give stability for winds up to about 5 m.p.h. At greater windspeeds, the craft would heel excessively were it not for the hydrofoils. For a racing version, the ballast need not be used.

The Rudder. A skeg and fixed rudder are shown. A racing version would have a drop rudder. A Mill self steering gear is shown because I believe it to be the best one for racing and cruising alike. It has the advantage that the boat is always under manual control as well as control by the gear.

The Hydrofoils. These are two simple inverted T foils mounted at the ends of a 14 foot strut which is mounted by its centre to the hull by a universal joint. The foil strut is tilted to lee by a stay so that only the lee foil is in the water at any time. A small strut on the foil strut gives the incidence control. This is the simplest possible hydrofoil arrangement using inverted T foils and it must work well.


Rysa
AN EXPERIMENTAL
HYDROFOIL CRAFT
L.O.A 25 FT.
L.W.L. 24 FT. 6 INS
BEAM 3 FT.
DEPTH 3 FT 9 INS
DISPL. 800 LBS.
Designer John Morwood
15th April 1963.
MILL GEAR
BALLAST
INCIDENCE CONTROL
STRUT
TRANSOM
A
TRANSOM
B
BULKHEAD
FOREDECK
L.W.L.
LEE HYDROFOIL

Cockpit. No cockpit is shown because it is possible to sail this boat from *inside the hull*, thus saving the windage of the crew. Alternatively, a one foot wide well could be cut in the round of the desk for a distance of 10 feet so that the crew could move fore and aft.

Assessment. Though the hull of the plan may not be the best possible shape, even with transom A, the weight, wetted surface and windage must be far less than a 25 foot catamaran and the speeds to be expected must be far greater than anything we have yet known with catamarans or trimarans. As a cruiser with ballast, she should sleep two people.

Rysa as a Flying Hydrofoil Craft. The name of this craft is *Rysa*, indicating that it not only is an A.Y.R.S. conception (because *Rysa* is an anagram of AYRS) but that it may be the flying hydrofoil craft we have been looking for. The craft can be converted to the flying version as follows: the foil strut is jointed at its centre so that both foils can be brought into the water at the same time. Then, the Hook system shown on page 7 of the A.Y.R.S. No. 39 is attached to the stem which has been designed straight for this purpose. We now have a flying hydrofoil craft which has every promise of working.

Summary. An experimental craft is shown which will be very cheap and easy to build. It should sail at speeds far in excess of the 25 foot catamarans using its hydrofoil stabilisers and may reach speeds of 30 to 40 knots as a lifting hydrofoil yacht. For the less ambitious yachtsman, it will make a fast inshore cruising yacht with Spartan accommodation for two people. At the time of writing, I am trying to get a prototype made for trials.

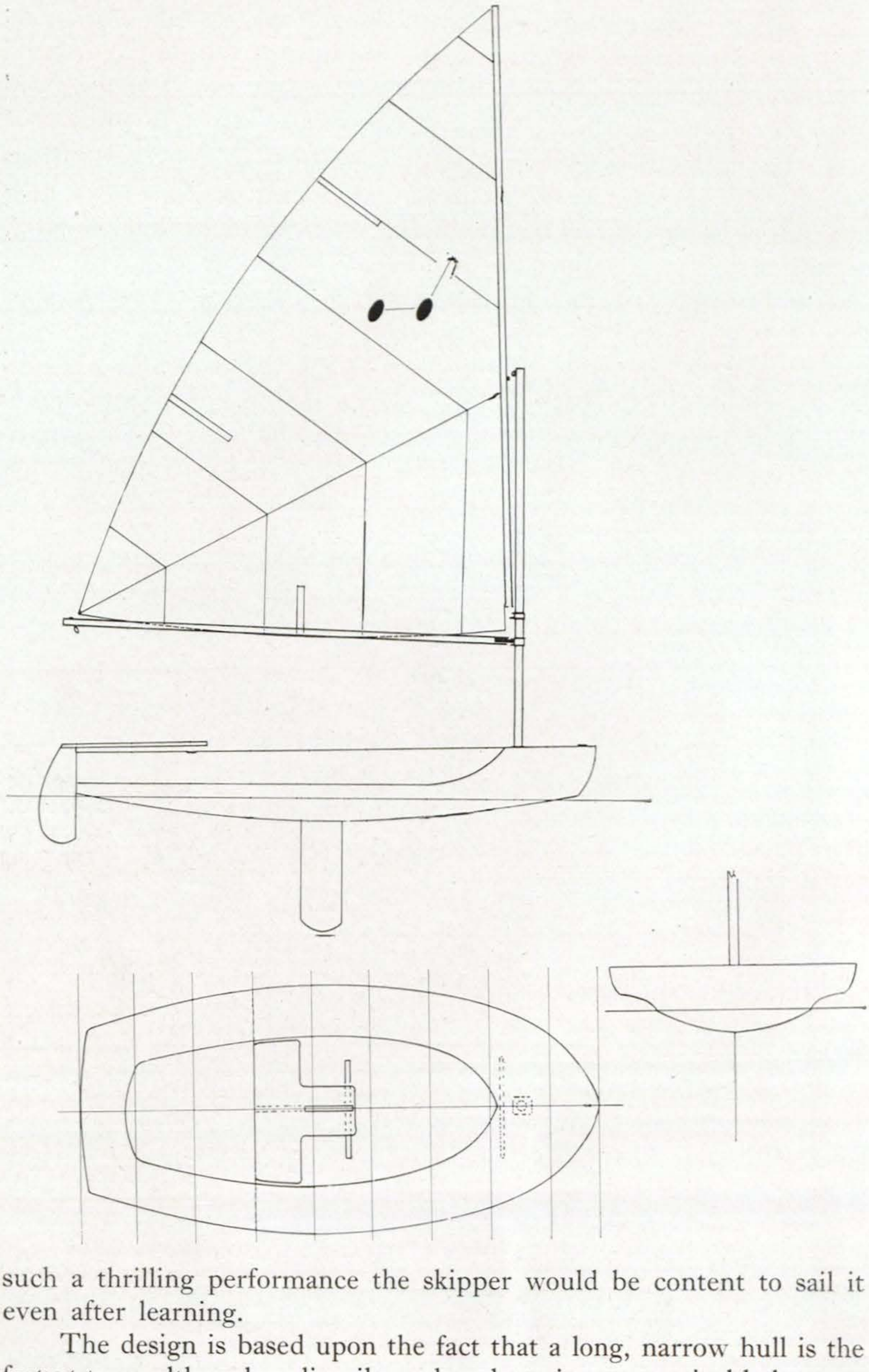
THE NARROW HULL DINGHY

Both General Parham and Arthur Piver have tried boats which consist of a narrow catamaran type hull below the waterline with an above waterline shape like a dinghy. This is, of course, a transitional type between the dinghy and the trimaran. Perhaps neither of these two designers have taken the craft to its ultimate state and we cannot assess the value of the concept. Arthur Piver describes his craft as in the following article.

SCOOTER

BY ARTHUR PIVER
50 Marlin Ave., Mill Valley, California

The 10 ft. x 5 ft. fiberglas dinghy *Scooter* is the result of an effort to present a beginner's safe boat which at the same time would give



such a thrilling performance the skipper would be content to sail it even after learning.

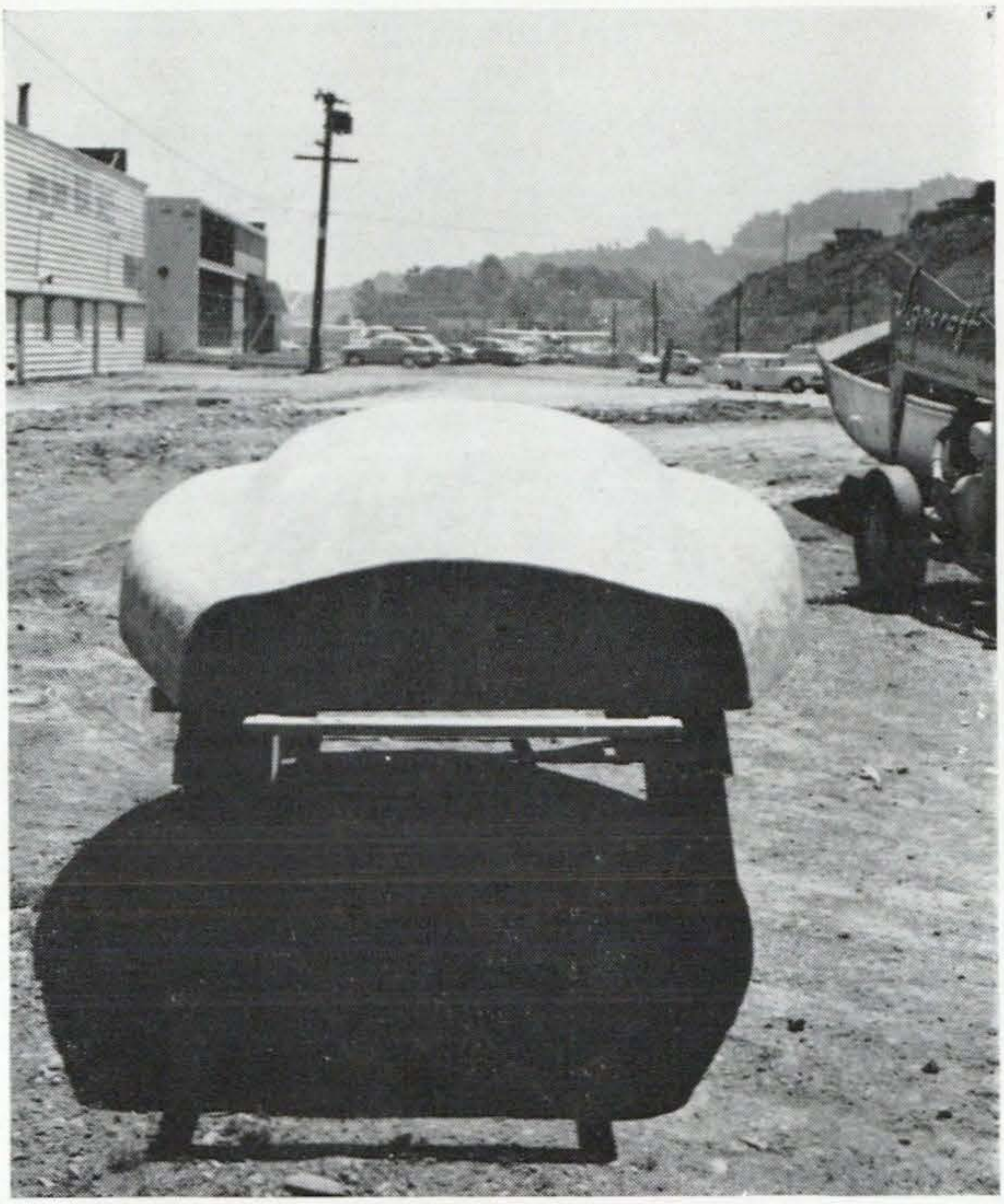
The design is based upon the fact that a long, narrow hull is the fastest type, although ordinarily such a shape is not practicable because of lack of stability.

As can be seen in the illustrations, when sailed level in the usual manner, *Scooter* has a narrow, easily-driven underwater shape.

When the boat is heeled by stronger winds, the effective beam increases rapidly, and as it is concentrated near the gunwale, a tremendous righting force is applied.

Because *Scooter* is decked, it can be safely heeled far more than the undecked boat, retaining the driving power of the sail under rugged conditions.

SCOOTER—Arthur Piver.



Plastic foam (Styrofoam) mould used for Arthur Piver's 10′ *dinghy SCOOTER.*

As a further safety precaution, the 50 sq. ft. gunter rig is arranged so that if the sheet must be eased in a particularly strong gust, the sail will swivel 360 degrees thus spilling the wind and relieving the pressure—even with the wind directly astern.

Scooter was designed in 1958.

THE DINGHY

Originally a small rowing boat or yacht's tender, the dinghy has never made much claim to efficiency because of its function as a load carrier. In order to get enough centre of buoyancy movement on heeling for stability, the beam and wetted surface have to be excessive for speed. However, with certain flat floored dinghies, they can rise up in the water at speed, the bow comes out of the water and the wetted surface is reduced, thus reducing the resistance. This is called "planing." The following article describes a planing dinghy design by Arthur Piver.

NUTSHELL

BY ARTHUR PIVER

L.O.A. 16 ft. 3 ins. Draught 2 in.
Beam 6 ft. 6 ins. Sail Area 150 sq. ft.

The 16 ft. dinghy *Nutshell* was designed in 1956. As I had never had a ride in a planing boat, photographs of these planing were studied.

It seemed that dinghy sailors were proud of their bow waves—but this seemed to merely indicate that these boats were not planing *on* the water but *in* it—and elimination of the energy going into forming a bow wave should be translated into easier planing and greater speed.

It was reasoned that because planing dinghies were the most fun when actually planing, every effort should be made to plane continuously—even though perhaps such a boat might not be always as fast as other dinghies which planed only occasionally.

Nutshell was built of $\frac{3}{8}$ in. thick spruce strip planks—with the hull weighing 155 pounds when finished and lightly fiberglassed on the outside. The centerboard was unweighted—for a weighted board does not aid stability until the boat is well heeled—and a heeled boat does not plane.

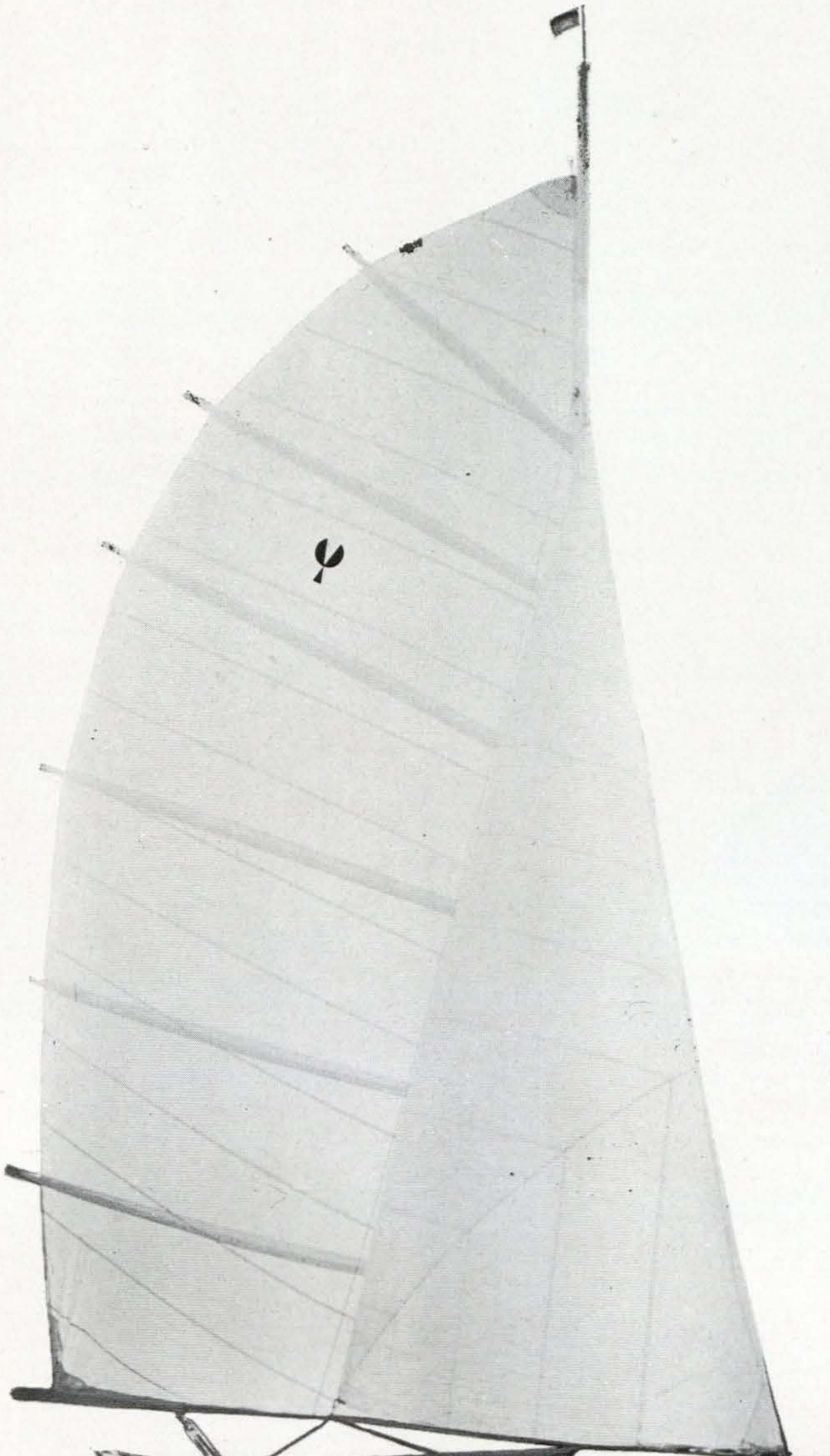
In order to eliminate the bow wave the boat was kept as shallow as possible—with the bottom being kept straight from the stem to a point several feet from the transom—where it swept upwards several inches.

At rest, the boat drew only two inches. With one aboard, it would plane in almost a zephyr. With two aboard, she would plane close-hauled at 8 m.p.h.—with three aboard—close hauled at 11 m.p.h. A crew of two could keep her on her feet in winds of 20 knots.

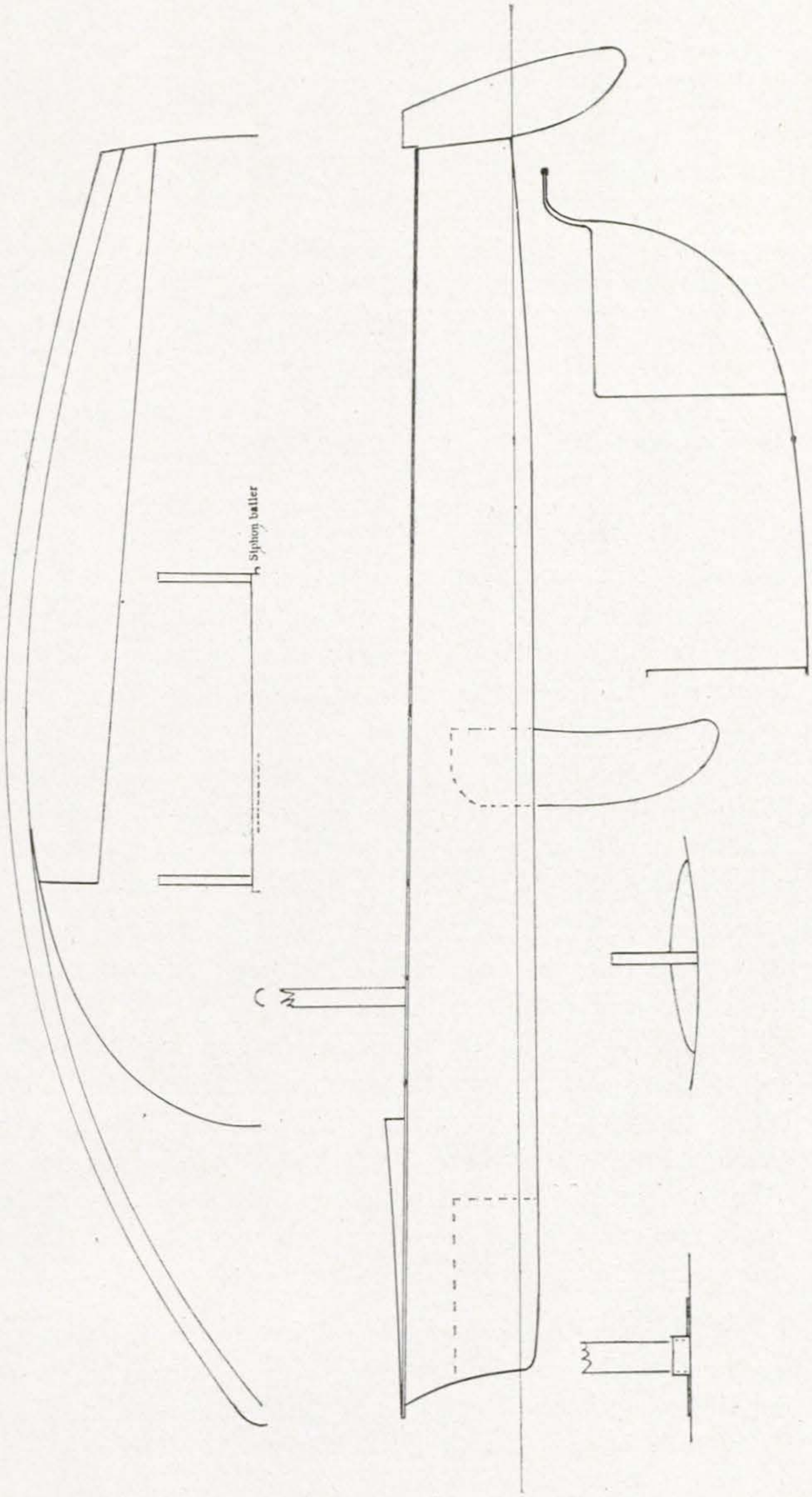
She would plane clear around a triangular course—with the only disappointment being the fact that she would come off the plane when putting about.

A 4 in. wide flaring gunwale kept out all spray, and it was found impossible to drive the bows under water when surfing down a steep wave—as dynamic lift from the flare forward kept the bows up.

We also developed a technique for jibing this boat in winds as strong as 35 knots. This consisted of having the crew pull the boom amidships—and as the sail jibed the helmsman would turn the boat *back* in the direction from which he had been turning. Thus the centrifugal forces which usual accentuate the jibe were counteracted—and the light (3 lb.) boom hitting the stay merely gave the boat a push ahead.



NUTSHELL—Arthur Piver.



We later built a V-bottom version of *Nutshell.* This was made of 1 in. thick planks of Styrofoam (4 lbs. cu. ft. density)—covered with a thin fiberglas coating.

The foam boat had similar performance characteristics.

THE KEEL YACHTS

The Meter Yachts. The first of the keel yachts which had any pretensions to hydrodynamic efficiency which means that they had a keel appendage to the hull and used outside ballast have developed into the "meter" classes such as the 5.5, 6, 8, 12 and J Class yachts. These are all fine seaworthy yachts which function with fair efficiency as sailing machines when one considers that they carry around a high proportion of their weight as ballast. Indeed, if we all had the money to buy such boats and could get the crews to run them, many of us would be very well pleased with them. But, if we should be limited as to cost and crew and want more speed than these craft give, we will look for other types.

The Square Meter Yachts. The principle behind these craft which originated in Scandinavia is that the designer is allowed a sail area of a fixed amount such as 22, 30, 50 or 75 square meters and can put any hull he likes underneath this. The classes of sailing craft which developed from this rule were extremely light, as compared to the "meter" classes and the hulls were very shallow in the water. A short, fairly deep and ballasted keel gives stability. Cruising accommodation which had low headroom was obligatory but this feature became a farce in many types. The *Dragon's* accommodation shows this, though it is a one design, not a square meter class boat.

As regards efficiency, the square meter yachts are better than the meter yachts, though some nineteenth century craft such as the large American centreboarders and the English Sibbick "Raters" were better. The sail rig is of high aspect ratio and the fin keel also is deeper for its fore and aft length than the meter boats. The hull merely serves to support the craft and give some stability, while the long overhangs fore and aft increase sailing length when the wind is strong. The weight of boat and ballast is very small for its size and, by and large, one can say that these classes approach the "Theoretical Yacht" more closely than any other ballasted yachts.

The Royal Ocean Racing Club and Cruising Club of America Boats. These are the offspring of the metere" boats, changed to fit in more accommodation. The result is a loss of efficiency as sailing machines.

MULTIHULLS

Catamarans. Undoubtedly, each catamaran hull is a good way to hold up the rig and centreboard of the "Theoretical Yacht" but, when both hulls are considered together a loss in efficiency appears due to the extra wetted surface added to the windage of the bridge deck. Though in practice, the catamaran is the most efficient yacht in existence, it does not appear so good on close examination and I feel that we should continue our search still farther. The design of *Freedom* is shown as the Editor's opinion of the best catamaran hull shape yet produced.

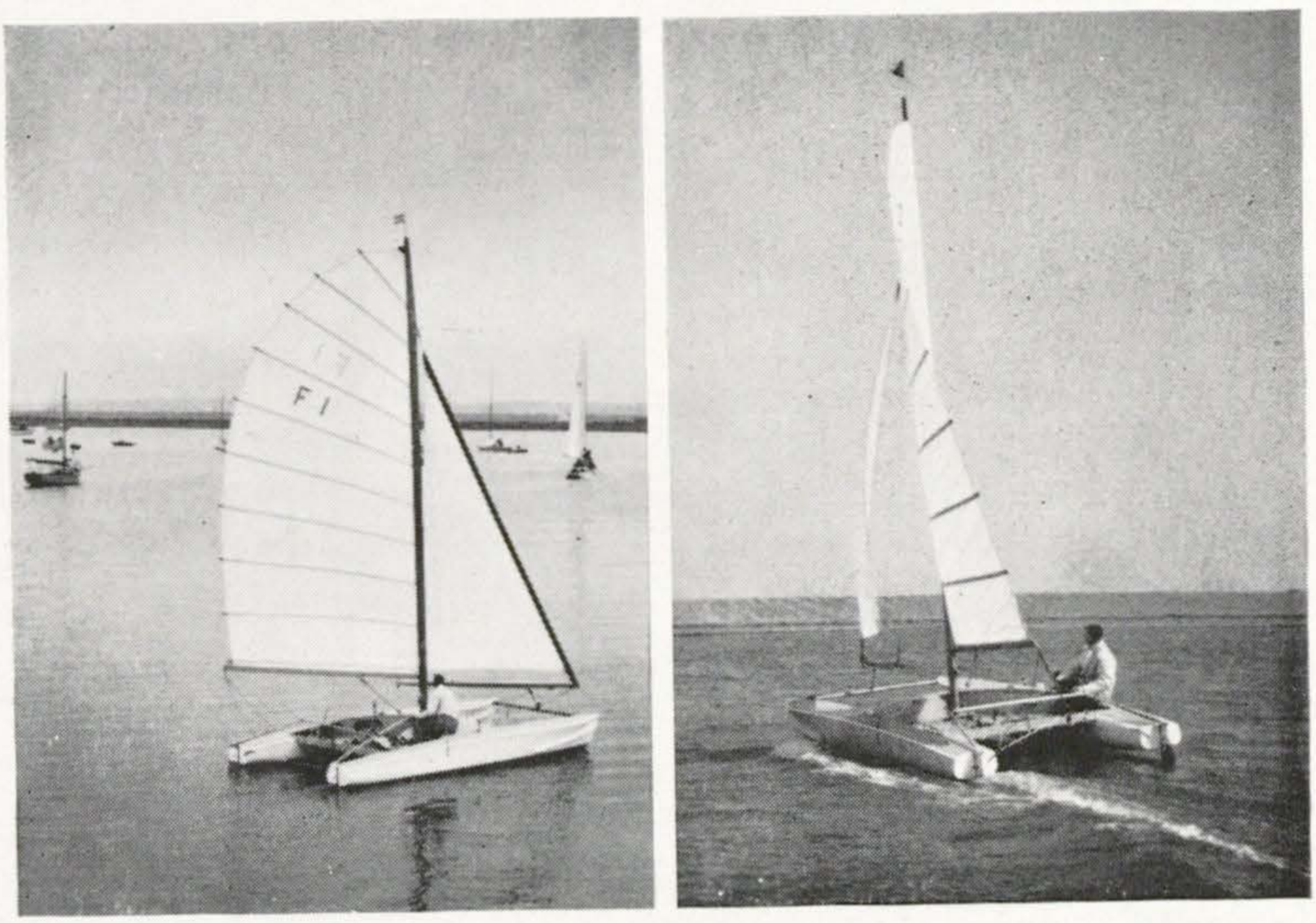
" FREEDOM "

L.O.A. 18 ft. 6 in.	Draught 7 in.
L.W.L. 16 ft. 10 in.	Freeboard 1 ft. 6 in.
Beam O.A. 9 ft. 5 in.	Displacement 585 lbs. + crew, say 350 lbs.
Beam (hull) 1 ft. 10½ in.	Sail Area 270 sq. ft.
Beam (hull, L.W.L.) 1 ft. 7 in.	main 176 sq. ft.

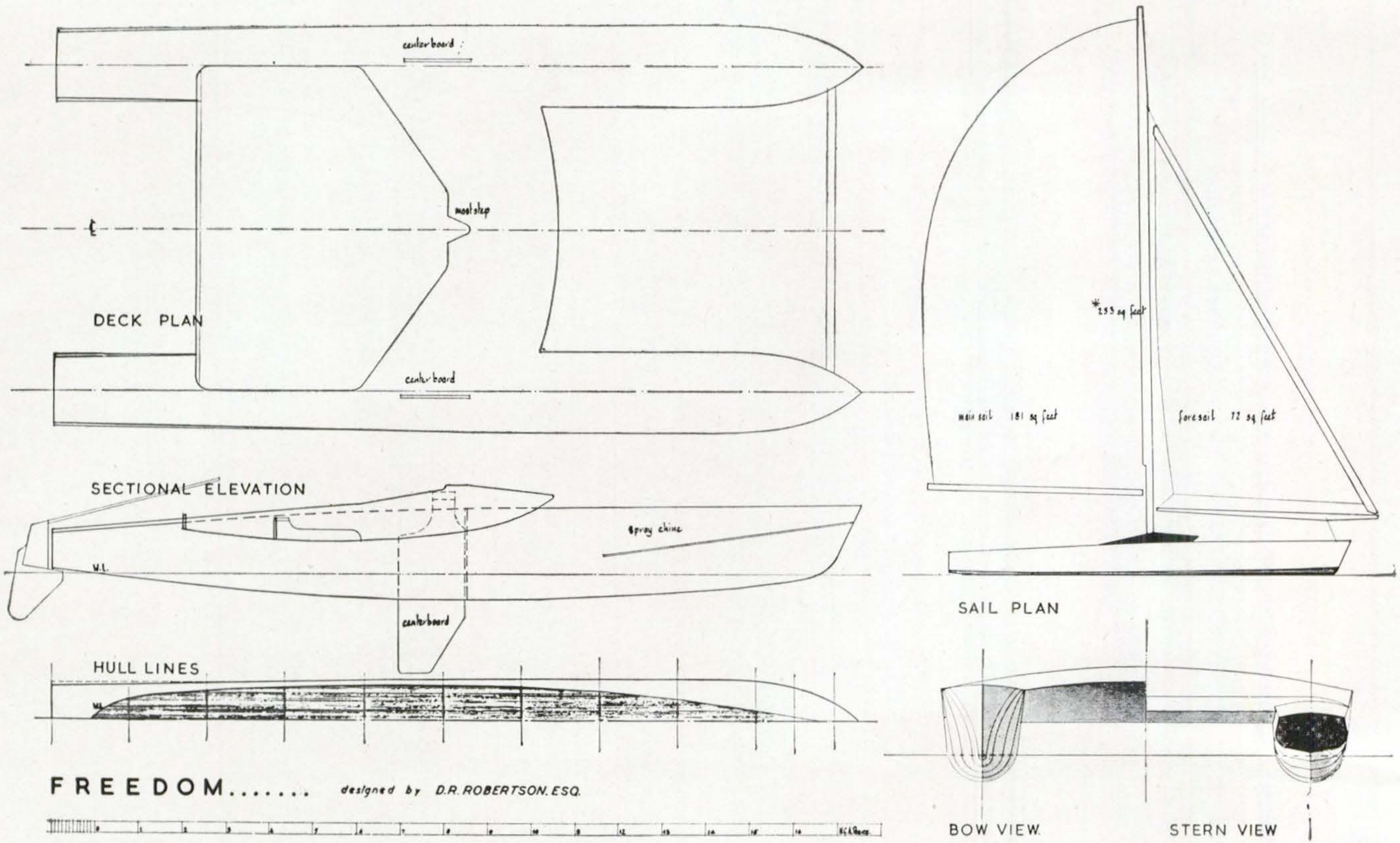
Designer, builder and owner: Donald Robertson.

Just before *Endeavour* crossed the finishing line in the Cross Channel Race in 1958, the second craft was coming into Boulogne Harbour and stormed across the line quite as fast as she and only 7 minutes 38 seconds behind. It was *Freedom.*

Freedom is not such a cut down craft as *Endeavour* and has more freeboard to keep her dry. Her success is due rather to a great attention



Freedom



centerboard
mast step
DECK PLAN
centerboard
SECTIONAL ELEVATION
spray chine
W.L.
centerboard
HULL LINES
W.L.
*253 sq feet
main sail 181 sq feet
foresail 72 sq feet
SAIL PLAN
BOW VIEW.
STERN VIEW
FREEDOM....... designed by D.R. ROBERTSON. ESQ.

to many small details of design and construction than any one radical alteration. Donald Robertson used to be a test pilot of aircraft and this training was clearly of the utmost value in *Freedom's* make-up as it allowed him to evaluate each feature as a separate entity while not losing sight of its overall purpose.

The Hull Design

The hull differs from that of *Endeavour* in having a gentler sweep-up to the buttock lines aft with a slightly wider floor. Forward, the entrance is just slightly finer, leading back to a semi-circular midships section about the centre of the length. There are twin centreboards, one in each hull, which we know gives extra speed to windward but, of course, they were not used in this year's race as the wind was free throughout.

The Rig

Freedom is kept in the River Alde and so it was felt that some kind of working jib would be a great convenience for short tacking. This took the form of a balanced jib with luff spar and boom, with a single sheet to the boom. However, this jib sits well without twist and is a far better sail, in my opinion, than the normal jib. I do not know whether it is better aerodynamically to have the luff of the jib to *Windward* of the centreline of the craft where it gets more of the properties of the "slat" of an aeroplane wing or to *Leeward* of the centreline where it tends more to have the properties of the upper wing of a bi-plane.

Handling

Freedom puts about very quickly indeed. Donald feels that this is due to the flatter floor and shallower sections aft, an opinion of this feature shared by Arthur Piver.

Summary

Freedom is a very fast craft which is easy to manoeuvre in narrow waters. *Freedom* was only launched 10 weeks before the Cross Channel Race and had never been in salt water till the actual race itself.

In the 1961 Catamaran One of a Kind races, Freedom achieved third place on handicap though presumably not at the peak of her racing condition. Surely this proves that her design and construction are the best possible.

Trimarans. As compared with the catamaran, the trimaran holds up its sails and centreboard with a single hull which can be of ideal shape. When not heeled, only the tips of the floats are in the water and only hold the boat back by their weight and windage. If the weight is small, the total weight is much less than with a catamaran and the wetted surface is much less also. The trimaran therefore looks much more like the ideal sailing craft than the catamaran.

TRIMARAN PROGRESS REPORT

BY ARTHUR PIVER

Three years have elapsed since the first of our cruising trimarans made a deep-sea voyage.

This may be a short time in which to completely evaluate a new type of boat—yet a good deal can occur in this period.

Much practical knowledge has been gained, for many additional ocean crossings have since been made—thousands of deep-sea miles have flowed beneath the triple keels—every condition from calm to hurricane—has been encountered—from smooth, windless seas to vicious storm waves—all this has combined to present a picture of the characteristics of the trimaran.

Some drawbacks as well as assets have been noted—these will also be examined.

Reports continue to come in—there are at least four of our multi-hulls now bound around the World—three 30 ft. *Nimbles* and a 32 ft. *Herald*. Many more are being used—with more than two hundred sailing and building in little New Zealand alone.

First Ocean Voyage

Our first trimaran trans-ocean voyage was that of *Nimble* 1, which sailed in May, 1960 to England from Swansea, Mass. The second and third occurred the following year, when a 35 ft. *Lodestar* and a 24 ft. *Nugget* cruised to Hawaii from California.

In 1962 the oceans were cross-hatched by trimarans going in every direction. This trend continues—with at least four from San Francisco alone slated to take off for the South Seas during 1963.

Of the dozens being built in 1963 at the Ipswich, England factory, five have been sheduled in Spring to be sailed across the Atlantic by their new American owners.

So far, we know of no other designers who have actual blue-water experience with this type. We will therefore examine the characteristics of the trimaran as we design it—noting incidents which seem to us illustrative.

These boats have evolved from native craft which for centuries have been noted for both speed and seaworthiness.

The problem with the modern versions has been to preserve these attributes and in addition provide carrying capacity in keeping with long-voyage requirements.

Safety First Consideration

We will first examine the aspect of safety—as this is the primary consideration.

This begins with non-sinkability. A wooden boat with no ballast (ours have none) and no considerable amount of machinery does not sink. A craft made of glass laminate alone will indeed sink—except that makers of ballastless glass boats provide sufficient flotation (we use plastic foam).

After non-sinkability, the problem is that of stability.

The trimaran relies on considerable beam, with the outriggers providing the righting moment.

In 1961, when the 24 ft. *Nugget* was en route to Hawaii, rugged conditions prevailed on the first night—choppy seas and gusty winds.

The boat was being driven to the utmost by the novice helmsman, Rich Gerling.

About midnight he noticed the trimaran had slowed, was heeling considerably, and the water which had formerly been dashing over the end of the leeward deck was now washing around the cabin!

Flashing a light, he discovered the lee deck to be entirely under water.

Putting about and calling his shipmate, he found a hatch cover had disappeared—and the lee float was filled with water. Foam flotation, which is sometimes employed in the outriggers of these boats—was not used in this particular one.

Apparently the wind spilled from the sails as the craft heeled; and the buoyancy of the light deck and float structure was sufficient. The fact that the underside of the windward wing and float were exposed to the wind was apparently inconsequential.

In October of 1962 Wayne Norwood—temporarily in Thailand—was caught for eighteen hours on a lee shore in the Gulf of Siam—in a Typhoon! Under a stormsail, his *Nugget* survived 80-90-knot winds with no damage.

He said his chief concern was the possibility of the powerful wind getting under the wing section and blowing his little craft away. This did not happen.

Leroy Fry and Gerry Allen of Redwood City, Calif., readying their 35 ft. *Lodestar* for a deep-sea cruise in 1963, for six months vainly sought a weak spot in their boat—which is our practice before going off-shore.

In a storm during January, 1963, they had all sails set and were driving the trimaran as hard as possible. An end fitting pulled out of one of the diamond stays on the mainmast—which broke. Checking with the nearby airport, they learned that the wind at that time was blowing seventy-five miles an hour—hurricane force!

With hundreds of our craft sailing all over the world—many by inexperienced personnel who go out in sometimes appalling conditions—we have yet to hear of a capsize of any of our cruising trimarans.

A Matter of Motion

Comfort at sea is largely a matter of motion, and here is a province where the trimaran has surprised even its designers with a remarkable sea-kindliness.

The slender hulls knife through waves—having enough buoyancy to rise without pitching.

Of course the trimaran must conform to the shape of a given wave, but in practice this is a surprisingly gentle motion—and in even rough water the boat will travel with a skating—rather than the usual rolling, heeling, pitching—motion.

They do nor roll because of the wide stance—with no circular athwartship shape under water, nor a ballast keel to act as a pendulum.

Heeling in normal conditions never exceeds several degrees. In the example mentioned above of the *Lodestar* in hurricane-force winds, heeling under full sail was estimated at twenty degrees—extreme for these boats.

These tests included deliberate attempts to capsize this craft. Other similar tests have been made—including those by English sailors aboard *Nimble* 1—resulting in a rash of broken rigging and spars. In general, the rig is engineered to stand a wind force of approximately 60 knots—under full sail with the boat unladen. It is assumed that the personnel will reduce sail before such a condition develops.

It is interesting to note that regardless of the amount of heel which may be obtained, the central hull does *not* rise. The rig will carry away first.

The automatic-release used by these boats is usually set to let go in wind pressures equivalent to about 40 knots.

Actual gentleness of motion is apparently the result of the non-heeling tendency, for even in an ordinary rolling boat there is a pivotal point where motion is minimal. The trimaran can seem lively indeed, under some turbulent conditions, but things left on a flat surface simply stay put—even during gales.

On a particularly rough passage between Hawaii and Tahiti in 1962 aboard *Lodestar*, the stove merely set on its shelf—not even being fastened down. Although not a recommended practice, the two-burner alcohol unit cooked merrily away—and nothing spilled.

When testing his 40 ft. *Victress* at Seattle in 40-knot winds, Darrel Cole discovered at the close of the day that a flashlight in the galley had remained standing—on end—all day long.

Performance is Evaluated

As far as performance is concerned, we have a number of reports. A racing trimaran is yet to be built—the existing ones have very small sail areas—which in such easily-driven boats is adequate for cruising.

One of the early performance reports came from Texas in 1961, when Bruce Plunkett's 24 ft. *Nugget*, although denied entry because she was too small to qualify, started the Corpus Christie to Tampico (Mexico) Race.

Beginning the beat to windward (in moderate conditions) after the other boats had started and were a half-mile ahead, she sailed right through a fleet of the fastest boats in Texas, and at the end of the first day was not only ahead of all the others—but to windward as well.

Only boat near her size was a 28 ft. racer. *Nugget* went by her so fast close-hauled in two hours the conventional craft was but a tiny speck on the horizon astern—and far, far to leeward.

We have a later report on a sister ship—this time from the opposite side of the world—Australia.

Ken Berkeley had plenty of company at the start of the Sydney Harbour-Botany Bay Race in February, 1963—consisting of the finest Australian yachts—with ocean and Hobart racers included.

He was lonely at the finish—for his little *Nugget* was four miles ahead of the Number 2 finisher.

On the 1961 cruise to Hawaii—*Lodestar* averaged 220 miles per day for the first three days—under only genoa and mizzen (about 200 ft.). Because of the particularly rough sea, the mainsail was furled to slow the boat.

There was not much wind during those first three days, and thenceforth was practically none. For one windless four-day period only the genoa was set—as a gesture. The boat averaged 150 miles per day for the 2,225-mile passage. She had no light-weather sails.

On another Hawaii trip—this time in a 30 ft. *Nimble* in 1962, the trimaran sailed 1,100 miles in a week—under only the jib or genoa. Because of the presence of novice helmsmen aboard, no boomed sails were used in order to prevent jibing. Winds were light and variable—with no regular following sea.

We have not yet heard of good conditions for a 24-hour period on any of our trimarans.

Between Rarotonga and New Zealand in 1962, *Lodestar* averaged approximately 15 knots per hour for ten consecutive hours—all done under working jib alone—in frontal squall conditions from astern at night.

There were but two in crew, with one man on deck at a time.

Sensational Performance Expected

Following an article in *Motor Boating* (June, 1962) which suggested the possibility of setting a new speed record for a 24-hour period, we have had many enquiries as to what happened on the projected run in the "Roaring Forties" East of New Zealand.

The voyage was made in December, 1962, with *Lodestar* under the command of John Daigneault (Dane-yo) of Los Angeles and two New Zealanders as crew.

Unfortunately, at that time the "Roaring" Forties did not "Roar." The trimaran is once again cruising French Polynesia—homeward-bound after a calm trip through the Forties.

As far as scepticism concerning such a feat is concerned—any visitor to Hawaii has seen tourist-laden canoes surfing the waves—it being obvious these boats can remain on a given wave (and thus go as fast as the wave) until it dissipates upon the sand.

Our trimarans surf like canoes—or even surfboards on particularly large seas, and it is but a question of time until we find suitable conditions. If waves in the Forties actually do move at the reported rate of forty knots—we will do the same.

Handling in Storm Conditions

As far as seaworthiness is concerned, the most dangerous thing in a storm in an ordinary boat is to run too long down-wind (for fear of running under). With our trimarans, it is the most comfortable procedure. This is because of the surfing noted above. It is possible to run for hour after hour in a fierce storm with no water on deck—except for spray from adjacent breaking seas.

As the wave steepens prior to breaking, the boat surfs ahead of it—and the sea breaks well astern! In very large waves, it is possible to run across the face—still staying ahead of the break but having more choice of direction. Deep-sea waves are unlike beach waves in that only some portion of the top actually breaks.

On two occasions during *Nimble's* 1960 trans-Atlantic voyage—she was surfing at 16-18 knots when a freak wave suddenly welled up ahead—and the boat crashed into a vertical wall of water!

This knocked the crew off their feet but the craft immediately rose to the surface and continued sailing—in a rapid-fire movement. There was no apparent danger—although the crew was understandably apprehensive.

Even when surfing swiftly down almost vertical slopes—it was found impossible to drive the bows under—due to the overall light weight and reserve buoyancy in above-water bow sections.

If there is not sea-room in a storm, these boats will continue to windward under any conditions yet encountered. The slender hulls knife through the waves, and the remarkable stability keeps the sails upright where they can hold the wind.

Under deeply-reefed canvas—or without mainsails in the case of the split-rig boats—they continue doggedly to windward in winds of hurricane force.

Sailing off the New Zealand Coast on the 39th parallel in *Lodestar*, it was found in heavy winds she would sail herself to windward under working jib alone—with the crew resting comfortably below while the boat slogged up-wind at 100 miles per day.

These boats heave-to nicely under mizzen alone—or deeply-reefed mains in sloop versions.

Shallow Draft Convenient

One of the convenient features of these trimarans most mentioned by their crews is the shallow draft. This ranges from 18 in. (board up) for the 24 ft. *Nugget*, to 33 in. for the 40 ft. *Victress*. A new dimension is thus added to cruising areas.

These boats are beachable—the ones over 28 ft. do not have centreboards—but small fins on the floats (for manoeuverability) which do not reach as far down as the keel of the central hull.

Disadvantages Enumerated

We have learned these are not the boats for everyone. They do have drawbacks—some of which can possibly make their ownership impossible.

Ordinary sailboat yardsticks cannot be applied to craft which are so different from what has gone before—and this leads to some difficulty in approaching the sailor experienced in only conventional craft.

Traditionally, strength has been associated with massiveness—great heavy keels; with ponderous construction to contain that.

In terms of fabrication, our trimarans are the opposite. They are aircraft—not boats.

A sea striking a ballasted boat reacts like a wave striking a reef—an almost irresistible force meeting an almost immovable object. Thus this boat fights the sea.

Our concept is different. A sea hitting one of our craft is as a blow against a feather floating in air. It is all a matter of inertia—the feather yields—blow after blow—you can't seem to hurt it!

After 10,000 miles trans-Pacific in *Lodestar*—many of them rugged—we could find no sign of strain—a vindication of the light-weighted concept.

Most obvious drawback is of course the extreme beam—we customarily use a ratio of about 6 ft. of beam for each 10 ft. of length.

This limits the availability of marina slips—for there are not many end slips.

Mooring can be simpler than usual due to the shallow draft. Marinas in general are found only in the United States.

As these are aircraft in the sense of construction—the same holds for carrying capacity. They will transport enough for crossing the widest ocean—but as in aircraft—you take only essentials.

There is no allowance for heavy machinery—we have found that people who must have heavy machinery must also have considerable loads of fuel—these boats are not for them.

In smaller sizes—up to about 35 ft. in length—outboard motors make satisfactory auxiliary power—although only a few gallons of gasoline are usually carried.

Another factor—nothing extraneous can be dragged underneath while sailing. With light auxiliary motors in the larger trimarans, means of retracting propellers must be employed.

Larger Trimarans Building

Largest trimaran so far is a 58-footer being constructed at Redwood City, Calif. by Tim Seltenrich and Kirk Purvis.

Largest one now sailing is the 52 ft. *Tontine* (formerly named *Undine*). This is not entirely our design. We furnished a set of *Lodestar* plans to the builder, W. D. Barton of Danville, Calif. who had the lines scaled-up to produce *Tontine*.

Several of our 47 ft. *Medallions* are being built.

A design now being prepared for West Indies charter work is 64 ft. in length. It will have seven double cabins; one quadrupal cabin—not counting the central lounge and pilot-house—which has a 12 ft. long settee.

Cost of Trimarans

Because of light and simple construction, material costs for these boats are low, although there are so many components labour costs can mount.

In general, they cost less than conventional boats their length—with prices decreasing in proportion as size mounts.

Editor's Note : Above material was taken from manuscript of the Author's *Trans-Pacific Trimaran*—sequel to his *Trans-Atlantic Trimaran* of 1961. The new book is expected to appear in the Fall of 1963.

THE A.Y.R.S. YACHT

BY JOHN MORWOOD

It may not be apparent to members, but the A.Y.R.S. policy, which we have maintained fairly consistently for the last eight years, has in fact designed a yacht. It will be the purpose of this article to describe the yacht, which has been designed by a great number of our members sending in small items of information on many different subjects to A.Y.R.S. headquarters. It has been my good fortune, as your Editor, to receive all this information and its synthesis into a complete yacht has occurred due to the fullness of time and the continuous striving after the best possible efficiency.

The Hull

The hull of the A.Y.R.S. yacht, as I see it, is a catamaran hull whose ancestry takes origin from the traditional but altered by a host of people. Those to whom I feel most credit is due are Woody Brown, Alfred Kumulai, Rudy Choy, Hugo Myers, Roland Prout, Bob Harris, Bill O'Brien, Donald Robertson, Arthur Piver and F. M. Montgomery. Others have designed these narrow hulls but have not published their hull shapes for us, or their hulls are almost the same as those which had gone before. In general, what has been shown is the speed potential of the hull and also, as exemplified by the hulls of Bill O'Brien, Arthur Piver and myself, that quite a lot of lateral resistance can be generated. This has been useful and instructive but we can add to the designers' artistic flair certain scientific information which can take our hull one stage further.

Edmond Bruce has shown in his test tank that the lift to drag ratios of a sailing hull can be as great as 5 to 1 and as bad as 3 to 1 when there is excessive beam. We also know from the study of aerofoils that a thickness to chord ratio of 1 in 8 increases the maximum lift coefficient without increasing the drag disproportionately. Thus by the addition of scientific study to the artistic genius of the yacht designer, we can make a pretty good assessment of what our A.Y.R.S. yacht proportions should be. These are as follows :—

L.O.A. 32 feet. Beam W.L. 4 feet. Draught 2 feet.

As regards the shape of hull, one is, of course, severely tempted to have semi-circular sections from amidships forwards with lessening radii, with a flattening run. This gives the least wetted surface but, from consideration of the lateral resistance developed by the hull itself, I favour a right angled V starting near the bow and carried through to the maximum section after which it flattens to the transom. By doing this, I believe we can reduce the size of our centreboard considerably, thus saving approximately the same wetted surface as would be achieved by having the rounded sections.

The Hull Above the Waterline

Edmond Bruce has shown how great an inefficiency is produced by the above water part of the hull, which reduces very considerably the lift to drag ratio of the sails alone. Now, we are not tied to the tradition which maintains that we shall have a large flat deck, and it therefore seems worth while to have a very rounded deck which will allow the wind to flow over it with the least production of eddies, thus letting the sails do their maximum work.

The Construction

Members will know that throughout the existence of the A.Y.R.S. considerable attention has been paid to the construction of yachts with a view to making them as cheap as possible and to allow them to be built as far as possible with sheet plywood. Now it is very fortunate that the hull shape described above, which could well be the ultimate in efficiency both above and below the waterline, happens to be capable of being almost completely constructed out of one large sheet of plywood which can be rolled up into a long boatlike tube.

The ancestry of this method of yacht construction takes origin from the system of making boats of "developed plywood" such as was described in our publication No. 20—*Modern Boatbuilding*. The basic principles were given to your Editor by Dr. C. N. Davies and taken a stage further by F. M. Montgomery. However, the concept that a catamaran hull can be made from one large sheet of plywood can only have originated with the necessity for a very highly cambered deck, which in turn, derived from the work of Edmond Bruce.

The boat which is described in the next article is a cruising boat and the deck is far too highly cambered to walk on. For a single hulled boat, therefore, some form of catwalk would have to be made horizontally around the boat where the beam is greatest. This structure would act as a rubbing strake and need not be more than 4 inches wide. Life rails could be put on it for safety.

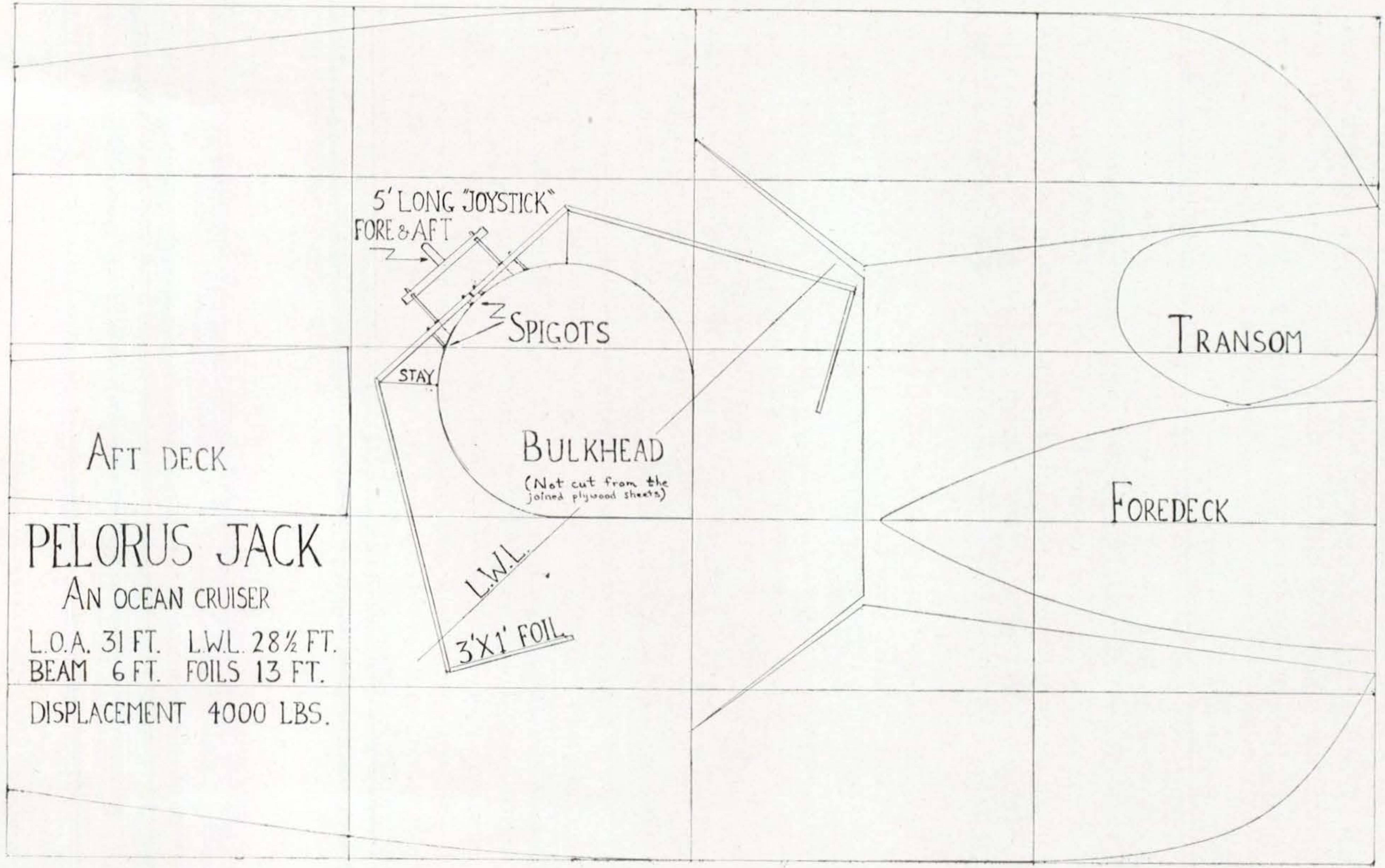
PELORUS JACK

L.O.A. 31 ft.	Depth 7 ft. 6 in.
L.W.L. 28 ft. 6 in.	Displacement 4,000 lbs.
Beam 6 ft.	Sail Area 500 sq. ft.
,, with foils 13 ft.	

Designer: John Morwood, Woodacres, Hythe, Kent.

Undoubtedly, the most famous and beloved of all animals is *Pelorus Jack*, the dolphin which lives (or used to live) in Cook Strait between the two large islands which constitute New Zealand. I am not sure if he is still living or has been replaced by another of his kind but he used to escort ships through the Strait and was said to be the best pilot in the district, never having lost a ship. For this reason alone, to use his name for a yacht would surely bring joy and good fortune to her but I have a special reason in that my wife is called Pat, my three daughters are Elizabeth, Maureen and Susan while my name, John, could well be made more nautical to Jack. The names combine thus: P (Pat), el (Elizabeth), or (Maureen) us (Susan). Also, a Pelorus is an old navigational instrument used to take bearings so, from every point of view, I cannot see how any name could be more appropriate for a boat to be owned by me.

Dolphins are credited with great intelligence, understanding and a sense of humour. I hope that, if *Pelorus Jack* has indeed gone to his aquatic mammalian heaven, he will look down on this design and suggest the improvements which will be necessary to make it have a performance as nearly like that of his own as is possible. If this



5' LONG "JOYSTICK"
FORE & AFT
SPIGOTS
STAY
BULKHEAD
(Not cut from the joined plywood sheets)
L.W.L.
3'X1' FOIL
AFT DECK
TRANSOM
FOREDECK
PELORUS JACK
AN OCEAN CRUISER
L.O.A. 31 FT. L.W.L. 28½ FT.
BEAM 6 FT. FOILS 13 FT.
DISPLACEMENT 4000 LBS.

doesn't happen, I am sure he will understand the principles better than many a run of the mill yachtsmen. Perhaps, however, on the other hand, this yacht may be greeted by the original *Pelorus Jack* as a subject for dolphinic ribaldry. We cannot tell till it has been built and perfected.

The Hull. This is made from 20 sheets of 8 feet by 4 feet plywood all joined together to make a sheet 32 feet long by 20 feet wide. This large sheet is then cut according to the outline shown which then makes a shape which can be bent around the "Bulkhead" and "transom" to form the hull. The essence of the shape of this boat is that the after part is more or less a cylinder while the bows are "conically projected." Between the two parts, there is bound to be an uneven junction. In thin hulls, this stress can be absorbed by plywood but in a thick hull such as *Pelorus Jack*, a V has to be cut as shown which gives a slight angle in the finished hull. This angle is not great and the hull looks reasonably sweet in the model. I favour a skeg of high aspect ratio to the rudder to give extra lateral resistance.

The Lines. The entrance is fine. It develops into a right angled V at the greatest section and flattens aft to the transom. This shape would be good for a catamaran or trimaran main hull but would probably not be as fast as a hull with semi-circular sections from the stem to the greatest section, using a centreboard. For our purposes where a small amount of ballast is used to give static stability, it is excellent.

The Decks. The foredeck is normal but aft of this, the deck becomes a segment of a circle, though it flattens aft somewhat. The reason for this is to give maximum inside room—apart from the constructional simplicity. It also makes the craft so that it is unstable if upside down which, though perhaps not often required, could be life saving. It is stronger and will not hold any water on it and it will have much less wind resistance when close hauled. For ocean cruising or general sailing, therefore, this shape of deck is much better than the conventional. In harbour, however, people like deck space and area and for this, I would have canvas stretched flat across the after part of the boat.

Stability. There can be no doubt whatever that: (a) if the wind never blew more than 7 miles per hour and (b) if we were only to have the same sail areas which we now use, the best form of stability would be obtained from a few pounds of lead on the bottom of a fin keel. This, under the given provisos would be better than having double hulls or floats. *Pelorus Jack* has just this amount of stability and in winds below 7 miles per hour, she may be expected to outsail any catamaran or trimaran she may meet.

But the winds often blow faster than 7 miles per hour and then *Pelorus Jack* would heel over at a great angle and slow up were it not for her hydrofoils. The hydrofoils shown in the *Rysa* design might be the best form but, in the plan shown here, a pair of permanently submerged hydrofoils are shown which can be given a differential angle of attack to the water by a "Joystick." They can also have their overall angle of attack increased. The "Joystick" in this case is horizontal and fore and aft when neutral and it is possible that its end could be dropped over a pin and forgotten about when sailing till one puts about on the other tack. Alternatively, the differential angle of attack might be worked by a downward pointing "Joystick" with a weight at its lower end. The pendulum effect would give the motion required. The hydrofoils can be removed when at moorings or alongside a quay wall.

The Sail Rig. As an ocean cruiser, *Pelorus Jack* is designed with extreme conditions in mind. Now, what one wants in extreme conditions is a bare streamlined mast, preferably without stays, which can either be made to weathercock so as to produce the minimum windage or, should conditions require it, will by itself produce enough sail force to beat to windward, without any canvas at all being set. But one also wants to sail efficiently in light winds when a semi-elliptical twistless sail should be best and it is hard to devise a perfect combination of these two things. The best I have done to date is to conjecture an elongated mast section symmetrical about both the fore and aft and athwartships axes on which is hoisted a semi-elliptical squaresail but a case for the balanced lugsail is made in the next section while a spinnaker which can be set close hauled is used on the model.

The Developmental Stages. The plan shows merely the kind of boat I think will suit me. The shape looks sweet in the model but may be capable of improvement. If the general design features appeal to A.Y.R.S. members, they will improve it.

The hydrofoil stabilizers would be best developed on a keel boat and I know that there will be enough interest for members to do this.

The sail rig will no doubt also be devised. My own intentions for this are to make the mast and sail for a 7 foot 8 inch dinghy (if I can find the time).

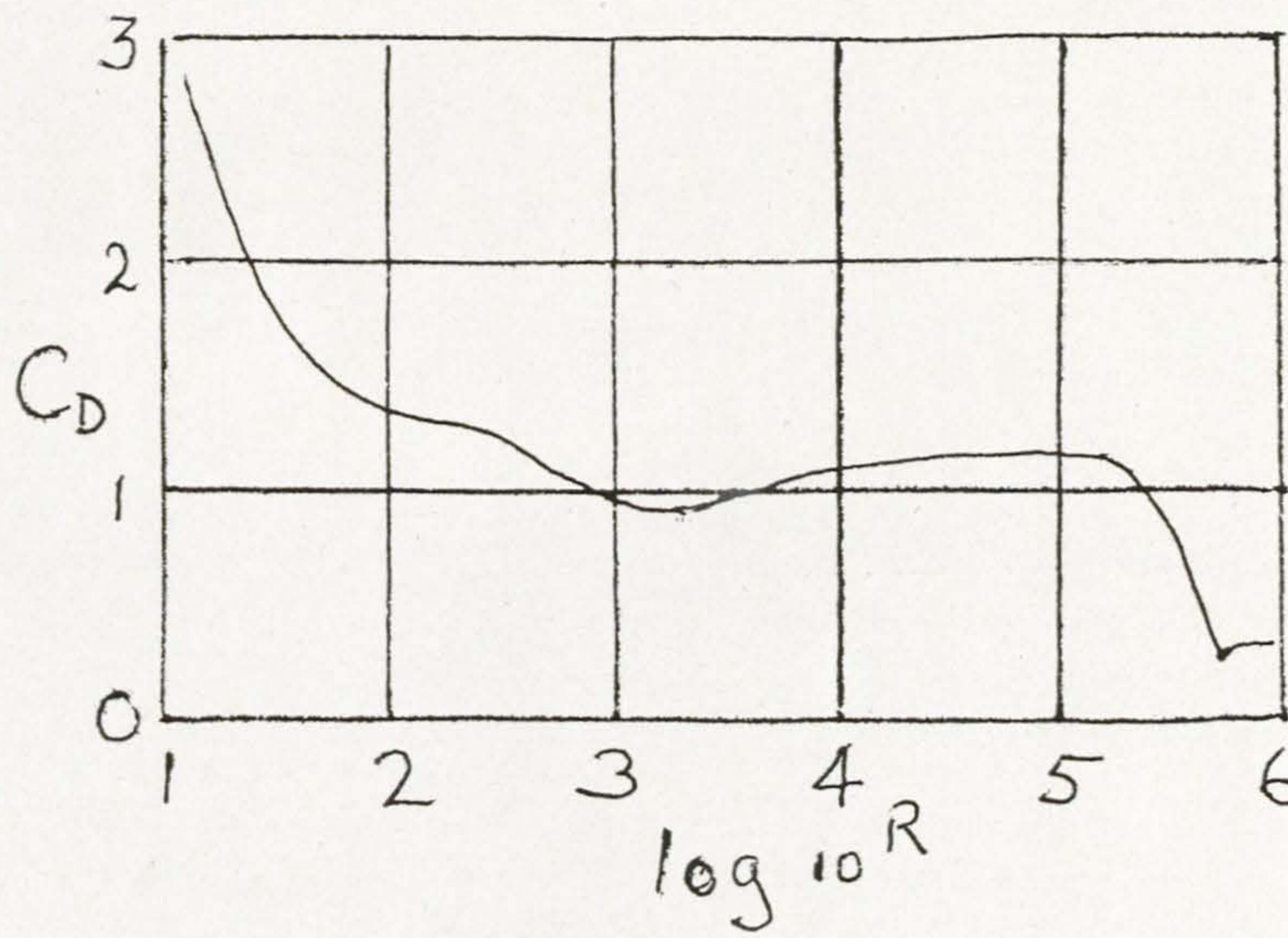
These developmental stages will be very interesting to do and, by easy steps, we will attain or object. In this way, we avoid the waste of money and heartbreak associated with making a full sized experimental craft only to find that a series of snags keep continually cropping up.

THE A.Y.R.S. SAIL

There is a good deal of evidence that a single sail, if properly set gives more thrust on all courses than several sails. This was shown by Lord Brabazon in his wind tunnel and by General Parham with his twistless single sail as well as by traditional boats, such as the Humber Keel, the Venetian luggers and many others. Unfortunately, single sail rigs are very sensitive to the angle of attack of the wind and so are slightly more difficult to trim but in our boat, this can be overcome by the self steering device which we will use.

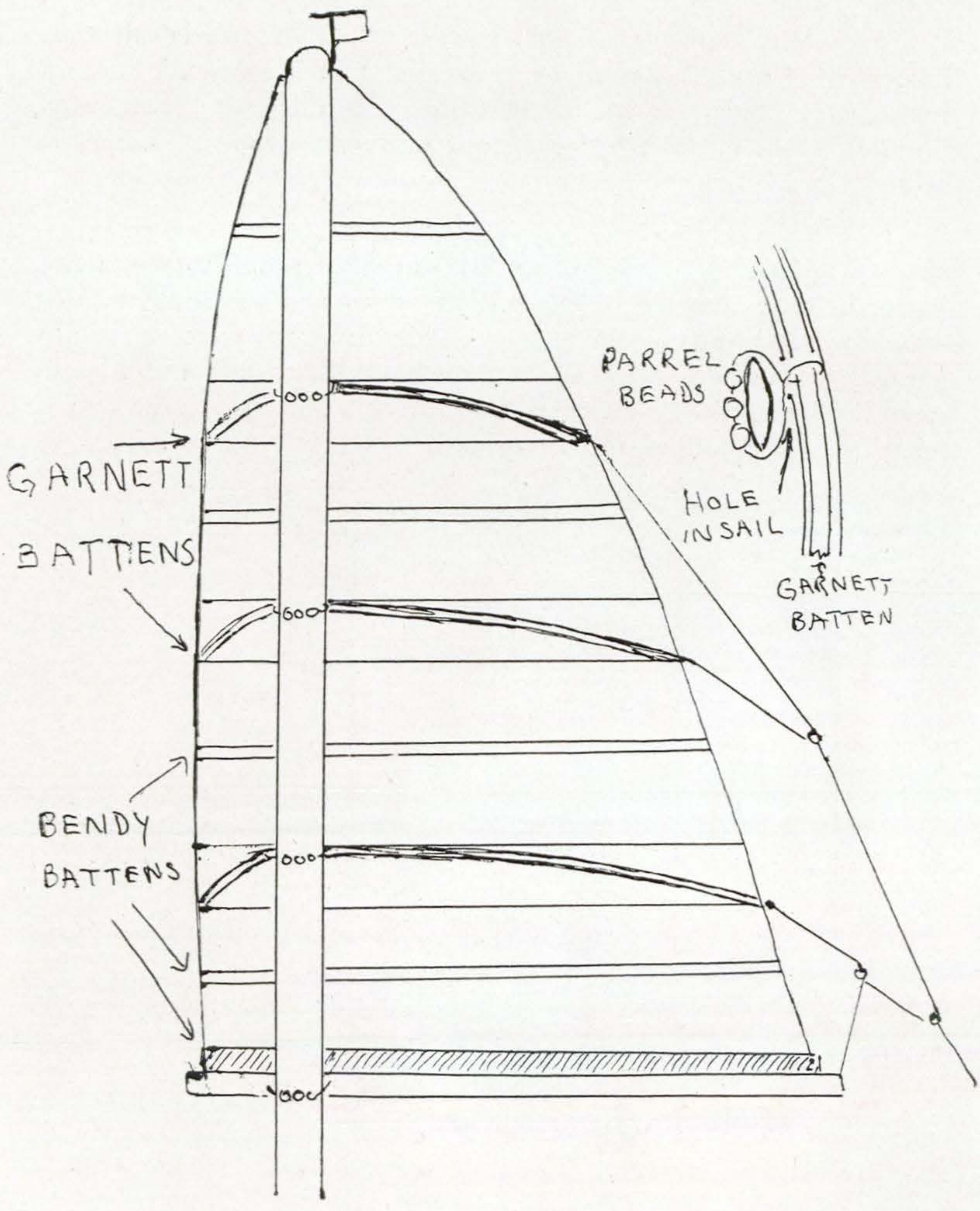
The Plan Form. It is well known to aerodynamicists that the best loading up an aerofoil or hydrofoil is of a semi-elliptical distribution and our attention has been drawn to this by Charles Satterthwaite. This means that, when our sail is twistless, the plan form should be semi-elliptical, like one wing of a Spitfire aeroplane, with a chord of the same shape all the way up.

The Mast. If we are to have a sail, as opposed to an aerofoil, we must have a mast. Now, round masts and streamlined masts which do not revolve produce eddies which spoil the wind flow on the lee side of the sail. This is very much worse in light winds as the graph of coefficient of drag against Reynolds Number shows and we must use a streamlined revolving mast.



Drag of a Circular Cylinder.

Reefing. We must have the maximum sail force in light winds but be able to reduce it quickly and easily as the wind increases until, in the greatest wind conceivable, we have the least windage possible from the bare mast. It might be life saving even then to have some drive from the mast and the streamlined mast can give this to us, even though P. V. MacKinnon has shown that a bare streamlined form can vibrate. Norman Davies, however, tells me that "Spoilers" on a streamlined form will prevent this and allow this kind of boat to be stable at moorings.



The Structure. Members will have seen the semi-elliptical squaresails and lugsails which are swung around the front of the mast on tacking which were the best sails which I could think of on my own. Then, when chatting to various people in Norfolk, I was reminded of the balanced lugsail rig which was invented thousands of years ago and perfected by the Chinese. In its modern version, the balanced lug rig was alleged to be faster than the high peaked gunter lug when short tacking up a river and it was only ousted with difficulty by the Bermudian rig from the Bembridge *Redwings* in the 1920's. Then, too, there is the experience of H. G. Hasler in the Slocum Society's Transatlantic race in 1961, with his Chinese lug. However, all these things do not make the balanced lugsail sufficiently efficient. What could give it the extra value is the use of a streamlined, revolving mast and, what may be the vital point, the use of rigid revolving battens as devised by William Garnet.

The A.Y.R.S. Sail. It is still too early to say for sure but it may be that the most efficient sail compatible with hardiness is a balanced lugsail of semi-elliptical plan form with rigid revolving battens of parabolic shape attached to a streamlined mast. With light alloy reinforcement, the mast would not need stays and a multiple sheet would be necessary to avoid twist. A "Flow" of 1 in 7 or even greater could be best. A "bonnet" attached to the foot made of Mylar or Melinex to be transparent would probably improve the performance by reducing the boom eddy and decreasing the "Drag angle" of the resultant sail and hull force.

THE CLOSE HAULED SPINNAKER

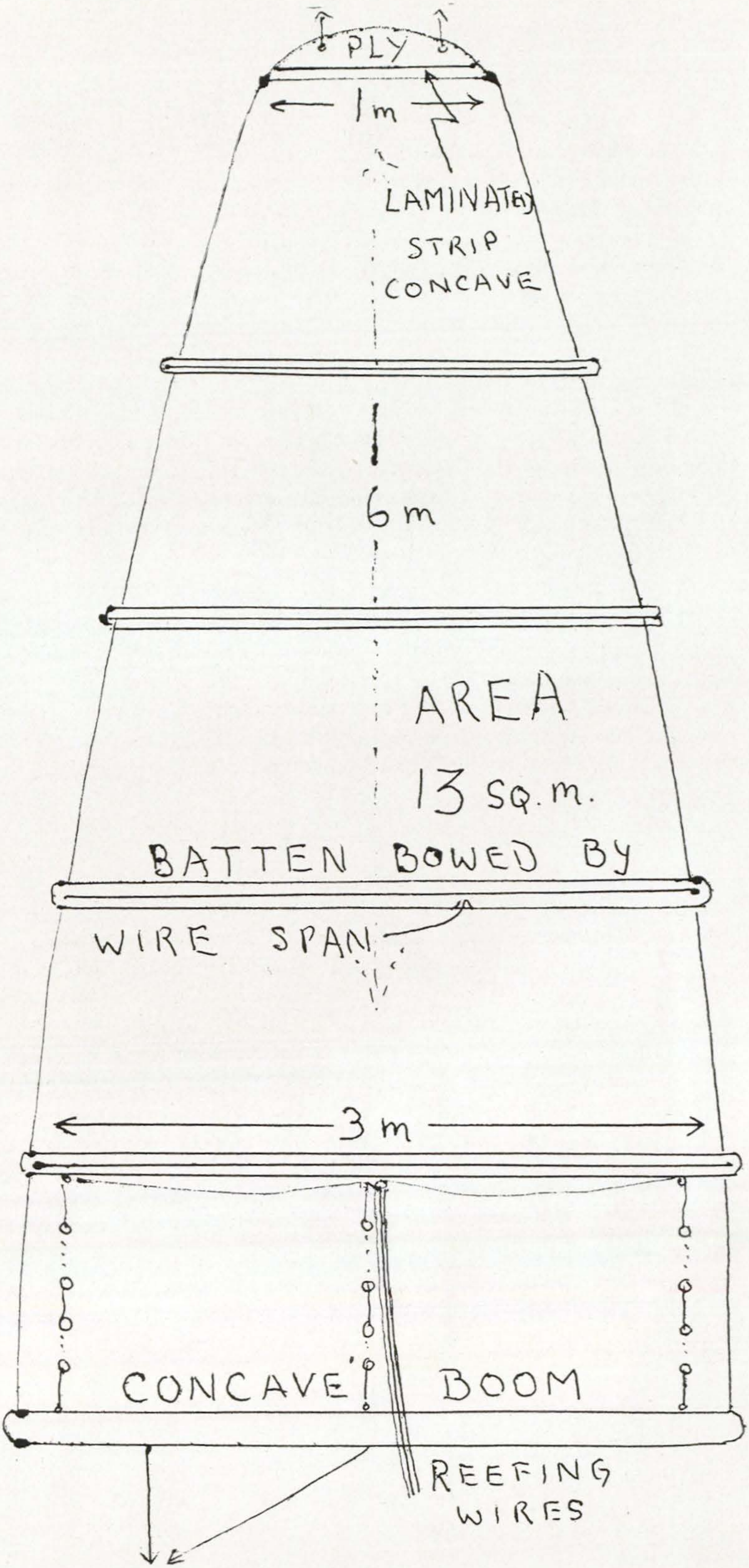
As Devised by Manlio Guberti-Helfrich

Grottarossa, Roma, Italy

There is a good case for using the A.Y.R.S. sail as a spinnaker of sorts and Manlio Guberti-Helfrich has sent in his drawings of this system.

The sail is given its flow by the use of a bent boom and battens which are kept in arcs by wire spans. For the arc to be true, of course, the battens would have to be thicker in their middles than at the ends.

Two halliards and two downhauls would be necessary to make the sail easy and safe to handle by bringing the axis of rotation forward of the centre of effort. A single or multiple sheet could be used.


PLY
1m
LAMINATED
STRIP
CONCAVE
6m
AREA
13 SQ. m.
BATTEN BOWED BY
WIRE SPAN
3 m
CONCAVE BOOM
REEFING
WIRES

The mast could be streamlined and placed inside the wire spans of the battens. If the sail showed any tendency to flog, the wire spans could be attached to the mast by loops.

The reefing arrangement is astute. It was first used to my knowledge some 2000 years ago by the Romans in their cargo ships which brought grain from Egypt to Rome.

CATAMARANS AND TRIMARANS USING THE A.Y.R.S. HULL

The Catamaran. Two *Pelorus Jack* hulls could be attached side by side as was done by James Wharram and Antonio Neto of Brasil. This would be most suitable for tropical waters. In colder climates, however, most people would want accommodation in the bridge deck and this would not be hard to arrange. With the rounded decks of the *Pelorus Jack* hulls the windage would be less than with the square sided "boxes" which tend to be put on the bridge decks of catamarans.

The Trimaran. Two floats of nearly the same length as the main hull could be added and this would make a cheap trimaran very suitable for ocean cruising. But, for inshore sailing, most people would again like to extend the accommodation over the water and the modifications necessary to achieve this would not be great.

THE A.Y.R.S. HYDROFOILS

After eight years study and constant discussion with a host of members, I am still convinced that the simplest form of hydrofoils either as stabilisers or lifters are the inverted T foils which Sam Catt and I tried out in 1954 and which were described in publication No. 2. I think some people have been put off from repeating our experiments by the apparent need to have an extra control and the general cumbersome nature of the foils we used. It is my feeling, however, that his form of hydrofoil stabiliser can be set and then forgotten about till the boat puts about or the course is altered.

The *Rysa* hydrofoils described earlier in this publication are merely a simple improvement of our original concept and the foils shown in the *Pelorus Jack* plan are almost the same but modified by a "Joystick" addition. These latter have the advantage of being easily removeable which is a necessity for a cruising boat in order to allow the craft to lie alongside a quay wall or at moornings. Also, *Pelorus Jack* is of a size which would allow it to be put on a trailer and taken home after each sail.

A MICRONESIAN HYDROFOIL CRAFT

BY JOHN MORWOOD

L.O.A. 20 ft.	L.O.A. Float 10 ft.
L.W.L. 17 ft.	Beam Float 3 ft.
Beam (hull) 3 ft.	Sail Area 200 sq. ft.
Beam O.A. 14 ft.	

This craft was originally conjectured and described in publication No. 36 *Floats, Foils and Fluid Flows*. Having now made a model of it and shown it at this year's London Boat Show, I am more than ever convinced that we have here the ultimate in theoretical sailing efficiency.

The Hulls. These are made of sheet plywood more or less to the *Rysa* forebody design but with a rounded "forefoot" at both ends of the large and small hulls. The two hulls are asymmetrical about the fore and aft as well as the athwartships axes. The beam of each hull is the same because the float will be very little, if at all, immersed when its relative beam begins to hold it back.

The Bridge Deck. In the model, this consisted of athwartships balsa wood planking but in a full sized craft it would be a plywood sheeting on either side of planks on edge to give a strong box girder construction.

The Hydrofoils. These are all the same size and shape. Of triangular plan form the upper chord is 3 feet long and the span is 4 feet 6 inches. The thickness at the base is 3 inches. The lee side is flat and the weather side is an arc of a circle (ogival section). The foil on the float is fixed but the other two foils are steerable, though only the after one on each tack is used as such, the forward foil on the main hull being fixed by dropping its tiller on a peg. On an even keel, all foils slope up to leeward as suggested by Commander Fawcett at 60°.

The Sail. On my model, the sail is a semi-elliptical squaresail, whose braces all come to a sprit at right angles to the sail. This rig is similar to Captain Mellonie's A.Y.R.S. No. 33. Unfortunately, in my rig, the braces to the top "yards" go up at a very acute angle, which might not give them very good control.

The Theoretical Evaluation. In this craft at low speeds, the hydrofoils might give excessive wetted area but the wetted area of the hulls would be small and might balance this. The semi-elliptical sail would be efficient, making the overall efficiency of the craft good.

In sailing as a displacement craft, the side force of the sails would largely be taken by the foils and converted into half its value as vertical lift which would be useful.

Rising from the Water. If the craft is now allowed to heel, the dihedral angle of the foils would decrease from 60° to about 45°, thus converting the side force of the sails into the same amount of vertical lift and, if the wind and righting moment of the crew are great enough, there is every hope that the craft would leave the water and run along on the three foils.

The Craft as a Flying Hydrofoil. Once up on the hydrofoils, one would then attempt to get the craft back on an even keel when it would become the nearest thing to "The Theoretical Yacht" which it is possible to imagine. Steering is by the aft foil and the crew would be at the end of trapezes, outside the float.

Possible Faults and Difficulties. 1. Getting the structure light enough. 2. Getting the sail to sit well without twist which would be in the opposite sense to that of a normal sail, i.e., the head would be more fore and aft than the foot. 3. The steering might be difficult for several reasons: (a) the "overbalanced" steering foil can develop a violent luffing force if there is a fraction of lee helm. A "stop" would prevent this. Weather helm is not so unbalanced but more normal steering might be achieved by a piece of shock cord acting against it. (b) The sail force comes much farther aft of the centre of lateral resistance than with any normal boat. I cannot guess the effects of this.

Summary. A Micronesian hydrofoil craft is described which could be the nearest possible craft to "The Theoretical Yacht."

EXPANDED POLYSTYRENE BOAT CONSTRUCTION

BY D. C. JEFFREY

I have completed four years of sailing and racing my expanded polystyrene catamaran *Chiquita II* and can now report on its durability and general performance.

The construction was described in the December 1958 issue of "Yachting Monthly" but here are the salient features:—

The hulls were formed without moulds from slab Polyzote $1\frac{1}{2}$ in. thick and bonded with Aerolite 306. The rounded bottoms were shaped "bread and butter" fashion and finished to templates, then the complete structure glued together as shown on the drawing. The aft, centre and forward crossbeams are the only parts of wood but experience has shown that even these and the fixed keels could have been of *high* density Polyzote.

The skin over all surfaces is Araldite epoxy resin on 10 oz. glass cloth. Note that cloth must be used instead of mat to produce a smooth surface and reduce the sanding time. The latter is the only snag in the process, i.e. excessive time to dress the resin surfaces smooth.

It will be observed that the hull lines are similar to the Prout *Shearwater* and the performance about equal. *Chiquita II* is lighter but the fixed keels slightly reduce the speed off the wind.

The boat has been exceptionally durable. There are no cracks or signs of wear anywhere, although the epoxy-glass is only .040 in. thick. The boat is much more rigid than one built of ply, due to the thickness of the Polyzote.

Since building this boat I have been investigating alternative boat building materials with a view to improving "dimple resistance," reducing labour and cost of material.

Dimple Resistance

I use this term for want of a better one to describe small area resistance of the surface material.

Boatbuilding materials can be defined in three ways :—

(a) Panel rigidity.
(b) Dimple Resistance.
(c) Surface hardness.

For example, marine plywood has poor (a), good (b), but only fair (c), whereas foamed polystyrene epoxy glass contruction has excellent (a), poor (b) and good (c).

Practical tests on a wide range of materials have shown the following plastics to be suitable for boatbuilding.

High Density Polyzote/Epoxy Glass

By using foamed p.s. in 4 lb. per cub. ft. density instead of the usual 1 lb., greatly improved dimple resistance is obtained. I have used this with only .020 in. F.R.P. for a deck $\frac{3}{4}$ in. thick and this made a fine job with minimum labour but still rather costly in materials.

Laminated High/Low Densiiy p.s.

Low density Polyzote $1\frac{1}{2}$ in. thick was urea glued to $\frac{1}{4}$ in. thick 4 lb. Polyzote and this produced an excellent combination of properties. I again covered it with thin F.R.P. but I believe satisfactory hulls could be produced if the surface were only filled and painted with a modern tough paint. An extremely light and rigid hull can be built in this way.

Sheet Polystyrene/Foamed p.s.

I have found that sheet polystyrene (e.g. Bextrene supplied by BX Plastics Ltd.) can readily be bonded to the same material foamed. The Bextrene must be roughened and carefully degreased after which epoxy resin or the cheaper urea glue will give good adhesion. This immediately solves the surface finishing problem, gives good (a), (b) and (c) above and is light and cheap. Almost the perfect boatbuilding combination except for one thing—it is good only for single curvature work in large sheets.

However, double curvatures can be produced by laying on the Bextrene in strips as in laminated wood boatbuilding and bonding the joints with epoxy/glass.

Although considered a slightly brittle plastic, Bextrene is amply tough in thicknesses down to .060 in. for covering hulls. I have just completed a rigid aerofoil or wingsail for *Chiquita II* made of $\frac{3}{4}$ in. low density Polyzote covered with Bextrene only .010 in. thick and this has resulted in an extremely light, rigid and smooth structure.

An alternative to Bextrene is the same Company's Cobex which is a rigid P.V.C. sheet. This material has superior strength and impact resistance but is 50 per cent. heavier, more difficult to bond and a little more expensive.

Solid Plastic

It is now possible to build plastic hulls without foam backing using sheets of Bextrene, Cobex or high density polyethylene for hard chine construction. Hulls built of these materials instead of plywood would prove extremely durable, light, inexpensive and would require less finishing and painting. From the present range of plastic materials readily available, the above mentioned have shown in tests to be the most suitable for boatbuilding. Many alternative foamed and solid sheet plastics could be used but in most cases, high costs rule them out.

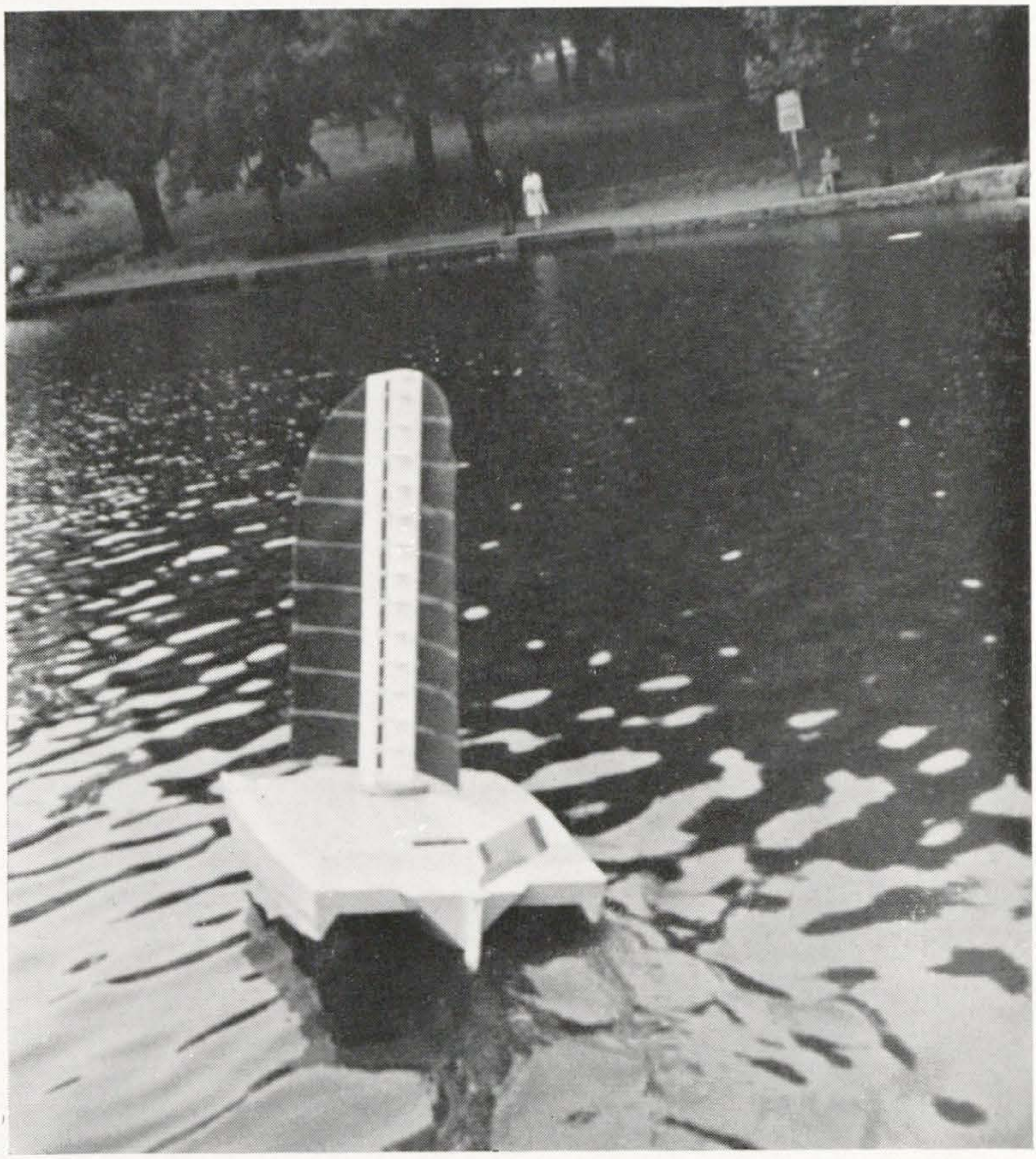
In view of the very real advantages of plastic construction, I feel sure that there is a big future, not only in the established fibreglass resin method, but in the foamed and sheet construction of little ships.

LETTERS

Dear Sir,

I have recently drawn up rough plans for an ocean-going trimaran: L.O.A. $37\frac{1}{2}$ ft., beam $20\frac{1}{2}$ ft., draft $2\frac{1}{2}$ ft. Photos of a 12th scale model are attached. The main hull is a 90° triangle, and the float hulls are of variable angle—max angle being 60°. The sail rig will be a symmetrical laminar aerofoil semi-elliptical squaresail on a double ladder aerofoil mast on a revolving turntable.

I am, however, thinking of using two similar sails of higher aspect ratio mounted in tandem on single aerofoil masts with stays, the present rig being unstayed. All controls will be by push button from the control panel. Self-steering gear will consist of a vane mounted on

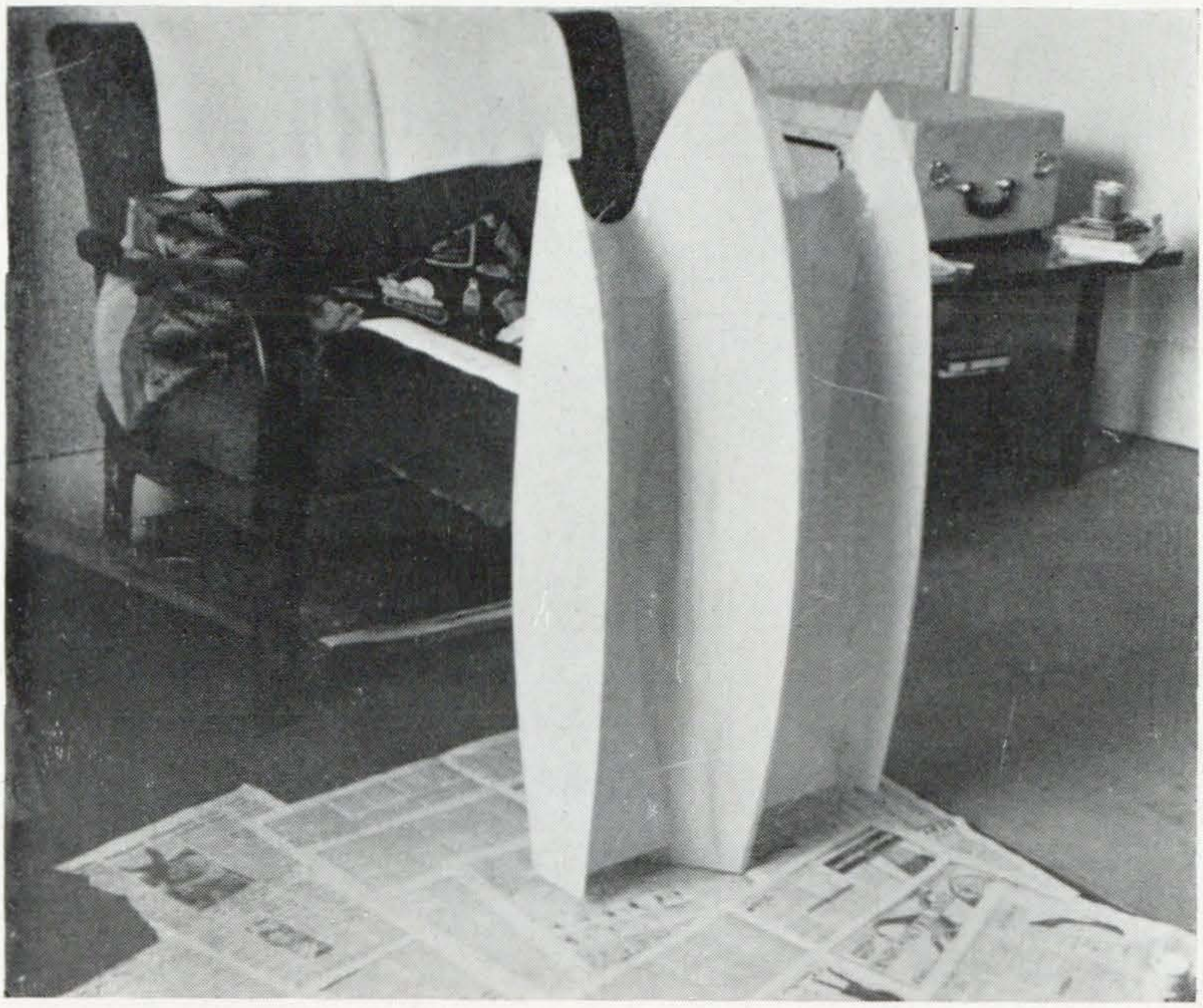


a servo flap on the rudder, a braking device being connected to the control panel by Bowden cable, enabling the vane to be clamped when the boat is trimmed on course in a steady wind.

I don't want to go into too much detail in this letter, but I would like a chance to show the model and plan and to get your opinion and criticisms, particularly on the sail rig and self-steering devices.

I hope to start construction within the next few months provided I can find somewhere to build and get the necessary finance. I intend using the boat for a round the world cruise, possibly solo.

As you can see from the photos I have already tried out the model, but the servo vane steering wasn't much use as there was no way of



controlling the sail. The model tended to come into the wind and lie with the sail in line with the wind. However, when the balance was just right it went very fast—as fast as the wind I should guess, and this speed probably added to the inefficiencies of the steering gear. I hope to try a vane incorporating a Pelton wheel sort of mast balancing device which I think might do the trick at fast speeds. I also want to couple the sails with the vane, which will entail the vane controlling the rudder rather than a servo blade.

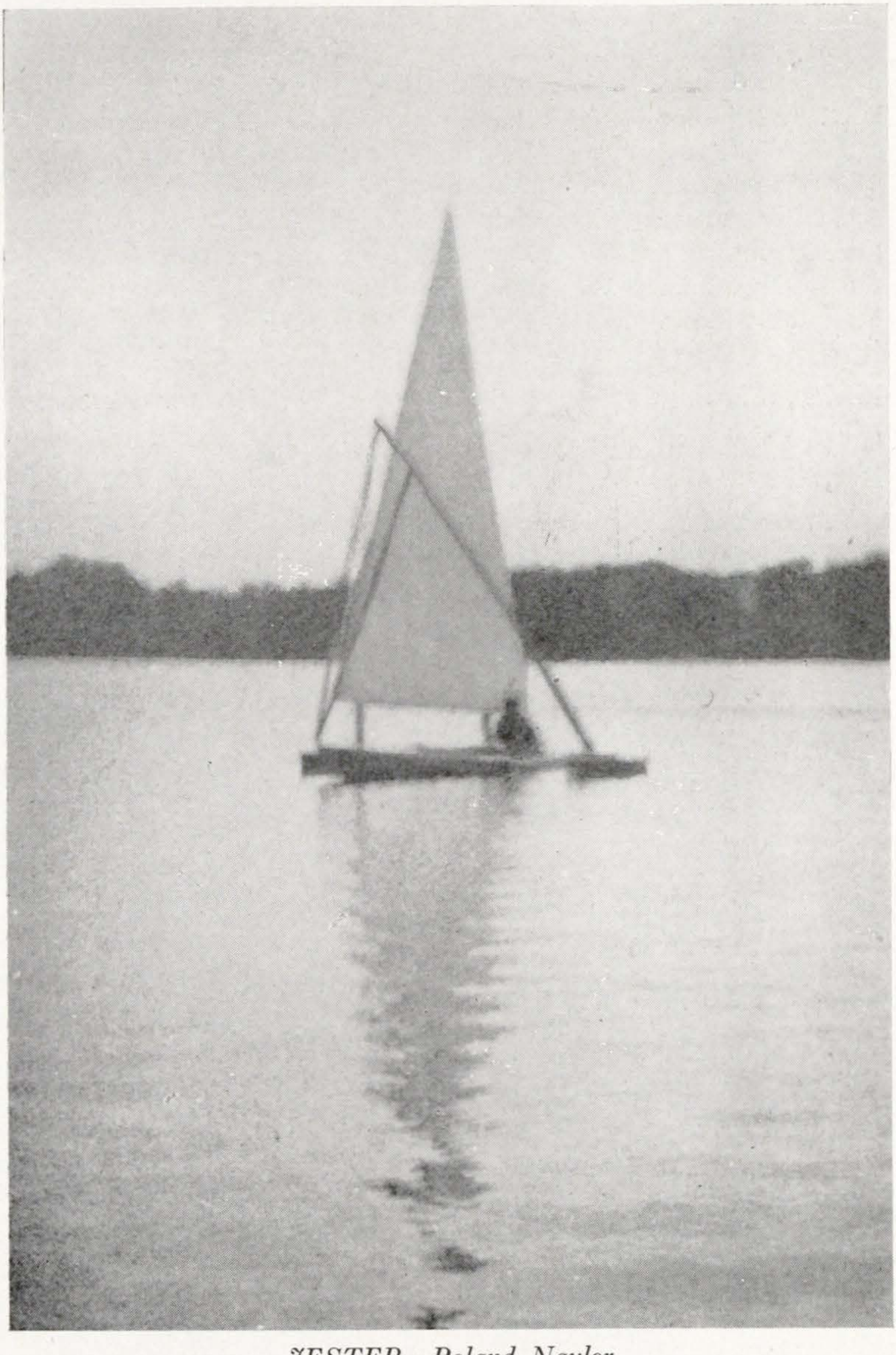
I may also try the twin-rig at the same time, this rig being more simple to construct and rather more secure than the single unstayed aerofoil.

I would like to call and see you some weekend if possible to discuss the design, and if this is possible perhaps you could suggest a convenient date.

The boat is very a la A.Y.R.S. and I think that the Society is serving an excellent purpose by bringing to the attention of the Members the latest advance in boat design and construction.

L. G. Walker.

41 Philbeach Gardens, London, S.W.5.



JESTER—Roland Naylor.

Dear Sir,

I now have a *Kayak* rigged for sail with outriggers. It is a lateen rig with a bi-pod mast. I put the bi-pod mast on after pulling out eye bolts from the deck on one occasion, and parting a stay on another. Since putting on the bi-pod mast, I have been out in some real "dusty" going, and have no trouble with stays and miscellaneous gear going overboard.

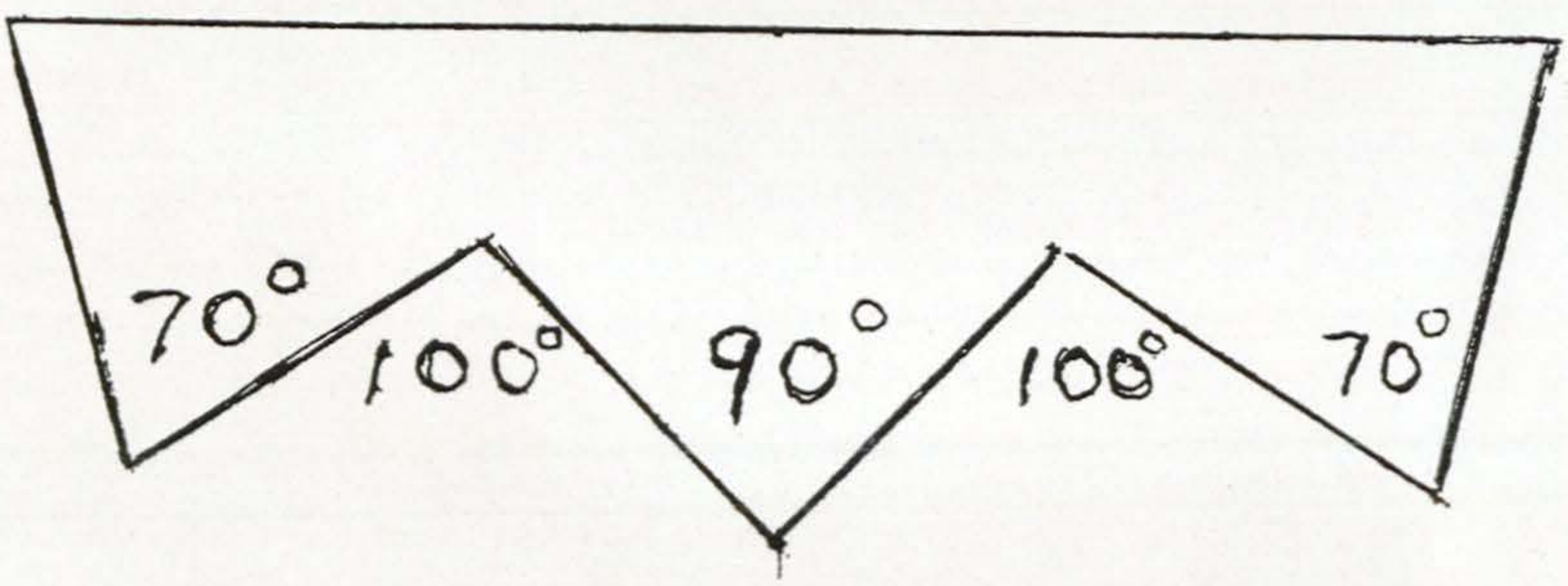
I hope to replace the floats next spring with longer floats, using the Micronesian style as used by Erick Manners on his tri-cruiser in Publication No. 39. I am also going to relocate the sail, as she doesn't head up into the wind as quickly as I would like.

Yours sincerely,

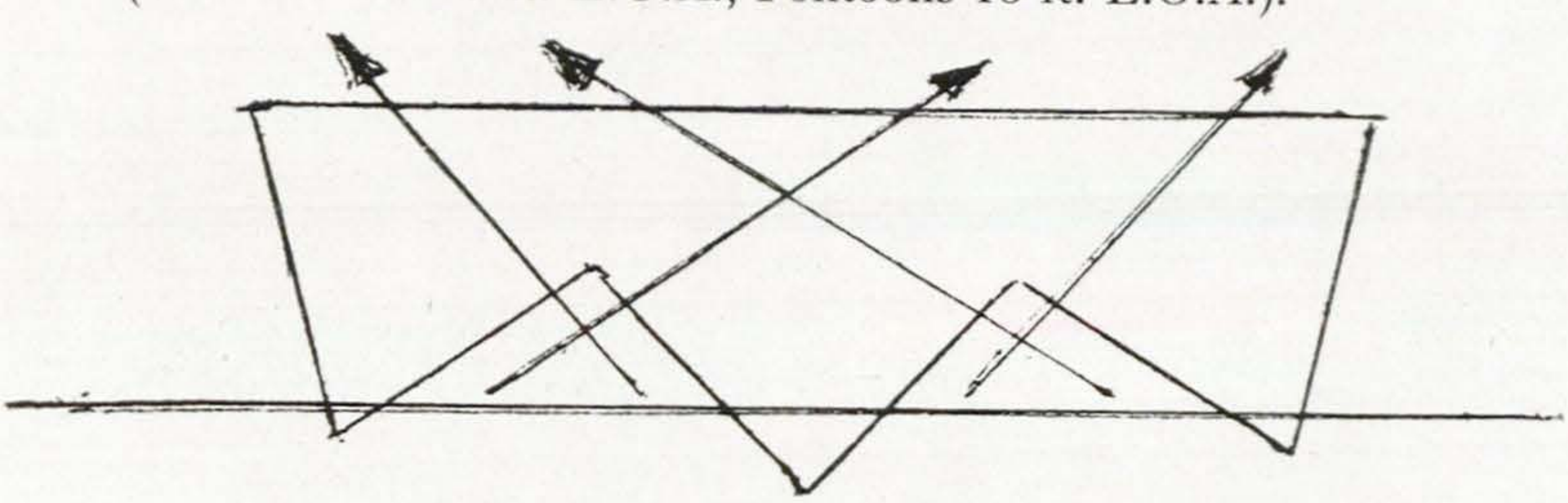
Linden, Mich. ROLAND NAYLOR.

Dear Sir,

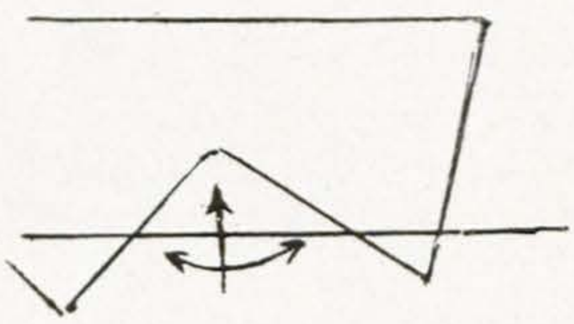
Recently I have had opportunity to be grateful to you and A.Y.R.S. for information on your numbers on Tris. Shapes had me bothered in a new drawing I am making of a 43 ft. TRI for offshore cruising. I got lots of reassuring data from you. Am especially interested in your idea of relating length and shape of pontoons to depth of submergence and possible speeds at those depths. *Of course* one should relate these. Would like to warn you that a certain shape in TRIS does *not* work well: I draw a little sketch.



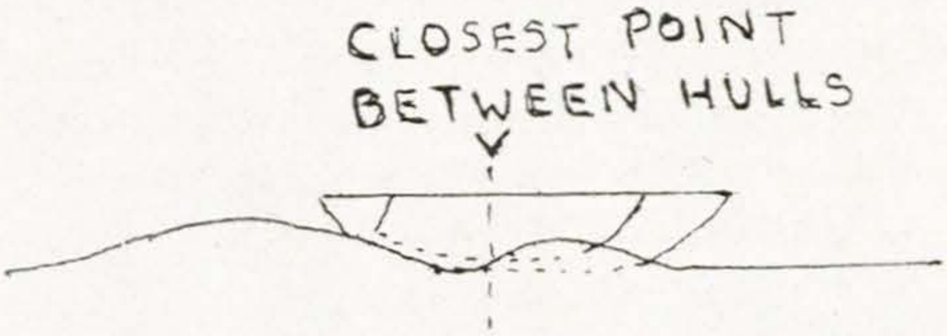
(The Tri was 23 ft. L.O.A., Pontoons 18 ft. L.O.A.).



The reasons are the spray and banging first thus—so that when you hit a wave at 45° (close hauled) you get a terrific slam and spurts of water as shown—the spurts to windward off the weather bow of the main hull and the weather bow of the lee pontoon are the worst, but the spray is a *mess*. Second—the shape seems to constrict the flow

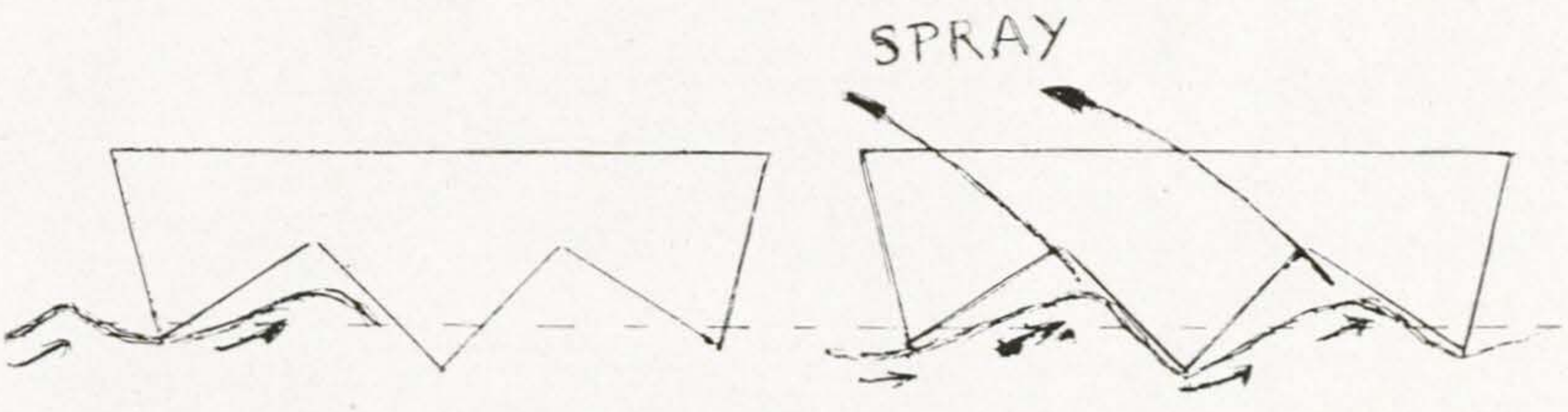


of water between the pontoons at the mid point of max camber and there is a sharp drop of the water level there, with a large wave aft and a large wave forward, thus:

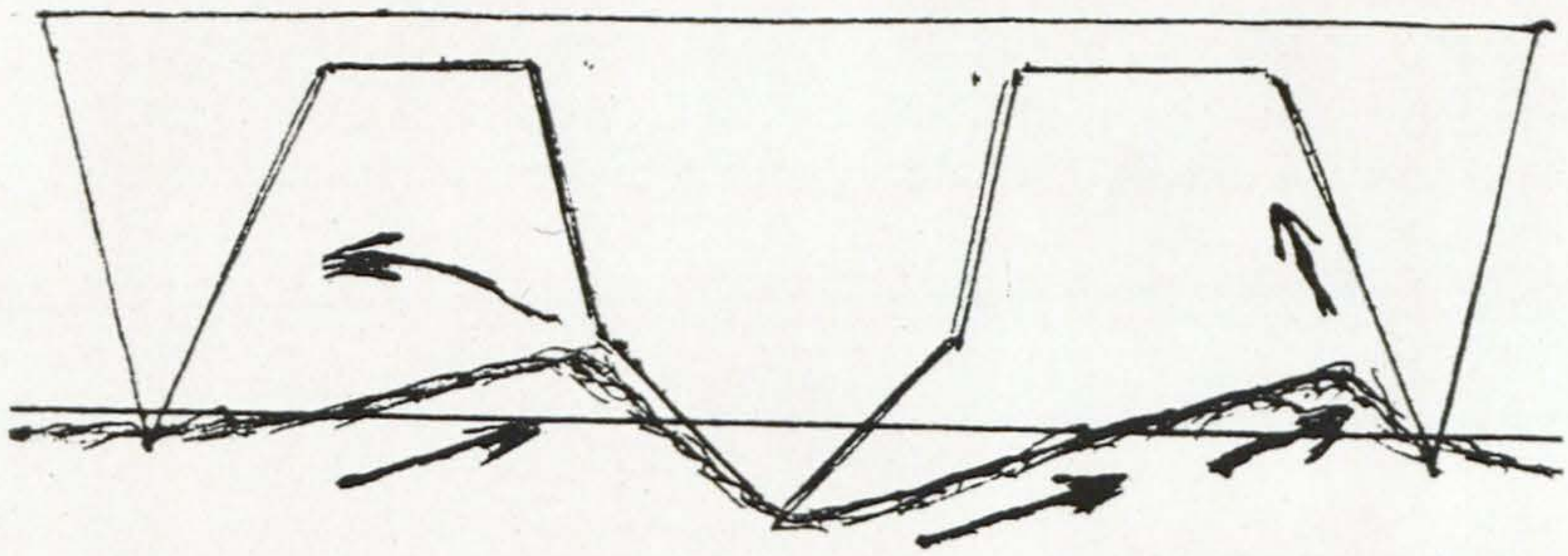


I think my hulls were too short and stubby, but I never dreamed I'd have so much wave making. I also noticed a "section gap" on the outer face of the weather pontoon, indicating (a) that there was rather a lot of leeway, or (b) that the rather straight outboard face of the weather pontoons was not following with its contour the lines of laminar flow. It's possible it was too flat.

The banging and spray going to windward is caused, I think by the coincidence of the angle of the wave face and its complement, the angle of the hulls, thus:



If the hulls were of the usual design then :



The spray would be divided and the force of the wave destroyed—I think this in fact happens. I believe, now, that the angle of hull side should be steeper than that of a wave face, or more or less so—a shallower angle or the same length will bang badly.

In conclusion, it's interesting to note that we get the "squeeze out" effect even with a calm wind and some head drop—not to say swells which do not exist here on the estuary, so it's not the cresting chop or the boat's speed that does it, but the shape of hulls and wave undulations.

A. F. MADLENER.

Once de Septembre 1856, 60A, Buenos Aires, Argentina.

Dear Sir,

The loss of the *Nimble Eve* continues to be quoted by those who strive to prove that multi-hulls will never be of any use for cruising or deep sea work, I cannot speak for cats—but let me outline a few facts about trimarans which, surely, speak for themselves!

Last winter (1961/2) I made 63 demonstration trips in *Nimble Eve*. Seven were in windspeeds of Force 8 and above, and 23 in excess of Force 6. I carried all plain sail closehauled in a squall of 43 knots, registering 14 m.p.h. on the speedometer. I sailed on all trips regardless of weather conditions.

Throughout all demonstration trips, *Nimble Eve* never carried a greater load than 12-15 cwt. The primary reason for her loss was overloading; Mr. Leaf, with a crew of 4, loaded the biggest supply of equipment I have ever seen put into a small yacht. Afterwards, on carefully working out all the weights, it would seem that he put on board between 1 ton and 1¼ tons including the weight of his crew.

In the event I noted that the water mark was submerged by approximately 5 in. forward and 7 in. aft and I warned him that in my opinion the boat would not be safe for winds exceeding Force 5. As he ran into Force 10 it is not surprising that he suffered damage.

Arthur Piver gives the loading rule of his trimarans as: three-quarters the built weight of the craft, including mast and sails, but excluding all other fittings such as pulpit, anchor and chain, outboard and bracket, water-tanks, mattresses, lavatory, cooker etc. In the case of *Nimble*, which weighs one ton when built, the maximum load is therefore 15 cwt. Total "extras" outlined above will amount to approx. 3 cwt. so that only 12 cwt. is left for crew, food, crockery and cutlery, blankets, water (at 10 lbs. per gallon!) and fuel (at 8 lbs. per gallon!) etc.

A trimaran which has been carefully loaded can undoubtedly survive almost any conditions and Arthur Piver reports that American *Nugget* No. 128 (24 ft. x 14 ft.; built weight 800 lbs. carrying capacity 530 lbs.) survived a typhoon in the Gulf of Siam in October 1962. Wind speeds were 80-90 knots and the owner, Major Wayne-Norwood said that a thermos flask, inadvertently left on the saloon table, was still there some hours later! No damage was reported to the craft. We have had many similar reports concerning Piver's trimarans.

When De Havillands built the Mosquito of balsa and ply during the War, our Government at first scorned such a flimsy aircraft. Yet balsa, ply and glue proved stronger than such mighty creations as the Flying Fortress which, in spite of its size and weight, couldn't carry as many bombs as the Mossy—and certainly couldn't fly as fast!

Why, then, shun the safety of lightness at sea?

This winter (1962/3), skipper Mike Fowler has so far made about 40 demonstration trips of which eight have been in winds of Force 8 or more—however, cancellations have been necessary because of cold, blizzards and ice.

Can cats claim such a record?

Cox Marine Limited are sole concessionairs for Piver's range of trimarans in the U.K., Europe and Africa. We also sell to America and, in fact, anywhere else in the world. Since the launching of *Nimble Eve* on December 1st, 1961, we have sold the following trimarans in conjunction with our Northern representative, P. & E. Patterson, The Shop, Soutergate, Kirkby-in-Furness, Lancs: 16 ft. *Frolic*, 5; 20 ft. *Banner*, 9; 24 ft. *Nugget*, 45; 27 ft. *Chariot*, 2; 28 ft. *Encore*, 1; 30 ft. *Nimble*, 48; 32 ft. 6 in. *Herald*, 5; 35 ft. *Lodestar*, 10; 40 ft. *Victress*, 7; 45 ft. *Medallion*, 1; a total of 35 trimarans have been built professionally in the U.K. since *Nimble Eve* was launched —most of them by Contour Craft, Limited of Great Yarmouth who build under licence for us.

Yet in spite of all this evidence in favour of Piver-designed trimarans (and no other trimaran designer has yet achieved such amazing results), most yachtsmen are cynically disinclined to give any credit to the creator of the first major breakthrough to safer yachting for many years. Not to worry—the time will come . . . .

The time will come, I am quite confident, when the mono-hull will be as rare as a Thames Sailing Barge or a Ship . . . When the majority will cross oceans in tri's as a form of temporary escapism (one year's release from the Rat Race) . . . when top speeds of 30 knots will seem laughably slow . . . when a trimaran surpasses the clipper-ship boast: "Hell or Melbourne in 60 days" . . .

We shall see.

Yours sincerely,

S/Ldr. D. H. Clarke, d.f.c., a.f.c. (ret.).

Cox Marine Ltd.

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