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HYDROFOIL VICTORY

A.Y.R.S. PUBLICATION No. 62

The A.Y.R.S. member — Dick Andrews

CONTENTS

AMATEUR BOAT BUILDING SOCIETY IS FORMED

A new organization for amateur boat builders has been formed with the aim of co-ordinating the interests and activities of the thousands of "back yard" yachtsmen throught the world. The group plans to catalog hundreds of available plans, commission new designs especially for amateur building in both sail and power and in all materials, and serve as a clearing house for technical questions and information of value to the amateur builder. Other goals include the establishment of local clubs with central building facilities in order to move the amateur from the back yard into heated, lighted, well equipped shops. A monthly publication reports on boating activities of special interest to the amateur and carrys building plans of several boats.

For further information write: International Amateur Boat Building Society, 1535 W. Farwell Ave., Chicago, Ill. 60626.

EDITORIAL

October, 1967.

The Annual Subscription to the A.Y.R.S. is now due. It remains at £1 or $5.00 as before and should be sent to Woodacres, Hythe, Kent, England. We thus distribute the publications for most of the members but Australian, French and New Zealand members may either subscribe to their "National Organisers" or to us, as they wish. If subscriptions are not paid by January 1st, 1968, No. 63 will not be sent. Again, Bankers Orders are enclosed for the convenience of members so that subscriptions will be paid each year without effort.

If anyone has had a misbound or faulty copy of a publication or has not had his full four, will he please let me know.

Winter Meetings 1967-8. Dates and subjects are as follows:

Tuesday 3rd October, 1967. The Multihull Capsize.

Tuesday 7th November, 1967. Arthur Piver will talk and show film.

Tuesday 5th December, 1967. A debate: "That the Atlantic can be defended against nuclear-powered submarines by 30,000 sailing trimarans." This debate could be fun but we need more people to speak in favour of the motion.

Tuesday 2nd January, 1968. Hydrofoils.

Tuesday 6th February, 1968. Subject not decided.

Tuesday 5th March, 1968. Subject not decided.

Tuesday 2nd April, 1968. Subject not decided.

The Weir Wood Meeting. This will be at Weir Wood Reservoir, near Forest Row, Sussex on October 14th and 15th. Sailing will begin at 10 a.m. on both days. These meetings are tremendous fun with members bringing their experimental and conventional boats. If you intend to bring a boat, however, it is most important that you contact the Organiser, Dennis Banham, Highlands, Blackstone, Redhill, Surrey. No one may sleep aboard their boat or in the reservoir area.

The London Boat Show, 1968. Will members with models or anything else which could be shown, please contact the Hon. Editor. As usual, we need stand helpers. Anyone who would like to help on the stand—and no great erudition is needed—please write in.

A.Y.R.S. Ties and Windsocks. A.Y.R.S. ties with a single device cost £1–1–0 or $3.00 each. Dinghy-sized windsocks are 5½ inches long and cost 14/- or $2.00. The Cruiser-sized windsock is 16 inches long and costs 28/- or $4.00. The windsocks are lettered with A.Y.R.S. on each side.

Advertisements. A full page advertisement in our publications costs £12 or $40.00 for an inside page and £20 or $60.00 for a back page—an increase over what we have previously been charging. The back page is only given to regular advertisers. These low prices only just cover the cost and matter for them is only accepted at the discretion of the Editor and must be in our hands at least two months before the publication is due.

An Ocean Cruising Section. As your Editor, I think that a study of the open ocean is relative to our ends. Races like the Round Britain Race or the Single-handed Trans-Atlantic Race give us a lot of information but the casual ocean wanderer can also pile up information of a totally different kind and I think we should keep in touch with it. I therefore think that with each issue we should have a few letters from ocean wanderers and these will be put at the last few pages.

Complete Sets of Publications. A complete set of A.Y.R.S. publications, starting from the beginning is relatively rare. It would be nice to know where these are so that we can keep a track of them and keep them alive. Would people with complete sets drop me a line?

Los Angeles Section A.Y.R.S. This is the most active section of all. They have had some interesting meetings as the following list shows. Their energetic Hon. Sec. is
John R. Novak, 23100 Vanowen Street, Canoga Park, California.

Subjects for their meetings in the last two years have been as follows:

March 1965
Hugo Myers—Theory of Sailing with Applications to Modern Catamarans.

April 1965
Film—35 knot Sailing Hydrofoils.

May 1965
Ken Bruns—High Speed Sails.

June 1965
Allan Arnold—Scale Models and Towing Tanks.

July 1965
Bill Rogers—W.E.T. Program.

August 1965
Morris Wright—Cambering and Reversible Sail Foils.

September 1965
Ralph Morris—Production Model 13 ft. Trimaran.

October 1965
Allan Arnold—Film and Discussion of 22 ft. Catamaran.

November 1965
Jerry Magarian, Allan Arnold, Hugo Myers, Bill Rogers — Round Table Discussion of Hull Design.

December 1965
Bill Rogers, Allan Arnold, Joe Dobler, Ed Horstman, Jerry Magarian, Bob Mosier, Hugo Myers — Round Table Discussion on Hull Design.

January 1966
Allan Arnold, Joe Dobler, Hugo Myers, Jerry Magarian, Bill Rogers — Round Table Discussion on Bow and Stern treatment.

February 1966
Joe Dobler—Trimarans.

March 1966
Ed. Horstman—Cruising Trimarans.

April 1966
Neil Harvey—Results of National One-of-a-Kind.

May 1966
Norm Riise—"Wild Wind."

June 1966
Stan Berman—Globemaster Trimarans.

July 1966
Fred Greenfield—25 ft. Trimaran.
Ralph Flood—15 and 19 ft. Catamarans.

August 1966
Jud Grant—Hedley Nicol Trimarans.

September 1966
Jay Johnson—Fiberglass and Foam Spraying.

October 1966
Dave Bradley—C. Class "Whirlwind".
John Walti—19 ft. Del Mar.

November 1966
Ed. Horstman—Cruising Trimaran Design.

December 1966
Hugo Myers—Proposed 46 ft. Catamaran.

January 1967
Terry Lewis—Sandwich Structures.

February 1967
Two Films:
- Care and maitenance of stainless steel.
- Finishing stainless steel in the shop.

March 1967
Lauren Williams—Trimaran Sailing Techniques.

April 1967
Will Beaumont, Bill Rogers — Film and Discussion of Hustler a 30 ft. Trimaran.

May 1967
Tape—Round Britain Race.

GROUP ORGANISERS

A. T. Brooke, 75, Craiglockhart Rd., Edinburgh 11.

Dennis Banham, Highlands, Blackstones, Redhill, Surrey.

F. Benyon-Tinker, 49 Pillar Gardens, Northfield Lane, Brixham, Devon.

M. Garnett, 7 Reynolds Walk, Horfield, Bristol.

John R. Novak, 23100 Vanowen St., Canoga Park, Calif, U.S.A.

approaching yachtsmen, the latter, possibly), I didn't rig the gear completely at the start. It was so rough when we did get around that I wasn't able to do the necessary things straight away. Then, two events occurred before I might have been in a position to prove the gear. 1—The blade kicked up on striking something in mid-Caribbean and the narrow part split. My replacement blade (of more normal shape, meant for local cruising when we got here) has no provision for the tab and 2.—With tiller lashed, close-hauled, she self-steered anyway! This was our point of sailing *all* the trip and with approximately 12 hour tacks. Except for the occasional steep wave that put her into stays (she came back from the other way herself), we just put hand to tiller to change course.

The trip took just over 13 days from Discovery Bay, Jamaica to Road Town, Tortola and, with due Easterlies, we logged 1,470 miles for a straight (bent to round Hispaniola) distance of 740 miles. This gives a course of 60° from the wind on either side but, with the Westerly current varying from 0.7 to 1.5 knots (not even counting off Puerto Rico where the flood tide takes it over 2.0 knots and forced us to take off around St. Croix). This is an average 4.7 knots, given an actual tack of 50° on either side of the wind. We set for pinching the whole way as it was rough anyway without going faster to compound this—getting a comfortable easting, rather than a faster rattling SE and NE.

I guess we're not really true multihull people after all! Certainly not "speed at any price," we appreciate the lack of heel and at 5-8 knots, don't consider the motion excessive: the acres of deck space and cubic footage of stowage. Since getting here, we have had some short-duration, merely choppy water sails with reaches of 10 knots and, all in all, are well satisfied with our compromise.

As I told you before, we are professional divers presently engaged in specimen collection for Marine Biological Research and this calls for use of a powered motor boat so the trimaran will be laid up until we can fit in another cruise. This will surely be down to the Grenadines and back, which will be two long broad reaches.

We plan to settle here in the British Virgins and, whilst looking around for land to build on, we find one suitable island is owned by Major Ian Major.

PAUL M. CHAPMAN.

C/o Road Town P.O., Tortola, B.W.I.

THE URGENT YACHT RESEARCH—HULL AND SAIL DRAG ANGLES

BY

JOHN MORWOOD

At this stage in the development of the yacht, every yacht test tank and wind tunnel, and all amateurs who regard themselves as scientific men should be studying hull and sail drag angles to find the minimum. Not that it is very likely that the minimum angles would ever be used on a yacht but the hull and keel shape and sail rig which produce them must be known.

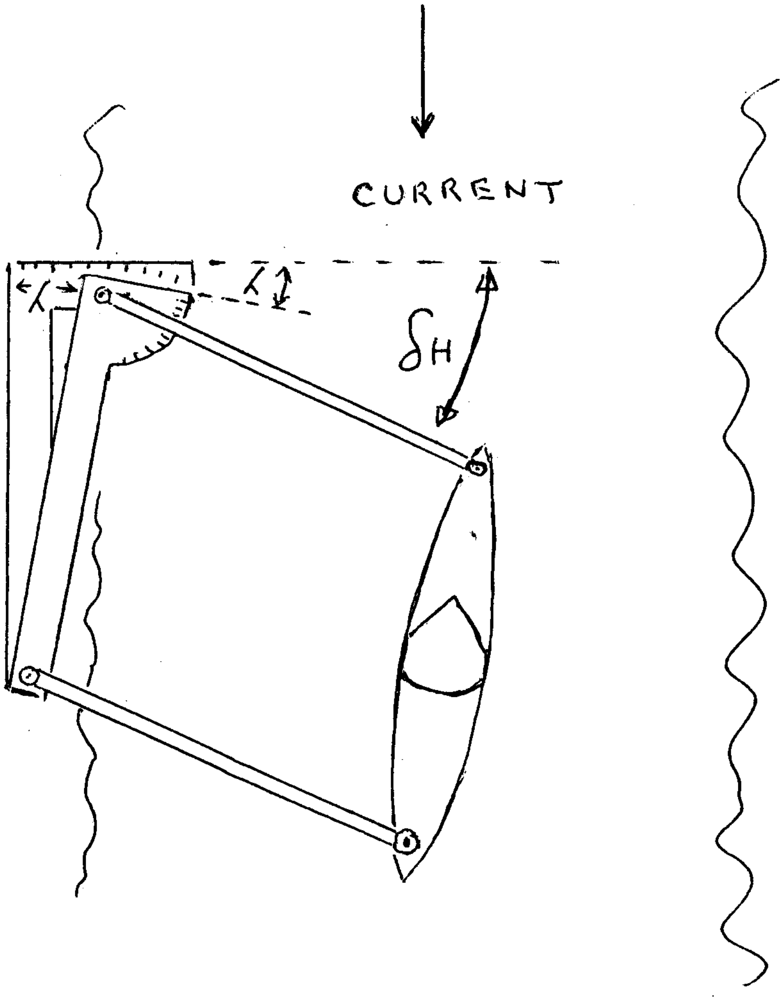
For instance, if the hull shape which produced a drag angle of 5° were known, this might be of a semi-circular main section with either a high aspect ratio centreboard or a low aspect ratio keel, like that of the Norfolk Wherry. Such a section would not have enough stability for a monohull yacht and it would obviously be worth while to have, say, a 4 : 1 ellipse for the main section with a drag angle of 6° or 7° in order to carry extra sail area. *But the least possible hull drag angle should be known.*

Similarly, very low sail drag angles may give the best speeds to windward. But sails with a higher drag angle will undoubtedly give greater drive on reaching courses.

The need to improve the hull drag angle is far greater than the need to improve the sail drag angle as shown by Edmond Bruce and myself. This is because it is the worse of the two, so the improvement in overall performance will be greater. Indeed, Austin Farrar, with *LADY HELMSMAN'S* sail has already reduced the sail drag angle to an excellent but unknown figure and we will be lucky to reduce this figure by any substantial amount, though General Parham's bent mast rig may reduce the weight if it can made seaworthy.

It is perhaps fortunate that sail efficiency has already been brought to such a high level because its study really needs a wind tunnel (though full size tethered tests are fairly easy). But hull drag angles can easily be studied by amateurs in a tidal stream or a fast-flowing river and, owing to water gradients and eddies, as measured by John Hogg, the figure obtained might not be absolutely accurate, it will be relatively accurate, and be of great value. "Bottom effect," which reduces the drag at certain speeds will also complicate the picture for low aspect ratio keels, like those of the 5.5 meter boats. *But none of these things invalidates the comparative value of such tests.*

A simple apparatus is shown in the drawing for taking hull drag angles at various amounts of leeway. The fixed plank is aligned to the



water flow by means of two light poles of the same length stretching out over the water. To the end of the upstream pole is tied a line which should drift down in the current and the plank is adjusted so that the line comes under the end of the downstream pole.

The "Leeway plank" swivels on the fixed plank and is calibrated to give leeway angles of 3, 4, 5, 6 and 7 degrees. Two pivots are placed on the "Leeway plank" (and these can be round nails) at a

Dear John,

Your speculations about a "multihull leap" are wrong, John, at least with reference to *TRICE* mentioned on page 19 of A.Y.R.S. 66 where you say she is almost doing an "air leap." Nonsense! The photographer merely waited for her to jump the wake of his fast motorboat while she was doing 9 knots hard on a force 4-5 breeze. She was nowhere near any kind of "leap" under these conditions. Long before she gets "leapy" we reef down for comfort and safety—as you mention later in your article.

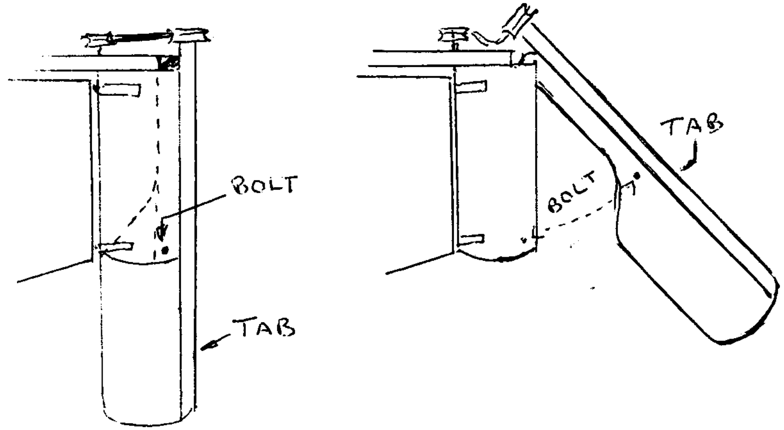
I will soon be leaving for a month's cruise through the lesser Antilles with *AY AY*. Good luck for your meeting July 16th. I'd like to be there!

DICK NEWICK.
Box 159, Christiansted, St. Croix, U.S. Virgin Is., 00820.

Dear A.Y.R.S.,

Please note the change of address. As I was busily carpentering and metal working my vane gear in preparation for this trip by my wife and I in our *NIMBLE* (30 foot trimarans), I was looking forward to the writing of this letter to you to let you know how it fared. Particularly, as I felt I was innovating to a certain extent by putting the gear onto a kick-out rudder. I sketch below the essential points but I am afraid it remains just an idea as it still is not proven.

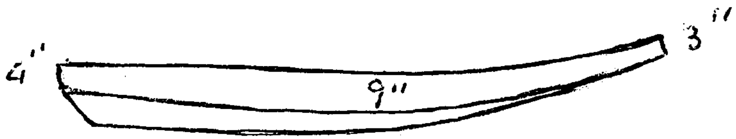
As we had to short tack along the north coast of Jamaica to take a departure on the starboard tack from the N.E. Cape so as to widely avoid Haiti and Santo Domingo (the former definitely hostile to



if a man is good enough, he can jump the ski back out to sea. If he is good enough. I know. With the idea that a Pig Islander can do anything an Aussie can do I tried it. I don't know if Aussies break their noses learning. I did.

My ski was not altogether suitable for the experiment. It is a compromise between the 14-footer and the shark fin type with extra bouyancy to allow me to take two passengers.

It would have been better with the buoyancy further aft and a deeper stern transom. As it is, it has a tendency to skid backward



when meeting a very steep wave. Shallower draft, less beam and greater length would be an advantage but it was designed for carrying on a motor-cycle side car.

Surf Boats. In the Montague whaler, the Australian surf boats, and the life boats there have been developed some fine designs. They are, however, all very heavy boats which require much power to drive them through the surf. Tom Pierce, of Auckland, the designer of a very successful pattern, has 120 h.p. in his twenty-footer. I am interested in developing a light boat which can be launched and carried to safety by one or two men at most; and preferably wind powered.

For this purpose, the Prout kayak type hull seems to be ideal. It would need to be fully decked, a turtle deck best, to withstand breaking waves. Since it requires power to lift a boat over a breaking wave, it should be able to dive through them. I am experimenting with three type. (a) a 14-foot sailing dinghy. Even with an outboard it is underpowered and would swamp in very moderate surf. (b) the surf ski above. It can be made to sail, but not satisfactorily and has to be forced under a wave. (c) a turtle decked kayak with a lace-up surf cover. It is fast, dives naturally under combers but is too lightly constructed for sailing. When shooting a breaker, the framework can be seen to twist under the stresses generated by the steering paddle.

Bow design is most important. If it is to dive through a wave, buoyancy must be at a minimum. However, coming ashore, bow and stern carry all the weight, and if the bow dips—disaster. Therefore dynamic lift forward seems necessary and I am sure that this can be got from planing floats or hydrofoils in a trimaran configuration rather like *JEHU* described in A.Y.R.S. No. 16.

distance apart exactly equal to the length of the boat being tested (or rather similar pivots on the boat) and both the upstream and downstream pivots are connected by light rods of equal length such as bamboo poles with bearings at both ends. A quarter circle attached to the "Leeway plank" with its centre at the pivot is calibrated in degrees.

When all is set up, the hull drag angle is the sum of the leeway angle and that on the quarter circle. It will vary slightly with the speed of the current due to wave-making.

The Testing. A paddling canoe is shown in the drawing because these are common and cheap but a skiff, skull or Canadian Canoe could be used. The reason why a canoe sterned boat has been chosen is that the head resistance will be less within the usual range of testing and thus the drag angle is likely to be less. I suggest that a 2 inch by 1 inch plank be glued along the keel of such a craft and various keels be fitted onto this with dowells.

As shown by Edmond Bruce, the ideal leeway angle is 5°. If, therefore, the minimum drag angle occurs at a leeway angle less than 5°, the keel is too big. If it occurs at a greater angle than 5°, it is too small. However, in the Southampton University tests, the minimum drag angles occurred at 7° of leeway for the best keel tested and 9° for the worst. However, we are looking for a very much more efficient keel than that of the 5.5 meters which were being tested—the drag angle was 22°, as stated in A.Y.R.S. No. 61.

Having written the previous paragraph, I am appalled by the anomalies and by our ignorances. Surely this emphasizes the importance of such a study as is suggested here. Every one of us should start bullying the test tank workers to start action or by an apparatus such as we show, to start action himself.

λ = angle of attack or leeway.
δ_H = drag angle of hull.

HYDROFOIL VICTORY

The A.Y.R.S. has done it. At last the sailing hydrofoil breakthrough has appeared through the endeavours of our members—and not a professional amongst them. We proudly present this publication to all.

I firmly believe that, within the pages of this publication, are all the ways in which the hydrofoil will be used to lift and stabilise sailing boats, though some simple variations have already been published.

However, the actual application which any individual member may want may need some seeking.

For instance, while the flying sailing hydrofoil boat is only likely to be compounded of relatively few of the ideas described here and so are easy to find, the significance of Dr. Clayton Feldman's little 8 foot trimaran and Paul Ashford's experiments with low aspect ratio hydrofoils for stabilising sailing boats should not be overlooked.

I suppose that out of pure habit, most of the low aspect ratio foils in this publication are either rectangular or triangular. However, on considering the matter, low aspect ratio foils with the lower edge the arc of a circle seem more reasonable and in keeping with the trimaran float shape.

Not only is this publication the culmination of our hydrofoil studies but it is a challenge to us all to build or buy an A, B, C or D class catamaran hull and fit it with stabilising or flying type hydrofoils with or without floats.

Perhaps, also, this publication is a justification for the basic A.Y.R.S. belief that, when something really difficult or original is required, the technically untutored amateur will produce it if he is kept informed of the world progress in our publications. One must note that the various vital articles in this publications come from a world-wide distribution—California, Connecticut, New Jersey, Canada, England, Denmark, South Africa. How could this have happened, if it weren't for the A.Y.R.S.?

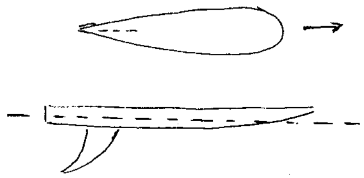
PRESENT FOIL APPLICATIONS

At an A.Y.R.S. Social Meeting, on hydrofoils, Paul Ashford described his *TRIPLE SEC* with Bruce foil. Paul Dearling described his Clark foil system on his canvas canoe and both appeared well satisfied with their boats. Martin Sanderson then showed the design of a hydrofoil boat he has nearly finished making consisting of a long cigar-shaped main hull with a Hook foil forward, designed by John Morwood with exact copies of Don Nigg's surface piercing foils aft, complete with "fences."

Christopher Hook then spoke, giving us details of his boats and principles of working. The two main items he gave which may be of interest were:

1. Air entrainment was a main enemy of surface piercing foils (and Paul Ashford had already described this with his Bruce foil with the float off the water). Cavitation was no problem with sailing hydrofoils.

4. The latest and most efficient ski is the 8-foot "inverted shark fin" type, made of balsa enclosed in fibreglass. They are propelled



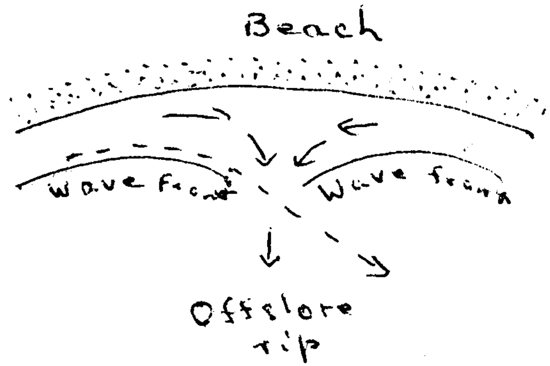
with arms and legs in a practically normal crawl stroke. Having less bouyancy and bulk than other types they can be more easily driven under a wave.

In shooting a breaker to shore, the same principles apply to all types. The ski lifts up on the steep front of a wave and begins to slide down it. As its velocity increases, the bow rises; as planing

Wave steepening to break and then flattening under the broken crest.

commences, resistance falls off and the ski slides down until only the stern is slightly lifted by the wave. The long board and the eight footer are steered by balance; the 14-footer partly by balance and partly with the paddle. On the eight-footer skilled Australian surfers can shoot diagonally along a wave front, standing erect and even trailing a hand in the wave as it curls over them. They can reach speeds as high as 45 m.p.h. and are so manoeuverable that at suitable places, they can be jumped back over the wave.

The sketch shows a wave approaching the beach in double crescent formation. At the junction of the two crescents an off-shore rip forms which flattens the wave and delays its break. At such points,



SURF BOARDS AND BOATS

BY

R. GILBERD

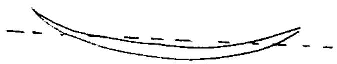
P.O. Box 49, Okaihau, New Zealand.

Surf riding as a sport is confined to those coasts where wide expanses of ocean allow waves originating in distant storms to arrive as long smooth rollers and where the offshore gradient of the sea bottom causes a gradual steepening and breaking of the waves. In the experience of surfers and in their experiments there will be some lessons in seamanship for yachtsmen, especially in heavy seas.

Evolution of the Surf Ski.

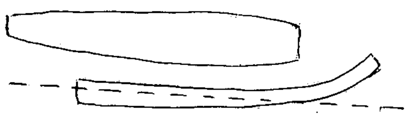
1. First used was a plain board, sometimes up-curled in front It was primitive but is still effective.

2. Rescue patrols on Australian beaches had often to intervene against shark attacks. Belt and reel were too slow and the line hampered the beltman. Surf was sometimes too heavy even for



specially built surf boats. A thirty foot "orange peel" ski came into use. Lying on one of these, and employing an overarm swimming stroke, a surfer could penetrate under almost any sea, pick up a rescuee and shoot a breaker back to shore. They lacked. manoeuverability and when other swimmers were about could be dangerous projectiles.

3. A more recent development was the 14-foot ski, built with an up-turned planing bow and most of the bouyancy aft. It is driven by hand or by a double paddle. How a wave is met depends on the wave and the judgment of the surfer. Paddled fast it jumps over



small seas and big steep seas before they break. Meeting a big comber breaking, the surfer paddles hard to the last moment then throws himself on the deck, paddle under him and holds hand grips at the sides. The bow is buried but lifts, driving the stern down. The flat deep transom resists rearward movement and the wave passes overhead.

2. Surface-piercing and inverted T foils were about equally effective at "Take-off speeds." Above these speeds, an inverted T foil was better.

The other speaker who had made a hydrofoil boat was R. R. A. Bratt. His boat confirms the point that fully submerged inverted T foils *aft* do not need incidence control, if they have dihedral and weathercock.

Low Aspect Ratio Foils. This is a new concept, if one excludes the traditional *very* low aspect ratio hulls and floats. They have the following advantages:

1. They can have enough buoyancy to float the whole structure.

2. They don't cause such great surface waves because of the longer waterline length at the surface.

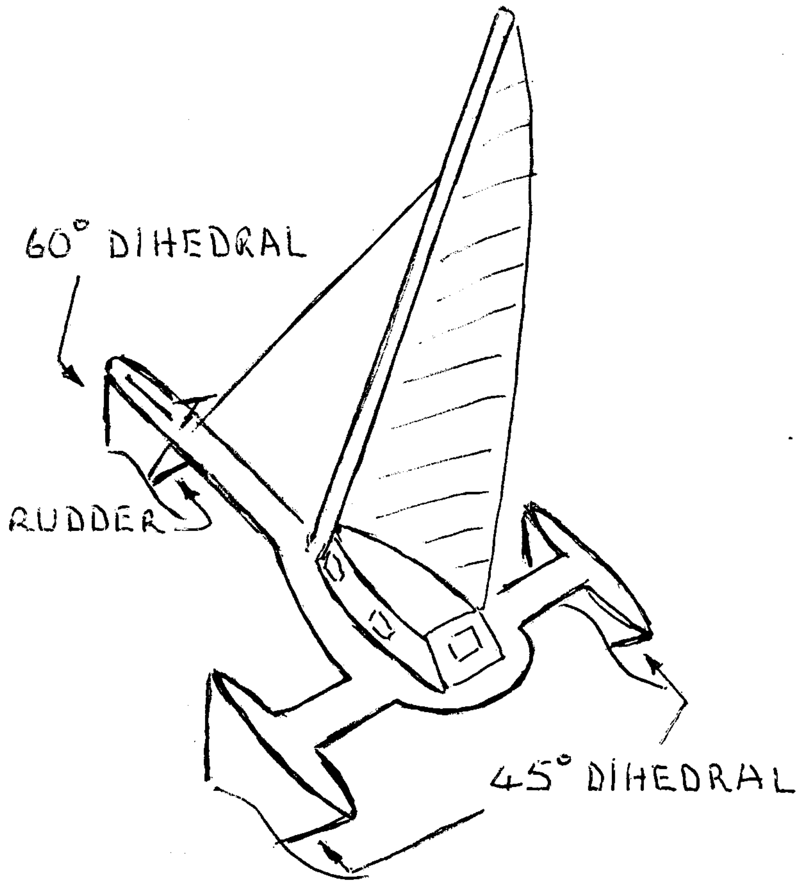
3. If the surface waves are less than a certain amount, there will be no air entrainment and hence no needs for "fences."

4. Don Nigg needed a 12 knot wind to give him 6 knots with which to rise off the water. With a craft floating on its foils only and assuming equal foil efficiency as those of Nigg, it should achieve 6 knots and hence "flying" in a 3 knot wind.

The Rewards of a successful Flying Hydrofoil. These are great. Cheap, light, sailing boats with small sail areas should travel at from 24 to 40 or possibly even 60 knots. Atlantic crossings should be possible in a few days, even to windward with such speeds and efficiency. The drawing shows a concept of a 60 knot "Trans-ocean" hydrofoil sailing craft with buoyant, low aspect ratio foils. A half-scale version would have a buoyancy of 840 lbs. and, if made at 200 lbs. or less would carry two people.

L.O.A. (excluding cabin)	50 feet.
Beam O.A.	30 feet.
Buoyancy	3 tons
Sail area	300 sq. ft.

Each float-foil is an equilaterial triangle of 14 foot sides and 14 inches maximum thickness, which gives a buoyancy of one ton. All three foils slope up to leeward, the aft ones at a dihedral of 45°, the forward one at 60° from the horizontal. On putting about, the foils flap over for the new tack in the manner suggested by the late Commander Fawcett many years ago. The rudder is placed at the aft end of the forward foil whose dihedral angle of 60° should let it work well.



A buoyant hydrofoil craft suggestion

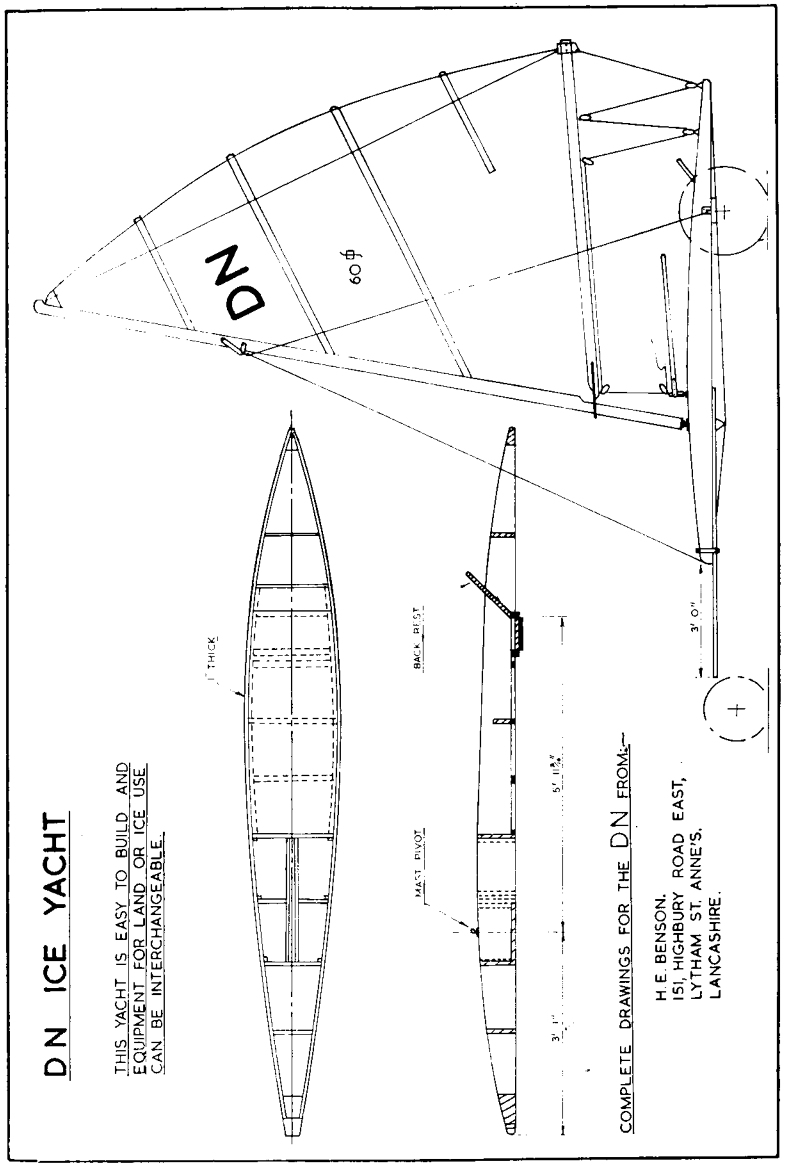
The sail is loose-footed and sheeted to the cabin side to give the correct shape. The platform at the base of the cabin partially prevents the boom eddy and acts as a "Walk way."

THE A.Y.R.S. "INVENTORS CONSORTIUM"

BY

JOHN MORWOOD

Under the above pretentious title, a group of us (arbitrarily elected by me) set out to invent a self-righting multihull for the 1968 Single-handed Trans Atlantic Race. The members were Jock



DN's is the Mini wheel. A-35 front hubs, Michelin-X tyres which can be run soft for ribbed sand surfaces and AC Invalid Carriage front hub assemblies with Mini wheels make up the rolling stock, but there are essentials of assembly which cannot be ignored.

Many people "lap" in the ball-races by pumping them full of Brasso, which is a super-fine abrasive, then after cleaning, run them in with oil—wheels must spin like flywheels. Aligning the three wheels is very vital. The front wheel must have a distinct castor action and from the wheel centre where it touches the ground to the centreline of the king pin, projected down, there should be about ¾ inch drift. The main wheels too are angled in towards the front wheel by about ½ inch and a great deal of careful measuring and positioning goes into ensuring that they do so. The actual steering—the amount of helm in fact—on a DN is strictly limited to a maximum 30 degrees and more than this would most probably result in a somersault capsize.

Buying a Completed Land Yacht

Although the Commercial world has not, as yet, quite realised what is going on with land yachts, it is nevertheless possible to buy rather than build, or alternatively to buy the bits and pieces and assemble them. Complete yachts can be bought ex-sails for around £100 to £125 from the Ice, Land and Sand Yacht Manufacturing Co., Newby Bridge, Lancs., and DN sails from either Ratsey and Lapthorn or Rockall. The builders will also sell spars, axles and so on for home assembly, but the wheels must usually be picked up from car-breakers separately.

Another source of supply—or sources rather—can be tapped by writing to the Hon. Secretary of the British Federation of Sand and Land Yachts, H. E. Benson, 151 Highbury Road East, Lytham St. Annes, Lancs., who will put inquirers in touch with various members who can supply parts to order. What is most important, say sand! land yachtsmen, is that any newcomer should first seek advice from the Federation before plunging in head first. It is important to suit type of yacht to type of terrain. It is also important to be guided on the way to set about obtaining permission to use flat beaches, etc.

Burrough, Edmond Bruce, Mike Henderson, Tom Herbert, David Mole, R. R. A. Bratt and Roland Prout.

The result of all this effort was a mass of more or less unconnected ideas when thoughts ranged over wide fields. However, from these ideas, however, I did come up with two craft (1) *MAGGY MURPHY'S HOME*—a sailing lavatory and (2) *PELORUS JACK II*—a self-righting foil-trimaran which follow. Later, I though up the design for the *KINNEGOE CRUISER* and the Flying-cruising hydrofoil. It must be realised that all these ideas are conjectural.

Other ideas were concerned with the following:

1. Self-righting—Tom Herbert. Method and suggestion of "Tunnelled hatches."
2. Pitch-control—Mike Henderson.
3. Gyroscopic self-steering—see A.Y.R.S. book on the subject.
4. Value of Prout *SEA RANGER* hull for a waterski or foil stabilised craft.
5. Working the yacht from *inside* with "Sleeves" or hatches around fore-stays.
6. David Mole favours three-masted rig with water-skis.
7. Putting out trailing warps from *inside.*

"*MAGGY MURPHY'S HOME*"

(A Sailing Lavatory)

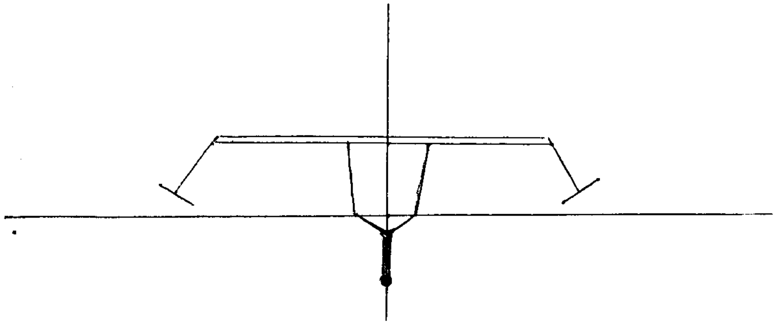
Designed by John Morwood from the ideas of the "Inventors' Consortium, A.Y.R.S.

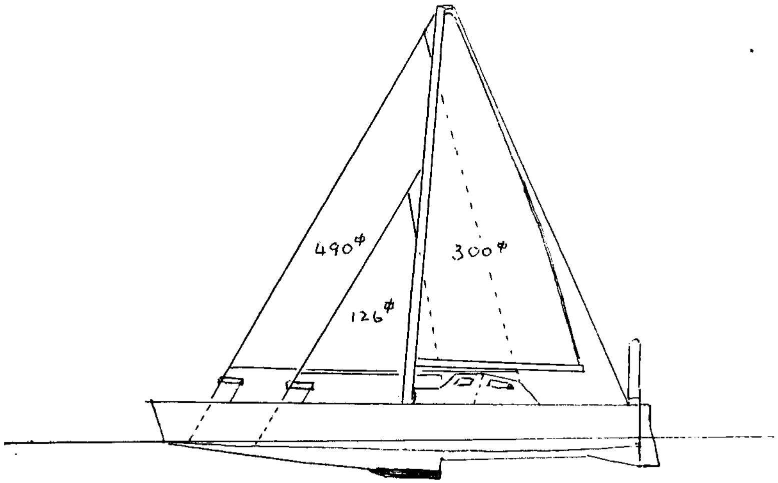
L.O.A.	50 ft.	Beam with outriggers	22 ft.
L.W.L.	48 ft.	Weight	1 ton.
Beam (hull)	4 ft.	Sail area	300 sq. ft.
Beam (hull) W.L.	3 ft.		

Maggy Murphy was the heroine of a ribald Irish Ballad who lived in straighten circumstances in the minimum of accommodation. I have never seen the ballad written down and it may be now extinct or not translatable from the Gaelic.

The objective of this design is to win the Solo Trans-Atlantic race in 1968. The result can only be described in the terms of the title. Consequently, the yacht may well be considered by any reasonable person to be uninhabitable.

The hull section and profile are as in the drawing.



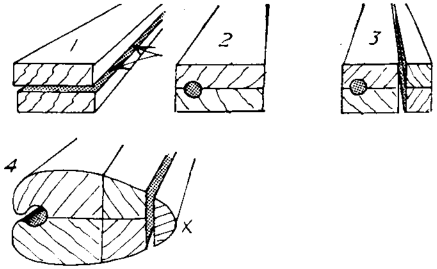


MAGGIE MURPHY'S HOME

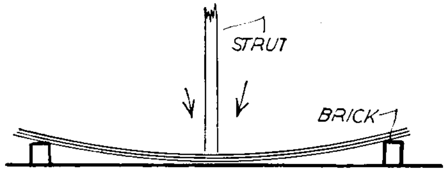
The main steering position consists of a 6 ft. 6 in. bed with 3 ft. 6 ins. headroom over the aft end so that sitting upright may be possible. Controls are as follows:

1. Wheel for setting self steering gear.
2. Mainsheet.
3. Reefing lines.
4. Control for drum holding the trailing warps.

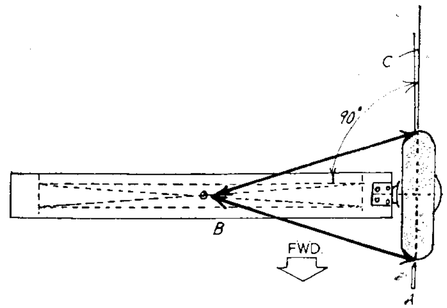
The backrest of the cockpit "bed" lets down, letting the crew enter the "kitchen-midden" with 6 feet of headroom. All the fore and aft parts of the yacht are bare, except for spare spars. A series of water-tight lockers up to the floor level could be used but are not necessary for the race.



Solid masts, to allow for planing down to adjust bendiness, are made of glued lengths arranged to give maximum grain strength. At Fig. 1 *the plank is sliced down the middle. Fig.* 2, *the two parts are grooved for the luff after end-for-ending one part to reverse the grain. Another slice is taken* (3) *vertically and the parts reversed. Then a nose strip is added* (4,X), *and all parts glued. Shaping down* (4). *Proportions reduced carefully to get right degree of flex*



A certain amount of bend is built into the axle plank while gluing. The plank, sawn down the middle on the flat, has its parts end-for-ended to reverse the grain. Two bricks on edge support the ends while a shore depresses the centre



The aligning of the wheels must be accurate. The axle is squared off (dotted lines) and the exact centre found. A wheel is given a spin and a pencil held against it (A) to find the centre line. With the hub bracket eased on one bolt to allow movement, the distances are measured from wheel fore and aft to centre "B" (thick lines) to position it at 90 *deg. The wheel is then angled in about* $\frac{1}{2}$ *inch "C" towards the front of the yacht and the bracket secured solidly*

The DN has tremendous sail curvature control and the speed range shoots quickly from zero to five times the wind speed. This is partly due to the bendy mast and partly to the six inch stretch-and-recover qualities of the luff.

From a standstill the DN must roll easily since there is no real power in her tiny sail until the apparent wind begins to build up. Towing off with a spring-balance the load should never be over 4-5 lb. from standstill.

Masts are preferably wooden ones for no better reason than that alloy masts cannot be planed down and whittled about until exactly the right degree of bend is found. Built up in sawn sections, grain reversed for strength, they are solid spars, pivoted to allow them to swing and bend aft. From new, each mast is planed away carefully or wrapped in glassfibre to add stiffness where needed.

In action the sheeting arrangement controls both the angle and the draft of the sail, hauling in the boom and tacking it down at the same time—which, of course, applies bend to the mast as well. The usual practice too is to let the staying hang so slack that the whole rig sags to leeward rather than flying a wheel too soon in the puffs.

The strains on the chassis are extra-ordinarily high and engineers have calculated a one-ton mast-step load under certain conditions. With the wide-spread rear wheels and the leading wheel out at the end of a springy plank, all manner of twist and torque is imposed, which is a good reason for sticking to the plans in building. The main axle, although simple enough to look at, is another target for tuning.

The aim is to set the wheels dead upright for an easy rolling start and then to have them toed in about 7 degrees at the top for fast running when the loads are building up on the lee wheel. The only way in which this can be done is to give the wooden axle just the right amount of flexion so that the increasing mast-heel load and the road-twist comes down on the axle centre at the right time to do the job. (More planing and whittling).

The axles are usually glued up from ash and given an initial "set" by propping the ends up on bricks while shoring down the centre as the glue cures. As with the masts, any weakness due to over-enthusiastic shaping down can be made good with glassfibre. While the length of the front spar or plank has an important bearing on handling and some European yachts have a length adjustment (shorter for easier tacking), it must, like the axle, have just the correct amount of spring consistent with weight, strength and shock-absorption. Equally important to both chassis and sails, of course, are the wheels.

Big wheels and heavy ones are superior in high winds where weight and momentum matter, but the well-established favourite with

The hull weight is 7 cwt. Ballast on the keel is 500 lbs. The rest of the weight would be the safety equipment, water and stores and, of course, the crew himself.

Sailing stability is derived from the ballast and two waterskis, one on each side 30 feet long and 2 feet wide, giving 30 lbs. per sq. ft. lift or 1,800 lbs. at 18 knots—lift to drag ratio 4.3 : 1.

The shape of the low aspect ratio keel may be noted. It is a guess at the profile which might give the lowest "drag angle." As previously stated, a curved profile might be better.

PELORUS JACK II

A SELF-RIGHTING FOIL-TRIMARAN

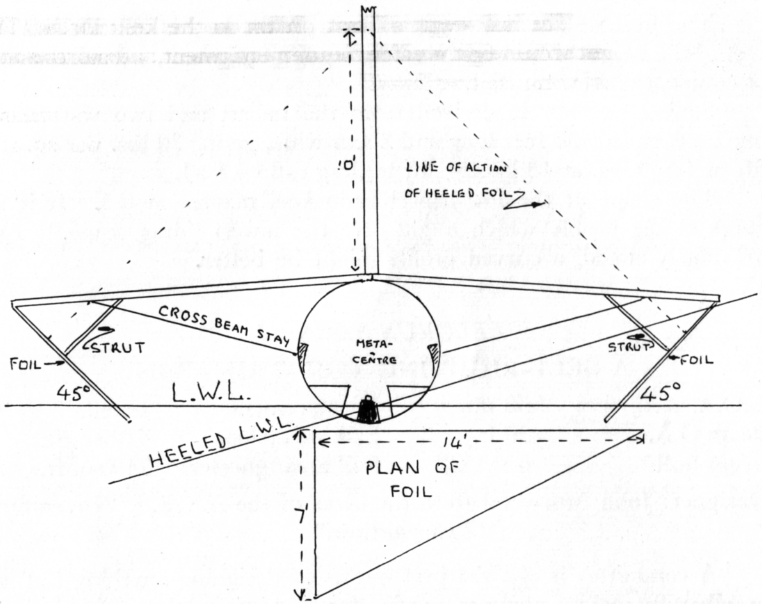
L.O.A.	50 ft.	Displacement	1 ton.
Beam O.A.	30 ft.	Sail area (sloop)	410 sq. ft.
Beam hull	6 ft.	Sail area (ghoster)	740 sq. ft.

Designer: John Morwood from the ideas of the A.Y.R.S. "Inventors Consortium"

A committee is not the best means of designing anything but is excellent for making analyses, putting forward information and pointing out difficulties. I hope that the others will describe the yachts which grew in their minds as a result of our letters. I can only describe that which grew in my own, which is a self-righting foil-trimaran.

Hull Section. The only hull section which is self-righting without ballast is a complete circle. By itself, it has neutral stability and will stay in any attitude of heel where it happens to be. But any weight of furniture or stores placed (and held) below the centre of the circle (the "metacentre" in the drawing) will have a righting moment. I therefore chose this section for the main hull section.

The Outriggers. Within the original premis, David Mole suggested water skis, Jock and I mulled around with foils, while Tom suggested bouyant water-skis foils of substantial dihedral. None of us appeared to like the Bruce foil because it suffers air entrainment at speed when too small or if the float is not placed above it in contact with the water. Now, water-skis have the remarkably high lift to drag ratio of approximately 4.3 : 1 and a lift coefficient of 0.2 (Edmond Bruce). I feel that, by increasing their aspect ratio only a little, this figure could be nearly doubled (doubted by Edmond Bruce) and thus approach that of a high aspect ratio hydrofoil which, it would appear, seldom rises in practice much above 10 : 1.



The foils I have chosen would be, at full size, right angled triangles with a top 14 feet long and a base 7 feet long, 1 inch thick and a dihedral of 45°. There would be no "toe-in." The result is a mixture between a water-ski and a Bruce foil. The effective aspect ratio would be 1 : 1 or, ignoring surface losses, 2 : 1. The buoyancy of such a foil would be about 4 cubic feet.

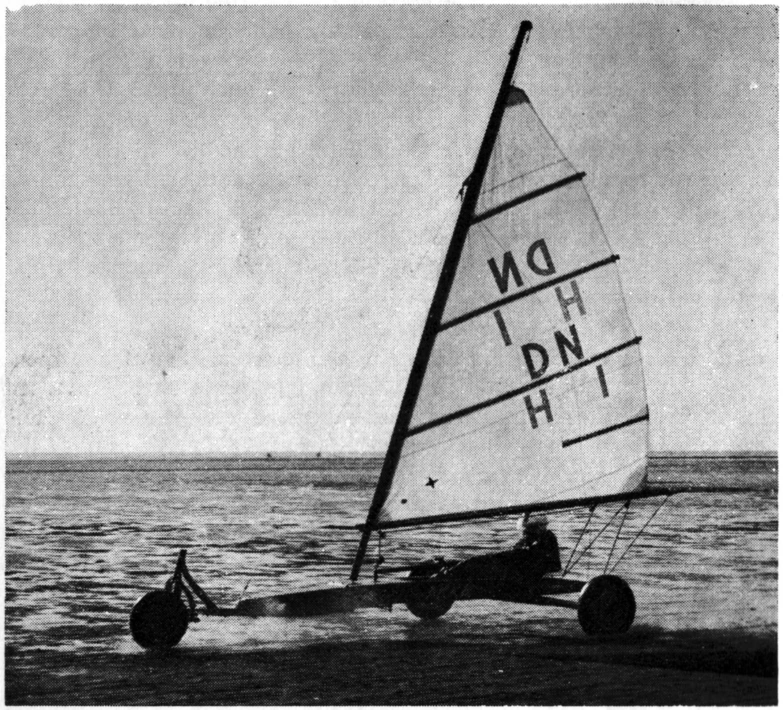
The appearance of 4 cubic feet of buoyancy in the foils or 256 lbs. at first appeared to be disturbing to the self-righting requirement. Reducing the circular hull section to an oval was at first considered or making a groove in the hull to reduce the side buoyancy by 20 cubic feet (shown shaded in the sectional drawing). In the end, it was thought that the slight departure was of little significance.

The Resultant Foil-Trimaran. We now have an unballasted yacht with outriggers the weight of whose furniture and stores would cause it to be self-righting. If now, the lines of action of the foils, when completely immersed should meet the centre-line of the boat *above* the true centre of effort of the sails, the sail force would not heel the yacht *no matter how hard the wind blows.* For the proportions shown, I calculate that the line of action of the foils meet the mast 10 feet above the rounded deck, which gives a mast height of 33 feet, if triangular sails are used.

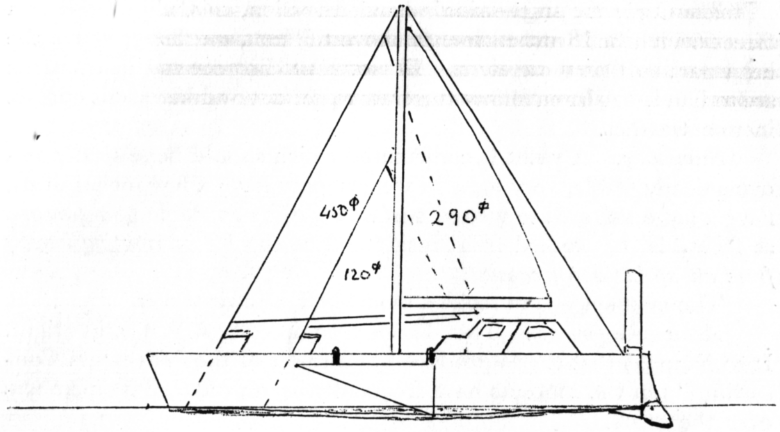
Powered by 60 sq. ft. of sail the little DN is capable of speeds approaching 50 m.p.h. in favourable conditions. For years this simple-to-build design has provided ice-boat enthusiasts with a lot of fun. Now in land form the DN is becoming popular wherever land and sand yachts race. Rig tuning and hotting up the running gear have a dramatic effect on boat speed years of development on ice behind it, has reached a pitch of tuning that would snap the satirical grin off many a crack dinghy helmsman's face. It is to be hoped that an open class will continue as an encouragement to Emmet-type experimenters, and serious researchers, out for speed. Their clanking, lunamobile contrivances may often look crazy, but they produce some very interesting results.

Tuning the DN

Standard advice to any newcomer to this sport who is considering building his first DN is "go and have a look." The marginal difference between a fast land/sand yacht and a slow one is very narrow and it takes the experienced hand to point it out. Karl Hughes, narrowly beaten in the European Championships, is nevertheless considered to be the fastest DN sailor in the game. His advice—build *exactly* to the plans. This is what a good many builders have *not* done and it is the essential starting point for the tuning which follows.



Kees Kortenoever, who introduced the D.N. to Europe and substituted wheels for runners



PELORUS JACK II

The Rig. This is normal enough within my own limitations of knowledge of the subject. The largest possible "ghoster" should be available and this could be used in pretty strong winds owing to the dynamic stability of the boat.

Working the Boat. We are all agreed that the boat must be worked from *inside*, as far as possible. A bow hatch for the anchor. A stern hatch to attend to the self-steering gear. The jib stays can come through hatches and be fixed to the keel so that jibs can be hanked on *below decks*. The design of the hatches for the fore stays have not yet been completely worked out. Folding canvas hoods on the fore sides of the stays could be used amongst other things.

The self-steering gear would be one of the latest A.Y.R.S. types and the course-setting lines would run to the cockpit and be capable of being worked either from inside or outside.

Sheets and halliards would also run to the cockpit or the bases of the forestays, as the case may be, and roller reefing could also be done from shelter.

Trailing Warps. It is not desirable to go on deck in storms to put out trailing warps. Low down on either side of the transom, two holes are cut. On the inside of the boat, two elongated S pipes run upwards from these holes. A length of chain runs through the pipes behind the rudder. In a storm, two lengths of warp can be shackled onto the end of the chain *inside the yacht* and allowed to run out.

The Cockpit. In the single-handed version, this will consist of a 6 feet 6 inch bed with 18 inches above the foot and 3 feet above the head part so that the crew can sit up. All controls and instruments are to hand. A hatch allows the crew to get out and he can sit outside in fine weather.

Summary. A yacht is conjectured which should be statically and dynamically stable, very light in weight, only have a few inches draft, have a large sail area to wetted surface ratio, be as stable going astern as forwards, be worked from inside *and be capable of righting herself from an upside-down capsize.*

The next stage is to make a model and see if it works.

Acknowledgements. This design is completely A.Y.R.S. in origin. It so happens that it was produced as a result of the "Inventors Consortium" but the concepts have frequently been produced by members over the years.

THE SANDERSON FLYING HYDROFOIL

Dear John,

After much correspondence and many ideas from you, I have completed a 20 foot flying hydrofoil, but so far have not had a chance to sail it.

The hull is a 20 foot by 18 inches square-sectioned, tapered shape, made from 4 sheets of 4 mm. plywood, with 1 inch square stringers along the four edges only. There are no frames. A vertical web inside gives the hull strength and it has at least four coats of polyurethane varnish inside and out to make it waterproof.

The front stem and three foils were all cut out of one sheet of 4 mm. ply—each foil being three pieces thick. I'm not sure if the foils will be strong enough made of plywood, but they were certainly easy to shape as the ply layers acted as contour lines.

The main foils are the same as those used by Don Nigg (A.Y.R.S. No. 58), as can be seen in the picture. The front strut, which is used for steering is about 4 feet high with the front foil pivoting on the bottom. The front foil is a triangle with 2 foot span and 9 inches chord, the top surface being curved to a 1 inch maximum thickness. Its angle of incidence is controlled by a 5 foot feeler arm.

The cross beams attaching the two main foils to the hull are 16 feet long, 2 inch aluminium tubes.

I hope it will be possible to balance the boat at low speeds without floats above the main foils, but these can be added if necessary.

The photographs show the boat just before completion.

Best sporting gesture of the occasion was provided by Wendy Hamilton when Clauss-Werna Wieben of Germany beat up one of his wheels while running as favourite for the Open Individual Championships. Wendy, upon damaging her own mast, quickly whipped off her wheels and handed them to the rival—a gesture which won her every sort of gallantry, but nothing else, of course.

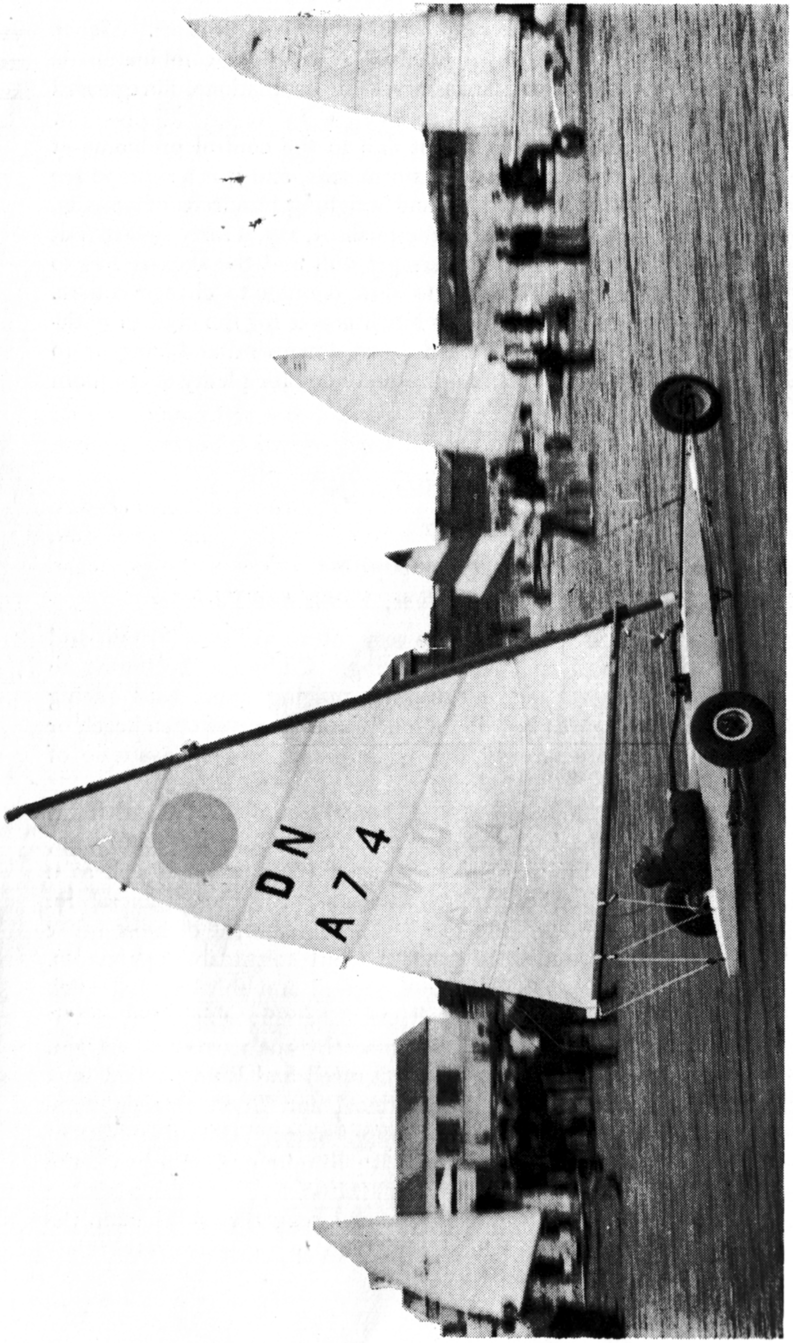
Land and sand yachts (one must never use one or the other of these terms in isolation for fear of indignant correction) are as much at the mercy of the flat calm as any other sailing device and the Great Grandsen Club Regatta on October 8-9th proved the point. An eerie, empty, silent and motionless void descended over their new H.Q. at R.A.F. Upwood in Huntingdonshire. The wind-sock made like an elephant eyeing its boots, chimney smoke oozed earthwards and one or two land/sand yachtsmen, driven slightly mad, took to legging it round the track shoving their machines and at intervals sitting heavily on them like broody hens with no high opinions of pot eggs.

The only event that came off was the Concours d'Elegance won by Gwyn Powell's DN "Xtra." Elsewhere in the ranks of parked yachts a Lytham man, suddenly aware of the fitness of things, began digging sand out of his chassis in embarrassing quantities.

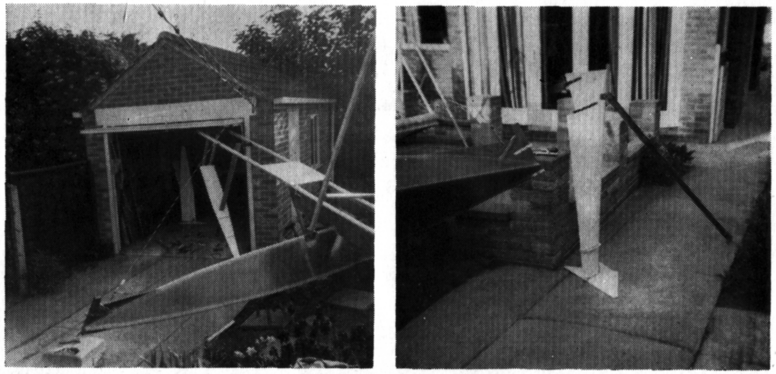
The Grandsen club, incidentally, have reached the acme of perfection in sailing grounds. Hounded from one old air-strip to the next by the relentless plough they have ended up at the still-operational (but only just) air-field of R.A.F. Upwood near Ramsey in Hunts. For around £2 per year per yacht, members enjoy an infinite choice of well-maintained runways, a heated club room and an enormous hangar to themselves.

Just as in the evolution of any other sailing craft, the early experiments are gradually settling down to the consolidation of one main racing type—the DN. Said Pete Shelton, founder of Great Grandsen club, "the big yachts now have just one more year of grace." The little DN, which stands for Detroit News and is a follow-on from the sponsored ice-yacht of that name, is the yacht to build and surest way of pitching straight into International competition. The three classes which will be in force by next year are 6.5 sq. m. (the DN at 6.25 qualifies), 10 sq. m. and 15 sq. m., but it looks as though ownership of one of the bigger yachts will offer no better chance of Championship success. The huge French and German yachts are getting old, creaky and generally worn out and both nations, as well as Dutch and Belgians, are building DN's as fast as they can.

The drawback to building any one-off bigger yacht is mainly a matter of providing a suitable sail. The DN rig, now with thirty



Joan Benson travelling at over 40 m.p.h.



Martin Sanderson's hull, cross beams and forward steering foil with "feeler"

Martin Sanderson's hydrofoils

Weights:

Hull: 115 lbs. Mast, sail and rigging: 32 lbs.
Foils and stem: 32 lbs. Cross beams and foil mounts 50 lbs.
Total: 229 lbs., which is 20 lbs. more than I had hoped for.

Prices:

Wood £12. Glue, paint, nails £7 10 0. Alloy tubes etc.: £13.
Rigging and fittings: £6 10 0. Mast and sail: £40.
Total: £79.

Thanks for your help.

MARTIN SANDERSON.

44 The Spinney, Cattingham, Yorkshire.

Ed.—Martin is emigrating to Canada in August. We hope he will have time to "fly" the boat before he goes. He has then offered to put the boat in the hands of someone else for further sailing trials. He will, however, have a detailed set of plans for sale by the time this article is in print. These will be available from Woodacres.

Dear Sir,

Your poem, "The Downhearted Boat-Builder" (A.Y.R.S. 57), stirred me, to renewed efforts to complete the 31 foot flying hydrofoil (A.Y.R.S. 58), now named *WILLIWAW*. It cheered me up to think that I've had less surface area to plank, fibreglass, and paint than a standard trimaran, and also no built-up cabin structure. I enclose a photograph. The hull weighs only 1,300-1,400 lbs., but is extremely rigid because of its proportions and its doubly-curved plywood. Practically all of its weight contributes structurally, including inside shelves and benches. Headroom inside is 5 feet plus a little. The living quarters appear spacious, since they run the full length and width.

I have sailed the craft once so far, in a light air, without hydrofoils. It balances and manoeuvers well. However, it is so easy to get confused about wind direction, because it generates its own wind going upwind, and kills its wind downwind. When a Force 3 wind is generated close-hauled, with 380 square feet of sail, the craft heels about 15°, and the underbelly adjacent to the leeward pontoon begins "planing." (Normally, a leeward hydrofoil would prevent such heel.) This planing effect is interesting, because it seems to stiffen the boat up against further heel. It makes me wonder if a racing trimaran could use to advantage such a pontoon planing effect after it has heeled a certain angle.

thrusts and cants the lee runner out for a better bite on the ice. Hence the temptation to whittle down planks. A frequent combination is aircraft grade spruce wood planks in several laminations, fibreglassed externally.

As winds increase, racing is out due to the control problems at speed. Some will venture out with storm sails, and it is a sight to see a big "E" boat nearly 30 feet long and weighing hundreds of pounds, driving at nearly 100 m.p.h. with the push of, say, a forty square foot scrap of heavy canvas! But runners get dull and the skipper has to set his hand-lever ice pick brake to slow enough to change course. And as a giant puff strikes with too much power for the craft to withstand, the one course left is to head direct downwind and hang on to the pick brake with all one's strength—and hope for plenty of ice room to lee.

THEY'RE ROLLING

BY

J. D. SLEIGHTHOLME

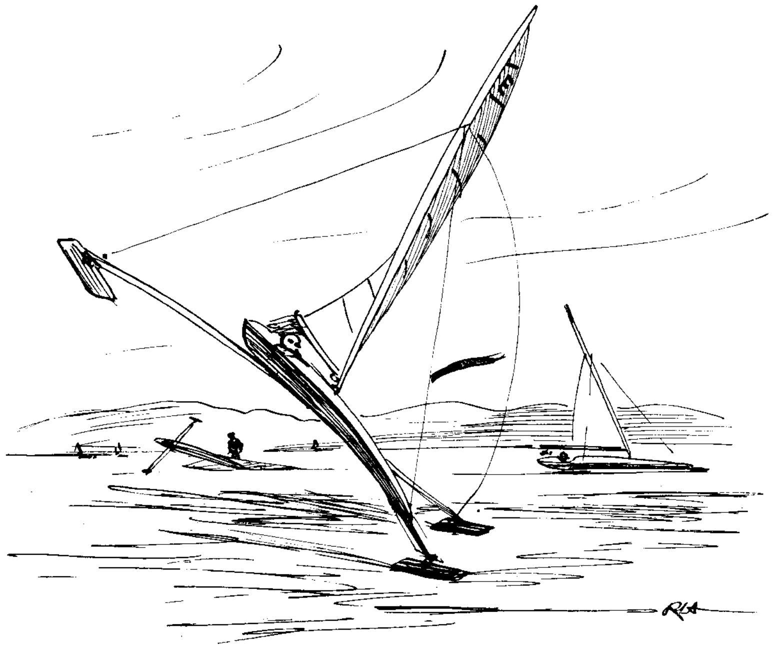
By Courtesy of the Editor, Yachts and Yachting

If ever there was a sport with a rosy future in Great Britain and Ireland then it's land and sand yachting. Clubs are beginning to spring up everywhere and enthusiasts, ranging from hard racing groups to solitary figures bowling a lonely course across open beach or deserted air-strip, are already deeply immersed in the mystique of finer tuning.

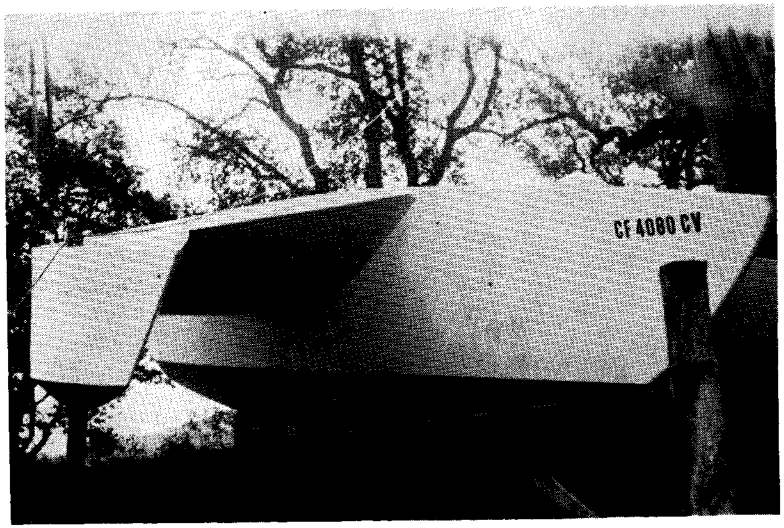
This year, in September, the Fourth (and first in Britain) European Sand Yacht Championships brought teams from Belgium, Germany, Holland, France, Switzerland and Denmark, as well as a team from the United States to Lytham St. Annes, Lancashire. British clubs, although lacking the long establishment of most other competitors, made it quite plain that they are formidable opponents. Karl Hughes and Garry Benson took second and third to Jan Dick Wevers of Holland in the 6.5 sq. Metre Championships, but left it easy to see that Hughes missed first place by the narrowest margin. British helmsmen Ted Parker, Leslie Damsell and Robin Wood took all three places in the Open International and Beryl Daniels came second in the European Ladies' Championships. Christian Nau of France took the European Individual; Monique Gimel won the European Ladies; Beryl Daniels won the British Ladies' Championship and Germany came first, France second and Great Britain third in the Team Championship.

ornament! However the stern-steerer has a nicer capsize, as it falls over backwards, so to speak, and settles down gently on the cushion of air under its sail. The bow-steerer falls over forward of the cross plank, and can come down very hard if going fast. If the mast breaks, it goes on over upsidedown. The big "E" boats with 18 foot cross planks are being fitted with roll bars.

The side forces in strong, gusty winds can snap a stay or break a mast due to compression. Generally the mast and sail flutter gently down to lee as the craft slides to a stop. More serious perhaps is cross plank breakage, as this throws the craft out of control and may release a side runner to dangle on the end of a stay. However a heavy stiff plank will not do, as it will cause skids, and the skids in turn will quickly dull the runner edges, increasing the evil. Control is then lost. A "soft" plank is generally a fast plank, as it absorbs mast



Another "heavy day" scene showing an "E" boat in a tall hike which must be put under control at once. (This can happen in less than 20 knot wind if the ice is slushy or snow-covered.) The skipper can ease the sheet or turn further off the wind. Another "E" boat is flat on with a storm sail. Another DN has gone over. (They are kites and hard to handle in heavy air.)



David Keiper's foil trimaran—Note small floats

Hydrofoils will be fabricated for *WILLIWAW* next month (Jan.'67). The hydrofoils will add 400 lbs. to the craft, but this isn't much more than the weight saved by not having large pontoons required.

DAVID KEIPER.

95 Mistletoe Lane, Black Point, Novato, California.

J-FOO-KIK

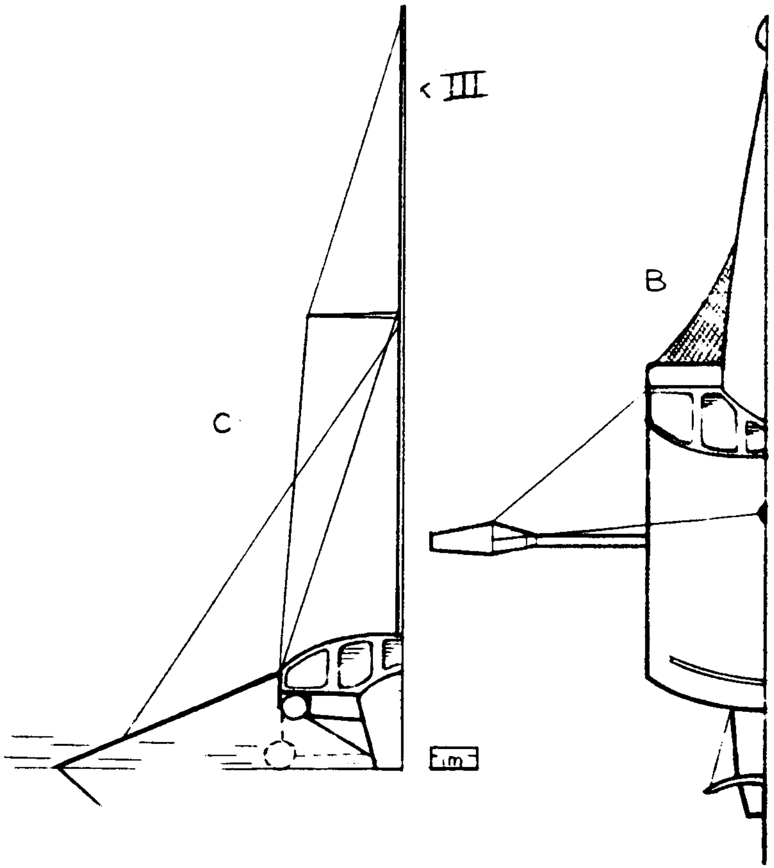
BY

KAG JORGENSEN

Taarbaek strandvej 34 A, Klampenborg, Denmark.

Although the concept of *J-FOO-KIK III* is not even revolutionary enough for a garden party, I fear nevertheless that it will readily acquire many of the wretched attributes of that which has not yet come to enjoy full comprehension.

Unlike the flying prau, the stability of which is open to doubt, there is no doubt about the stability of *J-FOO-KIK*. The craft dispenses with out-riggers as an undesirable drag and instead goes on to consumate the stability principle which has been demonstrated by Edmond Bruce of New Jersey.



C is a schematic view of the craft in section and shows the long foil arm. The force vector of the foil directly counterbalances the CE of the sails at all speeds. Just as the dihedral section prevents the craft heeling and making leeway, so the near-horizontal section, with its upward camber, prevents the unit from driving too deep in a seaway. By having a stability foil for each tack a relatively light scantling is enabled. As soon as the craft is under way the stability pontoons can be retracted. On a run it will be necessary to use both foils simultaneously and this will eliminate the very obnoxious rolling of conventional sailing craft. The alpha angle of the dihedral foils is adjustable by the guy-wires shown in B.

recover it before the boat slides to a stop. While he only needs the natural flow of air to keep the apparent flow at an angle of attack to his sail—that is essential, and critical.

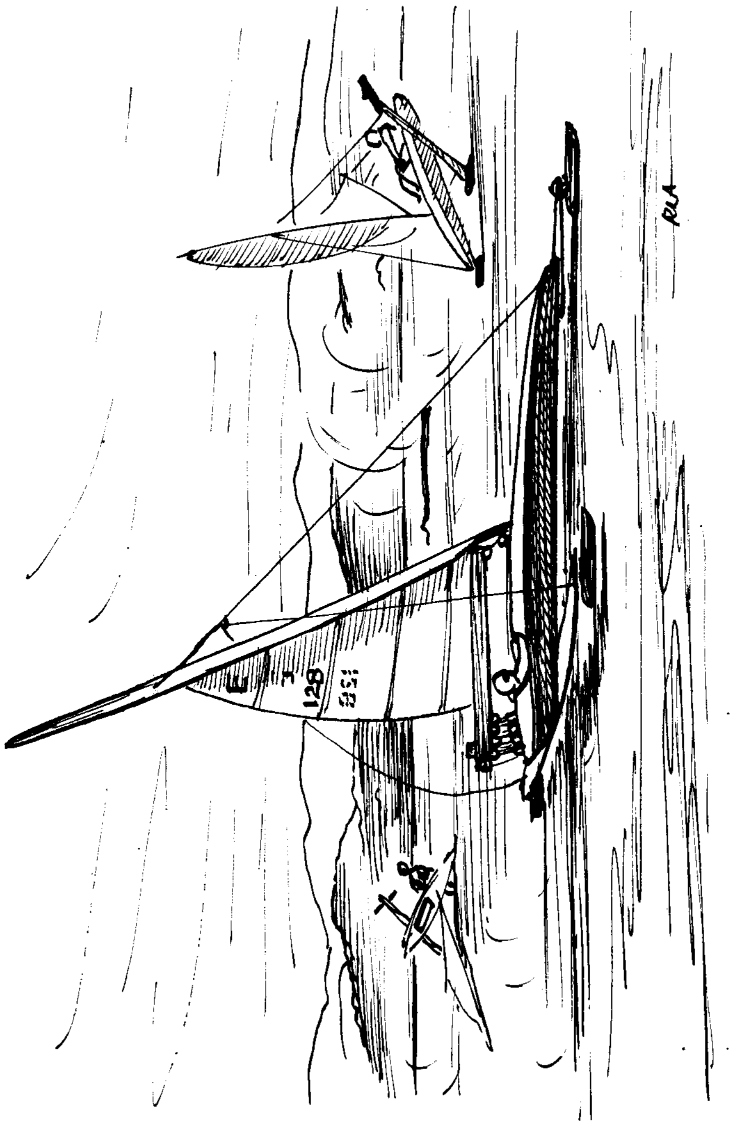
The old-time stern-steerers with big spreads of canvas can be good light-air boats. The modern bow-steering craft with their more efficient but limited sail plans must be in very fine tune to do as well. At a "DN" regatta during the past season, the wind fell away very light and the craft were drawn up and parked facing the wind in two long ranks, separated by about 20 feet. No one was trying to sail except the ablest sailor there—his boat in perfect tune—came gliding along on a beam reach between the two ranks of boats. He was moving at a slow walk—but moving—and it was as elegant a flaunt of mastery as his racing wins throughout the day.

The elements of this mastery certainly include a fine feeling for what the natural wind is doing, and also a set of runners in perfect condition and alignment. Runners can rather easily go out of parallel tram, or become nicked or scored, or even bent. The less contact a craft has with its supporting surface, the more critical the conditions of that contact and its elements becomes, particularly when the driving power for the craft is weak.

In strong and gusting winds above 25 m.p.h., there can again be a problem of disturbance of the angle of attack of air flow to the sail, with somewhat different results. Instead of having to push a boat to get going, and to use skill and tune to keep going—one can sail away from a standing start but will find problems in control of the boat. The forces may also destroy the craft or its gear.

The old stern-steerers are at their worst in heavy air, because the forward thrust on the mast tends to lever the steering runner off the ice. This season an experienced "DN" sailor acquired a big old relic of a sloop-rigged stern-steerer and had her out on the Hudson River. We saw him sail past on a course direct for the open steamer channel and we noted from his expression that something was not quite right. It certainly was not. He had put the helm down to come about and the old brute was paying no attention, but was sailing right on in a line regardless of the steering runner being 45° to her course! Fortunately she finally decided to mind her helm and rounded up.

The bow-steering configuration made one-man ice boats possible by putting the steering runner where the mast moment would hold it down firmly, and the crew weight aft on the cross plank. Thus the bow-steerer minds its helm, and is not subject to the awesome "flicker" —or a flat spin when the stern-steerer lifts its steering runner well up. The hand rail around the cockpit of an old stern-steerer is no mere

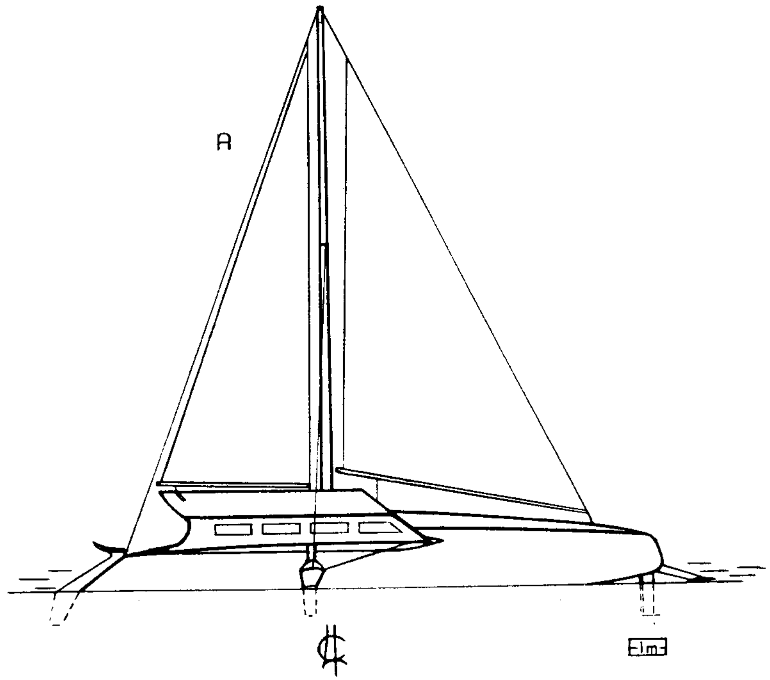


A "heavy day," showing an "E" boat thundering along with a storm sail of about 40 square feet. Note that her long cross plank is bent right down so that the "fuselage" is almost scraping on the ice. A DN is getting out of control and another has flipped.

At A is shown the *Hook-up* which can be retracted and detached. This is incorporated to eliminate wave-making, which otherwise would be inevitable at very high speed in a seaway.

This craft does not enable the ample spacing that is characteristic of multi-hulled craft, but is adequate for 4 persons for fast trans-ocean cruising.

However, *J-FOO-KIK* was conceived as an exhilarating, rather than as a confortable, cruising yacht. It has the sweetest set of lines



J-FOO KIK

possible with marine-ply. It has the sort of aft section that is often thought to plane—which of course, they do, but with most of the weight supported by bouyancy—and the sort of fore-sections that just knives through.

Although there are many ropes to be attended to the arrangement is very simple and *J-FOO-KIK* can be manoeuvred from the cockpit by one man. There is foot steering.

HYDROFOILS FOR A RACING CATAMARAN

DEVISED BY

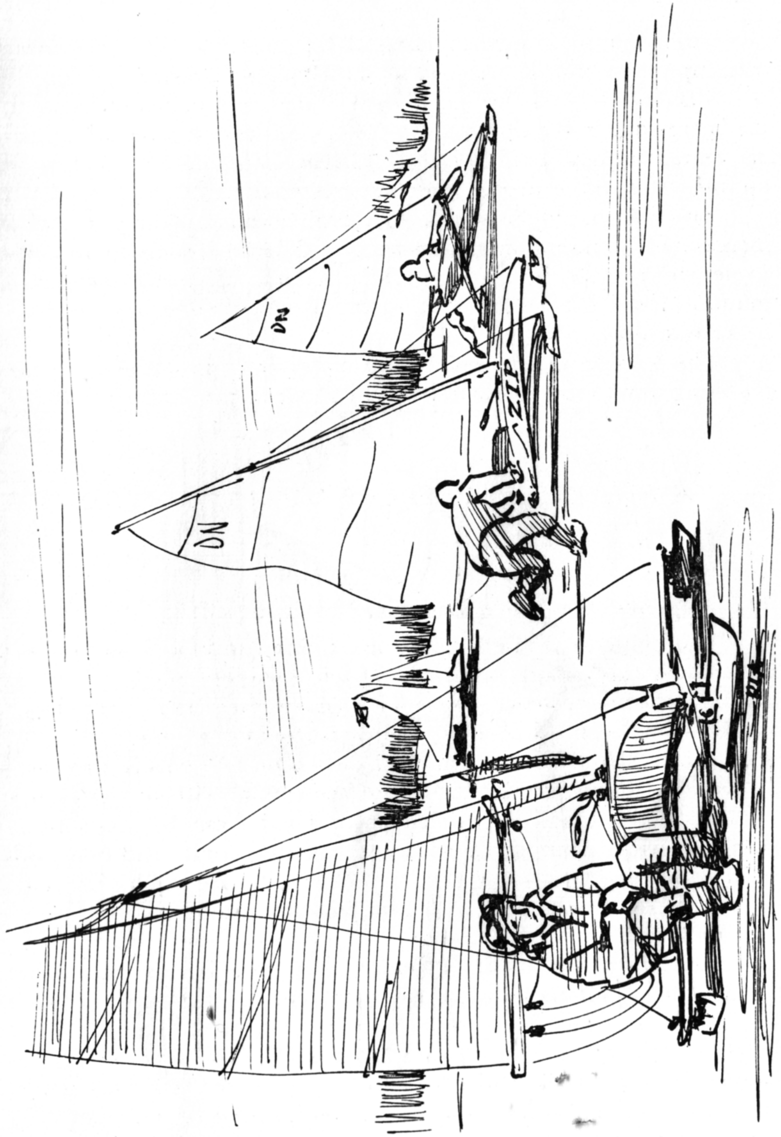
J. ROBERT WILLIAMS

P.O. Box 84, Cocnut Grove, Florida, 33233, U.S.A.

Here, we have a unique application of hydrofoils to a sailing craft. In light winds, the boat—a *PHOENIX* catamaran—sails quite normally but when the sailing speeds increase up to and beyond a $V/\sqrt{L}$ of 4, an inverted T hydrofoil is put down on the lee side of the boat to absorb the total capsizing moment of the sail force. This results in increased speed and a smooth ride because the boat is lifted above most of the waves.

Phoenix Catamaran—foil retracted

The Foils. There are two of these (one for each tack) mounted near the bows. Each is an inverted T type with a foil area of only ½ square foot mounted on struts which can weathercock to the water flow. The angle of attack is set by hand but need not be continually watched. It is usually set at about 10°, which allows for a downwards pitch of the bows to that extent without negative incidence. There is no lateral force taken by the foil because of its turning to the water flow and the normal centreboards are used.



A "light day," showing a played out skipper (from pushing on foot) while beyond him the fellow with "ZIP" shoves off, and a further fellow has got the forces going and is away! In the distance an old gaff-rigged stern steerer trundles along.

powered group of aerodynamicists) of the then new discovery that a wing tip tank could be designed to just about get a free ride.

The gist of it was that the tip tank made a substantial reduction in the energy loss in the tip vortex at the obvious cost of some added skin or wetted surface drag. The important part which was how to optimize this, unfortunately I don't remember.

The obvious application is to a keel boat and would consist of increasing the width or beam dimension of the lead to some compromise value which would drop the cg. of the lead and decrease the vortex,—induced drag I believe they call it—at the expense of a small increase in surface drag.

The problem is how to do this while keeping the design such that the thing won't foul on seaweed, ellgrass, potwarp and other obstacles.

ICE BOATING IN EXTREME WIND CONDITIONS

BY

RICHARD L. ANDREWS

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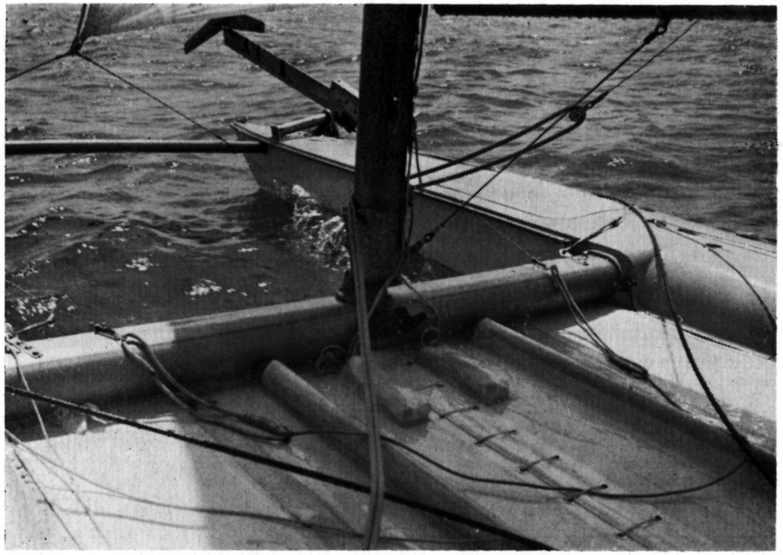
The optimum conditions for ice boating include smooth, hard ice and a steady natural wind flow of ten to twenty m.p.h. In these conditions runner contact drag is minimal and each craft can approach its aerodynamic lift/drag limit, which is about 3 : 1 for the "DN" and perhaps slightly better than 4 : 1 for a good "E" boat in fine tune. Poor ice conditions—rough or soft surface with or without snow cover—cause more runner drag which up to a point can be overcome in sufficient wind. But given good ice, extreme wind conditions will be natural wind flow under five m.p.h. or over 25 m.p.h., in which ice boat performance tends to fall off, and to be unreliable.

In very light air, an ice boat will not "drift" nor "ghost." An eager ice boater sits in his stationary craft and feels a puff. The telltale ribbon flutters a little. He jumps out and pushes the craft as fast as he can run with it, on a reaching course. He hops on, and hopes. Now if the natural wind force is too low in power for his runner drag, his crafts slides to a stop. But if the puff has enough strength in it, he "breaks through" and builds drive on apparent wind force above the natural wind force. It is a grand feeling, but a precarious one in these conditions. The wise sailor seeks to keep his boat moving and does not try to lie too close to the natural wind flow direction on either up-wind or down-wind tacking. Even so, he may "lose the wind" if the natural flow changes direction; he has got to



William's foil, retracted

Foil in sailing position

Advantages. The original intent of this experiment was to gain an increase in performance, primarily in the upper speed range through:

1. Reduction of wetted surface.

2. Drastic trim change to promote dynamic lift on the aft hull sections.

3. Retaining the original windward and ghosting performance by having a fully retractable system.

Advantages not foreseen were:

4. Reduction in spray (virtually no spray at full lift).

5. Eliminating of lurching, surging forward motion caused by blue water contacting the main cross beam and trampoline.

6. Ability to span or leap across troughs and operate in rougher water at higher speeds in greater comfort even at only partial liftout.

Disadvantages.

1. Difficulties in docking (not manoeuvering) with the long overhang of the foils in the retracted position.

2. The bows are protected from damage at the expense of the strut-foil joint.

The Angle of Attack of the Foils. The foils shown in the photographs (lee one only) provide partial lift-out from 17 to 23 m.p.h. Between 25 and 28 m.p.h., the lift of the operational foil is such that it can be flown if not properly set. The system is somewhat self-correcting since a portion of the load is carried by the hull and, as the stern rises, this serves to decrease the angle of attack of the foil.

Sailing Trials. In use, these foils become operational at wind velocities in excess of 11 to 12 m.p.h. They then become a reaching or running necessity.

It has been found best to retract both foils in light airs or when going to windward. At the windward mark, the lee hull for the next reach or run is selected and that foil only is dropped. The pitch control is set positive at 10° or so. As the boat falls off the wind, the speed increases and the lee bow starts lifting. The wetted surface is now a bit less and the speed increase continues. A manual reduction in the foil pitch to offset the induced pitch caused by the high attitude of the bow. As the bow is lifting out, the heeling force is predictable until the boat starts sliding off in a planing attitude—at which time, the weather hull flops down and the heeling force diminishes as the speed increases.

The A.Y.R.S. is to be congratulated upon having a member of the stature of Edmond Bruce. I can think of no one who combines his ability to recognize and weigh all the factors it takes to design and sail boats and keep them in proper perspective and be willing and able to publish it as freely and lucidly as he has done.

This issue reminded me of a few random pieces of information which are frequently overlooked and which should be a part of the background of all good amateur naval architects.

The first is two comparative coefficients. A good sail, properly cut and trimmed in a 15 knot breeze will have a gross lift of about one pound per square foot.

A man descending in a parachute falls at about 15 knots and if you make reasonably accurate assumptions about his weight and the size of the chute you will come out with about one third of a pound per square foot.

Conclusions: A square foot of good lifting surface is about three times as good as a square foot of dragging surface such as a chute or a spinnaker. Sometimes it pays to tack down wind.

Without the chute the man will fall at about 120 m.p.h. This is the speed at which an irregular object of the size and shape and weight of a man will have a drag equal to his weight. This is sometimes a handy number for keeping things in perspective.

I would hazard a guess that most of the numbers I have seen in the A.Y.R.S. journal for realizable lift drag ratios are slightly pessimistic. More than a few entire airplanes have done 20 and shortly after the advantages of flush rivets and polished skins were discovered, a Northrups plane did 25. I have no recent figures, but doubt if they would show much improvement.

With reference to Bruce's curves showing angle between apparent wind and course versus various lift/drag values for both boat and sail, on page 18 of No. 37 and with conclusions on page 20, it is very much to be noted that leeway angle fails to appear in this analysis, i.e. The hull could be making 90° of leeway but so long as its lift drag ratio is what the curves call for, the performance will be as predicted.

Most texts agree that an attack angle of around 5 ° usually gives the best lift/drag ratio. When you read in the papers that the current cup defenders are sailing close hauled at one or two degrees, it makes you wonder.

Here is an idea for the pool that conceivably could have some far reaching effects.

I once had occasion to sit through a discussion (by a fairly high fooling around when a friend was sailing the boat. I was thrown overboard in a tight turn. I landed on my belly and slid about a mile before stopping. The friction ground all the buttons off my coat. This is the worst that ever happened to me.

As a result of this and other experiences, I would say that the problems of getting adequate driving power are neglible in comparison with the problems of reducing hull drag. Edmond Bruce has said it much more elegantly in A.Y.R.S. No. 37 page 20. In general it seems much easier to pile on more sail than to tinker with some of the wierdies one finds people working hard to consummate.

Some short sighted rules committees have made a rule that says you may not pile on any more canvas. You must stick to whatever the class rating allows. This forces the ambitious individual to knock himself out with elliptical sails with fancy battens and bendable masts and that sort of thing. One wonders what the same amount of money and man hours might come up with if they were spent instead on a new committee to dream up a new set of rules with no limitations that foster uneconomical designs.

With a thorough understanding of the convergence bit re the rear steerers I still think the basic iceboat configuration is a very good one for experimental purposes.

One may replace the runners by long slender hulls like the hull of a racing rowing shell. This has been evoluted over the years to have as low a drag as possible. Some sort of a keel, a dagger or a spade will be necessary to provide lateral resistance. This seems to be well understood.

In all the back copies I have read, I have found no reference to an out and out planing design. A few years ago one of M.I.T. s top N.A.'s, Martin Abkowitz, expressed the thought that a properly designed planing hull could do about as well as any in the liftdrag ratio battle.

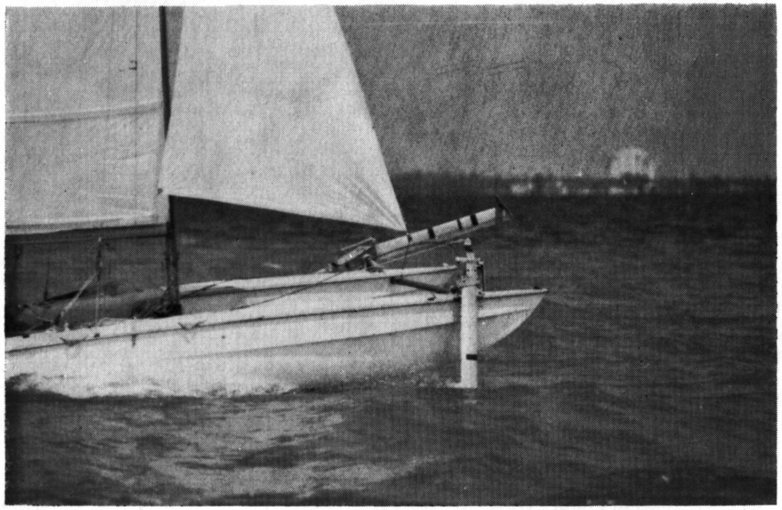
I visualize the old iceboat form with each runner replaced by an articulated planing type hull of perhaps 25 or 30 square feet area. At each end of the runner plank would be a down coming member of two or three feet. This rests in a ball and socket or universal joint on the bottom of the planing hull. The hull is then free to adapt its angle to whatever the wave surface presents at the moment, without feeding any vibratory forces to the main hull and passengers.

Again some lateral plane must be provided. With comparative ease this keel member could sprout lateral surfaces making like inverted T hydrofoils which could carry some or all of the load.

In theory this could be a planing boat up to a certain wind speed and then become a hydrofoil boat for higher wind velocities.

When top speed has just been reached, the pitch control should be adjusted. The foil should be set as fine as possible while still supporting the bow but should not allow it to start dropping. Some extra incidence is used for practical reasons since, if a puff should squeeze the bow down and the pitch control was too fine, the foil attack angle might go negative with predictable results.

The weather hull has not yet been flown with the heeling force in the full planing state. In fact, since only the lee foil is used, the boat sometimes runs with a weather list.



The Williams foil lifting the lee bow

Construction. The foils, struts etc. are made from light alloy. Owing to the speeds obtained, several parts failed from the unexpected loading. The foils can be lowered or retracted at 10 m.p.h.

Summary. Mr. Williams has produced great benefits for the high speed sailing of his *PHOENIX* catamaran by the use of a foil outside the lee bow. These not only produce increase in speed but almost complete freedom from spray. The system may be of great benefit to any racing cat where the rules allow it.

Dear Sir,

I could not resist sending you some photos of my second trimaran —a little eight footer—mostly to show that the small tris can be pretty (as I think this one is) as well as functional. They show the form fairly clearly. My wife and I made the sail also, and this, our second sail-making venture also, was considerably better than the first one we

Dr. Fieldman's low aspect-ratio foil trimaran

made. The whole thing can be put together in fifteen minutes and the main hull is easily manhandled by myself from cartop to the trolley.

She sails very nicely and a bit faster than the popular eight foot "El Toro" prams so ubiquitous in this area. in spite of the fact that her small size makes her very weight sensitive.

She has one interesting feature in that, while she may heel a few degrees in a crisp breeze, a sharp puff tends to make her sit up squarely

Most of these boats had the mast located practically over the crossing of the backbone and runner plank, or very slightly forward.

Close observations of the races on days when there was a good wind revealed that in the majority of cases, the loser lost the race by spinning out, i.e. he tried too hard. The side force on the rear steering runner was more than it could take, so it skidded or made leeway.

The boat would never come up into the wind stably and stop but might go around one or two revolutions completely out of control and presenting frightening hazards to the rest of the fleet.

A few years later, with more courage, (or was it foolhardiness), facilities, ambition, etc. I decided to build a big boat and see what I could do.

She had a 23 foot backbone, 17 foot runner plank and 28 foot mast and the mast was stepped well forward to put the centre of effort as close as possible but just astern of the runner plank. She had a permanent backstay. This was one of the controversial features. And I clubbed the sail maker to cut the sails just as flat as the Lord would let him.

I won every race I ever entered. The main sheet was like the throttle of a high powered car. You could go any speed you liked by trimming or easing the main sheet. We used to sail in narrow figure eights at 90° from the real wind. I suppose you have to call it reaching, but the apparent wind in an iceboat is always dead ahead, and you are going 5 or 10 times the speed of the real wind.

I timed her once at 47 seconds for the length of the lake in about a 15 or 20 mile wind. The lake is about $1\frac{1}{4}$ miles long, and you have to slow down for turns long before you get there.

There is nothing in the world that has the acceleration of a properly rigged iceboat. You go from practically standstill to 80 knots in 2 or 3 seconds. You really need a good rail around the cockpit, and a firm grip on the main sheet.

An iceboat will make its best time with the windward runner about a foot off the ice, called lifting. Skippers who cavort around with the runner 8 feet off the ice are either ignorant or trying to impress the girls.

When a rear steerer lifts, the angle of attack is reduced slightly. When a front steerer lifts, the angle of attack is increased slightly. The former is a convergent phenomenon, the latter divergent and explains why front steerers never sail lifted, and when they capsize, it is all over very suddenly. I have never known a rear steerer to capsize. The accidents were pretty rare and happened from getting a runner caught in a big crack in the ice or in attempting to hold a course too long, and running up on shore in a turn. Once I was in which a boat may achieve roll stiffness. One way is by a broad flat hull form, and catamarans and outriggers are extreme cases of this. The other way is to have the cg. as low as possible so it hangs like a pendulum.

If two boats have equal roll stiffness but by opposite methods as just outlined, it will be found that the wide beamed boat will follow the surface wave shape comparatively accurately and as a consequence may roll much more than the boat with the semicircular hull form with a deep fin keel with lead on the bottom. *Ed.*—Not so.

Maybe there are several, as yet undiscovered, tricks for achieving a pleasant boat without the necessity of carrying all that lead around. But we will never find them out unless we give their findings some motivation.

Iceboats

I built my first iceboat as age 14 or 15. That was in 1917 or thereabouts. The backbone and runner plank consisted of some 2 by 6 timbers stolen from a nearby house construction job. The runners were some outmoded skates which some ancestor had made by fitting an old file into a slot in a piece of hardwood with appropriate holes for straps, enabling them to be strapped onto the sole of your shoe. The file or course was ground sharp like a skate blade.

The mast was a former bean pole, and the first sail was a sheet, also stolen. It didn't last long. The next one was made out of a hay cock cover. That one lasted for years.

It was a rear steerer, of course, as front steerers hadn't been invented. Any time the ice and wind were any good you could get all the sailing you wanted and let your friends have a ride too while you skated around a bit to get warm.

I can't remember any problems of sailing or learning. You simply put the thing together and it went.

This was on "Little Mystic." (Winchester Massachusetts).

Through a bight and a quarter mile downstream was "Big Mystic," roughly a mile across, where the big boats used to sail. We couldn't mix with them because they went so much faster.

There were a half a dozen or more of these, including some of the fanciest boats in the world. The older ones were gaff rigged and the newer ones Marconi or Bermuda. The rivalry was very keen and there were races every Saturday and Sunday weather permitting, and sometimes even on week days. We loved to watch them, and the millennium was to be invited to go for a sail. On windy days ballast helped.

Front—Side view

rather than heel further, her low aspect ratio hydrofoil fins apparently doing the work. The fins also substitute for a daggerboard, the lack of which seems to be no great loss, as her pointing ability is just as good as the centreboard dinghies on the reservoir—and besides, in that tiny hull it's either a daggerboard case or me!

The vital statistics are as follows:

L.O.A. 8 feet.	Floats L.O.A. 6 feet.
Beam O.A. 5 feet 10 inches.	Floats beam 9 inches.
Beam, hull 2 feet 0 inches.	Foils 18 inches long.
Beam, hull at L.W.L. 17 inches.	Foils 9 inches deep.
Beam, hull at bottom 12 inches.	Foils dihedral 45°.
Weight 65 lbs.	Sail area 38 square feet.
Cost $50.00.	

Side view

The January issue of the publication was superb. I can hardly wait to start designing an overnighter-daysailer for the Bay. I hope that the membership list so thoughtfully supplied will lead to regional meetings in this area.

CLAYTON O. FELDMAN.

2271 Constitution Drive, San Jose, California 95124.

that looks important is the single outrigger, always carried to weather and hopefully skimming the water with little or no down force.

I would like to hear more details about tacking in a heavy blow and most of all I would like to hear from a practical sailor who has spent a few weeks aboard and who would report on the double ended feature, i.e. How much inconvenience is it to be required to live with either end as the bow?

As described to me the South Pacific proas are very narrow, usually asymmetric hulls, roughly the shape of a good lifting surface and have no keel.

In more scientific language, this boat makes the hull provide both buoyancy or load capacity and lift to equalize the side force of the wind.

Most boats designed by smart guys with test tanks and a long string of degrees find it better to separate the buoyancy and lateral plane and let each function be performed by a specialist; a low drag hull for buoyancy and a dagger or spade keel for weatherliness.

But when we race these boats, the one designed by the aboriginee, who hasn't even a pencil, wins.

There probably are a lot of things the proa can't do. I'd like to see one pick up a mooring in the middle of Marblehead Harbour some dusty day in August, or go from City Island to Governors Island in New York.

There are many reasons for liking and wanting boats, presumably related to the various things boats can do, and the list is interminable. Many of the items on the list are mutually exclusive or contradictory, i.e. you can have one but not both.

Rules

Research on sails and hulls is fine but how about some research on rules committee men? Or maybe we could even have some study on the rules themselves.

Instead of saying how big the sail may be why not specify what the boat should do? Like bring in a boatload of fish from Georges Bank 365 days in the year. Or take the wife and kids on a 3 day week end cruise of 100 miles in anything up to No. 5 seas. Or within a 30 foot overall length, go the farthest up the coast and back within a 24 hour period and disqualify if you run over.

Sailing Comfort

I happen to feel that a comfortable boat is very much more desirable than an uncomfortable boat. Rolling and pitching are two things that boats do which I classify as undesirable. A boat has to have roll stiffness in order to be stable. There are basically two ways about 4 knots or about where the drag curve starts steepening so the model should lift out at about 1.6 knots.

It did exactly as predicted. The joy and rapture lasted about two seconds, however, because as soon as the wind tips reached the surface it generated a geyser about a foot high (six foot at full size) and the now well known big air bubble ran down the full length of the tops of the foils and the whole project went back to the drawing board.

About this time another friend came back from Minnesota or wherever Baker holds forth, with the story that Baker had a good sailing model which required the very expert services of an accomplished airplane pilot to operate. By the time he had been sailing for a half hour he was ready to come back and turn in to his bunk for a rest.

This took all the joy out of life and the project was dropped.

An obvious cure to the geyser problem and probably to the air bubble trouble, would be a much thinner foil section with the suction side the arc of a circle and so arranged that a tangent to the leading edge was precisely horizontal in normal cruise. One day I found such a section in an Aluminium Shape catalog. Apparently somebody cuts these up and makes large commercial fans out of the pieces.

Now, thirty years later, and having read A.Y.R.S. including No. 58 my confidence is restored. I am sure a stable sailboat can be built, and I would not hesitate to guarantee to a potential customer that any reasonably accomplished sailor could learn to handle the thing in a few days.

Ed.—The above system appears to be used successfully in the *SEA CAT* 14—See p. 60.

OUTRIGGERS No. 23 AND No. 47

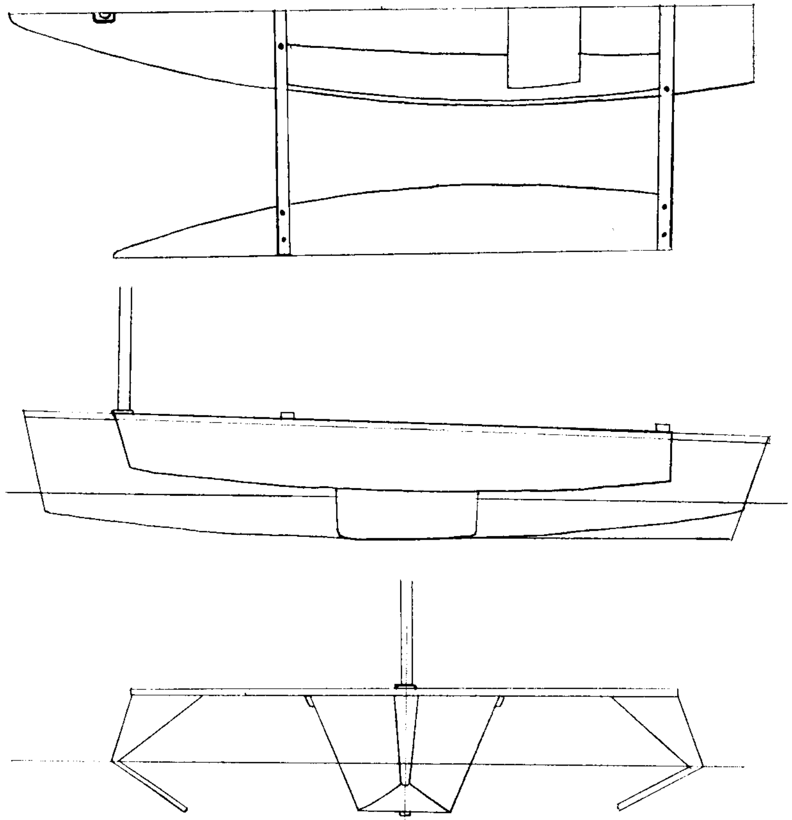
Ever a since a neighbour returned from the South Pacific with stories of Proa's doing 12 knots, I have been intensely interested in the subject.

Now I find the list includes:

Micronesian canoe	Proa
Trimarans	Micronesian trimaran
Triscaphe	Flying Proa
Polynesian canoe	

Will somebody please tell me where I may find a dictionary, lexicon, thesaurus, or other writing that provides lucid and unambiguous definitions of the above.

At the moment I would be inclined to put my money on the proa or the flying proa, I'm not sure what the difference is. The ingredient



SCALE 1" = 1'

EIGHT FOOT TRIMARAN
HYDROFOIL STABILIZED
C. A. FELDMAN, M.D.

TRIPLE SEC WITH LOW ASPECT RATIO FOILS (CENTRE)

BY

PAUL ASHFORD

Holly Lodge, Strumpshaw, Norwich, NOR 77 Z.

This season's experiment arises from last year's trials with a single Bruce foil and ten foot long outrigger which were reported in A.Y.R.S. No. 58. Further sailing fully confirmed the early impressions of the value of the foil and I am sure that this configuration was a considerable improvement on the original trimaran and is well worth further attention, particularly for a light and exciting racing craft.

However, I was left doubtful whether the single outrigger would provide a safe design for a larger cruising boat. When sailing with the float to windward, stability was provided partly by the action of the foil and partly by float and crew weight. When the wind was strong enough to lift the float, about half of the foil would rise slowly from the water without significant loss of foil stabilising, but beyond this point, the foil would let go suddenly and although this has not yet led to complete capsize, it came fairly close to it on occasions.

Furthermore, I felt that the foil when fully immersed was unnecessarily large and wasteful of wetted surface, but with the single outrigger to windward, one needs some spare foil area so that the float can begin to lift before the foil lets go of the water. The answer seemed to be to return to the trimaran configuration using a smaller foil on each float, with the added gain that foil action would on both tacks reduce hull displacement drag.

In fairness to Edmond Bruce, I must admit that I did not fully follow his design set out clearly in A.Y.R.S. No. 51, which requires that for complete stabilising, the line of thrust of the foil should pass through the centre of effort of the sail plan. On *TRIPLE SEC*, this line of thrust passes nearly three feet below this point. This was obtained with an overall beam of 9 feet, neglecting 1 foot 6 inches seat projection. To obtain full foil stability, this beam over both hulls would have had to be increased to 11 feet 9 inches. This seemed rather excessive on a 14 foot boat. Since I did not try it, I cannot say whether the general qualities of the boat would have been impaired by it.

This year, I am using the original pair of asymmetrical floats 8 feet long (shown in the middle left hand photograph of p. 6 of A.Y.R.S. No. 50) but with an increase in cross-beam length from 8 feet to 10 feet, and the floats placed a foot further forward. The drawing shows the general arrangement. The foils are hinged to the float bottoms and

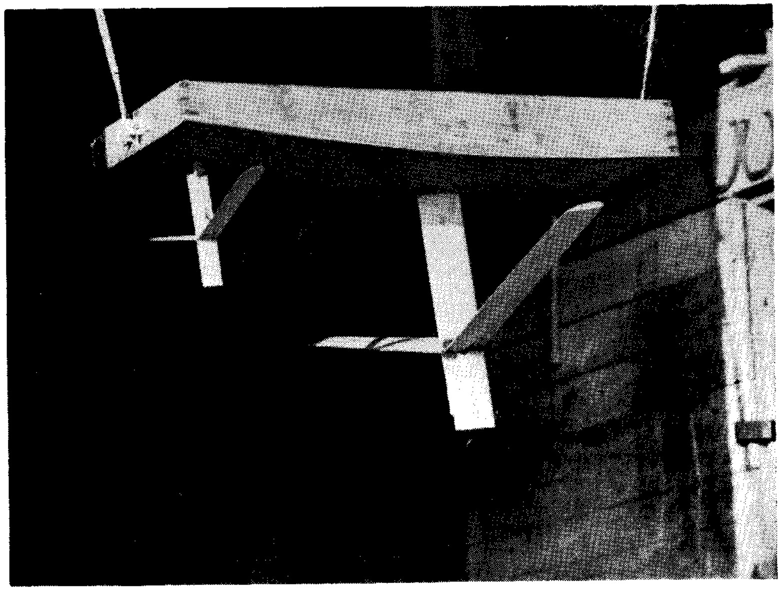
principal one to be slightly forward of the cg. and the after one to carry perhaps a sixth of the load and to also act as rudder.

The geometry was to be such that when the "wing tips" just began to break the surface, the hull would be just clear of the surface. Further increase in speed would raise the craft still more, losing lift, more to weather, and hopefully achieving a working balance in this manner.

As a refinement it looked attractive to design the part of the foils which would be in use at cruising (racing) speed to have about a 5° attack angle for max L/D ratio, while the outer ends of the foil would have 15° angle to maximise the lift at take-off.

Another design criterion was that an ordinary do-it-yourself carpenter such as me should be able to build this thing in his home workshop. This meant all wood construction and began to look very attractive when data from my fluid dynamicist friend indicated that the foils could well be made from 3 by 12 stock which was available in any good lumber yard. This meant a high thickness to chord ratio and by now there were enough uncertainities in the picture so that a note of caution suggested a model test to check on exact numbers for lift, drag, ratio and the usual unpredictables.

So I made a 1/6th scale model (photo attached) and towed it. The full sized boat, about 15 feet, was supposed to clear the water at



1. All the keels discussed or shown work by acting as fences under the boats, thus making the hull waterlines generate the lateral resistance.

2. Hulls with low aspect ratio keels may need special sailing techniques. Hedly Nicol could take his *VAGABOND* to windward excellently, from what I hear. Others cannot. Ron Burroughs, who owns *VAGABOND II*, thinking that this was due to the keels on the floats being too far forward, took them aft four feet and found *VAGABOND II* very docile and fast to windward, even at sea.

3. Low aspect ratio keels, allied with relatively narrow hulls, give excellent courses to windward and could be better than dagger boards on the A, B and C Class catamaran hulls.

In this matter, it may be a little unfair for me to bring in the Norfolk Wherry. They slways sail in shallow water and at certain speeds and depths, their hulls would have a greatly lessened head resistance. Also, the shallowness of the water might prevent some of the water from flowing under the hull. This does not invalidate the overall opinion but it might flatter the shallower keel at the expense of the deeper.

THOUGHTS ON THE A.Y.R.S. SUBJECTS

BY

BEN DRISKO

Drisko Farm, Harrington, Maine, U.S.A.

Here are some notes which have been inspired by a reading of some back numbers of A.Y.R.S. journal which have just come to my attention.

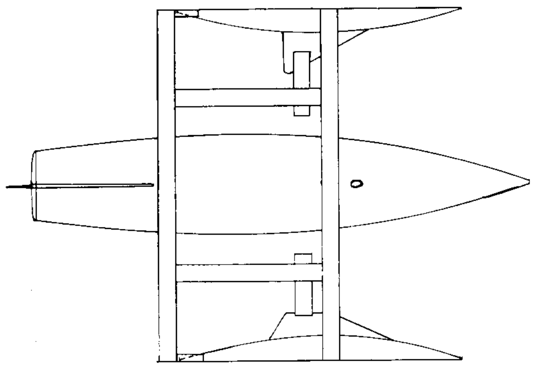
No. 19 HYDROFOIL CRAFT

Sometime in the middle thirties, I crewed for a racing skipper who had been a colleague of Gilruth and told me much of his experimental hydrofoil boat near Langley Field in Virginia.

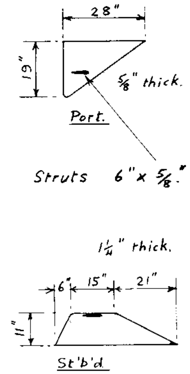
After a short incubation period this bug came to life, and I started designing one of my own. From Gilruth's reports the principal problem appeared to be pitch stability.

An unmanned sailing model offered little in the way of design numbers, so I started thinking along the lines of a boat that would take one 180 pound man for sure and two if we were lucky and had a strong wind.

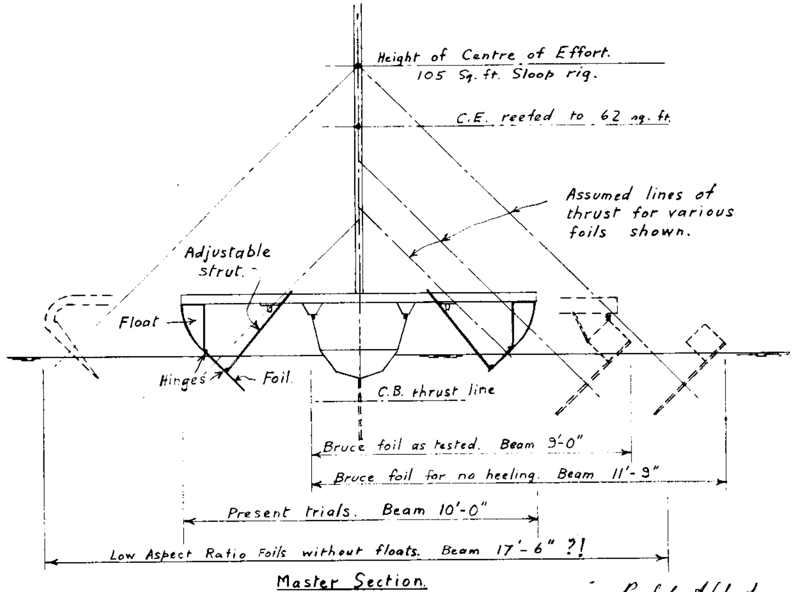
The proposed design started with a low drag hull that could plane easily if necessary and two hydrofoils with high dihedral. The



Plan.



Foil Dimensions.



'TRIPLE SEC' - FOIL TRIALS

supported by variable length struts so that dihedral can be varied, and, by insertion of packings between the aft crossbeam and float, an angle of attack can be given.

From rather limited trials, the impression has been gained that the best all round results are obtained with a dihedral of 45° and the foils angled up about 2°. The actual angle of attack is increased by leeway. Reduced dihedral brings the foils nearer the surface and this produces considerable surface disturbance at fairly low speeds. On occasions, a steep, almost breaking wave has appeared over the rear edge of the foil at speeds of 2 or 3 knots, but the wave pattern improves as speed increases.

Two different foil profiles are being tried. Both appear reasonably effective for windward sailing without using the centreboard. The leeway angle is judged to be somewhat greater but not excessive with the lower aspect ratio foil. If the lower aspect ratio foils were fitted on both sides, this would give the advantage that the boat could be beached on the centre hull with a fixed foil dihedral of 45°, and also that the windward foil would lift clear of the water at a smaller angle of heel.

The floats are on the small side for a trimaran relying on float bouyancy for stability and a very useful increase in stability is given by the foils. The trials confirm that low aspect ratio foils do work but for windward work, full foil stabilising cannot be expected without a considerable increase in beam as shown in the drawing. The present arrangement probably roughly doubles the stability obtained from the given float bouyancy compared with the use of a centreboard. Some fast "planing" has been enjoyed on a close reach.

The struts, which are not free to weathercock to the water flow, have been given a slight angle of attack to try to avoid a capsizing moment. This seems to work fairly well, but the presence of the strut tends to confuse judgement of the foil performance. I think they must add to drag as they throw up a good deal of wake and spray. The starboard lower aspect ratio foil has this week been glued rigidly to the float so that the strut can be dispensed with. I am looking forward to trying this out very soon.

The boat handles and tacks well but a disappointing feature with cruiser development in mind is that it heaves-to badly, swinging uneasily back and forth, pivoting on the leeward foil and making a great deal of leeway. Lowering the centreboard corrects this behaviour but it is unfortunate that it seems necessary to provide a centreboard for heaving-to which is definitely not required for sailing.

Ed.—A high aspect ratio Bruce foil or twin Bruce foils could be "fenced" to prevent the air entrainment when the float leaves the water.

bottom of the keel along its length, and if this is the case, there is argument for a shorter deeper keel.

The A class *BAMBI* with low A.R. keels was never really well balanced. It was in the first instance a compromise because I could not get the mast as far forward as I had wished due to the cockpit position, so she always suffered from excessive weather helm, and I do not feel was given a real chance to prove herself to windward. However, on reaching runs *BAMBI* was more than a match for the best A Class in the trials, and running did not seem to lose anything from having keels permanently in the water. Keels have buoyancy and to a certain degree increase the aspect ratio of the hull and may theoretically help reduce wave resistance.

We are at present building an A Class for the International trials from our Shearwater I hull mould on Bambi lines for Neil Coster to rig and sail. This boat has normal dagger boards and we look forward to seeing her go.

I feel now that there is every reason to believe that keels may be of some advantage notwithstanding the convenience and saving in costs when moulding in glass. That keels are a must for cruising cats when all is considered, and that it seems very worthwhile to persue experiments with keels on the lighter performance cats of A, B and C Divisions. I think also that a Trimaran hull could have a keel in its central hull to some advantage, as I heard from a competitor in *MIRROR CAT* that *TRIFLE* looked difficult to steer and was yawing about in the waves during our dash across the Channel in the Crystal Trophy race. This could be due to having centreboards in each float and alternately dipping one and the other in the seas running at the time.

We had a very good discussion at a Press Conference held on Monday by Courages on the capsize of their sponsored boat *GOLDEN COCKREL*, and quite a lot of useful information will come out of it.

Roland Prout.

The Point, Canvey Island, Essex.

LOW ASPECT RATIO KEELS SUMMARY OF EVIDENCE

BY

John Morwood

In the fore-going pages, we have had the account of the Norfolk Wherry and various opinions of low aspect ratio keels. Summarizing this evidence is difficult and I can only do my best.

Dear Mr. Morwood,

Thank you for your letter of April 21. After building the Cross 26 and the Nicol Clipper, I would say that the larger fin keel on the Cross design is more functional than all three on the Nicol. The total area in square inches is almost the same, but the Nicol fins are not deep enough.

I am enclosing photos of both the Nicol and Cross boats we have built so that you may see for yourself.

J. WARD GRANT.

4230 Glencoe Ave., Venice, Calif, 90291. Area Code 213 391-8583.

Dear John.

I have only just returned from the Crystal Trophy race which kept me away from the Office for a week and am sorry not to have written before.

The race was a great success for *PELICAN* (previously named *TITWILLOW*) our 45 foot Ocean Ranger. We were quite heavily loaded with all Dr. Pugh's equipment and extra items for his holiday which he is commencing in the boat from Plymouth. We must have been carrying about a ton of unnecessary items such as extra outboard motor for dinghy, large dinghy with sailing gear, Generator, extra anchors, extra gas bottles and a host of other equipment which would normally be left behind for a race. Yet we were more than a match in all conditions for the lightest and fastest Cats and Tris. We actually did the 350 mile course about 1 hour 20 minutes faster than *MIRROR CAT* and 1 hour 30 minutes faster than *TRIFLE.* We could easily have pressed *PELICAN* harder, and we badly missed a large spinnaker which all the others had.

To get on to the keels, I feel that as far as the cruisers are concerned they have been a great success. *PELICAN* is able to go to windward very well, and makes hardly any leeway, about 3°. Yet her tacking ability is very good and I have no reason to believe it would be any better with boards.

I have found that the centre of lateral resistance must be calculated exactly the same as for a normal centreboard, and I feel that the length and depth of the keel is influenced by what one considers the limit for proper manoeuvreability and tacking. If one did not have to consider this you may well be right that an even longer shallower keel may prove more effective. Though of this point I am not sure, as one may build up a resistance from the small eddies created along the

Paul's low aspect ratio foil could have its area increased by extending it fore and aft without increasing the drag significantly.

If the foils dynamically balance the sails completely, the stability can be placed in the main hull and the floats abolished completely.

A LOW ASPECT RATIO BRUCE FOIL CRUISER

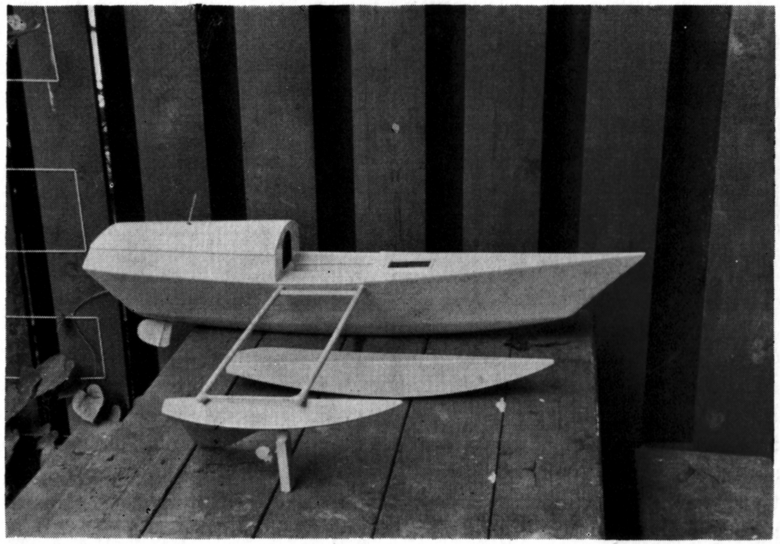
BY

ROBERT D. PERKINS

I have been experimenting with various types of foil stabilisers since 1960 using three to four foot scale sailing models as test vehicles. In the Fall of 1962, D. N. McLeod, a brilliant, young engineer from Brockville, Ontario, suggested that I try out what have become known as Bruce Foils. It did not occur to either of us that this type of stabiliser would work if it were kept to windward. My first model, therefore, was a three foot proa. I tested it in January at 5° below zero in a plastic wading pool in my garden and despite clouds of steam and cold winds, etc. it proved a qualified success.

The following summer, a larger 50 inch model was built. The stabiliser was simply an elongated floil drawn out to form a shallow triangle 32 inches long and 8 inches deep. This model refused to capsize even in gusty winds of approximately 35 miles per hour and moved very quickly.

I then started construction of a full size, 23 foot day sailer which was to be used to develop a larger cruiser-racer. Before I had completed the main hull, Edmond Bruce's lucid article was published. In my opinion, this was the most important and significant paper prepared to date by any member of the Society—a real breakthrough. After reading Mr. Bruce's paper, I decided to abandon the proa form and to develop a boat which would tack in the conventional manner. The practical advantages of low aspect ratio foils I had been using soon became apparent. They are stronger; they are more easily attached to the outrigger beams; they draw less water; they can be made weedless; they do not have to be adjusted fore and aft on opposite tacks; they are more easily retracted in shallow water. My fifth model, 40 inches long carrying 600 square inches of sail, was exhibited at our annual A.Y.R.S. Club meeting at the Barrie Yacht Club last year. In breezes of five to ten knots, it pointed very high and moved so quickly that several members who set out after it in catamarans and trimarans were unable to catch it. It sailed out of sight and was lost permanently.



Bob Perkins' model foil cruiser

The Cruiser. The cruiser shown in the enclosed drawings is 38 feet long with a water line of 30 feet. It displaces a little more than 4,000 lbs. and carries 600 square feet of sail.

Construction. Half inch plywood is used throughout. The sides (five 4 feet x 8 feet sheets of plywood) have a constant width of four feet from stem to stern. The curved bottom section is achieved by covering the flat floor with styrofoam which is, in turn, covered with fibreglass.

Hull Shape. The bottom of this boat is shaped in accordance with current A.Y.R.S. theory for optimum speed having a sharp, narrow bow and a broad partially immersed stern. The maximum beam at the water line is 32 inches and the section at that point is almost semi-circular. The long, high dory-like overhand of the bow is designed to avoid bow burying at speed without slowing the boat.

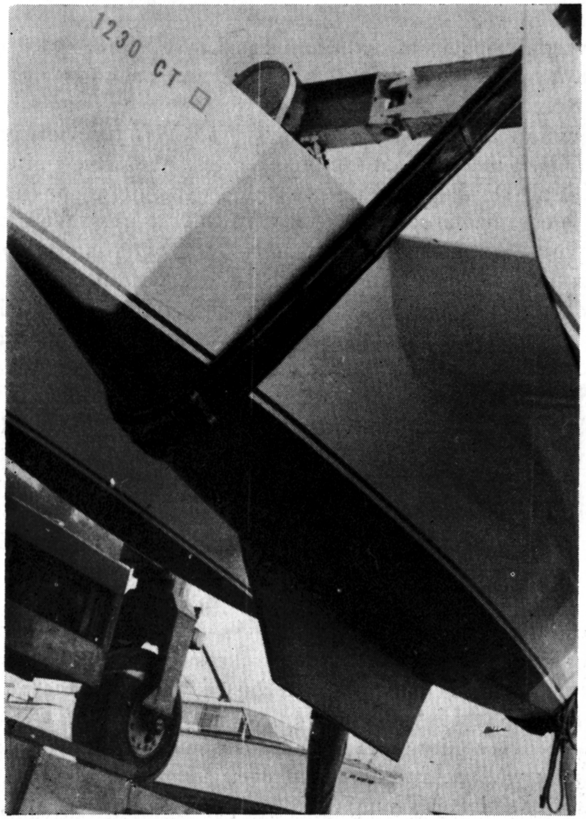
Self-Righting. The boat is self-righting on either tack and will bail itself almost empty depending on the load carried.

Rig. A modified junk rig mounted off-centre is to be used. This rig permits easy handling of the 600 square feet of sail and keeps the centre of effort low (distance between the centre line of the boat

Regarding your idea to tank test various designs—Recent A, B and C class cat designs out here are all based on Quest design thinking i.e. minimum possible wetted surface and minimum possible hull beam. Hence canoe sterns and maximum permissible L.W.L., with rounded off box midship section giving slightly narrower hulls than circular shape. Narrow hulls definitely go faster through waves than fat hulls and this is one place where tank testing doesn't help. Resistance to motion through waves is probably the most important of all the causes of drag.

By the way Charlie Cunningham and Co. with *QUEST III* have scrapped plank masts, as too heavy, and are using pump up air bags inside a sail sock on a conventional mast. LOCK CROWTHER.

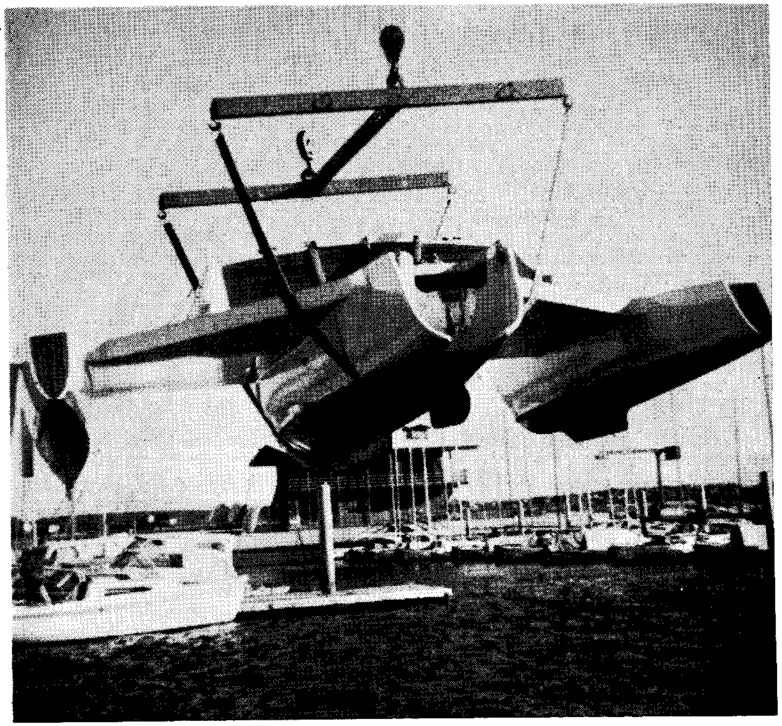
11/100 High St., North Sydney, N.S.W. 927390.



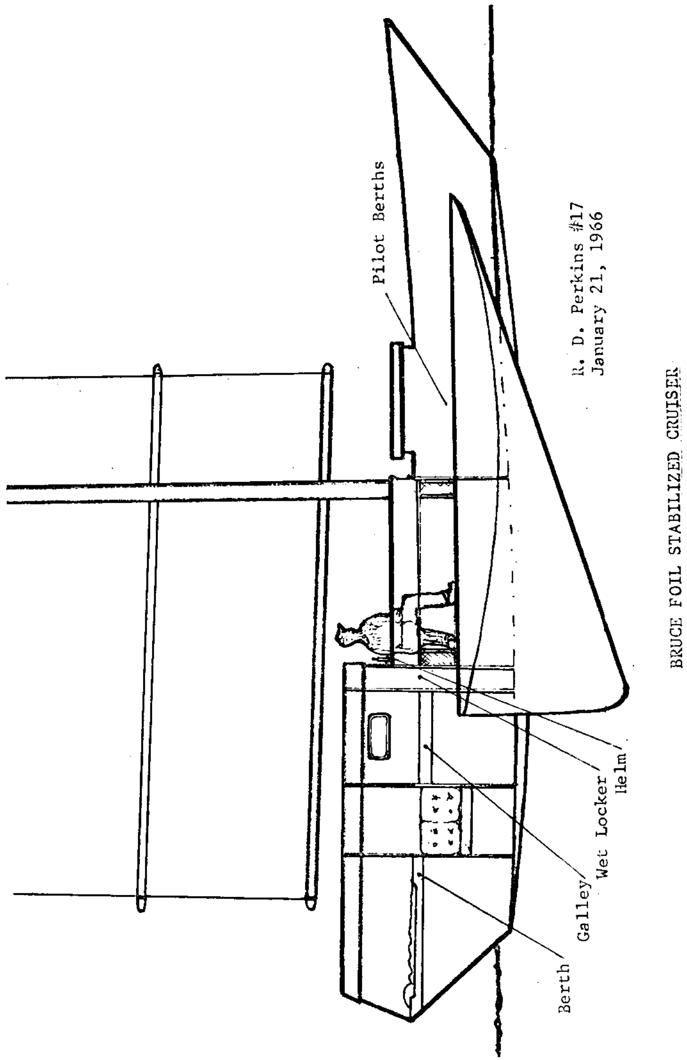
Cross 26

the mainhull is about to lift. Several boats have flown their mainhulls here, usually Nicol designs stripped for racing. Alternatively, if one has very small floats like Hartley's *SPARKLE* and narrow beam, one has insufficient stability and this is again very dangerous. Although a Sparkle has circumnavigated Australia, two have capsized, one right outside Middle Harbour Yacht Club, home of some of the Sydney-Hobart fleet, and on the day before this important race. This resulted in adverse publicity for trimarans in general.

Regarding low aspect ratio fin keels, these are definitely useless at sea in strong winds and rough water. The Nicol Wanderer gave up trying to beat around Tasman Island in the Sydney-Hobart race because two 45 mile windward legs brought her back to the same spot! One must have reasonable depth. Fins or plates in the floats are not as efficient as a centreboard and are very vulnerable. In addition, they impose tremendous strains on the floats and float-crossarm connections.

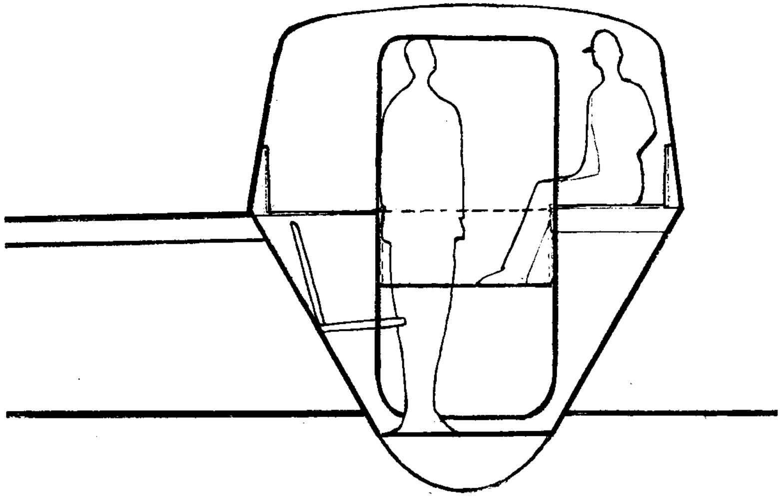


The Nicol CLIPPER



and the centre line of the float is only 20 feet). The modifications to the junk rig which I will be testing over the next month or so should overcome its unwillingness to go to windward.

Accommodations. There are two berths in a separate cabin at the rear of the boat with ample locker space. In the main cabin there is a



hanging wet locker immediately inside the entrance, a galley, seating for four people, a chart table, and an inside helmsman's station with clear visibility forward. The cockpit which is amidships is protected by a bulwark and is well above the surface of the water so that it should remain dry and confortable in rough weather.

The Stabiliser. The stabiliser shown is one of four which will be tested shortly on the 23 foot boat. It is flat bottomed with its maximum buoyancy placed well forward. Tests on all of the models indicated that the foil will be driven under in strong winds in the few seconds before the boat gets under way when it is to leeward unless there is ample buoyancy placed well forward. The flat bottomed form has been chosen because it planes readily reducing resistance.

The foil, as indicated in the diagram, is retractable inwards. In the retracted position it acts as a displacement form and it is hoped that it will develop some lift towards the port side of the boat so that in very light conditions when the stabiliser is to leeward the foil may be kept completely out of the water.

Conclusion. The cruiser is not, of course, in its final form. The 23 foot boat is now complete and in the next few months I will be running tests with various size foils. The outrigger arms on this boat are completely adjustable and the mast may be moved to any position so that it will be possible to predict exactly the position and size of all the components of the stabilising system on the cruiser.

was evolved for use in narrow rivers where the utmost windward ability was necessary. Frank Carr says: "But, when there was any wind at all, the Wherry was able in narrow waters to sail almost into its very eye by reason of the shape of her bow and the flatness with which the sail could be sheeted home." They also had a trick of using interaction of the bow wave and the lee bank to prevent leeway, the dynamics of which I cannot see. In any case, they were most certainly the most weatherly craft evolved by traditional methods. And that is where they concern us. Perhaps they were not the fastest sailing vessels in the world but for windward work, I suspect that they were the best ever produced.

The shape of the Wherry will be of great interest to our multihull designers. Being on the whole a slow sailing craft, the canoe stern is valuable and has the added advantage that the shallow rudder can be used. Otherwise, the shape is useful for a multihull, though the beam is a little excessive. The low aspect ratio false keel may be noted by all.

Summary. The Norfolk Wherry is shown as the most closely winded commercial sailing craft ever produced. There are lessons in her shape for both the multihull and single-hulled yacht designer and, though she was a capsizeable craft, I believe that she had a lower drag angle than many of our best modern yachts.

Dear John,

I have not seen the report from McGill University on a wingsail, and would be very pleased if you sent it to me.

In your letter of the 31st March you mention the ability of low-aspect-ratio boards to "bite" at low speeds. I agree to that, and understand your point for a cruising yacht. But I still have a doubt: Does a thin foil of low aspect ratio have less drag than a thicker foil? Perhaps the best results may be obtained by some sort of cross-breed between a foil and a float. Only practical experiments can verify.

FIN K. L. UTNE.

Fjellveien 7, Askim, Norway.

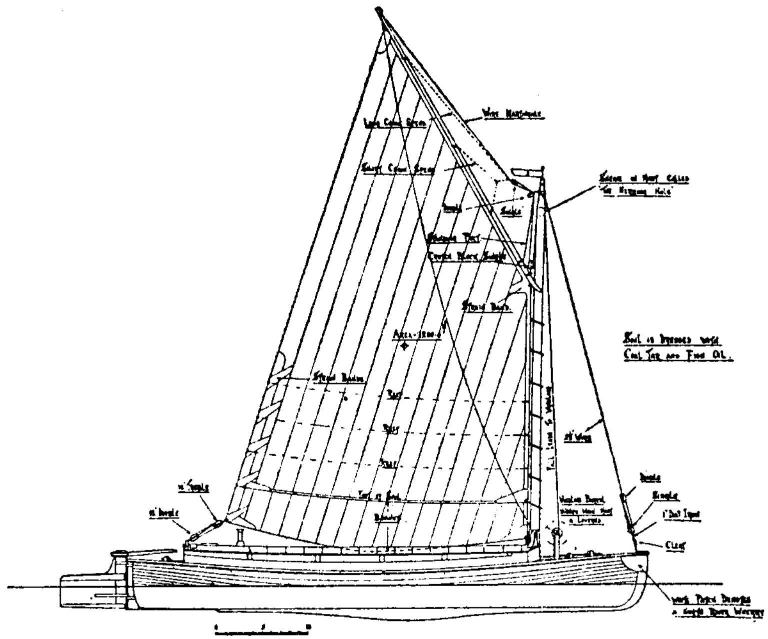
Dear John,

Bandersnatch and Kraken 40 have floats just small enough to bury when hard pressed, hence the need for the stilts. I think that this system is essential for a light spidery, relatively large sail area trimaran. It enables the boat to be driven at its limit of stability with no danger. With the larger float style it is impossible to tell when

The plans, lines and section of the Wherry *GLEANER* are shown, taken from Frank Carr's book and used by courtesy of the Editor of the "Yachting Monthly." L.O.A. 57 feet. Beam 14 feet. Moulded depth 4 feet. Though these are not typical dimensions, most Wherries being beamier and deeper, she shows the type well. She was a North River (Bure) craft which doubtless explains her lack of beam in an attempt to get a closer course to windward in the narrower rivers.

All sailing Wherries carried a false keel which is shown in the *GLEANER* profile. This varied in different craft but was only about 1 foot to 1 foot 6 inches in depth at the maximum. It was used to let the Wherry sail a closer course to windward and could be unbolted and left ashore when the shallower stretches were being sailed or quanted. It extended right to the bow and up the stem to which it was fixed by iron loops. This keel also increased the handiness of the Wherry and a Wherry yacht has been said to turn "in her own length."

Further details of the Wherries can be got from Frank Carr's book or other sources but what so deeply concerns us is the fact that the Wherry is the most recently evolved working sailing craft. And, it



The sail plan of Norfolk Wherry Gleaner

THE KINNEGOE CRUISER

(An easily made boat)

BY

JOHN MORWOOD

L.O.A. 25 feet.	Weight 600 lbs.
L.W.L. 23 feet.	Sail area 231 square feet.
Beam 15 feet.	Main 150 square feet.
Beam hull 4 feet.	Jib 90 square feet.
Draft 2 inches	Ghoster 231 square feet.
Headroom 6 feet.	

Designer: John Morwood. No plans available.

At the age of 14, I decided to put my life-long ambition to sail into practice and my next door neighbour, Fred Rogan, and I built a boat from old lumber and sheets which we tarred. It floated but leaked and we were persuaded to forget it after one trial. At age 15, I made a boat of 3/8th tongue and groove wood, 14 feet long by 1 foot 6 inches wide. I paddled it about for one afternoon on the Quoile estuary, near Downpatrick and then forgot it.

At 16, I decided I should know something about boats and read every book on yachting in the Linen Hall Library, Belfast and designed *JEHU*, 20 feet long and 4 feet wide to the section used here. With *JEHU*, we sailed many miles over Lough Neagh, in Ireland, which is often very shallow and the low aspect ratio keel shown dotted on the plan seemed very efficient in getting her to windward. Four of us slept in her under the decks and glass and wood lifting cabin sides. She gave us a lot of fun and taught us sailing. For a total cost of materials which included the mast and home-made sails of £8, she was good value.

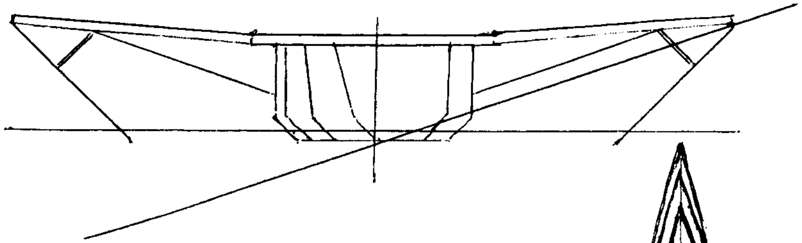
Now, 36 years later, I still think she was a good boat and, as an acknowledgement to Lough Neagh and the companions of those days, Henry Crawford, John Moffett, and my brother James, the first two of whom built boats and joined me on the almost yachtless Lough of those days, I call it the KINNEGOE CRUISER.

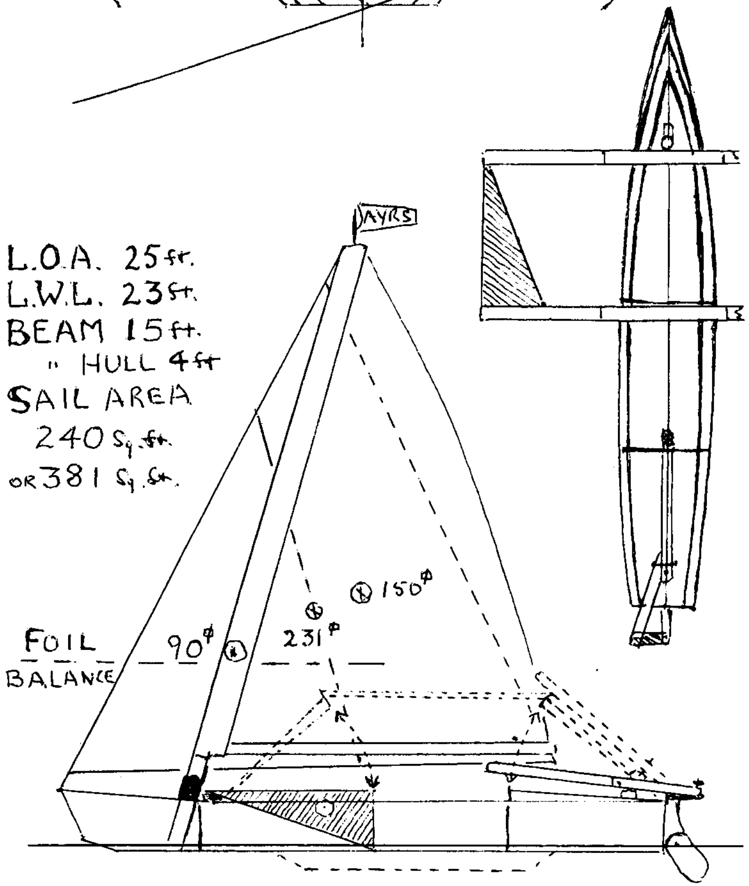
The Hull. This is frameless, the ¼inch plywood being held together by chine strips, while three bulkheads hold her to shape. *JEHU* pounded occasionally in a head sea of a certain length and the forward lines should be fine to minimize this—possible finer than I have drawn.

The Cabin. The hull is two foot in depth but the fore and aft decks lift to give 6 foot of headroom under a canvas cover and sides—

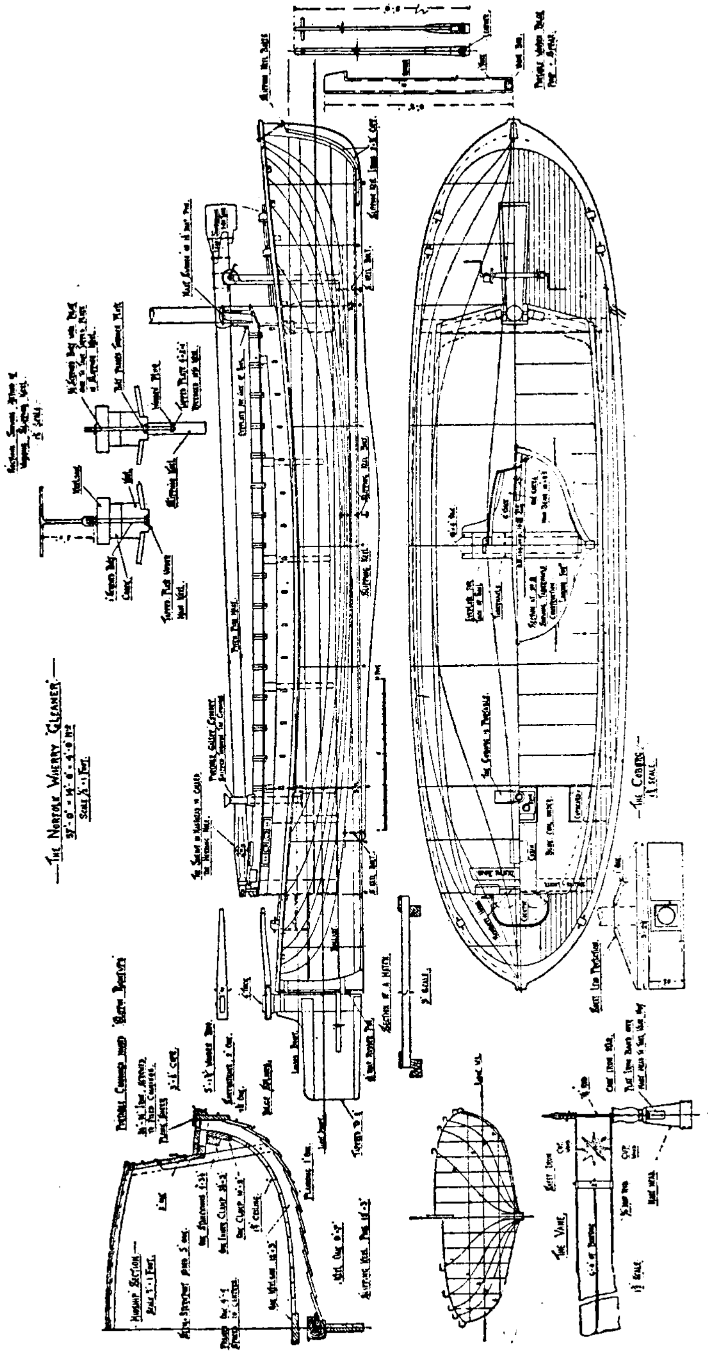
or opaque white polythene could be used. The tiller is mounted on the lifting after deck and has a 2 : 1 gearing to the rudder because its length of travel across the boat is limited.

The Hydrofoils. My original *JEHU* used a low aspect ratio keel, 2 inches wide and 7 inches deep. It eventually got waterlogged and exerted considerable righting moment when the boat heeled enough





The Kinnegoe Cruiser



GENERAL PLANS OF NORFOLK WHERRY GLEANER

LOA 57 ft. Beam 14 ft. Moulded depth 4 ft. Details of the "slipping keel" are shown, with method of fixing, as described in the article.

and re-rigged and in October the same year made a voyage under sail only from Yarmouth to Norwich, the first for a great number of years. Since then, besides carrying freight, she has competed in races against pleasure wherries, cruised the Broads with holiday-makers for extended day trips; has made the sea passage from Yarmouth to Lowestoft and has revived many of the traditional activities that wherries took part in formerly.

Ed.—The *ALBION* only partly pays her way and the Norfolk Wherry Trust needs funds for her maintenance. Donations can be sent to: Major J. A. Forsythe, Scoutbush, Hoveton, Norwich. NOR. 062. Members of the Trust, which only costs 30/- a year are entitled to sail in the ALBION.

THE NORFOLK WHERRY

BY

JOHN MORWOOD

The Norfolk Broads are in an alluvial plain formed from the silting up and peat growth in three arms of the sea which have now become the rivers Yare, Bure and Waveney. When the sea arms were open, the Saxons and Danes colonised the shores from their longships and the Viking merchant vessels—the halfship. In medieval times, the sea level was about 4-6 feet lower than it is today and large areas of the peat were cut for fuel down to the water table. When the sea rose, the water filled the areas from where the peat had been cut, forming what are the Broads or lakes. The Dutch in the 18th century (mainly) drained much of the low-lying land and confined the Yare, Bur and Waveney to their present banks.

On first seeing the Wherry hulls on the Broads, I was struck by their very close resemblance to the Viking longship, a replica of which stands on the foreshore at Pegwell Bay near Ramsgate, Kent and thought they were "living fossils"—however apt and seaworthy they were for their work. However, in Frank Carr's book "Sailing Barges," evidence is produced that the Broads cargo carrier was the Norfolk "Keel" while the Wherry was originally a passenger-carrying boat which grew in size until it supplanted the keel about 1830. The keel used a squaresail while the Wherry originally used a spritsail which later became the gaff sail. However, the hulls were very similar, though the "keel" sported a small transom. Actually, Frank Carr misses a point in his argument by not calling attention to the fact that the coamings of the hold are called "standing right ups," possibly because they allowed passengers to stand up instead of crouching under the hatch covers.

to bring it out of water. The conventionally minded could use such a keel but I have drawn triangular stabilising hydrofoils instead, whose shape and fore and aft position might need some experiment. Their depth might also need some experiment. I have drawn them drawing the same amount of water as the hull and at a dihedral angle of 45° which would give a draft of 1 foot 6 inches and a dihedral angle of 30°, when heeled to the waterline shown.

Mast and Sails. A swivelling and lowering mast is shown, mounted forward of the accommodation. Lack of sail area is an abomination on a sailing boat and 381 square feet are shown set on the 26 foot mast. This amount of sail could only be used if the foils work satisfactorily. My brother James and I found 200 square feet too much for poor old *JEHU* when we tried it, though she, being canoe sterned had less stability than this boat.

It will be noticed that a line is drawn across the sail plan at the height where the line of action of the foils meets the centre line. The centre of the sails' area are all above this but only by a few feet. The crew weight should balance this upsetting moment.

Summary. An experimental yacht design is shown which could be tremendous fun to sail. It should be extremely fast, stable and provide sleeping accommodation for four. Mounted on a trailer, it would provide sleeping accommodation while being towed to distant sailing waters.

A FOIL TRIMARAN

DEVISED BY

HENRY W. NASON

366 Farmingham Ave., Plainville, Connecticut 06062, U.S.A.

Having first made a Polynesian outrigger, it was thought that the float was not quite the perfect solution to stability. This led to the study of hydrofoils and all the problems of stability in general. The result was the usual conclusion that hydrofoils are the perfect solution for stability when underway but some outrigged floatation was needed for static stability and in very light winds.

The result of this line of though was a small float acting as a surface senser for a fully submerged hydrofoil with incidence control and retraction out of the water for beaching and in light winds.

In practice, what had been achieved is trimaran stability in all strengths of wind with tiny floats and foils. The future possibility of making the craft a fully flying hydrofoil is, however, a possibility.

Fig. 1 shows the principles involved. The float or floats are mounted on pantograph arms with dashpot dampers to prevent too quick an action on the foil and the rising and falling of the float actuates the angle of attack of the foil.

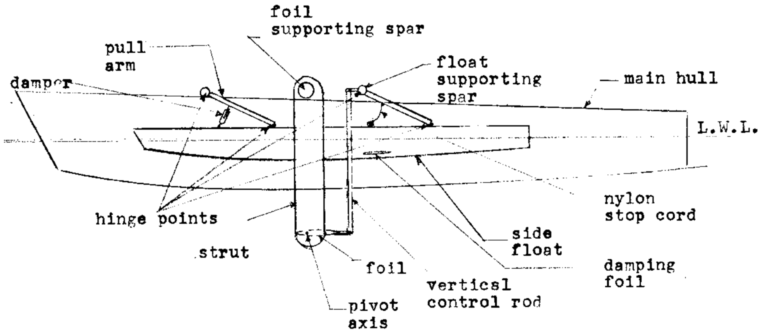


Figure 1.- General arrangement of parts

Experiment One. A 13 foot canoe has this arrangement mounted on one side only and this boat sailed well on the very first test. It will be seen from Fig. 1 that the foil will stay horizontal on swinging the foil struts up aft, thus allowing retraction while travelling.

Experiment Two. Here, an *AQUACAT* hull with no inherent stability was fitted with the float and foil system on either side. However, the wing tip floats shown in the photograph were not at first fitted and the foil incidence variation was only 5°. There were four capsizes on the first trial and there was not even enough stability when travelling.

The reason for these capsizes was not at first realised. In experiment one, the system was self adjusting—more heel pushed up the float and gave more incidence to the foil. In experiment two, the foils were set at angles to oppose each other and the lee foil was not powerful enough to overcome the upsetting angle of the weather foil. On the second trial with Experiment two, a continuous trim adjustment and foil incidence angle indicator were added and, with adjustment, the boat speeded up and levelled out. No more capsizes were experienced but at zero speed, the boat heeled too easily and wing tip floats were added.

Performance Observations.

1. The foils start giving stability at very low speeds.
2. Usual foil deflections were about 3°. The foils were, however, larger than the calculated necessary area which would have given 5° deflections. In speed boat wakes, the deflections were 7° to 8° with quite a bobbing of the float.

The chief trading route was between Norwich and Yarmouth—a distance of 27 miles which, with a favourable wind, would take about 3½ hours. Merchandise was transferred from sea-going ships at Yarmouth into the wherries which varied from 40-60 tons burden and approximately 50 to 60 feet long and 13 to 15 foot beam, and taken to Norwich. Smaller wherries from 25-35 tons sailed up the river Waveney to Beccles and Bungay and also up the Bure and Ant rivers to the market towns of Aylsham, Stalham and North Walsham. Locks had to be negotiated on the upper reaches of these rivers and these were not big enough for the larger wherries. On these routes, a slipping keel was fitted which could, by the removal of two bolts, be detached from the main keel and this allowed the wherries to be used in places where there was less than 3 feet of water.

The cargoes were varied and comprised of coal, bricks, cement, timber, drainage pipes, grain, manure, farm produce—in fact, everything imaginable. Before the advent of the railway, most of the perishable goods and groceries were conveyed by water in this district as the roads were bad and at times unusable.

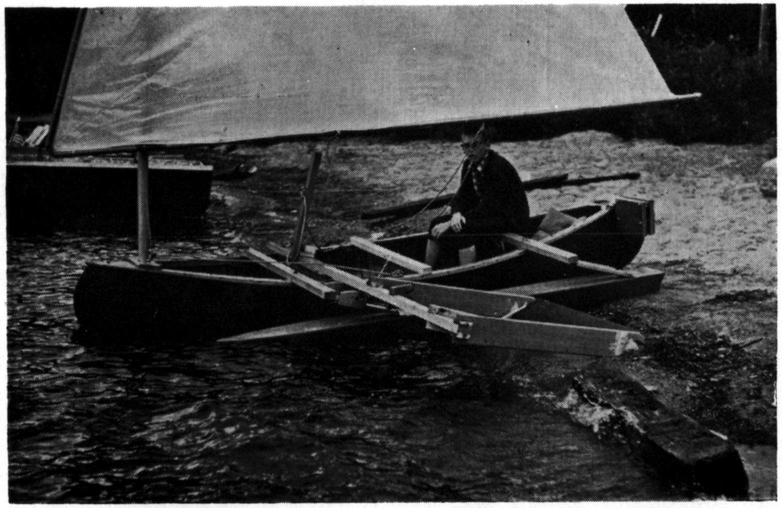
These craft were built to be used on inland waters but in the past they sometimes sailed at sea between Yarmouth and Lowestoft which took just over the hour, while the inland route took more than twice that time. This sea trip could, however, only be undertaken in calm weather because the unstayed mast could strain the tabernacle on rolling, due to its inertia.

Prior to 1844 when the railway between Norwich and Yarmouth was started, the number of sailing wherries could not have been much less than 300. After the railways linked up the market towns, the numbers declined and this process was made worse by the introduction of iron towing lighters on the R. Yare. But they still traded in considerable numbers to the farms and villages till completely put out of business by the motor lorry, by shallow draft sea-going vessels which could take their cargoes right up to Norwich and the diesel engined river lighter.

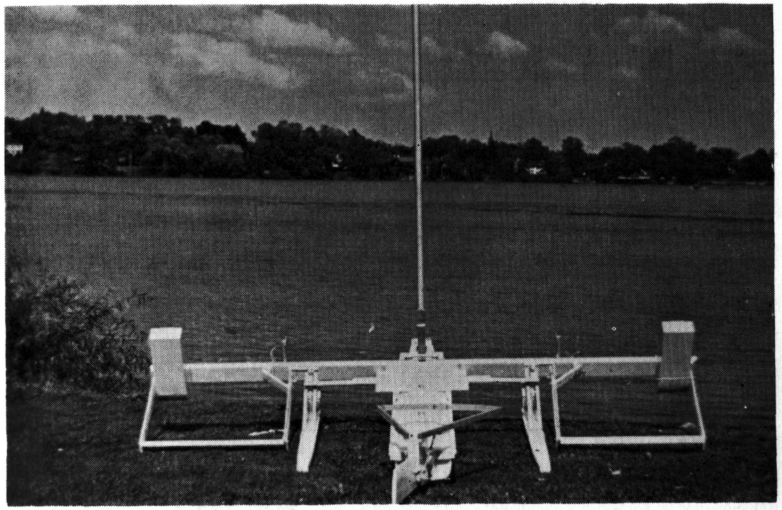
Up to 1939, there were two or three of these sailing craft earning a precarious livelihood for their owners. One was destroyed during an air raid on Norwich in 1942 and, by the end of the war, not one remained under sail, but many wherry hulls remained with their masts, sails and gear removed. They were used as lighters and towed by tugs.

The Norfolk Wherry Trust was launched at a meeting in February 1949 to get at least one of the wherries sailing on the Broads again. A carvel built trading wherry—the *ALBION*, was acquired, repaired

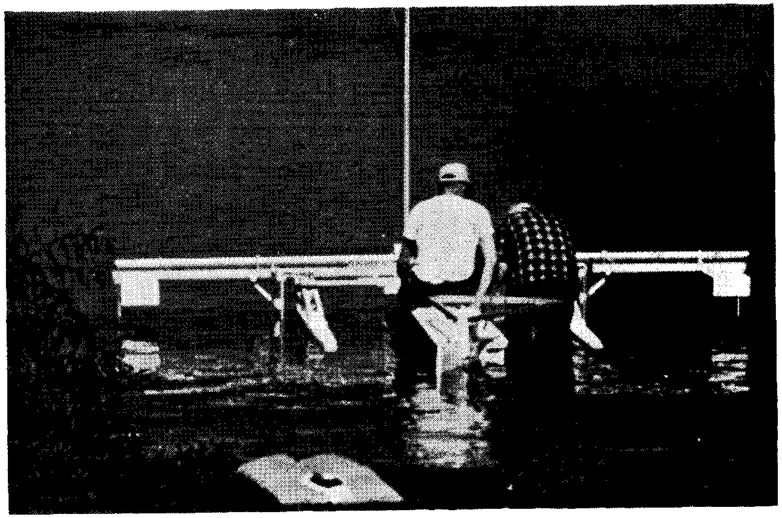
Norfolk wherry ALBION



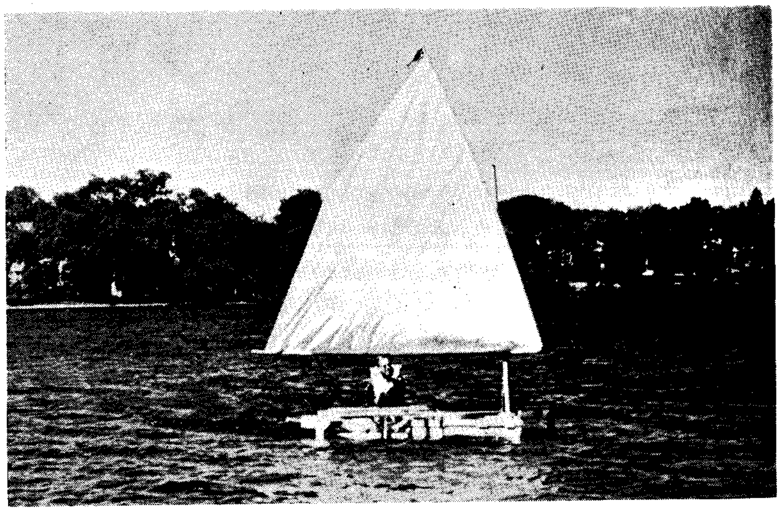
Experiment No. 1



Experiment No. 2



Experiment No. 2. Adjusting the foil



Experiment No. 2. Coming about

give two berths, loo, galley and all in reasonable comfort, possibly using lifting cabin top or hatches. Do you know if there are available plans to meet up to these requirements?

W. O. MEEK.

Rockstone, St. Martin, Jersey, Channel Islands.

Ed.—By all accounts, low aspect ratio keels put about surely, if slightly slowly. Jim Wharram's *HINA* meets the catamaran requirement.

THE NORFOLK WHERRY

BY

H. BOLINGBROKE

Norfolk Wherries are a class of trading vessel peculiar to the Norfolk Broads district though now almost extinct. They are clinker (lap strake) built with a mast stepped well forward in a tabernacle and, by means of the forestay, a man can easily raise and lower it, together with the sail, when shooting through bridges. This is made possible by the mast having 1½ to 2 tons of lead fixed at its foot. The large, double-ended hull with a well curved sheer line, consists of practically one long hold for the cargo, which is covered by several vermilion coloured hatches. However, there is a small cabin in the stern and aft of this, a well from which the wherryman can steer and tend the main sheet, which leads down to a block on a horse fixed over the cabin roof. The loose-footed sail has three rows of reefing points and a 3 foot wide "bonnet" can be laced on its foot when the wind is exceptionally light. The sail is hoisted by a winch just forward of the mast tabernacle and this winch can be swung clear when the mast is lowered.

One of the unique features of the wherry is the single halyard which first hoists the luff of the sail and then tops the peak. One advantage of this system is that the peak can be lowered when a heavy gybe might dismast the vessel and the sail gybes over in two separate instalments and thus relieves the strain on the unstayed mast.

In their heyday, the mastheads were brightly painted and varied according to the firm which owned the wherry and they were topped by a vane to which was attached a six foot pennant.

When tacking, a member of the crew, which comprised of two men or else the wherryman and his wife, might sometimes help the wherry's bows round with a quant. The quant was a 22 foot pole and it was also used in calms to maintain steerage way by pushing the wherry along and, owing to the absence of shrouds, this could conveniently be done along the whole length of the hull.

Evaluation—This rig has shown the ability to eliminate sail twist and permits excellent draft control in a simpler and more efficient manner than by conventional methods.

The sail plan as shown is suitable only for a una rig as it is difficult to maintain a tight forestay with such an arrangmeent.

RALPH FLOOD.
3883 Sunbeam Drive, L.A. 66, Calif., Phone: Clinton 5-1970.

Dear Sir,

I have been contemplating the purchase of a catamaran of the Motor-sailer type and encountered several problems which may be of general interest.

Sheathing Plywood with Glass Cloth. On my existing boat, built by a well known firm, the plywood joints are sealed with 2 inch glass tape. After the second season, I noticed that the tape had come away at the ends and, on pulling it, it came away easily. At first, I blamed the glue but on examining the tape, I found that there was a thin layer of wood adhering, which showed that the wood fibres had sheared off. I know that plywood in common with other woods, swells with dampness—the floor boards, 2 feet wide were an easy fit at delivery of the boat, but had to have 1/8th inch planed off after being on moorings for some time—say, $\frac{1}{2}$% expansion.

Now, glass cloth does not expand and it seems reasonable to assume that the failure of the bond between the glass cloth and the plywood was caused by this difference.

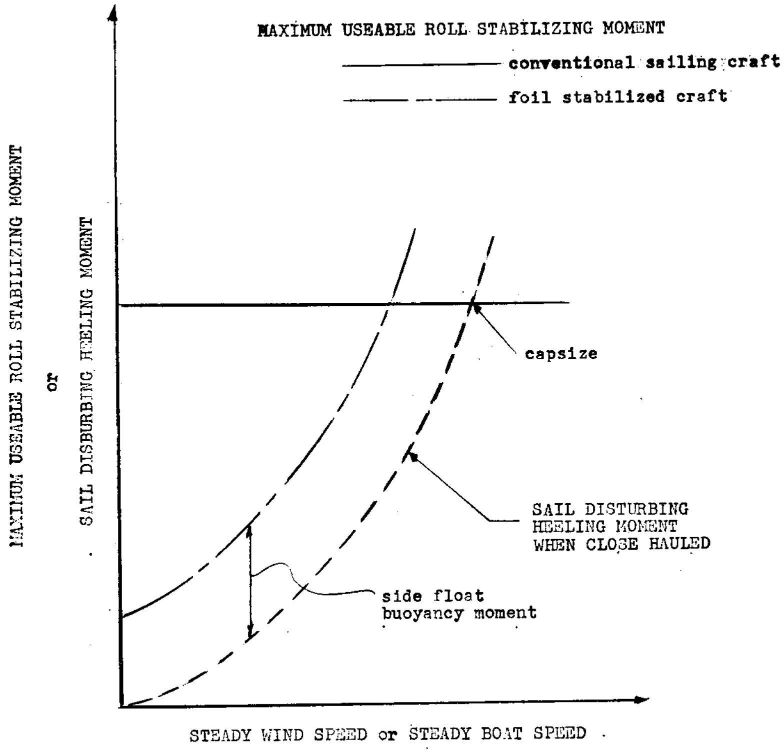
The vital question is—if a hull of plywood is sheathed completely, will it stay that way?

Some time ago, a sailing dinghy in glass fibre, broke away from its mooring and was smashed up. The construction was a wooden frame encased by the fibre. I noticed that the bond had broken between the wood and glass fibre nearly all the way round. Also, the transom of ply, completely enclosed in the glass fibre was delaminated and going rotten. The result of all this was that the boat's strength was greatly reduced.

I know very little about glass fibre but it would appear that both methods are sound, but when they are mixed, it may lead to trouble.

I have read the A.Y.R.S. article on hull sections and on low aspect ratio keels. For a cruising boat, this seems a very good solution—but is there any difficulty when going about?

Now, my personal problem. If I build, I am limited in length to 21 feet for the hulls, and on this length, seek an accommodation plan to

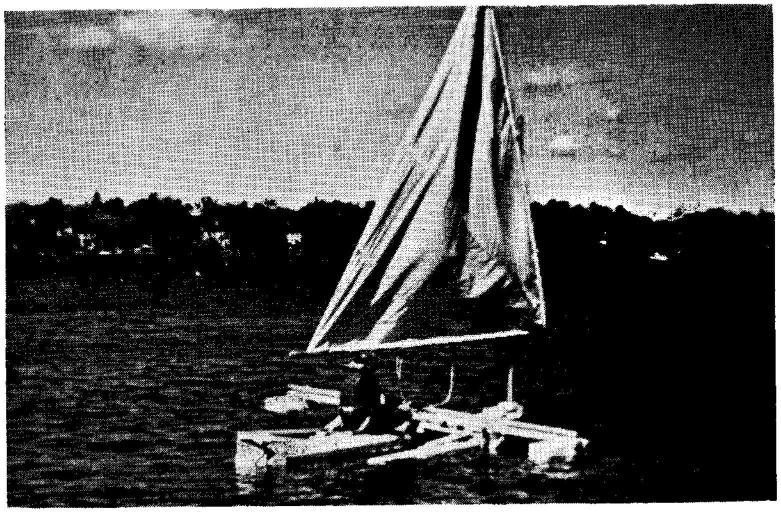


3. In severe wave conditions which caused the floats to bob, the boat was quite steady, presumably due to the difference in frequency in roll of the main hull and the float-foil system. The variations in foil attack must have caused extra resistance and damping of their action would be of value.

4. Coming about was easy. Sufficient speed was always maintained to remain foil borne in the sense that the tip floats never struck the water before full speed was resumed on the opposite tack.

5. The boat sailed close hauled with good stability from 2 knots to the strongest winds sailed (about 22 knots).

Summary. Hydrofoils are the most natural method of roll stabilisation of a sailboat since they are effective when you need them and are not particularly effective when you don't. In contrast, the



Experiment No. 2. Conventional stability

common methods of roll stabilisation have far too much stability margin at low boat speeds in light winds and have a narrower reserve stability in strongest winds. However, a hydrofoil stabilised boat must also have a specific amount of conventional stability which is always there for transient conditions such as coming about, starting up and slowing down.

SUBSEQUENT LETTER FROM HENRY NASON

Dear Sir,

Received your letter of February 4, and appreciate your consideration of the problem and have read the very helpful article in publication No. 50. A waterline beam to depth ration of 4 : 1 will give me a roomy main hull and at speed I should make up the 5% loss with foil dynamic lift.

Trying to improve on an ancient art like sailing is a difficult thing, and it gives oneself respect for his predecessors. I seem to be continually making starts and stops. It is not possible to completely evaluate all schemes which come to mind either experimentally or theoretically and one must make many decisions somewhat on intuition alone. I find I must now modify the write-up I just sent to you a few weeks ago. A better arrangement of the components appears possible.

sails when the mast is moving differently from the boat and, also, the large foil area necessary to do the job. This system absorbs sudden shocks and is very difficult to capsize.

Perhaps someone has already though of this and solved the problems (or proved the project worthless!)

Yours sincerely,

JOHN PHILLIPS.

9 Daleswood Road, Highfield, Tavistock, Devon.

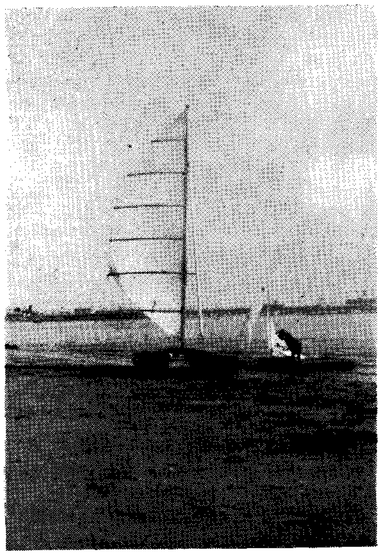
Dear Sir,

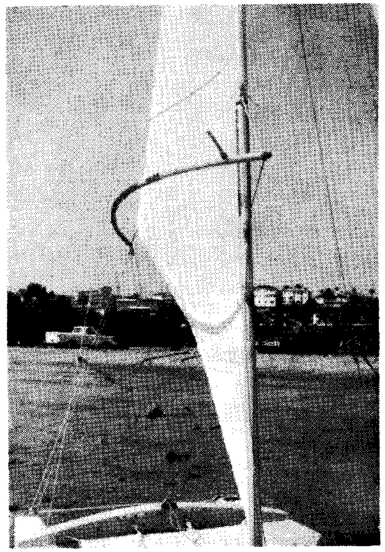
AN ELEVATED CURVED BOOM RIG

The Objective—to develop a non twisting and easy to control mainsail rig. Photo 1 shows the developed rig.

The Rig Design—photo 2 shows how the boom is supported. Sail draft is controlled by varying the tension on a line connected to the forward end of the boom.

A simple mainsheet system allows the entire pull on the boom to be from the weather hull on either tack. This arrangement minimizes distortion of the sail area below the boom level.





Ralph Flood's twistless sail

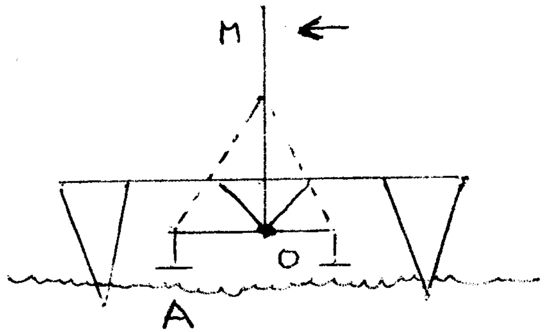
Carrying 6 people, this family boat provides fast, safe and economical progress over coastal seas to otherwise inaccessible coves and beaches.

Specification (*Provisional*)

Length: 24 feet.	Beam: 13 feet.
Height:	
Hull Borne 7 feet 3 inches.	Foil Borne 11 feet 6 inches.
Draft:	
Hull Borne 2 feet 3 inches.	Foil Borne 1 foot 9 inches.
Hull Borne, struts down 6 feet 3 inches	
Weight:	
Fully loaded 3500 lbs.	Empty 2200 lbs.
Speed:	
Take off 12 knots.	Cruise 30 knots.

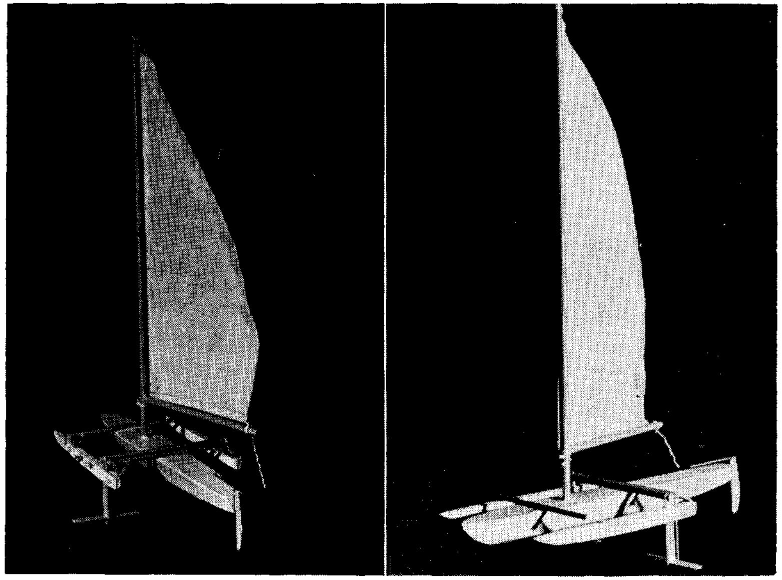
Dear Sir,

I have been toying with the idea of building one of Wharram's Tangaroa designs when I can find time, space—and cash. Whilst not, perhaps, the last word in sailing efficiency, it seems to be simple, straightforward and cheap and, as you say, safe. I am wondering which is the most effective wind steering device for a catamaran of this type.



You may be interested in an experiment I have carried out recently with a model catamaran. The mast M is pivoted between the two catamaran hulls at O. When the indicated wind tilts the mast, a foil A is immersed and counteracts the force of the wind on the sail.

I haven't tried the alternative but the two foil system appears to work. What rules it out, however, is the difficulty of controlling the



The Nason foil model

Although, I have been aware of this arrangement for some time, I had not modelled it and so could not fully evaluate it. A series of photographs are enclosed of the model. It is not a working model. Sizes are scaled to an 18 foot boat.

The strut will be enclosed in a slot cut in the aft end of the float. Foil actuation is the same in principle as before. Neglecting structural and weight effects, the best position of both the foil and float is out as far as possible. The farther the float is out the more effective is its buoyancy for common stability and the more favourable the relation between roll sensitivity and height sensitivity. Also the farther out the foil is the smaller it can be. Thus to mount the foil and strut in the inverted T arrangement and centred with the float is the best compromise. Placing the strut in a slot in the float will eliminate the wave drag of the strut and will result in less interference between the main hull, the floats and the struts. The strut is less exposed to floating objects. Since the slot is open to the rear there should be less fuss than with the conventional daggerboard or centreboard slot. The open slot will allow foil and strut removal from the water as before. Although, I will only be able to lengthen my float from 6 feet to 8 feet, its centre of buoyancy will be forward of the foil and will give a small measure of large wave anticipation. This anticipation is hardly needed on such a small craft which is not flying, but is more than before.

At first thought, it might appear to be a disadvantage to have the float slot moving with respect to the strut. My first thought would be that it would wear away the strut and bind. However, I don't see why one could not take advantage of this rubbing by installing a water lubricated flat damper. My son is buzzing about looking into this. Another benefit would be from a load stand-point. The strut could support lateral forces on the float and vice cersa. They would become mutually self supporting. There are many plastics that may be suitable for a flat damper. There are floor tiles made of ashphalt and vinyl which can take a lot of scuffing. A continual scraping noise would be objectionable, but water is a very good lubricant and the bottom part of the slot damper will always be immersed and possibly a proper material would be quiet and give the required damping force.

The struts, foils and floats will be a little more difficult to make. However, the general appearance is much improved and the attangement will, I believe, give superior performance.

HENRY W. NASON.

Dear Dr. Morwood,

My correspondence on the non-heeling foils, described in A.Y.R.S. No. 51, has increased greatly. Some of my answers to questions have been as follows:

My example of a non-heeling single outrigger was chosen for its simplicity. Of course it can be used double as a trimaran, if spread is no problem. The use of two foils does not economize on the arm length of each. The reaction to the sails' side force is then divided by two, if both foils are used simultaneously. Varying the foil area does not effect the optimum arm length. The rule-of-thumb that a line normal to the foil centre must pass through the sail C.E. is incorrect. The sail can be moved laterally anywhere without affecting its heeling moment. The criterion is to have the dynamic moments equal zero independent of the static moments of buoyancy or weight.

A trimaran has some marked advantages. By employing only the leeward canted foil on each tack, a speed increasing overall lift is provided by the usually wasted side force without dissipating any of the precious driving force. When winds get dangerously strong, using both foils neutralizes all lift or depression. If great directional stability is desired for self-steering schemes, only the windward foil should be used. Depression of the hull then results.

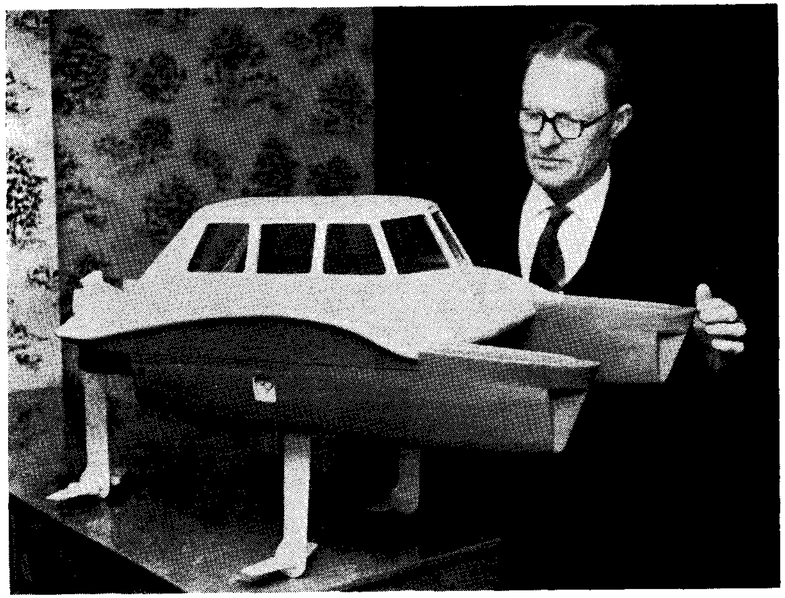
SEAGLIDER 6 TRIMARAN HYDROFOIL

DESIGNERS:

SEAGLIDER LTD., 219, Sycamore Rd., Farnborough, Hants.

The Seaglider 6 Trimaran Hydrofoil offers a smooth, 30 knot ride above the waves, supported on fully submerged foils. Small waves pass under the hull while larger waves are detected by retractable sensing arms mounted on the bows of the two outer hulls. These sensing arms operate the hydrofoils to lift the boat over the waves.

The twin screws are mounted on the rear foil and are hydraulically driven from the 80 b.h.p. motor, to restrict power loss and simplify retraction.



SEAGLIDER 6 *Trimaran hydrofoil*

The two forward struts retract backwards and contain parallelogram linkages to retain the correct foil angle in all strut positions. A hydraulic system holds the struts in position during flight and if they hit an obstruction they will briefly retract against the hydraulic pressure and immediately return to their correct position.

All three struts can be retracted to give the hull a normal draft for shallow water work at low speeds.

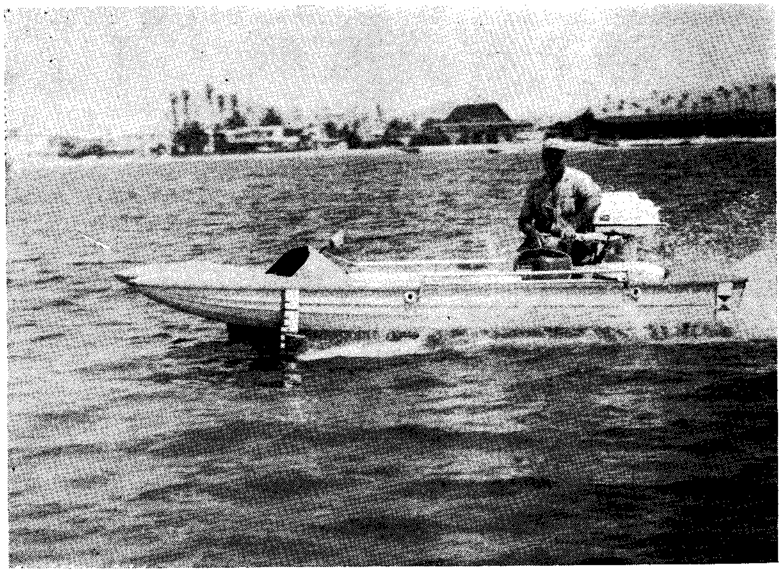
THE SEA CAT 14—A MOTOR HYDROFOIL

DESIGNERS:

HYDROCRAFT, P.O. Box 3381, San Diego, California.

HYDROCRAFT is a firm which sell a range of fibreglass and plywood catamarans from tiny ones to 45 foot cruisers. After some research on hydrofoils in 1963 and a review of "the state of the art," they produced the motor hydrofoil shown in the photographs, in 1964.

The forward foils seem to be surface piercing with dihedral, while the aft foil is presumably a horizontal one between vertical struts. The hull on which the foils are mounted is one of their fibreglass range.



The SEA CAT 14—Motor hydrofoil

With an 18 h.p. motor, the craft flies 8 inches high with one person, 6 inches with two and 4-5 inches with three people aboard. This is high enough to clear the wakes of other ski boats, they claim.

The foils can be retracted and are sold as a separate kit which can be attached and removed without greatly altering the basic boat or motor mounting.

Speed increases of 38% to 44% are claimed, depending on the number of persons carried and the type of boat used.

Catamarans having a rule-limited beam, usually cannot achieve complete non-heeling. However, even partial neutralization of heeling can easily double their heeling stability in strong winds.

EDMOND BRUCE.

Lewis Cove, Hance Road, Fair Haven, New Jersey, U.S.A.
May 7, 1967.

Dear Sir,

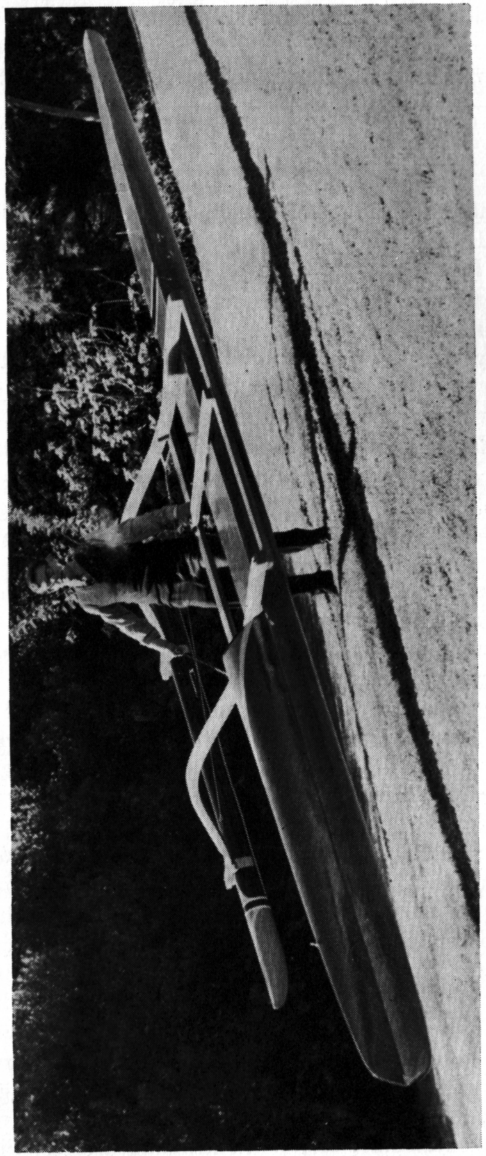
I enclose herewith photos of my almost complete single outrigger with Bruce Foil. For some time I have been interested in building a Proa, but the Proa characteristics (outrigger always to windward—rudder or oar at each end—unsatisfactory sail plan) have prevented me from building same.

Early this year, I became a subscriber to A.Y.R.S. and purchased several back copies from S.A. Yachting. In A.Y.R.S. publication No. 51 I read with great interest Edmond Bruce's article—his theory seemed to be exactly what I was looking for, and I set about designing and building a single outrigger coupled to a virtually C-class main hull. This hull is 21 feet long and, although made of glass fibre, weighs only 60-odd lbs., but with bulkheads well distributed is exceptionally strong. To save weight, I have eliminated freeboard where I consider it not essential, only retaining sufficient at the bow section (as can be seen in the photograph). The hull is designed for virtually maximum sailing length and has diminishing semi-circles except for a very fine V-entry with rounded edges.

The outrigger is joined to the main hull by 2½ by 2½ laminated curved sections, curved for both strength and to avoid wave action. These laminated joiners are stayed to avoid any forward-to-back action. The design, however, allows the outrigger to lift separately to waves (slightly).

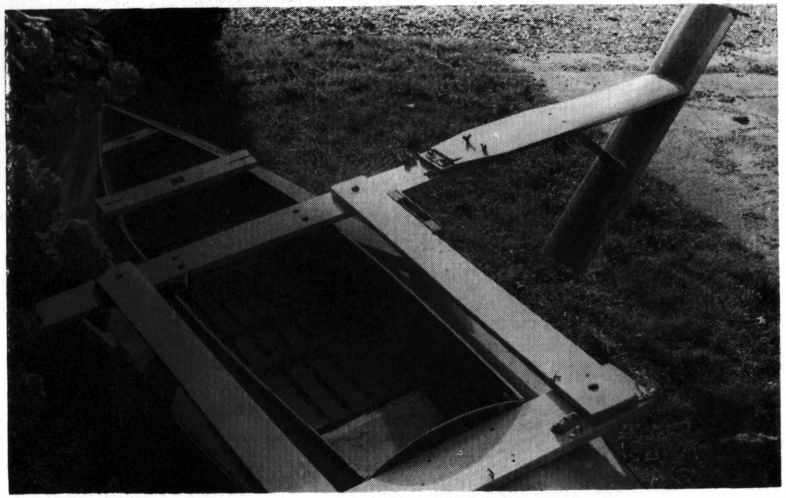
For experimental purposes, the outrigger is made from a section of plastic pipe with glass fibre bow, and is fitted with a centreboard casing to hold pivoting foil (just in front of my right hand in the photograph). The outrigger is attached to the laminated joiner by stainless steel brackets, so that it can be moved back or forward. By this means, I am also able to adjust the angle of the foil. I expected difficulty in preventing the outrigger from turning in its stainless steel brackets, due to water pressure on foil. This I have successfully eliminated by placing rubber sleeves between the brackets and outrigger. Even when using leverage I found it impossible to turn the outrigger.

For experimental purposes, I intend using a set of dinghy sails of approximately 130 square feet (main and jib). This, coupled to a



David Buirski's 21 ft. single outrigger with Bruce foil

Paul Dearling's canoe with Bruce Clark foils



Bruce Clarke foil

Paul Dearling's canoe with foils

With the present foils and sitting-out "benches" (mounted above the side decks (we feel that a sail area of between 120 and 140 square feet could be carried successfully. The present hull however is unsuitable for further development and next year we hope to transfer the foils to a purpose-made hull and continue with our experiments.

Any advice or exchange of correspondence would be more than welcome.

21 foot craft weighing only 140 lbs., should give me a really good performance. Later, I would like to use a wing-sail plan and would appreciate any suggestions.

I intend launching within a week or two and will let you know the results. Should you be interested in more details, I will gladly send same.

There are three factors which I am most impatient to find out about:

1. Will I have to fit a foil on the main hull to prevent drift when the main hull is to windward—one which can be lifted on the opposite tack? How will it come about? (Outrigger round main hull—here foil in main hull could be of assistance).

2. Will there be any difference performance-wise between the two tacks? Should one tack be much superior to the other, the design falls down—there are several obvious solutions, but none of them is as simple as the present design.

Edmond Bruce, in his article, says that there is very little difference between the tacks. I hope he is right.

DAVID BUIRSKI.

Suikerbos, The Grange, Camps Bay, S. Africa.

June 26, 1967.

SUBSEQUENT LETTER FROM DAVID BUIRSKI

Dear Dr. Morwood,

Thank you very much for your encouraging letter. As promised, I set out below details of my foil yacht's performance to date:

Aims at this Stage.

To check the following points:

1. Does foil do its job efficiently, particularly regarding slip when outrigger to lee?

2. Are my joiners and staying sufficiently strong?

The boat at this stage was not yet complete—being impatient to check above points the mast and foil for convenience were placed much too far forward to enable craft to come about efficiently. Temporary Rudder blade from existing 11 foot dinghy far too small, but sufficient to check on points (1) and (2) above.

Tuesday:

Launched . . . no wind . . . proved nothing other than that my waterline was perfect . . . also that I had to raise the deck slightly and that I had to sit amidships or I buried the transom. (This I expected, as it is so fine). Perfect when sitting in the correct position.

Wednesday:

Raised platform.

Thursday:

20 *m.p.h. Wind Blowing.*

First tack with much trepidation . . . outrigger to windward . . . very fast acceleration . . . undoubtedly moving *fast* . . . strong feeling of stability . . . foil working perfectly, not leaving water at all. Hardly any wake behind main hull . . . far too much turbulence behind outrigger . . . outrigger was definitely being dragged through water, slowing down main hull . . . came about, not too easily . . . this tack equally fast, I think . . . foil working perfectly on this tack as well. Then, outrigger turned in brackets, causing foil to collapse and lie flat on surface of water . . . sailed in with sheets free . . . no damage.

Friday:

Wind very light . . . performance quite good . . . coming about slow . . . used different sets of sails, best being Quick-Cat fully battened main (120 square feet) and small jib.

All points of sailing satisfactory, other than slow coming about. In this light wind, outrigger being dragged was even more marked . . . (bad shape?).

Tried to lift foil out of water by hanging out . . . could not, even when moving as slowly as 2-3 knots.

Impressions.

Foil seems to work perfectly. Will have to do some heavy wind sailing to make sure.

Stability seems more than Catamaran.

Performance will be much better, but not with existing outrigger, which was only temporary anyway. Having done its job, it will have to be replaced with a more efficient unit. Have definite impression that an outrigger which is shorter than main hull is not satisfactory, as it reaches maximum speed far sooner than main hull and then has to be dragged through the water. (This must apply to Trimarans). Admittedly, temporary outrigger did not have a good shape.

the same as the airfoil and fixed under the hull (not visible in photo). In the photo the wind speed was about 4 knots and the craft sailed at 6 knots.

I am putting the finishing touches to a 25 foot improved version of this design which I hope to launch next month. The mancarrying edition has a beam of 14 inches at the water and maximum beam at deck of 24 inches. The controls are hydraulically operated and the hull has been provided with water ballast tanks if needed. The airfoil has a detachable tip for strong winds and an area of 150 square feet. In light down hill conditions I will use a soft sail hung between the air foil and bows of the hull measuring another 150 square feet bringing the total off wind area to 300 square feet on a hull of 400 lbs. I hope by doing this to match this craft's amazing windward ability with its somewhat poorer down wind performance.

John Goodwin.

Applegarth, Hout Bay, C.P. Tel.: 706168, S. Africa.

Ed.—In effect, this is the reverse of the Bruce system.

P.B.K. 18 CANOE WITH HYDROFOIL STABILISERS

Hull 17 feet 6 inches Length	Foils—Incidence 4°.
Hull 2 feet 6 inches Beam.	Foils—Dihedral 45°.
Sail area 85 square feet.	Non-Adjustable.
Total Beam 9 feet.	
Total weight 175 lbs.	

DESIGNED AND BUILT BY

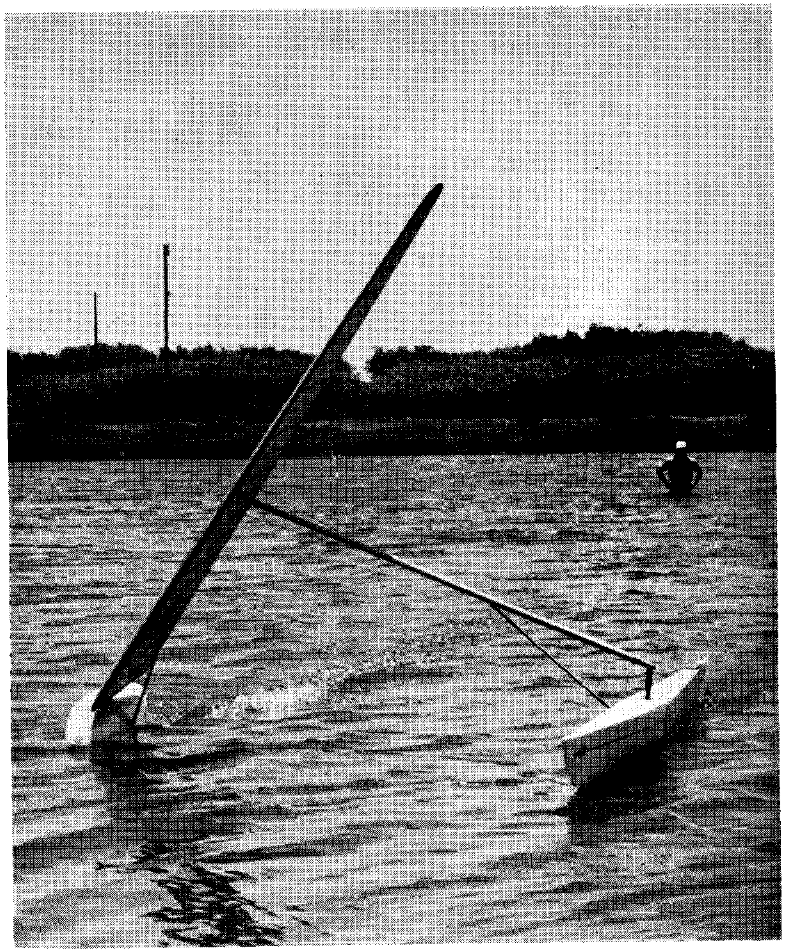
P. Dearling and M. Sutton-Pratt

11 Vale Close, Strawberry Vale, Twickenham Middlesex.

During the summer of 1966 we decided to fit stabilising foils to a standard PBK.18 canoe hull and add approximately 85 square feet of sail.

All previous attempts to sail the boat had been with a sail area of about 25 square feet and leeboards.

We got the idea of foils from reading an article by Mr. N. Van Gelderen of Miama, U.S.A., who was at the time successfully using foils of the Bruce Clark "Y" type on a smaller but similar canoe. Making the foils was fairly simple and we feel that any success we achieved with them must have been due mostly to the excellent descriptions and sketches we received from Mr. Van Gelderen.



John Goodwin's "Aerohydrohull"

Dear Sir,

re: AEROHYDROHULL.

I enclose a photograph of my Aerohydrohull which you may find of interest. The name is an abreviation of Airfoil-Hydrofoil-Plus Hull and as you will see from the photo the craft has dynamic stability in that all the capsizing thrust from the wind is transmitted down the outrigger spar and counteracted by the Antidrift foil which is angled

Solutions:

1. To build a well-shaped, light 21 foot outrigger. This I can do with no more weight than approximately 30 lbs. Not too keen on this, as it will place far more strain on my joiners and will be difficult to bring about.

2. To use a foil with sufficient bouyancy at rest to be used alone. Even the smallest hull above the foil I assume would cause the same trouble as the existing outrigger.

Next Step:

At present I am busy completing foil with sufficient bouyancy at rest. Also fitting correct size rudder and stepping mast in the correct position. This should be finished in two weeks' time, when I intend putting the craft back in the water.

Unfortunately, the photographer did not turn up on the day arranged, so at this stage no photographs of craft afloat. Will let you have the results of second trials.

Could you let me have a plan or details of D.N. Ice-Yacht sails and, if possible, the price of a secondhand set which I could use for trials?

DAVID BUIRSKI.

Suikerbos, The Grange, Camps Bay, S. Africa.

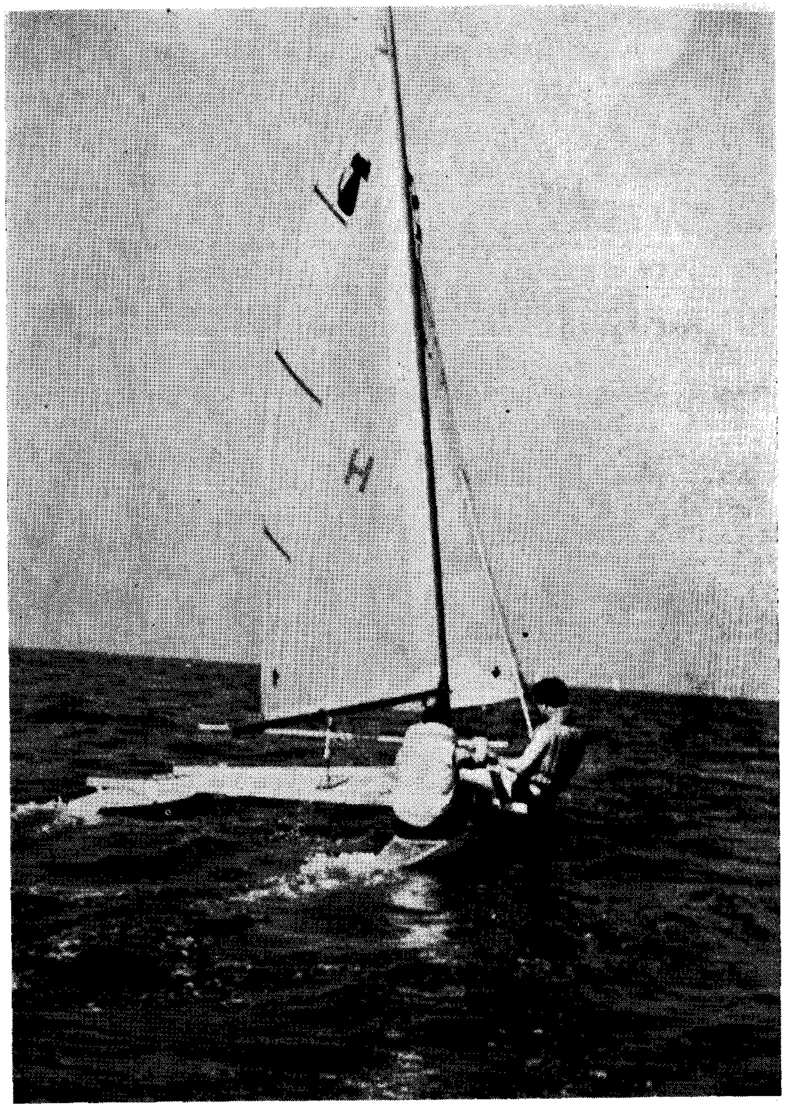
July 26, 1967.

Dear Sir,

In 1963, I intended to sail and built a boat. The first catamaran was square box section, 12 feet long, weighed 300 lbs. and had 100 square feet of sail. Then, I found the A.Y.R.S. publications and I accepted the following ideas:

1. L/B ratio = 12 (Bruce).
2. Unequal hulls (Morwood).
3. Rotating mast.
4. Half-circle bottom.
5. Aluminium, expanded foam.
6. The Bruce foil.
7. Boom vang.
8. Very sharp bow.

I took an aluminium race-canoe, rounded the bottom with foam and covered it with glass fibre and polyester resin. I had two tubes 6 feet long and laid them across the hull. To these tubes, I fitted two smaller tubes, also 6 feet long and, fitting snugly in each other, they made cross beams 11 feet long. The thicker tubes protruded on both sides of the hull and the stays were fastened to the after one while the mast stood on the forward one . . . The smaller tubes protruded only to port, thus making the craft a single outrigger and to their ends, the



O. Holtman's Bruce foil outrigger

8 foot outrigger hull was attached. The small hull was made by the "opening up" system and had a 90° V form in the middle. The bow was very sharp and the transom squared off. As published in A.Y.R.S. No. 51 on page 66, the New Zealand Maori knew exactly the right dimensions.

My heart bounced. My mouth was dry, as I took the rudder and sheets. After 100 yards, alone, I cried "Hy doet het" which is Dutch for "It works."

Tacking was difficult and I replaced the tubes to put the mast 1 foot out of the middle of the hull towards the outrigger. On holiday in France, the 420's and the *FLYING JUNIORS* tried to catch me but I was faster. I was helped with tuning and the results were flattering for the Maoris. When the wind was more than force 4, I had to sit on the tubes to balance the boat.

In the North Sea, I sailed against a *SCHAKEL*, 15 feet 7 inches long, 30% more sail than my boat but weighing 300 lbs. to my boat's 200 lbs. Again, I was faster. I sailed very close hauled, thanks to the Bruce foil. The effect of the foil holding the mast upright could not be measured by me.

I'm convinced of a few things:

1. The unequal hull is fast—perhaps the fastest.
2. Building and tuning are easy.
3. The weight is low.
4. Taking apart takes a short time.

The canoe is too light for two persons so I'll change it for a *SHEARWATER* hull. The sail area will be 150 square feet, the weight under 200 lbs. The mainsail and jib will both have the same height and both will be loose footed. There will be one boom from the clew of the main sail to the tack of the jib and the clew of the jib will open automatically 9 inches at the mast. I will then have only one sheet to turn the whole sail area and mast. There will be four stays to the ends of the cross-arms with the mast standing between them with no forestay. The mast will stand on the gunwhale of the *SHEARWATER* Hull at the outrigger side.

Thank you for all the information and the pleasure of reading.

O. HOLTMAN.

Stoeberghlaan 16, Voorschoten, Holland.

July 5, 1967.