TRIMARANS 1970

A.Y.R.S. PUBLICATION No. 73

SHANGAAN

CONTENTS

THE AMATEUR YACHT RESEARCH SOCIETY

(Founded June, 1955 to encourage Amateur and Individual Yacht Research)

Editor and publisher:

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TRIMARANS 1970

Editorial by Dudley Soulsby

In the Editorial for No. 72, members were asked to write about their experiments for the benefit of the AYRS. This request still holds. The more information we receive, the more interesting we can make the publications.

Both the articles by Osborne (Page 40) and Rand (Page 60) show ideas and experiments carried out by members of the Society within the true meaning of 'Amateur Research'.

The development of trimarans seems to interest members more than the development of catamarans. The latter craft seem to have been accepted by the ordinary sailing man—they thus seem to be more conventional than the trimaran.

There are some very good second-generation trimaran designs available at this time; but we feel that more development in this field is possible by the use of foils on the floats of the larger craft similar to those used on the *SHARK V* and *SULA* trimarans (AYRS Nos. 60 and 68) The October publication is likely to be wholly devoted to hydrofoils and this should stimulate ideas on the subject.

The production of the *BUCCANEER* 70 trimaran, designed by Lock Crowther and marketed in kit form by the Trimaran Design Centre, 4320 Glencoe Avenue, Marina Del Rey, California, 90291, enables a design from an experienced designer's board to be available for the general public for a reasonable price. Whether the market will be sufficient to make the project a viable proposition of not, we cannot say but, if the *BUCCANEER* 70 catches on in America, we look forward to hearing a lot more about her.

COX 32

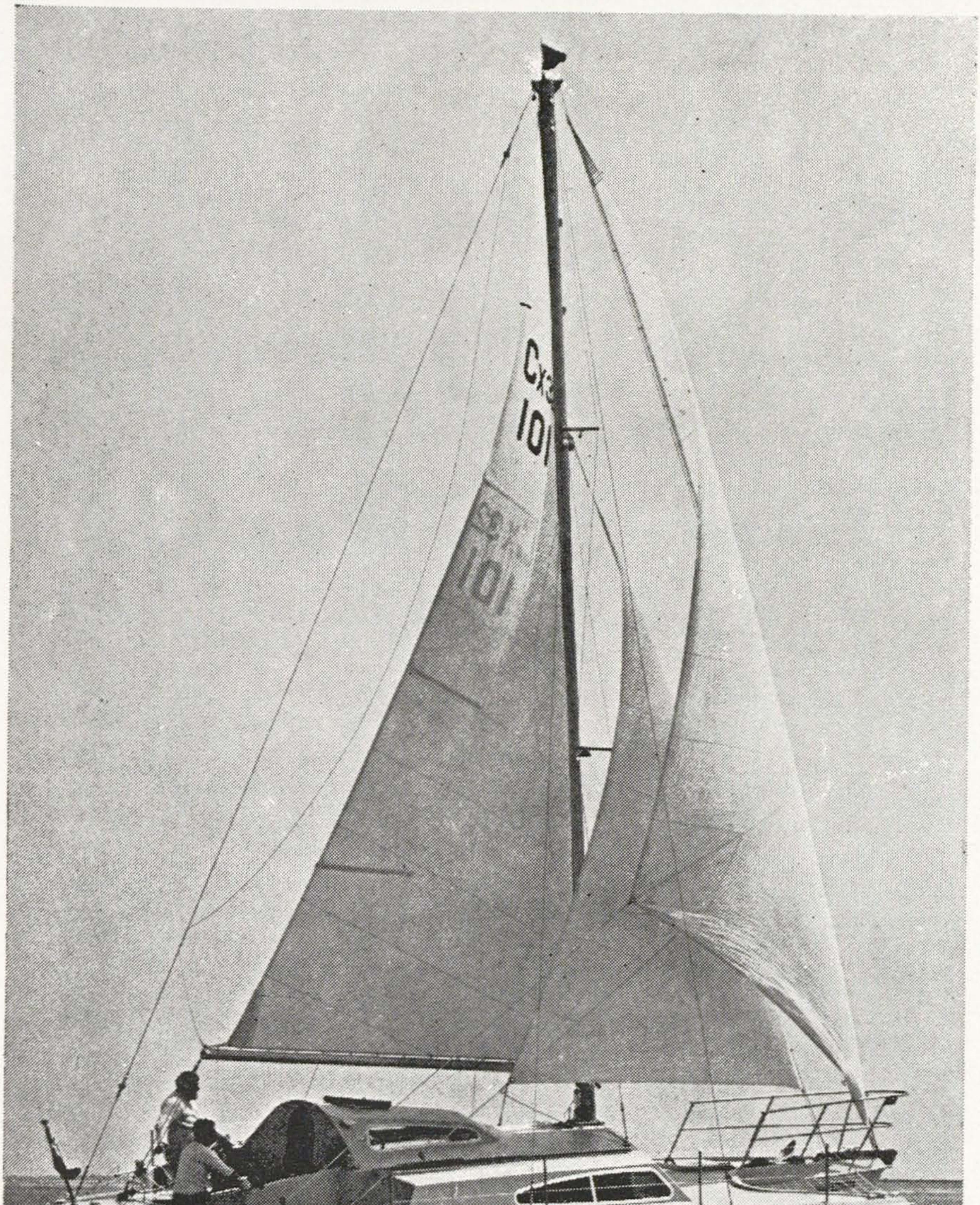
Test Report by courtesy Editor *Yachts and Yachting*.

L.O.A.:	32 ft 8 ins	Beam: 18 ft 8 ins
Six Berths		Basic Price: £5,000

Cox Marine Limited of Brightlingsea have specialised for some time in the production of the late Arthur Piver's trimaran designs and considerable numbers of these, particularly the *NIMBLE* and the larger *VICTRESS*, have been built. These were all constructed of marine plywood sheathed in glassfibre and the new *COX* 32 is the first yacht of this type to be built entirely in glassfibre. The ability to carry a full load without impairing the windward performance of the craft has been particularly considered in this new design.

Construction

From the constructional point of view, the hull and floats are regarded as one unit and comprise two mouldings only. The lower moulding forms the centre hull and floats and the upper one the decks and coachroof and these



COX 32

are bonded together at gunwale level with a substantial overlapping flange. This in itself should provide a high degree of strength but additional strength is provided in high stress areas by bonding in end grain balsa wood (also used to insulate coachroof and decks). The two main bulkheads of $\frac{3}{4}$ in marine plywood are carried the full width of the hull and floats and reinforced with glassfibre to provide additional lateral stiffening. The whole assembly, therefore, can be regarded as one single but unconventional hull which should possess a very high strength/weight ratio.

The main hull is of round bilge form with a single moulded spray chine and a shallow, low aspect fin keel. The wing floats are of vee section below the waterline radiused to the topsides. There is no external access to the floats which are therefore completely watertight.

Decks and Cockpit

The overall beam of the yacht is nearly nineteen feet and the minimum width of the side decks is two feet so it is no exaggeration to say that there is ample room to set up deck chairs both on the foredeck and aft of the coachroof on the wings without unduly impeding movement around the boat. This feature in itself inevitably must present a considerable attraction to many owners. In proportion, the cockpit seems to be relatively small and a full crew of four would probably be a crowd.

The deck extends some 4 ft forward of the coachroof, most of the space between the main hull and floats is filled with nylon netting. Inherent in the design of this type of boat is the relatively narrow beam of the centre hull and this shows itself in the narrowness of the centre foredeck. Thus the high stainless steel pulpit which extends right round the centre well is an essential fitting on grounds of safety. A very heavy stemhead fitting of channel section stainless steel was fitted to the prototype boat tested and this served as an anchorage for both inner and outer forestays. This was an unsatisfactory arrangement as it prevented the channel serving as a fairlead for the chain or warp and will be modified on production boats. A heavy duty mooring cleat completed the fittings at this point apart from the port and starboard navigation lights which were mounted on the pulpit. Rather unusually, there was no provision for a stern light which is a legal requirement for a sailing vessel under way. However a masthead light is fitted as standard.

High double lifelines on stainless steel stanchions are fitted to the floats. These lines are carried down to anchorage points well short of both the stemhead and transom so that the lines only offer protection for the length of the sidedecks adjoining the coachroof. Whilst there would seem to be little likelihood of a crew member needing to work right forward on the floats at sea, the after end of the wings will be used by members going from the cockpit to the foredeck and an extension of the lifelines to give additional protection at this point might be desirable. No stern pulpit is fitted. Mooring cleats and a screw-down plastic ventilator are fitted at either end of the floats. The large area of deck has an all-round moulded toerail and water drains away through the scuppers at the aft end of the floats.

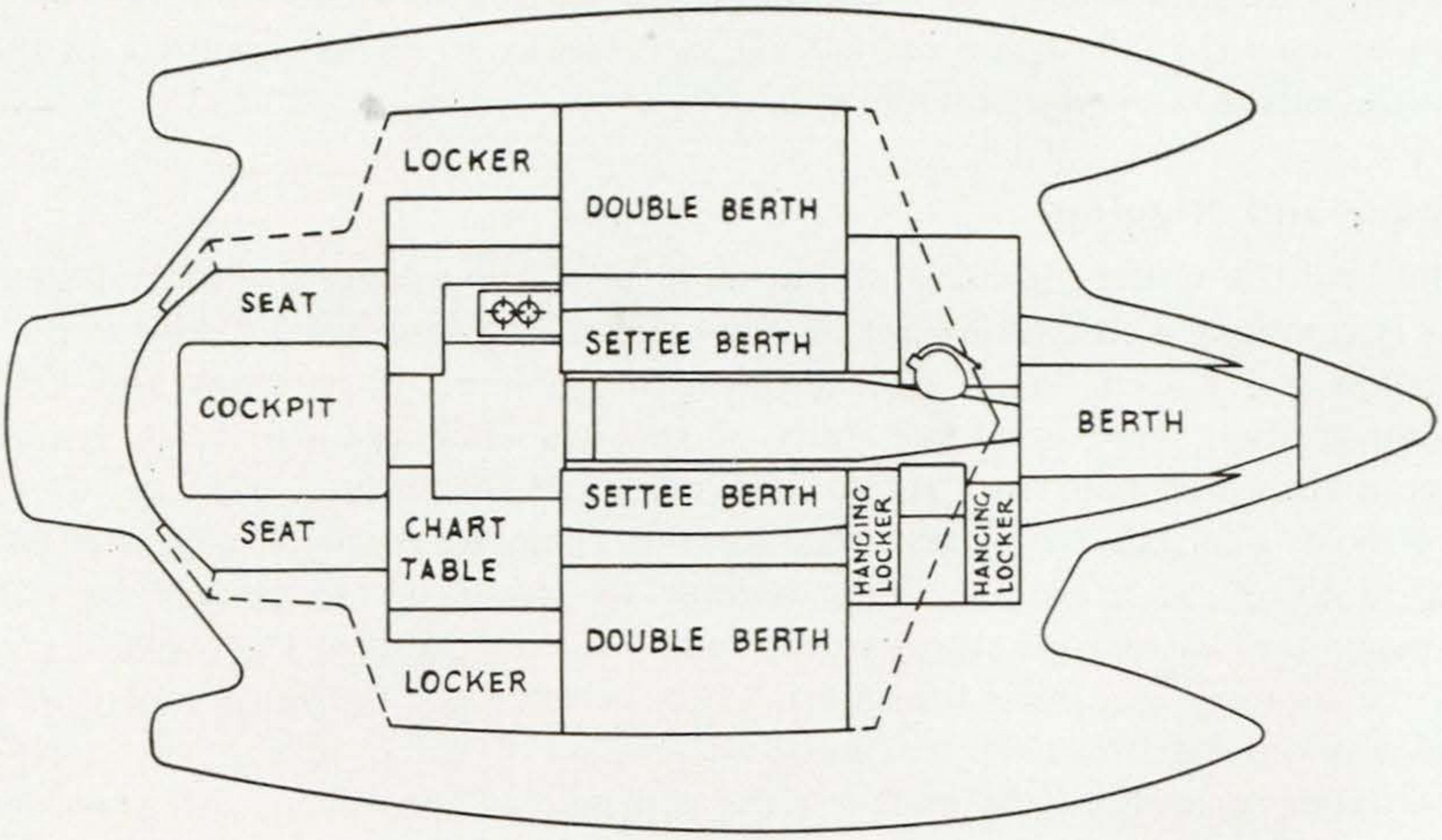
The cockpit is self draining. The teak sole may be removed to give access to the engine and stern gear. There are deep lockers under both side benches and at the aft end of the well, the latter having a screw-down ventilator on deck. All three have teak covers. Four Lewmar 501C stainless steel winches are mounted on moulded turrets outside the coamings with Tufnol cleats for each mounted vertically on the inner surface. (These winches are standard on the de-luxe version only). The coamings are high and give a good sense of security whilst providing comfortable backrests. The rudder stock of the spade type rudder rises through the stern deck and is fitted with a stainless steel lifting tiller provided with a locking screw. The four part double ended mainsheet has its lower block secured to a short stainless steel horse, the twin falls being carried via lead blocks to cleats mounted on the insides of the cockpit coaming.

Spars and Rigging

The yacht is cutter rigged with the alloy mast mounted on a hinged step. As is common with multihull craft, the mast is of rather heavier section than normal and is well stayed. In addition to the standing backstay and fore-topmast stay, there are three pairs of shrouds anchored to widely spaced chainplates, one pair from the masthead carried to the deck edge abeam of the mast, one pair from the upper hounds again to the deck edge well aft and a third pair from the lower hounds to a pair of chainplates set well inboard and carried via straps to the full width bulkhead at the forward end of the saloon. An inner forestay is fitted between the upper spreaders to a point about 2 ft from the stemhead and a pair of diamond shrouds stiffens the upper sections of the mast via the top pair of spreaders. All standing rigging is of stainless steel, halyards are of similar material with rope tails and running rigging of pre-stretched plaited Terylene. Roller reefing, halyard winches and sliding lead blocks for the headsail sheets are standard. The staysail lead blocks are mounted on the coachroof and those for the jib right aft on the wing deck and these appeared to be rather far inboard for the most efficient lead of the sheet and this will probably be modified in later models. Accommodation: In a trimaran of this size, only the main hull can be used for living accommodation thus restricting the accommodation layout.

The coachroof at the after end of the saloon takes the form of a large raised blister without a sliding hatch over the companionway. Hinged doors with ventilating louvres are fitted to the top part of the companionway and the bottom end is closed by weather boards, there being no bridge deck separating the saloon from the cockpit. The general arrangement takes the form of a separate fo'c's'le containing a single berth right forward and a long and fairly narrow saloon with settees and double berths on either side where the coach-roof extends over the wings. There is over 6 ft headroom throughout and the cabin sole at the after end under the blister is raised in way of the chart table fitted to starboard and the galley to port.

In greater detail, the fo'c's'le berth takes up the full width of the hull and would be wide and comfortable for one. Immediately aft to starboard is a large, enclosed hanging cupboard and a fitted washbasin with a pumped water supply installed between the cupboard and the bulkhead with shelves both above and below. A marine w.c. is located opposite the washbasin. There is a pair of oval deadlights in the yacht's sides above the berth and two large windows in the forward end of the coachroof. Privacy in the fo'c's'le is provided by curtains and moving aft into the saloon there are two further hanging cupboards on either side. The after end of these cupboards is again a heavy, structural, full width bulkhead and the doorposts of the cupboards of heavy timber serve to carry the thrust of the mast via two stainless steel girders from the mast step to the keel.



COX 32 accommodation plan

Whilst the relatively narrow beam of the main hull makes floor space in the saloon somewhat restricted, this is to some extent compensated for by the extension of the coachroof over the wings, which gives a marked sense of space below. These extensions have two 4 ft wide double berths with large cupboards behind each. Hatches under these berths give access to the floats which can be used for the stowage of a considerable amount of light gear such as warps, fenders and perhaps sails, but heavy items such as spare fuel and water cans should be retained in the main hull. The settees are set high on each side with cupboards below which provide footrests. The settees are upholstered p.v.c. with button decoration and are extremely comfortable. A solid folding table can be mounted between them.

A step up leads aft to the working area of galley and chart table. The galley is fitted with a two burner alcohol stove and large stainless steel sink as standard with its water supply pumped from a thirty gallon tank located beneath the cabin sole. Around and beneath the unit is a wealth of both open and closed stowage space and if the available working surface is a little limited, there is room to spare on the chart table opposite when this is not in use. There is space for the installation of an ice box under the raised part of the cabin sole between galley and chart table.

The chart table is full size and will taken an Admiralty chart unfolded. Storage for spare charts laid flat is provided beneath the working surface. There is a further large closed locker below and a small open locker at foot level. Behind the working surface is a bookshelf with another closed shelf below it for instruments. There is ample space on the after bulkhead and behind the working surface for the installation of electronic equipment whilst a combined switch and fuse box is located here as standard. Spare waterproof connector sockets for additional equipment are located at the foot of the mast and in the cockpit.

The general internal finish is light and attractive with the deckhead lined in a washable p.v.c. All timberwork is of solid mahogany, teak or teak faced plywood. Electric lights are fitted over all berths with additional lighting for galley and chart table and a large fluorescent light in the main saloon. Apart, however, from the main hatch, one must as usual criticise the fact that the ventilation is inadequate with only two Tannoy vents over the galley and chart table and a screw down mushroom vent in the forepeak.

Engine Installation

Unlike most multihulls of this size, the *COX* 32 is designed for the installation of an inboard engine and either the 7½ or 15hp Arona diesel models are offered as extras, the latter adding all but £700 to the basic price of the yacht. The boat tested was fitted with the higher powered model which gave it a speed of about 6½ knots and was acceptably smooth and silent in use. On this basis, it would seem that the smaller engine would do little more than provide purely auxiliary power to assist manoeuvring in harbour. Both installations fit neatly below the forward end of the cockpit with start and stop controls carried to the side of the chart table just inside the cabin doors and the single lever throttle and gear control to the port side of the cockpit well.

Performance

Perfect summer conditions with a wind of around Force 3 were the background for our trial off the mouth of the River Colne. In view of the high speeds often claimed for multihull craft, it is to be regretted that the electronic speedometer was not available to check the actual speeds obtained. It was quite clear, however, that the speeds achieved by the trimaran on all points of sailing in what was comparatively light wind conditions were, by normal standards, unusually high. The mooring was left under power and once accustomed to the wide beam, manoeuvrability was fully up to that which might be expected from a monohull. After leaving the narrow and crowded creek at Brightlingsea, we hoisted the large yankee jib, staysail and main and on a broad reach rapidly left the estuary astern. On this point of sailing, it can be estimated conservatively that the yacht was moving at not less than eight knots but the very smooth wake and almost total absence of heel did not convey this impression of speed. In slightly stronger gusts than the general prevailing breeze, the weather float lifted to a point where the keel was just cutting the water and it was possible to sense the considerable resistance to any further heeling as the lee float resisted further immersion. For all practical purposes, the yacht remained virtually upright.

As might be expected, movement downwind was somewhat slower but the difference did not appear to be any more marked than might be expected in a conventional monohull. The performance to windward came as something of a surprise. The ships head altered by not more than ninety degrees between tacks and it appeared that a speed of between 6 and 7 knots was being maintained. Whilst a degree of leeway could be discerned from the angle of the wake, this combination of speed and weatherliness would mean that in these conditions a speed of about four knots would be made good over the ground. Tacking was quick and certain and the yacht carried way through the eye of the wind and paid off on the other tack without any need to let either headsail aback to assist her. This ability to tack quickly and surely became even more evident when returning to moorings when we made rapid progress against both wind and a strong ebb tide up Brightlingsea creek. The helm remained light and responsive throughout on all points of sailing. The only criticism of the yacht which became evident at this point was the fact that the sheet of the staysail became fouled by a cleat on the forward side of the mast each time we went about.

Conclusions and Price

From a cruising point of view, there seems little doubt that under favourable conditions the *COX* 32 would be capable of making very fast passages indeed as compared to a traditional yacht of similar size. Again under pleasant conditions and in harbour, the vast deck space must in itself be an attraction particularly for those with children, whilst the almost total lack of heeling under way would certainly do much to overcome the aversion many weekend sailors have of going below when under way.

On the accommodation side, the limitations imposed on the layout by the narrowness of the centre hull might well make for difficulties with a mixed as opposed to a family crew. The yacht is intended as a four berth cruiser but in practice this is provided by only two double berths. This might well suit a family but not comparative strangers who may prefer to sleep alone, although the use of the berth in the fo'c's'le could well simplify this problem to some degree. Additional privacy for the occupants of the double berths at night could no doubt be provided by curtains. Summing up therefore, it would appear fair to say that the degree of comfort which the yacht provides on deck is not fully matched by that provided below. The excellence of the galley and chart table arrangements, however, are such that they compensate for the lack of accommodation.

In the matter of price, the yacht is offered in both standard and de luxe forms, the boat tested being the de-luxe version. The difference between the two versions is largely one of comfort and finish since it includes such items as carpeting and metal as opposed to rubber window surrounds, but it also includes such essential items as additional sheet winches for the headsails and lifelines on deck. The engine installations are extra as are sails since the builders consider that the choice of a sailmaker for a yacht of this price and size should come within the realm of personal choice. Taking all this into account and assuming that an inboard engine is included, the on-the-water price of the *COX* 32 would total between about £5,000 and £6,500 depending on the basic choice of model and the standard to which it is equipped. It must however be pointed out that both standard and de luxe models include a good basic range of equipment.

THE KELSALL TRIMARANS

Derek Kelsall Ltd. Sandwich Marina, Sandwich, Kent, England·

TRUMPETER

L.O.A.:	44 ft 0 in	Beam:	26 ft 0 in
L.W.L.:	40 ft 0 in	Sail Area:	300 sq ft

Owner: Philip Weld, Esq.

The design shows an example of Derek Kelsall's latest thinking in trimaran design for the Round-Britain Race of 1970. The result is a pretty, efficient and fast boat with good, all inboard accommodation.

Derek's main design principles are as follows:—

1. All GRP or GRP/PVC foam sandwich construction. Hence they incorporate durability and minimum maintenance, insulation, buoyancy and high strength to weight ratio.

2. One float rides clear of the water at all times which gives best performance, reduces the stresses in the connecting beams and gives an easier ride in a seaway. In the event of a knockdown blow there will be reserve stability at a greater angle of heel than would be the case with floats lower relative to the main hull. At mooring the rocking from float to float is not disturbing and can be eliminated by putting a small extra weight on one float.

3. All hulls are round bilge for minimum wetted surface.

4. Most of the designs have a flare on the main hull to give extra living space and cockpit floor space without increasing the water line beam. This does not detract from the performance in any way. If an outboard is fitted, the well is positioned over the flare and the motor is permanently mounted with an opening in the hull entirely above water level.

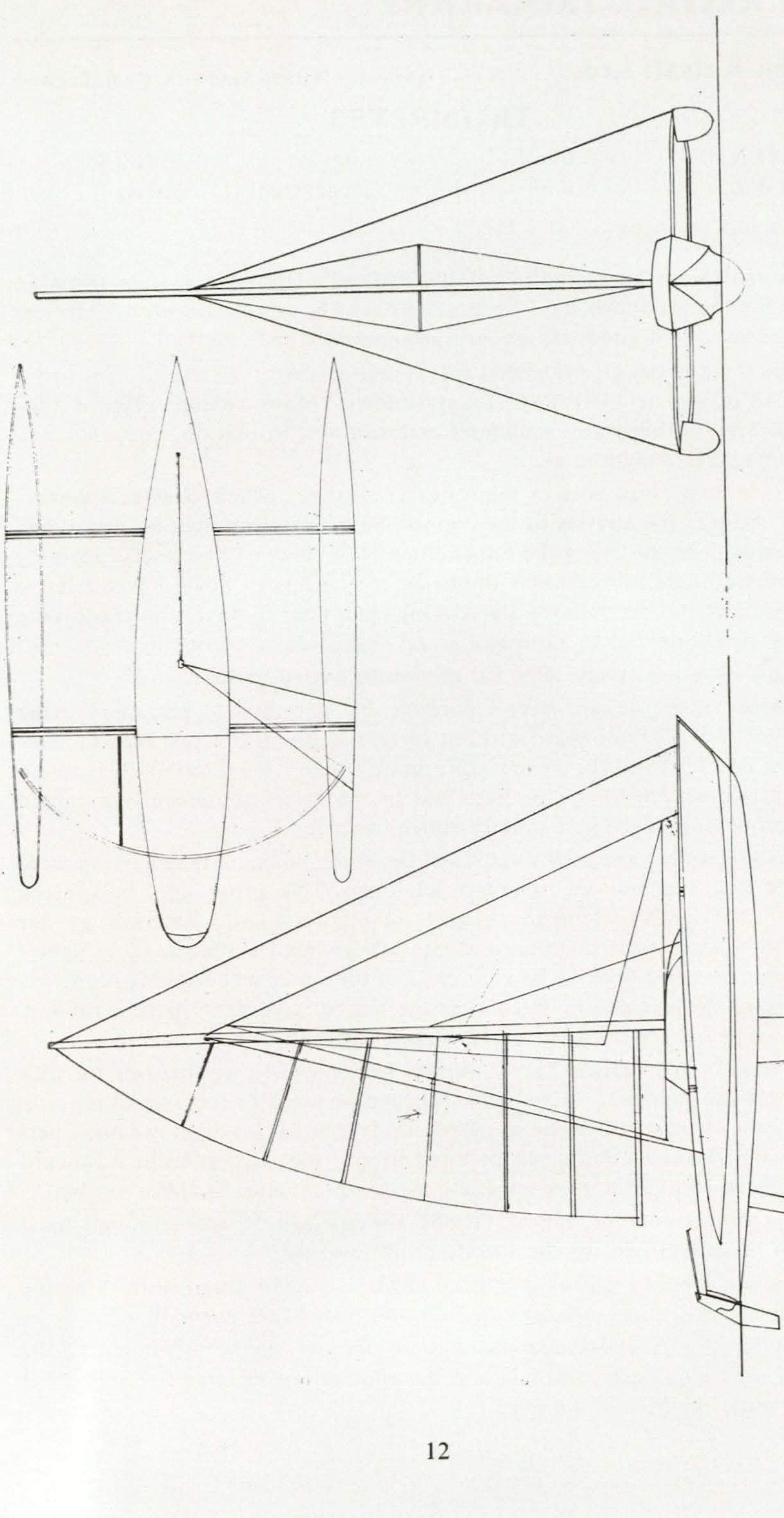
5. Alloy beams are used to connect the three hulls. These carry a wide cat-walk and nets but are otherwise left open. No other solid bridgedeck is used. This gives serveral advantages—saving weight and materials, greater seaworthiness in severe conditions, floats can be smaller and therefore lighter as there is no solid deck to be kept clear of the water when sailing hard. A terylene trampolene can be fitted over the nets to give deck space if needed. (This would be removed in severe weather conditions).

6. Most of the designs have a simple and efficient three-quarter rig with fully battened mainsail. Alternative rigs can be fitted to suit special requirements e.g. where extra large headsails are required for light weather performance. Rotating masts can be fitted to give the most efficient windward rig. Special reefing lines are normally used in preference to rollar reefing.

7. Centre boards or dagger boards are normally fitted although fixed fins can be substituted for the strictly cruising vessel.

8. Small inboard petrol or diesel engines can be fitted with Variable Pitch sailing propellers although 10-20 hp outboards are normally used.

9. A large part of the success of these designs can be attributed to the efficient use of modern materials and the elimination of large flat areas that add surplus weight and windage.



THUNDERER Kelsall designed, owned by Philip Weld

TRIFLE is one of the most successful trimarans ever built. She has entered all the multihull events on the south coast for three seasons and been either first or second across the finish line in every race.

All these tri designs stem from *TORIA* the outstanding winner of the Round Britain Race in 1966 and the first trimaran to win a long distance ocean race.

Any of the above listed designs can be modified to suit particular requirements or we can produce a custom design. Due to the amazing versatility of our building method we can claim a very wide range of experience in trimaran design and development as well as in the constructing of most other types of pleasure craft.

All materials, fittings, fixtures and interior joinery are of high quality marine standard. Colour scheme to owners choice throughout. For the best appearance we recommend lining of the glassfibre interior with a washable vinyl.

BUCCANEER '70'

Designer: Lock Crowther

Exclusive American Builder: TRIMARAN DESIGN CENTER,

4230 Glencoe Avenue, Marina Del Rey, California 90291.

Length Overall:	24 ft 3 in
Load Waterline Length:	23 ft 0 in
Beam Overall:	19 ft 0 in
Beam of Cabin:	7 ft 2 in
Beam of Main Hull:	3 ft 0 in
Draft (Board up):	1 ft 3 in
Draft (Board down):	3 ft 6 in
Designed Displacement of L.W.L.:	2000 lbs
Payload:	1000 lbs
Sail Area Racing:	402 sq ft
Cruising:	320 sq ft
Mast Head Above L.W.L.:	34 ft 0 in
Headroom Main Cabin:	5 ft 0 in

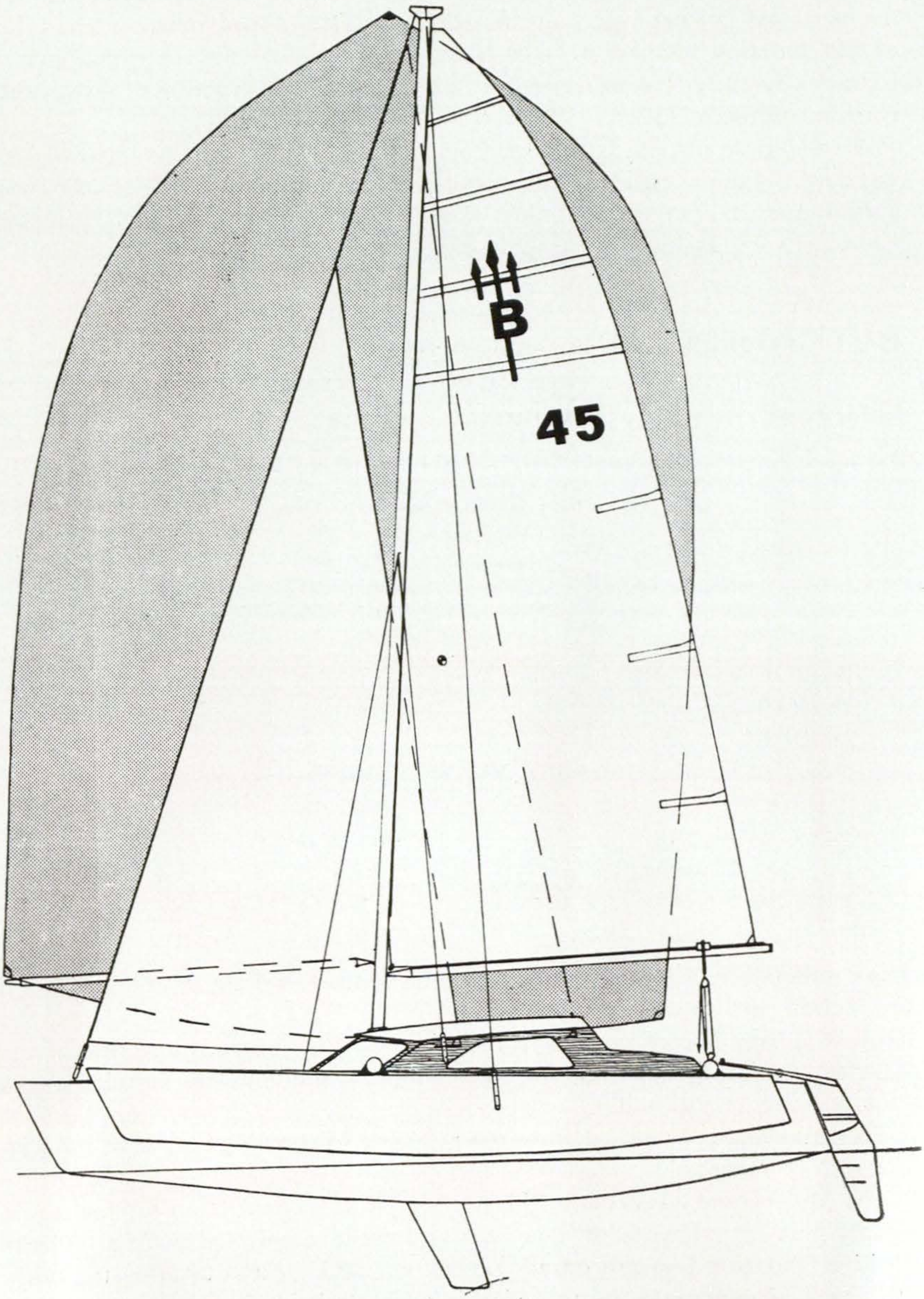
The combination of a well known Australian trimaran designer and American production and sales technique should prove highly successful. This, the latest of a long line of designs from Lock Crowther's board and one of the "second generation" of trimaran types with low windage and no wing decks should prove very popular.

The following is extracted from the publicity to show just how the modern trimaran is being sold.

The Multi-chine construction insures simplified construction for the home builder plus optimum underwater lines and minimum wetted surface. Great positive floatation forward on all 3 hulls, net decking and locating the cross arms well aft eliminate the undesirable characteristics found in other small racing and cruising trimarans.

BUCCANEER '70's close winded sailing characteristics, coupled with hydrodynamically clean lines and superb high aspect ratio sail plan, make possible speeds equal to the speed of the wind or better. Your *BUCCANEER* '70' will be a hard boat to beat!

Large, self-draining cock-pit with comfortable back-rest and cushioned seats. All running rigging can be handled from the cockpit. Two con-



BUCCANEER

venient snubbing winches are mounted on the backrest storage compartment. Four 6 in waterproof hand holes in the backrest give easy access to loads of storage space for cameras, binoculars and other sailing paraphenalia. The main cabin hatch door converts into a handy cockpit table.

Two 5 gallon water containers are mounted on the forward side of the galley bulkhead with clear plastic piping to the galley pump. This arrangement makes it convenient to take the containers ashore for water in out of the way ports which may not have dock side water supply.

Double curvature stressed birch marine plywood over kiln dried vertical grain spruce stringers create an ultra lightweight strong hull structure. For easy maintenance the hull is glassed with 4 oz fibreglass and finished in a wide choice of colours.

Cross arms are high strength aircraft grade 6061 extruded aluminium with a black hard anodize finish. Nylon net decking between the main hull and floats provides additional deck area for fun and relaxation at sea or in port.

Forward main compaionway and lazarette hatches of marine plywood, spruce and fibreglass mounted with stainless steel hinges and hardware. Three high impact hand hole hatches in each float.

Rigging

Aluminium alloy, 6061T6 mast and boom with internal sail track, anodized for superior corrosion resistance. Stainless steel standing rigging with swaged terminal fittings and stainless steel turnbuckles. Roller reefing. Stainless steel halyards with dacron tails. Dacron main and jib sheets.

Sails

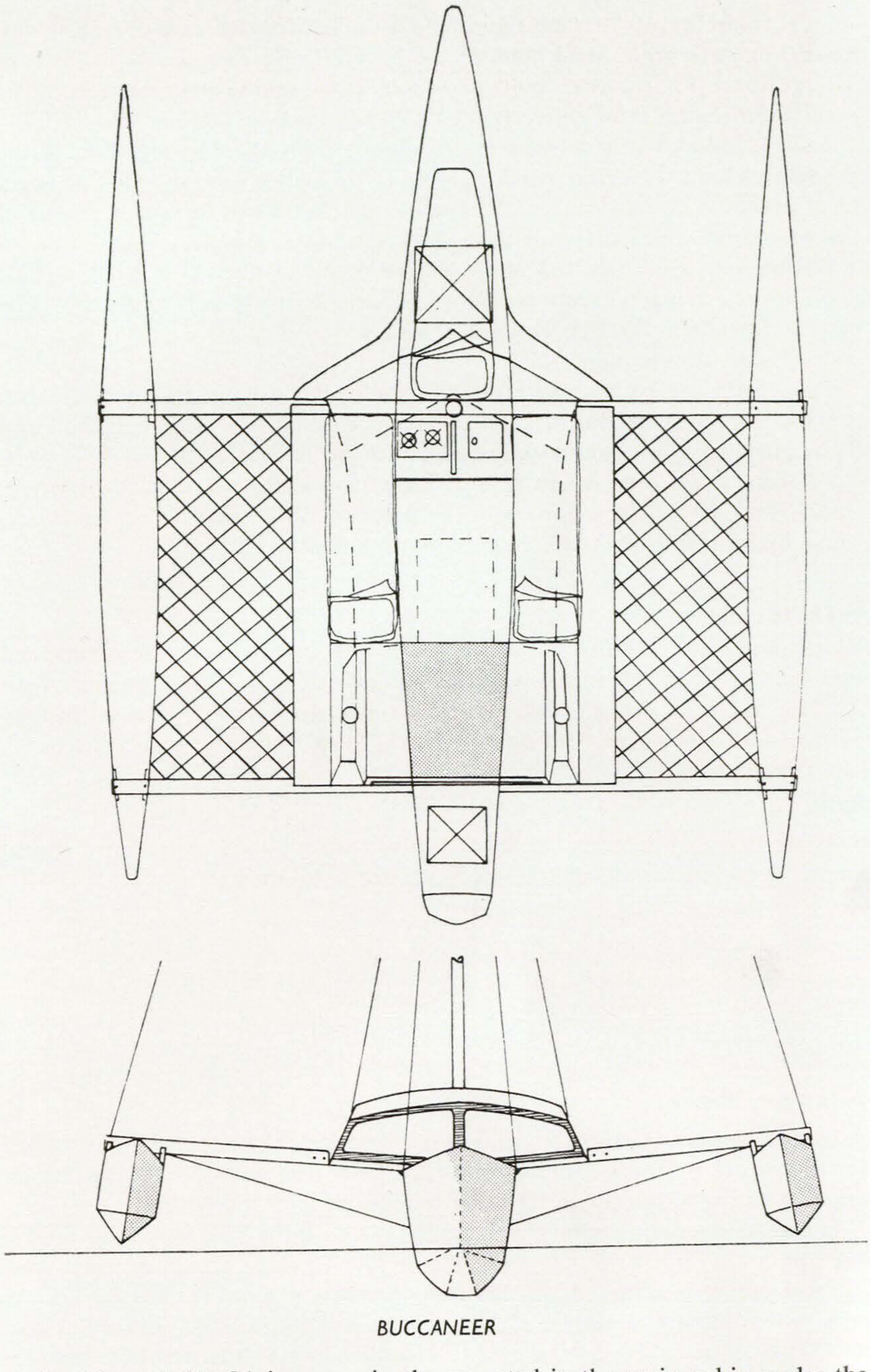
Sails are made of dacron. Main and genoa are supplied as standard equipment. Full sail complement is made up of the following.

Main:	6.5 oz 190 sq ft
Genoa:	4.0 oz 212 sq ft
Jib:	6.5 oz 51 sq ft
Jib:	5.0 oz 126 sq ft
Spinnaker:	.75 oz 430 sq ft

Auxiliary Power

A Seagull Century 4 hp outboard motor with a long shaft is an ideal auxiliary for this vessel. Motor is mounted on a special dismountable bracket which attaches to the aft starboard cross arm convenient to the cockpit.

The spacious main cabin sleeps two in comfortable 6 ft 3 in wing bunks. An optional third bunk can be fitted in the forward compartment. The cabin structure is of mahogany naturally finished in hand rubbed oil. Four large tinted picture windows, plus four ventilators and large companionway hatch, make the cabin cheerful and comfortable in even the worst of weather. For reading or chart work, two high intensity bullet lights, with integral switches, are mounted on the aft cabin bulkhead. There are a streamlined dagger board and kickup rudder on stainless steel hardware and a wood tiller with special tillerhead fitting.



BUCCANEER

The "Head" (W.C.) is conveniently mounted in the main cabin under the companionway. It is covered when not in use by a mahogany cabin seat which doubles as a step to the cockpit.

The Trimaran Design Center, 4230 Glencoe Avenue, Marina Del Rey, California 90291 are producing the Buccaneer '70' in kit form for home construction and the following prices were valid in January 1970.

1. HULL KIT: Pre-cut and pre-assembled hull and float frames and sides. Pre-cut cabin structure parts. All required wood, nails, glue, stainless steel hardware, aluminium hard anodized cross arms and other needed items to complete the wood construction of the boat. Staples are not included due to the wide varieties of guns available on the market. Full instructions. Boat fire extinguisher—used on boat when completed—safety during construction. Budget price, at only $2,500.00.

2. FINISHING KIT: All the fibreglass cloth, laminating resin, sanding resin, prime coat, hull and deck paint in your choice of colours, interior finished for wood work, seamless epoxy, windows and hardware. Instruction. Budget priced at only $1,000.00.

3. FITTING OUT KIT: Head, sink, anchor assembly, deck, rudder and cross-arm assembly hardware; snubbing winches, wiring supplies and lights, nylon decking and other related equipment. Instructions. Budget priced at only $1,000.00.

4. RIGGING KIT: Anodized mast and boom. Stainless steel running and standing rigging, mast head, roller reefing gear, tangs, boom end, etc. Instructions. Budget priced at only (Sails not included) $1,000.00.

Note: Tools, abrasives, rags, paint thinners, solvents, paint brushes and other expendable items are not included in kit prices. Price includes designers fee, class registration and crating charges.

PLANESAIL

Designer: John Walker

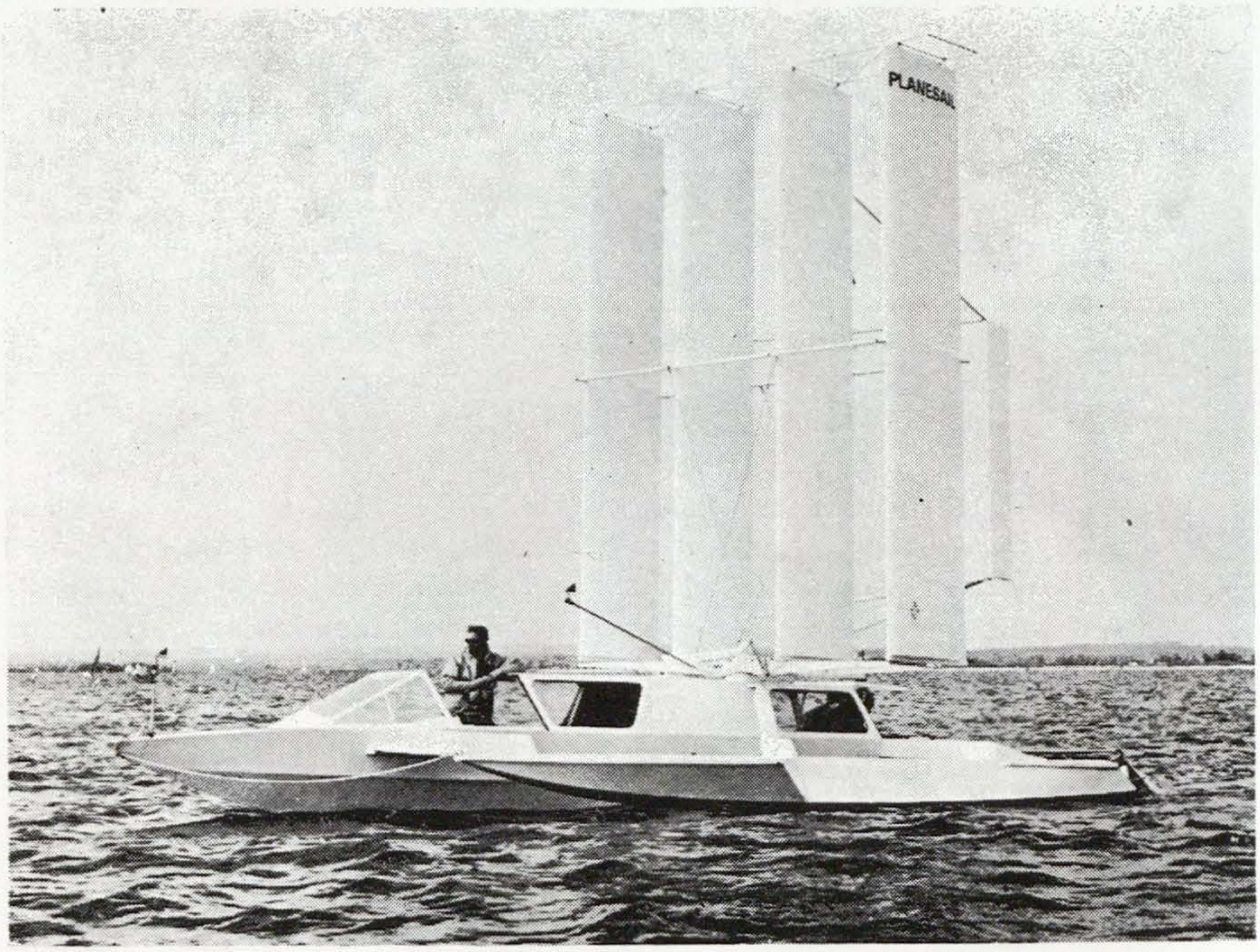
Planesail Limited, Old Reservoir Road, Farlington, Portsmouth, Hampshire.

1968 was a year of paradox for *PLANESAIL*. After the early model and much experimental work the first full size prototype was launched in May. *AYRS* No. 66a, p. 67. There was a tremendous struggle to meet the Tomorrows World TV programme deadline which had given us just three weeks to move from Devon and complete 85 per cent of the boat and it was perhaps a little too quick. She was then a 24 ft open dayboat with two seats weighing only 1,600 lb laden and with 280 sq ft of sail. Her performance was good and the hydrofoil/stability system was first-rate but all distinctly underdeveloped. The sailing through the summer was tremendously promising but infuriatingly erratic and unreliable and one major accident lost us a lot of time when a small clip failed in the vane linkage. This was a classic example of for-want-of-a-nail and rubbed in very clearly the fact that there is no substitute for time spent preparing for eventualities. The basic principles of the sail plan, where four main sails are mounted on a free 360° swinging bearing and are then weather-cocked by a controllable vane, were proved to be sound and reliable and trouble free, giving delightfully easy and delicate control.

The very great, sincere and friendly interest shown in our project at the 1968 Boat Show had continued and by the middle of the summer our list of inquiries had grown to over 800 but the continued unreliability of P1 had meant that we had been unable to make any really convincing demonstration of the boat's qualities, especially at sea. To be proposing yachts which are fast, stable, level and safe, offer single handed control without physical effort and then not to be able to demonstrate these qualities effectively in open water, was tremendously frustrating. A questionnaire which we sent out to our enquirers was returned by over 200 people and gave most fascinating information.

With so much and yet also not enough achieved by the end of the summer, I decided to rebuild the boat almost completely as a cruiser. She should be longer, with as near to standing headroom as possible, using the same sail set. This had proved reliable and tough with its glassfibre skin construction supported by foam.

The new work almost doubled the weight of the boat but this was offset by a 5 ft increase in waterline length. To give access to the after part of the vessel the main bearing was fitted 17 in off centre. This caused many eyebrows to raise but in fact this had no noticeable effect on either performance or handling.



PLANESAIL

P1(b) as then re-launched almost a year to the day after her first launch and immediately showed herself to be a safe and delightful light cruiser. The controls were simplified, since later theoretical work had shown the lateral hydrofoil system to be unnecessary at speeds below 20 knots. This, therefore, was left off and replaced by a simple centreboard in a housing in the main hull. Two high aspect ratio rudders are controlled from a 12 in steering wheel through an irreversible wormdrive box and the tail vane is controlled by a simple lever and pushrod system. The lever works laterally, with an 'ahead is to windward' convention, which has proved very good. The helm is positive, the boat's head moving strongly and accurately in response to delicate movements—and of course it stays where set.

The accommodation comprises a double berth after cabin, aft of the main bearing, a flushing head in a separate compartment ahead of this and a combined day saloon/cockpit with a sliding windscreen assembly forward. This gives superb visibility from the control position, which is forward and to port, while a sun lounge effect in the after cabin with the after hatch open has proved very pleasant. The boat has still not been arranged to fold its floats into the main hull and so far no netting has been strung between floats and crossbeams (now at the full 6 element standard for maximum fail safe). Even so she has adequate sunbathing space. As with all multihulls our problem has been to keep the crew down to the designed three or two and two halves, the boat having on several occasions gone sailing on gentle sunny days positively festooned with lovely girls!

However, the crucial thing was to prove and demonstrate effectively the qualities of the design concept. The project started by writing down a general vehicle specification and designing a yacht to it, the list being something like this:—

(1) She should be as safe as it is humanly possible to design. This means that capsize must be designed out: statements like 'if you are a good seaman you won't capsize, being inadmissible. Fundamentally, therefore, she should not broach, not capsize, be instantly controllable in direction and speed without effort and be capable of sailing herself.

(2) She should be comfortable and practical. This means she should sail level or very nearly so, provide good headroom and space inside, adequate stowage, berths, heads and have proper attention paid to ventilation, insulation and the all important cooking.

(3) She should work efficiently. This means ease of initial learning, plenty of continuing fascination to improve one's skill, high performance in all weights of wind, seakindliness and weatherliness in tough conditions. The man who, sporting a gaff or sprit rig, said 'only a fool goes to windward in bad weather' was, I think, only a fool, because he had forgotten about the possibility of a lee shore.

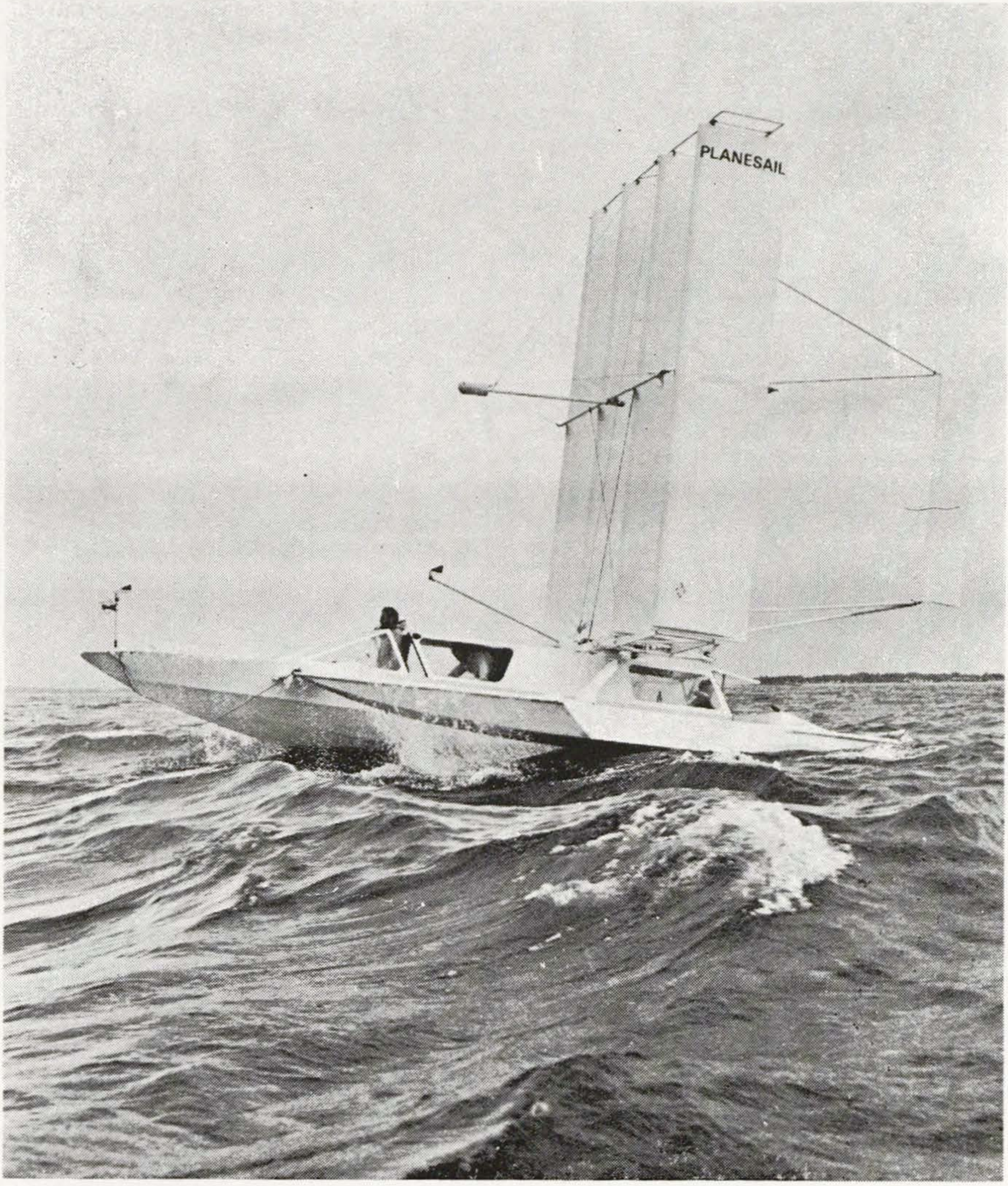
For minimum problems of communication and discipline she should be controlled by one person who should have the maximum possible sensitivity at his or her fingertips to sail ahead, brake, go astern and make three point turns. She should tack firmly and effectively going both ahead and astern (tacking backwards up the channel, while not easy, is perfectly practical and can solve many a problem for the man who prefers manoeuvring under sail to using his engine) and she should as soon as a course is set automatically steer on that course until told otherwise.

The outcome of setting such a stiff specification was *PLANESAIL* and the ideas are developing towards some lovely boats.

P1(b) is in many ways now out of date and P2 which is scheduled for quantity production next year will be far more advanced. Even so P1(b) is delightful to handle. Recently we wanted to give a good friend and brilliant hydrofoil engineer Christopher Hook a sail so we went out to P1(b) lying to our buoy off Sparkes Boatyard on Hayling Island. There was a good Force 5 which later rose to 6 gusting to 7 and we were all rather damp by the time we reached the boat. She had her sails up and the vane centered so that the rig weathercocked and was lying quietly to her buoy. Earlier problems of surging on moorings had finally been overcome by careful and systematic elimination of backlash from the cane linkage. We climbed aboard and stowed our gear, checked bilges, rudders and so on in the routine check, transferred our 4 hp Ailsa Craig outboard from inflatable to big boat as auxiliary and were ready to go.

I moved the sail lever one inch to windward to give a touch of ahead, put on full port helm and as the boat started to move, went forward and lifted our buoy strop off the mooring cleat and over the side. Then, going back to the helm the lever went one inch to leeward, the boat stopped moving forward and going astern in a tight sweep at about three knots (our new log reads just as well astern as ahead) cleared the buoy and the line of other boats. As she rounded up the lever went back to ahead and we were away at six knots quietly down the channel. Christopher Hook commented at this point on the uncanny quiet of it all. I, concentrating on my ship handling, had said nothing to anyone and the rig is totally silent. So the only sound was the hiss of the water and the very considerable weight of wind. This silence was not anticipated in the design, but quietness certainly adds enormously to the already relaxing qualities of the boat. Clearing the H.I.S.C. mooring trots off Sandy Point with great care, we went across Chichester Harbour towards East Head. At this point, protected by the Winner Bank, there was little sea, Force 5 southerly on the anemometer and nine knots on the log. With our 25 ft waterline this is $1.8\sqrt{L}$, at which speed we have under most conditions a wavemaking hump which stops her. The somewhat piecemeal history of the main hull has resulted in a less than ideal form—with a little reshaping $2.5\sqrt{L}$ or 12½ knots, should be P1(b)s usual maximum, while the longer P2 is designed for 18 knots. These modest speeds are, we feel, satisfactory for a cruising boat and represent reasonable, true parameters—a very great deal of nonsense is talked about yacht speeds.

Our second new crewman, 13-year-old James Norman was then introduced to the controls and was soon handling the ship with confidence and pleasure. With full helm on and left alone P1(b) will make consecutive circles of about 100 ft diameter, the helmsman merely moving the sail lever across from tack to tack as she passes through the eye and tail of the wind. This, while largely a stunt, is useful practice at operating the sail control. With a vane free to pass over the bows of the boat, gybing is innocuous, and sailing by the lee is unimportant as well. I think that the main difference between *PLANESAIL* and a conventional yacht is that a great deal of skill and effort in the cloth sailed boat goes into making the mechanism work well, angling the sails, keeping the wake straight, avoiding accidental gybes, taking large parts off, carrying them about, putting them back on and all in as skilful and efficient a fashion as can be. This leaves only a small amount of the crew's



PLANESAIL, pitching

time free for navigation and watchkeeping. We say that these actions are analogous on a motor car to adjusting the mixture, pumping lubricant, taking the cylinder head off, putting it back and so on. Feeling very strongly that an advanced vehicle looks after its internal problems automatically, responding to simple go-faster, turn left types of instruction. I have tried to design all such action out. In *PLANESAIL* the human being does what it is best at i.e. assessing the situation making decisions as to course and speed, navigation and communication; the boat responds intelligently with exciting and controllable performance. There will always be craft available for those who are looking for athletic sailing and indeed I sail an International 10 sq metre Canoe myself . . . but it shouldn't have to be athletic.

The wind was Force 6 gusting to 7 as we headed down the channel and out to sea into some really short steep waves over the Bar. This most punishing case is where *PLANESAIL* revels because the sail plan does not have the wind shaken out of it by pitching and the resulting steady drive at about 40° to the true wind is most purposeful. In calm water and at low speeds she will point up to within 30° of the true wind but in lumpy conditions she is best freed off 10° or so.

As we cleared the Point the spray started to fly and the accompanying camera boat would disappear for periods in the trough. The Bar produced some really nasty combinations of two or more very short very steep waves over a boat's length apart, but our big boat rode them like a swan at 7½ to 8 knots, her deep-vee forefoot giving a very soft impact. The punishment meted out to a multihull structure by these conditions is considerable, the raft-like proportions giving the passengers the most level and comfortable ride possible but absorbing in the process far heavier straining than a monohull. This is why amateur designed monohulls can be perfectly safe, while amateur designed multihulls can be lethal. We find that our fail-safe system with its main hull structure stressed as a huge torsion tube, using six half cross beams to transmit the forces, is extremely good but even so the problem is becoming completely soluble only as we develop computer techniques for stress analysis. Certainly, as we bucked and leapt through the Chichester Bar boil the racking and inertia loads were violently alternating from one diagonal to the other. At such times one's engineer's intuition sees the problem crystal clearly, and demands a rigorous aircraft style solution. Several tacks were made to give the cameras full scope, with all on board finding it tremendously exhilarating—my colleague, Christopher Hely-Hutchinson, was carefully noting accelerations and watching the structure for any sign of weakness. Christopher then took the helm and confirmed something I had noticed that at say 35° off the true wind in these conditions she would go at about two knots, and would not accelerate while if paid off by 10° she would pick up speed to 8 knots and hold this as she was brought up to the original course of 35°. Finally our intrepid cameramen signalled no more film left and we turned for home. Running was at first by comparison a very calm and quiet procedure, with just occasional surges as a wave passed but as we approached the Bar again it became very different, with tremendous acceleration as a wave picked us up to around 10-12 knots. In these conditions of very broad reaching the non-broaching characteristic of the boat was most comforting and indeed she was being sailed by Christopher largely hands off.

Then the day's crowning moment occurred, a really steep and powerful wave came up astern, we shot ahead as though jet propelled and a great howl of '15 knots and on the stop' went up. For about twenty glorious seconds we surfed, understanding totally Arthur Piver's immortal words about the sea being friend and playmate . . . so immensely powerful as to command absolute respect, but exhilarating and utterly fascinating. After this the rest of our trip home seemed tame as we skated past a big fat cruising cat with only a jib up and making about two knots in Force 6. Young James Norman very competently took the helm when we collected our buoy again and was duly pronounced a fully checked out crew member. We purred damply home in the dinghy. The Ailsa Craig had gone with us and returned without being run yet again, not only from a preference for sail over power, but because of the marginally greater degree of fine control over the sails.

A few days after the delightful short sail came an opportunity for a more extended test. MOCRA, The Multihull Offshore Cruising and Racing Association, was to have a rally at Studland Bay, almost exactly 50 miles from our mooring off Hayling Island Sailing Club, and we decided to go to this returning outside the Island to complete our long promised mini-circumnavigation.

Three of use were to go, Hugh Murray being not only our wizard with what he calls his 'numbers', analysing stress and performance design by computer, but also having considerable offshore racing experience, and Christopher Hely-Hutchinson, who in times of stress can always be relied upon to comfort us with some infinitely more horrifying tale of what happened in the submarines.

The early part of the voyage was uneventful with a brisk reach through the night to Hurst Castle. We covered the 32 miles in just under four hours with the help of a good tide and spent an enjoyable couple of hours watching the Cowes-Torquay race roar by. Then to Studland, anchoring with great pleasure in the lovely bay and meeting friends like Mike Butterfield with *MISTY MILLER* and George Tinley with his new *IROQUOIS MARK II.* We took George and his two little boys for a brief sail in P1(b) and they seemed to enjoy her enormously. Mark did a perfect gybe under complete control in his first 30 seconds at the wheel, while his younger brother did an equally perfect tack. George himself got the hang of the new system faster than anyone else so far and was soon handling her with complete confidence as he braked, stopped, reversed, chassé-d and generally cavorted among the anchored multihulls.

Unfortunately and far too soon we had to say goodbye, with another night sail ahead round St. Catherines. I took first watch which pulled the Needles light slowly abeam and then turned in for my deep and dreamless, coming on watch 8 hours later to the sight of Hugh Murray sitting calmly at the controls with outside water flying absolutely everywhere. It was more like being in an inside out aquarium than a yacht. "Blown up a bit" he bellowed. There was a steady Force 6 and except for a pleasant sheltered leg in past Shanklin and Sandown which we used to take breakfast, it was sheer hard pounding dead to windward between Bembridge and the Nab Tower. The sun was shining brilliantly and as soon as we realised that explosive wave impacts, clouds, sheets and rivers of water were in fact nothing to worry about, we all thoroughly enjoyed the sail, the 16 nautical mile taking just under four hours, of which about half an hour was a full Force 7.

Our confidence in the sail system is now unbounded. It behaves better than I could have dared hope, while our carefully designed multihull structure seems to be bearing out the promise shown by analysis from first principles. The information carefully amassed by this experience, which we hope shortly will include a cruise to France, has made the design of P2 much more definite and confident. Our new premises in Old Reservoir Road are spacious and efficient and will make the building of P2 even more enjoyable. She will be faster, more comfortable and more highly developed. We can't wait to sail her, even in grim November when everyone will have hauled out and retired to their fireside.

SIMPSON-WILD MARINE PARTNERSHIP

19 Kings Road East, Swanage, Dorset, England.

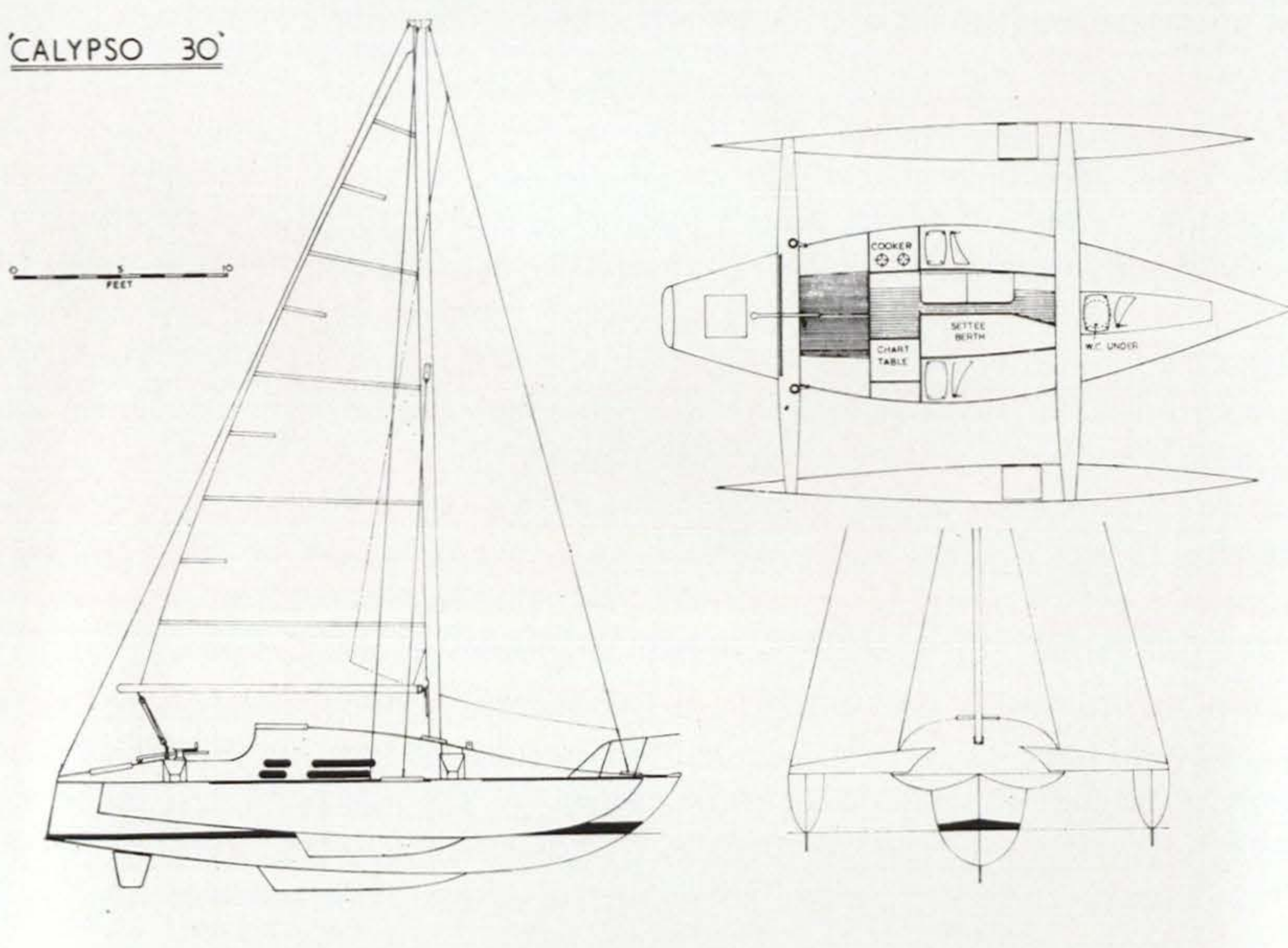
CALYPSO

L.O.A.:	30 ft 0 in	Beam:	18 ft 0 in
L.W.L.:	27 ft 6 in	Draft:	2 ft 6 in
Sail Area:	380 sq ft		

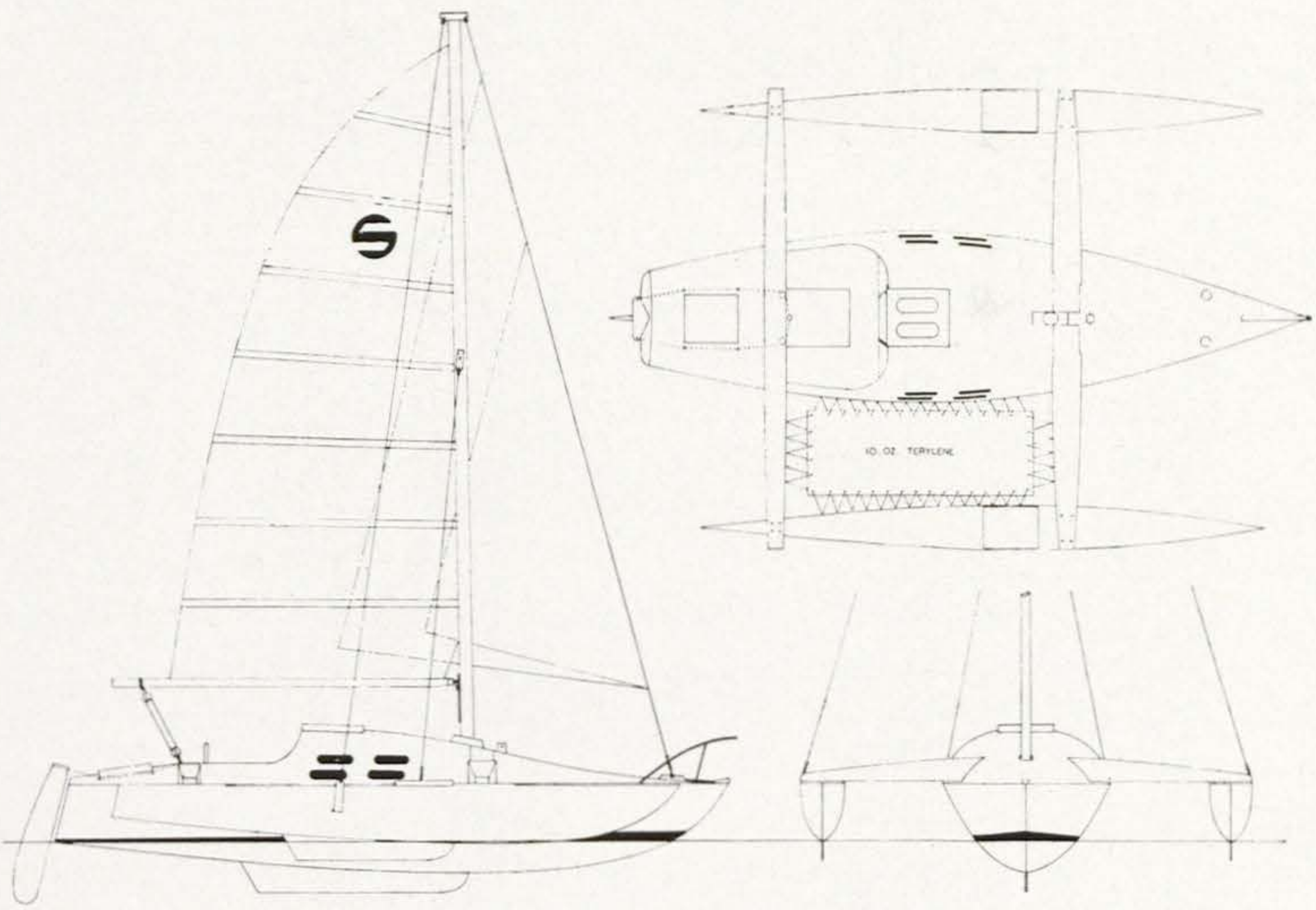
Dear Mr. Soulsby,

Many thanks for your letter concerning our trimaran designs. Please find enclosed drawings of our *SHANGAAN* and *CALYPSO* and a photograph of the former. My apologies for not replying sooner—Boat Show preparations leave little time to spare.

During the past season *SHANGAAN* has acquitted herself beyond expectations and has proved phenomenally fast and weatherly, turning in some remarkable passage times. We have found the aerodynamic shape has greatly enhanced her windward ability—when compared to similar craft—and largely contributes towards her easy handling characteristics and docility on moorings. She is now being produced commercially by Border Marine of Berick-on-Tweed in cold-moulded plywood. (*AYRS* 68, page 5).



CALYPSO is a natural development of her smaller sister and embodies many of *SHANGAAN'S* features. The unusual sectional shape has been chosen to increase the length/breadth ratio whilst permitting the installation of wing-berths into the main hull. It will also assist in keeping water off the decks and will discourage burying of the bow in steep seas. In the unhappy event of a capsize the overhanging areas—previously packed with polystyrene chips in polythene bags—will allow her to float sufficiently high to permit some kind of protection within the main hull. It would be possible to fit a waterproof escape hatch into the hull side above both normal and inverted waterlines.



SHANGAAN

A semi-balanced spade rudder has been chosen to eliminate vibration caused by air entrainment which we experienced on *SHANGAAN* at speeds over about ten knots. It was found necessary to fit a cavitation fence to the leading edge of *SHANGAAN'S* rudder to prevent this.

CALYPSO'S rig is of higher aspect ratio than *SHANGAAN'S*. Full length battens have been retained, although the amount of roach hardly demands it, to increase control in light weather conditions and to prevent flogging. In my opinion the benefits of full-length battens far outweigh any inconvenience incurred.

Concluding, both *SHANGAAN* and *CALYPSO* are real sea-boats and are designed to face the harshest conditions with maximum safety. Absolutely no concessions whatsoever have been made to 'caravan comfort' although both accommodation layouts are emminently practicable. Further designs are in the pipeline.

SALLY LIGHTFOOT

By Courtesy Editor *Multihull International*

Designers: **WALT GLASER,** 508, Pine Street, Aptos, California. 408-688-6309.
DICK HOMESTEAD, P.O. Box 243, Sausalito, California. 415-383-0540.

SALLY LIGHTFOOT is a tidy and nautical little double outrigger. She is 26 ft long, 15 ft wide, and draws 18 in of water. With main centreboard down she draws four feet. Basically she is a cruising boat and has been designed and rigged within the context of off-shore voyaging. But she is other things also and is meant to be handy and easily gotten underway for

SALLY LIGHTFOOT

either day sailing, week-ending or summer fun in general. Her wide decks, pipe railings, mean she is a fisherman too.

SALLY LIGHTFOOT has one double and one single berth. These, of course, are the practical and appropriate accommodations for a craft her size and for those who understand something of what the sea and sailing is all about. She is not a floating motel nor something that looks as if it belongs either on a rocket launching pad or in a trailer park.

Her construction is a lightweight plywood and fibreglass but allows for a unique building approach due to the shape of her bottom and the fact that her "tumble-home" cabin does not leave or overlap the central hull. Aside from its many valuable rigging and structural dividends this is also of great advantage spacewise—to the builder—as the major portion of construction and interior finish work can be accomplished before final assembly.

The designers believe that an all purpose cruising boat should be equipped with a motor. Since outboard motors are suitable as auxiliary power in small boats careful attention has been paid to its installation. On *SALLY LIGHTFOOT* there is no clumsy or unsightly bracket hanging over the stern which allows the motor to be pooped by a sea or function inefficiently as is so often the case. Instead there is a transom cockpit with motor well that provides ideal protection, reduces cavitation, and offers a great deal of room for effortless operation. The motor raises and lowers on stainless track and cannot be seen in profile.

SALLY LIGHTFOOT has a large watertight main centreboard case that contains a pivot type board. The entire unit is a composite construction of aluminium plate, stainless steel, and plywood and fibreglass. Her kickup rudder is similar in material-makeup and both are designed for maximum strength and longevity. They will be trouble free. *SALLY LIGHTFOOT* also has a stern daggerboard which operates from the motor cockpit. She does not carry the vulnerable float "fins" seen on so many three hulled craft.

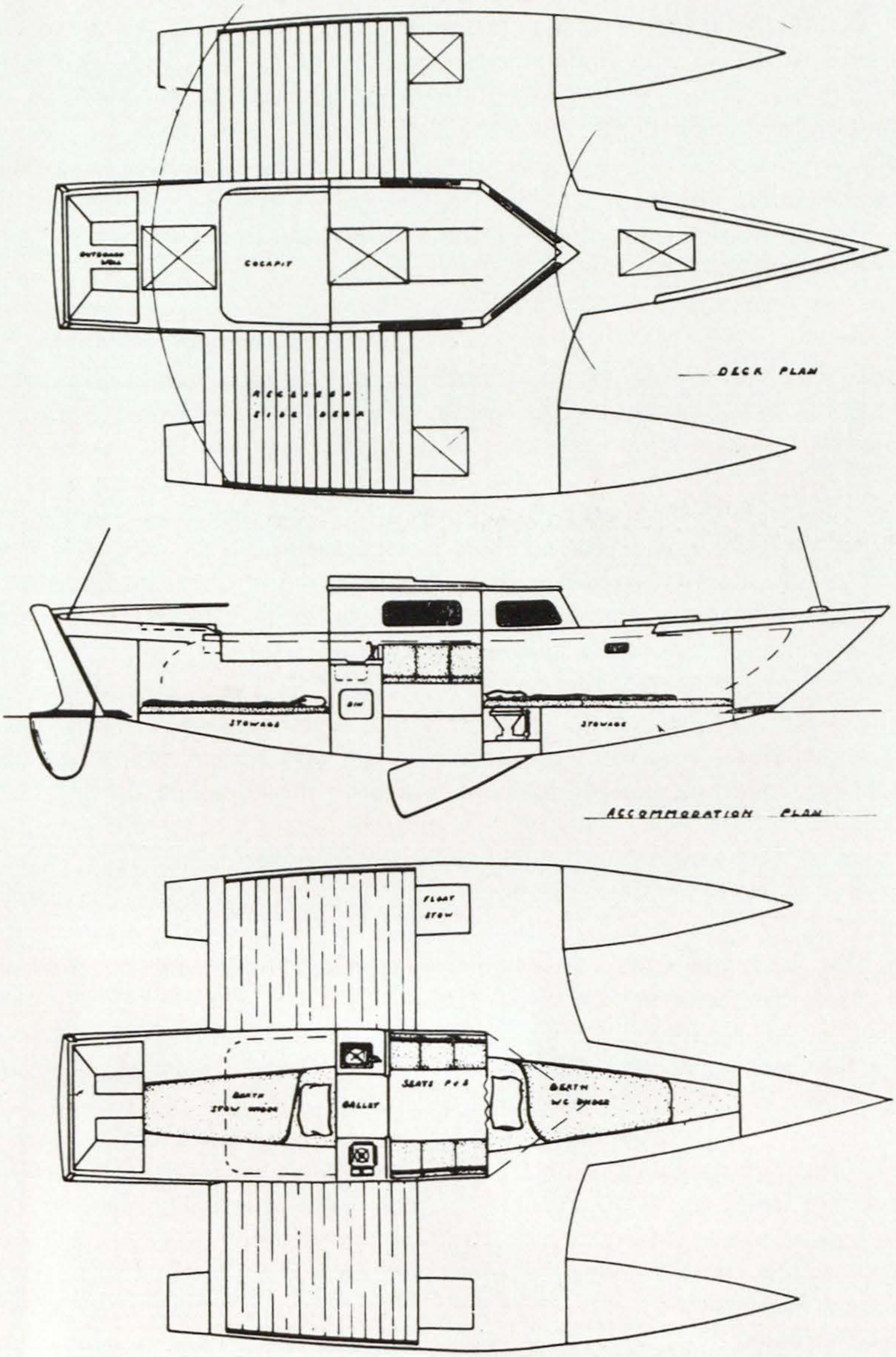
In the grand quest for headroom many small multi-hull designs show outlandish and quonset-hut type cabins. *SALLY LIGHTFOOT's* cabin silhouette is compatible and pleasing to her overall length. Yet near head-room has been achieved. This is due in large part to her unique bottom shape which is a narrow flat rocker and actually forms the base for the inside cabin sole. This bottom has many virtues during construction as well as being ideal for beaching.

Building plans for *SALLY LIGHTFOOT* are well detailed, accurate and easily understood. Many construction photos accompany them.

Each builder becomes a member of the *SALLY LIGHTFOOT* Cruising Fleet and every four months will receive an up to date list of new members so that if desired, contact, discussion and exchanges may be carried on.

Price of plans is $125.00.

Note: There is bound to be much lively discussion and enthusiasm about *SALLY LIGHTFOOT* and it might be mentioned here, for new-comers on the multi-hull scene, that the designers have a long and fuitful association with sea and boats. Having been actively involved in yachting all of their lives, their combined experiences both building, cruising and racing (Dick



SALLY LIGHTFOOT

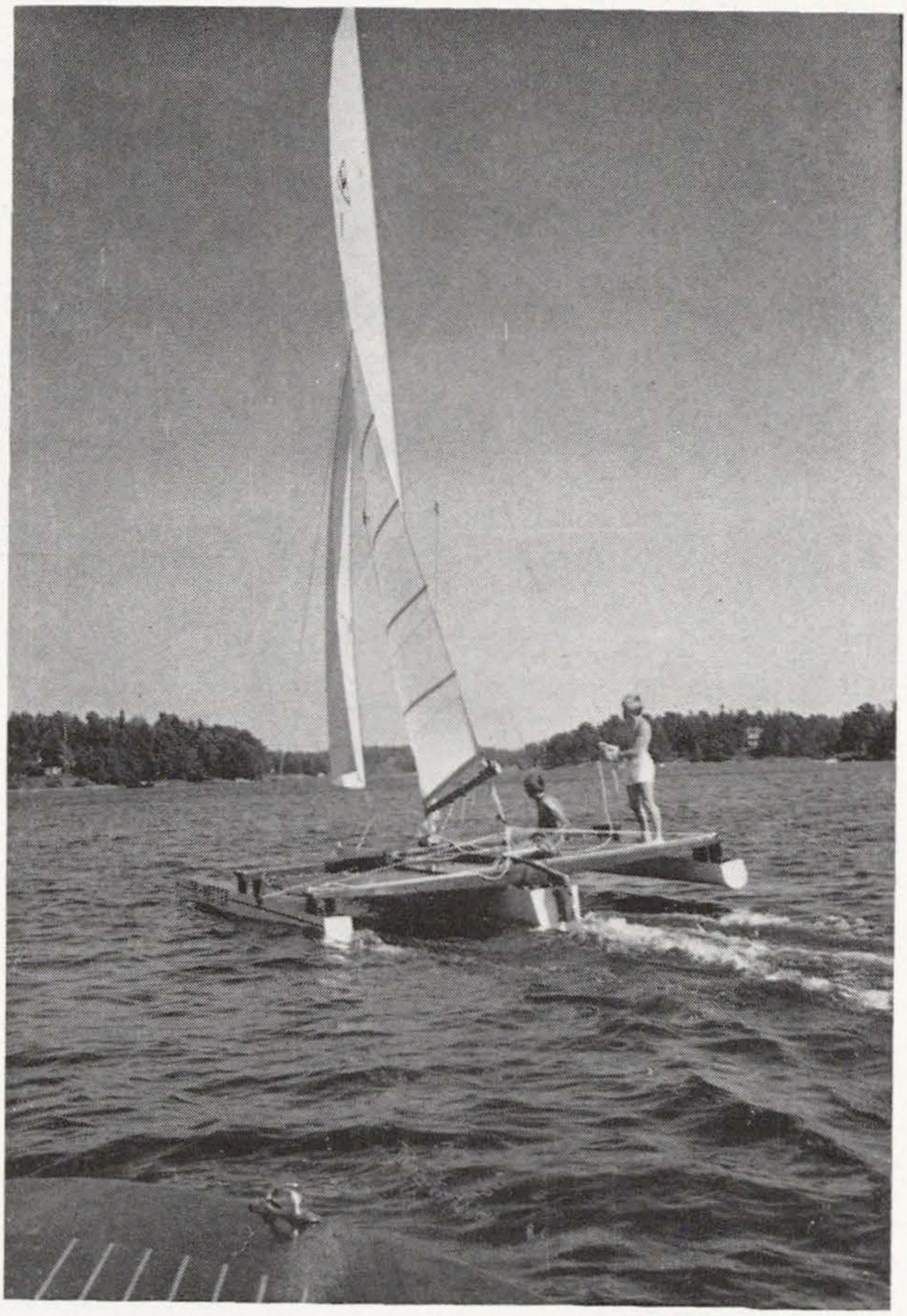
Homestead has sailed with many notable east-coast skippers) is broad in spectrum. As of this date no other three hulled vessel has bested their return voyage time of 19 days from the Hawaiian Islands aboard Walt Glaser's *TYPEE II.* It was this boat incidentally which wrote finish to the great centreboard dialogue and caused most designers to now show centreboards in the drawings of their larger boats.

TRI-MASTER

by Klas Werner, Hasthagsvagen 47, S-182 35 Danderyd/Sweden.

L.O.A.:	6.0 m	Beam:	4.5 m
S.A.:	21.8 sq m	Weight:	250 kg without crew

Glass cloth and resin hulls with decks and crossarms of plywood. Trampoline between crossarms of p.v.c. cloth.



TRI-MASTER

THE WINDMILL POINT OUTRIGGER

by S. L. Seaton 460 Windmill Point, Hampton, Va. 23364, U.S.A.

In 1929, while sailing in the South Pacific, I became quite interested in the Polynesian outrigger canoe. More recently (1961) I designed a 16 ft outrigger for home construction using modern materials, but retaining as much of the Polynesian characteristics as feasible. The result is shown in Figure 1, which is my own boat moored at Windmill Point.

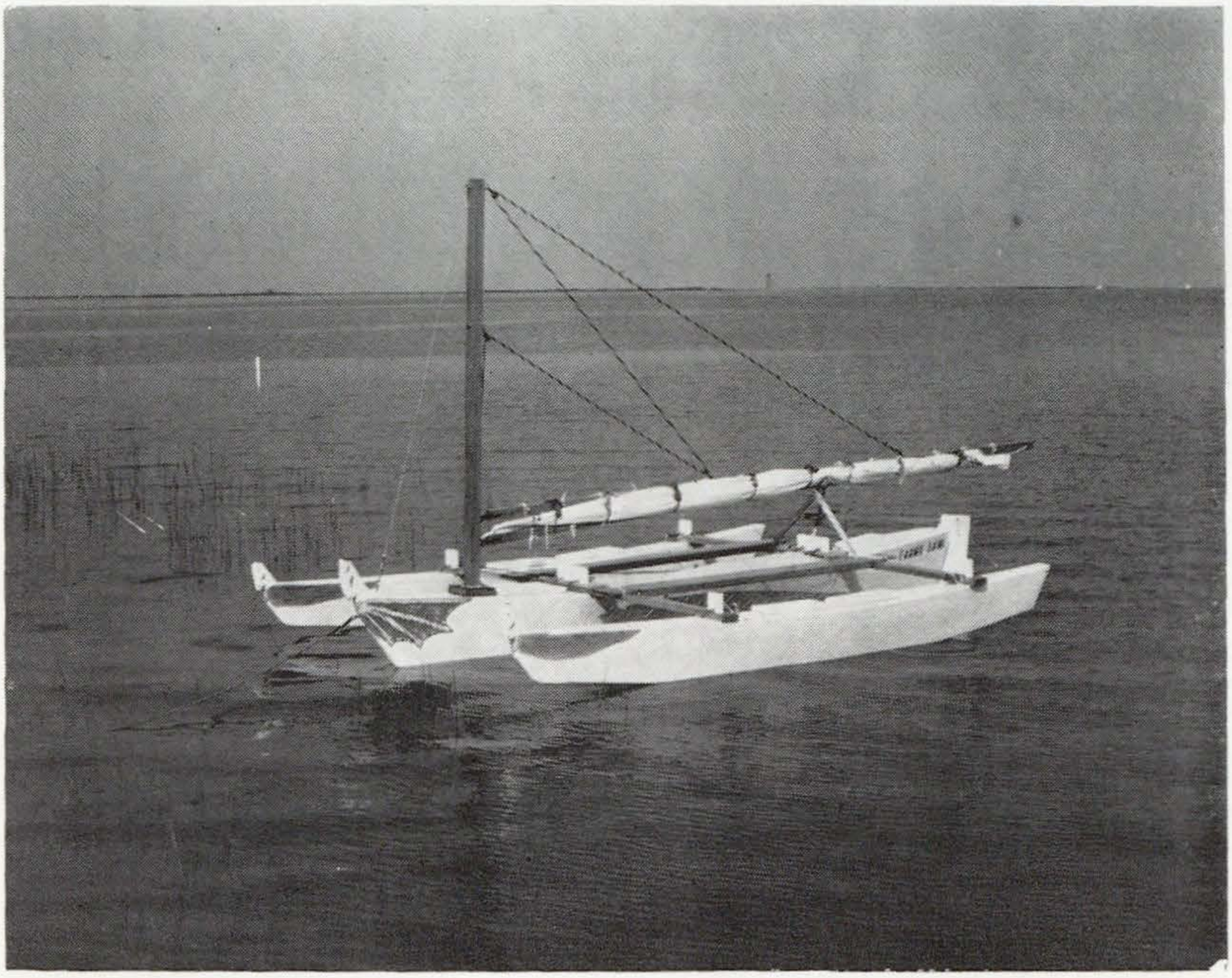


Fig. 1. Windmill point outrigger

The performance is gratifying. The boat goes well, is easy to handle and is exceptionally seaworthy. The main features are:

a) A design capable of execution by the amateur builder; all layouts being flat prior to final assembly.

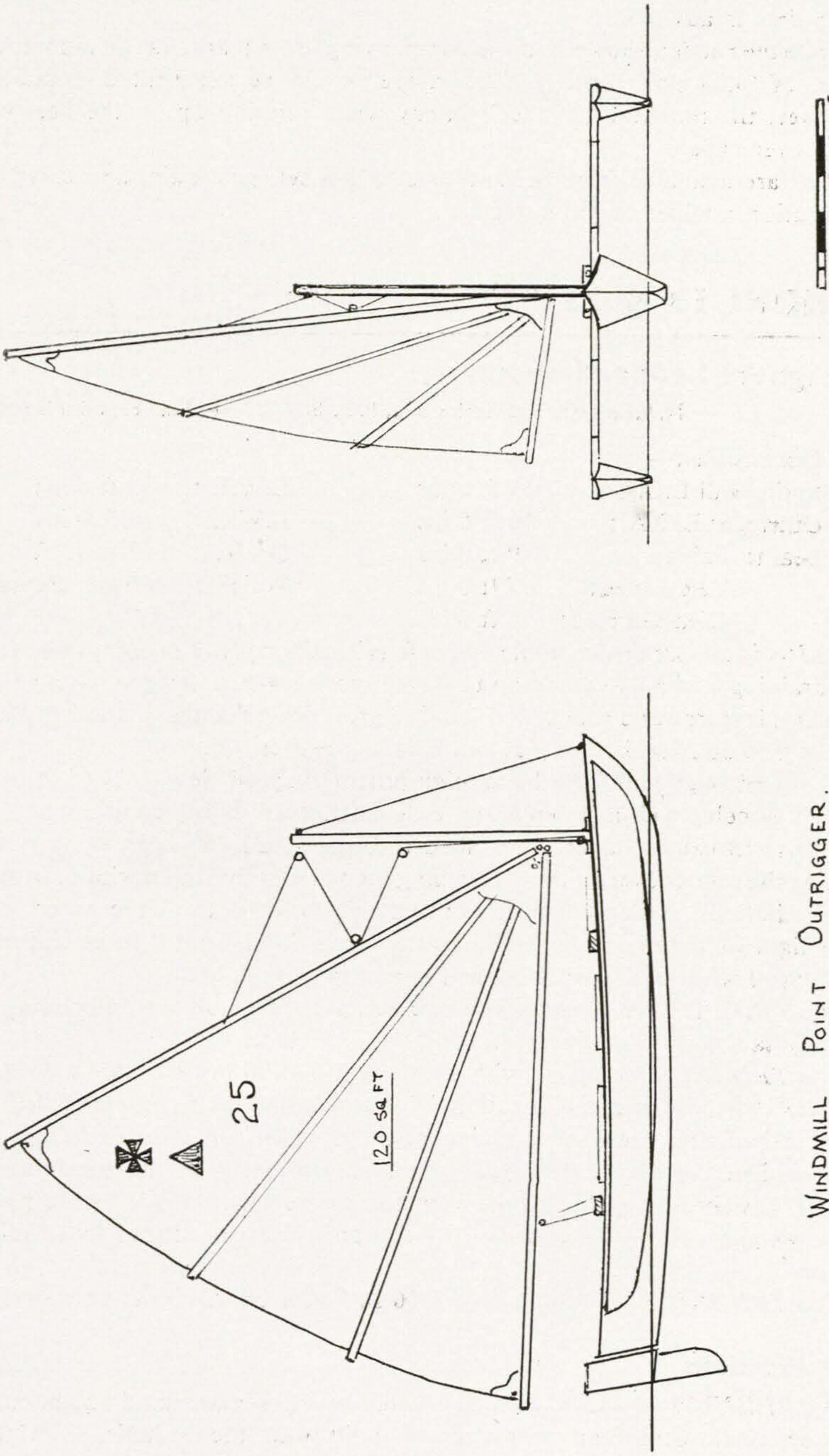
The outriggers and cross-arms are removable by withdrawal of eight oak wedges.

c) The action in a seaway is easy owing to flexibility of the cross-arms.

d) If capsized, the outboard wedges can be removed, the main hull righted, and the outboard hulls reassembled to the cross-arms with the boat in an upright position.

e) Lumber and plywood required is all stock size giving minimum waste, e.g., the main hull is 16 ft long; requiring two sheets of 4 ft x 8 ft plywood $\frac{1}{4}$ in thick.

f) The boat can be easily "knocked down" for trailering and for winter storage.


25
120 SQ FT
WINDMILL POINT OUTRIGGER.

The sail is of synthetic material available from "Rockall" in England and is of 125 square foot area, fully battened with two battens. One set of reef points is advised.

While the rudder, shown in the accompanying set of plans, has an aluminium blade, of "kick-up" form, a solid rudder could be substituted if desired. However, the retractable blade is handy when running up on the beach or going over shoals.

Plans are available from the author at $10 a set, post paid, and carry the registration number of the purchaser.

TRIKINI 13 & 13 "S"

Designer: Leonard Susman

N.A. Lenman Industries Inc., P.O. Box 32, Des Plaines, Illinois 60017.

Dimensions:—

Main Hull L.O.A.:	13 ft 0 ins	L.W.L.:	12 ft 6 ins
Outrigger L.O.A.:	10 ft 5 ins	L.W.L.:	10 ft 0 ins
Beam: Sailing	9 ft 0 ins	Draft:	7 ins/2 ft 6 ins
Telescoped:	7 ft 0 ins	Weight:	160 lbs complete
Disassembled:	5 ft 0 ins		

TRIKINI is an extremely simple and safe (virtually capsize proof) craft with a self-draining cockpit well and an unstayed mast. While designed as a single-hander it is sturdy and robust and stands a great deal of usage. The *TRIKINI*-13 has a 50 sq ft deck area that can handle a real crowd.

Its round bilge hull form has a high potential speed (in excess of 15 mph) as well as being well mannered and a delight to sail in any conditions. The *TRIKINI*-13 can be tacked and jibed through a full 360 degrees by simply putting the rudder over, without touching the sheet or shifting position, without any hesitation. When balanced both outriggers are clear of the water.

Its light weight of 160 lbs and 3 unit construction permit it to be trailed or car-topped without any problem and stored in a small area.

The *TRIKINI*-13 is in fact a safe-one design family sailboat, fully equipped for day sailing or casual racing.

The *TRIKINI*-13 complete with an 85 sq ft dacron sail costs only $852.00.

TRIKINI-13*'S'* is a modification of the standard craft, intended for the more demanding needs of a racing oriented sailor. A new maindeck has been designed to accept the rigging for a stayed mast. A full batten sail of 90 sq ft has been designed and the wing decks have been extended aft to permit more weight shift. The craft is fully equipped from masthead fly to hiking straps.

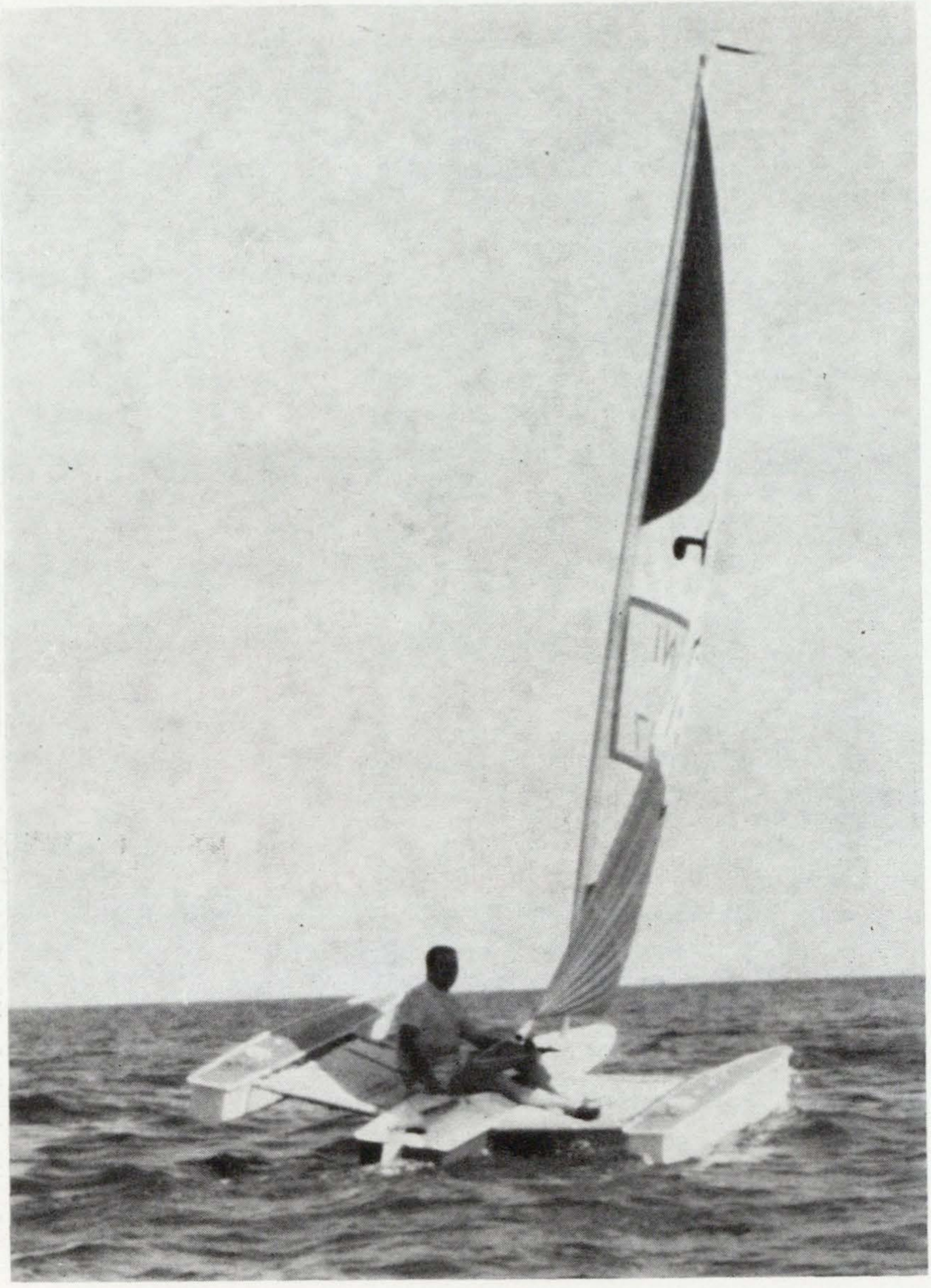
The *TRIKINI*-13 *'S'* complete with 90 sq ft dacron sail costs only $995.00.

Specifications

The *TRIKINI*-13 and 13*'S'* are constructed of a fibreglass hand layup, colour impregnated. Styrofoam floatation is built into the 3 hulls. Rigging and fittings are first quality being mainly stainless steel, marine aluminium, dacron and nylon. The rudder blade and daggerboard are foam core fibre-

TRIKINI

glass. The tiller, tiller head, rudder head and tiller extension are anodized aluminium. The rudder is of the kick up type and controlled by the tiller. A 12 in hatch is fitted to the foredeck to give access to an 8 cu ft storage unit between the cockpit and mast. *TRIKINI*-13 has a 2-piece mast of anodized aluminium. The dacron sail is Red White and Blue panels and is loose footed. The sail is of the pocket luff type and can be furled by rotating the mast. Wing Decks are White Dacron. Standard colour is all white hulls,



TRIKINI

white float decks and blue main hull deck. *TRIKINI*-13*'S'* has a one piece aluminium mast 18 ft 8 in long. Sail is white dacron with full length tapered and varnished ash battens. Rigging is S.S. with adjustors. An adjustable full width traveller, boom vang and mainsheet cam cleat suspended from the boom are standard. Standard Colour white as above but Red main hull deck. Both craft feature the Telescopic Cross arms that permit reducing the beam to 7 ft. for trailering by pulling only 4 pins.

"AY-YILDIZ"

Designer and Builder: J. B. Norton

Former Lifeboat House, Hythe, Kent.

Sloop Rigged Trimaran 29 ft (26 ft W.L.) × 15 ft 10 in × 2 ft

This trimaran has been under construction for some time; some 3,000 man hours work having been done on her. She was the subject of John Morwood's poem "The Down Hearted Boat Builder" (*AYRS* 57, p. 56).

I. General Geometry

(a) Retaining the AYRS "V" for sea kindliness, ease of construction, "grip" and directional ability, but using no chine, thus reaching out towards the side hulls result in an underwing area 20% of that in the normal vulnerable 30 ft tri. Then building out on the floats to achieve sufficient water line beam for transverse stability (got by stress on water at extreme W.L. beam). The result is a sort of bilge-keeled float which is a low aspect ratio low drag foil with maximum chord at mid-point more or less to an N.A.A.C.A. Series.

(b) Equating the $\frac{L}{B}$ ratios of all hull W.L.'s.

(c) Giving a low freeboard.

AY-YILDIZ before launching

(d) The "best" sections then had to be got in the main hull (where only it was possible) by equating the maximum buoyancy at mid-ship sections where the main weight (an estimated 1 ton laden) was disposed, to a geometrical expression for the wetted perimeters at these sections, when

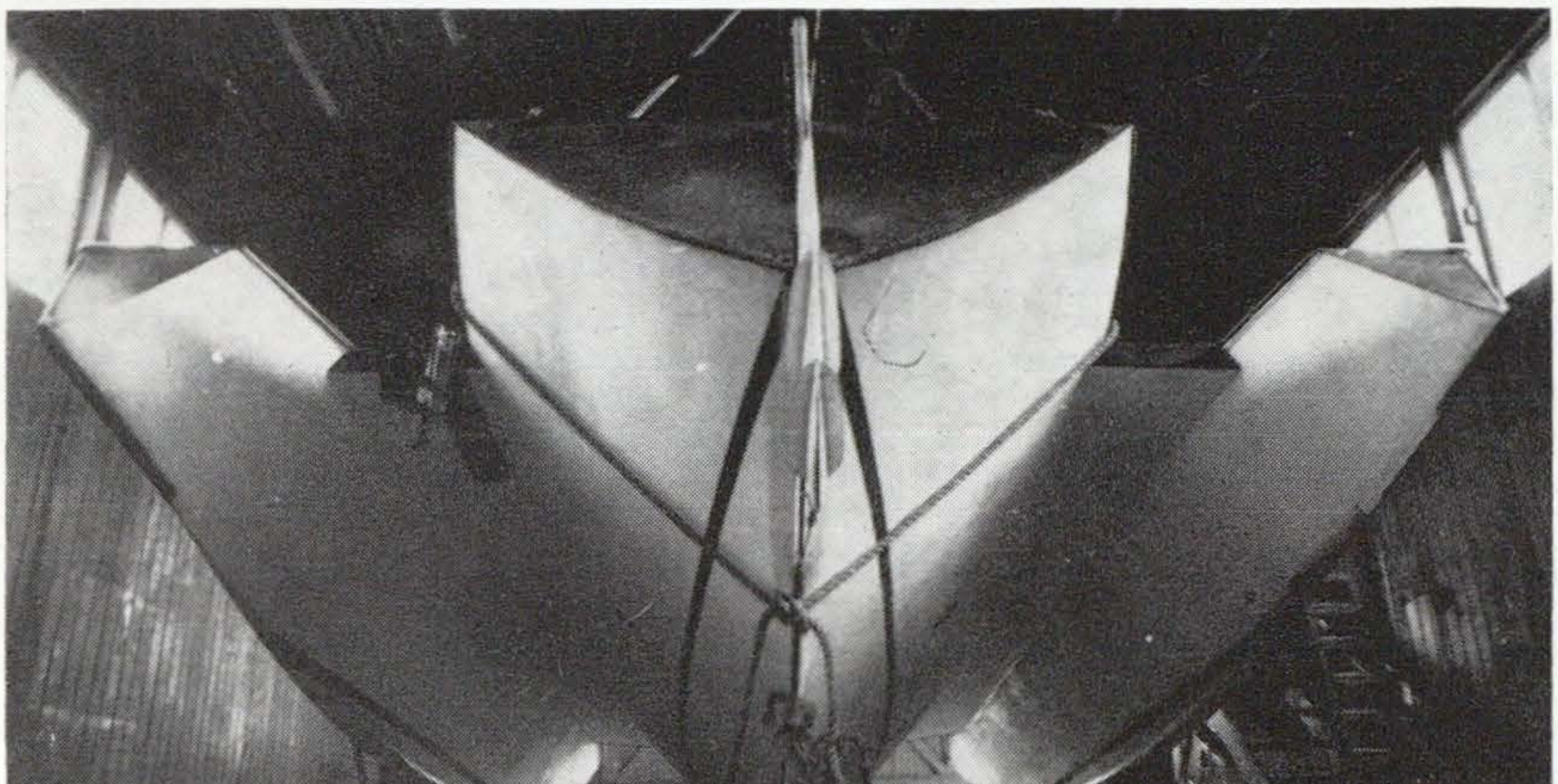
$\frac{dy}{dx} = 0$ for a minimum of latter with a maximum of the former which

gave the ideal "V"—at least for the 10 ft amidships. And the cross-sectional areas curve is almost flat for this distance, with the whole of it symmetrical about a point somewhat aft of the midship section to give a flat run and sharp entry with dog house and cabin weights disposed accordingly.

2. Structure

Using space frame cantilevers every 2 ft instead of the usual two 16 in (approx.) deep box beams for a 30 ft tri, the lower (double) booms being only $2\frac{1}{2}$ in deep, through which slipped the upper laminated booms which formed the cabin roof and window frame supports; and these upper booms reach two-thirds across the beam of the floats towards the rear of the cabin, to admit access to them from the main hull, thus eliminating hatches on deck. Heavy wedges of decreasing depth fore and aft (midships 8 in, aft 4 in, forward nil) were knocked into the double lower boom to lodge hard between the adjacent planking of main and side hulls to give enormous strength at the maximum bending moment. There are 9 cantilevers, one full beam aft and 2 forward (one sloping back) on each side. All this gives a thin but strong wing section with a slight under-curve. The deck rests with its longitudinal stringers on these lower booms; and is double, (of stripped marine ply mahogany laminated over sheets of Douglas fir marine ply); and it is this lower double boom which enables the freeboard to be lowered 1 ft 0 in.

A further bonus is clear access right through from bow to stern with semi-bulkheads to enhance the feeling of great space inside; and the ability to build all bunks low (not wings) to keep the c.g. down.



AY-YILDIZ—under surface showing hull and float shapes

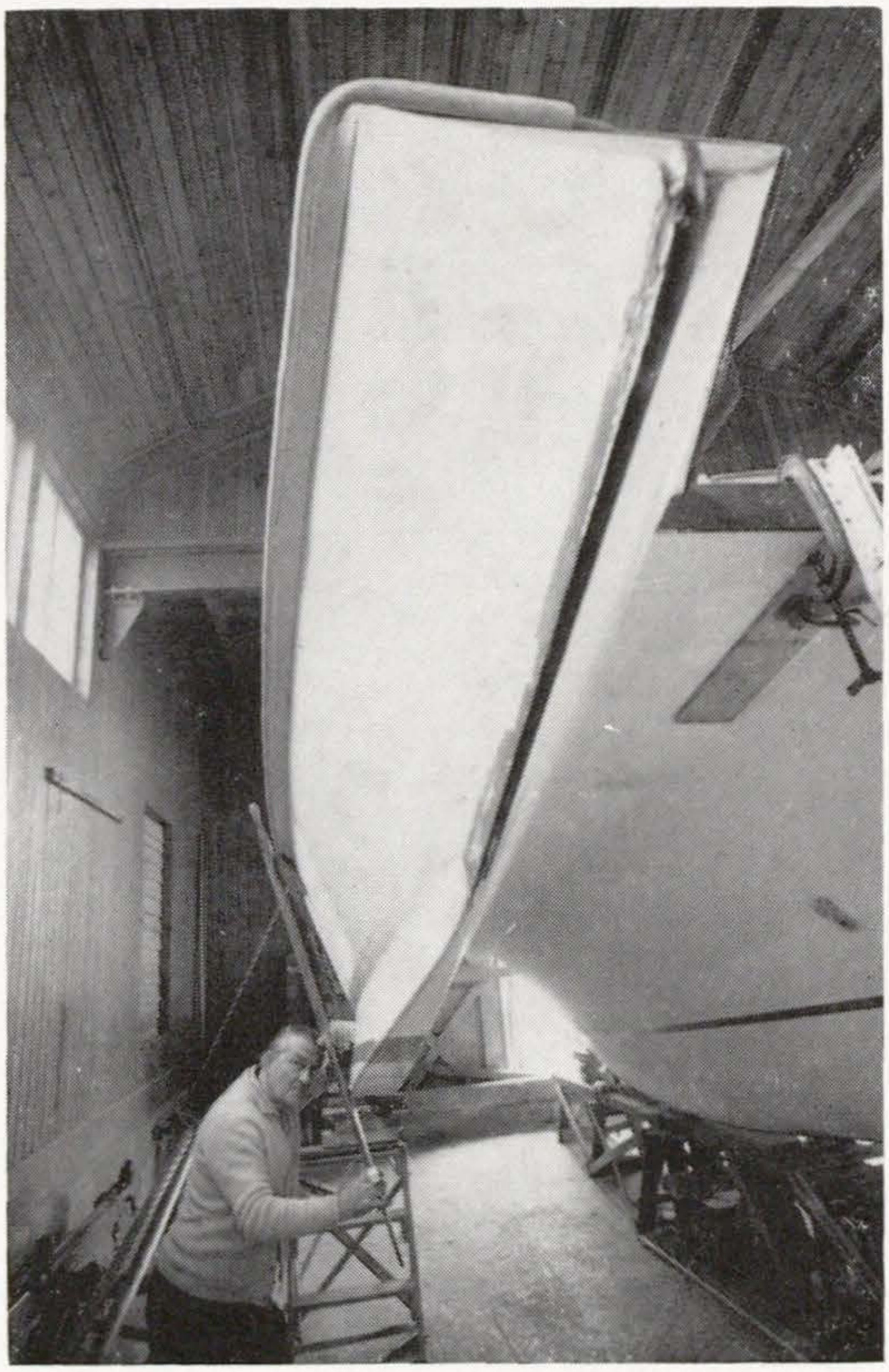
3. Aerodynamics

The deck is curved, with a parabolic down-swoop 8 in from gunnel edges deflecting wind up to curved roof top where suction on the lee side is broken up by the top walk which ends in the hatch forward and cockpit aft, along which main control activity is pursued. If seas come aboard they will hit $\frac{3}{8}$ in Perspex windows (20 in $\times$ 8 in maximum depth at rear) laid on $\frac{1}{2}$ in marine ply frames of 2 in wide perimeter which rest against the down-coming upper booms of the cantilevers; but in any case washboards may be flapped against them or dropped between the deck stanchions.

4. Interference

It may be thought that this narrow tunnel will result in joined waves but the high initial "submarine" buoyancy which presents also a lateral surface against lee drift and gives some dynamic lift, enables the hull profiles to be so juxtaposed that any interference should occur well back. And on certain points of sailing the side hull can ride on the bow wave, which I hope will not be large for other reasons than imposing weather helm; because the boat is expected to sail almost upright with its moderate sail area of 300 sq ft and numerous stays, 13 in all, (including twin backstays) on a 32 ft mast which sits on the cabin roof where it is specially reinforced by a curved steel arch in a semi-bulkhead.

The dihedral of the float cut-waters is only 25°.



The undersurface of float showing low buoyancy, which is a low aspect ratio keel

5. Materials of Construction

English oak for frames, pitch pine for stringers and cantilevers, Thames marine ply for planking, epoxy FRP'd with 12 oz cloth on deck level. The whole boat being resorcinol glued and the cantilevers cadmium bolted in addition.

6. Self Steering

A horizontal shafted streamlined vane driving the part balanced streamlined rudder which carries fins to stop air entrainment down it. The vane is easily replaceable in 30 seconds by others of smaller or larger size (each with its own shaft attached).

7. Tests: Main Hull

Keel dropped on to a 4 in × 2 in deep timber which smashed: no damage to hull.

Side Hulls

Starboard hull with M/Hull resting on concrete floor (the deck being level) allowed to drop 1 ft 7 in on to it: no damage.

Side Hull deflection

With side hulls supported centrally as in photo, a man (140 lbs) stood on either end: deflection at opposite end of hulls ½ in upwards in both cases.

8. Foam

(a) Roof: 4 in sandwich (laid).

(b) Submarine Buoyancy: Foam (poured).

(c) Wings: Sandwich (laid).

Total: 56 cu ft

AY-YIDIZ has since been tested on a lee shore in heavy breakers riding to a kedge for 6 hours, when she suffered no damage except the tearing off of the keel-iron on bow of main hull. Due to a leg illness, John Norton now of 66 Shorncliffe Crescent, Folkestone, is willing to sell her.

"WINDCHEETAH" (18 ft Day Sailing Trimaran)

Designer and Builder: Dennis S. Banham

"Highlands" Blackstones, Redhill, Surrey.

Main Hull: Hard Chine Construction
18 ft Overall.
17 ft W.L. length
2 ft Beam.
Draft: 6 in
Boom: 10 ft

Outriggers "V" Shaped:
15 ft Overall.
14 ft W.L. Length
1 ft Beam.
Mast: 22 ft 6 in Hollow Spruce.
Sail Area: Main 100 sq ft
Jib 70 sq ft.

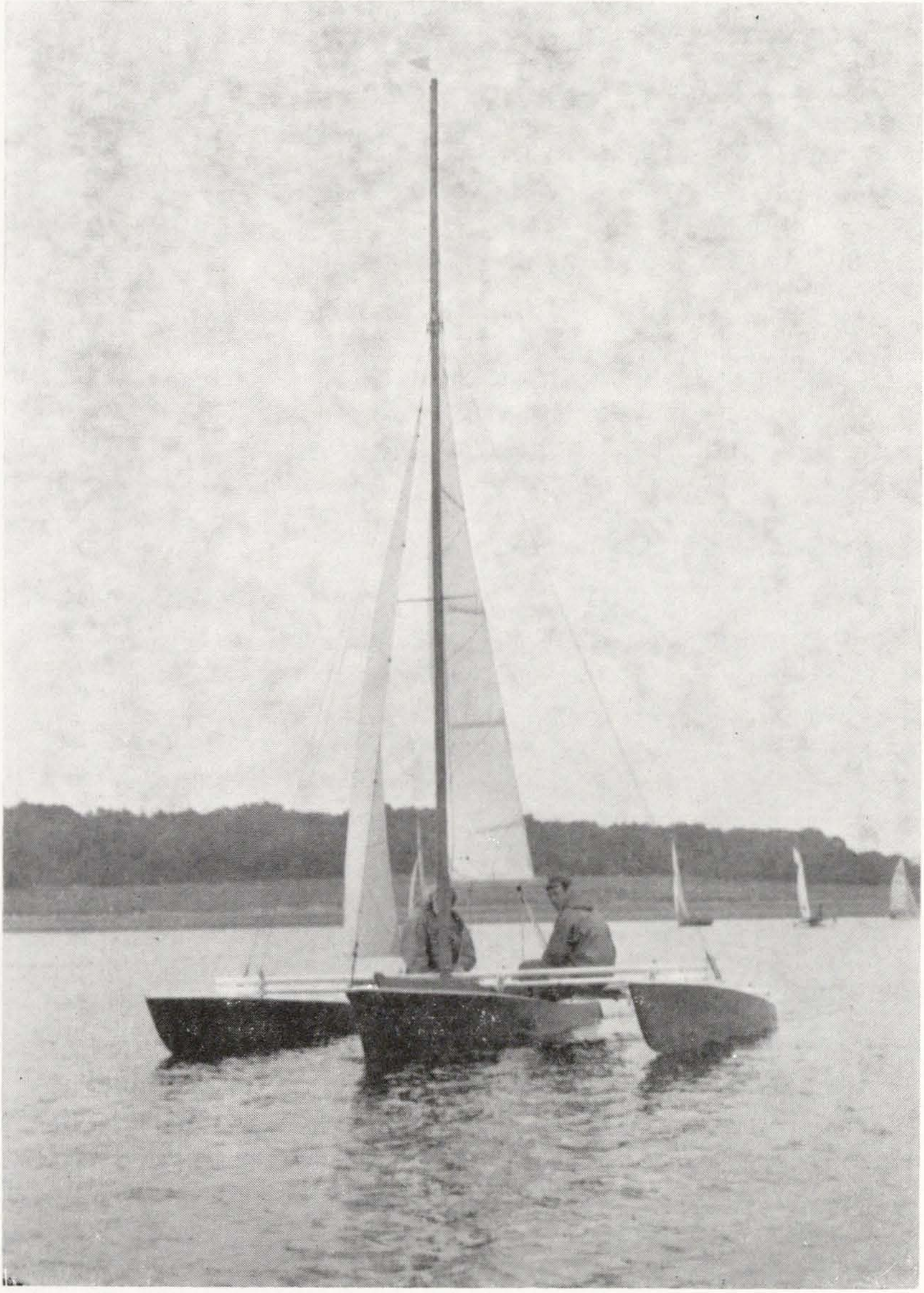
Total Cost Ready to Sail: £79.10.0d.

(see *AYRS* No. 67, pages 15 and 16)

The idea was to build a day sailing trimaran, that could be assembled and sailed by one man. The final craft can be assembled and dismantled by one person, but it proved rather a handful to sail, and for maximum efficiency needs a crew of two.

The "hog" of the Main Hull is 2 in × 2 in parana pine with a "spine" of 2 in × 1 in oak along the centre portion to prevent any possibility of the craft breaking its back when launched off a beach.

Gunnels and Chines are of 1 in × 1 in parana while the ribs (Bulkheads) are of 3 in × 1 in Mahogany with a 2 in × 2 in laminated beam across each Hull to take the bolts holding the cross-member clamps.



Dennis Banham's *WINDCHEETAH*

The outriggers have 2 in × 2 in hogs and 1 in × 1 in gunnels of parana, the former being shaped down to a "V". A Brass "halfround" strip is screwed to the keel of the three hulls.

Brass screws (every 6 in) and Aerolite 306 glue are used to fix the 4 MML: BSS 1088 Marine Plywood Skin to all three hulls.

Three alloy 2½ in dia by 12 ft long tubes are used to connect the hulls together for sailing. These are removed and two 4 ft tubes are substituted when trailing; the outriggers being moved inwards, and fitting snugly against the main Hull.

Time for assembly, or for dismantling, is approx. 15 minutes.

It was found to be necessary to have two of the 12 ft poles clamped together to form a parallelogram to give the required rigidity, just aft of the mast, and a single pole at the rear of the open cockpit.

The result is a very light craft, of simple construction and carrying as she does 170 sq ft of sail area a very good "Power—weight" ratio.

The long narrow slicing hulls, and the flat run aft of the main hull, has given this craft a performance that exceeds all its designers expectations, and even allowing for his enthusiasm, it can only be described as terrific. In a very few seconds the helmsman realises that he has a very potent machine on his hands, and unless he keeps his wits about him he can soon be in trouble. Carrying little or no weather helm the large lifting rudder feels light to the touch, and the craft balances beautifully. The large 70 sq ft jib helps to bring her round when coming about, ably assisted by the big rudder. No centre-board was fitted as it was considered (and subsequently proved correct) that the slab sides of the Main Hull, plus the two 15 ft outriggers, would be sufficient to prevent any excessive leeward drift.

Finished in Blue and White *WINDCHEETAH* is a beautiful craft, a pleasure to watch and sail, and which caused considerable favourable comment from onlookers when launched at Shoreham.

"SCIRON" Styrofoam trimarans with polyethylene wingsails

Styrofoam trimarans with poly. wingsails

By M. F. M. Osborne

5503 24th Ave., S.E. Hillcrest Hgs., MD., U.S.A. 20031.

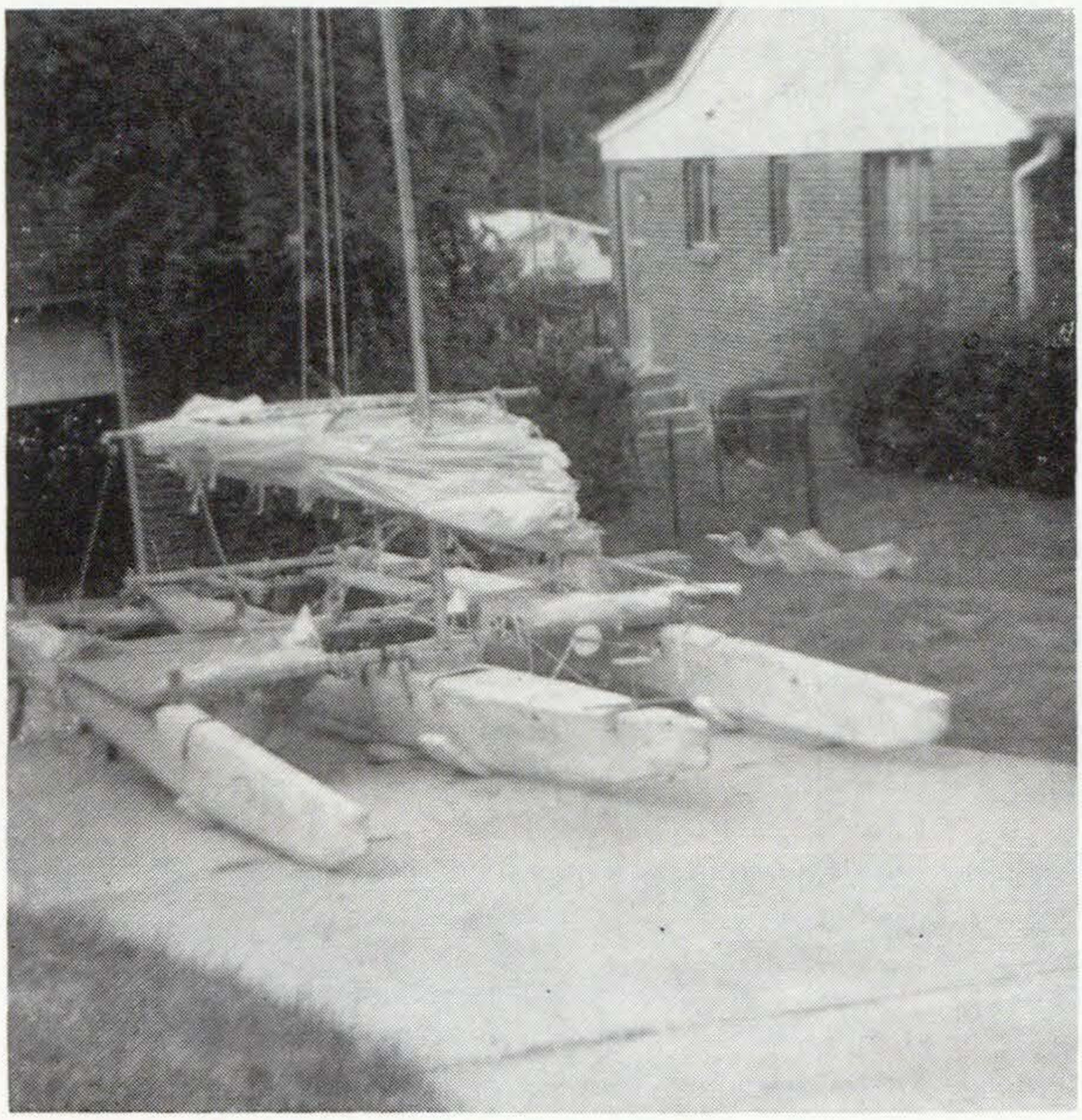
Principles

It should be pointed out, for the sake of conventionally minded readers, that I build these boats during the winter but don't expect them to last more than a year, junking or cannibalizing one year's model for the next. This allows the use of material that would otherwise be unacceptable, and makes innovation easier. The second point is that I have deliberately tried to separate the parts for functions of buoyancy, cargo (crew) carrying, stability, structural strength and propulsion, so that, as far as possible, a failure in one part does not jeopardise another function. Third, I try to build in a good deal of redundancy so a good many parts can fail before trouble develops. Failures, allowed but not encouraged to be numerous, should be easily and quickly

SCIRON. The wingsail reefed

repairable (bailing wire, sticky tape and string). I have deliberately avoided the use of stays higher than about 3 ft as I think a sail which can rotate through 360 degrees is a real safety feature. I am also devoted to "instant reefing" gravity, as in the case of Chinese junk sails. I have also deliberately stuck to unirigs, as being intrinsically easier to manage, though I am aware of the advantages of jibs.

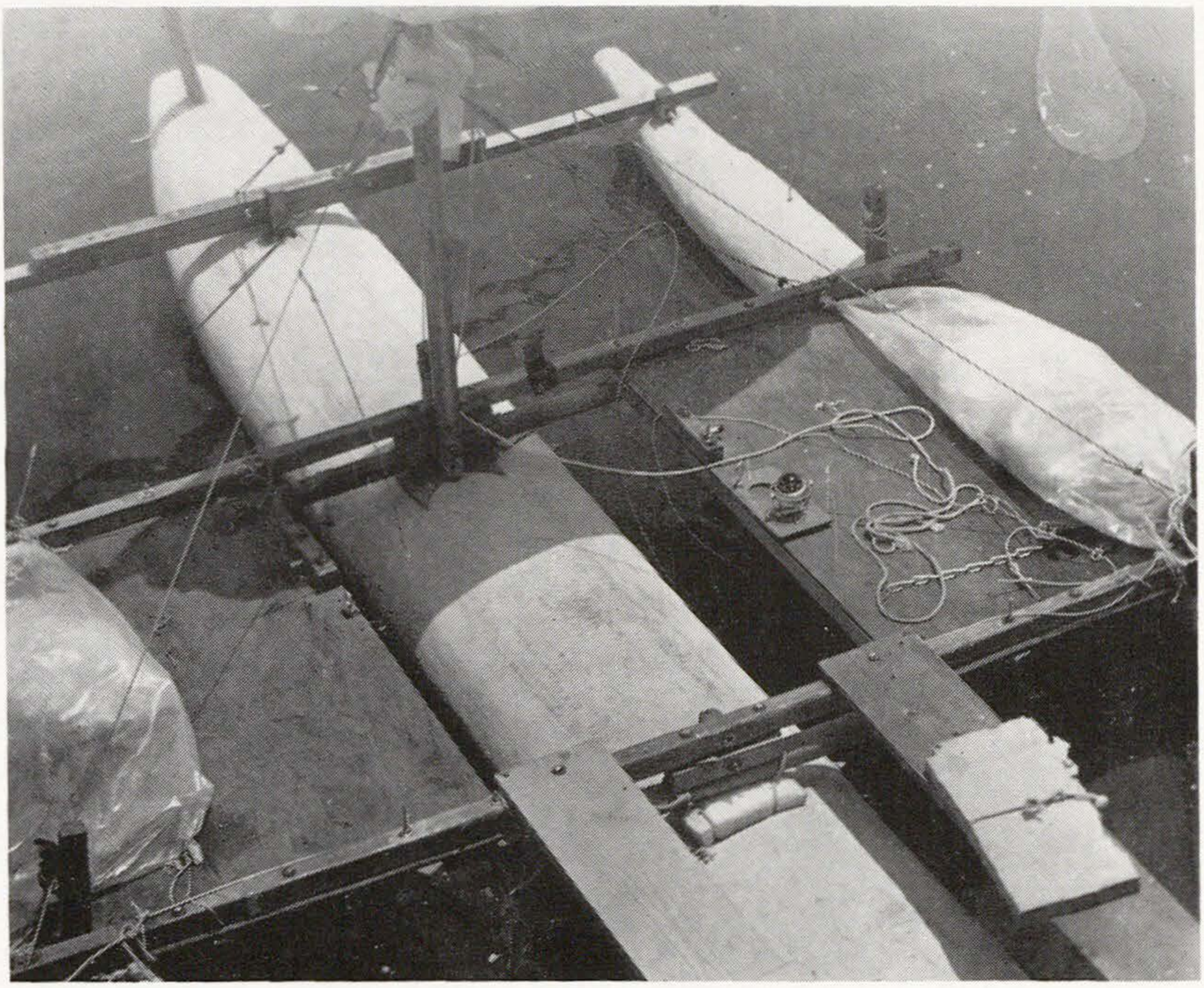
The motivation behind these principles is that for me, half the pleasure is in design and construction. The other half is that I like to sail these boats in thunderstorms, as I get a tremendous bang out of the ride obtained this way. It's an electrifying experience 'figuratively, in the past and in future I hope).



Wingsail furled

The above principles and objectives almost dictate a trimaran, with both centre and side pontoons completely filled with foam. A separate deck (the forward half) carries almost all the stresses of both sail and sideboards. See Fig. 1 and photographs. (I believe chinese junks are also designed this way, with the deck rather than hull taking the wind forces). These decks are fastened by five single bolts to vertical posts in the centre pontoon. However these bolts do not carry the weight of the decks, this weight is born directly upon the upper surface of the centre pontoon. The side pontoons are fastened to the deck in a similar fashion, and I also use shims of plywood or urethane foam (flexible variety) to cut down on the play, or rocking motion which this "one point" type of suspension allows. The two pivoted sideboards are also fastened to the deck and each other only. Thus the wind and water forces on sail and sideboards oppose each other directly through the deck, and not through the medium of the pontoons.

Construction details of the components follow:
Side and centre pontoons. Of the many varieties of plastic foam I have tried and used just two. The major ingredient is styrofoam floatation billets, (Dow Chemical Co.) or "logs" measuring in the largest size 10 in × 20 in ×9 ft (1 lb/cu ft). These, or pieces therefrom, are simply stacked like bricks into a size and shape large enough so that the desired structure could be carved from it. These "bricks" are then "mortared" or "welded" together with Urethan foam (Nopco Div. of Diamond Shamrock Co.). This is formed



Shows polystyrene hull and floats

of two fluids which foam up when stirred together, and I use a mix which gives the stiff rather than flexible foam. The resulting structure is then rough "carved" with a fine steel wire heated less than red hot with a toy electric train transformer. It is easily hand sanded with a course grade of production paper to the final shape.

The above method over builds and then cuts back. An alternative is the casting method, which underbuilds and then fills up. In this method two half moulds are made of long wooden strips, say one half inch wide, and spaced two inches apart. The half moulds are fastened together, and lined with polyethylene film, held in place with thumb tacks. It is not necessary to use a single piece of film, but let the overlaps be generous, a foot or more. The mould is then rough filled with mortared together blocks of styrofoam as before. The last inch or two against the side of the mould is filled with Urethane. When the mould is broken apart (urethane will not stick to polyethylene), the lines of the boat are marked on the casting by the marks of the wooden strips, the intervening two inch gap being swelled out like the wides of a pumpkin. So the casting is easily sanded down to its lines.

Since both styrofoam and urethane are attacked and softened by the resin used in applying fibreglass, it is necessary to coat these structures with a barrier, before glassing them. For this I use Weldwood water mixed (water resistant, formaldehyde base) glue, following a suggestion of Arthur Piver in an earlier AYRS publication. Two coats of a slightly thin mix. One can then apply

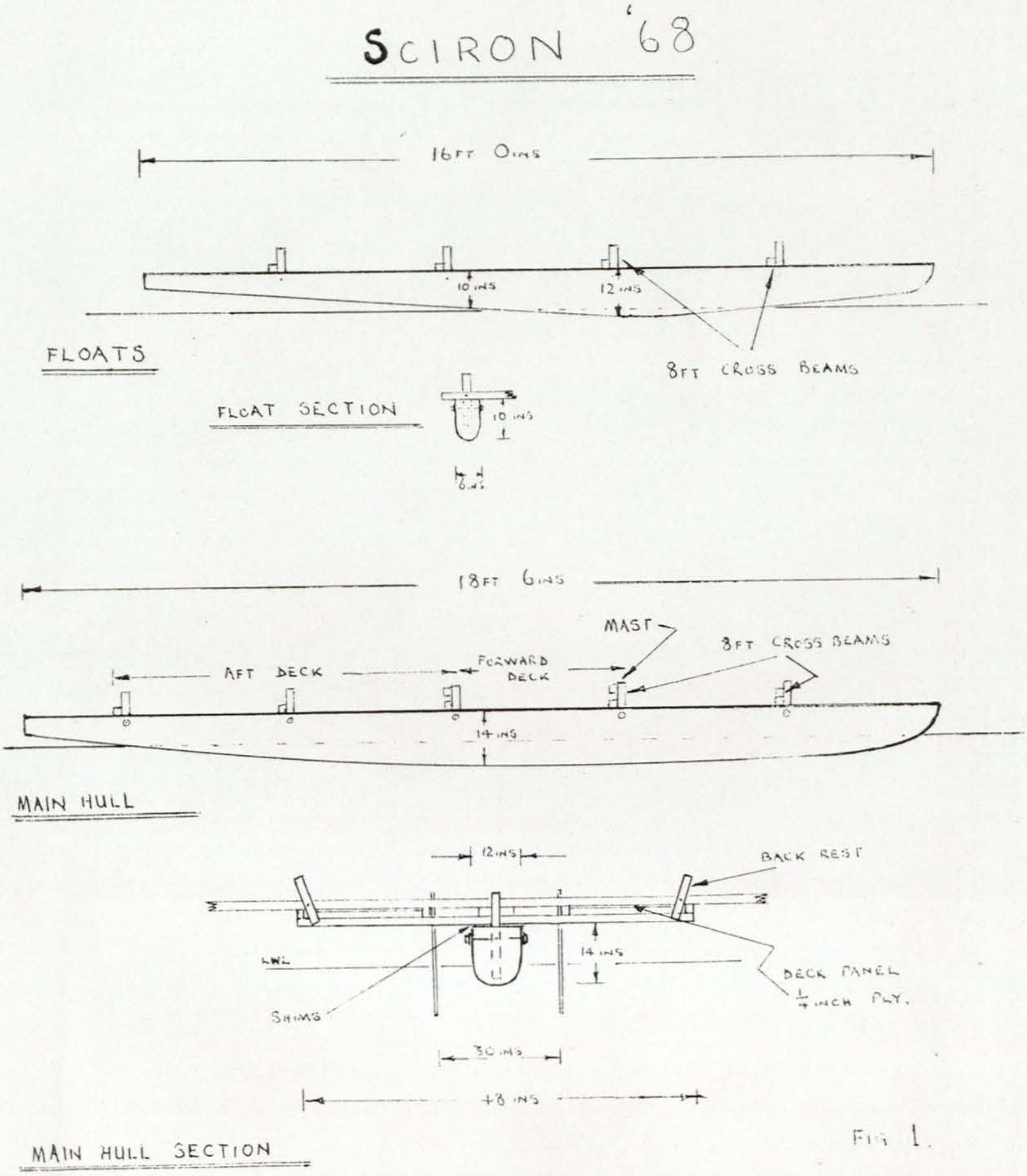
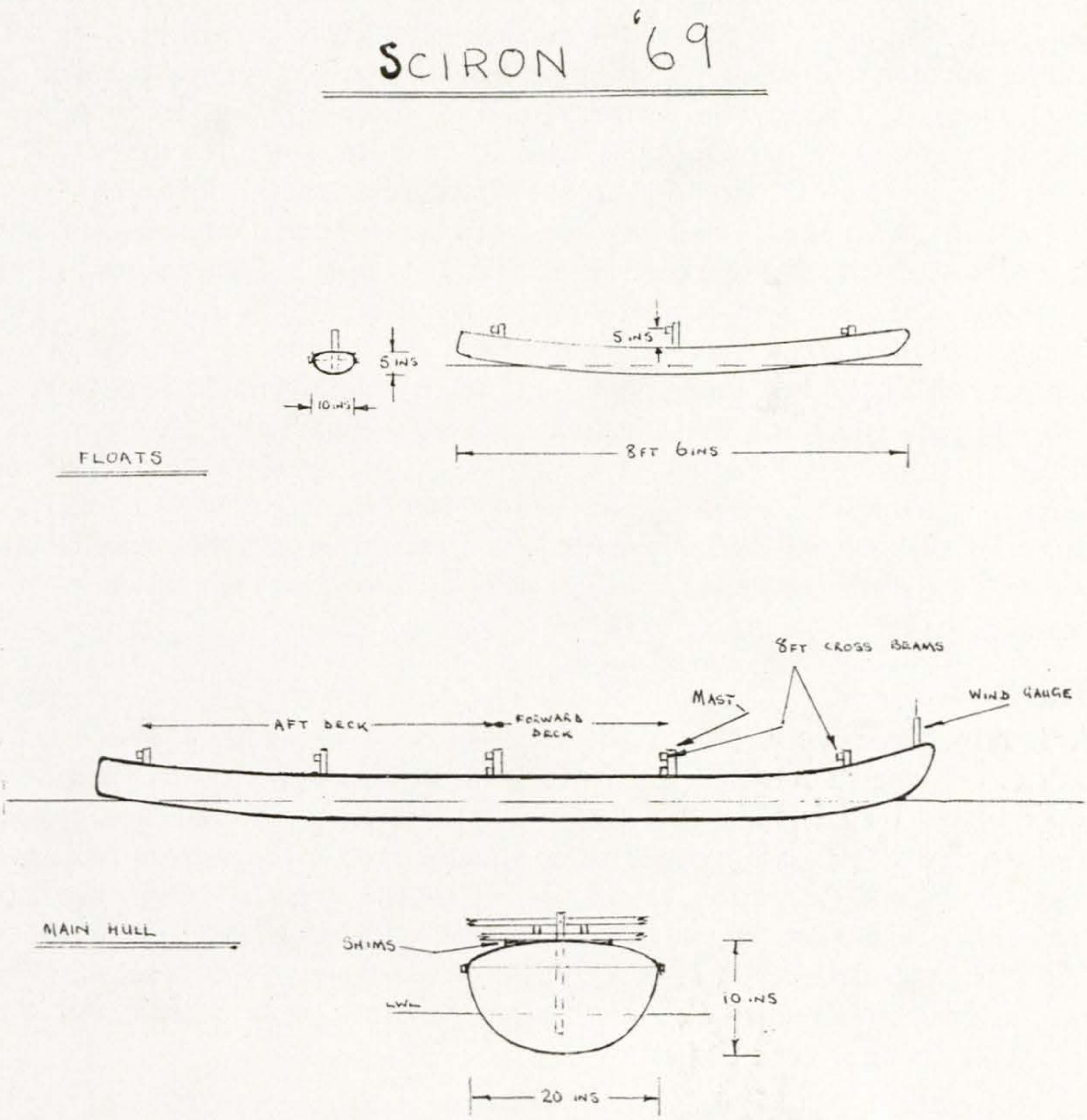


Fig. 1.

the glass. For the side pontoons I use one lay of regular (3 oz) cloth followed by one layer of deck cloth (1 oz). This latter is really a weight saving proceedure, it takes much less resin to then get a flossy finish. For the centre pontoon, first two layers of 3 oz cloth.

To mount the wooden posts shown in Figs. 1 and 2 first drill the bolt holes by thrusting a pointed rod through the structure and then excavate the post holes in line with the bolt holes with a kitchen carving knife, and long handled spoon. Naturally reinforce these cuts in the glass surace with 3 or 4 extra patches of cloth, and likewise the collision points at bow and stern.

Some comments and warnings are in order here. The strength of such a structure really resides in its skin (the glass) like a stressed skin aircraft (or tyre) and is primarily against tension, compressive forces are borne primarily by the foam. Practically, this means one can be a little sloppy about "welding" or "mortaring" the styrofoam blocks together. If there are voids, well the foam is all voids anyhow, it only has to hold together till you get the glass on.



Sometimes, not always, the styrofoam billets are cast with strains (the surface is under compression, the internal parts under tension. When the structure is carved with hot wire, these strains are relieved, and the structure warps badly in an hour or two. This can be very exasperating. Cut the warped sections and reweld with urethane, or stress relieve by cuts before assembling. If you can pick your billets from the suppliers stockpile, avoid those with deeply concave ends, a sure sign of internal strains. This warping is much less of a problem with the casting method.

After the first glass coat, you may notice some hollow or soft spots. These are places where the foam has been attacked by the resin due to a thin or absent Weldwood barrier. Fill them with resin thickened with chopped glass fibres. This problem can be minimized in applying the first glass coat by working with small amounts (a paper cup full) of resin at a time with extra catalyst, so the resin sets up quickly before it has time to soften the foam.

One might ask, why not use urethane foam alone. The reason is, if you buy ten cubic feet of styrofoam, you have ten cubic feet to work with. Ten cubic feet of urethane mix (which costs more) only gives ten feet of foam under ideal conditions of high temperature in the work space, and exactly the right mix of fresh chemicals in free expansion (no mould). Appreciable departure from ideal, likely for the amateur, can easily cut the yield to one fourth the nominal value. It is important to use the urethane under as warm conditions as possible, or the variations of density and hardness with respect to the styrofoam make it hard to sand to smooth curves. This point is important in patching up the shape prior to the first glass coat. Holes and cracks less than ¼ in across can be ignored, they can be taken care of when you smooth up after the first glass coat. Bigger ones can be excavated and filled with scrap styrofoam glued in with Weldwood, in preference to filling them with urethane. Note the weight distribution of the components of the '69 centre pontoon. Of its eighty pounds, slightly over half was glue and resin, the remainder was glass and foam. A completely closed structure, which the above is, can use the compressive strength of the foam to cut the total weight, which cannot be done so easily with the conventional shell or half shell structure of a boat. I suspect this may be the reason why Piver concluded that his glass covered foam dinghy was "too heavy". (*AYRS* No. 20, p. 37).

The Deck

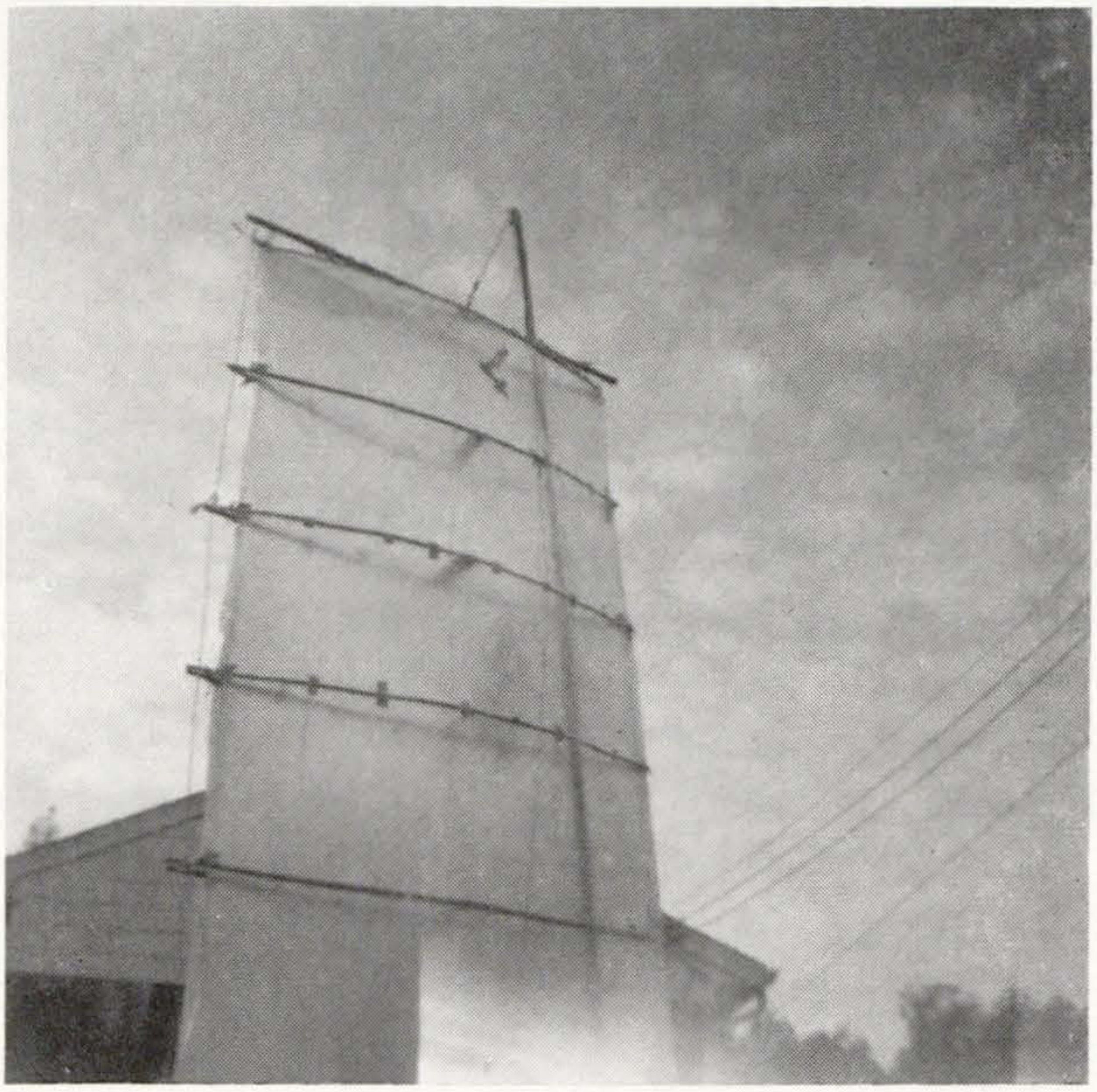
As indicated in Fig. 1 or photos, the deck consists of two parts. The forward part is a frame of nominal 2 in × 2 in fir beams, doubled and spaced on inner half. To this the two panels of ¼ in exterior plywood are bolted. The two lee boards are pivoted to this frame, and swing across the open cockpit. This deck section carries almost all the stress of both mast and leeboards. The mast (or mast socket) is stayed by six cables to a height of 3 ft. The rear deck section is simply two planks which serve as seats. The two rudders are mounted not at the stern but on a cross beam about 4 ft aft of the forward deck section.

The Rig

Due to the absence of high stays, a somewhat stiffer mast than normal was required. I used a 15 ft length of 2 in diameter 1/16 in wall aluminium tube (a piece of an amateur radio antenna mast). This was extended telescopically via a pulley and rope, with 10 ft of wooden clothes closet pole (fir) covered with fibre glass. This was more than ample mast, for the sails which follow. The mast was not drilled to attach the stays. Instead I used hose clamps on a seat of tyre inner tubing. No slippage whatever, and they are easily adjustable for height.

The Sail

The sail consisted of polyethylene film (0.004 in gauge) stretched around ten symmetric airfoil ribs of bamboo, as shown in Fig. 3, and photo (partly

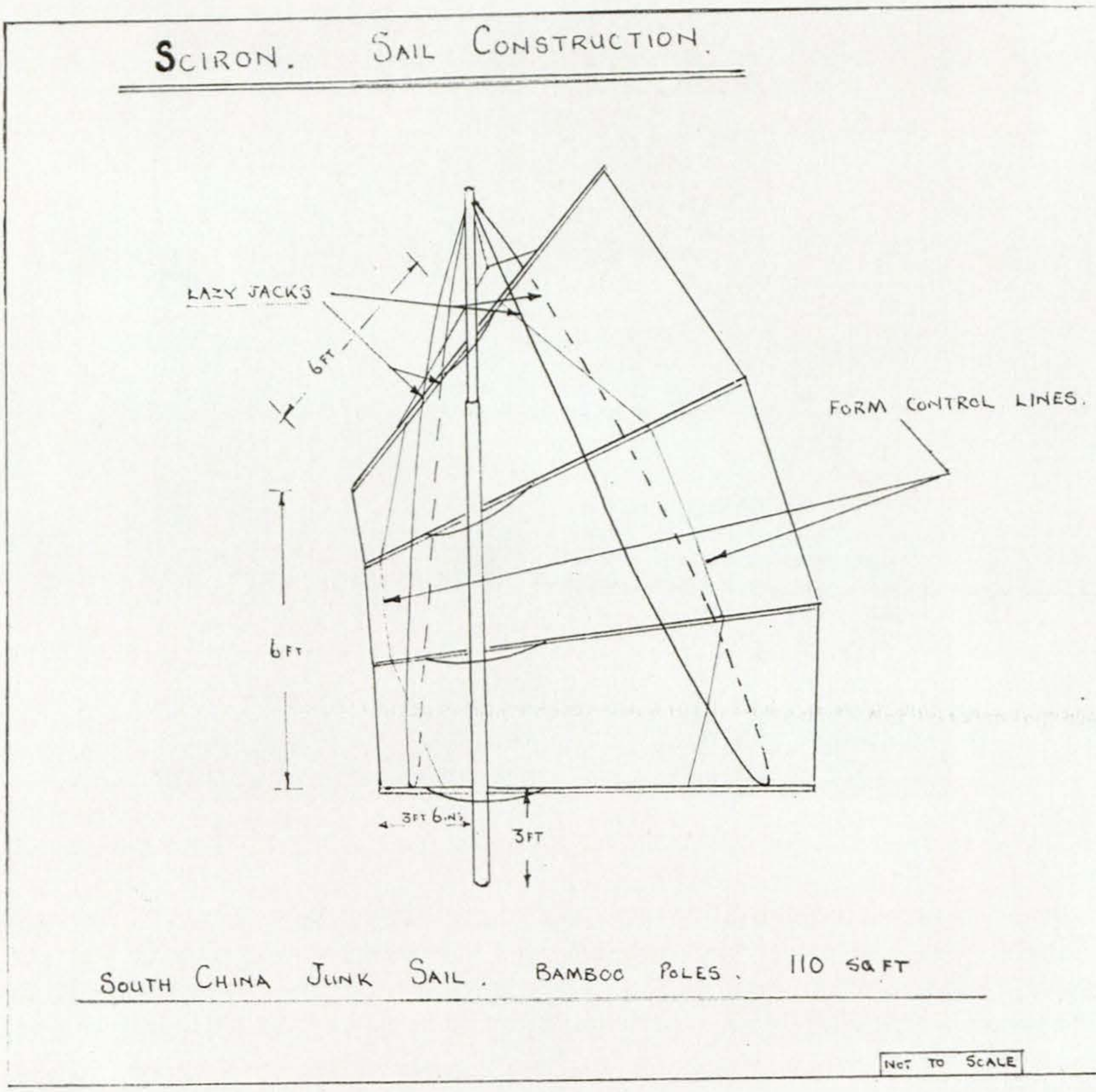


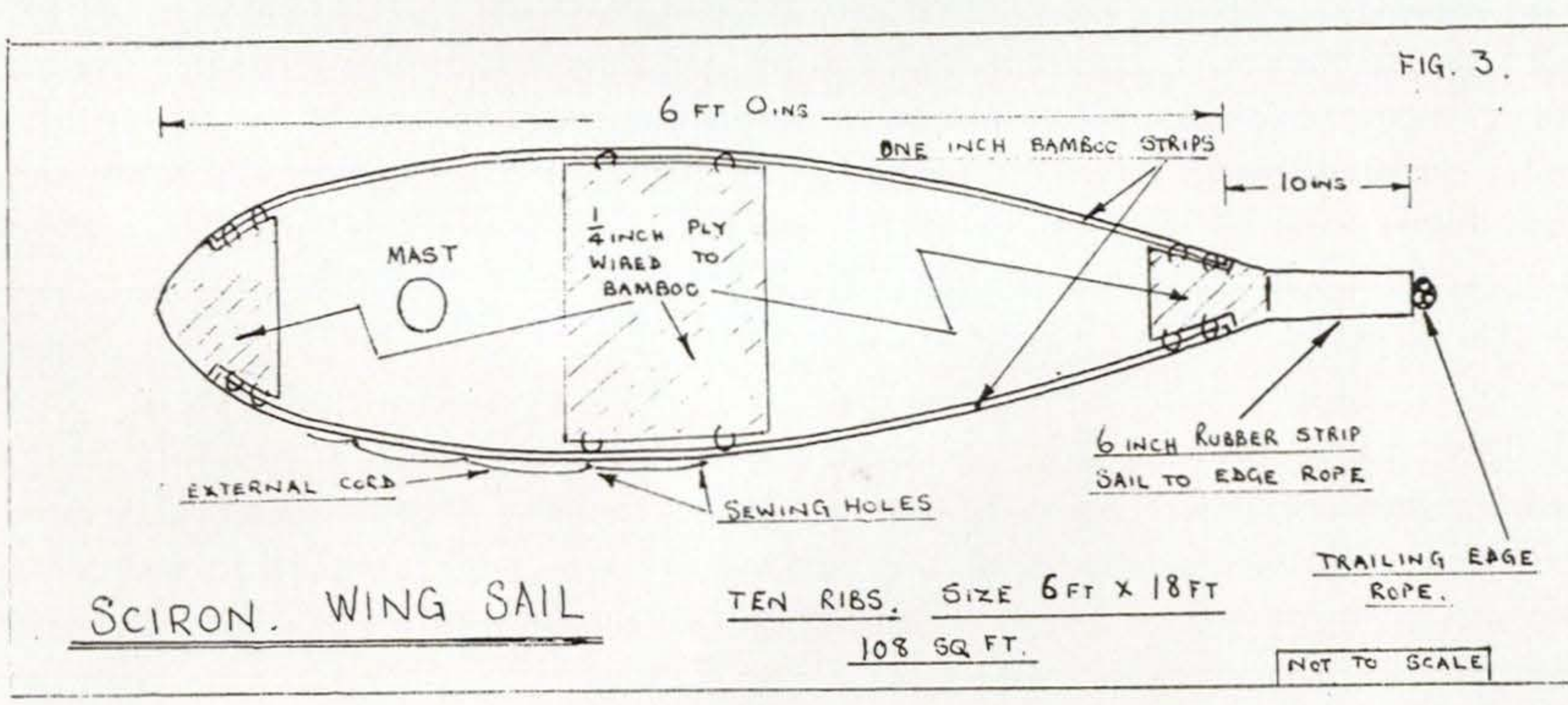
Polyethylene two-sided symmetric airfoil. Halyards and topping lifts are inside the sail

reefed). Since this material can, but only with difficulty be joined by heating, a single sheet was folded around the wing form and joined to a line at the trailing edge, not directly, but through the intermediary of 6 in strips of rubber (tyre inner tube), so that it could be held in a state of tension, which was adjustable. The leading edge also had a liner of film to diminish chafing. The film was "sewn" to the ribs at 1 ft intervals through holes (reinforced with cloth backed "Mystic" sticky tape, so that either the rib, or external cord, supported the film, depending on the direction of the wind on the sail. This sail, with the mast inside it was raised by placing it in the collapsed state over one of the posts on the centre pontoon. The mast was then socketed on this, the still collapsed sail bundle lifted, and the stays fastened to the mast.

I also made a simple South China junk sail, composed of four 12 foot bamboo poles obtained from the local rug merchant, Fig. 3. It was fabricated also of polyethylene (two layers) in a similar fashion. Both these sails were supported by lazy jacks, so that quick reefing was accomplished by lowering the sail an appropriate amount, and preferably also, tying the reefed portion in a bundle.

A number of observers have questioned the suitability of this material for a sail, despite its cost (1 cent per sq ft) so it might be well to comment on this. This material, when not embrittled by much exposure to sunlight, stretches plastically (with some slow recovery) perhaps 50% of its length before rupture, and hence even a tear extends itself with difficulty. In using it for a sail one has to make a sharp distinction between full length flexible *battens*, whose purpose is to ensure a continuous *smooth* surface, and *ribs* which a,ctually carry sail force and transmit it to the mast. A sail (mathe-





matically a "membrane") transmits all of the forces on it to the "boundaries" (leech, boom, mast). It is here at these "exterior" points that the stress on its material is an extremum. This is precisely why sails are reinforced at the edges and especially the corners. Ribs (as opposed to battens) act as boundary points, and cut down on the maximum stress the sail material must endure. The aerodynamic price for this is that there must be a ridge or flat groove along the rib for the wind force to be carried by the rib. Ten ribs

Wingsail furled. Note most staying

cut; roughly to one half, the maximum stress the sail material must endure without them. (The total length of "boundary" and or the wing sail with ribs, is approximately doubled). This state of affairs, plus the ability of the polyethylene to yield plastically and distribute or spread out the concentrations of stress without tearing, accounts for the fact that these sails held up as well as they did.

Much the same phenomenon, on a microscopic scale, accounts for the remarkable properties of fibreglass construction. Glass alone, or resin alone, would make rather poor materials for a hull. Together they are superlative.

Actually these sails, when they tore under wind stress, only give short tears around the sewing holes. These were easily mended with tape. I have just learned there exists a polyethylene film with embedded nylon net (scrim), for farm use, hay covering etc., this sounds interesting. Mfg. by Griffolyn Co. Houston, Texas, U.S.A.

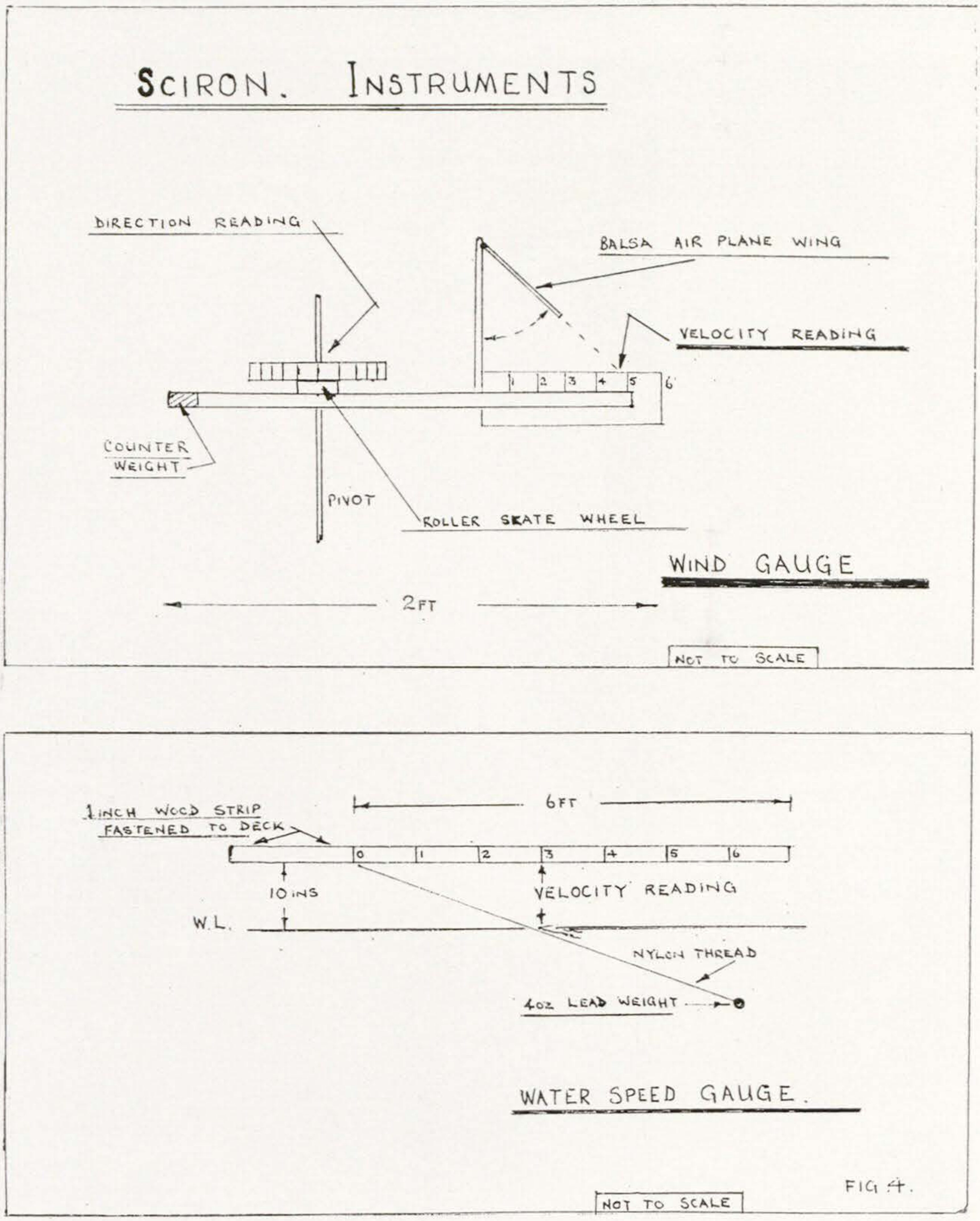
Instruments

Two simple instruments which helped considerably in getting the most out of this (especially in light airs) rig are shown in Fig. 4. The wind indicator was simply a roller skate wheel, with dial formed of a coffee can lid and scale of tape marked in 10 degree intervals. Speed was indicated by the hanging balsa toy air plane wing. Actually the speed reading increases as the square of the wind speed, with no weight on it, it goes off scale at about five knots. It was mounted at the bow about three feet above the water surface, and by sighting by the mast to its pivot down the centreline of the boat, one could read the bearing angle of the relative wind directly. By the course theorem (ignoring leeway) the cotangent of this angle measures the lift drag characteristic (combined) of both water and air foil and total drag systems. I find it much easier on the neck to sail by such a wind gauge, than by watching the luff, or a mast head fly. It is simply a stick, a weight and a thread.

The water speed indicator is also shown in Fig. 4. Its reading also increased as the square of speed and went off scale at about three knots. Both these speed indicators could be calibrated, but were used primarily as better-worse, more or less, indicators.

Some General Comments on Operations

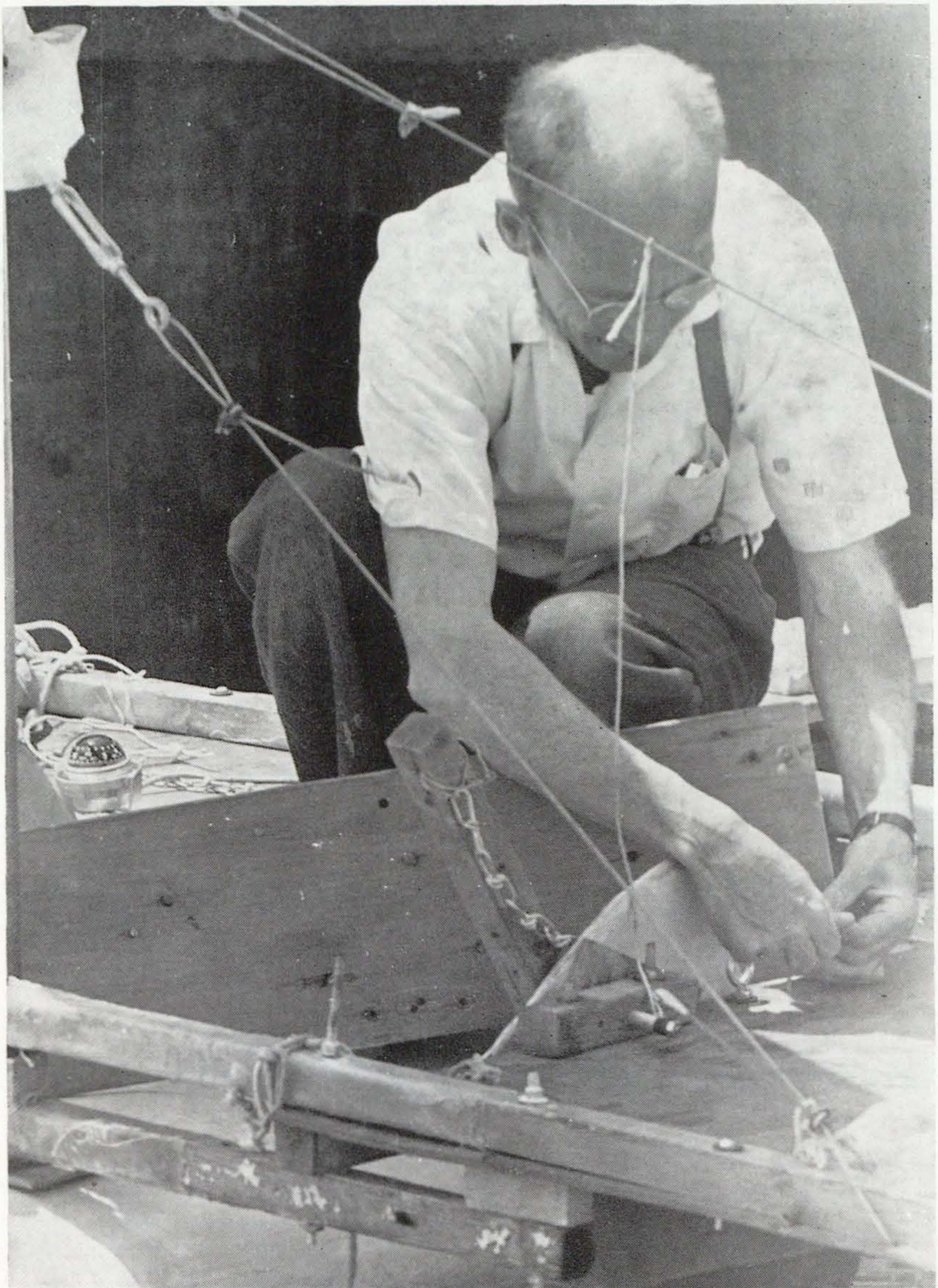
Examination of the figures and table will show that both '68 and '69 trimarans were literally three log rafts. There is no place for water to accumulate on board. They differ primarily in that '68 had side floats with individual buoyancy marginally greater than the total weight: '69 considerably less so. The sails and deck were common to both. '68 had noticeably deeper and narrower centre and side floats than '69 which was deliberately made flatter for ease in coming about. So '69 could be (and was) knocked down without capsizing (180 degree turn), but '68 could not. '69 could be and was rightable by one man. What happens with '68 if wind and sea rises indefinitely, to the point that something has to give, I don't know. But something surely must give sooner or later.



Based on my limited experience (Potomac River and Chesapeake Bay only) I believe I prefer *for extreme conditions* the non submerging ('68) to the submerging side floats ('69). Enough wind and water together can knock down, capsize or break-up anything. I don't know what the final answer to trimaran designs for extreme conditions is. (But note the problem at the end).

Some Comments on the Wing Sail

The wing sail described above could also be called a two-sided North China junk sail. Balance is achieved by swinging the sail and/or leeboards fore and aft. It is also convenient to swing forward when coming about, or to achieve a balance on a run. With the exception noted below, it had very little twist



Adjusting the leeboard

for the following reason. The centre of pressure of a symmetric airfoil (unstalled) is one forth of the chord back from the leading edge. As the photo shows the mast actually was about at the one fifth chord position. So the sail was nearly balanced without torque, and when pulled down hard there was only a few degrees of twist. The mast would bend a little but the sail stayed straight.

Despite all these elegant properties when unstalled in light to moderate breezes, there were some real problems. This is surely not the last word in wing sails. Operating with the mast close to the one fourth chord balance point also means operating close to the point of instability. When the sail stalled it stalled all over and was thrown into rotary oscillation. At zero incidence in a hard wind, it did not feather, but flapped, buckled, and bulged out of shape in a most alarming manner. It was not, as designed, a "rigid stressed-skin structure". This perverse behaviour could be somewhat curtailed by pulling down hard.

I have several times jibed while running in which the lower half of the sail comes over, but the upper half does not. The sail lifts and twists in its length through almost 180 degrees. One can twist the sail back by hand if the wind is say less than ten knots but it's an awkward situation in a strong wind. The moral is reef sooner and keep it pulled down hard.

I would like to be able to report at least a comparable if not superior performance with boats of comparable dimensions. Unfortunately this is not the case, at least for windward performance. Here I was regularly overtaken, nor could I sail as close to the wind. On a reach or run there was little to choose between us. Some figures will illustrate. The angle for best windward performance, as given by the bearing of the relative wind, was 45 degrees off the bow. This corresponded at the same time to one half the compass reading between tacks, of 60 degrees off the true wind. These are quite mediocre figures. Catamarans easily outsailed me on all points of the compass. However I occasionally had the smug satisfaction of seeing boats which passed me on the way out, when the wind rose, being towed back home dismasted or swamped.

I have used the '68 model primarily for day sailing on the Potomac, with the wing sail. It is here I got my thunderstorm rides. Note that this river, near Washington, is only a mile or so wide. The '69 model with both wing and junk sail was also used here, and also for cruises of a week's duration down the Potomac and also on Chesapeake bay, starting from Annapolis. I used the junk sail only for these cruises, it's easier to manage than the wing sail. I slept usually on the beach or if the water was calm, on board. '68 certainly gave a wetter ride than '69, it lifted much less to the wave motion. With '69, I crossed Chesapeake bay, in a 20 knot wind, once on a run and once on a close reach. I was pleasantly astonished the way '69 lifted and let most of the waves pass under the deck despite the fact the deck was only 10 inches above the waterline.

A Problem

According to John Morwood after his visit to the U.S., if you have problems you have status. Obviously I've got lots of little problems and very little status, either as yachtsman or designer. But I think I can suggest a problem that would give the AYRS big status.

A sailboat is just a device for exchanging momentum between the air and the sea. In return for this transaction the vehicle and its crew extract a little brokerage for themselves and sail off under control. As the wind rises, the broker's fee increases, the boat goes faster up to a point. At fifty knots there is such an embarrassment of riches (momentum), that the big problem is to stay comfortably alive. Speaking as a professional physicist (not as a very ignorant and very amateur yachtsman) I feel obliged to contend that *this* approach is patently ridiculous! The problem should be turned around. Instead of the vehicle's performance being an optimum below 30 knots, and barely operable above, it should be optimal above and just operable below. Very little calculation or experience is needed to show that there is plenty of momentum around, at wind speeds greater than thirty knots, to either lift the boat above or send it swiftly below the surface of the sea. We should use this momentum not try to fight it. *SO,* I throw it out as a challenge to the assembled ingenuity of the AYRS. Devise a wind-water powered vehicle (I hesitate to call it a sailboat) which while operable at lower wind speeds achieves an increasingly optimal performance at thirty knots and higher.

Optimal performance means quantitatively, maximum speed made good to windward; maximum ratio of vehicle to wind speed or some reasonable combination of these two criteria. A few comments will suggest some lines of thought. Floating at the air-water interface is at the root of most sail boat's problems in a high wind.

So get out of that interface up or down. If up, one can imagine a V winged glider, towing a small keel and negative lift hydrofoil (modified dynamic soaring a 1a albatross). A sea anchor would be more appropriate if you just want to imitate dynamic soaring. Going down, one can imagine a scuba diver in a streamlined pod carrying a pole with a sail and other control foils at one end, and a keel and other control devices at the other. I think an Englishman once crossed the channel this way, in a rubber suit. He lay on his back, a small mast and sail tied to this feet and a paddle under his arm. About 1880.

If there are waves he feathers the upper and lower to take advantage of varying wind and water motions. We should not exclude the use of auxiliary power sources. Sail boats and gliders sometimes have them and we all use a paddle at times. There is room in this problem for expertise in automatic controls, computers and hydrofoils, not to mention meteorology, oceanography and aeronautics.

This I contend is an appropriate problem for the AYRS to consider. A real status bringer. Give it your best and tell Dr. Morwood and the rest of us how to do it, or better yet, how it was done.

	SCIRON 1968		SCIRON 1969	
	Main Hull	Floats	Main Hull	Floats
L.O.A.:	18 ft 6 ins	16 ft 0 ins	16 ft 0 ins	8 ft 6 ins
Weight:	90 lbs	40 lbs	80 lbs	12 lbs
Buoyancy	900 lbs	350 lbs	1200 lbs	150 lbs

Beam O.A.: 8 ft 0 ins		8 ft 0 ins
Leeboards: Total area 4 sq ft.		Length: 2 ft 6 ins.
Forward deck and leeboards: 109 lbs.		Aft Deck and rudders: 35 lbs.
Mast: 12 lbs.	Wing Sail: 11 lbs, 108 sq ft.	Junk Sail: 13 lbs, 110 sq ft.
Total weight: *SCIRON* '68 337 lbs		*SCIRON* '69 271 lbs

STABILITY OF MULTIHULLS

by M. F. Gunning, M.R.I.N.A.,

Little Hawsted, Steep, Petersfield, Hants.

"Stability" may be defined as the moment which tends to return a boat to the upright position after it has been heeled over. Its numerical value is (see Fig. 1) the arm of stability (GF') multiplied by the weight of the boat. A "normal" curve of stability, ie one for a ballasted yacht will look something like Fig. 2. It climbs rather slowly to it's maximum value and remains positive far beyond 90°.

A critical point in the curve of stability is the angle at which the maximum moment occurs. Once this is reached the yacht is liable to be pushed over further. It is true that the area of the sails, as projected at right angles to the wind, diminishes with large angles, but one should not put too much faith in this phenomenon; most boats will heel more when sailing close hauled (ie with a small projected sail area) than with the wind abeam. So, once the angle of maximum stability is passed, a yacht is liable to go further. A further concept used by the naval architect is the "dynamic stability". This is the energy required to heel a boat to a certain angle, and is represented by the shaded area in Fig. 2. This area is the sum of an (infinite) number of (infinitely) small rectangles, each representing the moment at a certain angle of heel multiplied by a small increment of this angle of heel.

Let us now try and draw a curve of stability for a catamaran. It is obvious that the curve will climb steeply until the weather hull emerges, and then curve down, more or less like a sinoid, and become zero at roughly 90°. Then the curve continues, so that the curve between 90° and 180° is somewhat like the inverted image of the curve between 0° and 90°. In other words, at 180° we find again the great stability of the cat at 0°, only now working the wrong way round, keeping the vessel capsized, instead of turning it upright.

Another factor in which the cat differs basically from the keelboat is the dynamic stability. It is quite obvious that the shaded area in Fig. 3 is much smaller than that in Fig. 2. This means, that the cat can absorb but little energy before it turns over, and takes but little time to do so. It can be whipped over quickly, whereas a keelboat will only be forced over slowly. The difference is something like that between cast iron and mild steel. One will stand up rightly, and then crack; the other will bend, yield, but it will not break.

Basically the multihull is dependent for it's safety on the alertness of the skipper. A capable skipper will be able to deal with almost any situation, but if his attention is diverted, even for a second or so, disaster may strike

FIG 1

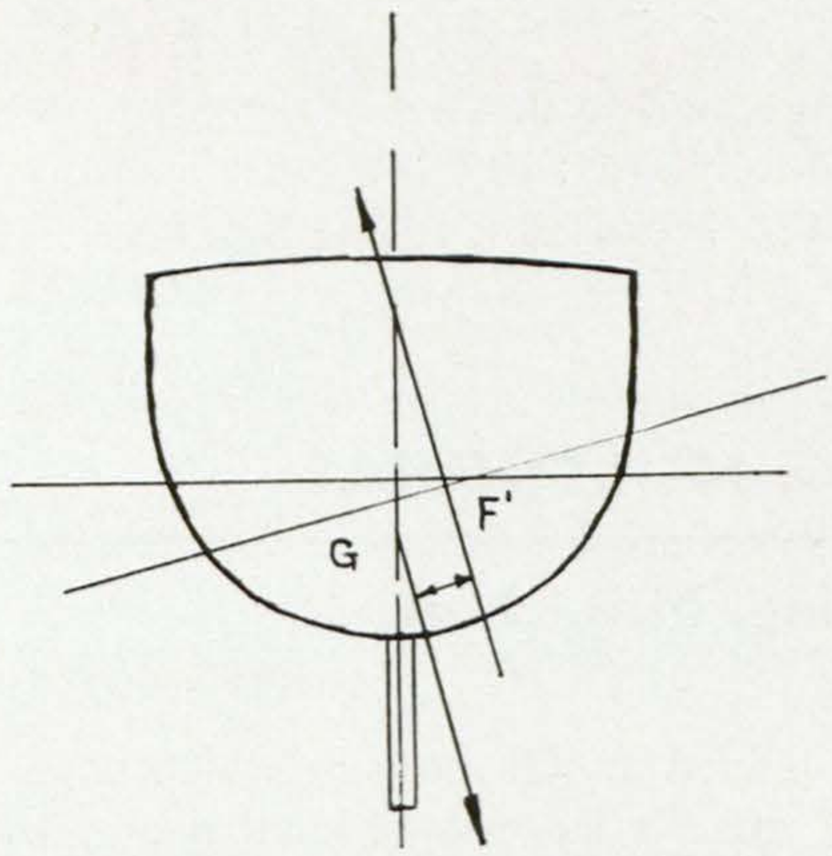


FIG 2.

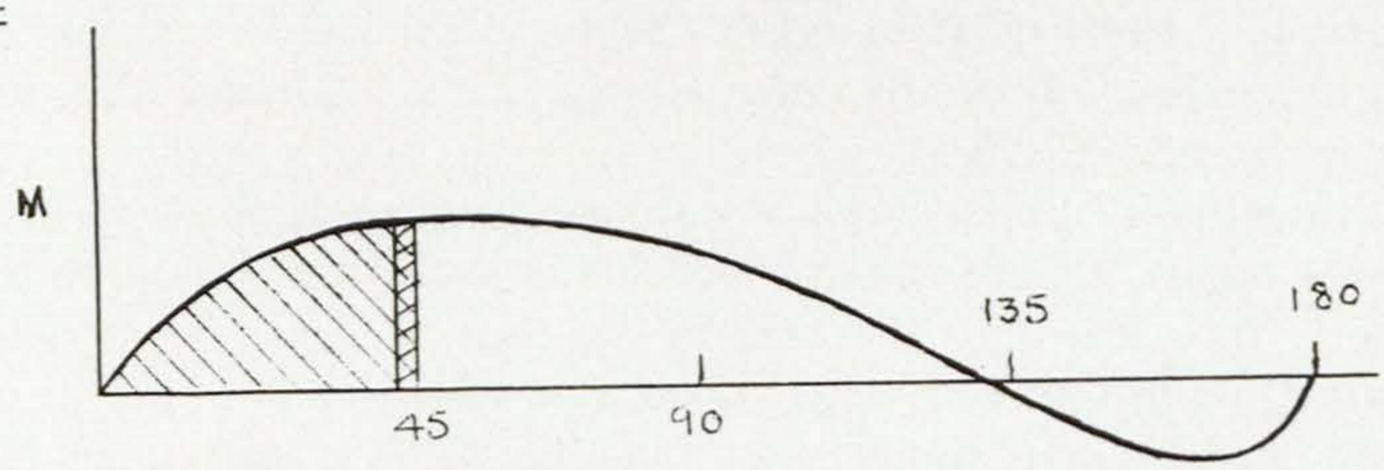


FIG 3.

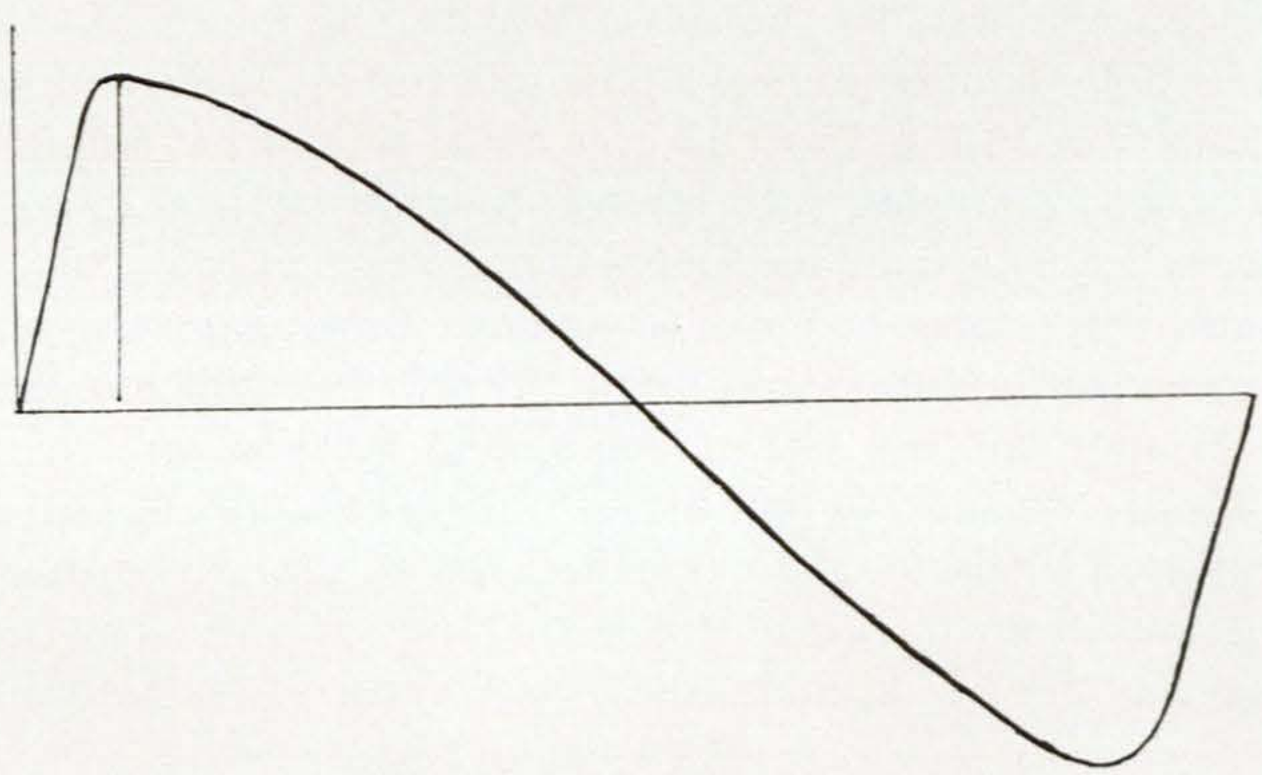
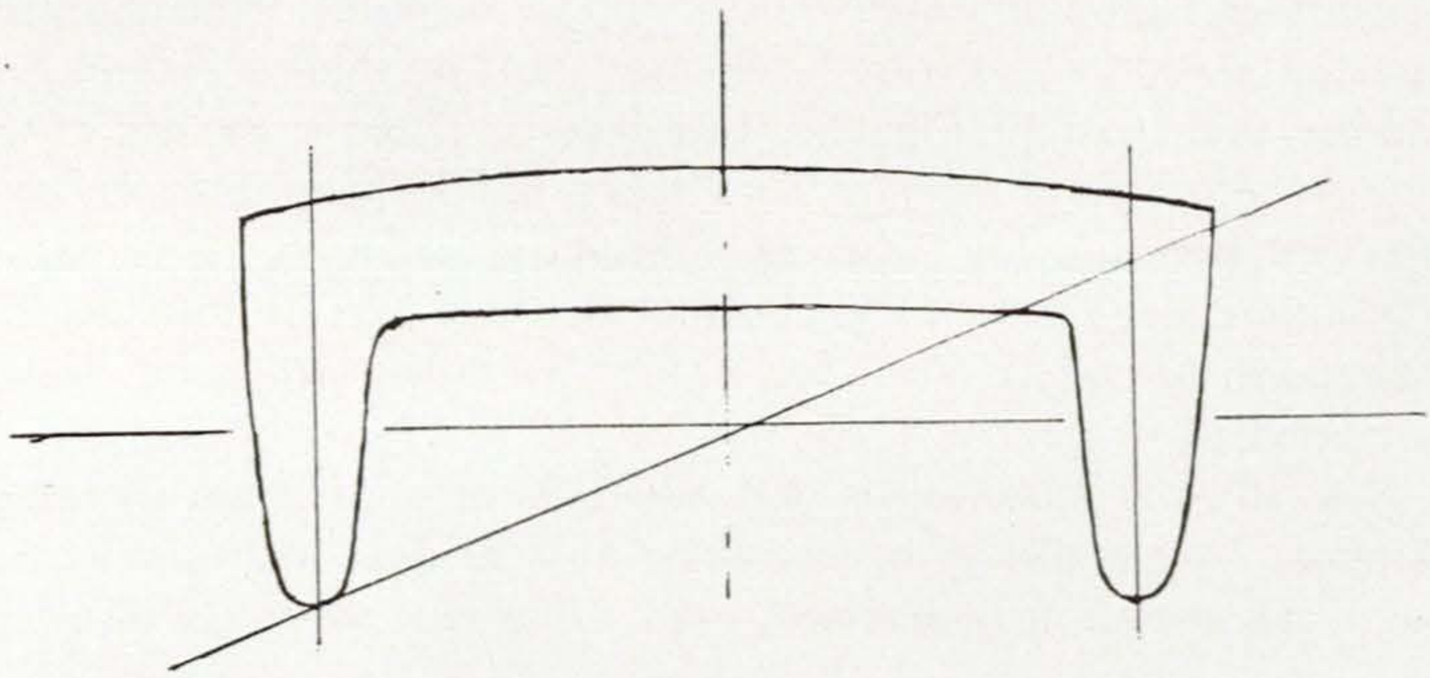


FIG 4.



in the form of an unexpected squall. And who of us can honestly swear, that we have never been caught napping? And if so, there is no pardon, no minute's grace. The cat will turn turtle, and stay there, as is borne out by it's curve of stability. And there are numerous instances on record that this can happen, even to a cruising catamaran in sheltered water. But many keelboats have been knocked down flat, even beyond 90°, have even been rolled right over, and yet have come up straight, perhaps minus a mast, a deckhouse, or what have you, but still capable of carrying on the fight.

What can be done to make a catamaran more safe? One obvious way is to increase the weight of the craft. This weight should preferably take the form of heavier construction. Catamarans are subject to large, and as yet unpredictable forces, so make them strong. Whether the weight is high or low makes little difference at the small angle of heel at which the cat should be kept. And no one will be greatly interested whether the final capsize occurs at, say, 83° or 87°.

A much better way is to try and shift the point of maximum stability to larger angles of heel, and so increase the amount of energy that can be absorbed before the point of maximum stabiltiy is reached. This can be done by giving the hulls deep and narrow sections (see Fig. 4). It will be seen that the geometry so developed is exactly that of *REHU MOANA*, perhaps not a very fast cat, but certainly, for her size, one of the safest afloat.

As regards trimarans, in general the same argument applies. There is, however, an important difference: by placing the floats HIGH (cf *TORIA*) we can shift the point of maximum stability to appreciably higher angles. All this, however, remains improvement in detail. The basic weakness of the multihull, as described above, remains. It is an exciting racing machine, a fast comfortable cruiser, suitable for coastal waters and short passages, provided the skipper is made fully aware of the dangers inherent in his craft; and not lulled to sleep by sales talk about people who got away with it. But I feel, that a multihull should not be allowed to participate in single handed ocean races. The skipper MUST eat, navigate, and above all, sleep, and then disaster may strike. It may take the shape of a sudden squall, a rogue sea, or what not. A well found yacht will survive, like *GYPSY MOTH* in the Tasman Sea. A multihull may not.

THE TROUBLE WITH TRI'S

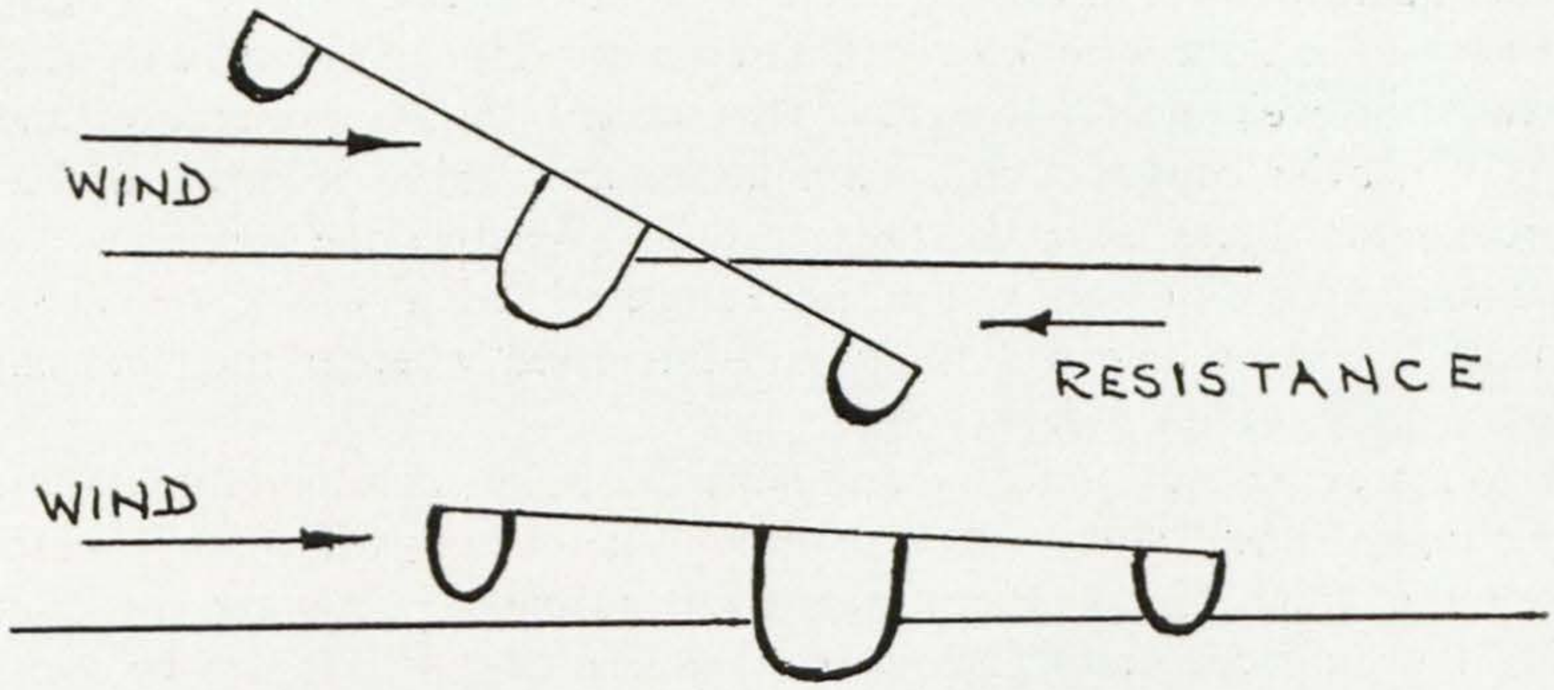
by Leonard L. Tiemann 6 Hillside Drive, Malvern, Pa. 19355, U.S.A.

I write these words with mixed emotions. It is my hope that by expressing my thoughts, reasoning and conclusions I can cause others to do likewise. I further hope that any ensuing discussion will cause a re-examination of motives, prejudices, biases, foredrawn conclusions that we are all so susceptible to.

I have been a multihull sailing enthusiast for about nine years and I have been particularly enamored with trimarans for about the last five years. However, *AYRS* No. 63 (Multihull Capsizing) and other reports in the boating press on multihull losses have caused me to re-examine the bases for my preferences and to reconsider the uses to which catamarans and trimarans *ought* to be applied.

Why the Tri?

Speaking in generalities and from my own point of view; at a given length, cats offer lower air and water resistance and are therefore faster than tris. Thus for racing purposes in all size categories, the cat is preferable to the tri Racing results over the years have provided confirmation of this



However, my own long term interests lie with extended blue-water cruising. The most "effective" boat for my pocketbook has been the tri. Sufficient space could be achieved in a tri of about 35 ft L.O.A. to permit a family of four to six to live very comfortably for long periods and the speed differential is not that important.

Recent information on the reasons for multihull capsizings has tended to reduce the usefulness of the available space that the tri provides. This information indicates that wind pressure acting on the underside of the wing joining the float to the main hull (either at rest or while underway) can produce a sideways capsize. The way to reduce the possibility of capsize from beam winds is to ventilate the wing and instead of using a solid surface to use netting or if the design permits, nothing. Following this concept greatly reduces the deckspace that is available to "house" over. It virtually precludes use of the floats for anything but storage space. Cruising cats appear to be inherently less likely to capsize from beam winds than cruising tris because they are unlikely to fly a hull and even if they were to do so, the wind force would tend to produce side slip. But, they are certainly not completely free of that eventuality. The tri differs from the cat in this respect due to its float which does not provide sufficient buoyancy to float the entire displacement. Rotation occurs about the main hull, and once the float is sufficiently depressed it acts to resist sideslip and capsize may then occur.

Still continuing to be an optimist, the tri seems to offer advantages over the cat in sizes up to about 35 feet L.O.A. because of the size of the main hull, the fact that standing headroom can usually be achieved without too much difficulty; and because enough of the wing area can be used without inviting capsize problems to provide ample living space. In sizes of about 35 feet LOA and over, the cat can generally provide standing headroom throughout and this consideration loses significance.

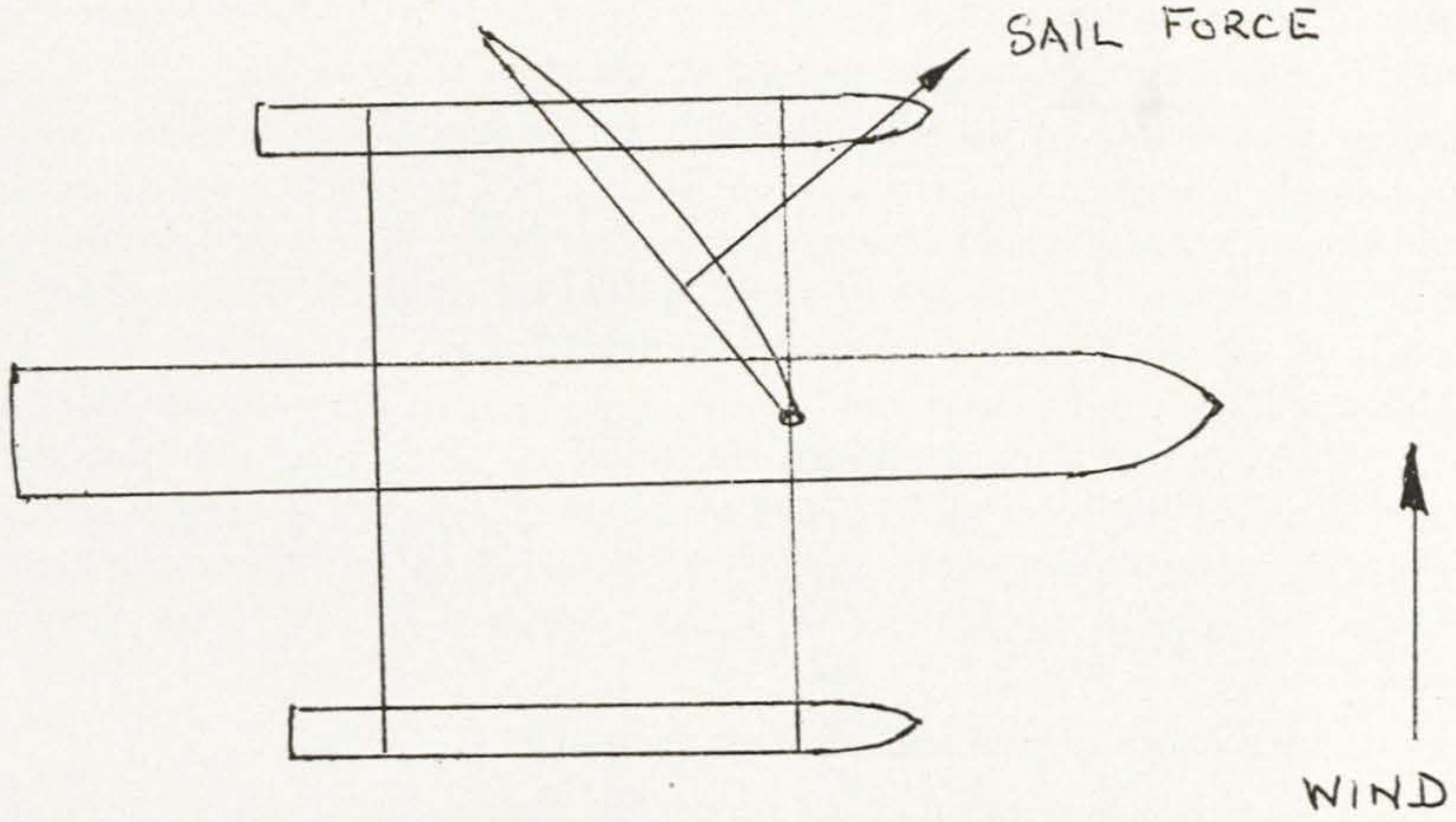
Reflection and Reconsideration

I have been forced to reconsider my appreciation of the tri as a result of the most unfortunate loss of Nicol and Piver at sea; Nicol in his own boat and Piver in a borrowed boat built to his designs. Is there something inherent in trimaran design that could have caused or contributed to the loss of these very competent designers and seamen?

I do not propose to have the answer(s) to the question I have posed. There is too little evidence to permit any direct conclusions to be reached.

However, my reflection has resulted in a personal conclusion that there is a liability which is inherent in tri design and which goes beyond the capsize problem already discussed.

On the cover of *AYRS* No. 63 is a picture of tri model at the very start of capsize. The model has only crossbeams to the floats with *no wing structure*. What is causing the capsize is apparent from the following sketch:



The sail force is acting across the bow of the lee float. Due to the height of the C.E., an overturning torque is produced that lifts the main hull stern, rotates the whole boat about the main hull and depresses the lee hull bow. Under rough conditions with the boat moving fast, a sudden puff or peculiar wave might be sufficient to cause the bow of the lee hull to bury. Once this occurs, the boat could capsize over the lee bow with or without the occurrence of major structural damage. The bow of the lee hull could also be crushed due to static and dynamic pressure effects.

The cat, on contrast, does not suffer from this liability at least in the cruising hull designs. Either of the cat hulls has enough initial with added reserve buoyancy to float the entire displacement. Thus, although the lee hull can be depressed somewhat it is unlikely to be driven to the point where the bow is buried and a lee bow capsize can occur.

Could the tri be designed to reduce or eliminate this problem? The following design features could act to delay the point at which a diagonal capsize would occur:

Float bows even with main hull bow

Fuller forward float sections

Dynamic lifting from float sections or foils

Only one design feature could be used to avoid the problem:

Float size sufficient to float entire displacement

This last item followed to its logical conclusions would result in a three hulled catamaran. Obviously, a cat needs only two hulls. The third hull of this three hulled catamaran would be "excess baggage" that would seriously detract from performance and probably would reduce safety by lowering the responsiveness of the boat.

Of course, care and caution can greatly reduce the likelihood of this sort of capsize. But, I still consider it to be of sufficient possibility not to take the risk.

How Now the Tri?

It is with regret that I drop the tri from consideration as my ideal blue-water boat. Does that mean that I would never own a tri? No. I feel that under the right conditions a tri can be an excellent cruising boat.

Areas with protected waters where storms are unlikely to provide "bad" sea conditions and coastal areas where shelter can be reached safely at the approach of a storm would offer ideal areas for tris. However, I would not go on an extended sea voyage in a tri. I also feel that those who promote the tri for this purpose may cause unnecessary losses. Those who race tris under open sea conditions should understand the possible consequences of their actions not only to themselves but also to others who may conclude that if a tri can be successfully raced at sea, then a cruising version should make a most satisfactory vehicle for long range cruising. These comments can also be applied by analogy to a proa design that utilizes the float to leeward.

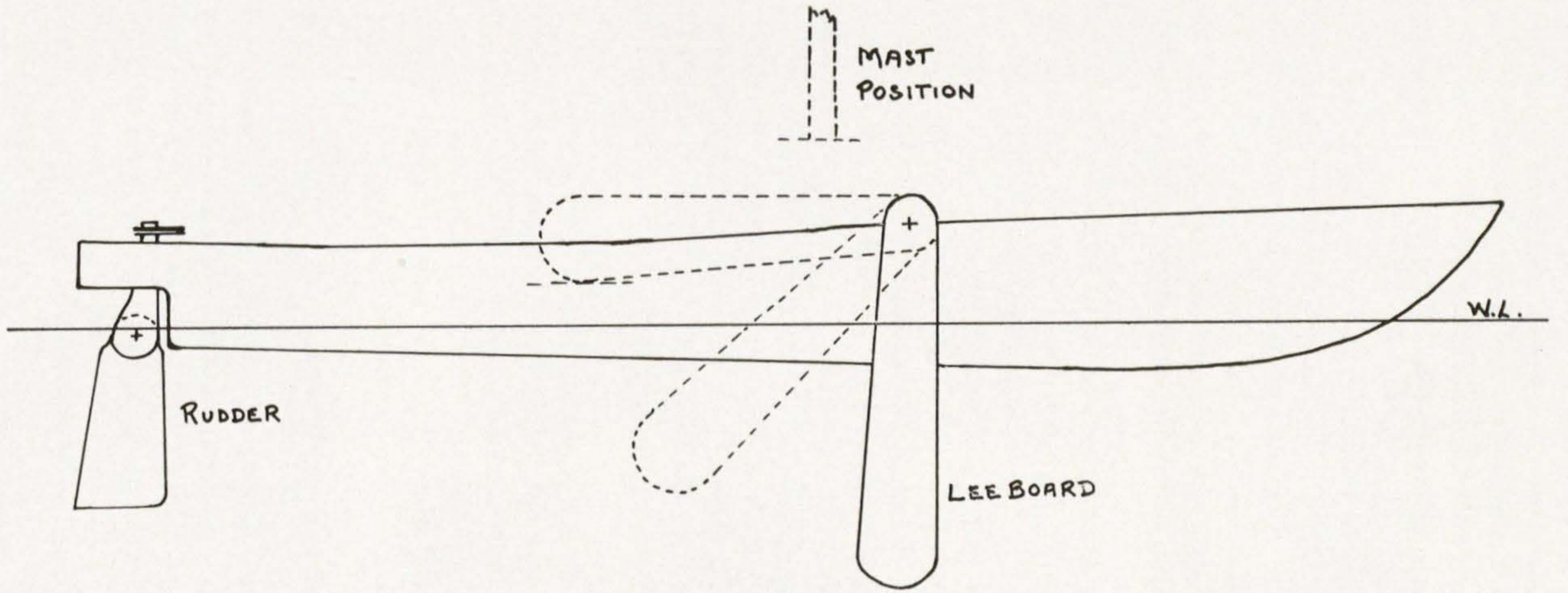
In summary then, my conclusions are as follows:

1. The tri is basically unsuited by design for general use at sea. Although it can serve admirably in protected waters
2. Design changes can be made to reduce the tri's unsuitability (and in fact have been incorporated in some designs), but these changes carried to their logical conclusion would serve to severely degrade the tri.
3. Any boat design can be capsized if its limits are exceeded. This point must be paid particular attention in multihulls which are stable right-side-up as well as up-side-down. Any boat types or design varients that are significantly more susceptible to capsize than others must be ferreted out.

PRACTICAL LEEBOARD DEVELOPMENT

by Maxwell B. Rands 218 Riddell Rd., Auckland 5, New Zealand.

A leeboard, is a pivoted board which swings down into the water from the "lee" side of a sailing boat to offer lateral resistance. The function is the



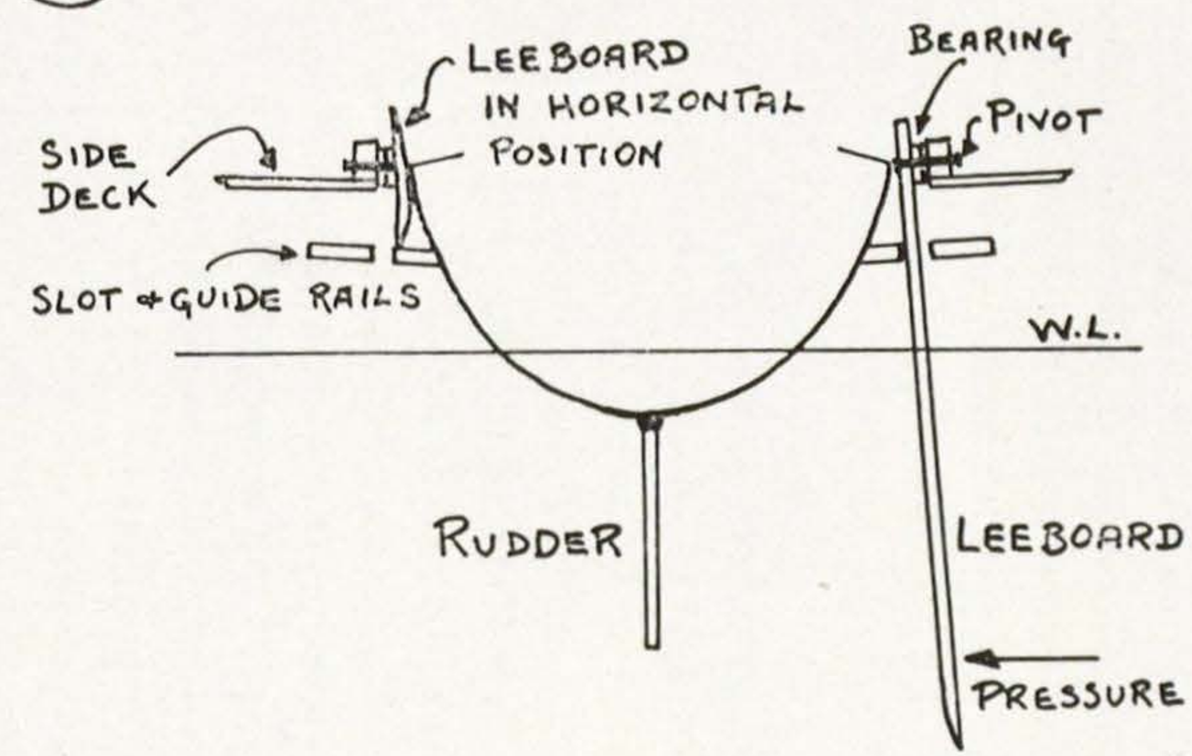


FIGURE 1

Leeboard arrangement

"Susannah"

same as that of a fixed deep keel or centre-board. Two leeboards are required, one on either wide, pivoted about midway between stem and stern, so that when tacking, the board on the leeward side may be lowered to provide the desired resistance to leeway and balance of centre of effort and centre of lateral resistance, while the windward board is raised above the water line. On going about, the raised board becomes the "lee" board and is dropped, and the other board, now on the windward side, is raised.

Fig. 1 illustrates the leeboard arrangement fitted to the centre hull of the trimaran *SUSANNAH*.

The origin of the leeboard is lost in antiquity, probably originating as a paddle held to the side of a sailing canoe. The leeboard is said to have been osbserved in the Pacific Islands by Spanish explorers who introduced the idea to Europe. Sailors, mainly in England and Holland, adopted the device to a limited extent, but credit for development must be given to the Dutch. They developed flat and round-bottomed leeboard boats suited to their shallow water conditions.

The Dutch leeboards were weighted with an iron band which also protected the edge of the board on contact with the sea bottom. When released, the end of the board remote from the pivot, would then sink to its full depth, if required. Hoisting the windward board on large boats must have been a major effort for the crew, even when assisted by a tackle of good mechanical advantage. It was probably the labour of repeating this manoeuvre frequently, especially when sailing boats became racing and pleasure yachts, that caused the decline in popularity of leeboards, the gain in convenience in tacking with a centre board being preferred to the higher efficiency of the leeboard. In the Dutch leeboard craft, hulls with the amount of tumble-home estimated to bring the board close to the vertical axis when heeling, were specially strengthened and provided with a heavy rubbing or guide rail, to take the leverage of the board against the side with the pivot bolt acting as fulcrum.

Despite the tendency to anachronism of the traditional Dutch boats, it is rather curious in the present age, familiar with powered hydro-foil craft and with a developing interest in wind powered hydrofoils, that the leeboard, which is a true foil acting in the vertical plane, has not attracted more interest in recent years. This article draws attention to the possibilities of further development when applied to modern types of unballasted craft.

Virtures and Disadvantages of the Leeboard:

Virtues:

(1) Very suitable for shallow water sailing, as not only may the operating depth of the board be varied at will, but the centre of lateral resistance may be maintained within reasonably wide limits by moving the pivot fore or aft. Furthermore, in water deep enough to take the hull only, a leeboard can still provide sufficient lateral resistance for windward sailing. Under such conditions a centre-board would be fully retracted and lateral resistance would be minimal with a round bilge hull. Fig. 2 illustrates the larger and more effective area for lateral resistance in the vertical plane of the leeboard, compared with a central plate, especially when heeling or in shallow water.

(2) Operating on the outside of the hull, no internal space is required by a centreboard casing with its attendant weaknesses and inconveniences.

(3) Ready accessibility of all parts while the boat is afloat. It is a simple matter to lift a leeboard on deck for repair or maintenance.

(4) In the event of accidental grounding with a leeboard "down", there is far less danger of damage than with some centre boards or dagger boards which cannot be retracted because of bending and jambing in the centreboard case from this or other causes.

(5) In common with centre boards, leeboards may be fully retracted for taking the ground, for sailing off the wind, and for "heaving to" in rough conditions.

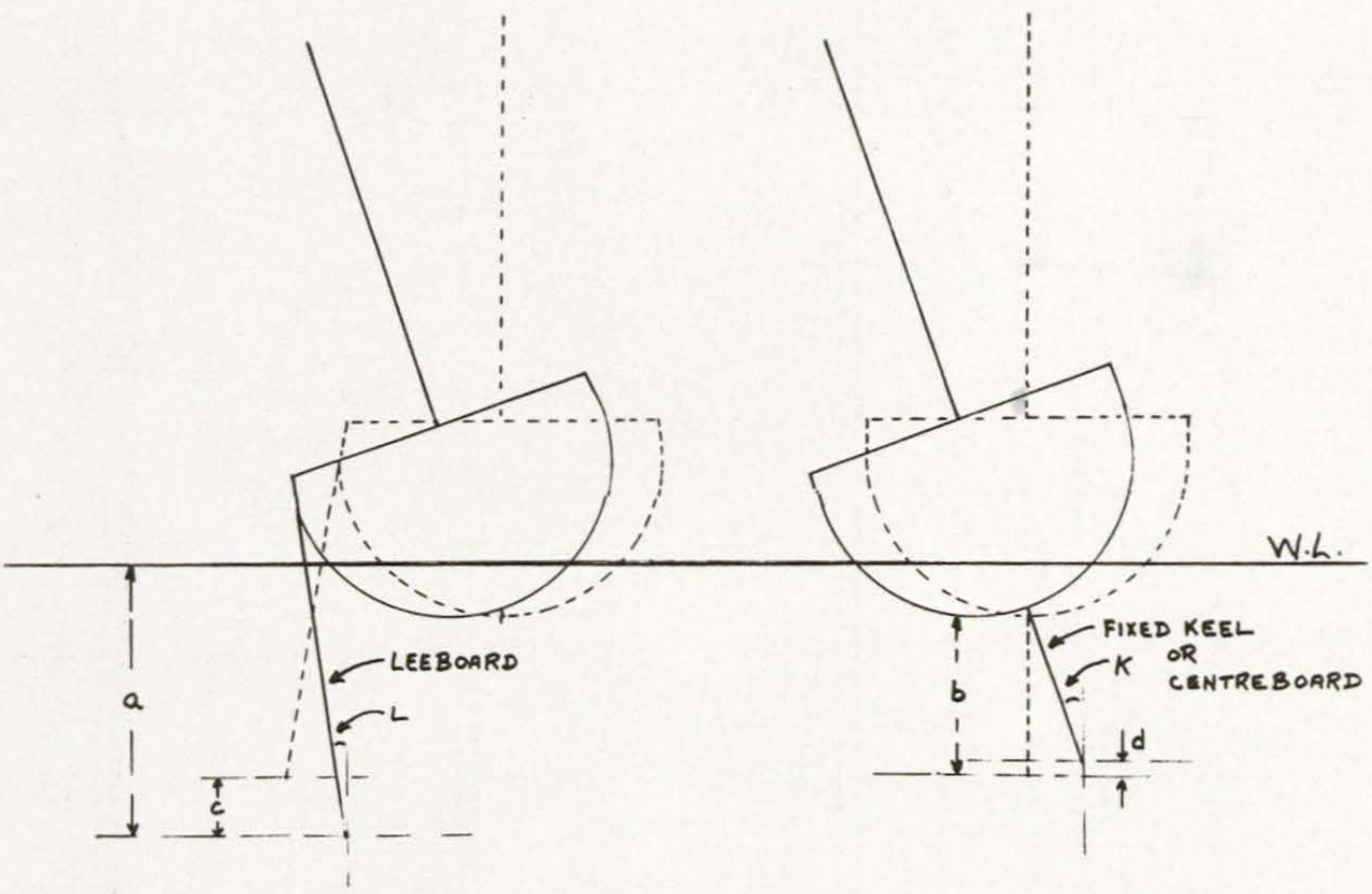


Fig. 2

(6) Because of the location of leeboards it is possible to take advantage of high aspect ratios which are found usually only in small racing craft with dagger boards. In larger boats high aspect ratios are difficult to arrange because of the length of casing which would be required for housing a pivoting centre board, and the excessively deep draft required by a fixed keel. The advantage of a high aspect leeboard over a fixed keel or centre board, may be illustrated by considering the effect of the co-efficients relating to the aspect ratios of immersed fins.

The resistance to sideways movement of such fins may be calculated from the general formula,

$$F = 0.995 \text{ (sea water)} \times C \times V_S^2 \times A.$$

When referring to asymmetric hydrofoils, "F" is usually replaced by "L" symbolying "lift" and when referring to symmetrical keels "Fs" indicates "sideforce." Similarly, CL substitutes for C for hydrofoils and is known as the "hydrodynamic lift co-efficient", while the convention for s keels, is to use C_S, the "side-force" co-efficient. 0.995 is a constant for sea-water, or 0.97, for fresh water. V_S is the boat speed, in feet per second, say, 8.45 (5 knots) in both cases, and A is the area of the foil or keel, in square ft.

If the areas of leeboard and keel are both taken as 9 sq ft, the ballasted keel or centreboard could have the dimensions 3 ft long × 3 ft deep, thus

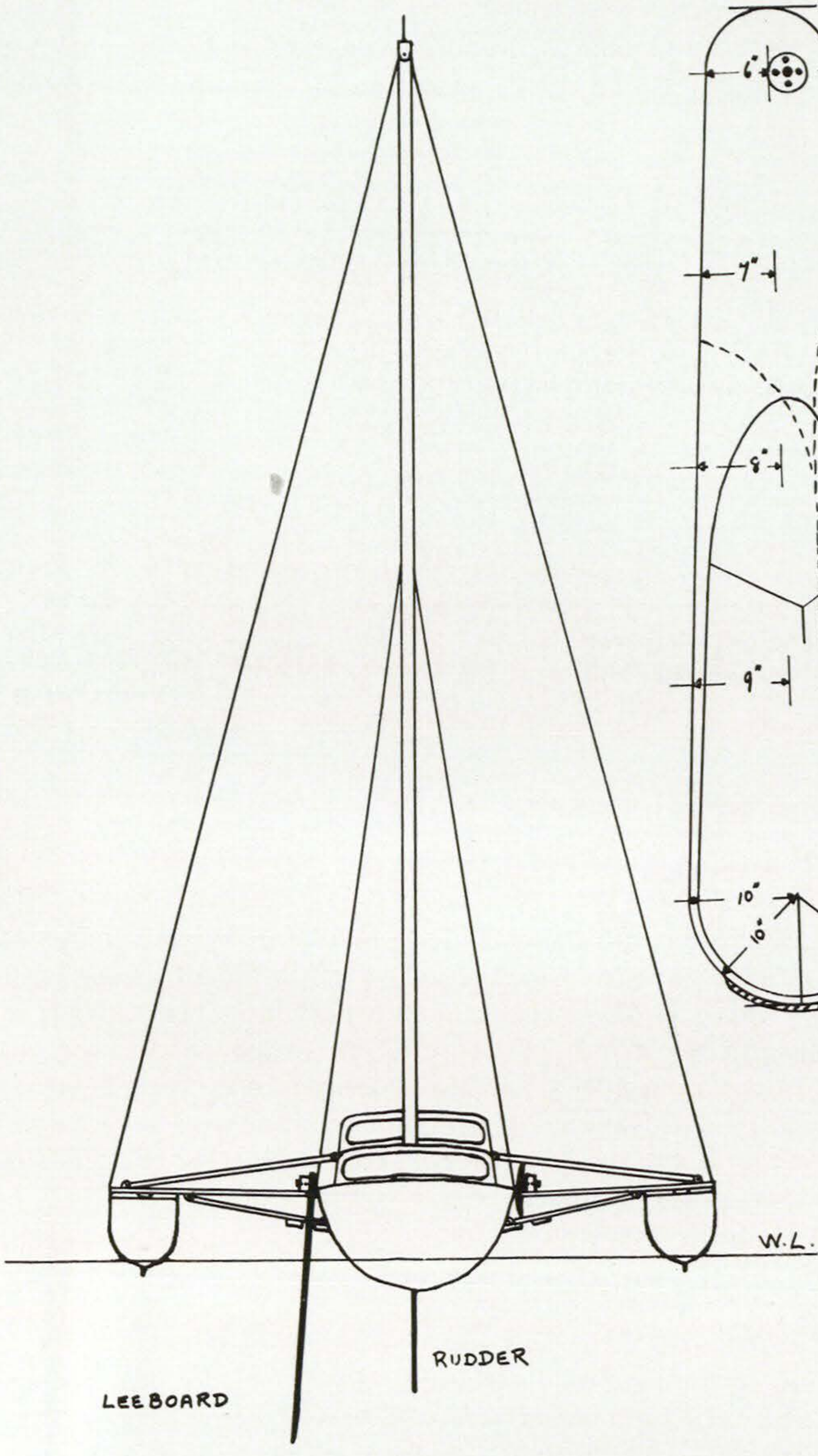


Fig. 3

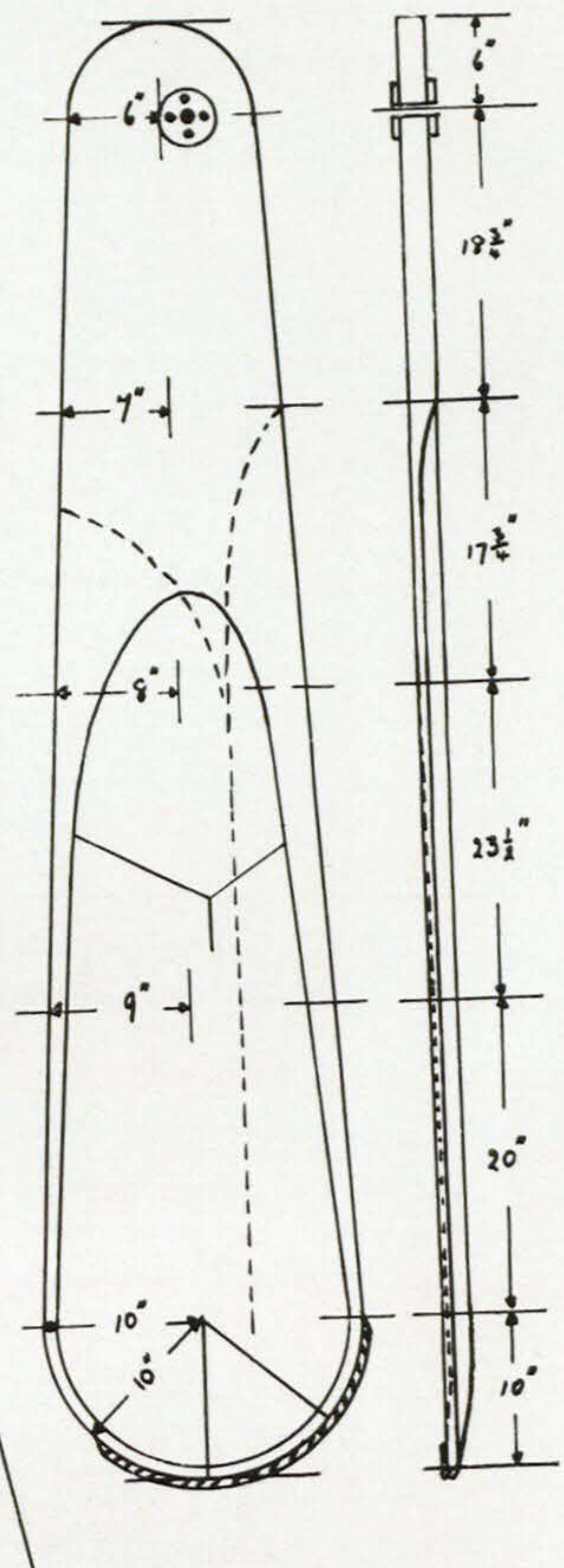


Fig. 4

having an aspect ratio of 1. If a further extreme shape of leeboard with an aspect ratio of 5 be taken, the dimensions of the immersed area could be 6 ft 9 ins × 1 ft 4 in.

C_S for an aspect ratio of 1, is 0.13

C_L for an aspect ratio of 5, is 0.4

therefore, $L = 0.995 \times 0.4 \times (8.45)^2 \times 9.$

$= 256$ lbs

and $F_S = 0.995 \times 0.13 \times (8.45)^2 \times 9$

$= 83$ lbs

The leeboard in this case is therefore about 3 times more effective than the keel in preventing leeway.

A keel of aspect ratio of 5, if it were a practical proposition on a 30 ft boat, to which the above calculations could apply, would have a C_S value of 0.3, which is three-quarters that of the foil. On the other hand, the immersed area of a modern leeboard would have an aspect ratio nearer 3 than 5 so that the L & F_S values could be closer in practice, but the point made here is, that the advantage of higher resistance to sideways motion, and incidentally less drag, resulting from high aspect fins is a more practical proposition with leeboards than with fixed keel or centre-board in larger than "sailing-dinghy" sizes of boat.

(7) In common with centre-boarders, leeboard boats may use the boards in any angle of drop from 0° to 90°. As the board is raised the centre of lateral resistance moves aft. There could be three main reasons for raising the board while under sail:

(a) with the wind aft, resistance to forward motion from the leeboard may be reduced or eliminated;

(b) if the water becomes too shallow for the full length of board, the boat may still be sailed to windward with the board partly raised;

(c) with increase of wind velocity, the partly raised board can assist in countering weather helm.

Because of the considerable movement of the centre of lateral resistance, with long, narrow boards in particular, provision was made in traditional boats, to move the leeboard pivot fore or aft to retain good balance between the sails and the lateral resistance. Various devices were used, the pivot anchorage usually sliding along a rod with holes for locating pins, or with a series of transverse slots in the capping of the bulwarks.

This alteration of pivot point was considered an important feature of leeboard boats and could not readily be done with centreboards because of the limitations of the centreboard casing.

With shallow draft, round bottomed boats, this feature allows, with an easy form of adjustment, a variety of balanced sail arrangements, and can have much the same effect as moving the mast fore or aft at will.

Disadvantages:

The main, if not the only real disadvantage of what we may call the "modern" leeboard installation to be described later, is the necessity to lower and raise boards when "going about." If a form of self-tending headsail is accepted, as could be the case of a cruising boat, operating leeboards can be a much less demanding chore than handling jib sheets.

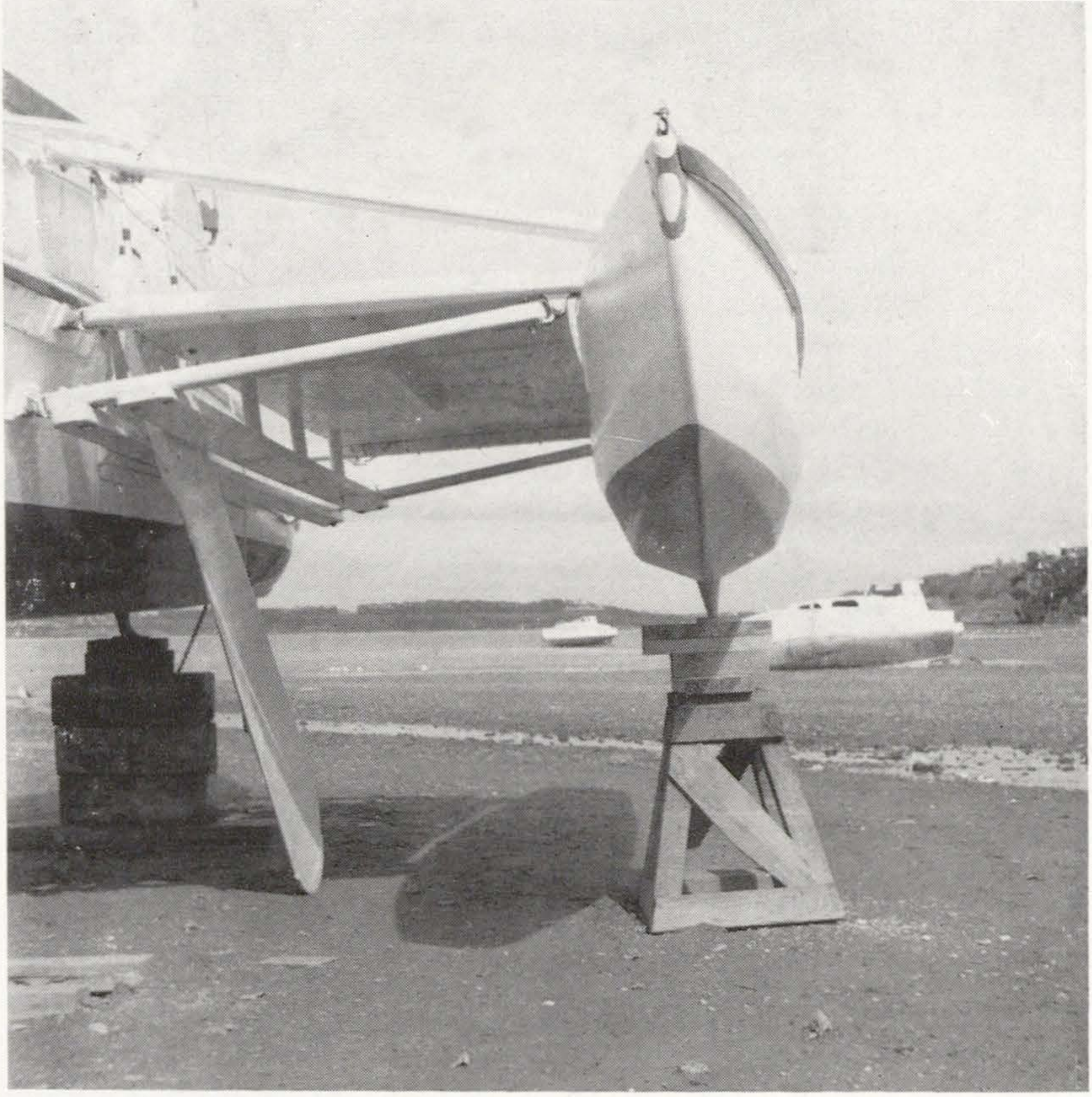
In the traditional leeboard boat, the boards were weighted to sink of their own accord. They were also unrestricted in outward movement and therefore used a form of universal joint at the pivot. On going about, the new windward board was inclined to lift out sideways until hauled up. In our early experiments, especially in a choppy sea, this "gull-winging" effect was found somewhat embarrassing and dangerous, should the more or less free-moving board pound into the side of the hull.

Stern view of *SUSANNAH*—hinged rudder down, outboard motor well in stern

The whole process of board manipulation was vastly improved when after a good deal of experimenting, the board was unweighed, and hence floated when released, and had side-ways movement restricted by operating in a slot. The ultimate in leeboard control would be to use hydraulic or pneumatic cylinders which could be pumped up to pressure by hand at leisure, and which by simple valve settings, would automatically raise and lower the boards as required, when the side pressure fell off as the boat came head to wind when going about.

Leeboards applied to the Trimaran

When, about 1960, the trimaran began to increase in popularity as a family cruising craft, the writer built a round-bilge hull and added floats, mast and sails. It immediately became obvious that for manoeuvrability easy tacking and good windward sailing characteristics comparable with good keel boats, that something more efficient than fins on floats, deep V's, assymmetric floats, etc., was required. A good deal of thought, experimentation and searching of the literature drew attention to the leeboard as a suitable possibility for application to this particular multihull form. About eight years of sailing and further experimentation and development has confirmed that suitability.



SUSANNAH'S leeboard housing

As briefly mentioned above, the success of the exercise has been influenced by modifying the traditional method of handling and installation, having light-weight, floating leeboards operating in a slot to restrict sideways movement of the slack windward board. This is where the outrigger construction attaching floats to hull, and carrying, if desired, side decks, may be used as a very convenient framework for guide-rails, adjustable pivot points, raising and lowering tackle, etc., without appearing ungainly or too obvious.

Unlike conventional trimaran side-deck construction, a leeboard slot must be provided on each side of the central hull.

On the writer's boat *SUSANNAH,* these slots are each 10 ft long and run the full length between outrigger attachment points on the main hull. As the leeboards are 8 ft overall. this allows about 2 ft of fore and aft adjustment length for the pivot points when the boards are retracted up inside the slots.

Fig. 3 shows a composite sectional view to illustrate the arrangement of mast, floats, outriggers and leeboards.

Leeboard operation

The "modus operandi" of leeboards is as follows. The leeboard is lifted by means of a small direct action winch on the cabin side, winding up a terylene rope passing from the winch, via a block on the cabin side, to the point of attachment on the board which is close to the after edge of the board and about two-thirds the length from the pivot end.

To lower the board, a catch on the winch handle is released, the board is lifted off the shelf formed by the guide rail and dropped into the water or lowered from its suspended position. The board is then pulled down to any desired position up to 90° to the water surface by hauling on a block and tackle, the tail being held by clamcleat. Because of the sideways pressure when sailing, the board on the lee side can be pulled down only when the boat is stationary or when head to wind. However, this is easily done when going about by keeping a small amount of tension on the tackle, and when the pressure on the board eases there is ample time to pull the board right down before the pressure comes on from sailing on the new tack. As soon as the boat is sailing properly the tackle tail may be taken out of the camcleat, as this must be done, in any case before the next tack to allow this board to float to the surface, which it does unaided when next the boat comes head to wind. It is a simple matter to wind the board above water level at one's leisure when on the next tack.

When manoeuvring at low speed to pick up moorings or in situations where there is not much room, both leeboards may be held, partly or fully down depending on the depth of water, so that rapid changes of tack are no more complicated than with a sailing dinghy or small keeler.

If the leeboards do strike the bottom, they are merely pushed up, protected from damage, in *SUSANNAH's* case, by an aluminium bronze edging to the semi-circular end of the board. Because of the freedom of movement in the slot and the "universal-joint" nature of the pivot, the leeboards can suffer a good deal of ill-treatment from bottom contacts without damage. The pivot bolts pass through the head of the board, but rest in slots where the bolts are held by the fixed side of the assembly, so that if a board in the vertical position is hit on the end, as could happen when the boat drops into a wave trough close to shore, the pivot is knocked out of the slot, preventing structural damage.

Similarly for maintenance, the leeboard pivots are lifted out of their slots, when the whole leeboard may be lifted and laid on the side deck.

Leeboard design

The writer has nothing to contribute on the basic designs of leeboards. A magnificent publication by Mr. Dr. T. Huitema, *Ronde en Platbodem Jachten,* published by Van Kampen & Zoon, Amsterdam, 1962, gives a wealth of information to Dutch readers and to others who can obtain translations.

While low speed, heavily built shallow-water boats traditionally used very wide fan-shaped boards for best results, light displacement, fast, present-day

SUSANNAH—port leeboard down

boats would seem to be able to take advantage of the long, deep water type of board of higher "lift" characteristics.

Unfortunately, there has been no opportunity in terms of time or money to further investigate leeboard design factors at this stage.

The type of board chosen for *SUSANNAH* and which has given impressive results, is shown in Fig. 4 and has been taken from *Ronde en Platbodem Jachten,* p. 34.

The leeboards were each constructed from two kauri pine planks, edge-glued with epoxy glue and dowelled, giving a blank a little over 8 ft long, 22 in wide, and $1\frac{7}{8}$ in thick. The plan shape was cut out and the hydrofoil section was worked up with plane, gauge and sanding disc, using templates cut from hardboard as a measure of progress. The pivot hole was faced both sides by screwed-on circular brass plates and the bottom rubbing edge of the blade protected by a cast aluminium bronze edge-piece.

Pessimists have emphasised breakage of leeboards in a heavy sea. We have not yet broken a leeboard, although the main guide rail has had to be made heavier. However, as with most nautical innovations, one must be prepared to add strength where experience shows a weakness, and even if the thickness of leeboards had to be doubled this would raise no real problems of installation or efficiency, as would the alteration of a centre-board casing.

The choice of dimensions of leeboards relative to hull size has been stated in very general terms by traditional Dutch designers.

Twice the overall depth of the hull has been taken as one guide to the length of the leeboard. With low velocities the broad-type boards generally found on river boats are said to be more efficient than long narrow boards, probably due to the difficulty of operating long boards full depth at sufficient speed for optimum efficiency. As mentioned previously, a unique advantage of wide boards is the ability of a boat with them to sail in water little deeper than the hull requires and yet have adequate resistance.

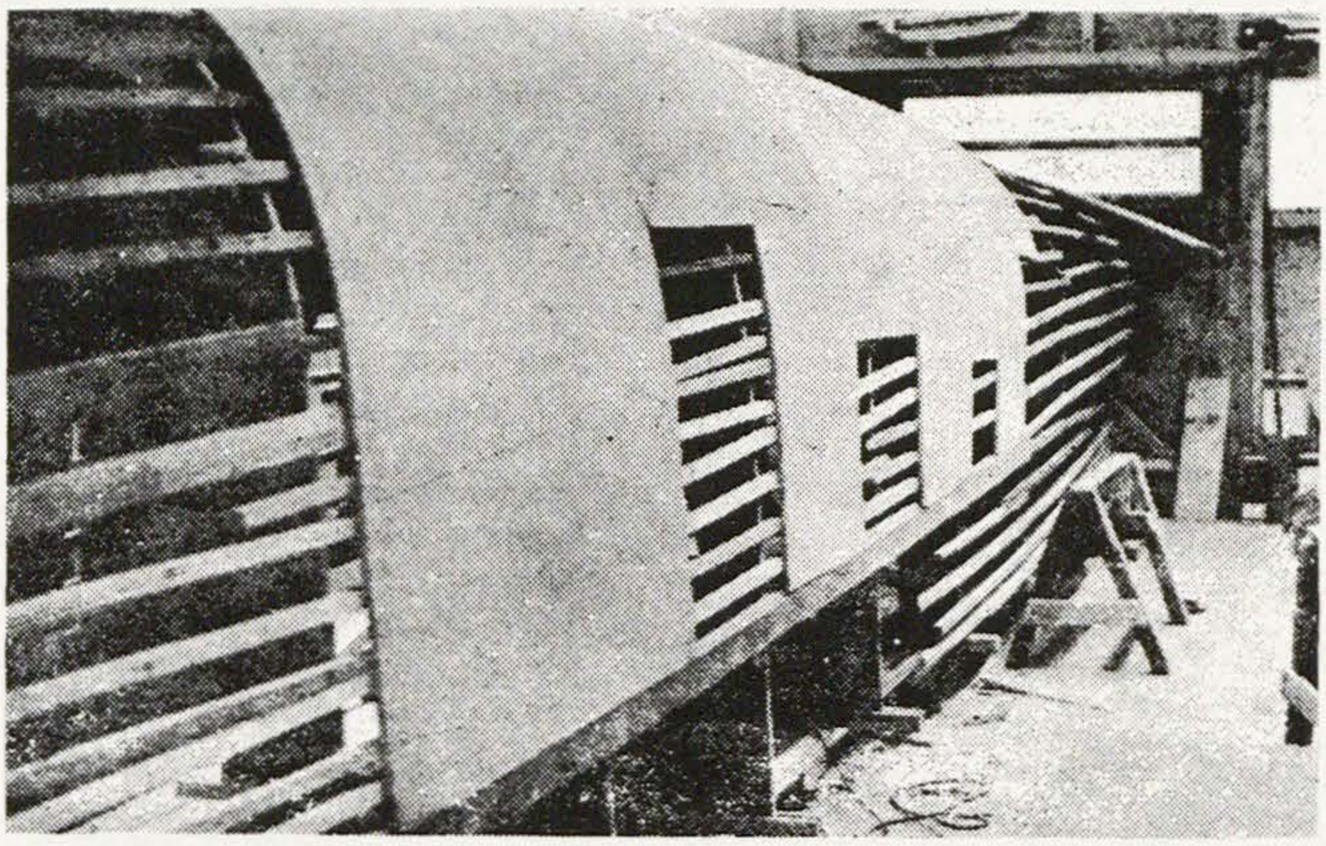
There does not appear to be agreement as to whether the guide rails against which the boards bear, should be parallel to the keel or whether they should be inclined inwards at the bow. In some types of boat the inclination with the axis of the keel is up to 4°. In others the rails are parallel for most of their length, but incline inwards at the bow end. In all cases the convex side of the board is on the hull side and the concave side faces down wind.

As soon as forward motion takes place, the "lift" effect of the leeboard forces the board hard against the guide rail, and in smooth water at a speed of 5 or 6 knots with *SUSANNAH* lightly laden, a definite "lift" to windward of the whole boat has been observed. *AYRS* Publication No. 67, p. 81 mentions a similar effect when *WILDCAT* was fitted with asymmetrical laminar flow section boards and keels.

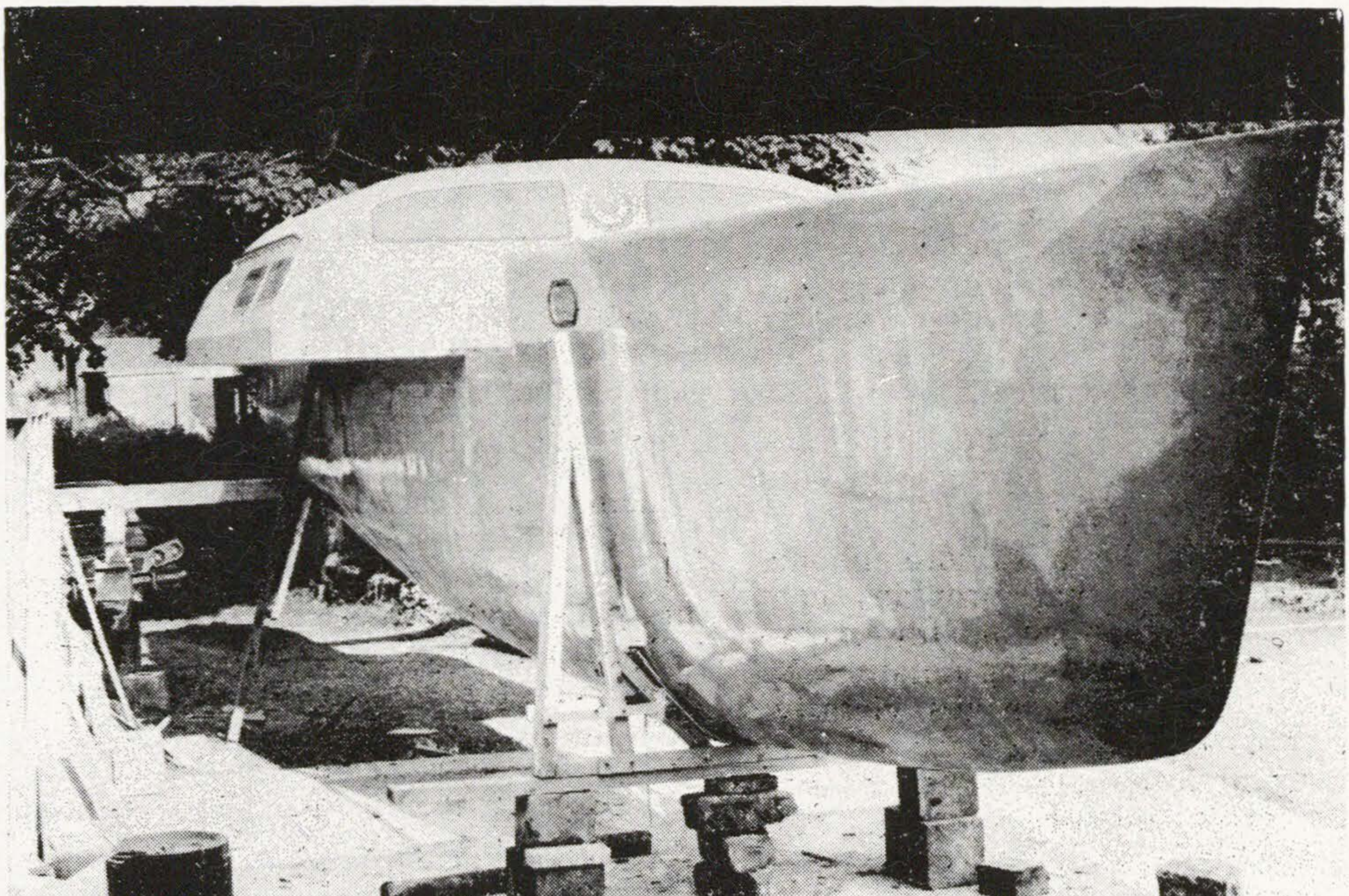
The immersed area of *SUSANNAH's* leeboard is approximately $8\frac{1}{4}$ sq ft and that of the rudder blade, $4\frac{1}{4}$ sq ft, giving a total of $12\frac{1}{2}$ sq ft. In *AYRS* No. 67, p. 55, Robert Harris suggests a centre board area of $1\frac{1}{2}$ per cent of sail area for good windward performance for catamarans. With *SUSANNAH's* a working sail area of jib and main of 290 sq ft, $1\frac{1}{2}$ per cent would be 4.4 sq ft and with genoa and main of 368 sq ft, 5.6 sq ft. This would mean a total of 8.8 and 11.2 sq ft respectively for a catamaran with a centre-board and rudder on each hull. One is not sure if these relationships also apply to trimarans, and whether *SUSANNAH* could do with more area in either leeboards, rudder, or both, will not be known until trials with larger areas have been made. The present boards and rudder were a marked improvement on previous smaller sizes, so that further experimentation is probably worthwhile.

LEEN VALLEY VENTURER

One of the more enterprising home building projects seen this year is *LEEN VALLEY VENTURER*, a 42 ft 6 in trimaran built by John Beswick at Hucknall, Notts. The boat is Derek Kelsall-designed (with interior by the



builder) and based on *TORIA*. She is 26 ft wide, of foam sandwich construction throughout, and will soon be launched. The floats are 39 ft 6 in long. Mr. Beswick began her last October, and she is ready in an impressively short time virtually single-handed construction. The floats are foam/GRP like the main hull. Cockpit floor and floorboards are of balsa sand-



wich, and the coachroof of foam. Cross-beams are ply box-section, with timber inside, the lot being glassed over. A centre-board is used, instead of boards in the floats.

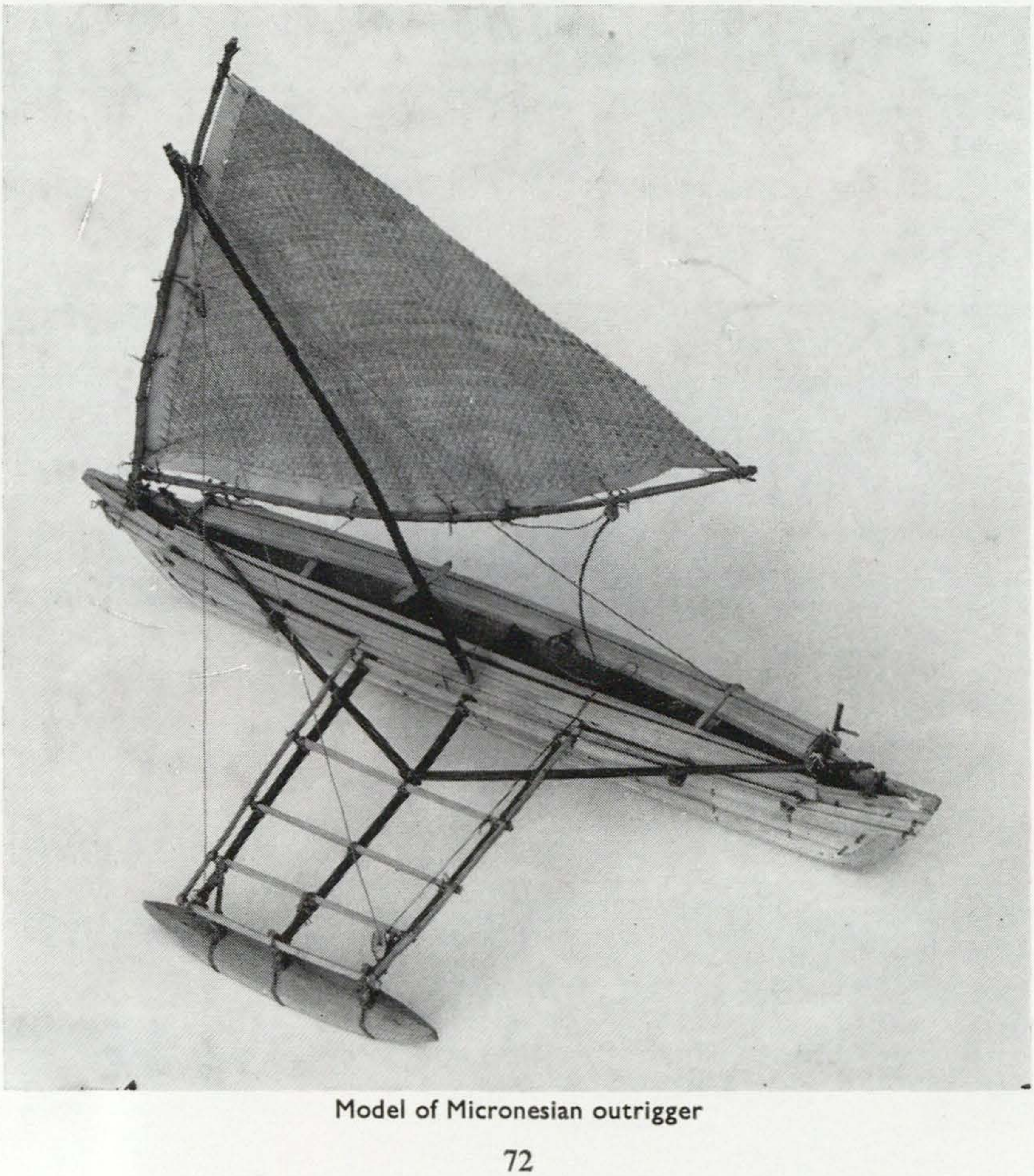
The mast is similar to the foam sandwich swivelling type experimented with by Kelsall on the *K*31. Rig will be high aspect ratio sloop similar to that of *TRIFLE.* If trials prove successful, Mr. Beswick and *LEEN VALLEY VENTURER* will be seen in the Round Britain race this year.

GILBERT ISLANDS PROA 1969

by Capt. E. V. Ward

Model in collection A.E. Bierberg, Denmark

This model stated to be an exact replica of the present day Gilbert Islands outrigger is 60 c.m. long and extremely detailed. Mr. Bierberg has kindly sent the photograph and drawings to us for this publication.



Model of Micronesian outrigger

For comparison between the age old design and experience of the native builder and the modern product which makes use of new materials see *KIA KIA. AYRS* No. 68, p. 13.

MULTIHULLS

From John P. Cadwallader

Hon. Publicity Officer, Trimaran Yacht Club of Victoria.

In recent months, multihull safety at sea has been questioned by the Metropolitan Daily papers, the yachting journals, and *LIFE* magazine. In most cases, an inaccurate, one-sided pessimistic view of the modern multihull yacht has been presented to the public. The press has covered the bad side only, ignoring, almost completely, the hundreds of successful ocean crossings made by multihull yachts, in heavy weather conditions, including hurricanes and typhoons. By the very tone and wording of their articles the press has tended to develop an unfortinate antagonism between multihull and monohull enthusiasts. Phrases such as "bitter argument", "opposing camps", "trimarans should be banned", etc. are extremely regrettable and only, tend to inflame enthusiasts of both views.

Simply, mono and multihull yachts are two different approaches by sailors to the problem of using the wind to move a floating object. Neither is the perfect solution; there isn't one. Every boat built has its advantages and must, of necessity, be a compromise. However, anyone who questions the suitability of multihull yachts for ocean crossing just does not have a thorough knowledge of their complete record in recent years. Seen in its full context, it proves their suitability entirely. Space does not permit me to list all the successful trips; however, full documentation is readily available.

In four years of active interest in multihull affairs, I have yet to hear from any critic who has actually sailed on a multihull, or made a thorough study of them. Hearsay, generalizations, and unqualified statements are not the basis for a logical conclusion on multihull safety in general. It is significant that, among multihull designers and sailors, there is a large proportion of former monohull sailors—many with ten to twenty years' experience of conventional craft. To my knowledge, the reverse does not apply.

The unfortunate loss of two trimarans during the recent Single-handed Transatlantic Race has triggered off the latest editorials. However, I must point out that both the craft in question were amateur designed and built, and were strictly experimental racing craft. Their breaking up no more condemns multihulls in general than the break-up of a racing car condemns motor cars as unsafe, or the loss of the keel yacht *AMBRINA,* during the same race, condemns all conventional craft as unsafe. The experience of both skippers in question was rather limited. Rod Macalpine-Downie's comments in July *Yachting World* on the multihull entrants, made before the race had started, were extremely pertinent. Unfortunately, most of the incidents which have sparked off storms of adverse publicity have been, in fact, in experimental racing machines—*VAGABOND, PRIVATEER, BANDERSNATCH*, the two single-handed Transatlantic trimarans and, lately, Arthur Piver, who set off single-handed, in the face of a gale warning, to test his latest and smallest (25 ft) ocean racing design. Yet, again and again, we have the failure of these racing machines used as "proof" that multihulls in general are not safe.

To a large extent, multihull designers have been pitting mere cents against dollars. In the 1966 Sydney to Hobart Race, Lock Crowther's 33 ft Kraken trimaran *BANDERSNATCH,* was only beaten on elapsed time by the 46 ft *BALANDRA* and the 61 ft *FIDELIS.* The total cost of *BANDERSNATCH,* ready to race, was 3,000 dollars; *BALANDRA* is reliably reported to have cost 100,000 dollars. If that sort of money were made available for multihull development, it would be enough to finish my Crowther desined Kraken 40 ft (potentially one of the fastest sailboats in the world and now under construction in Sydney), completely, outfit it, and cover the full expenses of a crew for a few years of overseas racing. We could then retire comfortably on what was left. A cost comparison between Dick Newick's Flying Proa *CHEERS,* 3rd overall in the Transatlantic Race, and the winning yacht, *SIR THOMAS LIPTON,* would reveal a similar vast difference. The purpose of the boats in this race was to take one man across the Atlantic Ocean, and to me the cost and size difference seems laughable.

The fact that, given the right contributory circumstances a multihull can capsize, is also very true for every other type of craft afloat—keel yachts, fishing boats, and ocean liners have all added proof to this statement in the past few months. But the fact that a boat can capsize is not the one and only thing that decides whether it is safe or unsafe at sea; it is only one of the many facets of overall safety at sea. But, with multihulls, it has been blown up out of all proportion to its actual importance. In nearly all boating accidents, it's the human factor, not the craft itself, at fault. "A yacht is as safe as the man at the helm", is often quoted and very true. A well found, and properly prepared keel yacht will usually come right way up if end-for-ended or capsized. Recent examples of this off the N.S.W. coast have given all yachtsmen information which can save future lives. However, not all the capsized keel yachts have survived. Many have filled with water and sunk, and the bottom is one place a multihull will never be. The natural buoyancy of their all-wood construction, and the absence of a heavy keel makes them unsinkable; even if filled with water or upside down. In which position they can become their own life raft. We have learned that extra positive buoyancy in the wing decks and roof will float a multihull high enough out of the water to make restricted living in the inverted boat possible.

A multihull of adequate size, design, and construction, competently handled, and with sea room, should weather any storm. The capsizes studied so far have been caused by overloading or poor handling. Every incident, logically and carefully analysed provides knowledge which makes yachting safer for all sailors. Easily seen colours are extremely important. Tom Corkhill is alive today because of his orange anti-fouling. Any multihull which races with the Trimaran Yacht Club of Victoria must have its under wing deck section painted air-sea rescue orange. The T.Y.C.V. spent 4 days searching Bass Strait for *BANDERSNATCH* from the air, and we could have flown over it every day, and not seen anything—33 ft L.O.A. dark blue cabin, duck egg blue deck, and white hulls are virtually impossible to spot in storm conditions. With orange underwater sections, and extra floatation placed to float her high enough to live in, the story may have been different. White life buoys are just about useless in the sort of conditions in which they are most likely to be used; paint them orange or yellow. They might not look as pretty, but they could save a life. Doubled cord life lines with snap hooks at each end seem the best.

The relatively high speeds possible in a multihull yacht increase the dangers of a collision with flotsam or another craft, and good wipers or preferably a clearview screen is desirable. Without these, visability in bad weather can, at times, be nil. On a cruising cat or tri, where the boat may have to look after itself at times, some form of automatic sheet release is a good safety feature. There are two types available; one is pressure-activated by a predetermined force, the other is triggered when a preselected angle of heel is reached. Both should be satisfactory. Masthead floats are an obvious solution to the possibility of a capsize, but their size and awkwardness has been impractical to date. Perhaps a designer will come up with an automatically inflated type of masthead float instantly activated by contact with water. This could sit on the masthead fitting in a streamlined small container. Aluminium foil can be easily stowed for use in an emergency as a reflector, and wooden masts can be metallically painted. Spray and wind protection is essential for ocean work, be it dodger, dog-house or Perspex screen.

When you do a lot of coastal work, it is amazing how often you see large logs, packing cases, and trees floating by. The bow section of each hull can be fitted with floatation; preferably small pieces of polystyrene foam inside sealed plastic bags. These can be jammed into all sorts of awkward spaces. The pour-in type foam may be all right when it is sealed completely but I have seen the top 2 in completely water-logged after 12 months, where it could only have been caused by condensation.

Masthead lights can double as morse signal lamps; they are the only light likely to be seen by passing ships as the sails and seas make the deck level lighting unsuitable for accurate signalling, except in flat conditions.

Electric bilge pumps are great, but make sure they are backed up by a large capacity hand pump in the cockpit. On multihulls a two or thee-way tap and permanent tubing to the bilge on each hull enables either hull to be pumped dry without leaving the cockpit and is an excellent safety feature.

The day of the "Roommaran" is gone. If a yacht looks like a floating caravan or barge then it usually sails like one. This is just as important to cruising and racing, as a yacht that won't go to windward well is dangerous for either purpose.

There are many modern multihull designs that sail well on all points of sailing. The trend is towards longer, slimmer hulls, which give more speed and comfort.

Lastly, a plea for a fairer and more representative coverage of multihull news in the future. Only a small portion of it has been bad and the Trimaran Yacht Club members are trying to remove this altogether by a preventive and educational approach to overall safety at sea.

BY TRIMARAN FROM ENGLAND

by Bernard Rhodes

By Courtesy of the Editor of Sea Spray, New Zealand.

KLIS is a 22 ft trimaran, my concept of the most economical ocean cruiser and floating home. I started building her, somewhat casually, to occupy my spare time in winter evenings. The project was far too big for my impatience, so I dared not think of her as finished at that stage. But she began to grow under my hands and soon I could think of nothing else; for a year until her launching, then another year of trials and fitting-out (during which time I lived aboard) she took all my spare time and money.

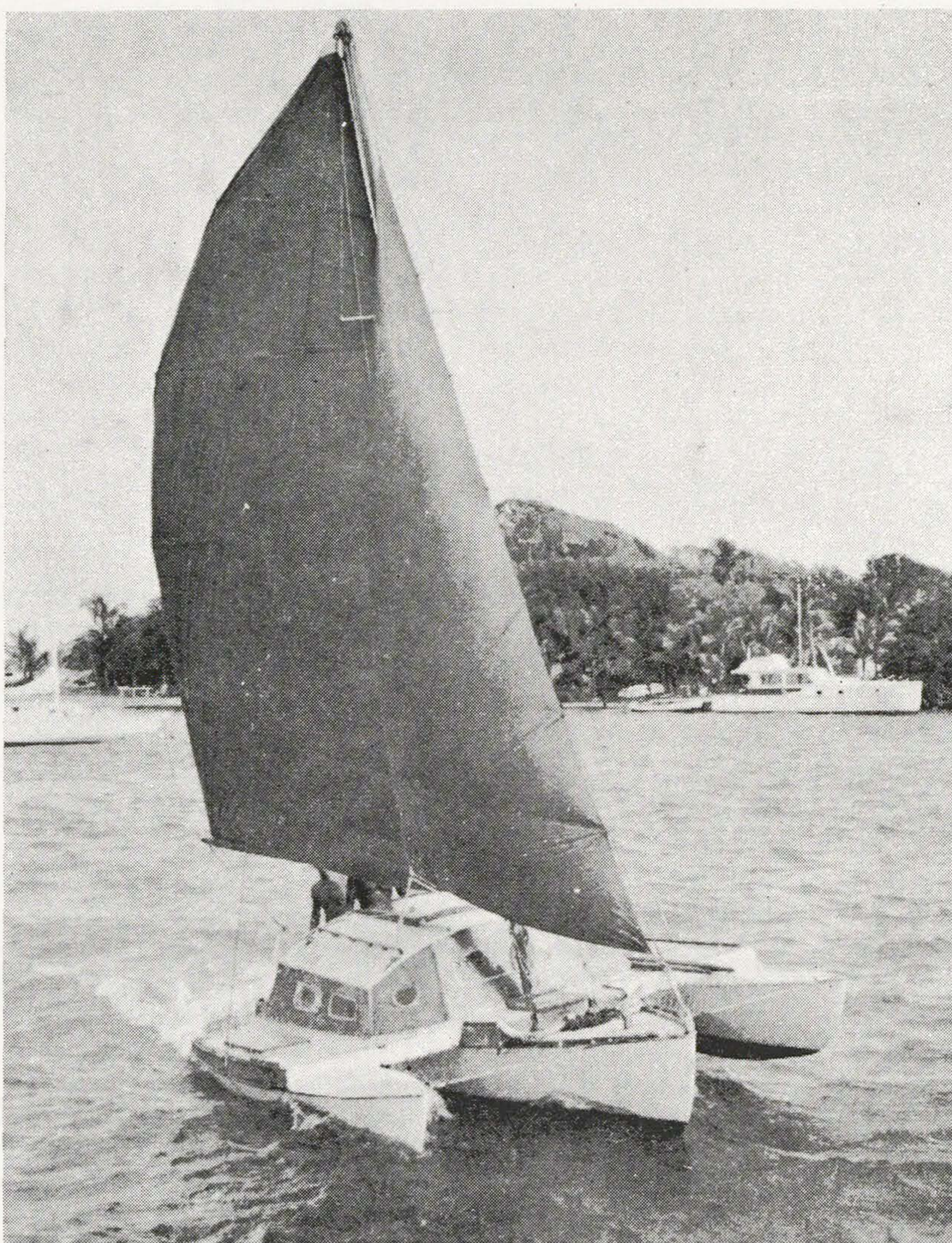
Finally she passed her trials—a season's hard sailing in the boisterous Irish Sea—and my dream was possible. This was to throw up my job in an office (which I detested), head south into the warm sunshine, pick up the North-East Trades and roll across the Atlantic to the West Indies. After that the future could look after itself!

At high water on October 1, 1966 I slipped moorings at Barrow, my home port and headed out across Walney bar. No sooner outside then a squall of gale force blew up from the west, breaking the fine spell, but no turning back now, the ebb would be running four knots across the bar, making it a maelstrom. Under a tiny scrap of mainsail *KLIS* headed into it while I lay in my bunk, sick in body and soul. However, soon the wind eased, relieving the worry somewhat, and that evening I listened to myself on the radio. Later, as I sat at the helm, I was astonished to see a brilliant lunar rainbow, the first I had ever seen. Coming at that particular time, it gave me a weird feeling. No wonder the old-time sailors were superstitious!

The lunar rainbow must have been an evil portent. I was four days weatherbound in the Isle of Man, a mere 45 miles from home, then took 40 hours for 80 miles to Dun Laoghaire in Ireland, including an uncomfortable ride through the tide-race off Chicken Rock, against a force 6. A short hop down the Irish coast to Arklow—the first good day's sailing—then the wind was howling again and the rain pouring, and I was very glad to be in a snug haven.

At the first let-up I was off again, sailing down inside the offshore sandbanks that clutter up this part of the coast. I was hoping to make Rosslare, on the south-eastern tip of Ireland, but the wind went ahead, the tide turned foul and a gale blew up from the south-east and all landmarks were blotted out by heavy rain! Well and truly caught on a lee shore, the only course was to head for the open sea—through a narrow gap in the sandbanks, with the tide setting across it. Under storm jib and close reefed main *KLIS* drove to windward as never before. Providentially, a buoy appeared in the murk to tell me where I was.

Once outside, the wind died off, and the night was spent hove-to, trying not to collide with the Arklow lightship, until the tide turned and we made some progress southward. In the wee hours of the next morning, as *KLIS* passed the Tuskar Rock and poked her nose into the Atlantic, she met a most enormous, steep sea; the motion was terrific. "So this is the Atlantic,"



KLIS at St. Croix, U.S. Virgin Islands

I scribbled in the log. "Hope I can get used to it." Attempting to cook breakfast, I dropped a dozen eggs, smashing the lot. "Scrambled eggs for breakfast. Pumped egg flip from bilges." But the wind was fair and all day we made good progress.

The following night I went to sleep in a calm, and woke in a gale. It was from the north—the right direction, at least. *KLIS* rode it out hove-to under jib alone, and by daylight it had eased to force 6. After breakfast I took the helm and continued running in a rough sea. I had settled to the rhythm of steering, sea following sea, and was daydreaming as usual, gazing into the cabin, when I was startled to see water trickling out from under the wing bunk mattress. A leak! Some part of the wing structure was opening up with the pounding of the seas; fortunately above the waterline, but alarming nevertheless.

Scilly Islands

I decided to make for the Scilly Islands, the nearest port of refuge; consulting the chart, I reckoned I could just make it before nightfall, provided the wind held. Seized with a strong desire to be in harbour, I set the reefed mainsail and stayed on the helm, surfing giddily down the waves, at times touching 12 knots on the speedo. *KLIS* skirted the outer rocks which cluster around the group and beat into St. Mary's Sound as dusk was falling. With the last light some friendly yachtsmen helped make fast in Hughtown harbour. I was dead beat.

Drying-out and repairs took 10 days. I built in extra floors, and stiffeners in the wings, and strengthened things up generally. I also saw something of the Scillies—a tiny group of islands, beautiful, a delightful cruising ground in summer. The people were very friendly; I was invited to hot baths and dinners, and had the use of a greenhouse to dry out my sodden belongings.

The next hop—400 miles across the notorious Bay of Biscay—was by far the longest I had yet attempted. It seemed an astronomic distance. However, came the day with a good forecast and a fair wind, so off we went. I set the twin staysails and hitched the sheets to the tiller, so *KLIS* steered herself, and all was well. Next morning the wind began to increase; soon it was too much for the twins, and I was at the helm, surfing down the seas under working jib alone. I had read how trimarans were safe running in heavy weather, surfing ahead of the breaking crests, and was determined to "make time." The wind was rising—a solid force 8 now—and those seas looked frightening. Suddenly, while my attention wandered a little, *KLIS* was surfing fast on an extra large wave, then she broached out of control, and at the same instant the wave broke. She was thrown over to about 80° heel, and hung there for a couple of seconds, flung sideways in the spume. The lee float disappeared under white water, and the cockpit half filled. I was sitting in the companionway facing aft, so was not thrown overboard. That was the worst moment I have ever lived, before she mercifully righted herself. I realised I had been very lucky.

There was no serious damage, and for the next 24 hours we lay a-hull, beam on to the seas, while the wind rose to force 9 in the rain squalls. I spent most of the time in my bunk feeling queasy and frightened, but *KLIS* seemed well able to look after herself. Every now and then a wave would burst right over her with a tremendous roar, squirting water through the chinks in the companionway and half filling the cockpit, but with the dagger-boards raised she rode the blows easily, and suffered no damage. I got some much-needed sleep.

La Coruna

After 24 hours the wind moderated sufficiently for sailing. The rest of the passage to La Coruna would have been easy but for a day and a night spent in the busy shipping lanes, the radar reflector gone and the Tilley lamp out of action, full of salt. I couldn't force myself to stay awake but dozed in spells of 15 or 20 minutes, and each time woke to find lights all around, and heard sometimes the ominous thrashing of large propellers. A sailor's nightmare.

The rugged mountains of Northern Spain were a welcome sight in the grey dawn of the fifth day, and by noon I was moored in the dirty fishing-boat basin of the grand city of La Coruna drying out and waiting for a force 10 to go by. Then we slipped round Cape Finnisterre in beautiful weather and began to explore the north-west coast of Spain. It was lovely; a maze of deep bays and islands, majestic mountains in the background, and good anchorages. A wonderful sense of peace and satisfaction swept over me, all the hard work, saving, trials and troubles had been worthwhile.

In Vigo I met four more yachts also bound for the West Indies, and began to find what wonderful friends one makes among cruising people. Somebody knew the Spanish for galvanised iron, and together we bought some to make a new radar reflector.

Lisbon

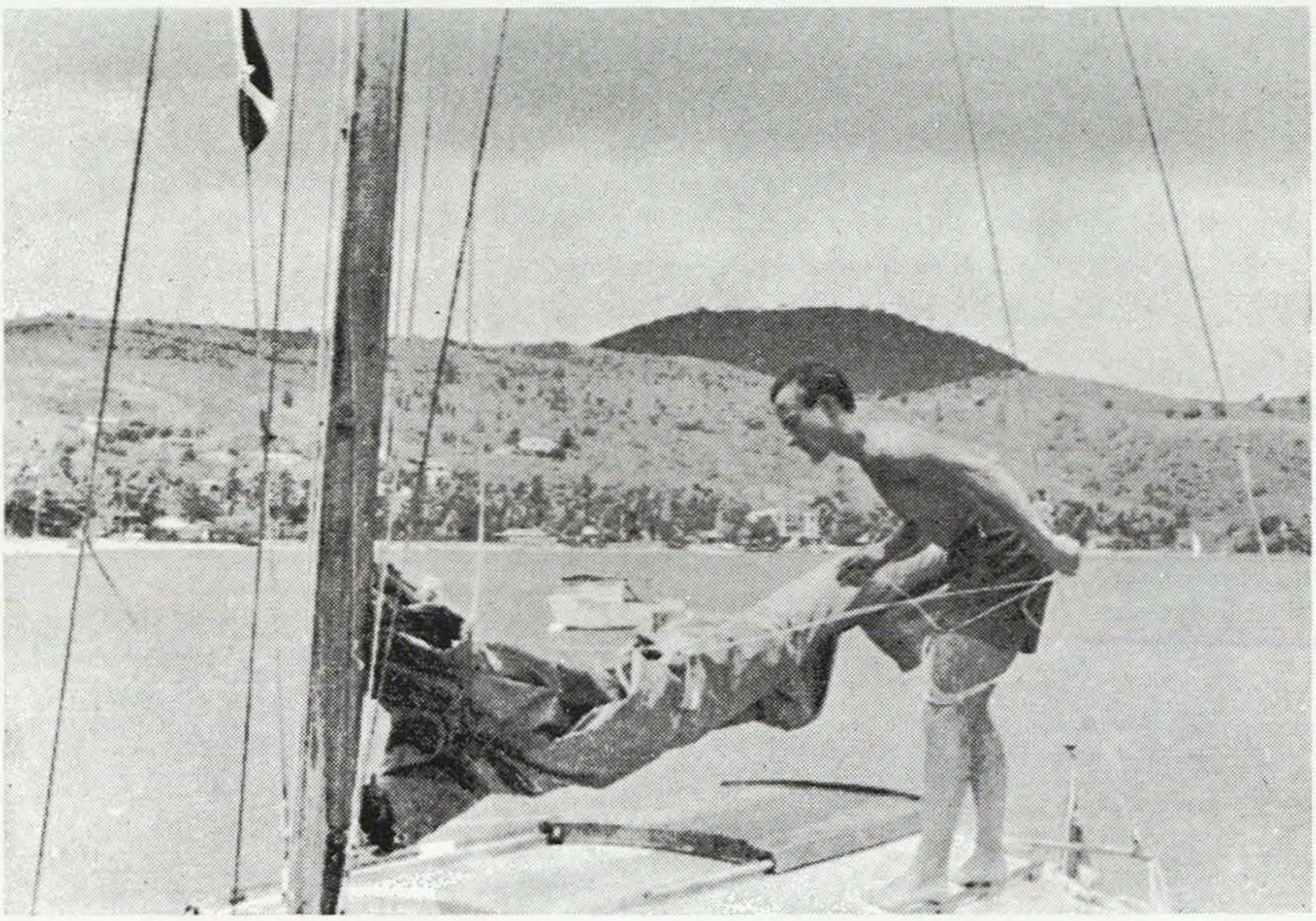
The passage to Lisbon was comparatively uneventful; sailing up the historic Tagus River, a large sign says "Foreign Yachts." Turning left into a crowded basin, I moored alongside the American yacht *KISMET,* which had nearly completed a circumnavigation. Sitting in her cabin, I was fascinated by their tales of the South Seas and the Far East, and I dreamed of visiting these places someday.

I had a very good time in Lisbon; it is the only city I have ever come to like. I made more friends on the other visiting yachts, and some local yachtsmen, who had built their own trimarans, entertained myself and the crew of another visiting tri in royal fashion with a feast of Portuguese cooking and a drive across the new bridge and into the beautiful countryside beyond. But mainly, I had work to do aboard; many jobs were still unfinished, and I was learning fast what I wanted; a lifeline and dodgers around the cockpit, for one thing.

On December 13 I was on my way again, having arranged with most of the other yachts to rendezvous at Las Palmas for Christmas. The 700 miles took seven days, mostly in light going, during which I finally gained some confidence in my celestial navigation. This was a subject I had grossly neglected in the rush of preparations. As far as Lisbon I had depended almost entirely on my little radio direction-finder. Opportunities to shoot the sun were rare, and teaching oneself is not the easiest way, especially when tired, and with the boat bobbing about in a big sea. But mostly I remember this passage for the gnawing loneliness that crept upon me; I had time to reflect. The transition from such gay company in port to the endless open sea is a big one. "If only there was someone to enjoy the sailing with me," I wrote in the log.

Las Palmas, capital of the Canary Islands, is a sprawling concrete jungle with seven miles of waterfront. I combined operations with three other yachts, all of us making self-steering gears; we moored up to the same pontoon, and the free exchange of ideas, tools and materials made the work much easier and quite pleasant.

In mid January amid tooting yacht foghorns *KLIS* sailed out of Las Palmas harbour, bound across 2,800 miles of Atlantic to Barbados in the West Indies. The thought of all that water made my mind boggle. Of course, so many yachts of every conceivable size and shape are crossing "The Pond"



Bernard stowing mainsail at Martinique

these days that it is often dubbed "the milk run"; but it's still an awful lot of water! And here was I, in this thing I had made myself, and whose faults I knew only too well. I felt very small.

After a short period of calm the first night between the islands of Gran Canaria and Tenerife, a light north-easterly whipered in and steadied. I set the main and genoa wing, and Fred, as the new self-steering gear was called, obliged by steering a perfect course. Could this be the Trades? I hardly dared hope. Many yachts were weeks working to the south-west before picking them up. The wind held.

Next morning, poking a sleepy head out of the hatch, I spotted a sail away on the port beam. I went over for a look, and found it was the German Yacht *RAIREVA*. She had left a few hours later than I, and motored through the night. "You O.K.?" "Yes, fine!" we shouted to each other, and took photos. She had twin staysails up, and looked very small in all that sea. "See you in Barbados!" I filled away, and carrying a much greater sail area, left them out of sight astern before nightfall.

Loneliness sets in

It was then that the loneliness really set in. I busied myself at odd jobs to keep it at bay, but things were bleak until I began to get used to it. I thought a lot of my new-made friends, and began to look forward intensely to meeting them again on the other side. However, the day's runs were encouraging; after making 90 miles the first day, *KLIS* ran 130, 120, 162, 171 . . . I began to see what she could so, and soon had more confidence. The fastest single-handed crossing to that time was 24 days, a sort of unofficial record; I began to have hopes of beating it.

On the fourth day out we entered the tropics. The sailing was glorious, and I was feeling in better spirits. I was driving *KLIS* pretty hard, surfing on the waves at what seemed giddy speeds—often the speedo needle flicked round to 12 knots for several seconds at a time—but she thrived on the treatment, and Fred was doing O.K. On the night of the eighth day it blew up hard—force 7—and I ran under jib alone until Fred broke, then lay-to until daylight when I could fix him. After breakfast the wind eased a little and we were off again—endless surfing, but not so fast as before, as the larger waves knocked the little ship about. Then it gradually quietened down till we were slipping along gently. I pottered about doing odd jobs, lazed a lot, and began to enjoy life very much. The log became, at times positively lyrical. Standing on the foredeck watching the sudden sunset, one had the sensation of flying low over the water, so effortless and graceful is the gentle dip and roll, and a sense of fulfillment overcame me.

The wind gradually increased again, but I hung on to full sail, surfing madly on the waves. *KLIS* told me when she'd had enough, as the job halyard block disintegrated, dropping the genoa into the sea and tearing the clew out of it. Of course it happened at night. Next morning I held a council of war with myself, and decided there was nothing for it but to go aloft with a new block, much as I funked the job. I trailed a line astern, and prepared everything. The motion up there was wicked, and it took all my strength to hang on. I was very glad when the job was done and I was safely back on deck, shaking like a leaf.

Pleasant sailing

Day followed pleasant day, and as we drove westward I began to have real hopes of making the passage in under 20 days. On the night of the eighteenth day, when the wind increased around midnight, instead of reducing sail I took the helm, and anticipating the waves, kept her running true. That day we ran an impressive 180 miles—not bad for such a little boat! The next night I expected to sight land around 2 a.m.; I was tremendously excited, and decided to take the helm after supper. Just as I finished eating *KLIS* suddenly broached round into the wind, and there was Fred, all broken!

Poor Fred, he had only been a lash-up, but he had done sterling services. He couldn't have chosen a more appropriate moment to die!

To my immense joy, at the expected time I sighted Ragged Point light and the loom in the sky over Bridgetown. By dawn I was slipping along the south coast, past green sugar-cane fields and white villas, and at 0730 anchored in the clear turquoise waters of Carlisle Bay, 19 days, 22 hours out. The sails were hardly stowed when the Customs launch came alongside, polite and courteous. Then two men came alongside in a dinghy. "We're from the Cruising Club of Barbados. Care to come ashore for a drink?" Would I!

Cut along line

The A.Y.R.S.,
Woodacres,
Hythe,
Kent,
England.

Dear Sirs,

1. Please enrol me in the AYRS. $5 or £2 is enclosed.

2. Please enrol our Yacht Club in "Associate Membership" of the AYRS. $25 or £10 is enclosed, for which we understand that 5 copies of each of the AYRS publications will be sent as they come out, and our members may attend AYRS meetings in London or any centre the room hire being paid for by a collection.

3. Please send leaflets of the AYRS to the name and address below.

*Delete whichever item is not applicable.

Name.. (*Block capitals please*)

Address ....

....

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Signed..

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