CRUISING CATAMARANS

A.Y.R.S. PUBLICATION No. 78

WINDSONG—Myers and Ewing

CRUISING CATAMARANS

HISTORY — DESIGN PRINCIPALS EXAMPLES

by

The AYRS Members

Edited by:

JOHN MORWOOD

FIRST EDITION: 1972

Published by:

THE AMATEUR YACHT RESEARCH SOCIETY,

HERMITAGE, NEWBURY,

BERKSHIRE, ENGLAND.

THE AMATEUR YACHT RESEARCH SOCIETY

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

National Organisers:

American: W. Dorwin Teague, 375 Sylvan Ave., Englewood Cliffs, New Jersey 07632.
Australian: Ray Dooris, 29 Clarence St., Macquarie Fields, Sydney, N.S.W.
British: Michael Ellison, Hermitage, Newbury, Berks.
Canadian: P. J. McGrath, 43 Thornecliffe Park Drive, Apartment 706, Toronto, 17, Ontario.
French: Pierre Gutelle, 3 Rue Jules Simon, 75 Paris (15°).
New Zealand: T. L. Lane, 32 Michaels Ave., Auckland, S.E.6.
South African: Brian Lello, S.A. Yachting, 58 Burg St., Cape Town.
Sweden: Sveriges Catamaran Seglare, Mistelvagen 4, Lidingo.

Area Organisers:

Dennis Banham, Highlands, Blackstone, Redhill, Surrey.
A. T. Brooke, 75 Craiglockhart Rd., Edinburgh 11.
Fred Benyon-Tinker, 49 Pillar Gardens, Northfield Lane, Brixham, Devon.
M. Garnet, 7 Reynolds Walk, Horfield, Bristol.
John R. Novak, 23100 Vanowen St., Canoga Park, California.

Editorial Sub-Committee:

Michael Henderson, John Hogg.

Editor:

John Morwood, Woodacres, Hythe, Kent, England.

CONTENTS

PREFACE

The AYRS has been studying various aspects of yachts since 1955 in a series of symposia of individual subjects which make up our periodicals. In each publication, we summarize what is already known of a subject, try to work out general principles of design and set challenges to our members of things to invent.

The results of our methods have been so successful that it has surprised everyone who was with us at the beginning, even ourselves. At the moment, we are trying to collect our researches into books, of which this is the third. The two previous ones are SELF STEERING and SAILING HYDROFOILS. Some other subjects have also been put out as books such as THE SINGLE-HANDED TRANS-ATLANTIC RACES and DEEPWATER SEAMANSHIP, which was an account of the seamanship used in the Round Britain Race of 1970. The full list of our publications is to be found at the end of this book.

Though several attempts have been made to get us to drop the word 'Amateur' from our title, we treasure the word and have found it most useful. It really means that we can criticise yachts and devices unbiassed by any considerations of advertisers or professional interests. We set out to help the man who wants to design, build or buy his own boat and we make an especial point of encouraging anyone with an original idea, no matter how 'way out' it may *seem* to be.

Our members include two types of exceptional yachtsman namely; 1. the careful, scientific, AMATEUR RESEARCHER who has always contributed the bulk of advances in yacht design in the past and seems to be doing so at present and 2. the INFORMED YACHTSMAN AND YACHT DESIGNER (whether amateur or professional), who wants to know as much about his sport as he can.

The AYRS has already contributed much to yachting and will do so in future. There are no qualifications for joining and we have a membership which is World Wide.

EDITORIAL

This AYRS book shows a collection of all the cruising catamaran designs which we have published since 1955 to which we have added some very recent ones. Its purpose is to put these designs before people in such a way that their good and bad points can be appreciated and future designs can include the good features and avoid the bad ones.

We begin by the 'Introduction' which tries to set out the desirable features of catamaran design. This is followed by the general principles of catamaran design in all its aspects such as hull design, lateral resistance and accommodation. This section has been written to give the reader some guide by which to evaluate the designs which he will see later on.

At the present moment, there are several different schools of catamaran design all of which seem to hold to their views tenaciously and sometimes even violently. We have tried to set out these opposing views to the best of our ability but are constrained by reason to take up a stand towards the type of catamaran which has been developed in England and the Eastern Coast of America. This stand has to be justified by us which I think can be done by the following line of reasoning.

Fig. 12.

Perhaps the most generally useful discovery of the AYRS is the full laws of 'scaling' between full sized boats and their scale models. The details of this are given later on. Now we can know for sure exactly how a full sized boat will behave IN ALL RESPECTS, including speed and seaworthiness by building a scale model and sailing it. At the present time, there are very many day-sailing catamarans of a wide variety which race regularly amongst themselves and against each other. We have only to observe how these small catamarans behave to know how a much larger catamaran of the same shape and scale weight will go.

The day sailing catamarans therefore act as 'trial horses' for the larger cruising catamarans and we show some of the fastest and best of these before we begin to show the strictly cruising catamarans. The man who can sail any of the small cats well will be able to sail a cruising catamaran equally well. It is a good apprenticeship and we thoroughly recommend it.

Two other facts emerge from the laws of 'scaling'. The first is that a catamaran for offshore cruising should not be less than 30 ft long. If shorter than 30 ft, it will capsize too easily. John Hogg has shown that the vortices in the natural wind revolve with a speed of about 3½ knots, almost irrespective of the speed of the wind itself. This means that the wind speed may suddenly jump up by 7 knots which is a lot for a small boat which may be knocked flat. Larger boats are less affected. The second fact, which was derived empirically by James Wharram, is that catamarans should be given a sail area which will not capsize them in winds under force 7 (35 knots). The explanation, I think, is again the wind vortices which are relatively greater in Force 5 (25 knots). Both these facts are tied together in so far as catamarans over 30 ft in length can have relatively more sail area than smaller cats, because of 'scaling'.

During the past years, we have tried to get accounts of every notable catamaran and have generally succeeded. A few are, however, missing to our regret and some have not been as well described as we could wish.

INTRODUCTION

Any "Cruising" yacht must be designed and built for comfort and safety. This means that she must be seaworthy, and have as easy a sea motion as possible. She must be so strongly built that she is able to withstand anything she is likely to meet in the cruising she is likely to do. She should be durable, being built to last at least 20 years. If she can meet these needs and also be fast, she will please her owner.

The modern cruising catamaran can meet all the requirements given above and is usually faster than a single hull boat of similar cost and accommodation. Unfortunately, she pays for her assets by usually having low headroom in the bridge which spans the two hulls and (fortunately very rarely) can be capsized. This can occur:

1 When she is caught overcanvassed in strong winds and
2 When she is trying to cross places where short, steep breaking seas occur, such as harbour bars. There is a temptation to do this because of her shallow draft.

Because of the hazard of capsize, a catamaran needs just as much seamanship as a single hull. When this is so, the risk in a catamaran from capsizing is probably less than the risk of sinking in a single hull from either the breaking up of the structure or hitting flotsam.

The Comparison of Cats and Tris

There is very little to choose between catamarans and trimarans. The trimaran is slightly harder to capsize. Full headroom in the central hull is slightly easier to produce and the accommodation is slightly better conforming to the human frame. Rolling is slightly less disagreeable. But these slight (and small) advantages are balanced by slightly less speed on the average, though very light trimarans are far from being sluggards.

Rolling and Pitching

Comfort at sea depends almost entirely on these two properties of a yacht which, incidentally, become less as the size increases.

When rolling, the single hull yacht is a pendulum. If the "frequency of encounter" of sea waves exactly corresponds to the period of roll of the yacht, rolling becomes intense and the crew becomes intensely unhappy. When running, especially in the Trade Winds, the roll can be as much as 30° or even more on either side of the vertical. The catamaran will, on the other hand conform to the average wave slope which is surprisingly gentle. It has been given as 10°. To offset this difference, however, the light weight and quick conformity of the catamaran to small waves means that sharp, short, up and down accelerations appear which can also be unpleasant. On the whole, the motion of the catamaran in roll is greatly preferred to that of the single hull.

In pitch, as in roll, the single hulled yacht also tends to be a pendulum but of such a high frequency that it is seldom a trouble. With it, as with cats and tris, the problem lies in avoiding a "periodicity" of pitch. Both sides of most boats must be identical in shape around a fore and aft axis but the bow need not be exactly the same shape as the stern. It is the difference between the period of pitch of the bow and stern which reduces pitching to its minimum.

In still water, if the bow is depressed, it will rise again at a speed which depends on its shape and it will continue to rise until it is above the L.W.L. At the same time, the stern will be depressed below the L.W.L. Now, if the bow and stern are exactly the same shape and of deep V section, when the stern begins to rise, it will do so at exactly the same speed as the bow had done before. The result is that the boat has a distinct period of pitch exactly analagous to a pendulum. If such a yacht sails in conditions where the "frequency of encounter" of head seas equals the "periodicity of pitch", the pitching can become frightful.

I have heard stories of catamarans being disturbed by the wakes of passing motor boats still pitching long afterwards. At the start of the 1970 Round Britain Race, Bill Howells *GOLDEN COCKEREL* (a C/S/K design) pitched far more than any other yacht, doubtless because she is of the shape described above and the "frequency of encounter" of the short seas matched the "periodicity of pitch" in the light wind. Of course, in other conditions of sea and wind, *GOLDEN COCKEREL* would not pitch as much. In the pitching condition, she was only average in speed but she came in 5th in the race so her pitching in certain conditions must only be a small handicap. James Wharram's cats, with fine sterns, should also pitch but the only account of this happening which we have was in an under canvassed *Tangaroa.*

I guess the maximum shape for pitching would be a flat plank, with a V at the lower edge and curved up towards both ends. If ballasted to float "on edge" and with some lead at both ends to decrease the frequency of pitch, it would make a good experiment.

The shape for least pitching in contrast would be a narrow, deep V bow matched with a wide, flattish stern with the Centre of Gravity between. The point is that one must have a marked contrast between the pitch frequencies of the bow and stern. A slow rise of the bow from depression or immersion in a wave is quickly neutralised by the higher frequency of the stern pitching characteristic. Oscillation cannot take place. Fortunately, the shape for minimum pitching is not slow and, according to Edmond Bruce's tank tests (see page 190) is actually faster than the symmetrically fore and aft hull.

THE CURE FOR PITCHING IN CANOE-STERNED CATAMARANS

Hearing that Jim Wharram was in Folkestone Harbour with *TEHINI*, I went aboard. We had a long chat about his boat, especially about pitching. *TEHINI* is now schooner rigged with equal sized Bermudian sails on the two masts. The previous rig was a Junk ketch of 1,000 sq ft. The present rig has 750 sq ft and Jim tells me that speeds have increased by 25 per cent. Perhaps all advocates of the Junk rig will note this.

Jim also tells me that pitching is far less, obviously due to the lowering of the mast and sail weight. C. Philbrick who has been doing model tests on a *TEHINI* has found that the Junk rig model "pitches to a standstill" in certain conditions. The cutter rigged model sails smoothly.

Conclusion

1 Pitching can be a nuisance with canoe-sterned catamarans *if the period of pitch is too great*. Reducing the weight of mast and sails and keeping the main weights aboard as near the centre of gravity as possible should reduce pitch.

2 In the design of canoe-sterned catamarans, the stern sections should be fuller than the bow sections. The centre of gravity will then be further aft and there will be an asymmetry of pitch characteristics between the bow and stern which will help to damp out pitch.

3 Hull sections with a sharp V at the keel will pitch more than sections with a small amount of horizontal floor at the keel which will help to damp out the pitching. Bow sections should be V'd, of course.

Low Aspect Ratio Keels and Sail Area

Jim Wharram also feels that even his present sail area is too big and thinks that 600 sq ft will give a better performance. This idea is an accord with a study I have been making of traditional boats. The sail area of the Cornish Lugger, for instance, is very modest compared with yachts. My own *JEHU* of 1932, with 100 sq ft went quite well to windward while my very similar *JEHU* of 1969, with 150 sq ft, makes a lot of leeway and goes poorly to windward. The clipper ships, too, had very small relative sail area, if one excludes staysails and stunsails.

C. Philbrick, mentioned above, finds that, if he has too much sail area on the *TEHINI* model, it makes a lot of leeway in scale "strong winds" which he calls "Mushing out". If the sail area is reduced, the speed increases. "Mushing out" must be similar to the "Stalling" of an airfoil, which doubtless explains the matter.

Accommodation

We have just considered comfort at sea. Let us now think of comfort in harbour where yachts spend so much of their time.

It often seems that yacht designers start their accommodation plans by drawing in as many berths as they can. This may be a good selling point but "comfort" is far more than a berth. I think the better way to design accommodation is to make sure that the working and sitting places are free from annoyances. Only then should the designer work out how many people the yacht can sleep. I place the priorities in this order:

1 Galley

2 Lavatory (Heads, with basin and shower)

3 "Dinette" table and seats

4 Berths.

The Galley

If you cannot get a wife, girl friend or cook to sail with you, you will have to cook yourself. Food is the greatest morale booster at sea and a great pleasure in port. The cook must have a good stove with an oven and piped fresh and sea water to the sink, even if this last consists of a tube stuck in a plastic can and a small hand pump. There must be full head room (if possible at all) and a preparation table. If the cook is happy, so will the ship be.

Lavatory

Again, the space must be provided with ample headroom. Even in a small yacht, the flushing W.C. (or bucket) could be covered with a waterproof lid and there could be a shower. I have never known this to be done, however.

The Dinette

Part of the pleasure of sailing lies in the sociability. Having a fixed table with seats around it beside the galley is good. In some yachts the top is made to lower between the seats to make a double bunk but the procedure is somewhat of a nuisance.

Chartroom

Ocean voyagers and cross Channel sailors like a separate chart-room.

Berths

When all these essential things have been allotted, the bunks can be thought of and put in place.

CATAMARAN ACCOMMODATION

Saloon

This is usually on the bridge-deck as a low space of about 4 ft 6 in headroom. It is hard to get standing headroom in a cat of less than 40 ft L.O.A. unless the centre is dropped as a kind of third hull or "Pod" which reaches down almost to the L.W.L. Such a device can, as suggested by Ralph Flood, also house an inboard engine. It is seen in Prouts 1971 design *SNOW GOOSE.*

Galley

This is best placed in one or other hull alongside of the bridge-deck where the cook can be in sociable contact with those in the saloon but reasonably free from interference.

The Lavatory with Basin and Shower

These items (with a chart table, if used) are generally on the opposite side to the galley, though they may be more to the stern of the hull.

Berths

The essential items of living thus seem to take up most of the choice space in a catamaran and this only leaves the ends of the hulls for berths. Unfortunately, the motion is greater in these places and catamaran hulls tend to be noisy in a seaway. The best place to sleep in a catamaran underway is the quarter berth or bridge-deck.

Safety

Catamarans are relatively safe from many of the hazards of the sea due to their shallow draught, light weight and narrow hulls. But they can capsize. Mast head buoyancy is therefore often used to prevent complete inversion. At sea, the mast may well break after a time and inversion occur but there may well be time for any crew which are inside the craft to get out before this happens. Various suggestions have been made for safety in the event of a capsize such as lockers with survival kit which can be opened from below. These are being activated in new designs. Any hope of righting a capsized catamaran at sea, however, seems to be extremely tenuous.

CHAPTER I

CATAMARAN DESIGN

by John Morwood

The AYRS has quite a few discoveries to its credit. Some are the result of single individuals' work. Some show the effect of the work of several or even many people. The main discoveries which we have instigated are as follows:

1 The recording of sailing performance which can be thought of as a reduction of sailing to a science.
2 Finding the principles of design of catamarans, trimarans and hydrofoil boats.
3 Self steering methods.
4 Studying yacht design for ocean voyaging.
5 Studying seamanship.
6 Discovering the relationship between the performance of a model yacht and that of the full size, when the model is accurately "scaled down".

It is the last item which is of the greatest use to us in considering catamaran design. It means that there is no need to build a full sized boat to find out how she will behave. An accurately scaled model of one tenth or one twelfth the size will show us everything we want to know. For instance, if the scaling factor is 12, every linear dimension will be one twelfth that of the full size. Areas will be reduced by the square of 12 while volumes and weights will be reduced by the cube. The vital thing which we discovered (I myself learnt it from Edmond Bruce) was that *all velocities must also be scaled by the square root of the scaling factor*.

The above scaling of velocities means that a scale model which sails at 3 knots in a 6 knot wind will represent the full scale yacht sailing at 10·4 knots in a 20·8 knot wind if the scaling factor is 12 (the square root of 12 is 3·464). It may be that this unravelling of the mysteries of scaling is the most generally useful thing we have discovered so far.

From the point of view of catamaran design, the accuracy of model tests means that we can make scale models of one half or one quarter the full size and then build even the largest craft with confidence. We can also use the racing cats for our models and, for this reason, we show the lines and sections of certain racing cats before we show the cruising catamarans in this book.

THE PRINCIPLES OF CATAMARAN DESIGN

Wetted Surface

Catamarans make far less surface waves than single hulled yachts because of the slenderness of the hulls. The major source of resistance is therefore surface friction. Catamarans should therefore have as low a surface area below the waterline as possible. Every section could therefore be a semi-circle below the L.W.L. from the bow to the stern and cats with this hull shape have been shown to be as fast as any.

Broadening the stern sections and ending the stern with a transom has been shown by Edmond Bruce in his tank to be fractionally faster at high speeds than the "all semi-circle" hull and such a shape quickly damps out pitching. It is generally preferred by most catamaran and trimaran designers.

Length to Beam Ratio

Edmond Bruce studied this feature in a series of hulls whose bottom was an arc of a circle and all of whose sections were semi-circles. His conclusion was that for very light craft of high speed, a ratio of 12 : 1 gave the least resistance. For heavier craft such as cruising catamarans, 8 : 1 seemed better. However, owing to the fixed weights of people and their personal belongings, a very large catamaran can be relatively light. For instance, if we take a *Shearwater,* at 16 ft L.O.A. to weigh, with crew, 600 lbs, a catamaran scaled up to 64 ft to the same design would displace 17 tons. It should not be impossible to build a 64 ft catamaran to weigh less than this.

The Height of the Bridge Deck from the Water

No matter what distance there is between the bottom of the bridge deck and the water, occasional waves will hit it. The *SHEARWATER* (16 ft 6 ins O.A.) has 11 in at the stern and Prouts have kept to this proportion in their larger craft. Don Robertson's 36 ft *SNOW GOOSE* has a clearance of 19 in and has only occasional slams from waves on the bottom of the bridge. The central "Pod" on the Prouts 1971 *SNOW GOOSE* is alleged to soften wave blows but has, at the moment of writing, not been raced very much offshore.

The Wharram cats, without any structure on top of the bridge-deck, can lift the cross beams higher off the water and thus escape some of the blows of the usual type.

The Central "Pod"

This idea was first introduced by Ralph Flood to our knowledge. Its main purposes are to give more headroom in the central cabin of catamarans and to house an inboard engine, with or without a retractable propellor. Because it only just reaches down to the L.W.L., it adds little to the resistance and the extra headroom is a great convenience.

Lateral Resistance

All catamarans with semi-circular "Master sections" need extra lateral resistance. It would appear that both the C/S/K (Rudy Choy) and the Wharram cats can also benefit from centreboards at times, especially in light winds.

Extra lateral resistance can be achieved in two ways. Lifting centreboards can be used in the hulls where they are generally placed at the outsides to avoid interference with the accommodation. Or low aspect ratio fin keels can be permanently fitted.

The faster cruising catamarans at present are using boards while those for more leisurely cruising use the low aspect fins. Tank tests of many hulls have shown boards to be greatly superior to shallow draft keels with regard to sailing performance but at an AYRS meeting in London it was unanimously agreed that catamarans capsize by tripping over the lee side board.

Both Prouts and James Wharram were emphatic that shallow keels are necessary for safety. Bill Howell however stated that, in a violent storm with *GOLDEN COCKEREL* in the North Atlantic, he lifted both plates to enable the yacht to slide sideways and he wondered if, in those extreme conditions, a fixed keel might have been enough to cause a capsize by preventing sideways drift. Michael Ellison has suggested lifting the lee side plate in conditions where a capsize would be possible, leaving the weather board down. Obviously a fixed keel saves the trouble of adjusting boards.

The low aspect ratio fin was, we believe, first introduced by Dick Newick (see page 97). It is a far more seamanlike method because it keeps the hull bottoms off rocks when the yacht is in tidal harbours. It is stronger, has no working parts and there are no boxes to give trouble. There might be an extra advantage if the hull were to be given a slight V fore and aft of the fin of about 4 in in width to fair it into the rounded hull. Such a V is to be seen on the back fins of fishes. Olin Stephens uses it to great effect in his single hulls but it has not yet been used in any multihull.

OTHER SCHOOLS OF CATAMARAN DESIGN

Rudy Choy, working with Warren Seaman and Alfred Kumalai as C/S/K catamarans, has designed some beautiful catamarans with asymmetry, deep hulls and canoe sterns. In the larger sizes, these have been of very light construction and very fast. They have so dominated the Californian scene that the only catamaran built with shallow rounded bottoms has been Hugo Myers' amateur built *DREAMER*. As small racing craft, none of the C/S/K boats have done very well against the "orthodox" shaped catamarans.

Asymmetry of the hulls, where the outer sides are flat (or more or less so) and the inner sides are curved, is aimed at producing lateral resistance without boards. Each hull produces a force, when travelling, acting towards the centre line of the craft. On heeling, the lee hull produces more force than the weather one. The idea may work in strong winds but must only add to resistance when heeling is negligible. Few boats with asymmetry are being made now. However, the *HOBIE CAT* with asymmetry and no boards is fast and goes to windward well.

As has already been stated, the main resistance of multihulls comes from wetted surface. The minimum wetted surface comes when the sections are semi-circles. Edmond Bruce has done a study for us on the effect of deviating from this shape and showed that less wetted surface was added by having sections of shallow semi-ellipses than by having deep semi-ellipses. Another study showed that there was little point in trying to minimise wetted surface on heeling by using a "Sewer Section"—a section shaped like that of an egg which was invented by the Ancient Romans for their drains.

Canoe sterns, it would appear from the Australians' racing successes in the 'C' and 'A' class catamarans, are just as fast as transoms within the present racing rules for a given length. This is due to the saving in weight, windage and wetted surface. Heavy cruising catamarans would derive less benefit and lose accommodation. The drawback is the tendency of the canoe-sterned catamaran to pitch in conditions of light wind and a rate of encounter of the waves of the pitch frequency of the yacht.

James Wharram. Jim sells plans of easily built and relatively cheap cruising catamarans. There is no bridge-deck cabin, all the accommodation being in the hulls, which are deepish V and canoe sterned. There are neither centre-boards or fins. Leeway is large in light winds but windward performance is good in moderate and strong ones. If well made and light, the Wharram cats are fast enough with a normal sloop rig. With the Chinese junk rig or the spritsail, the windward performance is not good. When going slowly in certain seas, pitching can be unpleasant.

CRUISING CATAMARAN SAIL RIGS

Original people tend to experiment in several directions at the same time. This is a scientific fault because only one item should be varied at a time in any worth-while experiment. A fault it may be but multihull designers seem to have been trying out far too many sail plans. There are only three rigs which have any business being on any sailing craft namely, the ice yacht rig, the sloop and the cutter.

The Ice Yacht Rig

This is a single sail set on a slightly raked mast which can bend slightly with a concavity to windward. Messrs Holt Allen make an alloy extrusion for the *Shearwater* which is just right for the mast which must be made to rotate so as not to spoil the windflow on the lee side of the sail. The sail height should be about twice the length of the foot, giving an aspect ratio of 4 : 1. This is the rig which should be used for any multihull which aims to sail on a broad reach at a speed which is 50 per cent greater than the speed of the true wind. It is therefore suitable for the 'B' and 'D' Class catamarans and large, light cruising multihulls of comparable speed. I believe it to be faster than the large heavy wing mast and canvas rig which is at present being used by the 'C' Class.

The Sloop

This consists of a mainsail and jib. Various jibs are carried for various strengths of wind and the wide beam of the multihull allows a huge Genoa to be used hard on the wind in the light going. It is the rig of choice for the vast majority of cruising catamarans because of the easily variable sail area through a large range while still maintaining efficiency to windward.

The Cutter

This term has been used for several different types of rig of various efficiencies. As developed by Captain Illingworth and seen in Don Robertson's *SNOW GOOSE* (page 167), it is as efficient as the sloop and is more easily handled because the sail area before the mast is broken up into a foresail and a high cut jib. The mainsail is small and of a relatively high aspect ratio.

The main advantage of the Illingworth cutter is that, in a rising wind, the jib is easily taken down which makes the rig into a very snug sloop. This does not alter the sail balance.

Other Rigs

In my opinion, ketches and schooners, Chinese junk rigs and spritsails have no place aboard any yacht. They are all atrocious to windward. I have little accurate information about the Chinese sail or the spritsail but we can do some estimating about ketches and schooners.

The R.O.R.C. rate ketches and schooners at about 90 per cent of their sail area. This loss (which is probably an underestimate) occurs entirely to windward. These rigs must therefore lose some 20 per cent or 30 per cent of their sail area to windward. Now, the extra mast which they carry only allows them to set about 20 per cent more sail. To my way of thinking, this means that the extra mast and the sail it carries is useless to windward and windward speeds would often be better without it. For a cruising yacht, therefore, I feel that these two masted rigs are better avoided. A large Genoa or spinnaker will make up for the loss of sail area on reaching and running courses.

CRUISING CATAMARAN CONSTRUCTION

The materials which could be used for building a cruising catamaran are as follows:

1 Sheet plywood, either as "hard chine" or "developed plywood".

2 Cold moulded plywood for rounded hulls. In the larger sizes, the "planks" are usually cut from sheet plywood.

3 Fibreglass re-inforced polyester resin. Epoxy resin would be better but is far more expensive.

4 Polyvinyl Chloride (P.V.C.) foam or "End grain Balsa" and fibreglass sandwich.

5 Light alloy.

6 Steel or ferro-cement.

Commercially built catamarans are usually built of moulded plywood, fibreglass, P.V.C. foam (or end grain balsa) sandwich, or light alloy.

Amateurs can use any method but for the rounded hull, which will most certainly be the shape of the future, the absolute simplicity of the P.V.C. foam and fibreglass sandwich will certainly be used more than in the past. Derek Kelsall, who has more experience of the method than most people, thinks that it is the method of choice for the amateur. It is quite as easy to build as the sheet plywood method. It is far more durable and costs very little more.

A Warning

All plywood hulls, whether of sheet plywood or moulded ply will have a limited life if there are voids in the internal layers. A very well moulded hull may last 10 years if cared for lovingly. Covering the hull with glass cloth and polyester resin has been used in an attempt to increase the life of the hull but, at least in some cases, such hulls have perished in only two years of life afloat. Epoxy or resorcinol are the only resins accepted by Lloyds. Both are glues. Polyester resin is not a glue and water can get inside the cloth and separate it from the wood with disastrous results.

CHAPTER II

HISTORY OF CATAMARANS

Tying two boats side by side with a cross pole or poles stretching between the outside gunwales is probably as old as the history of boats themselves. The extra stability and carrying power would be used to carry some heavy weight.

The Ancient Egyptians must have used several boats side by side to bring down some of their long, extremely heavy, granite blocks from Aswan. The Nile current provided the propulsive power and the crew merely had to keep the craft off sandbanks. In later days "Obelisks" were transported on specially constructed ships.

The above uses do not, however, constitute a catamaran, as we understand it. They are merely rafts. What makes a catamaran to us is the use of the stability to carry sail and this principle was first used by the Melanesians who now inhabit Papua and the nearby islands. This is where there were still primitive types of dugouts and outriggers in the 19th century—"living fossils" of the development. They also had some beautiful sailing outriggers and multihull catamarans which they used for inshore fishing and cargo-carrying.

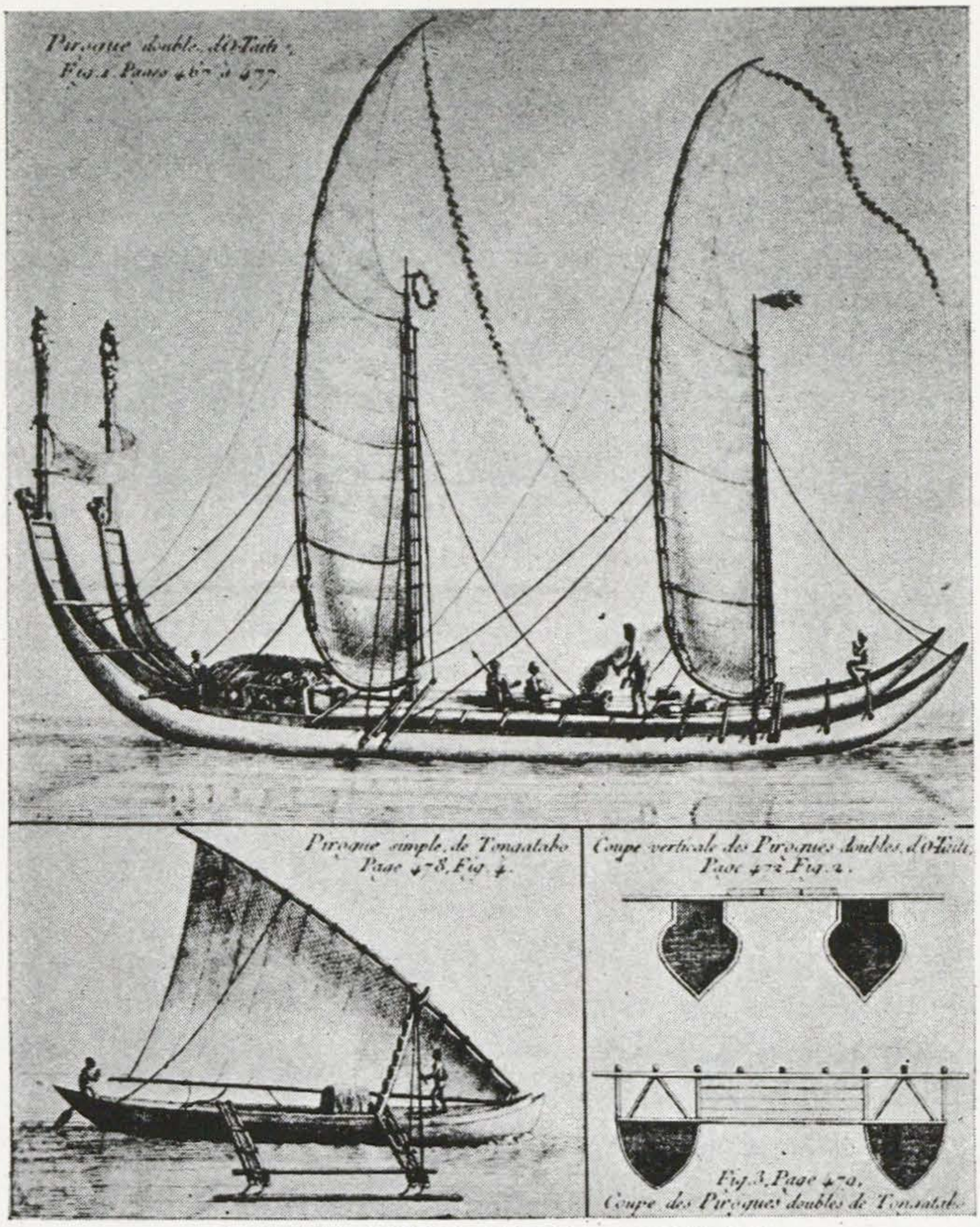
When the Polynesians, who then lived in what is now Indonesia, were driven out by the Malays just before the beginning of the Christian Era, they came in contact with the Melanesian single outrigger and catamaran and adopted a rather crude outrigger to their dug-out canoe, with the cross beams simply lashed to the float. The Melanesians had always used stick connectives between the cross beams and the float to avoid water resistance.

The Polynesian single outrigger was the craft with which they populated the islands of the Pacific. They almost certainly had a sail which was originally made from palm leaves. In New Zealand, they used a flax from which they made good cloth.

Polynesian boat building developed in the islands. In Samoa, they again met up with the Melanesians and adopted stick connectives between the fore cross beam and the float. The aft cross beam was a flexible stick which kept the float at a fixed distance from the hull but allowed it to pitch independently. In the Marquesas, quite large, plank-built single hulled boats were built, the planks being sewn together, though this may have been European influence.

In Hawaii, huge Redwood tree trunks floated out from California and these were hauled ashore. When two matching Redwoods were acquired, which often took many years, they were made into a large catamaran which was used for ceremonial and war. They were also used for planned migrations such as that to New Zealand, from Samoa.

When the Europeans first arrived in the South Seas, they seemed to have been little impressed by the Polynesian outrigger inshore fishing canoe. They noted the *Flying Proa* of Micronesia which sailed faster than their ships and Anson actually brought one home with him but their acceptance of new ideas



TAHITIAN SAILING CANOES—LESCALLIER

was not good. The seamen of the time would not sail in a boat which was not the traditional type with a fixed bow and stern and the designers wouldn't even consider it. As for the single outrigger, a dug-out was a savage thing only used by the "Wild Irish" of the time.

The attitudes of the 17th Century English sound quite modern. The prejudice arose, of course, from an incomprehension of the use of the human body as side to side shifting ballast in a sailing craft. The modern acceptance of the racing catamaran as a sailing craft, slow as it was, ultimately depended on the use of the sliding seat and the trapeze on dinghies. The yachtsman's mind was then able to envisage moving his body to keep a boat from capsizing.

The 17th Century English might not have been able to accept the Polynesian outrigger or Micronesian *Proa* but they were able to appreciate the double hulled catamaran which had bows and sterns and, in the larger sizes, did not need the weight of the crew for stability, when it was a sailing craft. It was therefore the double hulled catamaran which was taken up by western peoples. Single outriggers, double outriggers and proas were doubtless made here and there, but only as experiments by individuals and were quickly abandoned. We certainly have no account of them.

Sir William Petty was the first Western European to build catamarans. He built four: *SIMON & JUDE* (1662), *INVENTION II* (1663), *EXPERIMENT* (1664) and *ST. MICHAEL THE ARCHANGEL* (1684). The Marquis of Lansdowne, who edited and published any of the Petty manuscripts which dealt with catamarans, thinks that Petty knew nothing of the Pacific craft and independently invented what is now known as the "spread buoyancy" principle. What obviously happened was that Petty had heard of the Pacific craft in a casual sort of way and, later in life, worked out the principles and made the invention.

SIMON & JUDE (later called INVENTION I) (1662)

L.O.A.	20 ft (later lengthened to 30 ft).
Beam	"Over 9 ft".

She was built of two hollow cylinders, each two feet in diameter and bridged with a wooden platform. The mast was 20 ft long and set a fore and aft rig.

Apparently launched at Dublin, she immediately proved herself fast, routing all comers. " . . . one of them ye King's barge, another a large black pleasure boate laded with 2 tunns of ballast, and ye third a man of war's boate".

INVENTION II (1662)

She was larger than the first boat and was also launched at Dublin. Within a week or two, she had twice made the voyage to Holyhead and back, beating the regular packet boat. This won a wager of £50 for Petty, according to Samuel Pepys. *INVENTION II* was clinker built and the hulls were not cylindrical.

EXPERIMENT (1664)

Launched in the presence of the King and the Duke of York, she was larger that the two previous boats. Petty decided to send her to Portugal to test her. She arrived at Oporto safely and proceeded to Vigo. Homeward bound from Vigo, she was lost in a storm in the Bay of Biscay with all hands. Fifteen other vessels were also lost, so the storm must have been severe.

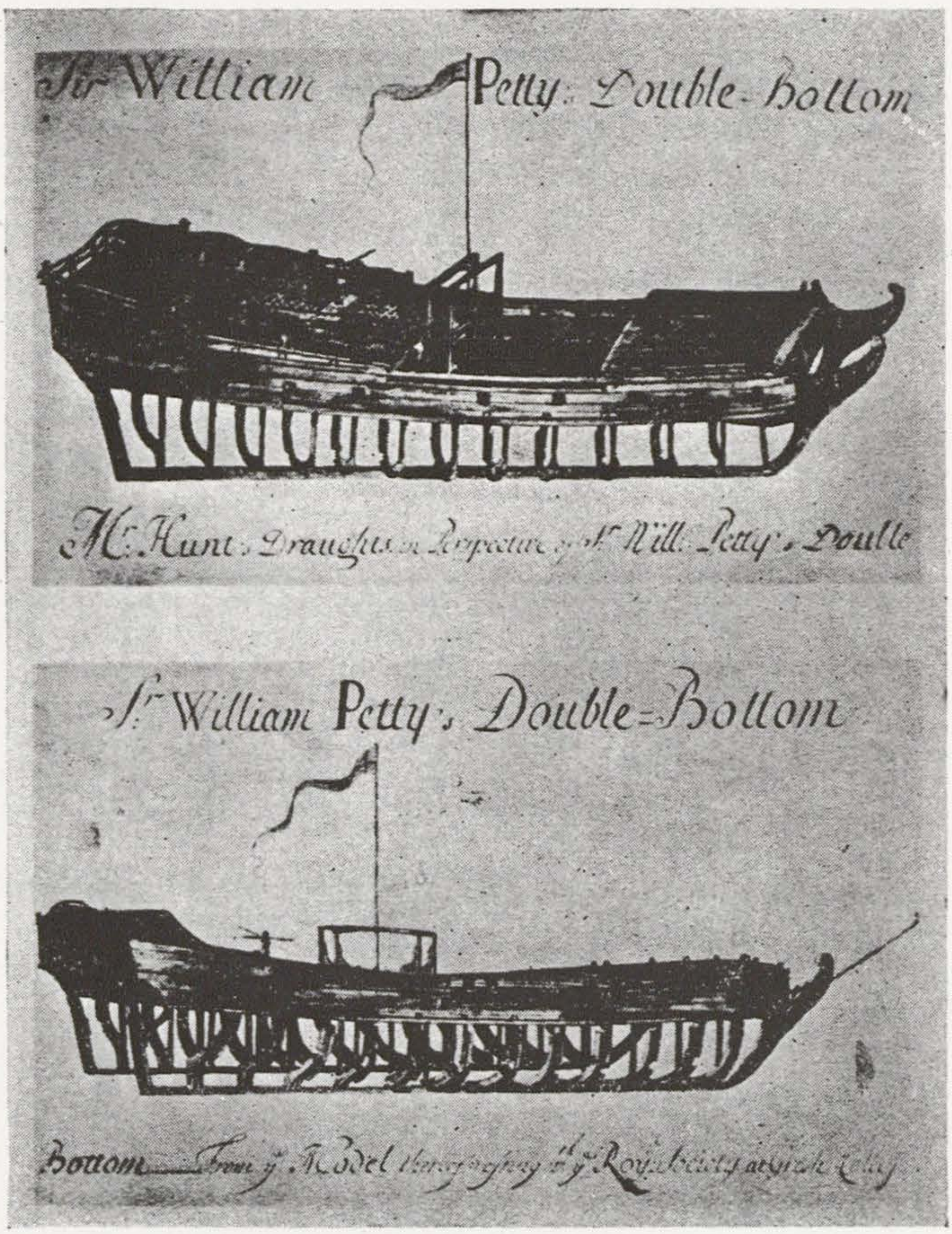
SAINT MICHAEL THE ARCHANGEL (1684)

Discouraged by the loss of the *EXPERIMENT*, Petty gave up his experiments for 20 years but in 1684, he again started building the last of his catamarans, *SAINT MICHAEL THE ARCHANGEL*. We have no record of her dimensions but she was a large ship. She had two decks and her mast stood 55 ft above the upper one.

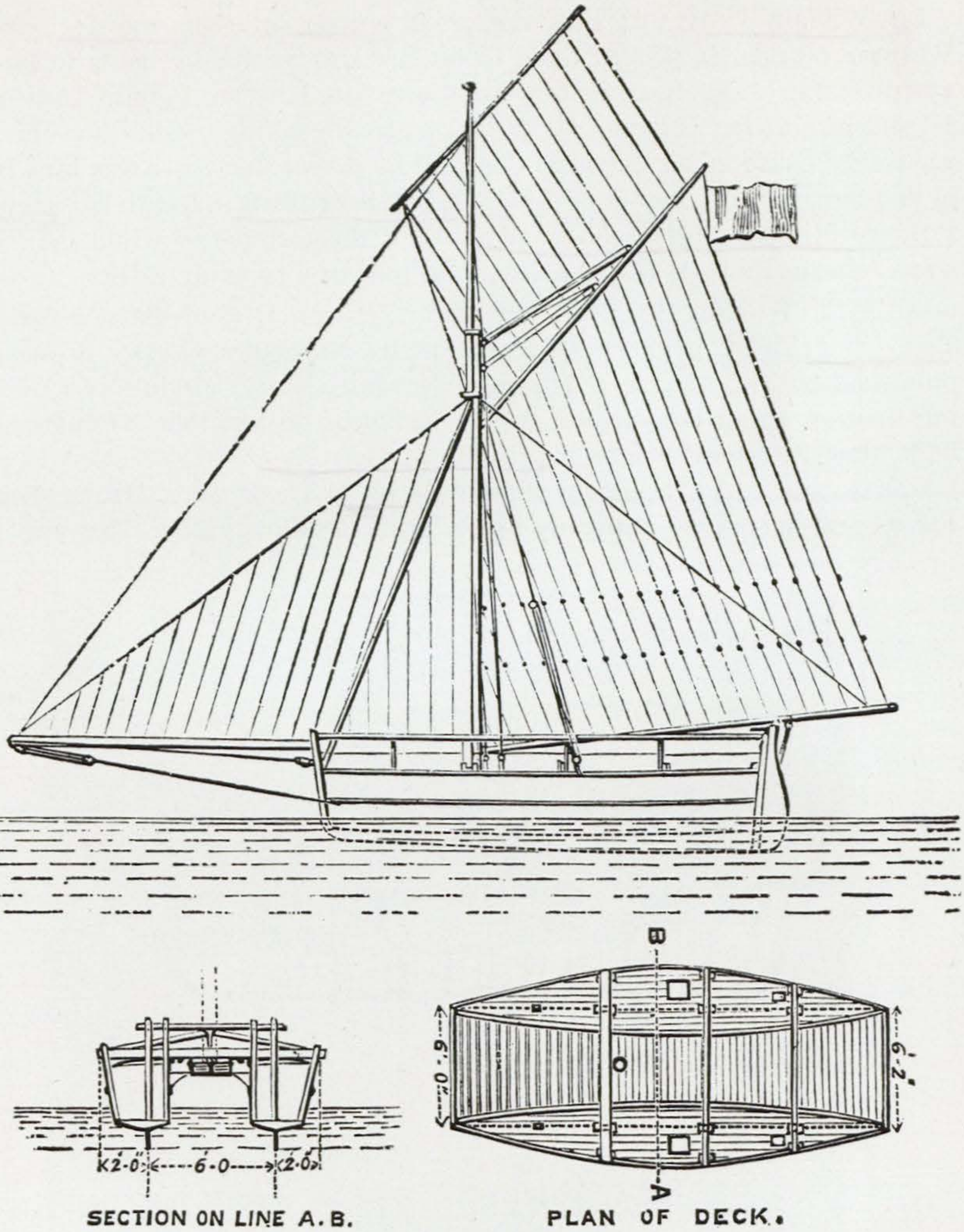
Again launched in Dublin, she proved so unmanageable that the crew would not sail outside the harbour in her. In view of the docility of the modern sailing catamaran, this seems odd. Perhaps the failure was due to the great windage—or it might have been due to the difference in sail balance between catamarans and single hulled boats—or the heavy displacement hulls may have been too close together, creating wave interference.

Sir William Petty was thus the great pioneer of the catamaran in the Western World. He proved them to be fast and seaworthy boats to himself and probably to us. His contemporaries were not, however, equally convinced. He did not, as far as we know, experiment with sailing models and this was a possible cause of his downfall. Nor did he realise that there was little point in building large catamarans—the single hull over 100 ft in length has adequate stability for less weight and windage than the catamaran while the "scale effect" means that the bridge uniting the hulls of a catamaran becomes weak.

After Sir William Petty, the catamaran was often re-invented by people. TWIN SHIPS, a 90 page booklet, written by Alexander Crosby Brown and published by The Mariners' Museum, Newport News, Virginia is a mine of information about the subject. Brown instances no less than 57 catamarans built after Petty and before Nathaniel G. Herreshoff's very successful catamaran yachts which began to appear in 1876. These were "Horse boats", Ferries and steamboats with only a smattering of sailing yachts. They appeared



ST. MICHAEL THE ARCHANGEL (1684)



John Mackenzie's 1868 Catamaran

to have been most successful as ferries where their low resistance and capacity to sail in either direction could be used. We will only quote the large ships and the sailing yachts and ships.

Steamers

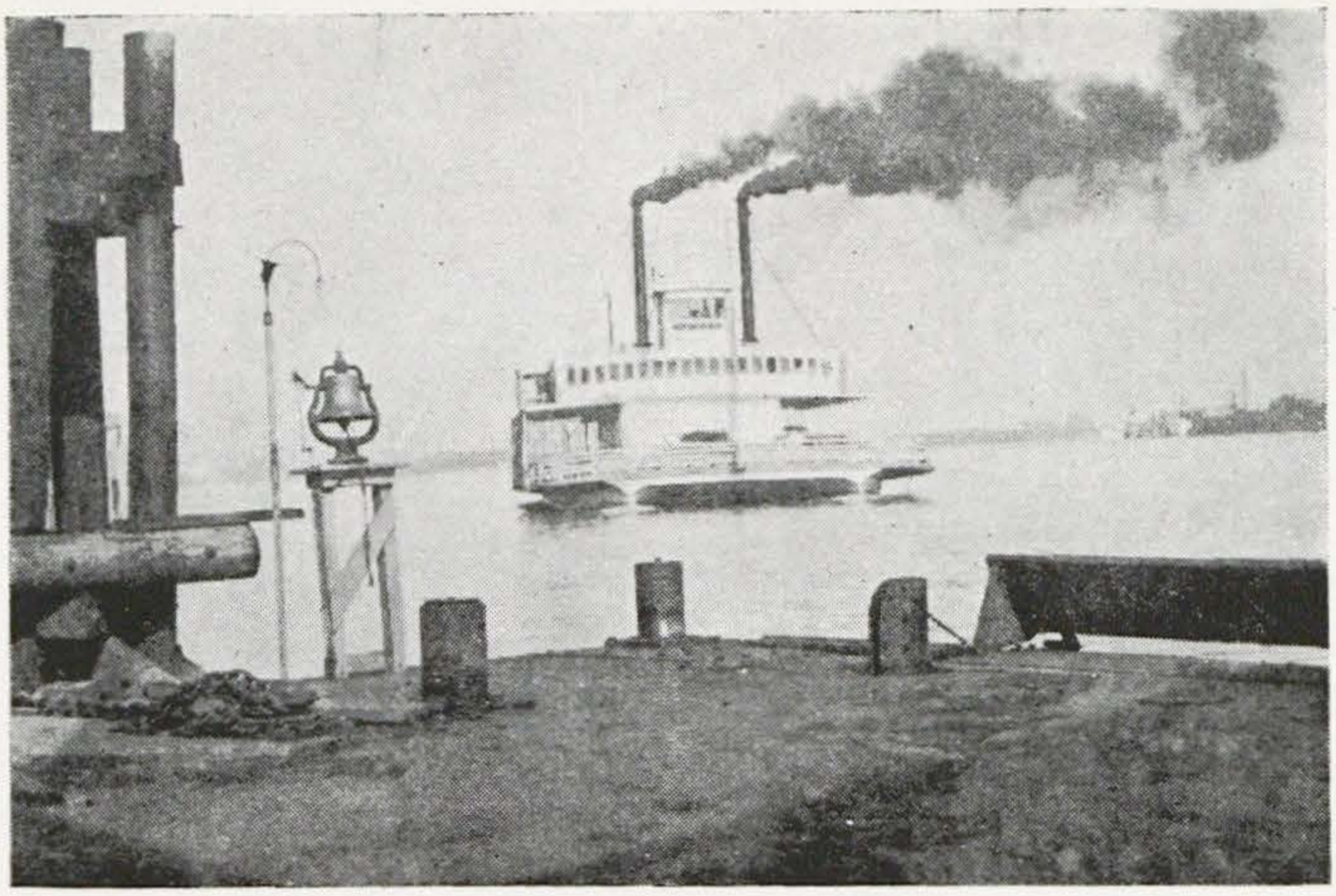
1834 177 ft Canadian catamaran steamer.

1838 *UNITED STATES*, 100 ft catamaran steamer built in New York for Lake Pontchartrain, La. (nicknamed "Siamese").

1843 Burdon's plan for a 600 ft Hudson River speed catamaran.

1857 *ALLIANCE*, 140 ft, Clyde built iron catamaran steamer.

1857 *BUNYIP*, Australian twin hull steamer.



Modern New Orleans steam catamaran ferry boat *ALGIERS*
Courtesy N. R. P. Nolan

Sailers

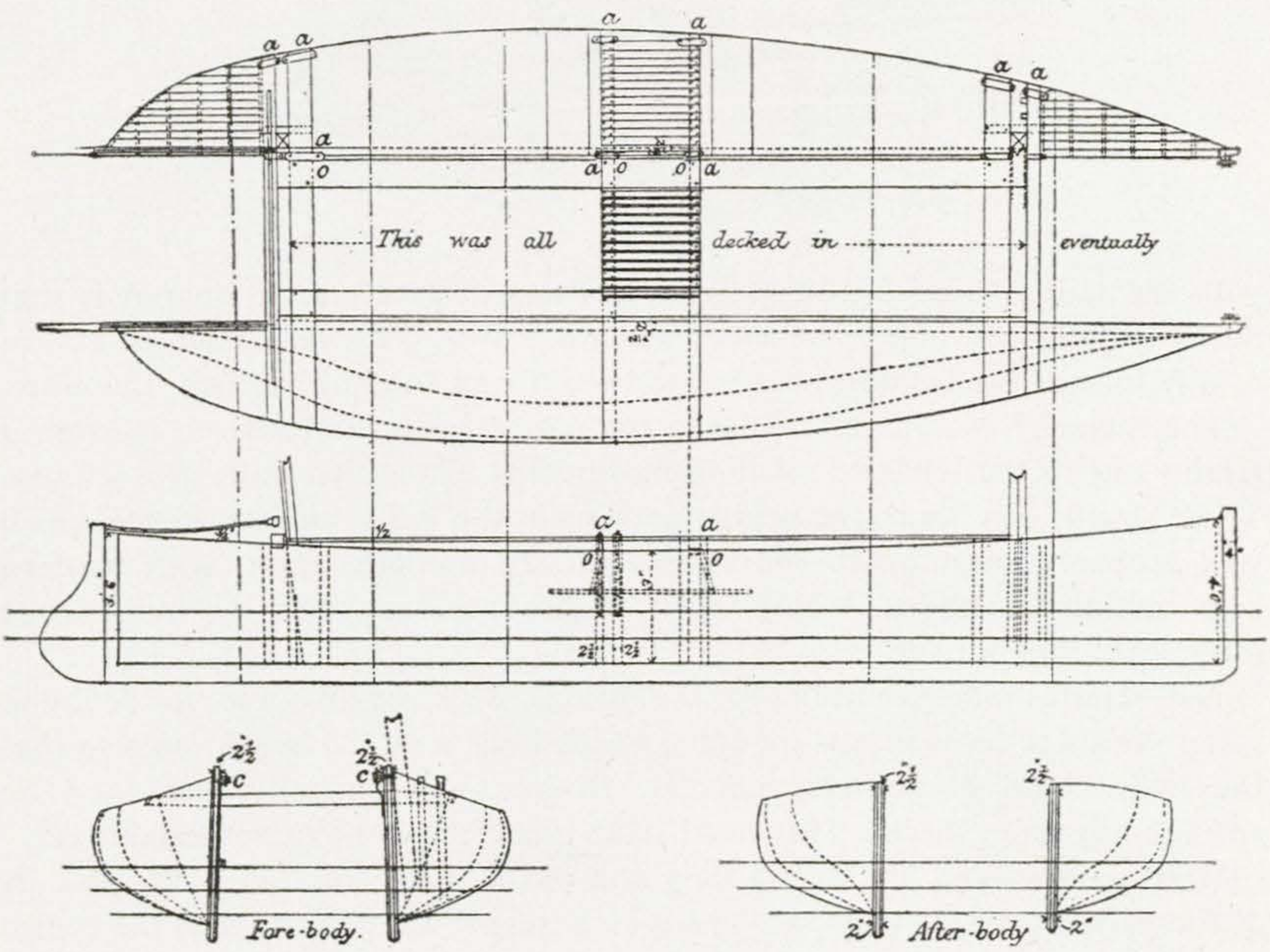
1687 *DOUBLE BOTTOM* built in Kerry of two decks and obviously a sailing catamaran triggered off by Sir William Petty's craft.

1786 Patrick Miller's 5 masted double ship, Scotland.

1820 *DOUBLE TROUBLE*, Stevens' experimental catamaran yacht.

1868 21 ft asymmetrical catamaran built by John Mackenzie, of Belfast.

1873 30 ft catamaran built by H. Melling, of Liverpool.

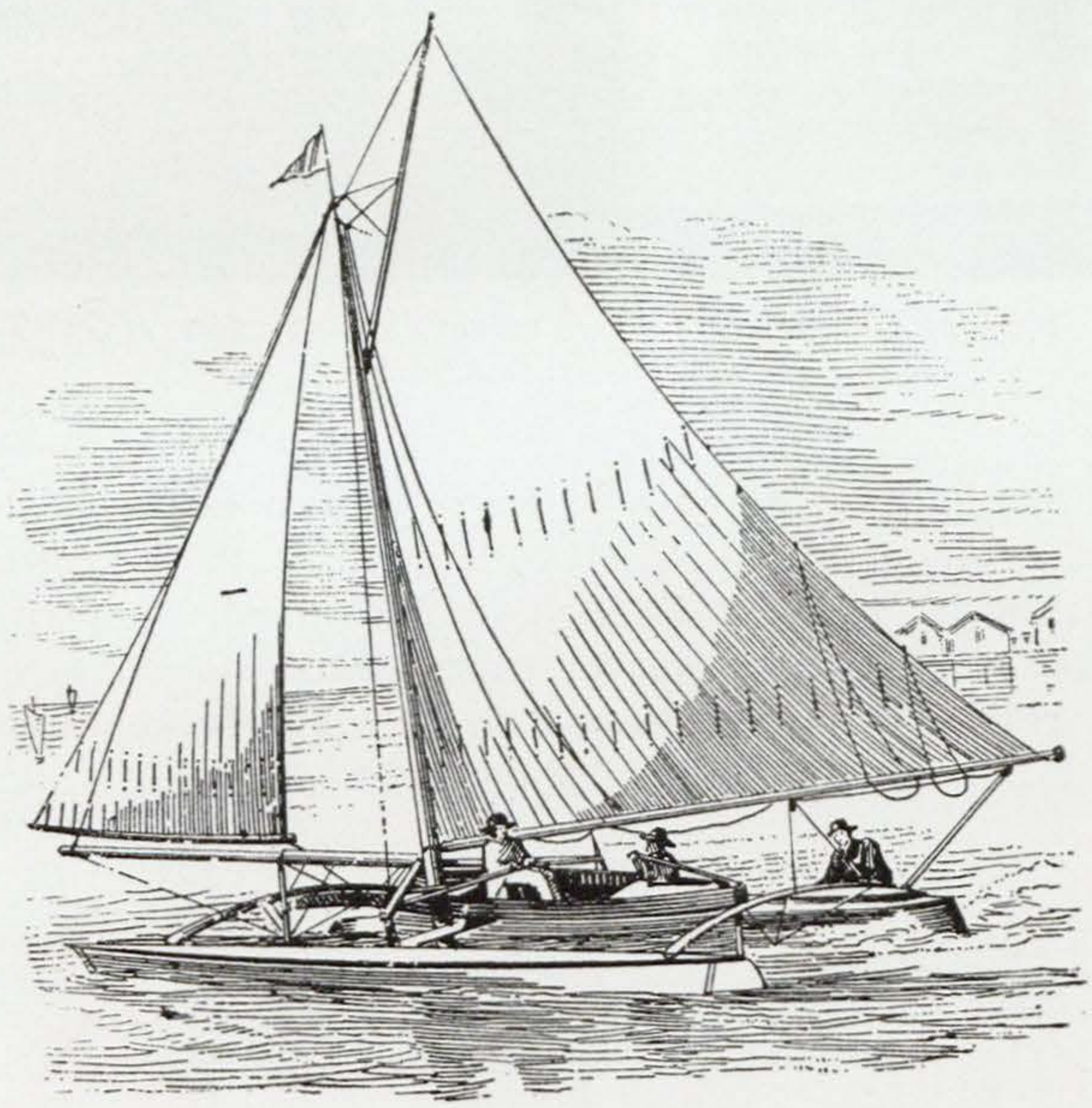


Col. Conway Gordon's *SPLITBOAT* Catamaran

Nathaniel Herreshoff

Nat. Herreshoff (the "Wizard of Bristol") re-invented the catamaran, taking his inspiration from the *flying proas* of the Ladrone Islands. Perhaps it was as well that either did not know or took no notice of the above mentioned British and American craft. They were fat tubs, most of them, with asymmetry often doomed to failure from the start.

The Herreshoff catamarans show that Nathaniel knew his trade. Long, slim, symmetrical, canoe-sterned hulls of light weight and low wetted surface were used. There was a centreboard in each. We could not build a better shape

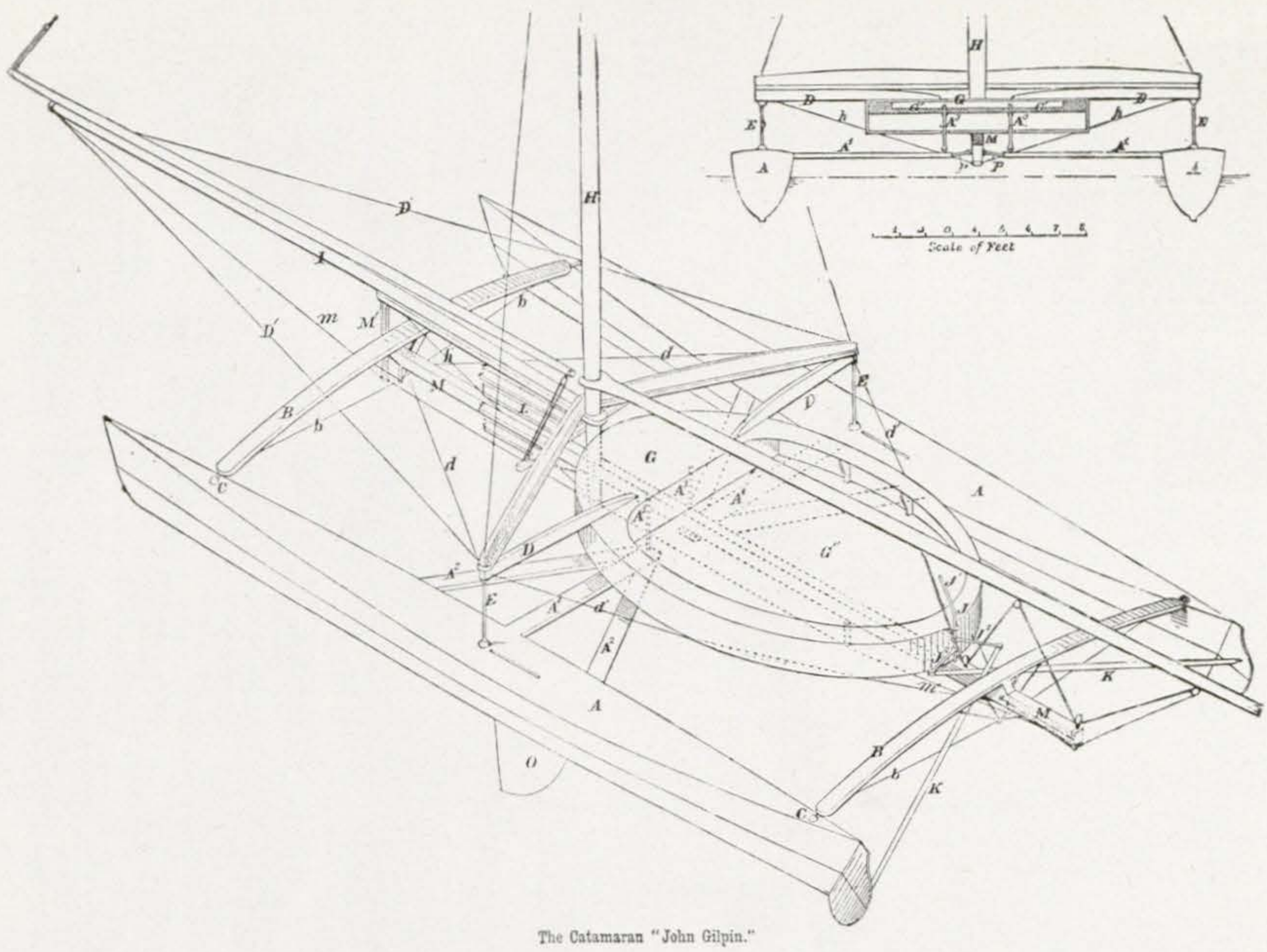


with the same materials today. What matters in a racing catamaran is that the slim hulls do not make large surface waves. The resistance is almost totally that of the friction between the water and the hull surface, therefore.

The majority of catamarans, even the native boats, suffer from enormous strains due to the separate pitching movements of the two hulls in a seaway. These strains can break the bridge deck from the hulls, an occurrence which was probably common in the early craft. In modern times, with modern constructional methods, I only know of one instance where the hulls broke loose after long service.

Nat. Herreshoff's solution to the bridge deck strains was to devise a system of three cross beams mounted to the hulls with universal joints so that the hulls could pitch independently. Rolling was partially restrained by springy ash cross pieces. This must have made the boat rather expensive.

Herreshoff spaced his hulls widely and put a "car", of oval form, just aft of the mast where the crew sat. The crew's weight was thus kept in the centre line.



The Catamaran "John Gilpin."

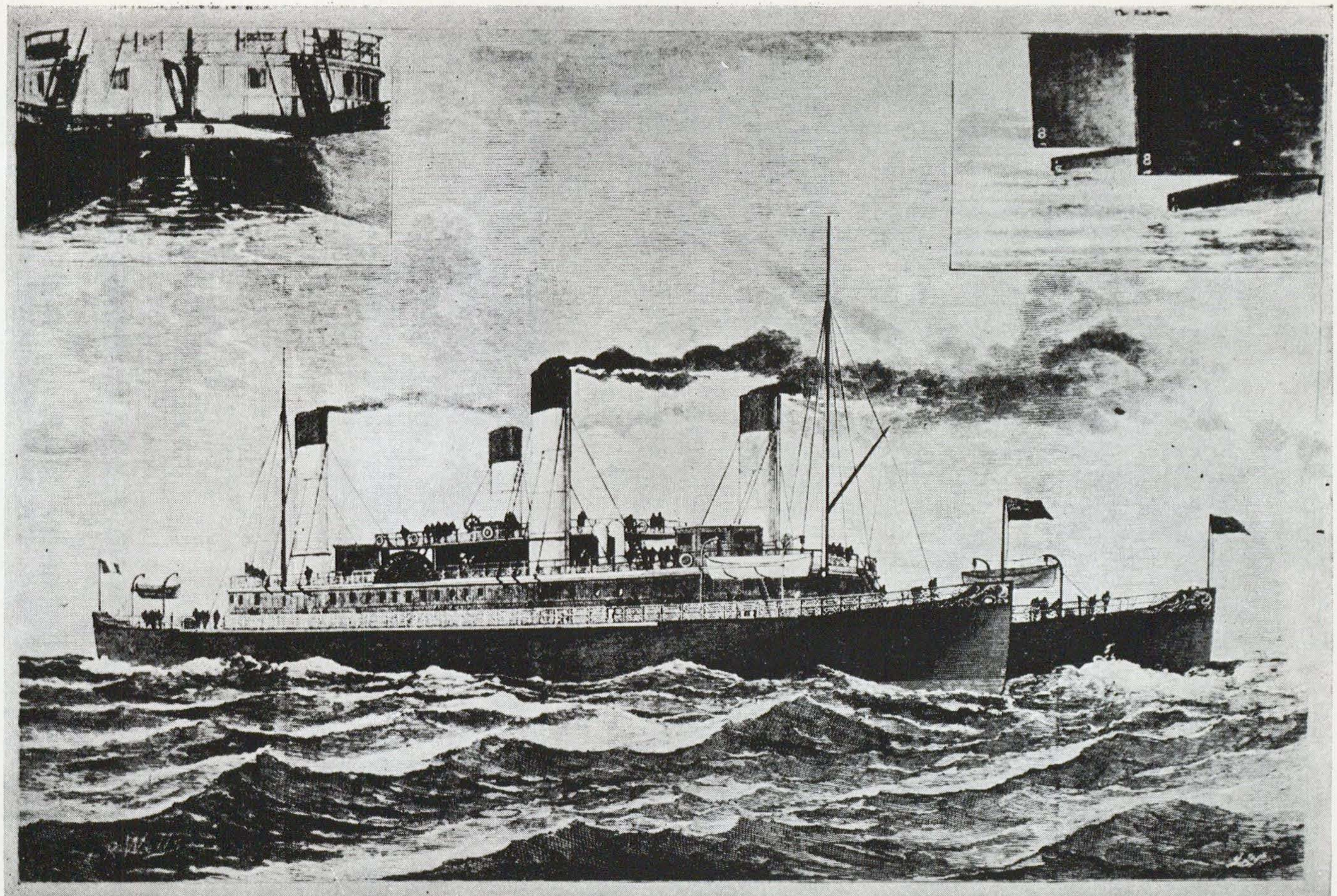
"Lee bow burying" was just as great a problem to Herreshoff as it is at present and he is reputed to have had his catamarans "pitch pole". This is an amazing procedure where the lee bow goes right under, the craft capsizes over it and finally, as a rule, finishes up by being upright in the water, facing the way it has come. The crew, meantime, have been flung off the boat. It is a condition to avoid.

The crew of the modern racing catamaran move aft in strong winds to keep the lee bow out. Dixon Kemp, from whom our illustration is taken, says that the same was done in the Herreshoff catamarans but the drawing clearly shows the crew member at the stern of the lee hull.

AMARYLLIS, a 24 footer, was Herreshoff's first developed catamaran. Launched in 1876, she easily beat a fleet of thirty-three yachts in the New York Yacht Club's Centennial regatta. *AMARYLLIS* was quickly followed by *ARION, TEASER, JOHN GILPIN,* 1878, *LODOLA,* 1879 and *TARANTELLA.* The last of these was 33 ft long and was timed at 18 knots on one occasion. Fifty-seven years later, in 1933, a copy of *AMARYLLIS* was made and officially timed at 19·8 knots over a measured mile.

Alexander Brown, in TWIN SHIPS, next gives a 60 ft schooner catamaran. She was launched in 1877 by Anson Stokes, having been built in the bowling alley of his house. Resembling the modern Wharram catamarans with all the accommodation in the hulls, *NEREID* won no races but was well able to keep up with the N.Y.Y.C. squadron.

Thomas Fearon, of Yonkers, New York, was another catamaran builder. We believe he followed the Herreshoff system. His craft were as follows



THE LONDON, CHATHAM, AND DOVER RAILWAY COMPANY'S NEW DOUBLE STEAM-SHIP, CALAIS-DOUVRES, FOR THE CHANNEL PASSAGE.

'CALAIS-DOUVRES

1877, *JESSIE;* 1881, *NIGHTMARE* (42 ft L.O.A., 21 ft 6 in Beam, 2 ft 6in draft); 1882, *DUPLEX* (40 ft × 20 ft × 1 ft 10 in); 1885, *HATTIE* (40 ft × 19 ft × 2 ft 6 in) and 1886, *CORSAIR* (42 ft 6 in × 28 ft × 3 ft). The Fearon catamarans were obviously successful but the details are scanty.

Coughtry and Felt were two other catamaran builders, their boats being *PARADOX* (1883) and *LOU* (1886) respectively.

After Herreshoff and Fearon, the catamaran went into a decline as a racing yacht. They were banned from racing in nearly all regattas and there were not enough of them to race amongst themselves. They gradually dropped out of the racing scene and were forgotten. However, their commercial uses continued and Brown gives 25 instances of their use (or planned use) for applications other than yachts between 1876 and 1898. The most noteworthy of these are as follows:

1877 *CALAIS-DOUVRES*, a 300 ft English Channel steamer.

1879 146 ft steam catamaran for Sarotoga Lake, N.Y.

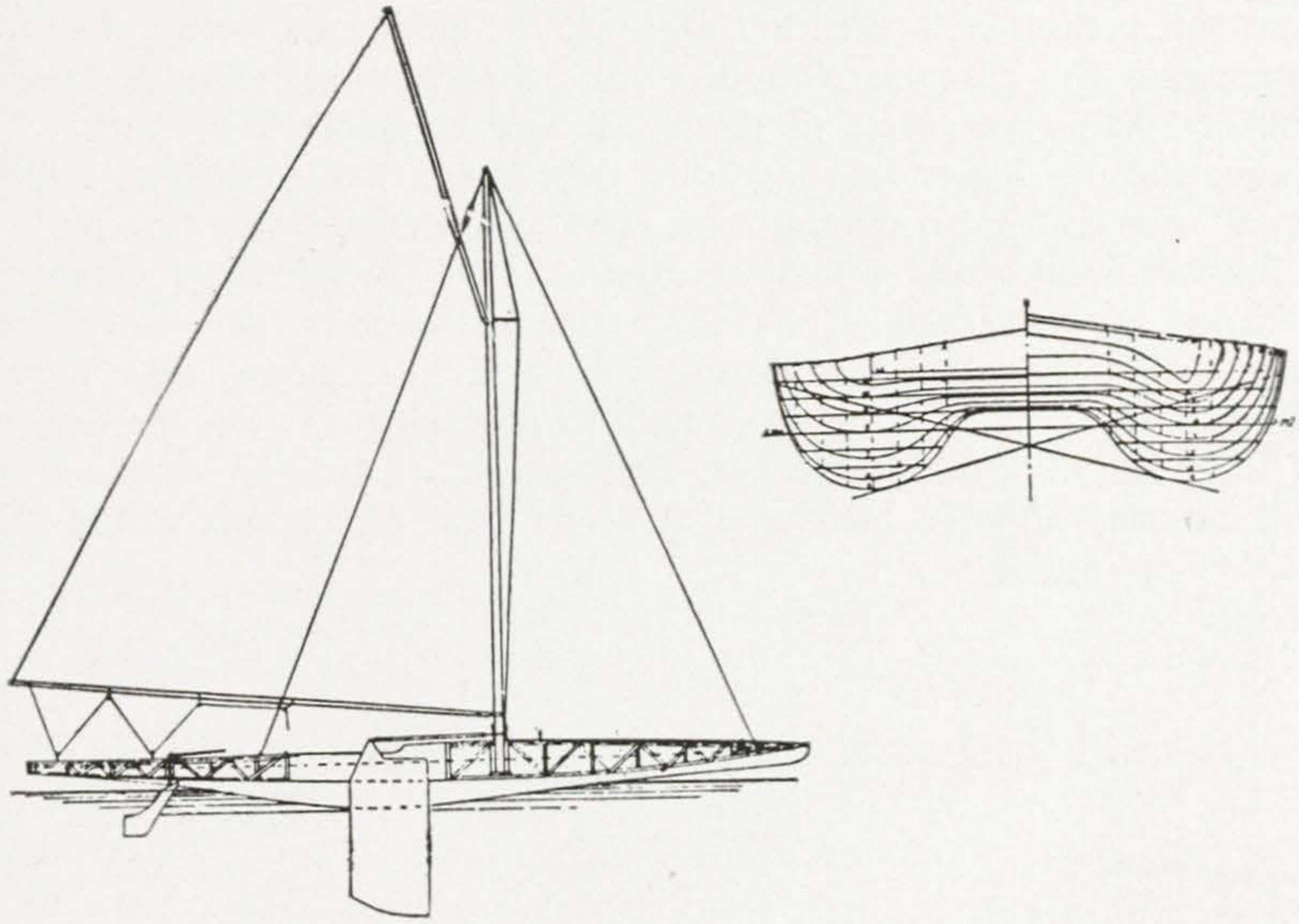
1879 *NOVELTY,* by Voorhis, a steamer.

1880 *HENRY W. LONGFELLOW,* also by Voorhis, a 200 ft steamer.

1882 *OCEAN PALACE,* an Australian catamaran steamer.

DOMINION and the Scows

The scow is an elongated dish of a boat taking its ancestry from the river punt. As a sailing yacht, the angles at the bilges are rounded off and two boards are carried, one for either tack. It is always sailed heeled to get the maximum L.W.L. and to produce a hydrodynamic shape which is far better



DOMINION

than that of any other sailing boat except for the Micronesian outrigger. As a result, it is faster than any dinghy and always beat the field in the magazine YACHTING's "One of a kind" races at Miami until soundly trounced by the racing catamarans in 1959 *TIGER* (Bob Harris), *COUGAR* (Prouts), *SHEARWATER III* (Prouts). On this occasion, it was also beaten by an International Canoe and a 505 dinghy.

DOMINION came out in 1898. Designed by a Canadian, G. H. Duggan, she was 37 ft L.O.A. on a 17 ft 6 in waterline giving low overhangs of 19 ft 6 in. Though having the deck of a scow, the bottom was raised in the middle to make her, technically, a catamaran. She beat all the other scows in her first year of racing and the type was promptly banned for evermore.

Alexander Brown instances 21 catamarans between *DOMINION* and Eric de Bisschop's *KAMILOA* of 1937, mostly Mississippi steam ferry beats. He includes, however, a couple of trimaran proposals and Malcolm McIntyre's highly engineered catamaran whose hulls were kept parallel with each other but the lee one could be pushed forward to take the capsizing moment of the sails. This was (and probably is) a good idea but the craft was fitted with sloping triangular sails which dissipated the sail force. Edmond Bruce has shown that the sail force falls off as the *square* of the cosine of the angle of heel of a sail.

KAMILOA was built by Eric de Bisschop and Joseph Tatibouet in Hawaii and was 45 ft long. She was sailed from Hawaii on March 7, 1937 and arrived at Cannes, in France, on May 21st, 1938. Undoubtedly, she has been the inspiration of the many French multihulls which appeared in the post 1939-1945 era.

Alexander Brown's booklet TWIN SHIPS was published in 1939. He concludes that there are recurrent waves in interest in catamaran types with inevitable periods of hibernation. He says: "Undoubtedly, occasional sailing catamarans will continue to appear from time to time, although it seems unlikely that whole fleets of them will ever be adopted by yacht clubs. Unquestionably highly sporting craft, they do not have, however, sufficient "boat" about them to interest more than an occasional yacht owner."

Brown's opinion was probably correct in 1939. The Herreshoff catamarans were too expensive and of only modest performance in light winds due to their weight. All other catamarans, with a few exceptions, were hopeless sailing craft. They were slow and hard to manoeuvre. It was the discovery of the resin glues during the 1939-1945 war which gave us sheet plywood and moulded plywood boats and thus very light catamarans with a firmly fixed bridge-deck.

CHAPTER III

MODERN SAILING CATAMARANS

by John Morwood

In 1947, I wanted a boat. Being poor and having had some previous experience with boats, I knew that the best place to keep a boat was one's own back yard. It is then always under one's control. When one wants to sail, it must be easily transportable to the water and then not take too long to get ready. I believe that the man who produces a 24 ft *Curragh**, with sleeping accommodation and perhaps stabilised with hydrofoils, weighing perhaps some 200 lbs in all, will be in the boat-building business for good.

In 1947, as today, the boat I needed was not to be bought, stolen or (except by me) begged. Trailers at the time were heavy and had to be made by the local garage. The boat I chose was a Prout folding canoe, which could be carried on top of the car.

In order to collect my canoe, I went to the Prout works at Canvey Island. Roland Prout and I got chatting and he very kindly showed me over their premises where I saw a "finger light" kayak hull of what I thought were lovely lines. It was made of "moulded plywood" and had a finish on it like glass. I was impressed.

I took my canoe home, and later tried out a squaresail on it and also did some "tethered tests". But the Prout kayak hull stayed in my mind as an example of minimum resistance. Thinking about this, I re-invented the multihulls and sent Roland Prout a letter showing how the kayak could be used as a basis for these, with lots of sketches. I got a letter back from Francis Prout saying that he apologised for replying in place of his brother but Roland was very busy these days experimenting along the lines I suggested.

I can thus personally vouch for the fact that Roland Prout had made his

*The Curragh is the aboriginal boat of the British Isles. The modern form is a lathe and tarred canvas craft 25 ft long and 4 ft beam. The ancient form was probably of the same dimensions, though the Welsh "Coracle" is of the same class. St. Brendan, an Irish monk from Co. Kerry who must surely be the first "Ocean Yachtsman", did a long Atlantic voyage in the 6th Century in a Curragh made from split hazel shoots and buttered bull hides.

St. Brendan's book was a "best seller" in Medieval times. He claimed to have seen "Mountains of fire" (Iceland), "Rivers of gold" (???) and "Fish which fly". These last must surely have resulted from a coasting voyage down the American East Coast. The "rivers of gold" are a little hard to place but then, St. Brendan and his crew had quite a few conversations with Biblical Characters on his voyage.

I do not dispute the accuracy of St. Brendan's story. Irish monks were found by the Vikings on Iceland when they arrived so they must have been regular "Ocean yachtsmen". However, St. Brendan's book does indicate that, if the ocean voyage has been daring enough, the perpetrator will be subsequently believed on any subject about which he cares to write. This may well have been St. Brendan's objective.

Curraghs were also used by St. Columba and his monks in founding their religious house on Iona, in the 6th Century. There must subsequently have been a considerable migration of the Irish (then called Scotii) in curraghs to found the kingdon of Dal Riada and subsequently to give their name to the whole country (Scotland). Previously, the land had been inhabitated by Picts.

first experimental catamaran in 1947 and was then sailing it. I suppose that my letter was "mulled over" a bit and filed because I was asked to sail in *SHEARWATER I* when it finally came out in 1954. It was, of course, made on a basis of two kayak hulls firmly united by a plywood bridge-deck, all firmly screwed and glued together.

The story of the Prout racing catamarans is not within the scope of this book. Suffice it to say that they produced *ENDEAVOUR* for Ken Pearce, *SHEARWATER II* and *SHEARWATER III*, *COUGAR* and various 'C' Class catamarans. We are only concerned with their cruising catamarans at present.

MANU KAI

Woody Brown and Alfred Kumalai

These two men lived immediately after 1945 in Hawaii where Captain Cook described the magnificent double war canoes of the 18th Century. Native outriggers still surf through the breakers to the shore every day. What could be more natural then that the catamaran should be developed there with the new waterproof sheet plywood and resin glues. Their first boat was *MANU KAI.*

MANU KAI (sea bird) was launched in 1947. She was built of the new materials and was very light. To my thinking, her asymmetry and deep hulls owed much more to the "split boat" tradition, backed by the motorised catamaran produced by Gar Wood in the nineteen twenties than to any incisive considerations of lateral forces and windward ability. It is also to be noted that the shape chosen could be "skinned" with sheet plywood.

MANU KAI was a great success. She was fast and could be sailed from a beach to take visitors day sailing because she had no centreboards. Indeed, she was such a success that asymmetry and deep hulls became an act of faith on the West Coast of the U.S.A.

C/S/K

Rudy Choy now joined up with Warren Seaman, who had designed the *Malibu Outrigger* (a very fast and seaworthy single outrigger "beach boat") and Alfred Kumalai to form the firm of C/S/K. All their original catamarans were of the *Manu Kai* shape with asymmetry, deep hulls and canoe sterns. By extreme attention to light weight and large sail areas, the C/S/K catamarans were very fast indeed. The single craft of the "British School" designed by Hugo Myers was *DREAMER,* a rather heavily built catamaran. She could seldom catch any of the C/S/K boats in any of the races. Perhaps one should note the majority of the West Coast "Spectaculars" are downwind races. The feather light designs of Rudy Choy would have beaten any contemporary British cruising cat.

In the day-racing field, the C/S/K cats, despite dropping the skin thickness to 2 millimeters, were not able to put up much of a showing against the British cats or those of Bob Harris, of Long Island. Moreover, centreboards were proved necessary, thus showing that the asymmetry was not very effective.

The Cunningham Catamarans

In Australia, the Cunningham brothers also took to catamaran designing in the immediate post war period. Using sheet plywood, they produced the *Yvonne* whose hulls were 20 ft long. They were symmetrical, shallow and canoe-sterned and were chined and plywood versions of the Herreshoff catamarans. The *Yvonne* was an immediate success in Australia. Fleets of them soon appeared. Another Cunningham design the *Quickcat*, with shallow box sections and 16 ft L.O.A. was designed for home building in sheet plywood and also became popular, locally. However, in racing with the Prout *Shearwater* the extra weight of hull from the stringers and frames and the chine construction gave extra wetted surface. In general, the *Shearwater* proved to be faster.

When the *Yvonne* first came to the notice of the AYRS, we were urgently seeking to find the best catamaran hull shape. It was my job as AYRS Editor to evaluate every design. Naturally, I approved of the shallow and slim symmetrical hulls of *Yvonne*. However, I felt at the time that the canoe stern was a "waste of boat" and that a shorter hull with a transom would be faster. This viewpoint still seems logical but I have been proved wrong in practice.

The Cunninghams have shown that the saving of weight and windage from a canoe stern, combined with the lesser water drag when the sterns are immersed in a seaway give the canoe stern an advantage. The series of very light *Quest* 'C' Class catamarans with which they have challenged the British and then the Danes in the "Little Americas Cup" have in the later versions proved faster than the transom sterned craft. The little 'A' Class *Australis* with a canoe stern also proved to be quite as fast, if not faster, than the transom sterned 'A' Class boats.

Nobody likes to be proved wrong and I am no exception. In order to justify my original opinion, I assume that the beam to length ratio decreed by the rules is low enough for the hull length not to matter too much. If the beam were larger in proportion to length, one would have to use the hull length more fully. This would result in the transom stern being faster.

The canoe-sterned racing catamarans do not appear to me to pitch more than the transom-sterned ones. This must be because they are so light that they cannot develop any "pendulum effect". The natural "damping" of the bow or stern going into a wave is enough to destroy the small amount of inertia of the craft. The steadying effect of the sail or sails also helps.

Summary

There were three groups of people who developed catamarans on the advent of sheet and moulded plywood construction and resin glues namely: The Prouts in England, Woody Brown and Alfred Kumalai in Hawaii and the Cunninghams in Australia. The shapes of their boats mean that each development was on its own and derived nothing from the others, each style of design being original. The Prouts were the luckiest of the three because they had the paddling kayak, built of moulded plywood, to work from.

From the three original schools, other designers came on the scene. Bob Harris on Long Island, Rod MacAlpine-Downie, of England and Young of New Zealand followed the Prout line. Bill O'Brien, in England and Peter Hooks in Australia followed this line with chined hulls. Rudy Choy followed Woody Brown in California while the *Australis* 'A' Class catamaran, follows the Cunningham school.

Cruising catamarans have been produced by nearly all these designers more or less as scaled up versions of the racing and day sailing craft though, of course, Rudy Choy was designing cruising or ocean racing catamarans right fron the start. Michael Henderson (*PETANQUE, MISTY MILLER* and *GOLDEN MILLER*) tank-tested hulls for his *PETANQUE* and then designed the other two craft.

CHAPTER IV

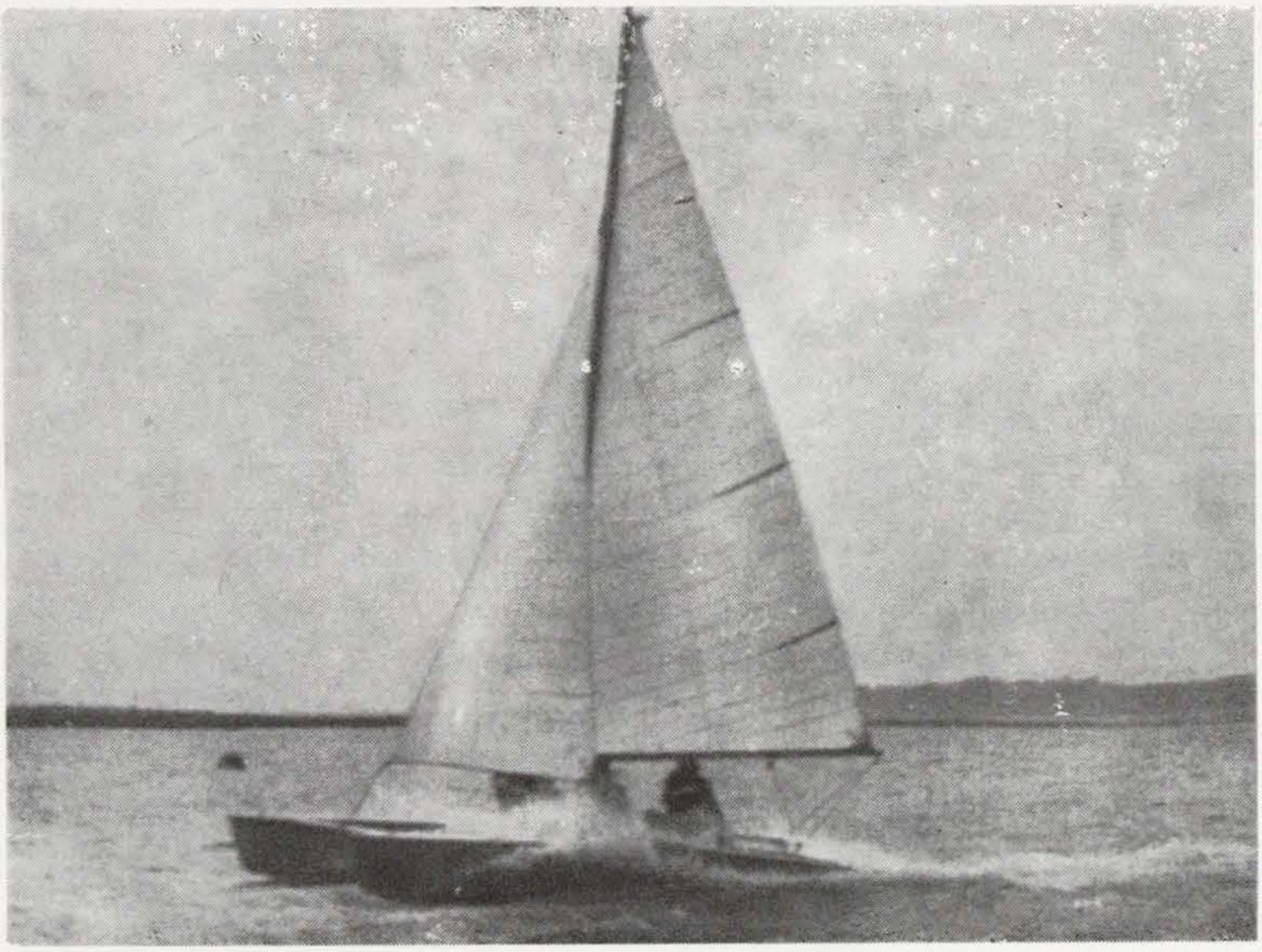
RACING AND DAY-SAILING CATAMARANS

April, 1956

Roland Prout

In 1947, Roland, helped by his brother, joined two of their canvas Esquimeaux Kayaks by planks of wood. These Kayaks had been designed for "Rolling" which is the Esquimeaux feat of capsizing, then by using the paddle, turning completely upside down and rolling over to break the surface again on the opposite side having made a complete circle *under* the Kayak. The sections of the craft were therefore fairly well rounded so as not to be too stable. This produced a craft with a small wetted surface.

The weight of this first catamaran was about 150 lbs including the mast and rigging. The hulls were 16 ft 6 in long, 20 ins beam and they were spaced so that the outside beam was 6 ft 6 in. A midline rudder and dagger board



SHEARWATER I

completed the craft. The sail was a single lugsail. This craft sailed quite well but was not exceptionally fast. It went to windward and came about but was slow in stays. Considered on its own, the experiment was encouraging and showed that the objections to the double hulled catamaran were not inherent in the craft but could be due to faulty design.

It was not until 1949 that the second catamaran was made. Perhaps again it needed a period of thought for all the facts which the first test had produced to assemble themselves for a second trial. This time, two of the racing Kayak hulls were joined by a bamboo frame and platform, a single dagger board and a central rudder being again used.

The weight of this craft was 80 lbs complete with a lugsail and the jib of a fourteen foot International dinghy. The hulls were 17 ft long and 16 in wide and spaced so the outside beam was 7 ft. This boat was very fast on a reach and also went quite fast to windward being comparable to the faster types of dinghys for speed. It came about but was rather slow in stays. Owing to the bamboo construction the hulls worked separately in the waves.

The third experiment was in 1954 when *SHEARWATER I* was made. The mould for this had also been designed for making racing Kayak hulls but the sections were almost semicircular to get the greatest possible paddling speeds, and as a result, they were rather unstable as Kayaks but ideal for a catamaran. The hulls were 17 ft 6 in long × 10 in waterline beam and were spaced to give an outside beam of 8 ft. The freeboard was built up by flat plywood to put the gunwale 1 ft 6 in above the water. A central centreboard, rudder and Bermudian rig of 145 sq ft were used. The weight was 380 lbs.

SHEARWATER I gives a very fast ride and has gone at 20 knots at its best. She is also an excellent sea boat, slicing through the waves without slowing down very much and without bringing much water aboard. At first, she tended to bury the lee bow when close hauled in strong winds but this was cured by bringing the rig back into the boat. Like her forerunners, she doesn't fail to come about but is still just a little slower in stays than other boats. She carries strong weather helm when the plate is up but is balanced with it down. She will beat to windward without any plate at all. Both bow and stern posts are in the water when floating.

SHEARWATER I was such a success that it was decided to design and make a mould especially for the hulls of *SHEARWATER II*. It was thought that with beamier and hence flatter hulls she would be faster and with more rocker, she would come about better. The almost semicircular sections were again used and the buoyancy was spread out rather more towards the ends to save a little on wetted surface and to prevent the lee bow from burying. The length of the hulls is 18 ft with a waterline beam of 14 in and a draught of 6 in. They are spaced so that the overall beam is 9 ft 6 in. The sail area is 170 sq ft and the total weight is 500 lbs without crew.

SHEARWATER II, which was launched in 1955, is better than *SHEARWATER I* on an average racing course by about 4 to 6 minutes in the hour. When reaching, however, especially in rather lumpy water the speeds are very similar. She is not quite so dry because she has a little more beam forward than the earlier craft but very little water comes aboard when travelling at the speeds of a normal planing dinghy. *SHEARWATER II* has been timed at 21 knots but has done better than that on occasions, Roland estimating 25 knots.

Compared to other dinghys, *SHEARWATER II* is very fast indeed. On an average racing course, she can give the Thames Estuary One Design

SHEARWATER II at speed

18 ft dinghy 15 minutes in the hour and still beat her handsomely. She sails fastest on a close reach but is still faster than the T.E.O.D. to windward. She puts about quite as easily as other normal boats and has been timed from tack to tack at 12 seconds, which is very fast indeed.

In all, *SHEARWATER II* is an ideal sail boat. The large cockpit, 9 ft square approximately, makes it very comfortable as a family man's day boat and it is quite possible to put up a canvas cabin for sleeping. The firm way she sits on the water at all speeds is ideal for the man who no longer feels he wants to sail in the uncomfortable attitude of the dinghy sailor in strong winds. It is possible to lift the weather hull out of the water in strong winds but this does not help sailing and it is best to ease the sheet if the weather hull shows any signs of coming off.

Whether we like it or not, the catamaran has come to stay. Looked at from the viewpoint of comfort, safety or speed, it is far superior to normal craft in the form to which it has been taken by Roland Prout. For cruising or racing, it will soon be seen in great numbers around the coast. It would appear that the hulls have got to be of the sections and shape described. No one has so far managed to make a successful catamaran with chine hulls though this may yet be done. Never tie your sheet, however.

After sailing a season with *SHEARWATER II,* the Prouts decided that she was too big for a commercial proposition, shortened the hulls to 16 ft 6 in and produced *SHEARWATER III.* The same mould was used for both craft.

SHEARWATER III

January, 1963

Length	16 ft 6 in	Beam (total)	7 ft 6 in
Hull beam	Max. 1 ft 6 in, on W.L. 13 in	Weight	255 lbs
Sail area	160 sq ft. Mainsail, 115 sq ft. Foresail, 45 sq ft		

This is a catamaran designed by Roland Prout. It is now being produced for sale at approximately £320 with terylene sails. It can be had as a kit with the hulls moulded and all other parts sawn to shape for £226 14s 0d with terylene sails. *Ed : Modern prices are very different.*

SHEARWATER III was designed to produce a reasonably priced craft of popular appeal, and it is now the world's best known catamaran, a British

SHEERWATER III in Jigs

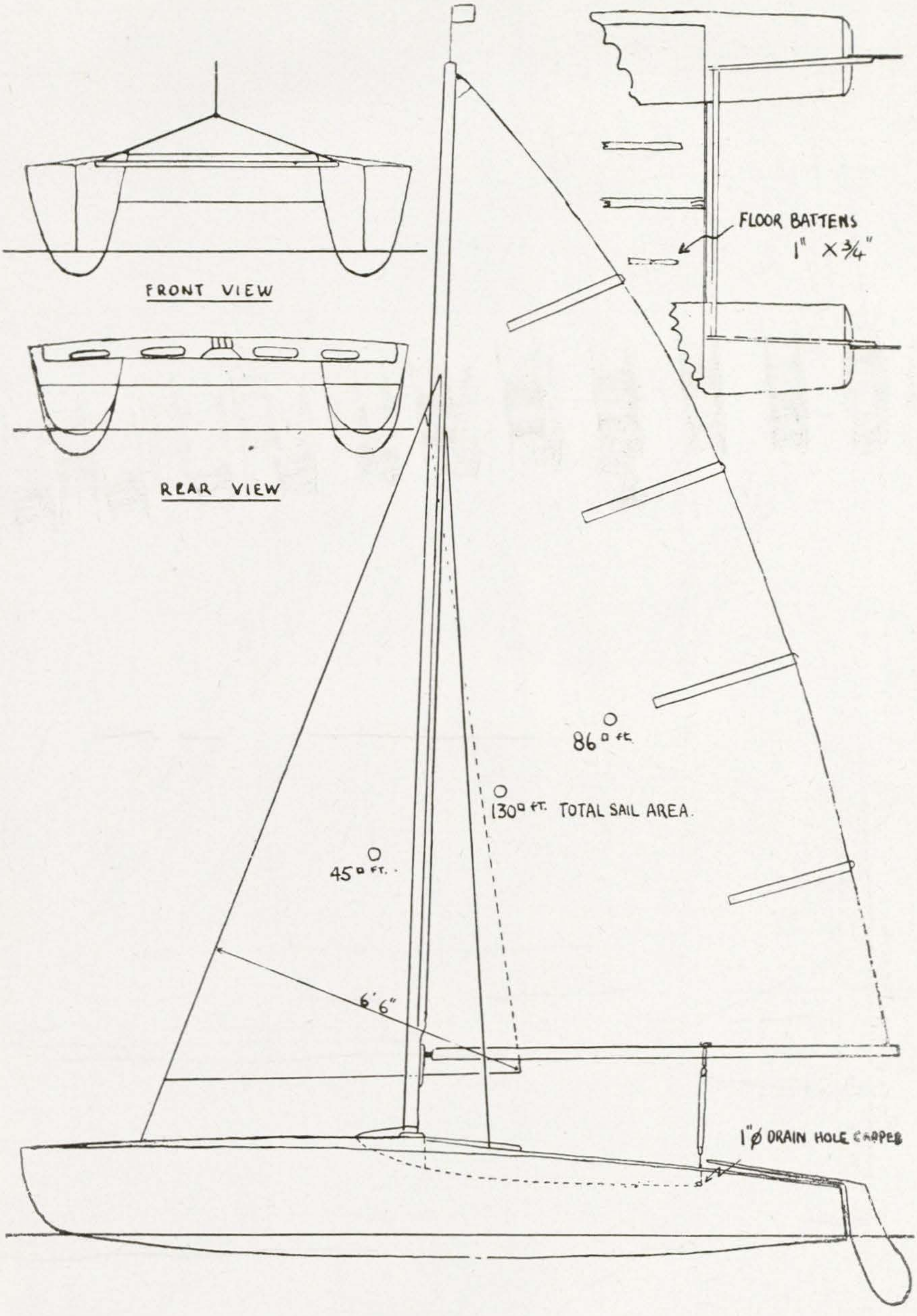

FRONT VIEW
REAR VIEW
FLOOR BATTENS
1" × 3/4"
86 □ ft.
130 □ ft. TOTAL SAIL AREA.
45 □ ft.
6'6"
1" ∅ DRAIN HOLE CAPPED

Fig. 1

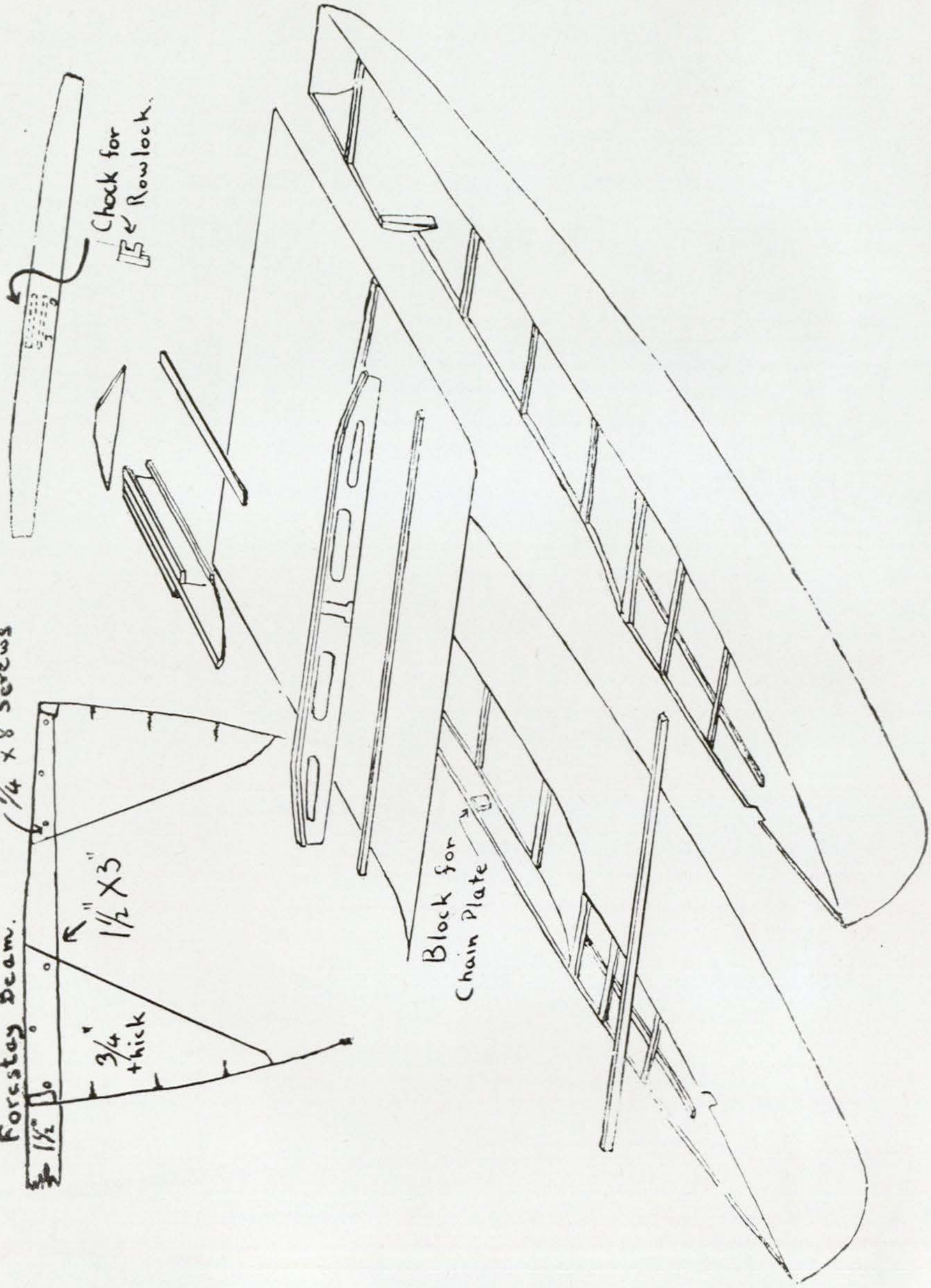

Forestay Beam.
1½"
3/4" thick
1½" X3"
1/4" x 8 Screws
Block for Chain Plate
Chock for Rowlock.

Fig. 2

National Class, and sail numbers have reached 1,200. *SHEARWATER* is built in wood or fibreglass and an all fibreglass model is being prepared for sale in 1964.

It is quite remarkable that although the *SHEARWATER* was designed seven years ago in 1956, it has never been outclassed, and has to this day the fastest and best all round performance for its size and sail area. In fact it has on many occasions and when competing in National events such as the R.Y.A. catamaran One of a Kind, beaten many larger craft with more sail area.

The *SHEARWATER III* has set a standard for most of the modern designs, and it is still used as a yard stick for performance when new designs are brought out.

Twin rudders are used with this craft, the two tillers are directly linked and at the ends of each there are short extension pieces which make for very easy and simple steering.

Two centreboards or dagger boards are now used, one in each hull, and the extra efficiency and ease of handling has been well worth the alteration expense to existing boats.

With only 7 ft 6 in beam, *SHEARWATER III* will be easily taken about on a small trailer or even carried on the roof of a car, if a strong roof rack is used. The cockpit is large enough for family outings and a tent could be erected over it to turn it into a camping cruiser. Some of its popular appeal must lie in the fact it is not too large and is easy to handle, in and out of water.

The kit for sale by Prouts has two pages of working details accompanying it which should let an amateur craftsman make one of these craft with little difficulty. The sequence of assembly recommended is as follows:

1 *Making Ready*. The hulls when received are of the exact measurements of the design. They are thus ready for the deck inwales of $\frac{7}{16} \times \frac{7}{8}$ in spruce or pine to be fitted level with the edge of the shell. To do this, each hull is placed in the crate-jig in turn with $\frac{1}{2}$ in of the stern end of the shell (measured at the upper edge of the hull) sticking out beyond the end of the jig. The transoms, inwales and crossbeams can then be glued and screwed into place in each hull.

2 *The Alignment*. One hull can remain in the crate-jig which, if possible, should be fixed to the floor. The second hull must then be jigged up to the correct height and spaced correctly with relation to the hull in the crate. To come within the *Shearwater* class measurement of 7 ft 6 in beam, allow 1 in for each outer rubbing strake.

3 *The Attachment*. Fit the rear sheet of cockpit plywood by glueing and screwing it down to the hull inwales. Then fit the forward sheet of cockpit plywood, butting it onto the rear panel. Glue and screw it down carefully onto the curve of the cockpit inwales.

4 *The Cockpit Completion*. The Cross piece of board at the rear of the cockpit can now be fitted. Then the pre-fabricated centre box and main beam can be put in. Make sure that everything fits well before glueing and screwing up.

5 *The Fore-stay Beam.* This is a very important structure and helps to make the catamaran rigid. It should be well fitted to the triangular pieces attached to the skin as in the plan. Again glue and screw.

6 *The Decks.* The main and side decks of plywood can now be put on and the craft cleaned up ready for the rubbing strakes.

7 *The Completion.* Glue the blocks to the skin which are to take the chain plates and fit these. Glue and pin the outer rubbing strakes. Make cockpit drain holes before varnishing and painting.

8 *Painting Recommended.*
   a Primer.
   b Filler paste.
   c Second primer coat.
   d Two coats of undercoat.
   e Finishing enamel.

Rub down well with wet and dry sandpaper between coats. A very smooth finish makes a great deal of difference to the speed of the boat.

The screws used for screwing down the plywood are $\frac{5}{8}$ in $\times$ 5, of brass. They are spaced 3 in apart.

A great deal of this work is eliminated with the fibreglass kit, as hulls are finished and fitted with centreboard boxes, inner and outer gunwales, inwales etc.

OTHER CATAMARAN EXPERIMENTS

Alexander Crosby Brown with his publication TWIN SHIPS is our authority for catamarans up to 1939. We find that he missed several catamaran and outrigger craft which is not surprising, These were:

1 A *Proa* described in RUDDER, in 1898.
2 1908. Victor Tchetchet in Kiev, Russia—a catamaran made from two kayak hulls.
3 1920. An Irishman in Cork—a split dinghy 16 ft long. Inboard sides flat.
4 1938. Sir William Acland's *Proa.*

CATAMARANS AFTER 1939

There were so many multihulls designed and built after 1945 that we cannot even begin to think that we have found them all. For instance, the *Patines a Vela* which number over 200 and sail from Barcelona without centreboard or rudder were not included in our list of 1956. Nor were the catamarans of the Cunninghams in Australia or those from New Zealand.

1 1944. Victor Tchetchet. Double hulls.
2 1945. Victor Tchetchet. Indonesian type: *Trimaran.*
3 1946. Woody Brown. 40 ft Round sections, Inboard sides flat.
4 1946. John Chartres. *JEAN-MARIE,* Nigeria. 18 ft, 1 ft 6 in, 7 ft 6 in, 350 lbs.
5 1947. Roland Prout's trial catamaran.
6 1948. Robert Harris. *NARAMATAC,* Box sections.

7 1948. M. Christiaen, French. *COPULA,* 46·7 ft, 5 ft, 17·75 ft.

8 1950. E. V. Wagner, Poole. 23 ft, Inboard sides flat.

9 1951. Arthur Locke. *TWEEDLEDUM AND TWEEDLEDEE,* 35 ft. Flat side out.

10 1952. *LEAR CAT* Box sectioned hulls.

11 1954. Robert Harris. 18 ft O.A., 15 ft L.W.L., W.L. beam 10 ft, Beam 7 ft 6 in.

12 1954. Roland Prout. *SHEARWATER I.*

13 1954. Tothill. *EBB AND FLO.* 40 ft.

14 1954. Commander Fawcett. 40 ft Indonesian.

15 1955. Roland Prout. *SHEARWATER II.*

Many of these trials were failures to produce a satisfactory sailing craft. The causes of failures are as follows:

1 *Too much wetted surface.* The several trials with boats split up the centre is remarkable till one reads the accounts of the Micronesian craft by Dampier and others of the early navigators. The Micronesian idea was, of course, misinterpreted by the craft with the inboard sides flat. Both this construction and deep box sections have too much wetted surface. This made the craft slow in light breezes.

2 *Bad manoeuvrability.* The long, flat underwater vertical surface of the split boat type of catamaran or of the deep chined sharpie hull gives immense stability in their direction of travel. This makes them very difficult to get about, especially in light winds when they are slow.

3 *Sharpie Construction.* There is an area of skin near the chine of a sharpie where the water flow is not simple from fore to aft. In this construction, when the chine is below the surface, the water has to flow inwards or outwards across it and this produces a swirling mass of eddies which absorb a lot of power and cause resistance. In the case of the long narrow hull of a catamaran which is of chined sharpie construction, a very high proportion of the skin is covered by this eddying flow and hence the resistance is much greater for each square foot of area than with a round bilged type. Long flat surfaces with a sharp angle below behave similarly.

So far, there has not to my knowledge been a thoroughly good sharpie double hulled craft. Some of the type have been fast when the breezes are strong but they must be slow in light winds and in stays relative to a craft with semicircular sections. However, Bill O'Brien has produced plans for a double hulled sharpie craft which are the best I have so far seen. The chines are on the waterline and will therefore not swirl the water if the craft is kept on an even keel. There is good rocker on the keels with the greatest depth forwards of midships so she will come about better than the others and there is a long flat run to the transom which just lips the water so true planing may occur, possibly making for higher top speeds. It has been doubted if a long narrow hull can plane. The argument is that the aspect ratio of beam to length is so low that there can be no hydrodynamic resemblance to the conditions occurring on the lower surface of a hydrofoil. In my opinion, however, the behaviour of water skis is evidence to the contrary. Bill O'Brien's design is now being built and will be launched in the Spring.

CHAPTER V

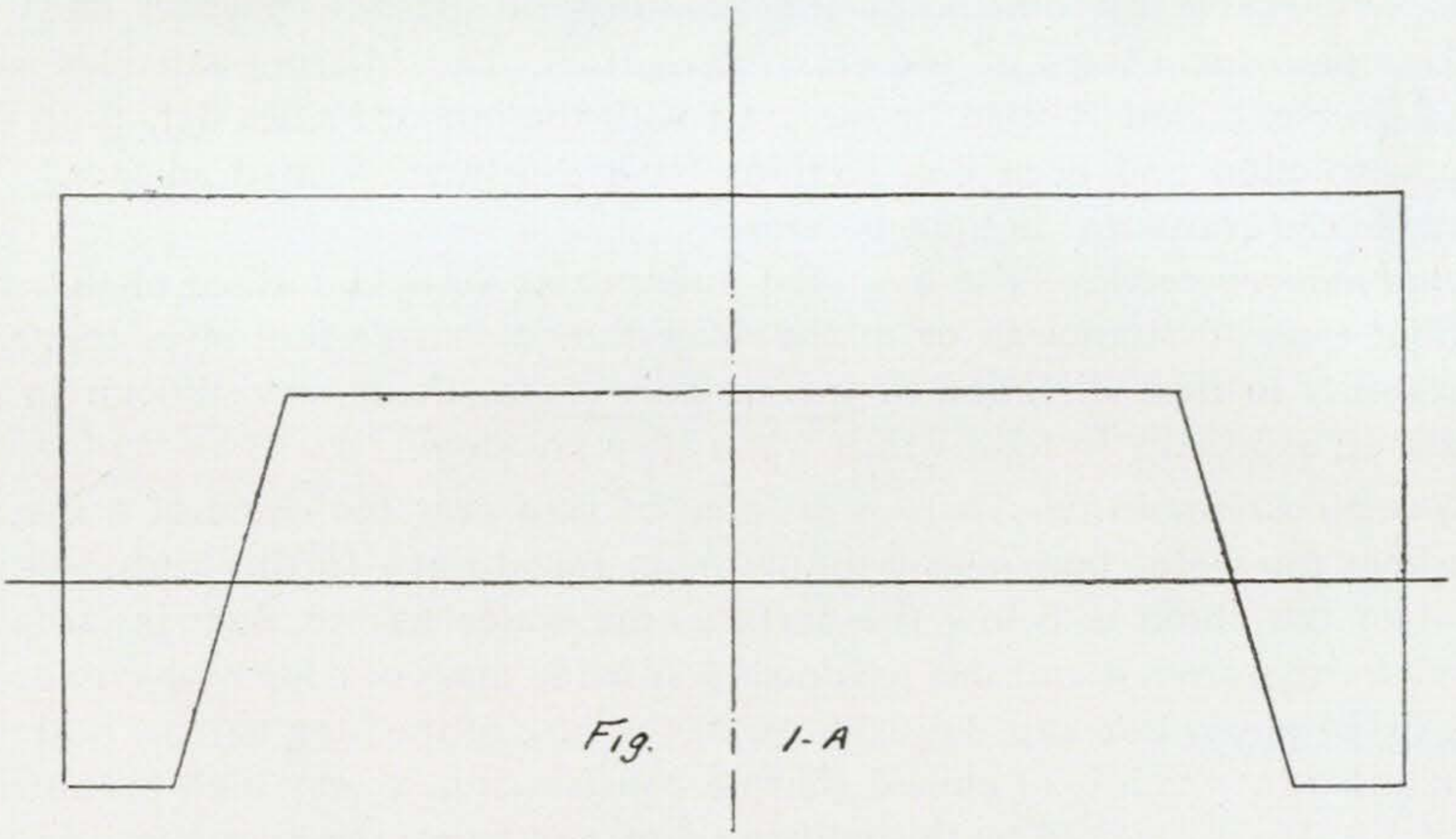
THREE DOUBLE HULLED CRAFT

April, 1956

Robert B. Harris

Ed: We include these three designs of Bob Harris to show how he progressed from deep box sections to his very fast and elegant TIGER CAT of 1959.

In 1948, I designed *NARAMATAC*, a 25 ft length overall catamaran. I was searching for a day sailer which, though not necessarily a speed demon, would easily go by other boats of her size, would manoeuvre well and go to



windward. I also paid some attention to making her easy to build with thoughts for the home builder. The deep, narrow, flat-bottomed sections (see Fig. 1a) of *NARAMATAC* were certainly easy to build but only in a fresh breeze would she really go well to windward, manoeuvre and come anywhere near being faster than other boats of her length. In light breezes, she was slow, would not go well to windwards and manoeuvred poorly. At good speed in a chop, the flat bottoms pounded. However, the underside of the wing seemed at a good height above the datum water line because green water seldom hit there. Briefly stated, *NARAMATAC* was too heavily constructed, lacked stability to carry enough sail and had too much wetted surface. Manoeuvreability was bad on account of the hulls being too deep in general, particularly aft.

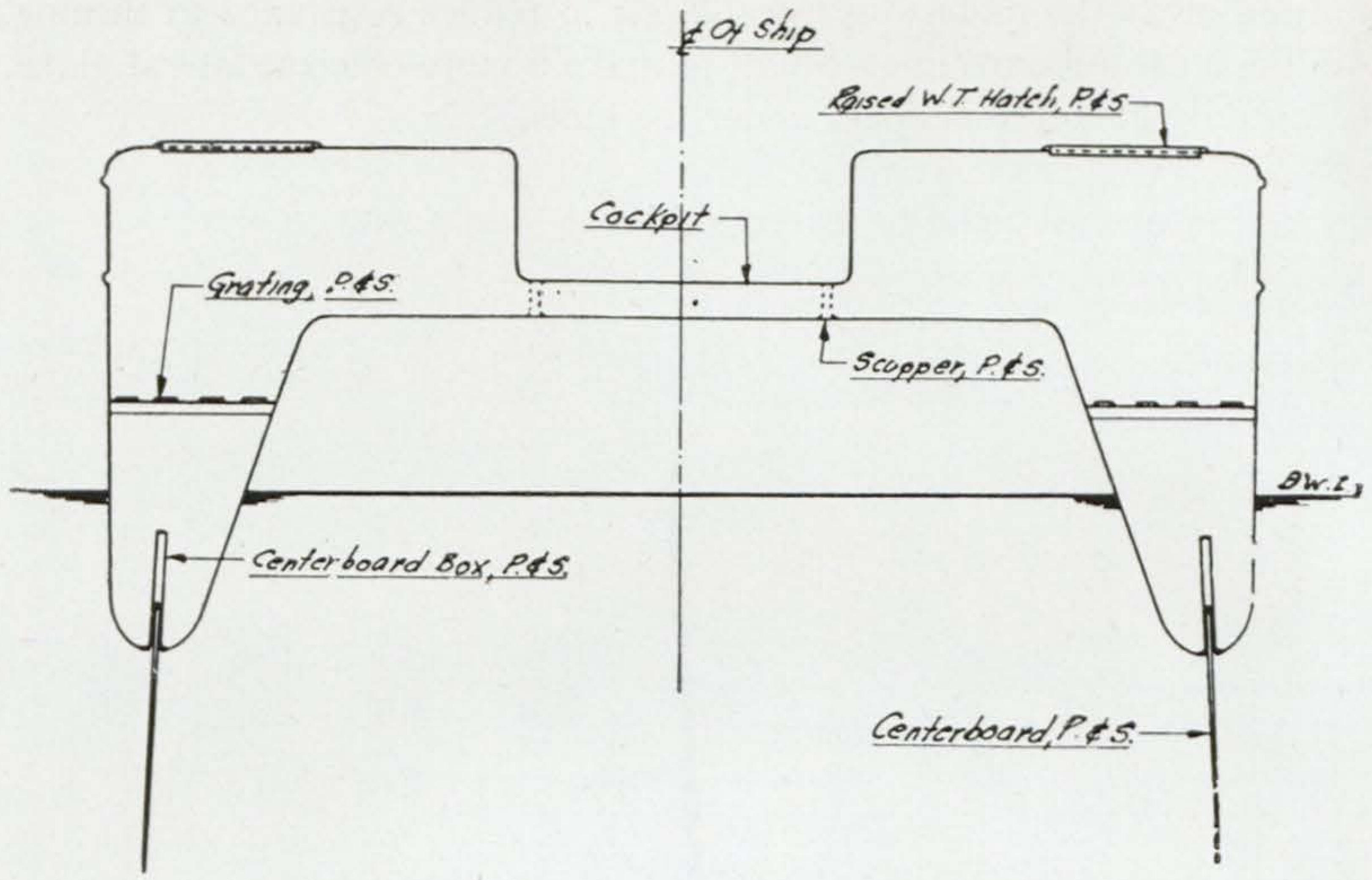
In March, 1953, I was able to eliminate most of the faults in the design of an 18 ft overall moulded fibreglass catamaran sloop by:

a Rounding the bottoms, thus decreasing wetted surface.
b Increasing the ratio of beam to length of each hull again to reduce wetted surface.

c Cutting away the underwater profile aft to reduce resistance to turning.
d Adding a centreboard in each hull to make a more efficient lateral plane.
e Using fully balanced rudders under the hulls.
and
f Increasing overall beam to increase sail carrying power.

Bob Harris's Catamaran *NARAMATAC*

All of these changes worked to advantage with the exception of the rudders which put up a terrible fuss at the boundary plane. At last, we had a catamaran which would go to windward well at all times and come about 90 per cent as well as a single hull. Unfortunately, the construction by hand lay-up of fibreglass proved much too heavy. The resultant added wetted surface and displacement again ruined the light weather performance but, even so, it was better than in *NARAMATAC*.



It would seem that all we had to do now to improve the breed is to reduce the weight, move the rudders back to the unbalanced condition and increase their aspect ratio. For beaching, the rudder blades will be pinned and completely cable operated. When going off the wind, much wetted area may be saved by lifting them slightly. The construction of a new catamaran with all these changes is now underway. Launching should be in March, 1956, at which time a further report will be made to the AYRS.

OCELOT

December, 1957

by Robert B. Harris

L.O.A. 20 ft 6 in

D.W.L. 17 ft 6 in

Beam, O.A. 10 ft 0 in

Beam, Hull 2 ft 0 in

Beam, Hull on W.L. 1 ft 2 in

Displacement (inc. one of crew) 709 lbs

Sail Area (100 per cent fore triangle) 268 sq ft

Wetted area with boards and rudders 68 sq ft

C. of Effort ·415 D.W.L.

C. of L.R. with C.B. ·415

C. of L.R. No C.B. ·25 to ·35 D.W.L.

C. of L.R. with C.B. no rudder ·407 D.W.L.

Righting moment (RMmax.) 6,600 ft lbs

Sail Area/Wetted area ratio 3·96 (Used △ to D.W.L.)

Sail area to weight ratio ·38

The disadvantages of the original form of T-26 later carried into *EGG NOG* and *FLAMINGO** were not apparent when racing against *NARAMATAC*, (a 25 ft flat bottom catamaran designed and built by the writer) and certain

*Three trimarans designed by Victor Tehetchet

Bob Harris's *OCELOT*

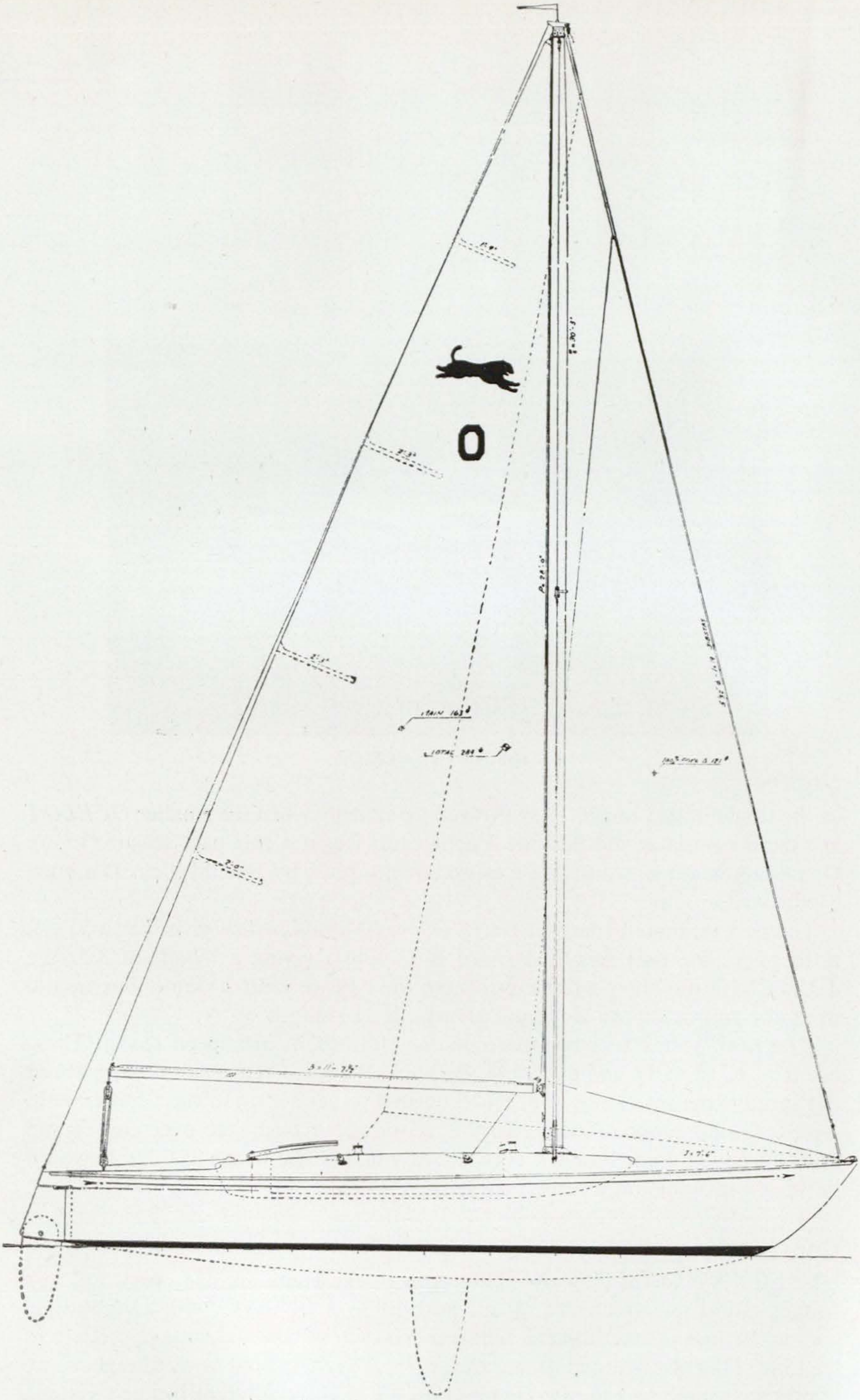
of the single hulled boats. They showed up sharply when the smaller *OCELOT* left them behind at the Bayside Yacht Club Regatta this past season (1956). Of the above dimensions, she was excellently built by Ned Mullen. Designed by the writer.

The best estimated speed of *OCELOT* is 20 knots, which gives her a $V/\sqrt{L}$ ratio of 5. The best recorded speed is 15 knots giving a $V/\sqrt{L}$ of 3·5. We did not have the Navy's radar out there the day we went 20 knots but we did time our course across Northport Harbour in smooth water.

OCELOT seems to have three distinct humps in her speed curve. These occur at 6, 12 to 14 and 20 knots. Perhaps, the most remarkable thing about the speed is the small mount of effort needed to get her up to the 12 to 14 knot region. Much more relative effort is required to push her over that hump than over the 6 knot hump. I even doubt whether the hump at 6 knots would be very noticeable on a drawn curve of resistance versus speed.

Construction

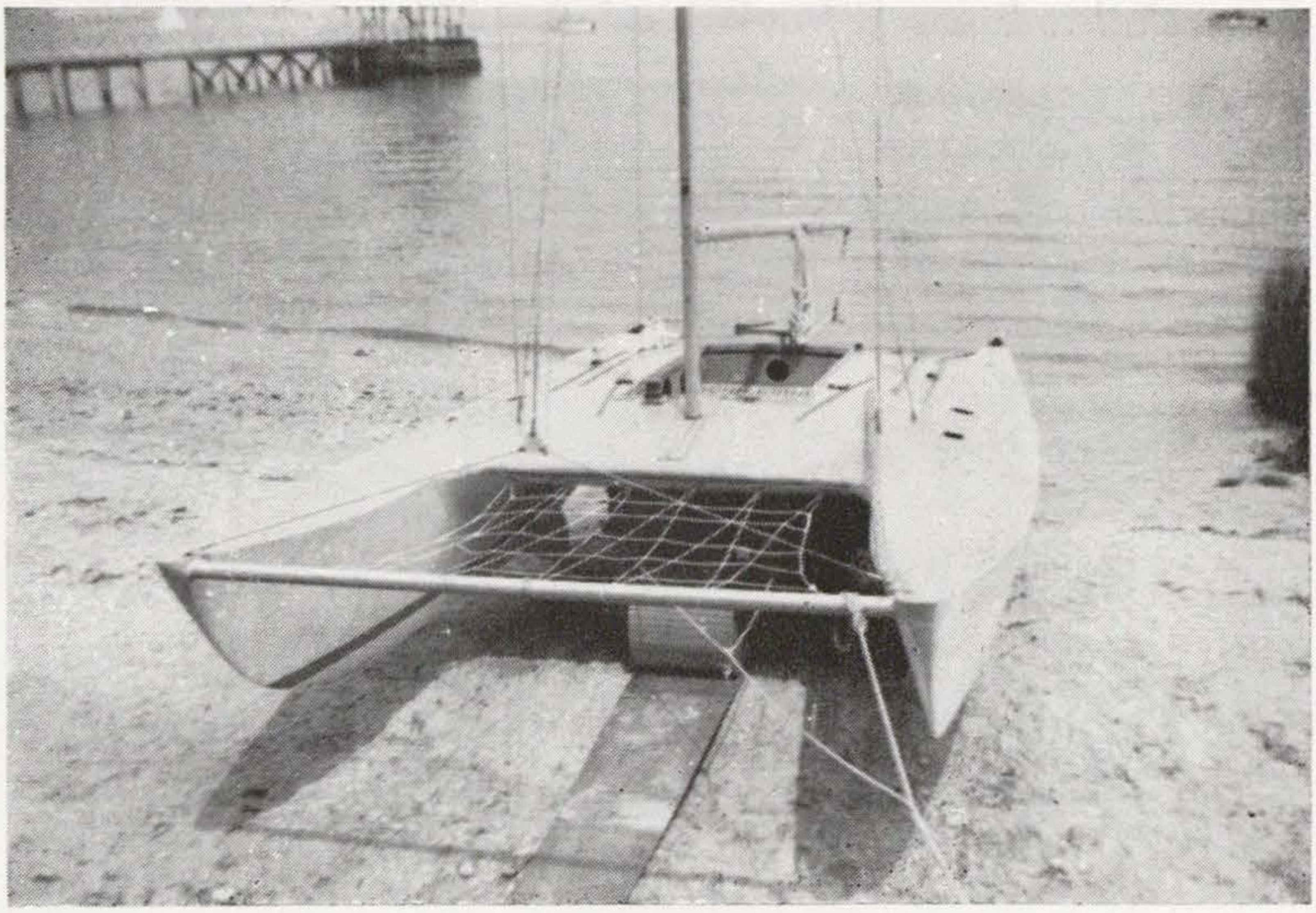
OCELOT is made of plywood sheet $\frac{3}{16}$ in thick. There are deep plywood web frames, some of which are $\frac{3}{16}$ in, and some $\frac{1}{8}$ in thick, with longitudinal spruce stringers to complete what is known as the *Isherwood* system of framing. Had we planned at the outset to cover the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



OCELOT

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

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

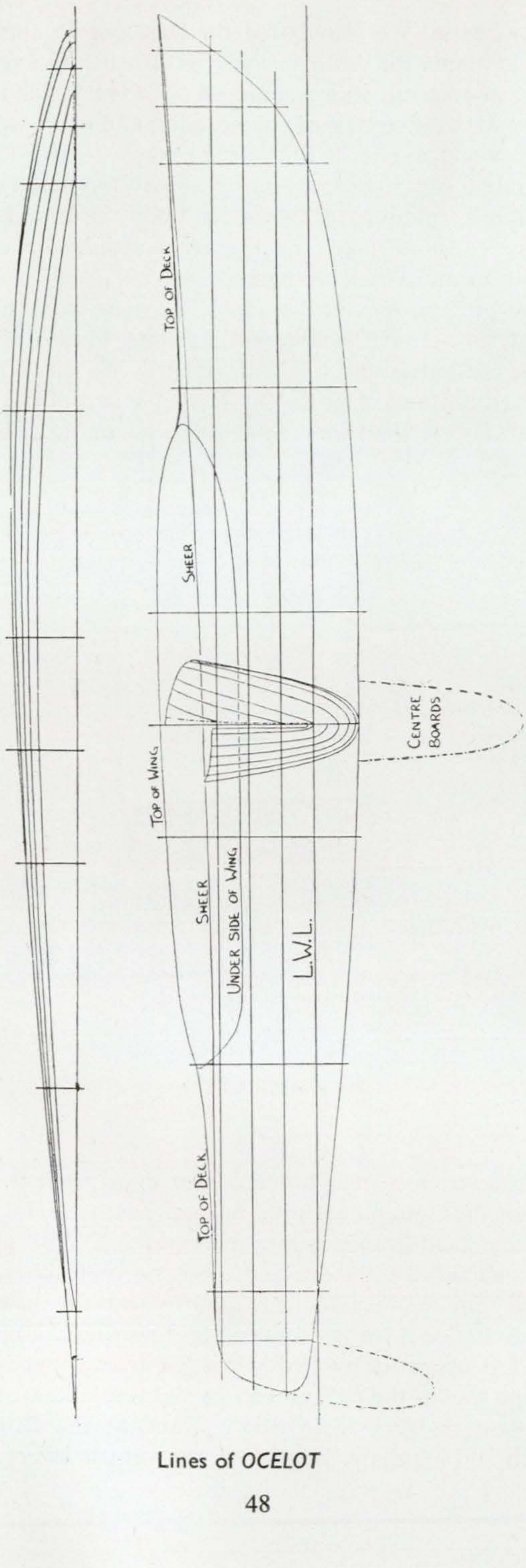


OCELOT

Balance

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

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



Lines of *OCELOT*

which reach to the decks so that the pins may be completely enclosed in their bearings.

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

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

The Lines

Either one designs a vessel for one particular service and takes what comes after that or, the design has to be the best compromise for all round services. We decided that *OCELOT* should be the best all round configuration by compromise that we could think of so that, as a future class boat she could be sailed anywhere in the world under any circumstances. It would appear that we have just that. The most important feature is that she can be sailed efficiently without the centreboards. This allows the use of thousands of square miles of shoal bay water along our eastern and southern coasts where the depth is one foot or more. Realising full well that semicircular sections would give us the minimum wetted area, we sacrificed some area for a better lateral plane with the boards up. The extra depth, when placed in the right position, would also improve her manoeuvrability. This compromise worked, as she will come about without backing the jib when no boards are down and is only a fraction slower than a single hull with the board down.

There is no doubt in my mind that we sacrificed some top speed by compromising these lines. We have attempted to make up for this in a generous sail plan which we carry easily with a big beam. We think that it is right, too. To wit, we have a day sailer which will fetch a mark on any course about twice as fast as the normal single hull, including the dinghies, do this with more comfort at all times, in shoal water, in rough water or just plain drifting.

TIGER CAT

by Robert B. Harris

L.O.A.	17 ft 0 in	Total weight, less crew	530 lbs
Beam	8 ft 0 in	Total sail area	235 sq ft
Draught	7½ in	Measured area	183 sq ft
Draught C.B.'s	3 ft 5 in		

Hulls

These are $\frac{3}{16}$ in moulded plywood covered with 4 oz glass cloth. The decks are $\frac{1}{4}$ in plywood, faced with phenolic plastic. The centreboards are $\frac{1}{4}$ in aluminium alloy plate, toed in $\frac{1}{2}°$. Only one board is down at a time, for example the port board on the starboard tack and vice versa.

The Mast

This is elongated in section and also aluminium alloy as is the luff spar.

The Production Model

The dimensions of this are the same as the prototype except for ½ in reduction in beam. The weight comes out at 55 lbs more. The craft is cleverly cast in two pieces, the upper one comprising the whole top deck and the lower one, the hulls and the underside of the bridge deck. These two pieces are joined at a flange which also forms part of the spray strips.

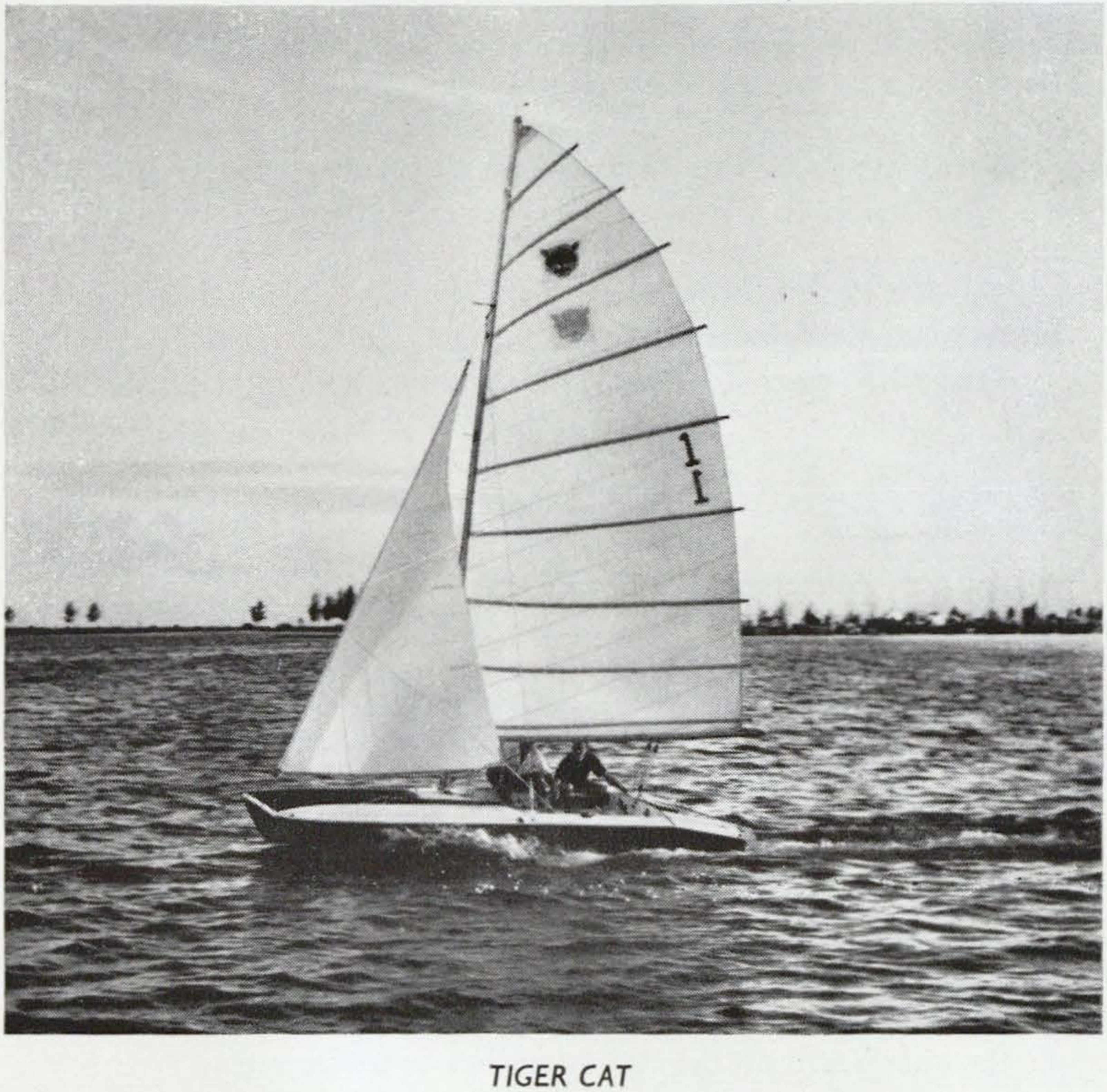
TIGER CAT won the Miami "One-of-a-Kind" races, beating the Prout *COUGAR* so she must be a very fast boat. The production model must be a little slower than the prototype and we can but see what the relative performances of the two craft are in future.

Letter from: Robert B. Harris, 5th April, 1959

Dear John,

Kindly accept my sincerest thanks for your congratulatory letter of 20th March re *TIGER*.

Allow me to say right off the bat that not one concerned with the creation of the *TIGER* expected that Eric Olsen would be able to beat out Roland



TIGER CAT

Prout, not only from the fact that Eric had had little or no experience sailing the catamaran, but that the designer had himself so very much to learn as yet about the design of small catamarans. I will however venture these comments in retrospect.

1 It was felt by all that the use of asymmetrially shaped centre-plates in each hull, both thin plates, and using of course but one at a time, set at an initial angle of incidence to the fore and aft centreline of the hulls gave *TIGER* her first advantage over *COUGAR*, using thicker plates, two down, symmetrically shaped. This is probably the second best advantage, if it was one at all. We could not prove any of these statements actually unless the boats were tested together in tanks under exactly controlled similar conditions.

2 The greatest advantage *TIGER* seemed to have was in the sails. She was carrying a tremendous roach compared to *COUGAR*, giving her not only much more unmeasured sail area, (an inequality in the rule) but I suggest that these sails stood better in spite of the roach than the *COUGAR's*. Besides this there was of course more measured area.

3 The second most important advantage of *TIGER*, and contrary to the reports you have had is that she had a flatter run and the aft sections were *fuller*, or rather flatter than those of *COUGAR*! *TIGER's* beam at the transom was also bigger. If she was down by the stern a bit it is because the crew was unable to move forward to the designed position due to the fact that the helmsman could not then reach his tillers effectively. Perhaps it would be more accurate to say that the extension tillers were not in the best position for this important measure nor were they long enough.

4 For the particular sea and wind conditions, 20 to 25 knots wind, with about a two foot to one and one half foot chop I believe that the greater freeboard and resultant greater height of wing off the water gave *TIGER* a bit less drag at speed than the *COUGAR*. There seemed to be considerably more wetting under the wing on *COUGAR*. There is also the fact that the underside of *TIGER's* wing is convex, curved upwards, thus allowing water droplets, (thus weight carried about) to be run off more quickly. This has something to do with surface tension of fluids which I vaguely remember from my physics class.

5 There is also a fifth and not so obvious a reason for *TIGER's* performance which rather sums up all of these advantages with the possible exception of the sails, and hull form, that being that *TIGER* was built especially as a prototype to met the competition of the "One-of-a-Kind". That is to say that in a production model we would probably come up with symmetrical smaller centreboards thus losing I feel some advantage to weather, although even this is inconclusive since at times *COUGAR* seemed to be doing better to weather than *TIGER* on pointing and footing. Anyway I must certainly say that Prout came here with his "stock" model and did very excellently indeed, to wit that there was so very little difference in their times and speeds, and not to mention that the *COUGAR* was probably built at a fraction of the cost of the *TIGER*.

We are of course planning to produce the *TIGER*, but she will be all fibreglass, with somewhat lowered wing for daysailing comfort, the symmetrical boards to eliminate having to change boards coming thru the wind and to make them of less area and weight, total, but we have learned that we will be able to have a somewhat lighter craft, possibly thus winning back some lost advantage otherwise. The hull form will be unaltered, as will the sails and the general configuration. We do not expect to lose much in our stock model, and I believe that putting this model against *COUGAR* one will see little or no difference in their performances.

By the way we had a spray rail on the inboard sides of the *TIGER* and we will keep these besides adding two to the outsides similar to *COUGAR*, to prevent outside wetting and crew discomfort at high speed.

The centreboards and rudders of the stock model will be of cast aluminium alloy, finding that these will have all of the properties of strength and ductility and anti corrosiveness needed and that they can be produced more cheaply in numbers than any other kind at this writing. We also feel in this connection that the thinner plates are better than the thicker ones, not only from the standpoint of frontal resistance but from the fact that the centreboard slots may have less drag where one is using a swinging plate versus a fitted dagger. The daggers such as Prout has will always be unpopular in our shoal waters versus the swing type especially in view of the speeds capable in these cats.

I hope that these remarks may clarify somewhat the conditions under which *TIGER* was able to "eke" out a win over her nearest competition, the *COUGAR*. I hurry on to say that the *COUGAR* and the *SHEARWATER* were the best looking catamarans at the race, and both far out-performed all other competition. Roland should feel himself well satisfied in producing two so successful craft, that having met him my personal regard for him is and will always be of the highest order. If I can handle my own cat designs someday as well as he does his then I shall only then consider myself of even equal potential.

Well that's about the whole story in the design of *TIGER*, except to say that the final proof of the form used in the hulls of *TIGER* was accomplished in the little 9-ft prototype of the *TIKI*. I would say that our transom was closer to *FREEDOM's* than *COUGAR's*, and so is our mainsail.

The only regret I have after the "One-of-a-Kind" is that I did not have more opportunity to talk with Roland. I feel in him as you do a great friend. I am proud to know him! I also met with Rudy Choy there and geatly increased my respect for him.

Very sincerely yours,

Robert B. Harris

CHAPTER VI

AMERICAN CATAMARANS IN 1957

by Robert B. Harris

MANU KAI

L.O.A. 40 ft 0 in	Displacement 3,000 lbs
D.W.L. 31 ft 6 in	$V/\sqrt{L}$ (Speed length ratio) 5
Beam, O.A. 13 ft 0 in	Vmax. 28 knots
Beam, each hull D.W.L. 1 ft 9 in	Planking 3/8 Fir Plywood
Draft 1 ft 9 in	Sail area/weight 167 sq ft/lb
Sail Area 500 sq ft	Righting moment 21,400 to 25,000 ft lb
	Heeling moment (20 knot wind) 15,000 ft lb

From Hawaii shortly after World War II came the most important development in multihulled craft since Herreshoff when Woody Brown, a former glider pilot, carried his light aircraft experience into the design of *MANU KAI*. Together with Alfred Kumalai, a skilled boat builder, the hulls, which had

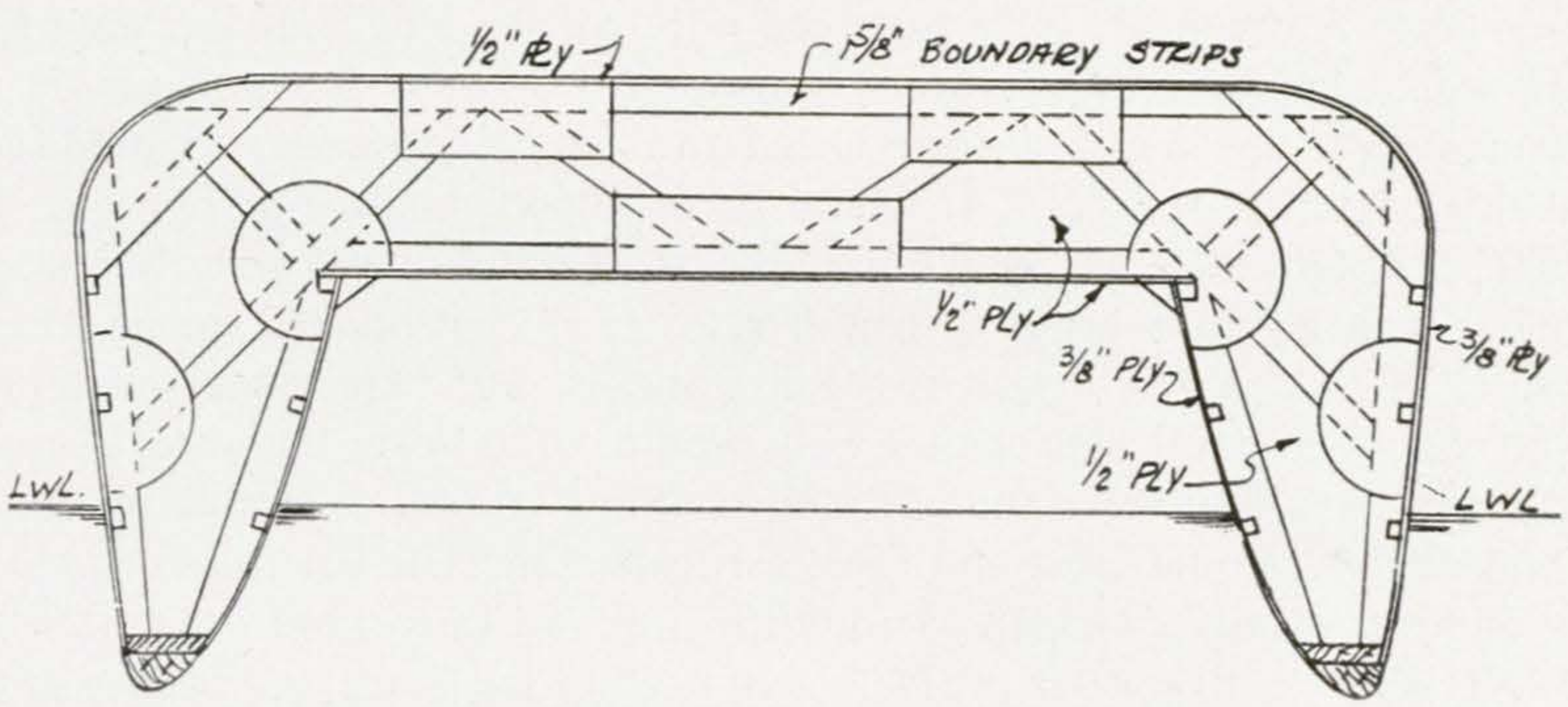


Fig. 1a. *MANU KAI*

before been lashed to the ends of bamboo logs were now rigidly connected with trussed beams not unlike those of wooden aeroplanes (see Fig. 1a). Following good engineering practices combined with native skill, Brown and Kumalai were able to keep the weight down to 1½ short tons (of 2,000 lbs) which, on a 40 ft length, is truly remarkable. Consider that the average 40 ft length overall hull will displace between 7½ and 9 short tons, 27 to 30 per cent of which is needed just to keep it upright.

MANU KAI's beam of 13 ft 0 in, with each hull nearly straight outside with flare and curvature on the inside might cause some water venturi, since it was indicated from tests made by Peter Joubert of the University of Melbourne, Australia on catamaran hulls at M.I.T. this past summer that, unless

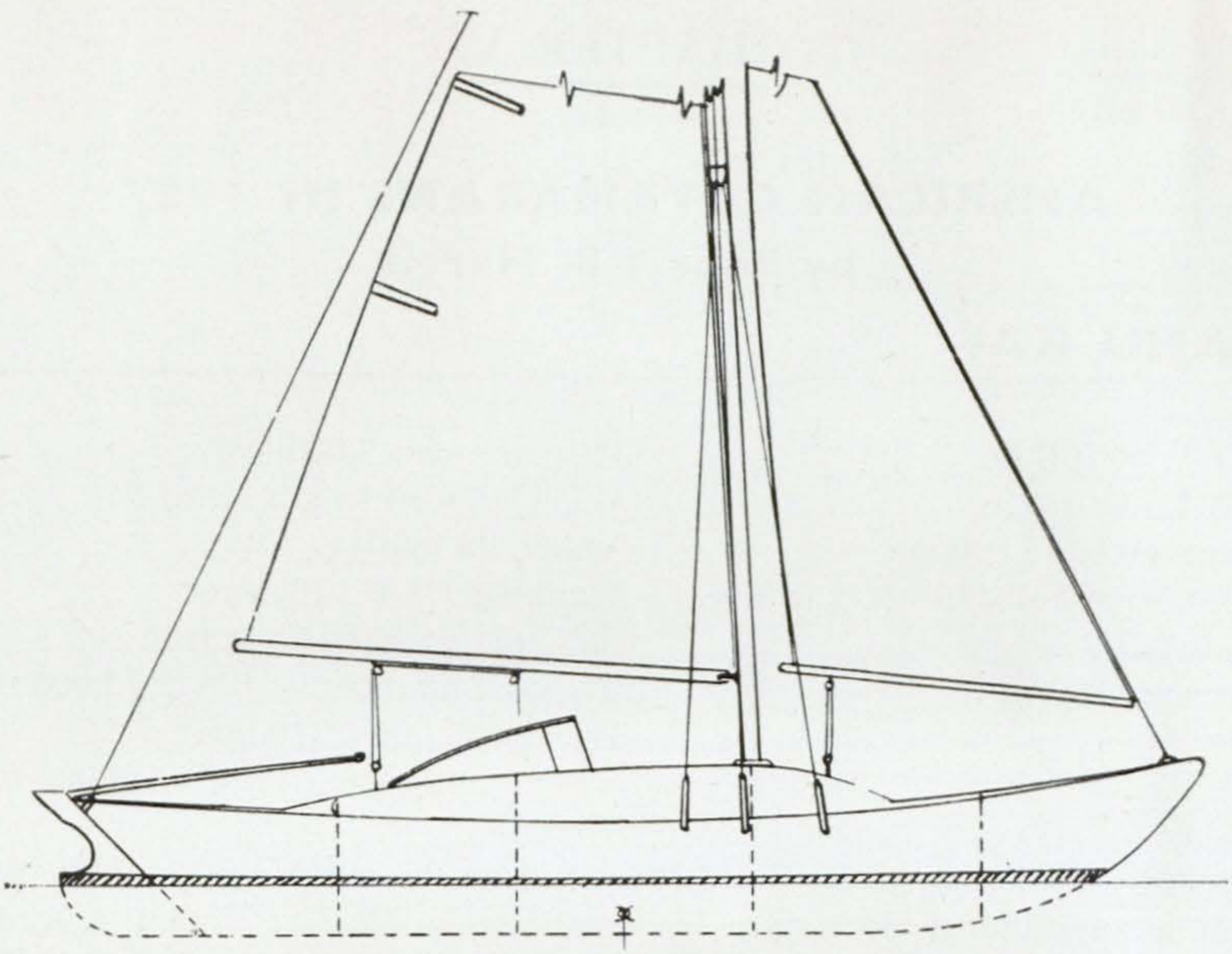


Fig. 1b. *MANU KAI*

the distance between the hulls exceeded one half the length of the waterline, there would be some interaction. However, Mr Joubert did not qualify his statement as to speed or hull form tested and, from experience, it would seem that this effect on *MANU KAI* would be extremely small. For example, my own 25 ft *NARAMATAC*, which has a beam of 8 ft 3 in and waterline length of 22 ft 0 in giving a beam to length ratio of ·375 produced no noticeable venturi. *MANU KAI's* length to beam ratio is ·357. The effect of venturi at the narrowest point between the hulls would be to lower the water pressure and cause some flow from the outsides, resulting in a wave formation which, at high speeds, would crest and form a rooster tail. The net result would be loss of some energy given up to eddy making and thus more drag.

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

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

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

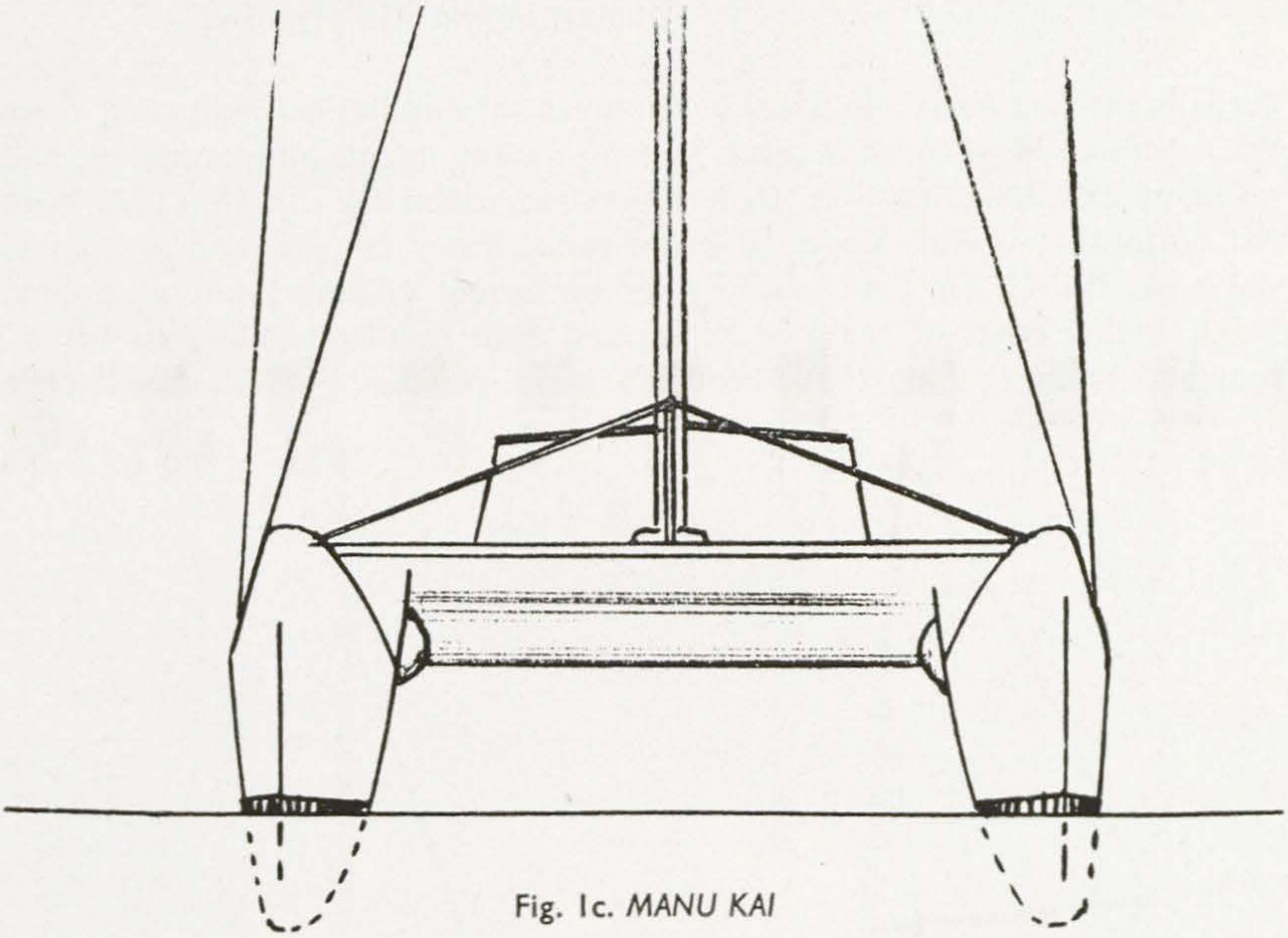


Fig. 1c. *MANU KAI*

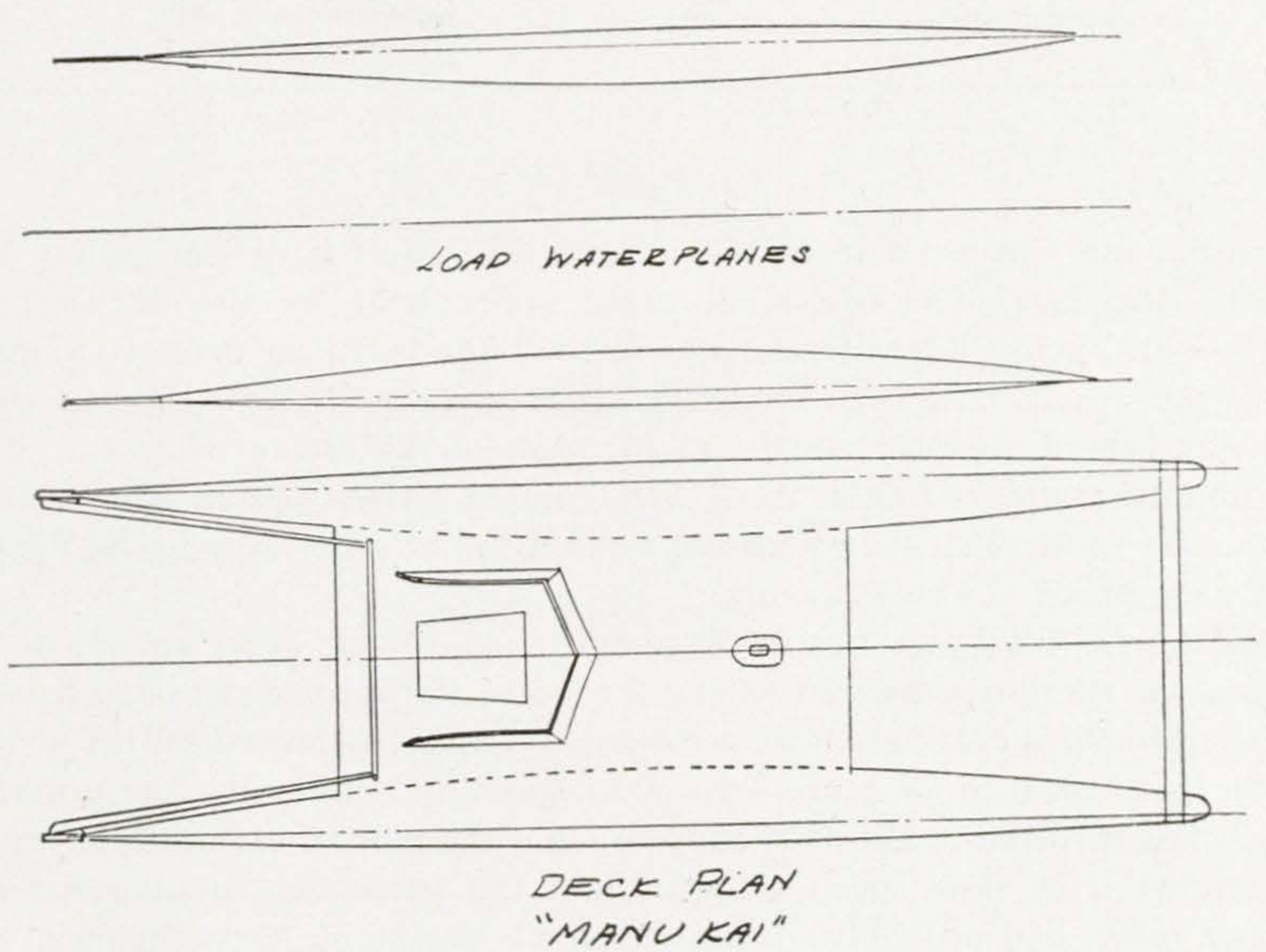


Fig. 1d

LEAR CAT

L.O.A. 16 ft 0 in
Beam, O.A. 7 ft 6 in
D.W.L. 13 ft 1 in
Draft 13 in
Beam, each hull D.W.L. 7 in
Displacement 500 lbs
Sail Area 150 sq ft
Sail Area/Weight ·30
Construction ¼ in plywood

Perhaps the next most important development of multihulled craft came from the American West Coast. Creger, a man of many talents and industries, had taken up the designing of a 16 ft catamaran called the *LEAR CAT*. With flat bottoms, low hull length to beam ratio, heavy construction and small sail area, the *LEAR CAT* was a poor performer on any point of sailing. Single hulled boats of her own length and even smaller would pass her by time and again. She may have been capable of reasonably good speeds on a

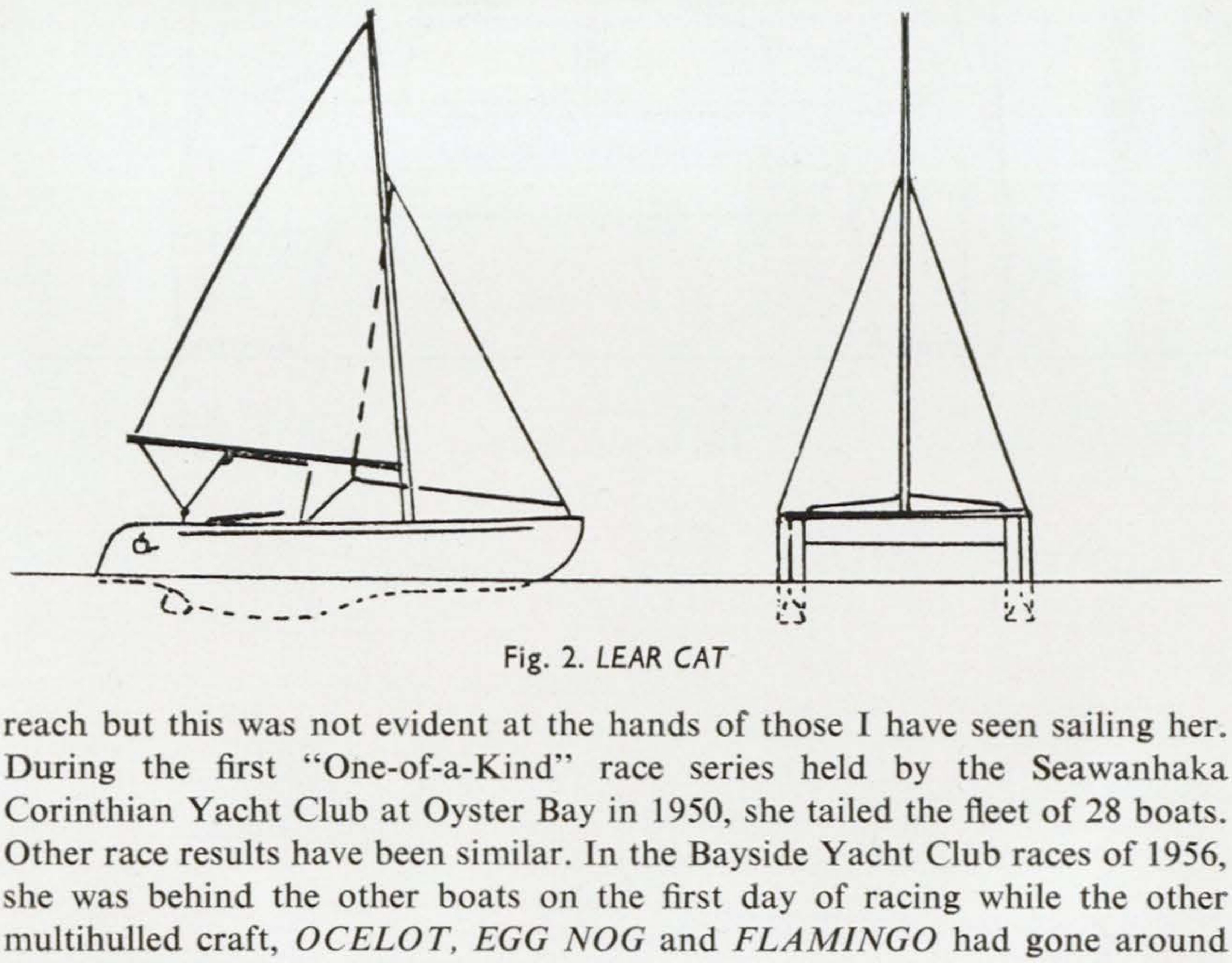


Fig. 2. *LEAR CAT*

reach but this was not evident at the hands of those I have seen sailing her. During the first "One-of-a-Kind" race series held by the Seawanhaka Corinthian Yacht Club at Oyster Bay in 1950, she tailed the fleet of 28 boats. Other race results have been similar. In the Bayside Yacht Club races of 1956, she was behind the other boats on the first day of racing while the other multihulled craft, *OCELOT*, *EGG NOG* and *FLAMINGO* had gone around the course so fast that they were not noticed by the other racers who figured that only *LEAR CAT* was racing.

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

THE SABRE CAT

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

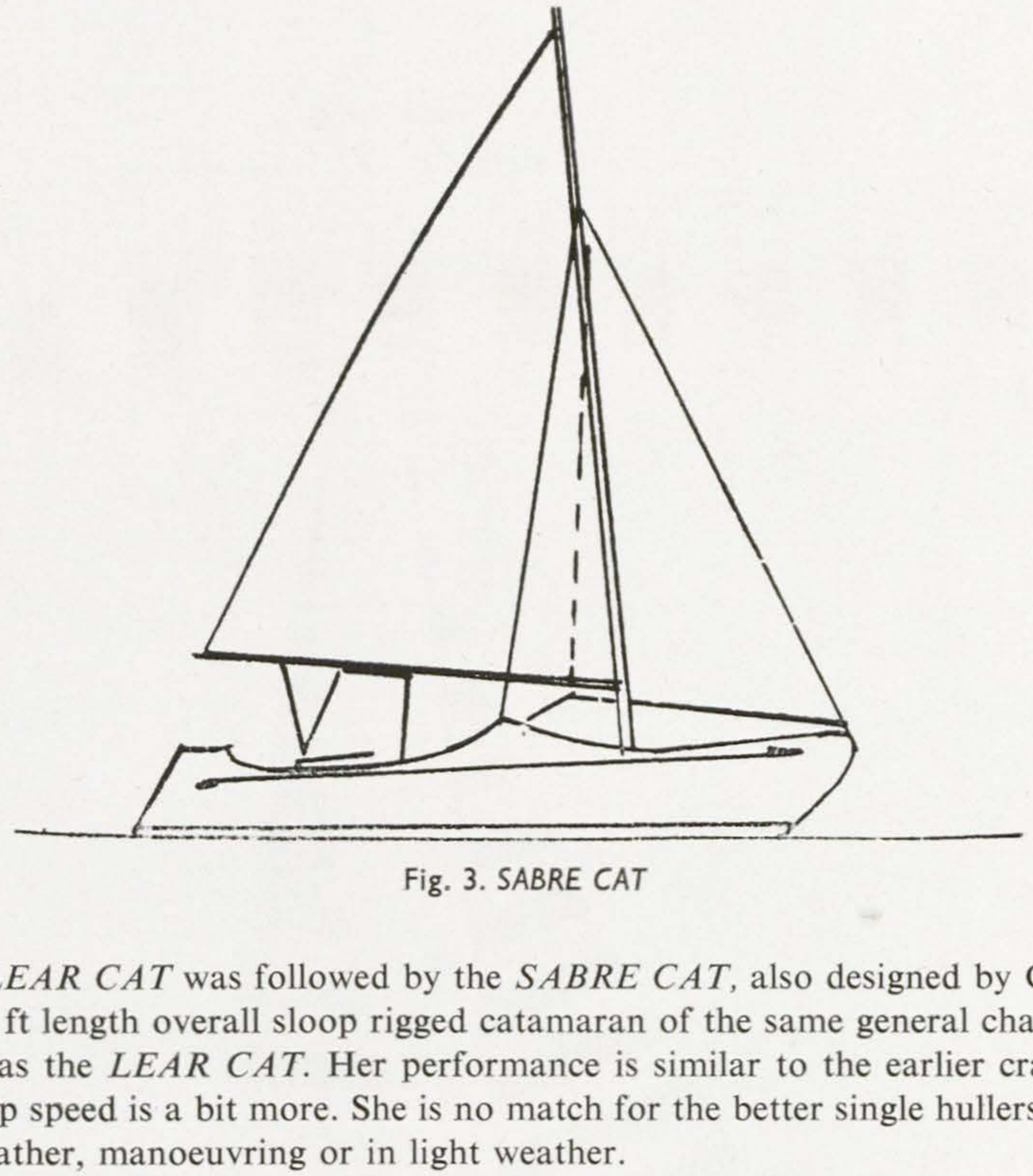


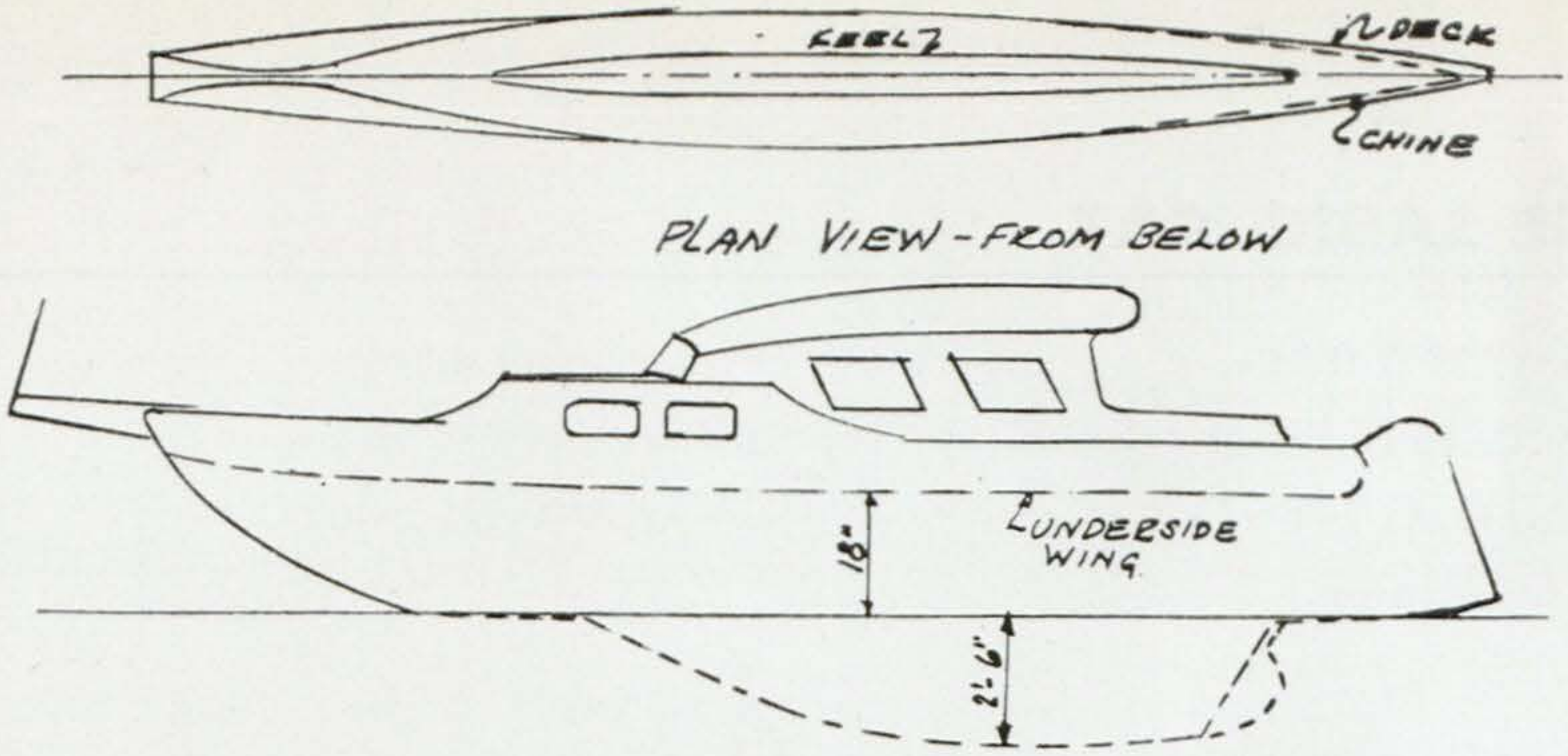
Fig. 3. *SABRE CAT*

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

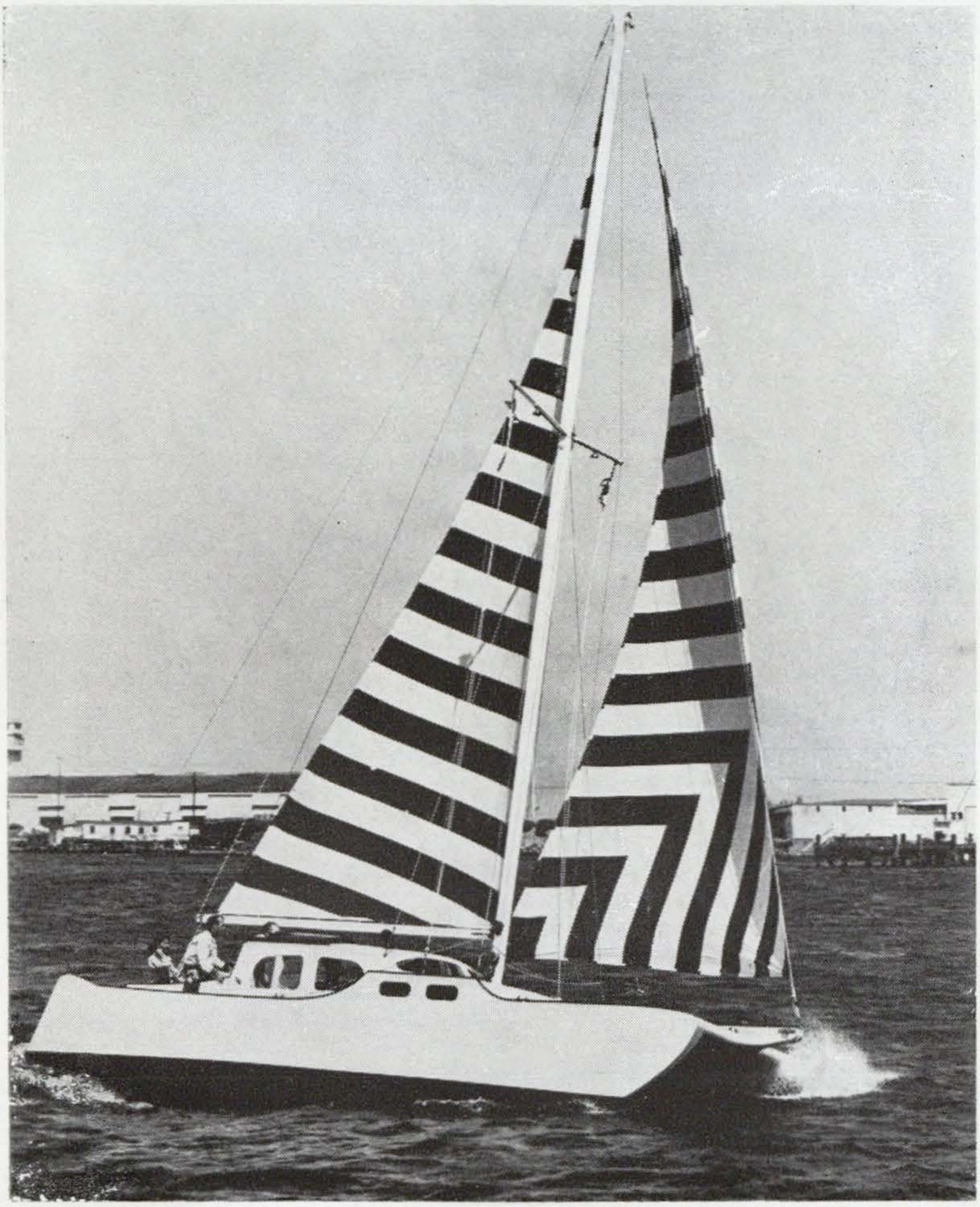
THE CREGER 32

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

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



PROFILE
"CREGER 32" - AQUARIUS
Fig. 4



CREGER 32

WILD WIND

L.O.A. 35 ft 0 in

D.W.L. 30 ft 0 in

Beam 12 ft 6 in

Displacement 8,500 lbs

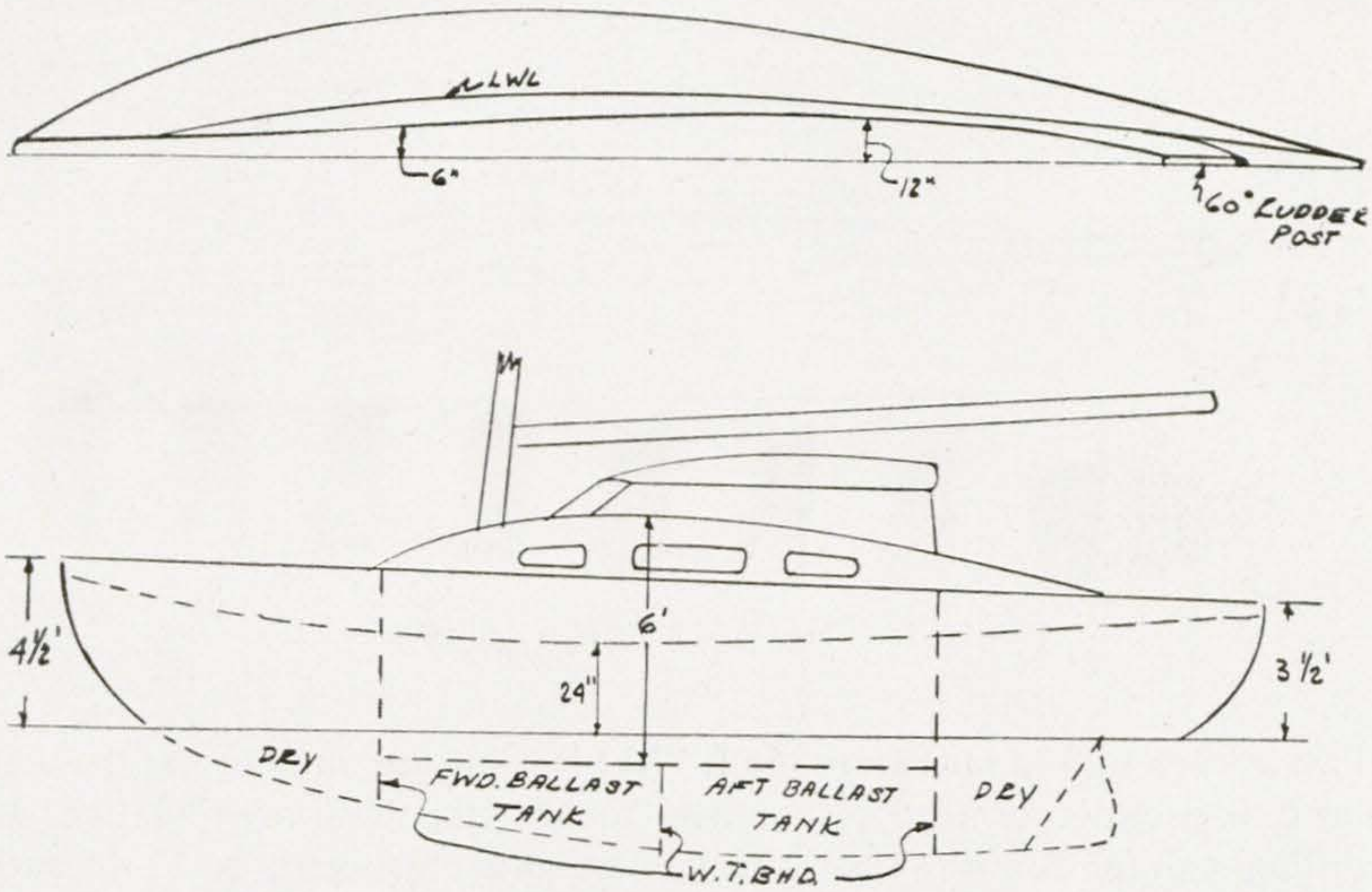


Fig. 5. *WILD WIND*

This craft was designed by Creger for Dan Brown of San Diego, California. It is reported by Bill Mehaffey of Oak Park, Illinois that her performance is much better than the Creger 32. Her outsides are flat and the insides are symmetrically shaped fore and aft. She has provision for water ballast in one tank in each hull and Bill says she can capsize without the water ballast, but with it, she will have her rig ripped off before she goes over. She has frequently beaten 10 meter conventional craft in a 30 knot breeze and she will beat many racing boats of conventional type in moderate to heavy winds. She is easy to beat in light airs, however.

SEA WITCH

L.O.A. 30 ft 0 in

D.W.L. 25 ft 0 in

Beam 12 ft 0 in

Draft 2 ft 6 in

Displacement 6,500 lbs

This design is by Bill Mehaffey to whom I am much indebted for the sketches of *AQUARIUS* and *WILD WIND*. The outsides of *SEA WITCH* will be flat and the insides curved, having a modified N.9 hydrofoil at a 15° angle of heel waterline. She carries up to 2,000 lbs of water ballast in two tanks in each hull. The hull weight will be 4,500 lbs, giving him 1,000 lbs of trimming

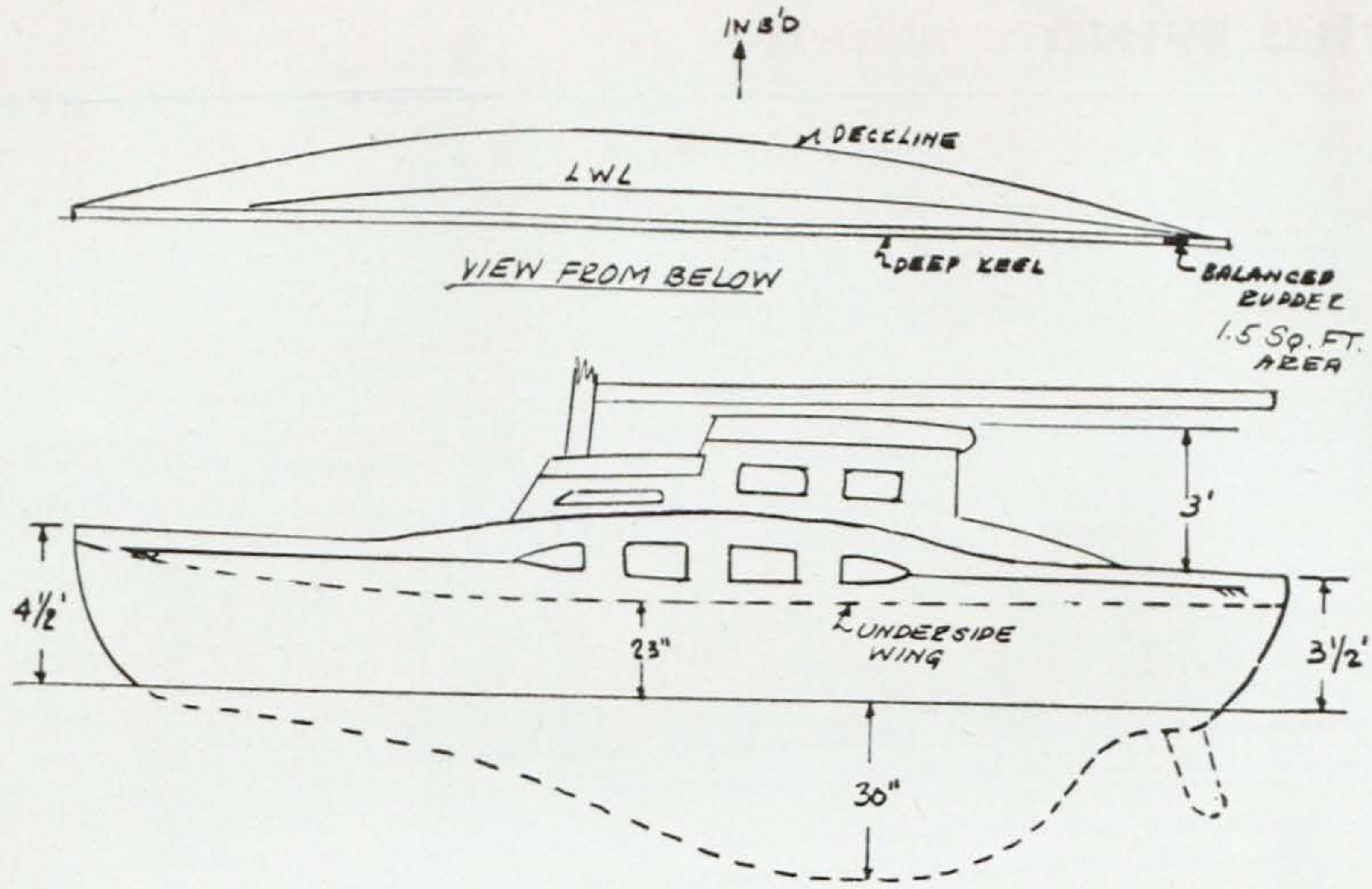


Fig. 6. *SEA WITCH*

ballast in each hull to set her on the L.W.L. It is his intention to use the water ballast to produce or restrict her heel to 15°, the best running line. Her scantlings call for 2 × 4 in ribs, ¾ in × 1½ in spruce stringers, on 12 in centres and planking will be ⅜ in plywood with fibreglass over all outside surfaces with extra strengthening, at the underside of the wing and hulls.

EVALUATION OF THE CREGER TYPE CATAMARANS

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

OTHER CATAMARANS

H. Morton Jones of Miami, Florida is the instigator of several catamaran designs in the Creger style ranging in length from 12 to 55 ft, some sail, and some power. Most notable of these designs is one he calls the *Little Fish.* This craft is 38 ft overall, 22 in draft and will go along about 12 knots under sail or under power. Victor Tchetchet has sailed in this craft in calm water and says she is very comfortable and roomy. Jones is also building or has in his stock line 12 ft, 16 ft, 20 ft, 26 ft, 35 ft, 45 ft, 55 ft, 65 ft catamarans, all of which are of the flat bottom type with very little rocker and twin rudders. There are no centreboards.

The Custom Hydrocraft Co. of San Diego, California is another outfit which is doing its best to defeat the prejudice against catamarans. Their main produce is the *Sea Cat* whose dimensions are L.O.A. 16 ft 0 in, D.W.L. 15 ft 6 in, Beam O.A. 7 ft 6 in, Draft 4 in, Displacement 288 lbs, Sail Area 170 sq ft, Construction ¼ in plywood. They are also building an outboard powered catamaran of 12 ft L.O.A., Beam 6 ft, weighing 220 lbs. Outboard power recommended is from 7½ to 16 hp.

CHAPTER VII

THE CHINED CATAMARANS

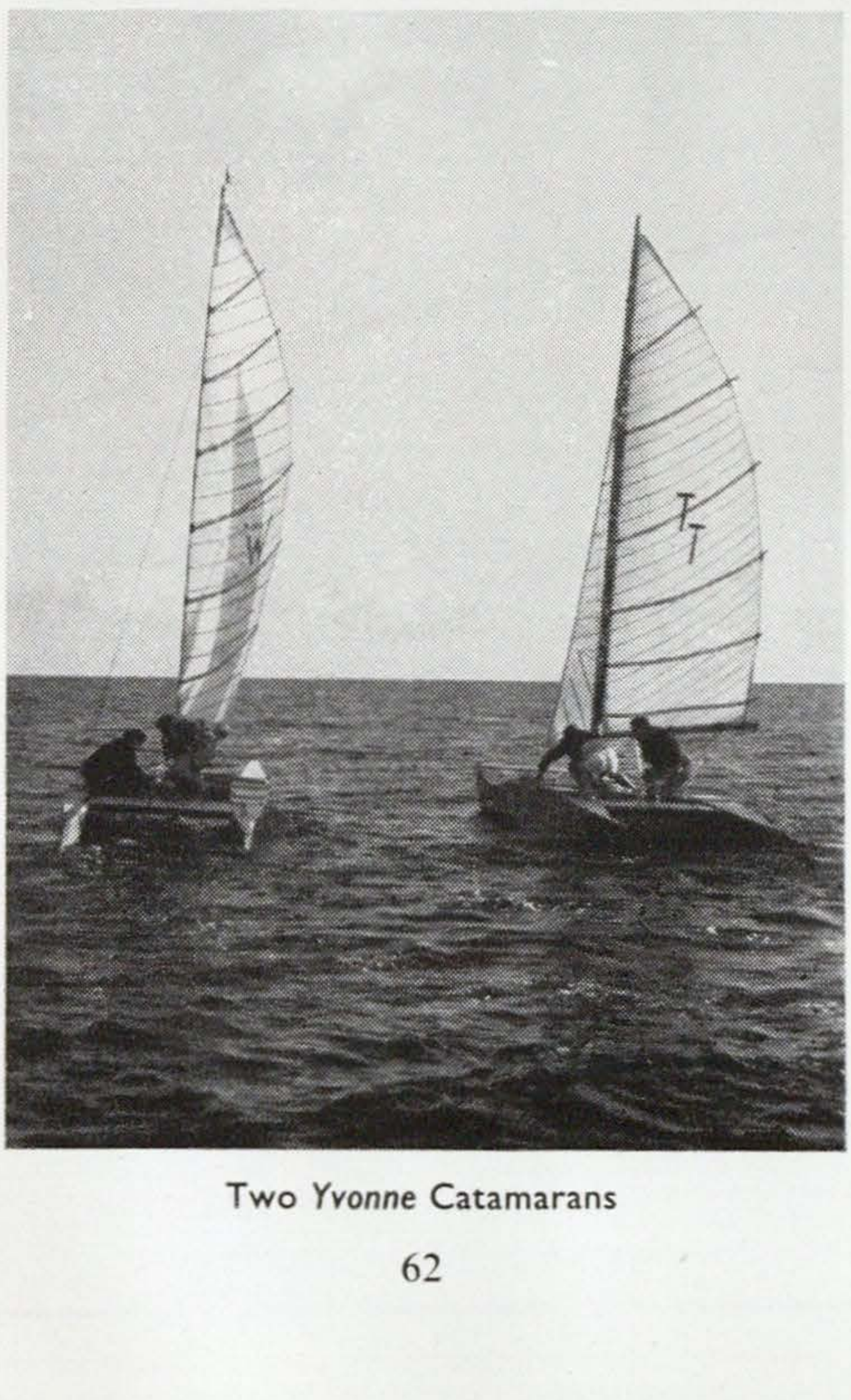
October, 1957

Ed: In our early studies of catamarans, we felt that the chined type would never be fast. As so often happens, we soon got reports of some very fast chined craft, of which we publish 3 designs. It is noteworthy that Bill O'Brien's JUMP-AHEAD once beat a SHEARWATER III in a series of races. She had more sail area, the relative amounts probably being in proportion to the resistances of the two boats.

THE YVONNE CAT

L.O.A.	20 ft	Draught	6 in
L.W.L.	14 ft 6 in	Sail Area	190 sq ft
Beam, O.A.	7 ft 4 in	Weight	
Beam, hull	1 ft $5\frac{1}{2}$ in		

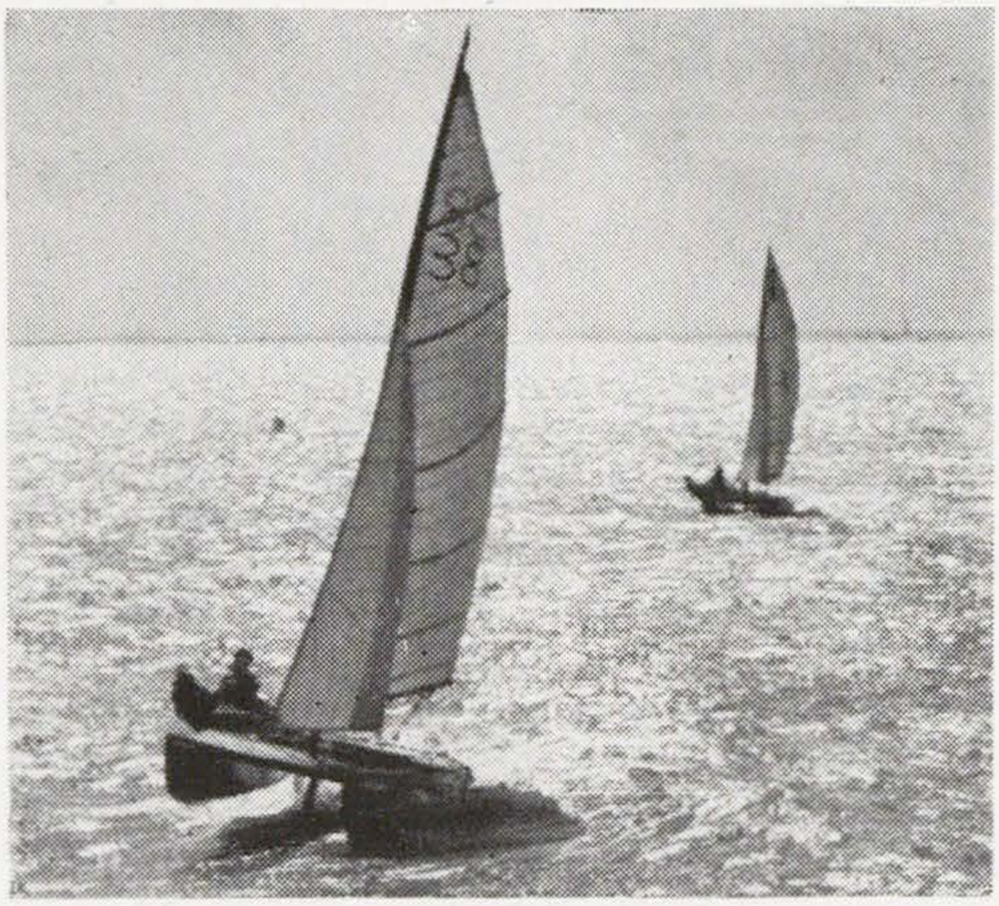
This catamaran was designed by C. H. and L. N. Cunningham of Victoria, Australia as a series of modifications of a hard chine catamaran with box shaped sections till it became the elegant craft shown in the drawings. All this



Two *Yvonne* Catamarans

was carried out full scale and started in 1952 and the craft took its final shape in 1953. For the Cunninghams, this was the only way to develop their craft because they had so little to go on when they started. Their development had to be carried out almost from the same point as the other catamaran pioneers.

The first catamaran with box shaped sections was well rockered on the keel to allow of easy manouevrability, had symmetrical sections, a canoe stern, a central centreboard and balanced rudders. It was very fast in smooth water but in rougher water, the fore and aft stability was not enough and the rudders lifted clear at times and the flat floors pounded. As a result the bows were extended two feet, lifted and flared, a false V-bottom was added from the bow to amidships and the rudders were enlarged. This cured all the faults



An *Yvonne* "Flying a Hull"

of the previous design and all the present *Yvonne* 20 catamaran owners feel that they have a very satisfactory craft. Today there are 10 *Yvonne* 20 catamarans registered in Victoria, with 87 sets of plans sold all over the world.

Performance

The *Yvonne* 20 has sailed over a mile distance at an average speed of 18 mph. In bursts, a speed of 20 mph has been exceeded. Over a distance of 21 miles in very rough conditions, 15 mph was averaged on a broad reach. It will be noted that these speeds are almost identical with those of the Prout *Shearwater, Ocelot* and others.

Design Features

As compared with contemporary British and American catamaran design, the main features of the *Yvonne* 20 are:

1 The forward overhangs.
2 The taking of the torsion strains between the hulls by two crossed girders instead of the rolled plywood system of most designs.

3 The ingenious centreboard design, which allows the board to come up below the cockpit when it is up.

Summary

The Cunninghams have produced a catamaran which is very fast on all courses, manoeuvres well, is fully seaworthy in hard winds and big seas and is suitable for amateur building.

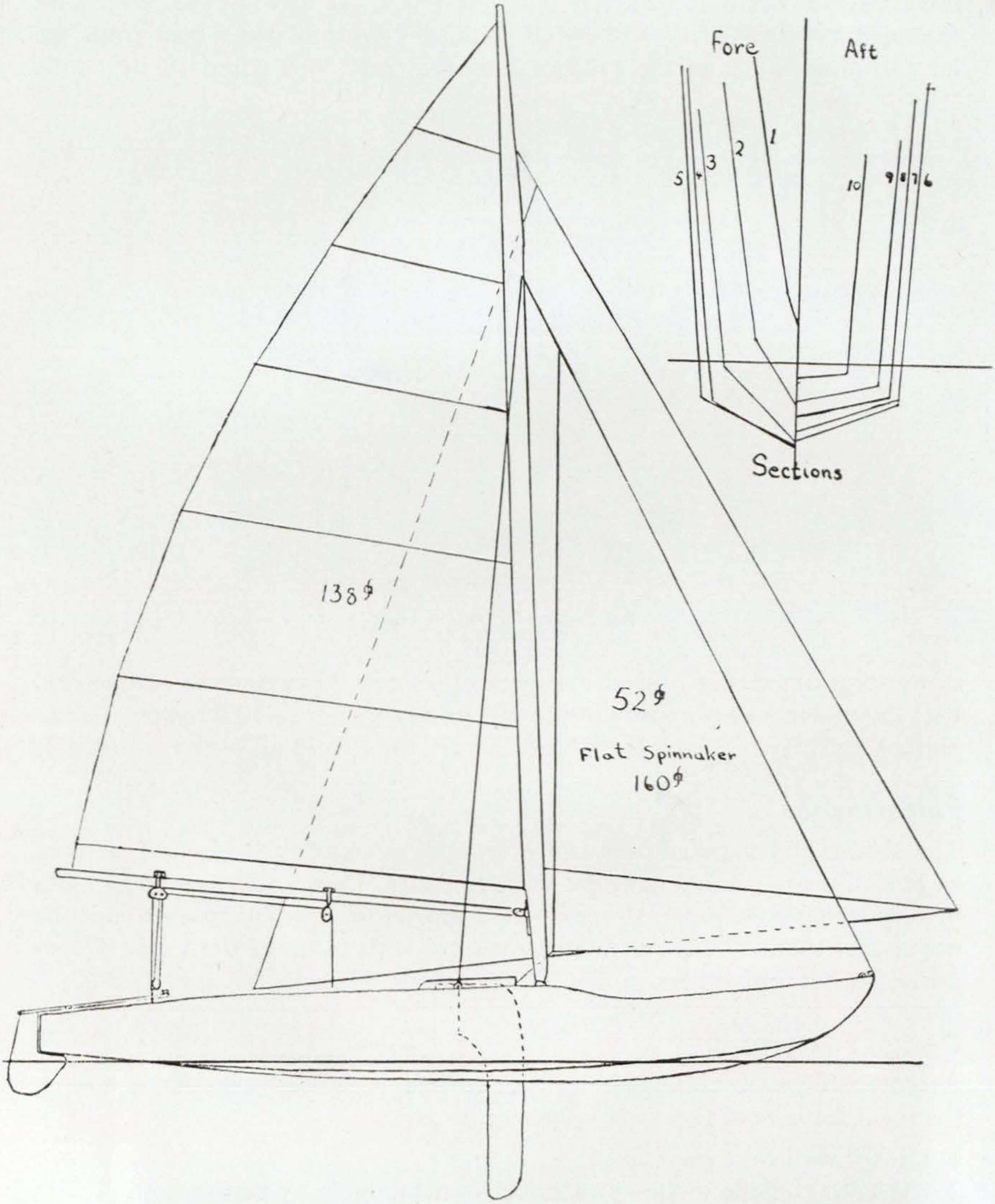


Fig. 3. The Cunningham's *Yvonne*

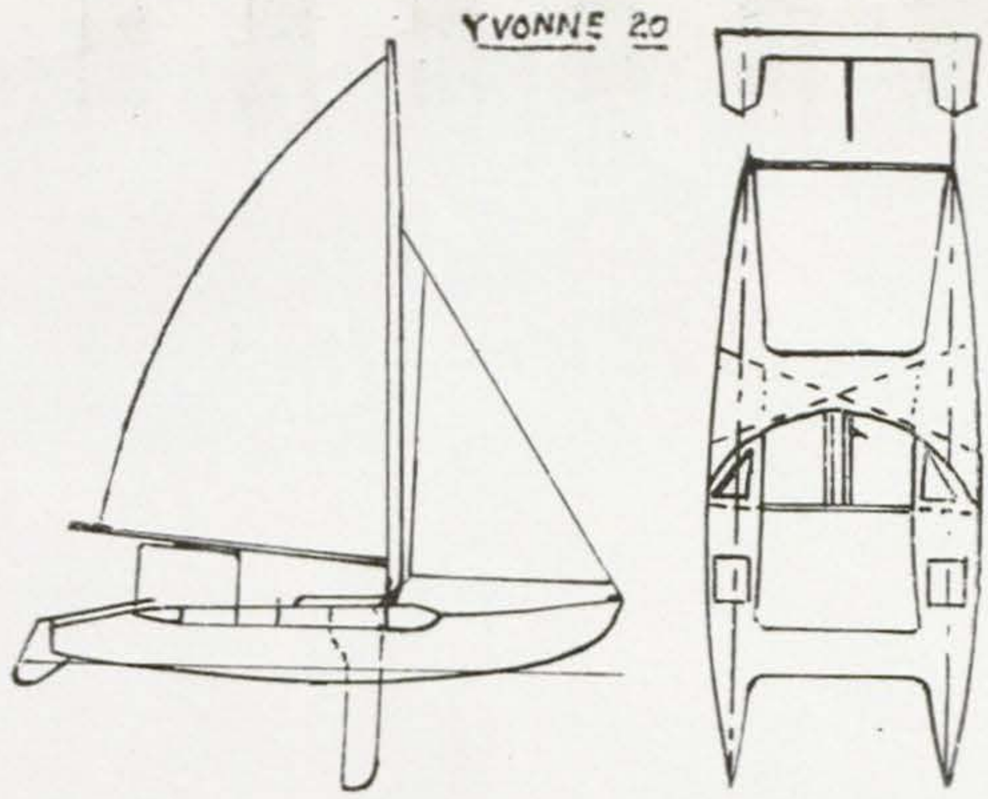


Fig. 4. *Yvonne*—Note X Girders

JUMPAHEAD

L.O.A.	16 ft	Min. Weight (Stripped)	200 lbs
Beam	7 ft 6 in	Max. Sail Area	167 sq ft

Designer: Bill O'Brien

This excellent design was produced by Bill O'Brien as a result of seeing *SHEARWATER II* sail in 1955 and talking to Roland Prout and myself at Weston, Southampton. In essence each hull is a modification of his 14 ft chine dinghy *DARING,* described in publication No. 8. This produced deep chested hulls with an unusual amount of rocker, a hollow entry and planing run, changing to a dead flat transom.

Light Winds

In light airs, the crew moves well forward to lift the transom clear of the water to reduce wetted surface. Sailing *JUMPAHEAD* at Lymington this year, Richard Creagh Osborne won a four hour drifting race against a 505.

To Windward

JUMPAHEAD gives of her best at 40° to the apparent wind with the sheets well in. She goes up to windward well by luffing to each gust which makes the lee hull bite deeper, and for cruising the centre board can be dispensed with.

Putting About

With practice this can be done in 5 seconds, but, as with other catamarans, the technique is different to that used with dinghies. The jib should be held in hard until it is on the point of "backing" but definitely not "aback". It is then changed over and sheeted in fast on the other side so that it is drawing her forward. Catamarans are generally light craft and, on coming up into

JUMPAHEAD

the wind with a large sail area, the flogging sail and the seas tend to drive the craft backwards so the sails must be kept drawing to the last possible moment. A wrong impression is also given by the change in speed when putting about. A dinghy slows down from about 6 knots to 2 or 3 knots whereas a "cat" may be doing 10 or 12 knots and slows down to the same speed as the dinghy when putting about.

Flying a Hull

When sailing single handed with *JUMPAHEAD*, hardening the sheets and lifting one hull about a foot off the water in a 12 knot wind *increases* the speed from 15 knots to 17-18 knots. This is due to decreased wetted surface of the weather hull, whilst maintaining sufficient dynamic lift on the lee hull.

Speeds

The highest speed recorded by the *Smith* speedometer, carrying 167 sq ft is 19 knots, in 2 ft seas, crew sitting inboard. Ideal conditions, i.e., strong wind and smooth water, are eagerly awaited.

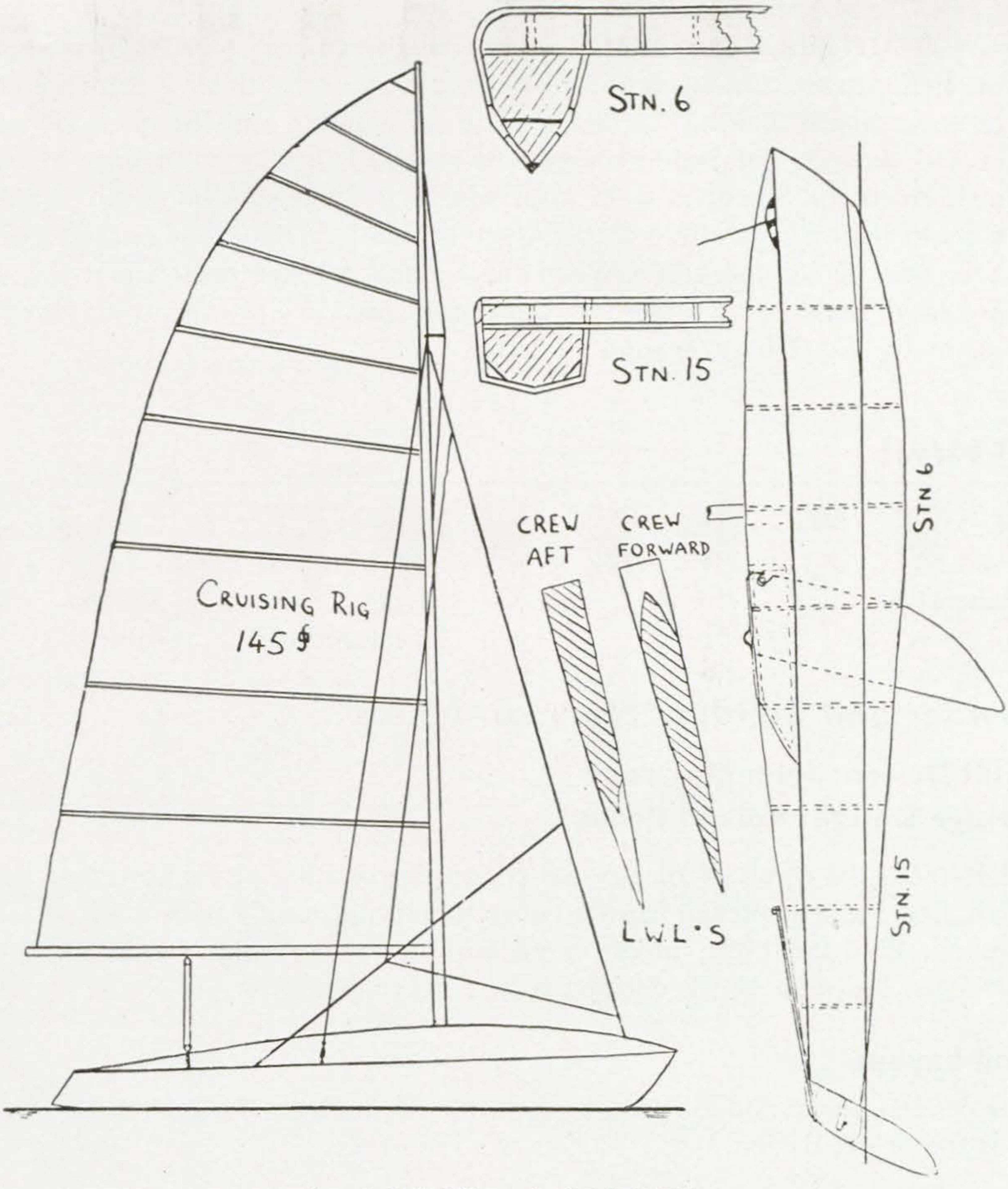


Fig. 6. Bill O'Brien's *JUMPAHEAD*

There are some objections to catamarans put forward by people, which Bill O'Brien would like me to state, with his answers:

1 *The catamaran cannot be easily trailed*

A *JUMPAHEAD* has been trailed thousands of miles on an A.S.T. designed trailer.

2 *Takes up too much room*

A *JUMPAHEAD* may be hung on the wall or placed on its side, the "shores" being the girders going right through it. The space needed is 16 ft × 2 ft and it could often be put at the side of a garage or hung from its roof.

3 *Lying at moorings*

As safe as a cruiser, having the self draining cockpit.

4 *Cannot be stopped quickly*

A *JUMPAHEAD* can be stopped in 10 ft from 15 or 16 knots by pushing the helm down. Similar action in a dinghy would result in a capsize. The catamaran will then lay "hove-to" with jib flapping and the mainsail well in and cleated. The rudders would be reversed. Bill says: "I have stayed hove-to in the Solent in a 25 knot wind with biggish seas (wind against tide) to light a cigarette and, on other occasions, I have sat on a starting line, waiting for the gun". When the rudders are centralised and the jib pulled in, she actually jumps forward to full speed in a few feet. Full planing seems to be achieved around 19 knots.

GEMINI

L.O.A.	16 ft 6 in	Hull beam, O.A.	2 ft 3 in
L.W.L.	15 ft 0 in	Hull beam, W.L.	2 ft 0 in
Beam, O.A.	7 ft 6 in	Weight	350 lbs
Sail Area	145 sq ft	Construction	Fibreglass and Plywood

Owner and Builder: Norman Naish

Hull Design: John Morwood
Bridge Design: Roland Prout

GEMINI is the result of the special conditions existing at Folkestone where boats have to be launched from a concrete jetty, generally with a bit of sea running. Plywood hulls, unless fitted with a metal runner would soon be chafed so Norman Naish decided to use fibreglass.

The Layout

The general layout and dimensions are those of the Prout *SHEARWATER III* as is the bridge design.

Hull Design

The hull has a long flat run with easy twisting of the bottom plywood. The chines are on the waterline and the keel line is rockered to the waterline fore and aft. The overhang forward is to preserve an easy entrance and to prevent the bow burying when flying a hull.

Performance

The top speed appears to be the usual 18 knots. "Flying a hull" appears to increase speed, rather than slowing her down. The light weather performance, on the other hand, is only about comparable with the dinghys which may be due (1) to the smaller sail area as compared with *SHEARWATER III* (160 sq ft) of *JUMPAHEAD* (167 sq ft); (2) the greater weight, which is due to the fibreglass construction; (3) the fact that the sails were home made, though they sit very well indeed, and (4) there is more wetted surface than with a *SHEARWATER III*.

(*Photograph by Fullers, Folkestone*)

GEMINI

Manoeuvring

Putting about is quick, easy and certain, if she is "sailed" from tack to tack as described by Arthur Piver. She then takes about a second more time than a *Firefly* dinghy. Putting about is very difficult indeed without the centreboard, though it can be done. In fact, the centreboard is hardly needed for windward sailing though it must be used for putting about.

Planing

I have never seen *GEMINI* plane, though she has the shape to do so. Even at 13 or 14 knots, the bow does not lift and she runs on her designed waterline.

In the design, the bow sections are full but I think that even fuller bow sections would be needed for easy planing, which must start at about 12 knots to be of any use to a catamaran.

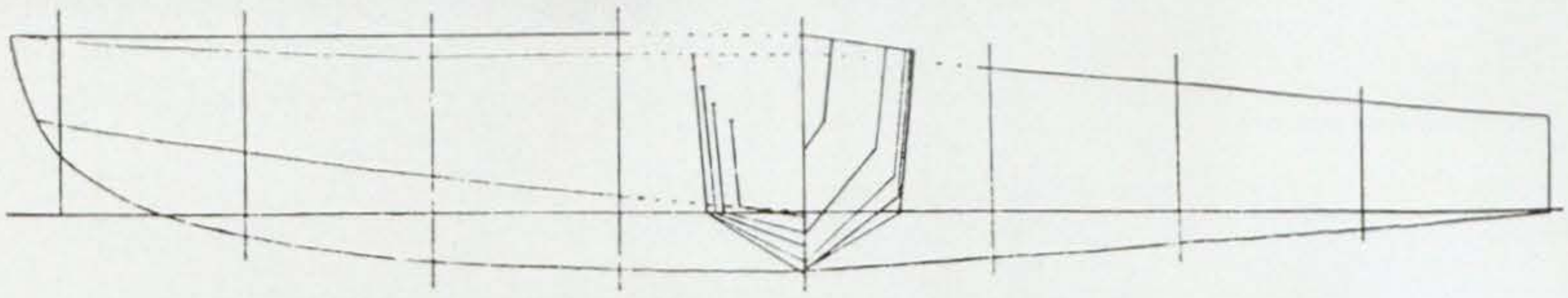


Fig. 9. Lines and Sections of *GEMINI*

Summary

A chine catamaran is described which is suitable for home building and which has a satisfactory performance. A *SHEARWATER III* will be sailing from Folkestone this month with a full rig and, by exchanging sails, it is hoped that full comparable performance data will be obtained.

Plans

Plans for building *GEMINI* will not be sold as it is felt that *JUMPAHEAD* will cater for the needs of people for this type of craft. However, one set of plans are available should anyone want to use them. It would be interesting to see how a light plywood version would go in relation to both *JUMPAHEAD* and *SHEARWATER III*.

The female mould from which the first craft was built is still available should anyone want to build *GEMINI* in fibreglass.

CHAPTER VIII

DESIGN OBSERVATIONS

by John Morwood

October, 1957

THE MIDSHIP SECTION

Eleven midship sections are shown in the diagram. On the whole, they show a tendency to reduce wetted surface in the more recent designs by having a shape approaching a semi-circle, the notable exceptions being Bob Harris' *OCELOT* and the *YVONNE CAT. JUMPAHEAD* by Bill O'Brien and *GEMINI* have a section with a near right angle at the keel which is not far away from the minimum wetted surface.

Deep underwater chines have also ceased to be used except by Victor Tchetchet in his trimarans. The modern chine catamarans have the chine very near to the water line.

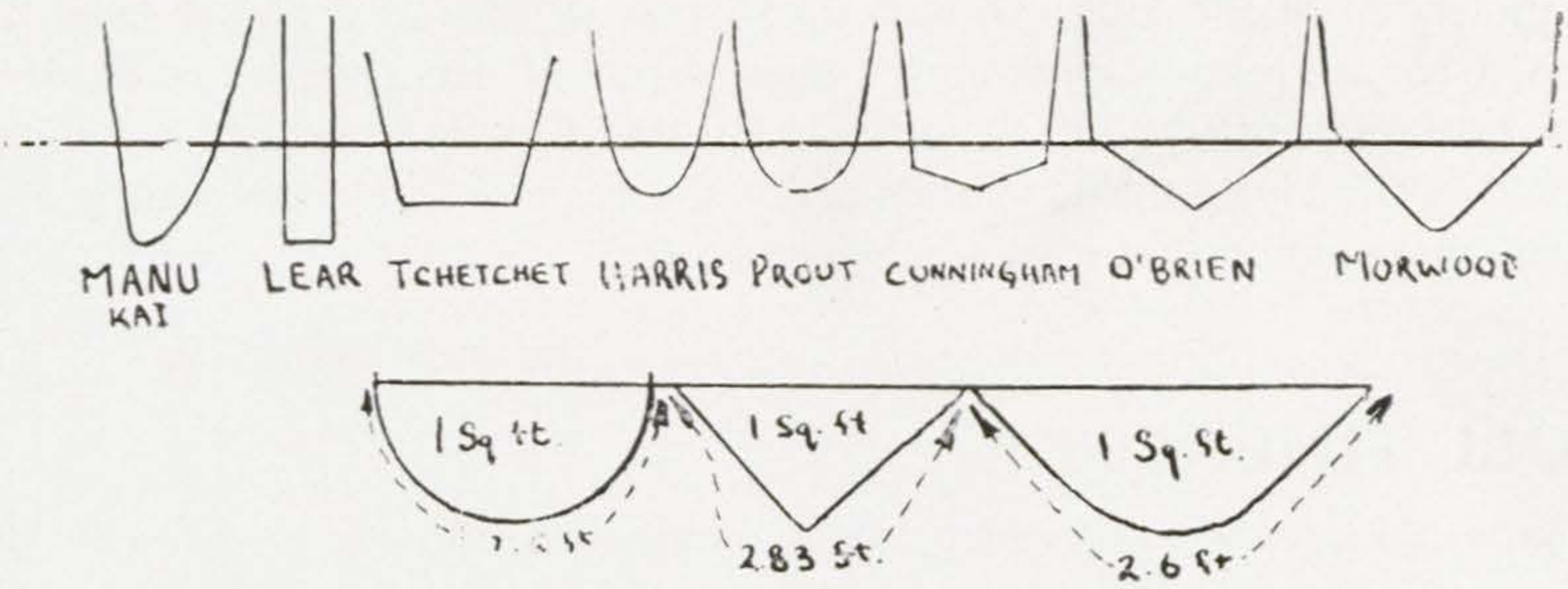


Fig. 1. Midship Sections

It has also been shown that a centreboard is a far better way of getting lateral resistance than deep, asymmetrical hulls and these are being less used.

The three lowest sections are instructive. All are drawn to include an area of 1 sq ft. The semi-circle has a wetted perimeter of 2·5 ft, the triangle with a right angle below has a wetted perimeter of 2·83 ft and the third shape, which is also a right-angled triangle with the point rounded off, has a wetted perimeter of 2·6 ft. These figures show that the triangle has 13·2 per cent more wetted distance, and the rounded triangle 4 per cent more distance than the semi-circle. If, therefore, wetted surface is of the greatest importance to catamaran speed, little is lost by having these shapes over a semi-circle. The rounded triangle could be of great use when designing a large cruising catamaran because most of the hull could be made from plywood sheet and even the bottom rounded part could be made from plywood "planks" laid either carvel or clinker (lap strake) without any significant loss of speed.

CAN A CATAMARAN PLANE?

From all the evidence at my disposal I have come to the conclusion that catamarans *never* plane. They simply go through the water and leave a groove after them when they have passed. David Jeffrey has made the best shape of catamaran for planing of which I know and states quite definitely that he did *not* plane even at 14 knots. In *GEMINI*, high speeds of the order of 18 or so knots have been obtained with the inside bow waves sluicing across the craft in a solid sheet of water and again planing did not occur. If these two hard chine, flat floored craft do not plane, a *SHEARWATER* certainly cannot. Additional evidence comes from tank tests of destroyer hulls which so much resemble *SHEARWATER*. Again, there is no planing.

There are, however, certain things which a catamaran does at speed which are very similar to planing. Firstly, she tends to lift her bows up and depress her stern. This is simply due to the fact that the under surface of the hull is a fair curve and the water in which it is sliding also has the same curve. Thus, by pushing the craft along in this curved groove, the bow will lift and the stern go down. Secondly, the whole craft gives the impression of being lifted bodily up. This is due to the fact that the bow wave is overrun by the speed of the craft and it is raised by flotation in its own bow wave.

True planing is due to the dynamic lift caused by particles of water hitting the underside of the hull, lifting it up so that it rides at a higher level than when it is stationary. Dynamic lift must certainly occur at the bows of the chined catamarans, but owing to the low ratio of beam to length, not enough lift will occur along the whole length of the craft to constitute true planing at the speeds which have been achieved so far.

HULL 'FINENESS'

Perhaps our greatest ignorance about catamaran hulls is to do with their "Fineness". We do not know the best ratio of length to beam. Neither do we know the optimum "Prismatic coefficient". Both of these can be found by the long process of trial and error at full scale or much more cheaply and quickly by testing models.

The Prismatic Coefficient

This is a figure which gives us an idea of how full the ends of a yacht are for a given maximum section. It is arrived at by multiplying the area of the maximum section by the waterline length. This gives us a volume, and the ratio of the volume of water displaced by the boat to this volume is the prismatic coefficient.

When the prismatic coefficient is high, the ends of the boat are full and the light wind performance will be good because the wetted surface will be less for a given displacement. When the prismatic coefficient is low, the ends of the boat will be fine and, though light wind performance may be less good, the strong wind performance may be better.

SHEARWATER III has full ends with a prismatic coefficient of 0·68.

OCELOT, with fine ends has a prismatic coefficient of 0·57. These two designs seem of equal merit to me. The fact that, in a trial between the two, *SHEARWATER III* was faster in light winds, while *OCELOT* was faster in strong winds, is exactly what could be expected from these coefficient figures.

'FLYING' A HULL

"Flying" a hull is amusing and even exciting. However, in catamarans such as *SHEARWATER*, Bob Harris' *OCELOT* and many others, this puts too much displacement on the lee hull and the craft is slower than when the displacement is more equally spread between the hulls. However, in *JUMP-AHEAD* and *GEMINI*, when one hull lifts off the water, the speed increases, instead of falling. The reason for this is hard to produce but it may be that the forward overhang gives a greater overall sailing length with the same fine entry as when they are on both hulls. When other catamarans dig their hulls in, the entry becomes much more bluff.

When sailing on one hull, the transom becomes more deeply immersed in *SHEARWATER*. In the two above craft, the flat floor aft might keep the stern raised and the transom from sinking so deeply.

CATAMARAN SPEED

Almost without exception, the top speeds which have been measured reliably for well designed catamarans and trimarans have proved to be between four and five times the square root of the waterline length. This again is further evidence that catamarans do not plane because hulls like those of *MANU KAI* certainly will not plane. If any catamarans *did* plane, their top speeds would be greater than those of those which did not.

Slim hulls and hulls with a V section should be tried to see if they have a higher top speed than the semi-circular sectioned hulls. Below $\sqrt{L}$ knots, the semi-circle will, of course, be the best and the only problem, therefore, which is left is to find out if another shape will be better at speeds in excess of this.

MANOEUVRABILITY

Catamaran manoeuvreability depends as in other craft on the under water profile. However, they always need to be sailed the whole time from one tack to the other not only because they are relatively lighter than other boats but also because the hull shape is such that it has good directional stability and tries to run a straight course at all times.

It is essential, therefore, to sweep the keel line of the profile up to the waterline both forward and aft and to provide a centreboard or two centreboards around which the craft can pivot. Both the Prout *SHEARWATER* and *GEMINI* are much harder to put about without the board than with it.

Catamarans with asymmetrical hulls such as *MANU KAI* and the *LEAR CAT* are harder to put about than craft with symmetrical hulls. Long straight sides also make manoeuvring difficult which is probably the reason why catamarans of the "Split boat" type have a poor reputation for putting about.

It appears to make little difference what shape the keel line is as long as it comes to the waterline fore and aft. It can be elliptical in shape as in the *SHEARWATER* or with an almost straight line from a deepest part forward of midships as in *GEMINI* and still manoeuvre well. The position of the centre of buoyancy also can be put where convenient so as to balance the weight of the crew and craft. If it is far forward, as in *GEMINI*, the crew must sit forward in light winds but come aft for high speeds.

CATAMARAN WETNESS

It is almost axiomatic that a fast craft will be wet and a catamaran is no exception. However, the catamaran has one aspect here not possessed by other boats. That is that the weather bow wave of the lee hull can rise up and produce a jet of water of large dimensions directly on the crew on the weather side. This is decidely uncomfortable.

Spray deflectors, such as are used with speed boats are now being fitted to the Prout *SHEARWATER* and are helpful. They consist of a batten of triangular cross section with a horizontal lower surface. Water being scooped up by the bow hits the batten and is shot outwards and does not rise high enough to come aboard. It has been shown by Professor Ata Nutku that these spray deflectors give increased resistance in the test tank but in practice, this is probably more than made up by the lesser water carried in the cockpit.

It is also possible to deck in the whole forward part of the craft between the hulls but this appears to trap air and to slow the catamaran very much. However, by studying the air flow forward, it should be possible to design a fore deck between the hulls which does not obstruct the air flow but still keeps the water down.

CATAMARAN STERNS

MANU KAI had a canoe stern. I believe that this was simply because she took her origin from the Micronesian canoe more than from the Polynesian outriggers or large war canoes which often had counters. All the craft which owe their origin to *MANU KAI* directly seem to have copied her canoe stern, except for the English catamarans which have the Europeanised Kayak transom stern of the Prout *SHEARWATER*. It is therefore worth while considering which stern is likely to be the best.

The canoe stern has the advantage of being streamlined and hence has less wind resistance than a transom. It is usually more attractive to the average yachtsman than the transom because it conforms more to most people's conception of a yacht. However, it is a waste of boat because, for example, a canoe sterned catamaran with fine lines of 20 ft overall length could be shortened to somewhere about 17 ft in length by using a transom and still have the same performance. In my opinion, the extra expense and weight of the stern is not likely to be worth while.

BRIDGE DECK DESIGN

The strains between the hulls of catamarans have not to my knowledge been fully worked out. However, without doubt the greatest strain leading to failure in the bridge deck would be a twisting strain between the hulls where one bow is lifted by a wave when the stern of the other hull is also on a wave crest. Strains from the hulls pressing together or apart, are I think, much less.

The separation between the hulls can be achieved by a sheet of plywood firmly glued and screwed to both hulls. At the bows, a cross beam is necessary to stand the compression strain of the wire span for the forestay and to support the bows apart and in torsion. At the aft end of the cockpit plywood, another beam such as a 4 in by a 1 in set on edge will also deal with these strains and also be able to take an outboard motor, if required, though this may not be a good place to have one because air can be sucked down to it from the surface. It has been found preferable in *GEMINI* to put the outboard on one of the transoms, even though it meant cutting into the deck.

As already mentioned, the torsion strains are most important. They are best taken by a tube or "box girder" stretched across the craft and, to come as near this as possible, many catamaran designs curl up one or both ends of the plywood sheet to form a part of a tube. Then, by curling plywood over the top, there is a structure capable of taking the torsion strains involved. The *YVONNE CAT*, however, takes these strains by two girders which are X shaped in plan view laid across the craft and this is also satisfactory. In the plywood version of *GEMINI*, the torsion strains are taken by a cross girder with an isosceles triangle for its section. This torsion structure, of whatever shape, is also given the job of supporting the mast at its centre.

CATAMARAN SEAWORTHINESS

When the long slim hulls of a catamaran meet a wave, they are supremely unconcerned. They simply go straight on and cut through it. This again is evidence that catamarans don't plane because, if they were getting dynamic lift from the water, they would be stopped by a wave; or at least have to jump over it. They suffer neither indignity. However, when they have penetrated far enough into a wave, buoyancy gets to work, unless they are too slim and deep, and they bob up like corks, thus once again achieving their designed state of surface travel.

This behaviour of catamaran hulls (of good design) means that their motion to small waves is less than that of a beamier boat.

In larger waves, the catamaran will take the main contour of the wave which is a surprisingly gentle slope, even in soundings, and it is found that on the deep seas, the motion of a catamaran is very easy indeed, compared to conventional keeled yachts. The reason for this is that a catamaran will only take the slope of the wave whereas a keeled boat will have a pendulum movement which will often cause it to heel at twice and even more times the angles of slope of the waves. For example, a keeled boat running down the trades will often indulge in the tactic of "Rhythmic rolling" where the frequency of the yacht's roll corresponds to the period of the waves. This cannot happen to a catamaran.

Summary

A catamaran will have far less motion and be far safer at sea than a conventional boat of the same size. As regards safety, this point is arguable in the case of cruising catamarans which can be capsized and one must keep an open mind about them till we have more information.

CATAMARAN CAPSIZES

Light catamarans can all be capsized. Usually, a light Catamaran like *SHEARWATER III* can be righted by her crew should she be allowed to tip up. According to Jack Blundell, capsizes fall into two types:

1 With the board lowered.
2 Without the dagger board.

In the case of No. 1, as the mast hits the water, the helmsman should slide over the hull onto the board, immediately. This will often stop the craft from turning further and halt it with the mast just below the horizontal. The crew should then free all the sheets and hand the jib sheet to the helmsman. The helmsman should then lean outwards, using the sheet to hold by, while, at the same time, the crew lifts up the mast as much as he can. As soon as the mast and sail leave the water and the catamaran is just past the point of balance, ready to plop back right way up, the helmsman must duck under the upper hull *forward* so that it doesn't hit him as it falls. He will then be between the bows when she is right way up.

In the case of No. 2 without the board and completely upside down, there is no great hurry. Again the sheets should be freed and the jib sheet brought up. Helmsman and crew should then get right forward on the lee hull or the hull which is lowest in the water. Both should then stand up and lean out using the sheets. The mast will gradually lift and as it does so, the person further aft should move aft to the after end of the cockpit. Again, when the craft is just past the point of balance, both helmsman and crew must drop off fore and aft of the bridge, between the hulls.

WIND RESISTANCE

It is most important to reduce the wind resistance of catamarans and outriggers. I have heard of a catamaran with a strong, light lattice work bridge deck whose performance was poor but became good when the bridge deck was covered in at an increase of weight. Fairing and streamlining of struts, aft beams of cockpits etc., can be easily and cheaply done with expanded polystyrene, weighing 1 lb per cubic foot.

The only part of sailing boats which few people have made any attempt to streamline is the crew. I reckon that one person sitting on the side deck of a craft has a windage equivalent to about 16 sq ft of sail area when close hauled, taking a side force to thrust ratio of 3·5 : 1.

CENTREBOARDS

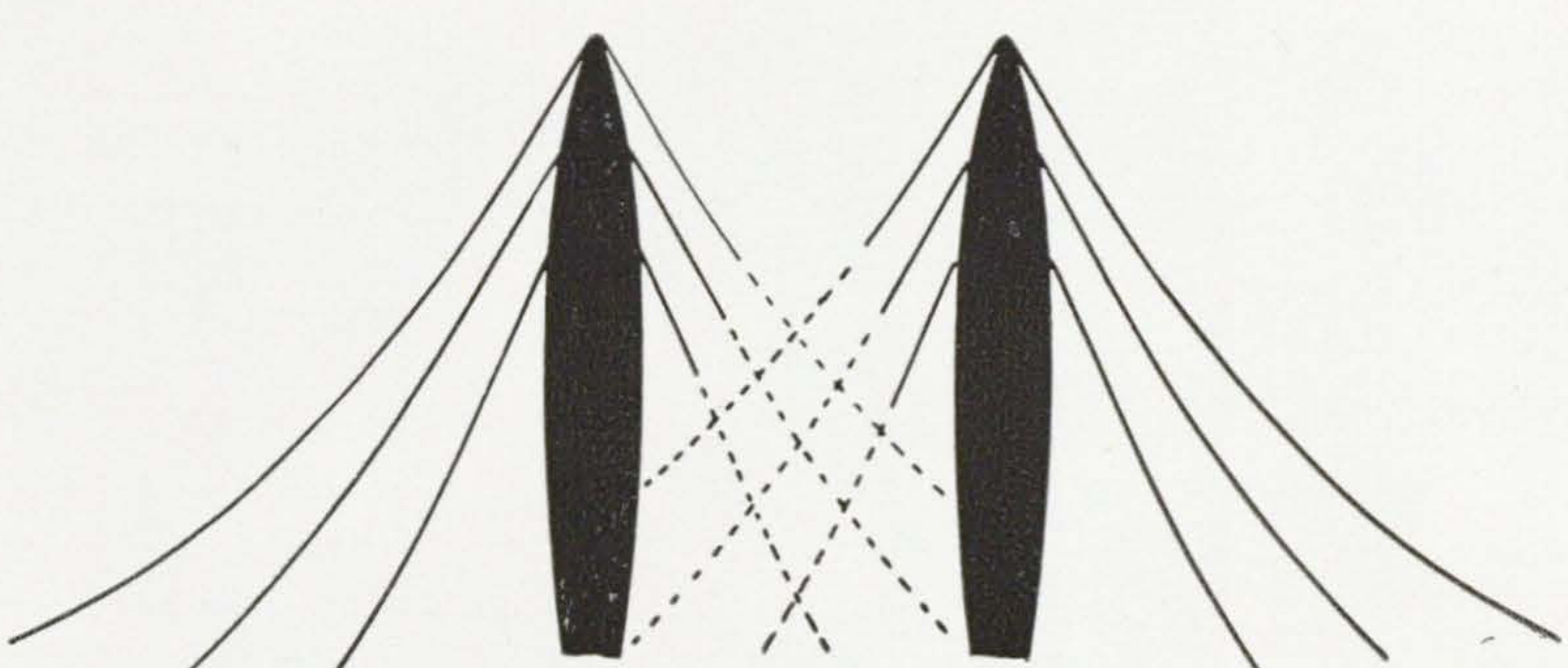
Roland Prout and others have proved that twin centreboards in each hull are better than a single central centreboard but hardly worth the cost of installing them in a one design racing class.

The long narrow hulls of these craft have a lot of lateral resistance in themselves, possibly two-thirds of the necessary amount needed to go to windward at greatest efficiency. Many people, who have tried angling their boards to abolish leeway, even in dinghies, have told me that they have not been successful and this is obviously due to overloading the board which has only been of normal size. It merely suffers from air entrainment or "stalling". Centreboards in my opinion, should always be placed fore and aft, even in dinghies.

CATAMARAN HULL SPACING

The result of spacing the hulls of catamarans too widely apart is that a stern over bows capsize will occur before the normal sideways capsize. This is simply a matter of the relative stability in the two directions. If the lateral stability is greater than the fore and aft stability, the lee bow will bury and the craft will sail under before it will capsize. One cure for bow burying, therefore, lies in reducing the overall beam.

When the two hulls are too close together, on the other hand, there may be a strong "venturi" effect between them with a hollow, instead of a wave system. The water flow is speeded up in this hollow and the whole condition is one of greater resistance. It is aggravated by having asymmetrical hulls with the more curved sides *inwards* and minimised by asymmetrical hulls



with the more curved sides *outwards*. If it is the intention, therefore, to have a very narrow overall beam for a catamaran, asymmetrical hulls with the greater curvature *outwards* could be considered, which is the opposite of that usually used.

The Optimum Spacing

The best possible spacing is, in my opinion, where the bow waves of each hull lie on the quarters of the opposite hull to lift it up and push it along. To achieve this, catamarans with bluff bows which throw off broader bow waves should be more beamy than those with finer entrances. Of course, considerations of stability take precedence over wave formation in considering beam, within reason.

CHAPTER IX

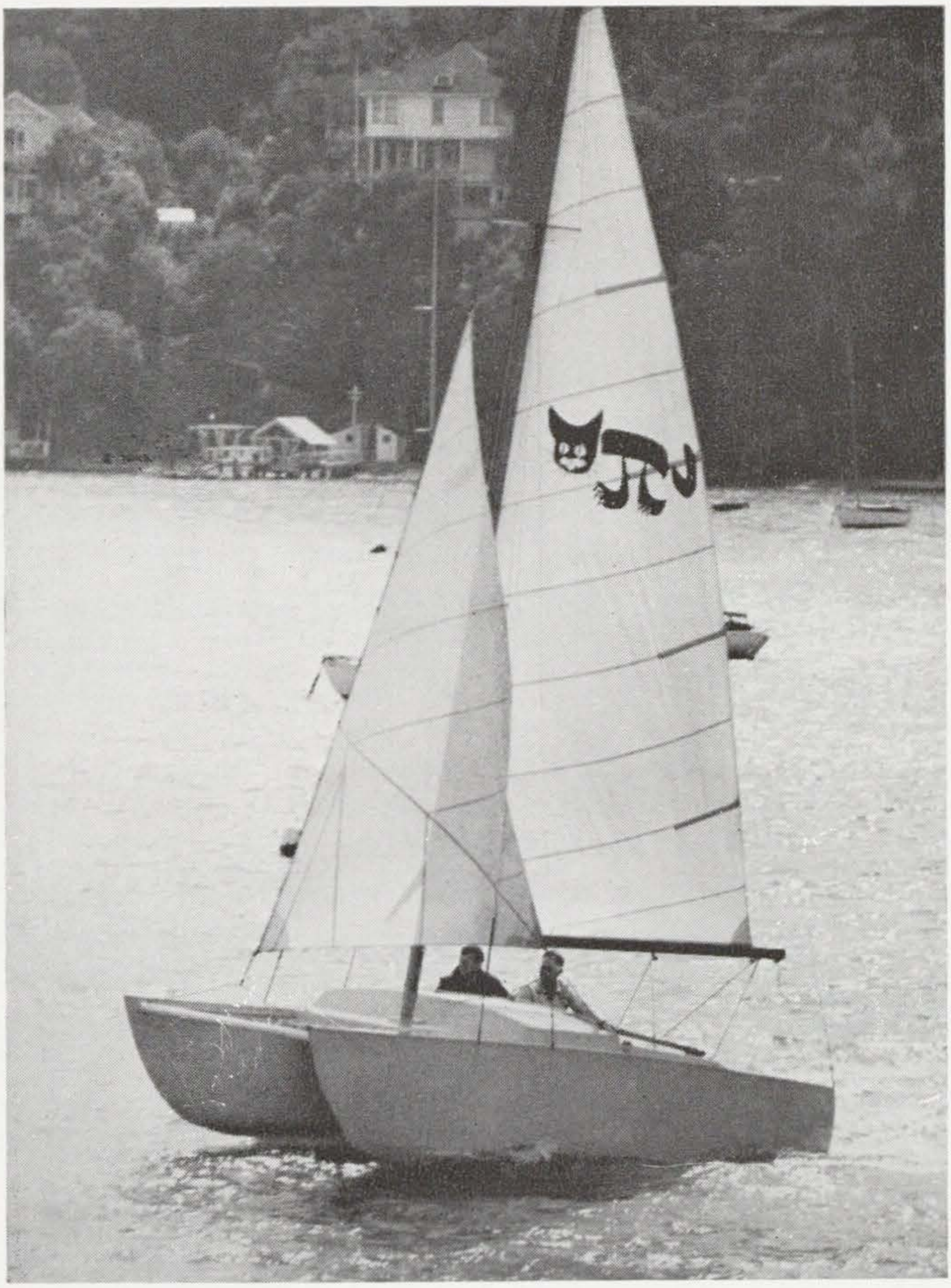
THE PI-CAT CATAMARAN

October, 1957

by Arthur Piver

Length	20 ft	Width of hulls	15 in
Beam	7 ft 11½ in	Weight	600 lbs
Draft	8 in	Sail Area	200 sq ft

The ideas which led to the building of the *PI-CAT* began accumulating just after I assembled a *LEAR CAT* kit about four years ago, and were an attempt to overcome what I felt were some deficiencies in the commercial design.



The 20 ft catamaran *PI-CAT*, designed by Arthut Piver, Mill Valley, California

The *LEAR CAT* is a much maligned boat, in my estimation, as the one I had was very fast indeed, and was then easily the best performing boat on San Francisco Bay, and could beat anything of any size off the wind, and on the wind could outpace any similar sized craft, including such vaunted types as the International 14 and the Hornet, except in light weather. However, other *Lears* hereabouts were far inferior in performance, a fact I cannot explain, although I did change the design somewhat by eliminating a good deal of the fore and aft rocker on the keel at the time of assembly.

The *Lear* had a tendency to bury the lee bow when driven hard, and as a matter of fact I sailed it completely under water on a half dozen occasions. It was quite a sensation, but was more inconvenient than hazardous, as the boat showed no tendency to capsize when fully immersed; but on releasing the sheet it would back out of the water, and was all ready to go once again.

It came about quite well, after I discovered that in a strong blow it was necessary to move the crew weight forward, as otherwise the boat would squat just before coming into the eye of the wind, and under these conditions it would not respond. Also, if there were more than three persons aboard, the craft was just dead in the water, unless it were blowing a young gale.

I also spent quite a bit of time aboard a 20 ft catamaran commercially manufactured over here, which had the worst hobby horsing habits I ever saw in a boat. This craft, although it manoeuvred well otherwise, spent most of the time just bobbing up and down in a most annoying manner. If it would come to a single large wave, for instance, it would pitch its bows so high that the after-decks were actually under water, and after the wave had passed it would continue hobby horsing along, in ever diminishing steps.

And so, from the foregoing experiences, I had three major tasks in my own design—keeping the bow from burying, better light weather performance, and the elimination of hobby horsing tendencies. The light weather performance dictated light over-all weight and less wetted surface, while the only way I could think of reducing the hobby horsing was to have no fore and aft rocker. This latter step also gave more buoyancy forward, which did indeed eliminate the bow burying.

Being my first design, and not being sure of my centers, I devised a track arrangement between the hulls, so that the single centreboard, which was fastened to a stout aluminium pipe, could move fore and aft. The original idea was to have a trim tab arrangement in the cockpit so that the board could be moved easily, but I never did get aroung to completing it, as the board proved insecurly mounted on the pipe, and indeed it twisted almost like a pretzel, even though composed of $\frac{3}{4}$ in ply. This lead to fastening it more securely through the centre section, but at least I had discovered the best point for balance.

Incidentally, here is an area for more research, for I believe that a readily moveable board would be a distinct advantage for a catamaran, as we have discovered that the best way to come about in this type is to sail it around, and the application of the rudder too soon in the manoeuvre will kill the turn in sloppy conditions. In other words, when the boat is close-hauled and it is desired to come about, the rudder is released while the trim tab is actuated

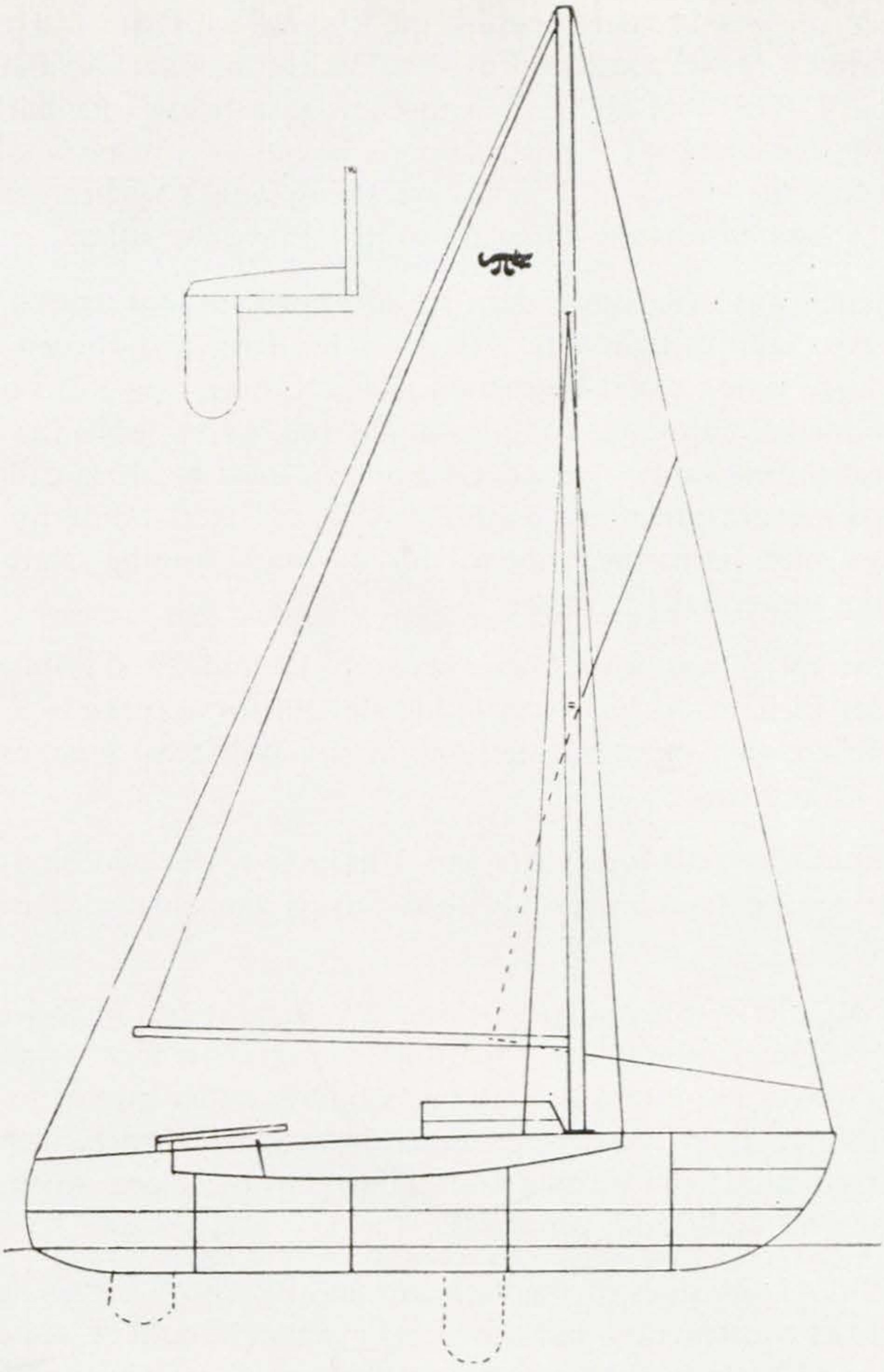


Fig. 2. Arthur Piver's *PI-CAT*

to give the craft a strong weather helm. When the boat reaches the point where wind begins to spill out of the sails, then the rudder is applied to continue the turn at a steady rate. Incidentally, we always pull the boom nearly amidships as the boat approaches the eye of the wind, maintaining drive as long as possible. When the rudder is finally applied, we find that the angle should be increased as the speed diminishes, although never more than 45°.

Although the single centre board seemed to provide sufficient lateral plane, I later replaced it by a board in each hull, and to my surprise discovered that although their combined area equalled that of the former single board, they were markedly more efficient. This phenomena was later explained by an article in an AYRS publication, regarding tip losses.

The hulls are semi-circular below the chines, with the full chine-beam carried relatively far forward to provide sufficient buoyancy so that the bows will not bury. The over-all beam chosen is just below the maximum for trailering on our highways. Construction is largely of ¼ in plywood, with the sections below the chines of ½ in square strip-planked spruce, covered with one layer of medium-weight fibreglass to just above the chines.

Performance was even more than I had hoped for, far exceeding that of the *Lear*, especially in light airs. The mast head rig was chosen so that an especially large genoa could be carried in light going, and this sail, which is made of spinnaker cloth and contains about 140 ft area, pulls the boat along in an almost unbelievable manner. Of course a mast head rig calls for backstays, which are not otherwise required. Also, an overlapping jib means the chain plates must be further inboard for on-wind sheeting; thus increasing mast loading somewhat.

Maximum speed was somewhere between 18 and 20 statute miles. Not having radar facilities, it has been found difficult to accurately judge speed, although we use two speedometers, one of the pitot-head type, and another a dip-stick arrangement.

As this boat was built four years ago, I have since decided on a number of changes, and have found that my ideas largely coincide with those of the Prout Brothers.

First of all, the semi-circular bottoms are a must for light weather performance and manoeuvrability. Moving the rig aft a foot or so turns the bow-diving movement into a heeling one which is taken care of by the boat's natural stability. Twin boards are superior in performance, although they must adversely affect the turning somewhat, and of course when housed in the hulls present additional problems.

In the *PI-CAT* the sides of the hulls are parallel above the chine as an aid to simplicity of construction, but now I believe they should be vee'd to reduce wetted area and build buoyancy faster as the lee hull is immersed. The veeing of the hulls above the waterline would also tend to offset the loss of buoyancy caused by adding rocker fore and aft, as although in *PI-CAT* there was no rocker, and it still manoeuvred well, some rocker will undoubtedly aid turning.

As a matter of fact, outside of public reluctance in general, I believe that the chief handicap to the catamaran type is the lack of manoeuvrability, and although a sailor with a good sense of feel will have no trouble, even under extreme conditions, the average skipper simple does not have what it takes.

For instance, we have here on San Francisco Bay about eight or ten catamarans, and although two of them are ones I have owned and which I know come about easily, still almost all now have outboard motors prominently attached to their sterns—a most disheartening sight.

THE PATINES A VELA

December, 1958

by G. Truzzi, Padova, Italy

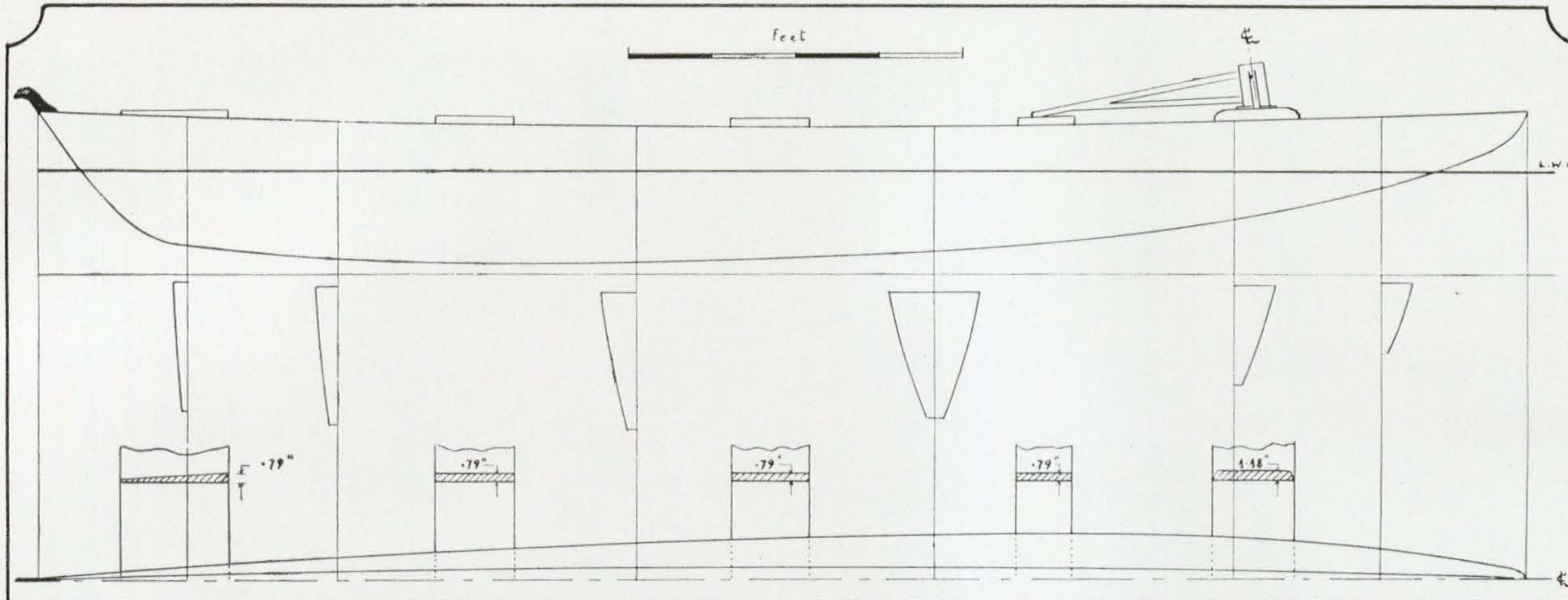
L.W.L.	16 ft 6 in	Sail Area	120 sq ft
L.O.A.	18 ft	Hull Beam	1 ft 1 in
Hulls Spaced	4 ft 3 in	Hull Depth	1 ft 7 in
Draught	1 ft 1 in		

Designer: Luis Montje

This boat was designed in 1944 by Luis Montje for the Club Natacion de Barcelona (Barcelona Swimming Club) to rather unusual requirements. It was meant, in fact, to serve as a tender to the Club members who wanted to swim off those beaches where restrictions on swimming costumes were too drastic. It had therefore to be handy, light, cheap both in cost and upkeep and, above all, fast and stable, for the boat was to take the swimmer to the chosen spot quickly where it was left unattended for a while.

PATINES A VELA

The result looks peculiar, though I think the hull design is clever and she would be very wet and hard to come about. When racing, she steers with a steering oar rigged in a crutch, but normally, she steers by alternative shifts of the crew towards the bow or stern, often helping the manoeuvre by dipping one leg. I have no detail of her scantlings, excepting for the cross members and the plan itself had to be enlarged from a very small sketch in my possession, so I wish to stress the fact that the lines drawn, though fairly accurate, should not be used for constructional purposes. I am told that quite a number of these catamarans are now sailed around the Spanish coast.

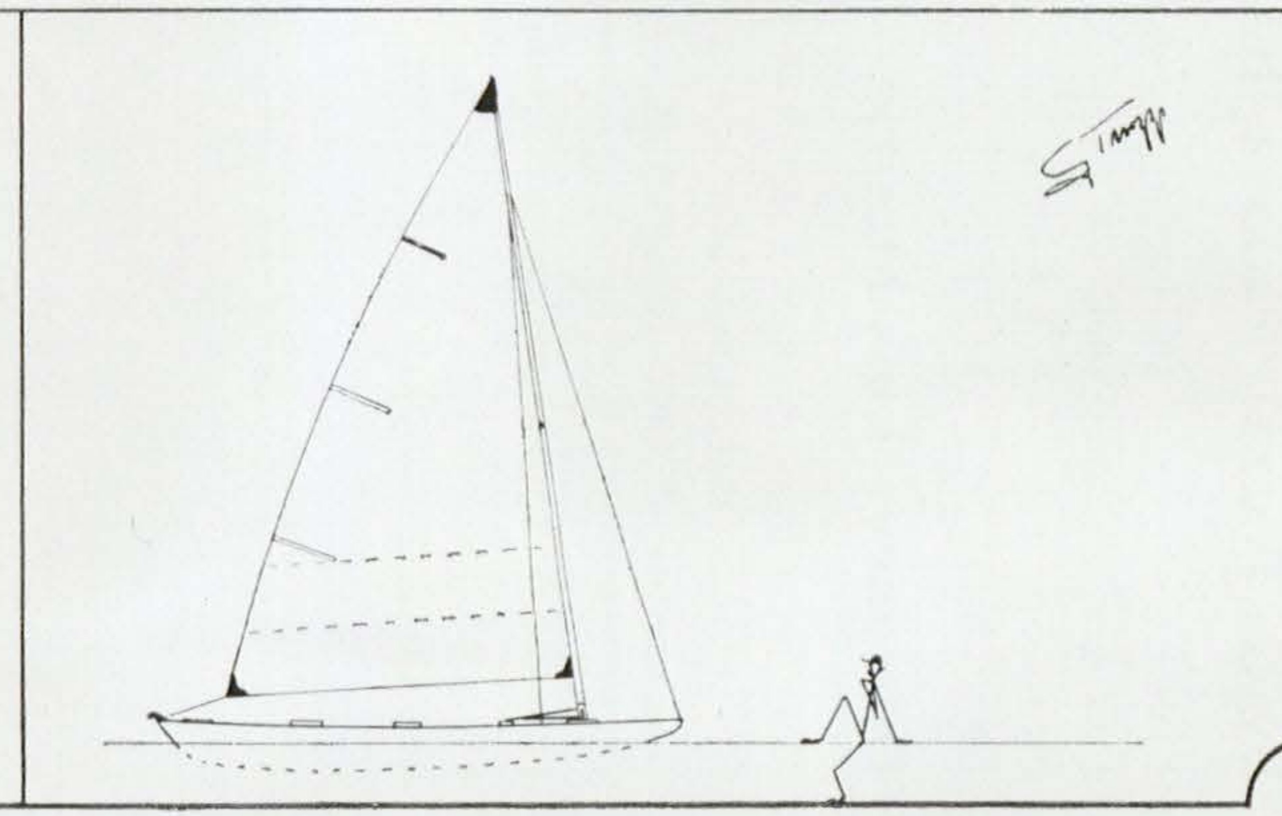


Sketch of Spanish

"PATIN A VELA"

L.O.A. 18 feet.

(hulls spaced 4 ft. 3 in.)



Ed: The main characteristic of these craft is their high speed without any appreciable wash, as in all deep narrow catamaran hulls. This usually kills light wind performance but the PATINES A VELA have less wetted surface than usual with this kind of hull section. Another feature is the low wind resistance of the bridge spars between the two hulls. This is much less than that of the conventional bridge as used in modern American and British catamarans.

Putting about seems to be a complicated manoeuvre but I believe it can be accomplished without any steering oar. The crew moves forward onto the weather bow. This brings the lateral resistance forward and the craft luffs into the wind. While head to wind, the momentum of the craft still continues the turn because the weather hull is pressed further into the water than the lee hull when the weight is out of the sail. As soon as the craft has passed the head to wind position, however, the crew runs aft to the new weather stern and the windage of the sail draws the head of the boat off onto the new tack.

Summary

The *PATINES A VELA* must be most amusing craft to sail. They have several unusual design features and are the second largest catamaran class in the world today with over 200 craft, only being outnumbered by the *SHEARWATER III.*

FREEDOM

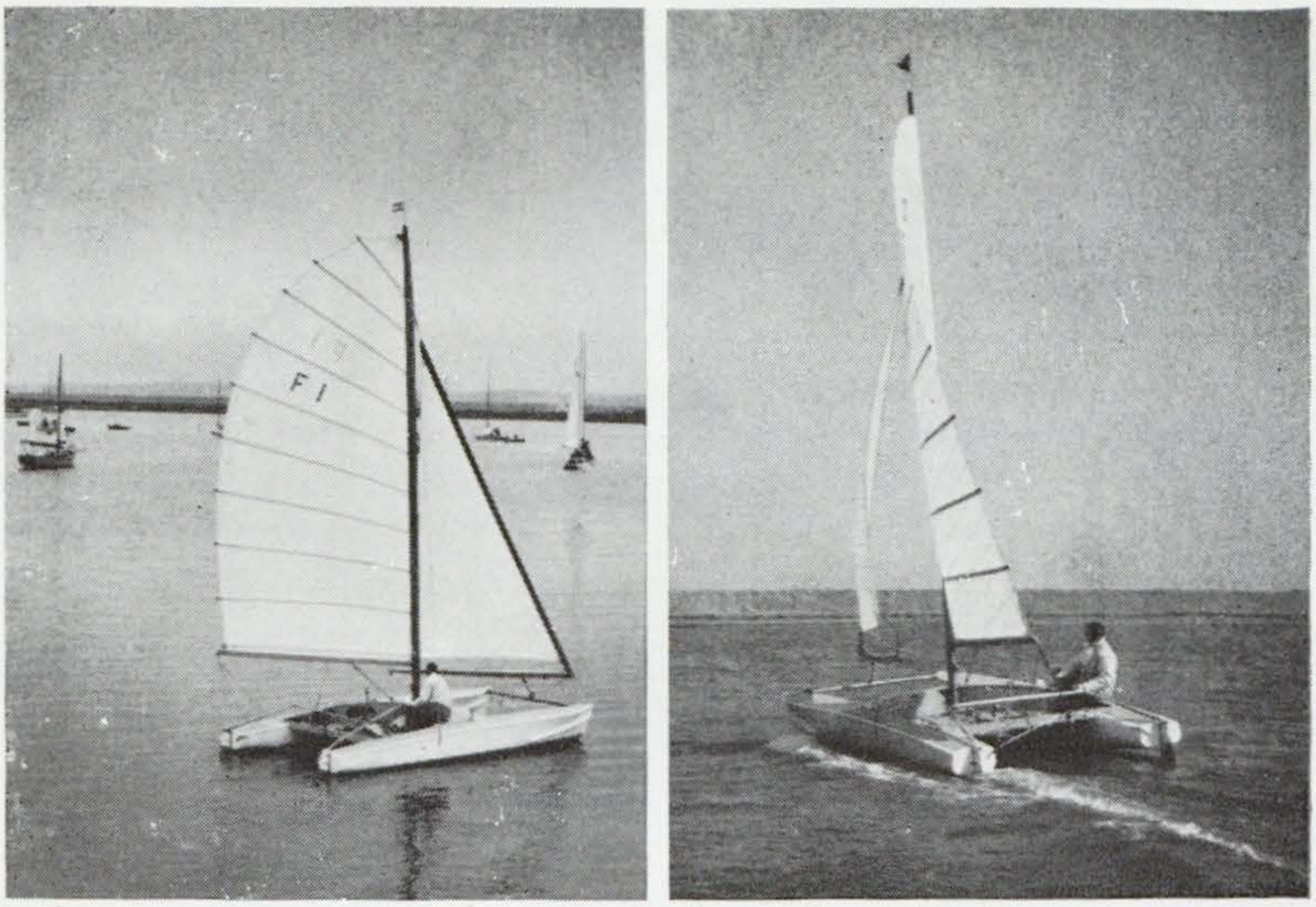
December, 1958

L.O.A.	18 ft 6 in	Draught	7 in
L.W.L.	16 ft 10 in	Freeboard	1 ft 6 in
Beam O.A.	9 ft 5 in	Displacement	585 lbs + crew, say 350 lbs
Beam (hull)	1 ft 10½ in	Sail Area	253 sq ft
Beam (hull L.W.L.)	1 ft 7 in	main	176 sq ft

Designer, builder and owner: Donald Robertson

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

FREEDOM is not such a cut down craft as *ENDEAVOUR* and has more freeboard to keep her dry. Her success is due rather to a great attention to many small details of design and construction than any one radical alteration. Donald Robertson used to be a test pilot of aircraft and this training was clearly of the utmost value in *FREEDOM's* make-up as it allowed him to evaluate each feature as a separate entity while not losing sight of its overall purpose.



FREEDOM

The Hull Design

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

The Rig

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

Handling

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

Summary

FREEDOM is a very fast craft which should be easy to manoeuvre in narrow waters. *FREEDOM* was only launched 10 weeks before the Cross Channel Race and had never been in salt water till the actual race itself. With more sailing and racing experience, we can hope that her performance will be still further improved.

FREEDOM, AN 18 ft 6 in CATAMARAN

by Donald Robertson

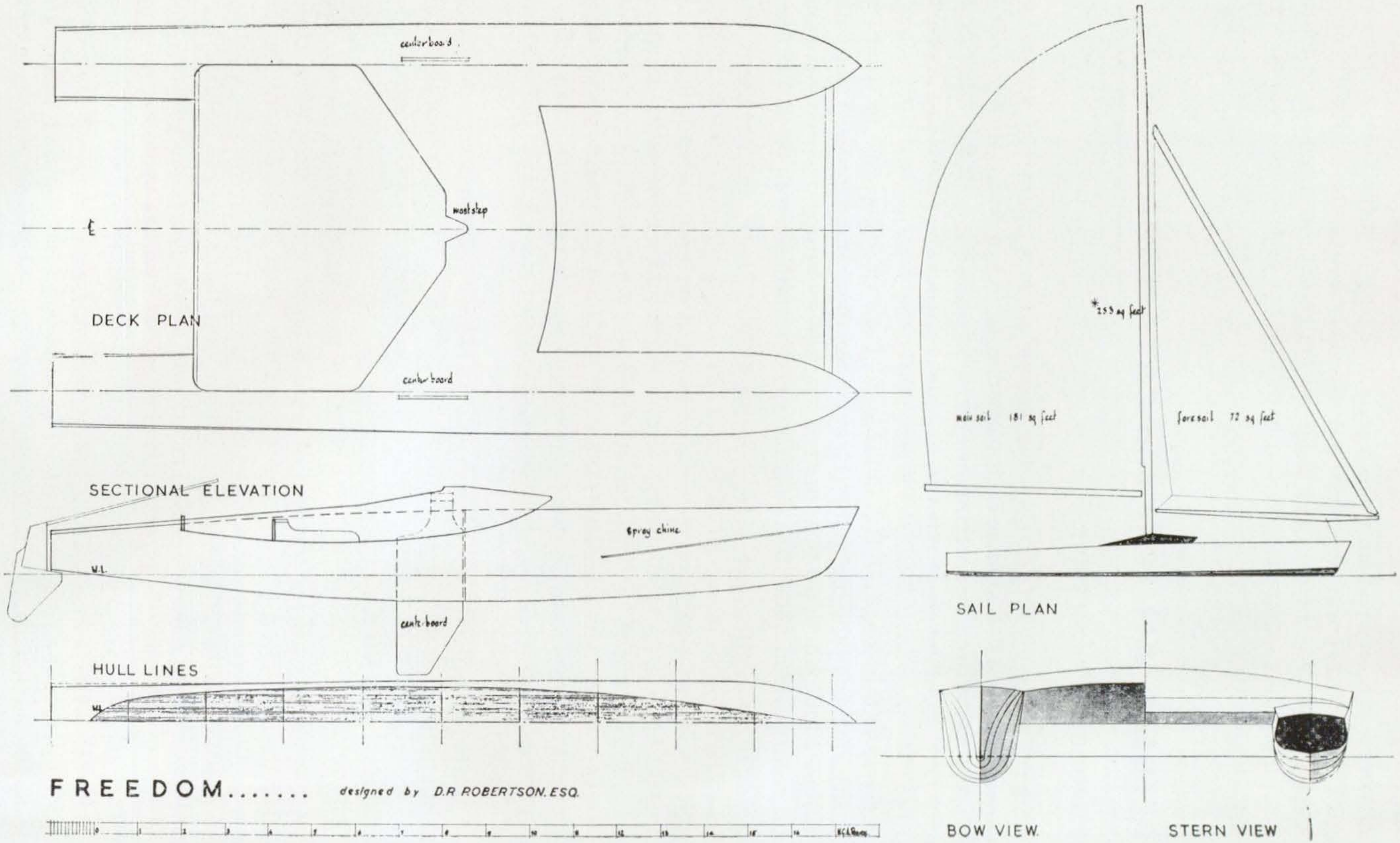
I designed and built *FREEDOM* after sailing my first catamaran *SNAP* for two seasons. *SNAP* was home built from two 18 ft 3 in *Shearwater* moulded hulls and has proved a success. However, after studying both the water flow and general handling characteristics, I thought it would be possible to improve on her. My new boat *FREEDOM* has nearly the same overall dimensions, namely 18 ft 6 in length, 9 ft 5 in beam, as I wished to be able to compare the performance of the two and incidentally use the existing trailer. The trailer is designed for loading the boat horizontally and by raising one side, the boat rides at an angle of about 60°. This reduces the width for trailing to 6 ft 6 in.

FREEDOM's hulls have more buoyancy than *SNAP*, the radius of the semi-circle being 10 in instead of $7\frac{1}{2}$ in. The reason for this is that when flying a hull the whole weight is on the leeward hull and the drag is greatly increased if it sinks beyond the semi-circular section. Each hull was therefore designed for a displacement of 765 lbs. Unfortunately, the total weight with a crew of two was heavier than anticipated ($585 + (2 \times 170) = 925$ lbs); but additional weight, say a third crew member, improves *FREEDOM's* performance in a strong wind whereas in *SNAP* a third member of the crew takes the edge off and she goes slower.

A further consideration for increasing the beam of each hull was to reduce the length to beam ratio from about 18 to 12. This is, I think, about the ideal ratio as it reduces the wetted surface and certainly *FREEDOM* appears to be fast in a light wind.

SNAP was very sensitive to fore and aft trim when running; unless the crew moved forward the transom dragged a lot of water. Also when close hauled the hull lifted forward and pushed the stern about 6 in below the surface. To minimise these two factors, the new boat was given a broad stern with a 10° deadrise rather like a speedboat, and the transom was lifted 1 in above the loaded waterline. *FREEDOM* runs more cleanly both slowly and fast and, in addition, the increased rocker on her keel has made her quicker in stays.

Whereas *SNAP's* bows have a convex section, I gave the new boat a pronounced flare and also a finer entry. The angle either side of the fore and aft line is 10° instead of 13°. Both boats have spray deflectors which, in my opinion, not only keep the boats drier but give lift to the bow when reaching.


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

The new boat does not bury her nose when reaching but when running in a steep sea, care must be taken not to go too fast.

FREEDOM has a dagger board in each hull slightly offset outboard from the centre line. This was done to avoid cutting and weakening the keels. The area of the dagger boards was increased by 50 per cent over the lifting centre-boards in *SNAP* and this has made a very big difference going to windward. The original boards were of wood and fitted the slots exactly, but these broke and were replaced with aluminium alloy plates. These have proved satisfactory so far as strength is concerned, but when the plates are not loaded i.e. running, free, they are very noisy. The noise is a useful warning to the crew to pull them up but the problem of dagger boards has not been satisfactorily solved yet. One of the difficulties is that to raise or lower the leeward plate in a strong wind, the crew must go down to leeward and there is a danger of capsizing.

As the boat is normally used off a concrete hard, the rudders are made to lift. Originally wooden rudders were used but it was found that the slightest warping, which occurred when the rudders were left in the sun, was enough to upset the balance of the boat i.e. weather helm on one tack, lee helm on the other. The metal rudder plates are water balanced to give improved directional stability and also to lighten the helm. These rudders have taken a lot of developing. *SNAP* had four sets and *FREEDOM* is now on her second set! Due to the speed of a catamaran the rudders are very sensitive, for instance 20 strokes of a file on one side of the trailing edge is enough to upset the balance of the boat.

The tillers are angled inwards to give an Ackerman effect and the length and height above the bridge deck is such that the helmsman can steady the rudders with his knee. This is important as when sailing fast the helm cannot be left, and two hands are sometimes necessary to pull in the main sheet. The main sheet is run round a snubbing winch mounted high enough to give a horizontal pull. The runner on the wire horse can be controlled from two jam cleats mounted on the aft end of the bridge deck.

FREEDOM carries a lot of sail, 253 sq ft against 202 on *SNAP*. However, before her new sails arrived *FREEDOM* used *SNAP's* sails and it was found that with the same weight of crew she lifted a hull more easily. It is difficult to give any satisfactory explanation for this but it may be due to more plate area increasing the lateral resistance, although the feeling is that the increased buoyancy has something to do with it. A third crew member in a strong wind gives a feeling of confidence and of course provides extra power on the wind.

The rig used on *FREEDOM* was developed on *SNAP* with the exception of the revolving mast which is a copy of Prout's *Shearwater* mast. I have tried a sloop rig, twin side by side masts, and a lateen rig with wishbone boom but came to the conclusion that a conventional rig with a large lifting foresail was the best compromise. Having, with a catamaran, overcome the loss of power caused through heeling, the next problem was to drive the boat forward without burying the bow. In an attempt to do this, the mast of *FREEDOM* was moved one foot further aft than on *SNAP* and the foresail area increased from 54 to 77 sq ft and the wooden foresail luff was raked more. The foresail is mounted on a boom which pivots 25 per cent aft of the leading edge, this is a copy of canoe practice and is a great advantage in a river where short tacks have to be made as it can be cleated and works automatically. In addition it holds the sail very flat when the sheet is eased and can also be goosewinged out for running. Although the sail is very powerful, the sheet can be handled under all conditions by a girl.

The fully battened mainsail was designed and made by Austin Farrar and carries an enormous roach. The area is about 170 sq ft on a 21 ft 6 in hoist 9 ft 9 in foot. The battens are doubled in the main part of the roach and in a strong wind the trailing edge bends slightly to leeward, but the large area is very effective in light winds and when running, although when going to windward in a very strong wind it pays to use a smaller mainsail.

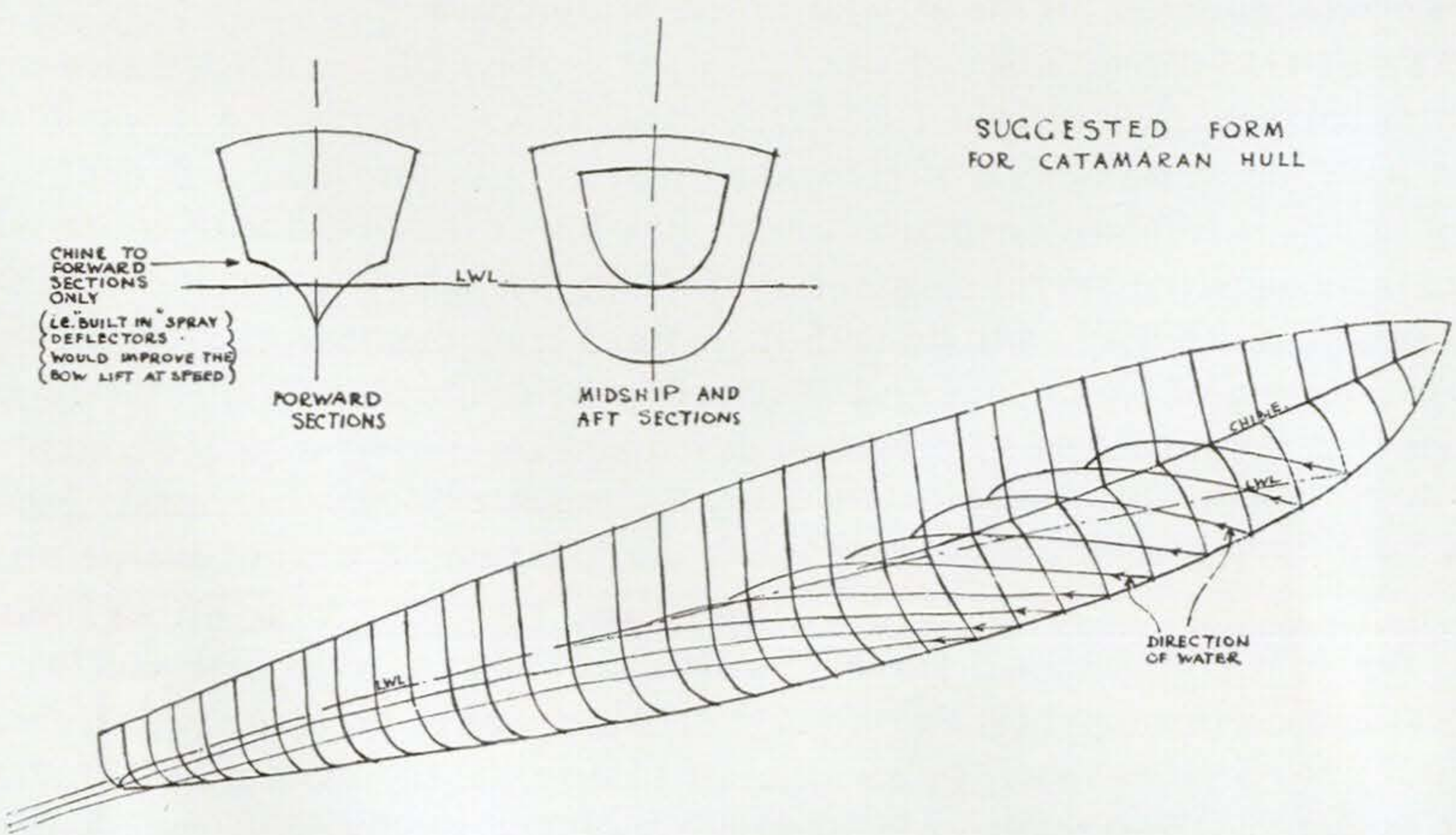
The balance of the boat is very sensitive to sail trimming. When close hauled the foresail is trimmed very flat, about 8° from amidships, and the mainsail is hauled in tight with the horse runner central, this gives an angle of about 75° from one tack to the other on heading, allowing 3° for drift, this works out at an angle of 40° 30′ from the true wind. When close hauled in a strong wind it is important not to cleat the foresail as if the main is freed in a gust the foresail on its own is powerful enough to lift a hull. In addition, the boat will bear away and can only just be held on the rudder.

A CATAMARAN OR TRIMARAN HULL DESIGN
by Derek W. Norfolk

December, 1957

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

The main difficulty with these long slim hulls is that the design has to be suitable for a greater range of speed than can be obtained from the normal



Derek Norfolk's suggested hull design

dinghy. When the speed is low, the wetted surface is an all important, which indicates a semi-circular under water section. When the speed is high, the speed boat and planing type of hull would probably be an advantage. For the best all round performance therefore, a compromise has to be arrived at.

The hull, to attain a good speed, has to be long and narrow so the wide, flat stern sections of the normal dinghy, which are mainly responsible for making a hull plane, are gone. However, higher speeds might be obtained if the bow is made to lift as far as possible by other means. These are:

1 lifting sections in the bow,

2 moving the sail plan farther aft and

3 keeping the centre of the sail low to reduce the overturning moment.

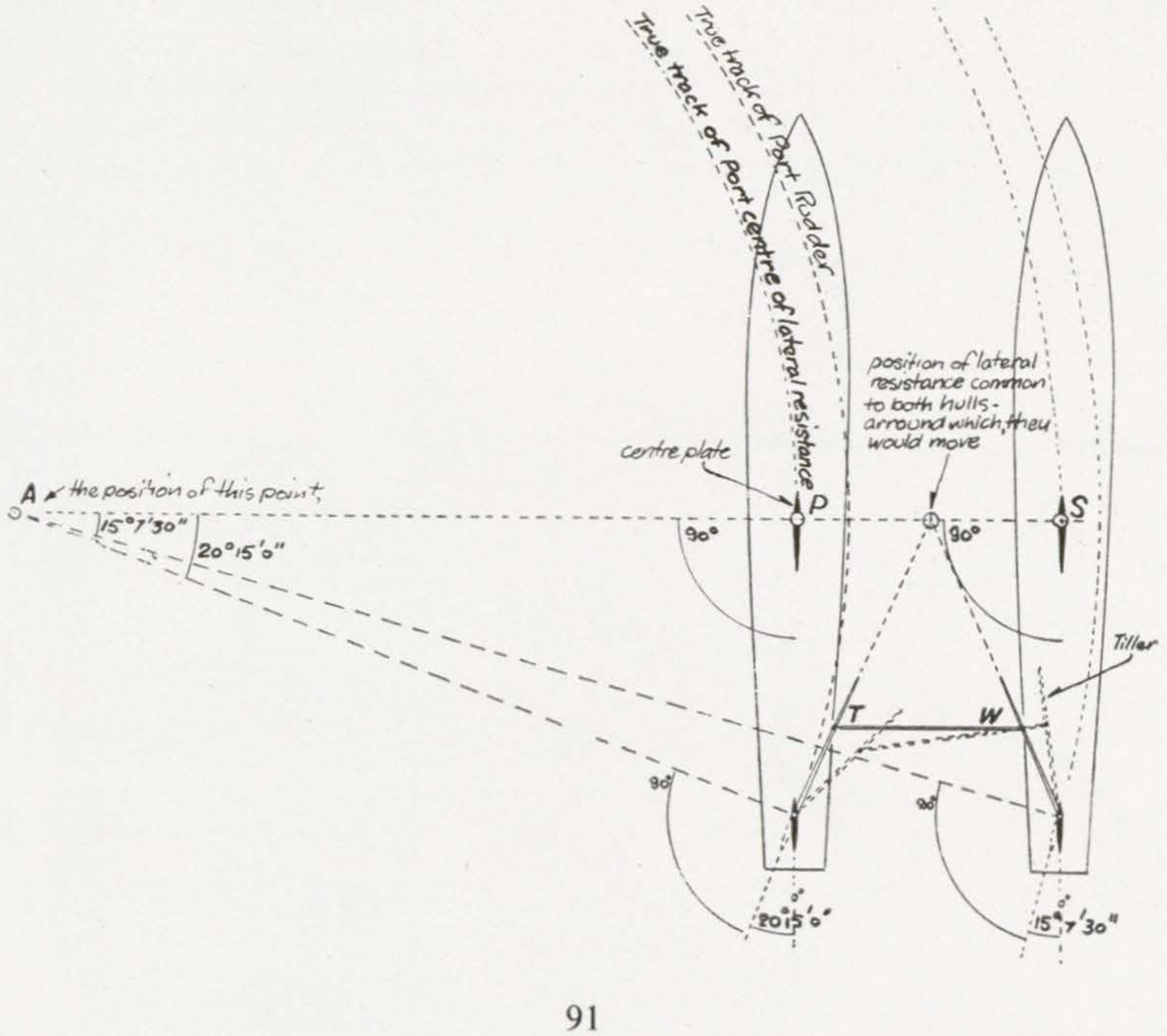
The sketched lines only deal with the hull, where an attempt has been made to introduce lifting sections and spray deflectors as a part of the design and not added as an afterthought. These lifting sections will only operate at speed, when they are required and be out of the water at low speed.

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

DIFFERENTIAL STEERING FOR CATAMARANS

by Peter H. Coley

Ed: The Herreshoff catamarans also used differential steering.



In an automobile, when a straight line is passed through the rear axles and produced beyond, it eventually passses through a series of points which would be the centres of various turning circles, provided the front axle steering arm knuckles and tie rods are in true Ackerman alignment.

In the case of the catamaran, I propose to use the same principle except that the steering linkage axis will follow instead of lead. In the drawing, the produced line SP, running through the centre of lateral resistance of each hull will pass through a series of points which will be the centres of various turning circles, if the tie rod, knuckles, tiller linkage are in true Ackerman relationship. This relationship could be worked out on paper but would not be 100 per cent attainable in practice due to the centres of resistance moving with each change of trim, resulting in increased drag on one or other of the twin hulls.

On paper, with the tillers parallel at all angles, it appears that the outer tiller and hence the rudder does not travel in a true circle in relation to the other rudder, therefore acting as a brake. This might be one of the factors contributing to the poor "going about" qualities of catamarans.

DIFFERENTIAL STEERING FOR CATAMARANS

December, 1958

by V. E. Needham

The account of Peter Coley's use of the Ackerman linkage for steering his catamaran in AYRS No. 18 is very valuable but some of the alternatives of this linkage and the principles of its design may enlarge the picture.

When a vehicle designer starts to lay out his steering linkage, he commences by angling the steering arms to the centre of the rear axle (Fig. 1), which is exactly the same in principle as intersecting the angles of the tillers of a

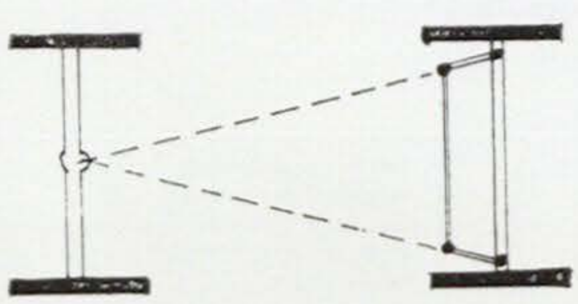


Fig 1

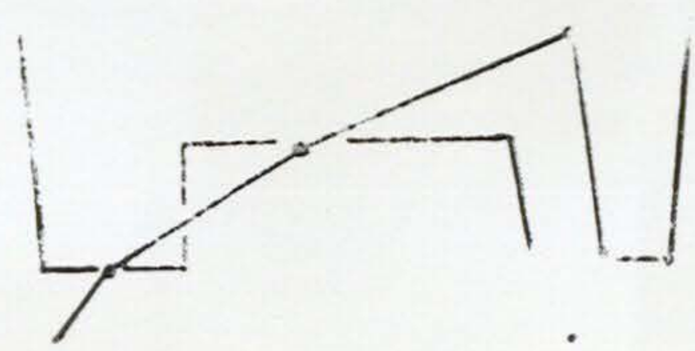


Fig 2

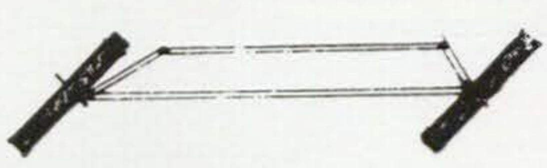


Fig 3

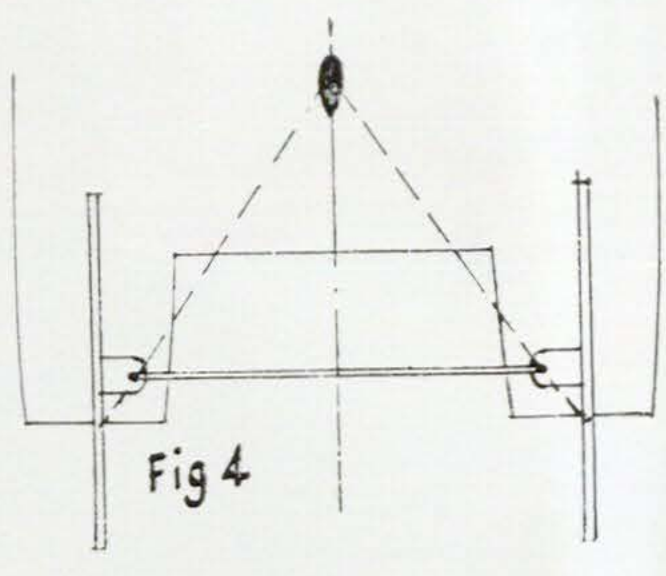


Fig 4

catamaran at the centreboard. This gives a very good compromise of angles when the arms or tillers are short and the link comparatively long. On a motor vehicle, the ratio between the length of the arms and the connecting link (track rod) is of the order of 1 : 7 or 1 : 8 but in the case of the catamaran the ratio between the length of the tillers and the cross link would be more like 1 : 2. The effect of this is to angle the cross link rather rapidly in relation to a line taken through the rudder pintles, which exaggerates the Ackerman differential, (Fig. 2). This means that the inner rudder on a turn is given an excessive twist relative to the outer rudder and thus acts as a slight brake—a better fault than the reverse condition.

Put in terms of practical application, all this means that, if we point the tillers at the centreboard on a normally proportioned catamaran, we obtain pretty accurate angles on the rudders up to approximately 30° of angle on the weather rudder, after which the error is progressively exaggerated. On the other hand, if we reduce the angle of inset of the tillers by some 5° or 6°, we can maintain the correct differential angles within 2° from 0° to 50° movement of the weather rudder. As an instance of this, if I point the tillers on my catamaran *GENETTE* to intersect on the centre of lateral resistance, the angles of inset are 22·75° on each tiller and the lee rudder angles remain within 1° of the ideal up to about 35° movement of the weather rudder. At 50°, there is approximately 6° of error and because we have now passed the dead centre position between the link and the tiller, there is an error of 14° at 60° helm. After some study, I found that the best compromise for *GENETTE* occurred when the tillers were inset 17°. At this, the maximum error is only 2° through the arc of the weather rudder of 0° to 50° and, even after the dead centre is passed, the error is barely 7° at 60° of helm.

In the case of the motor vehicle, the cross link (track rod) remains more nearly parallel to a line taken through the king pins (Fig. 3) and therefore does not have the same foreshortening effect as with the tiller linkage of a catamaran and so the errors are much less. It would be possible to improve the catamaran linkage by moving it aft, locating the pivots within 6 in or so of the rudder pintles and on the centreboard to rudder pintles line, (Fig. 4). However, I find the cross link so useful and to hand at the inboard end of the tillers that I would prefer it there in spite of the accompanying errors.

CHAPTER X

CRUISING CATAMARANS

WAIKIKI SURF

Written by Bob Harris

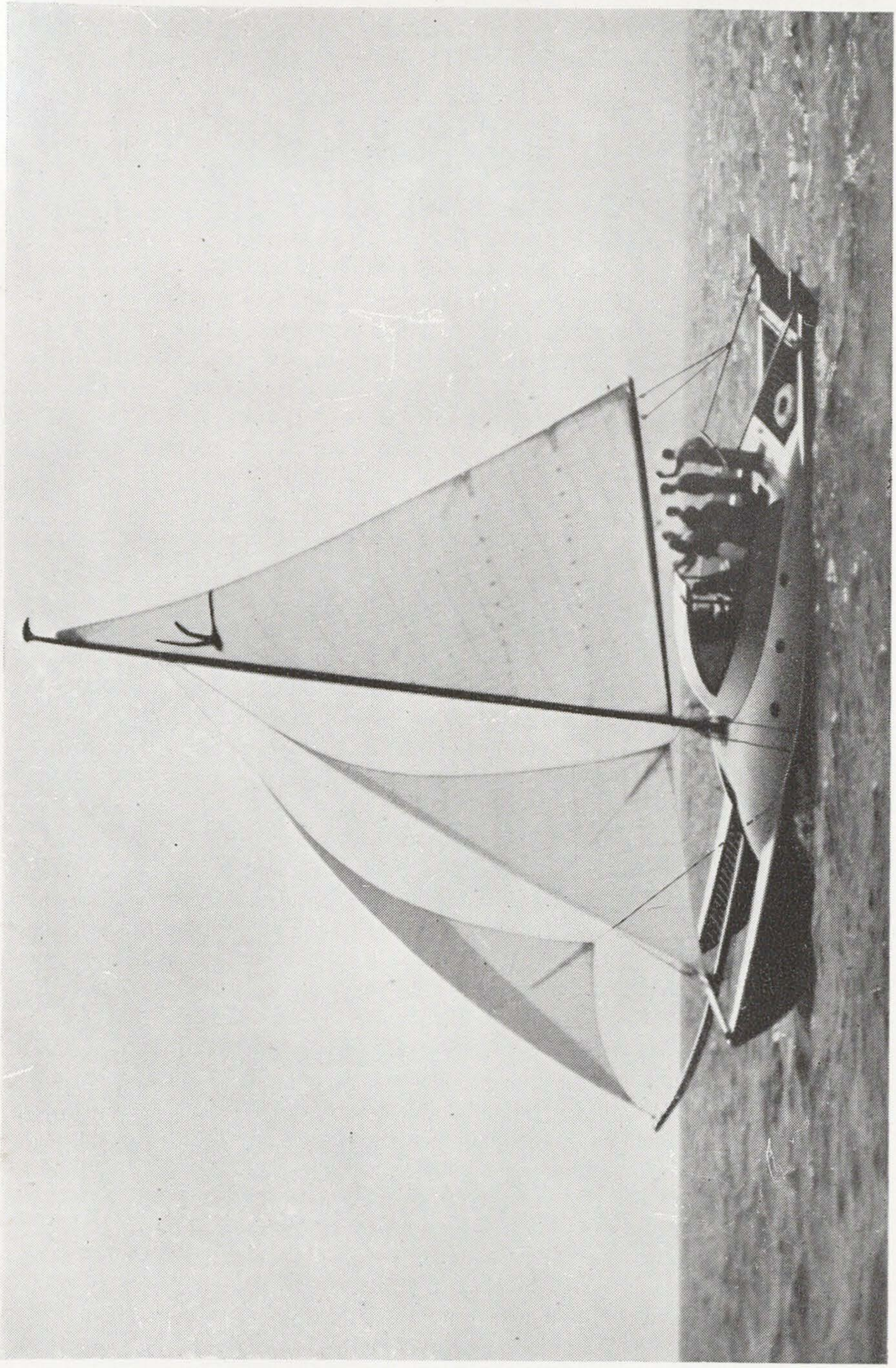
L.O.A.	40 ft 0 in	Sail Area	1,050 sq ft
Beam, O.A.	13 ft	Displacement	3,000 lbs

This amazing craft was launched on June 5th, 1955 in Hawaii and came like a fresh breeze in the design, building and sailing of ocean going cruising catamarans. Designed and made by Woody Brown, who produced the *MANU KAI*, described earlier, and Rudy Choy, she is similar in construction and dimensions to the earlier craft but of better shape, according to Brown. After being launched, she set sail from Honolulu on June 10th and arrived in Santa Monica 15 days and 12 hours later, an average of 180 miles a day for 2,700 nautical miles. They tried to enter her for the trans-Pacific race from Los Angeles to Hawaii. Her entry was not allowed but she sailed with the fleet of yachts and would have won the race on corrected time by many hours even after having had to reduce speed for a crack in the port wing section which they feared was a full failure. It turned out to be a minor local fault which took two days and less than $100 to fix.

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

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

In my 25 ft catamaran *NARAMATAC*, had she the same good proportions as *OCELOT*, we would have been able to fit two berths in the hull and, with some redesign in the wing, create a bridge area sufficient to house a galley, chart table, navigational instruments, all with a dog house over it. There are few 25 footers which can boast this kind of accommodation or even come anywhere near it. Not only that but to have all of this you would sacrifice very little in performance, being able to get out at approximately twice the



WAIKIKI SURF

speed of the single huller on all points. It is also worth pointing out that the entire watch can be put in one hull so that the comings and goings of the opposite watch will not disturb them. The galley being in the wing will not interrupt those sleeping below. There is also the advantage of having more complete privacy for two parties on long voyages, which under certain circumstances, would prevent many a social disaster.

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

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

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

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

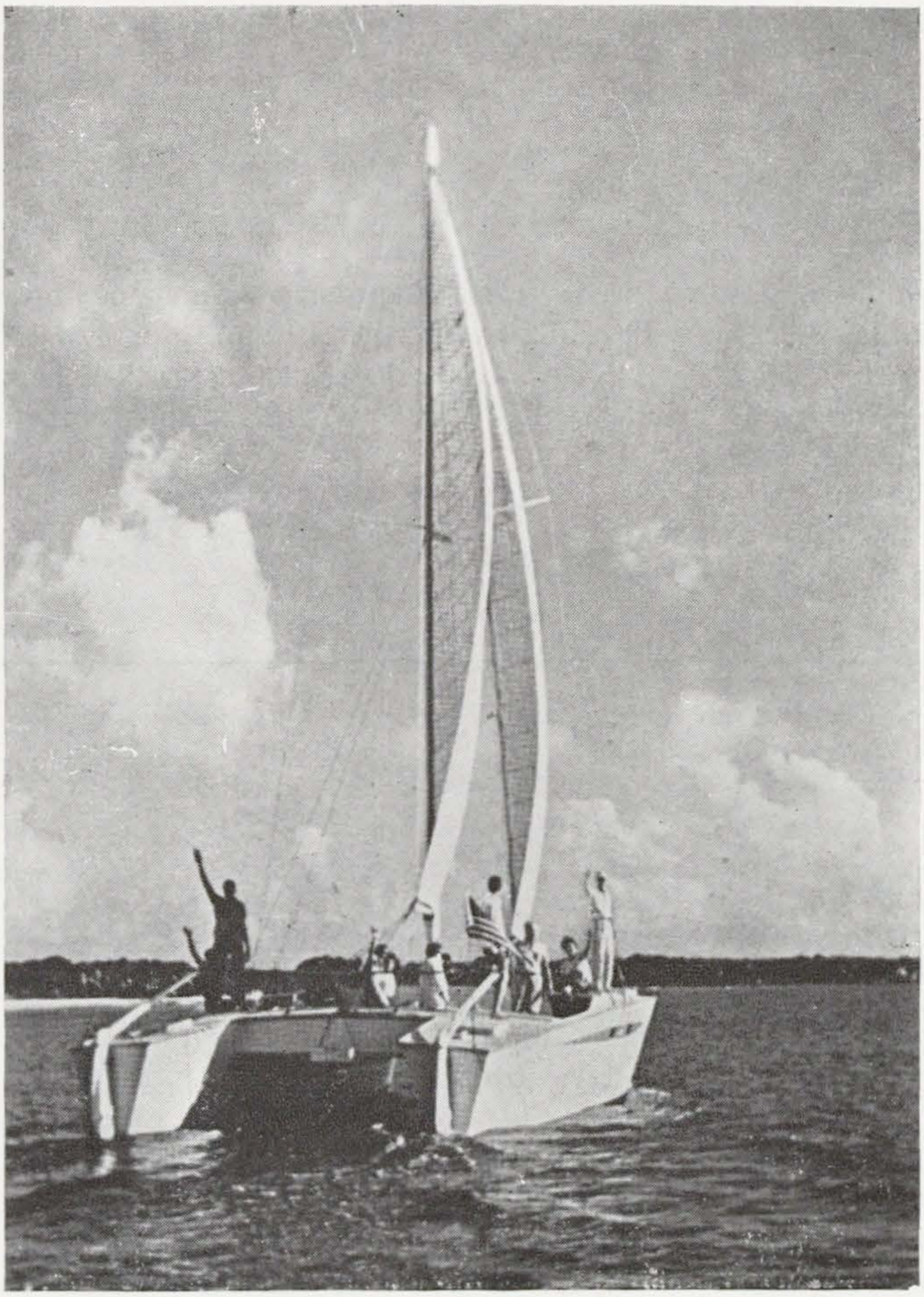
AY-AY

December, 1958

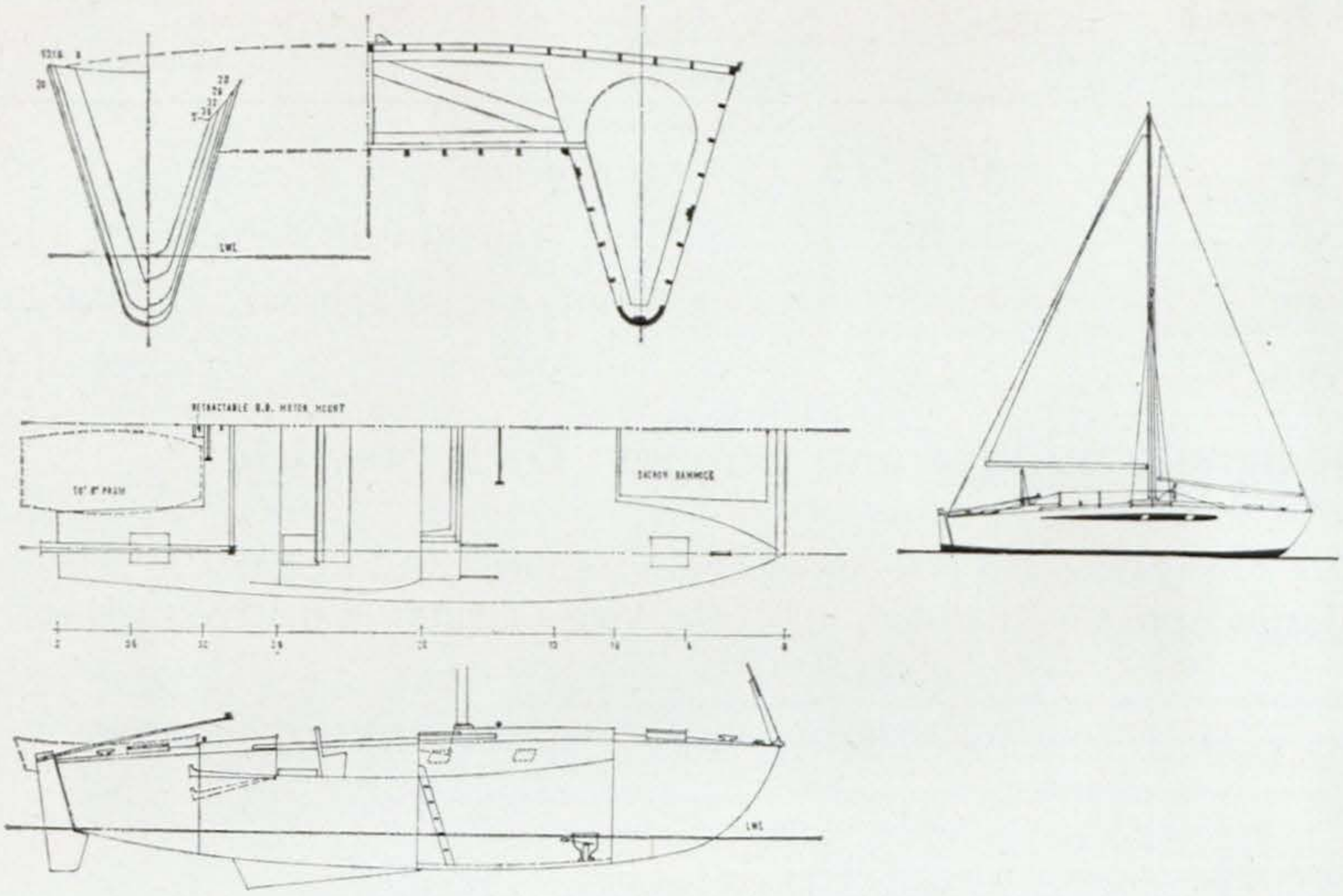
L.O.A.	40 ft	Hull draught	2 ft
L.W.L.	36 ft	Hull draught with skegs	2 ft 6 in
Beam	19½ ft	Empty weight approx.	6,000 lbs
Beam, W.L.	13½ ft	Sail Area	560 sq ft

Designer, Builder and skipper: Dick Newick

This large catamaran is a commercial vessel designed to carry 20 passengers on trips from Christiansted, St. Croix, Virgin Islands in the West Indies.



AY-AY



The Design

We have little information about this craft but the hull shape appears to be the wide-keel, deep V type and obviously goes well, especially in the Trade Wind area in which she operates. The designer comments that the next boat he designs for similar work would have 6 inches less freeboard and narrower keels with 150 to 200 sq ft more sail area.
Ed: Note the low A.R. keel.

TANGAROA

October, 1958

L.O.A.	23 ft 6 in	Displacement	¾ ton
L.W.L.	20 ft 0 in	Displacement loaded for Ocean Cruising	2½ ton
Beam	11 ft 0 in	Draught	9 in
Hull beam	2 ft 9 in	Draught with C.B.	4 ft 0 in
		Headroom	3 ft 10 in

Designer, Builder and Owner: James Wharram

Ed: This early design by James Wharram is included because it was one of the ocean voyages which took place BEFORE the refinement of the catamaran. It was Jim's first catamaran. His later designs are, of course, far more elegant and much faster.

TANGAROA was designed to produce a cruising craft in which the owner and his two companions could live indefinitely in comfort and be safe in harbour or on the Oceans. This object has been achieved by an ocean cruise

TANGAROA

lasting for two years in which some 5,000 miles was sailed. All this was to be done at the smallest possible cost. *TANGAROA* only cost about £200 to build and the cruise and living expenses only amounted to £1 per week per person. This craft will therefore mostly interest those who want to cruise *now,* though their means are limited, rather than wait for the possible chance of a larger boat. The small draught is another economy factor as it enables the smaller ports to be visited, where things are not so expensive.

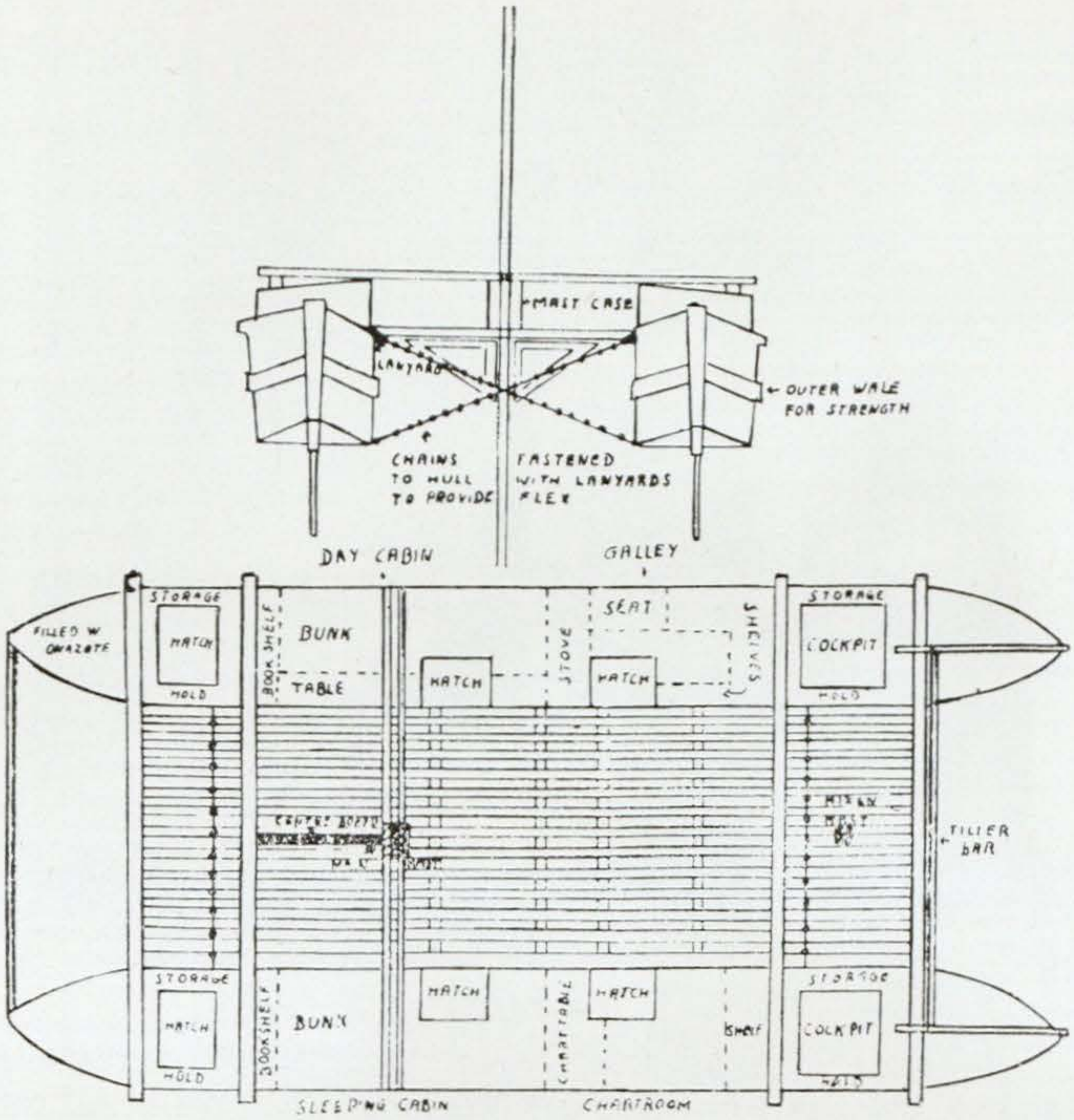
TANGAROA was launched in August 1954 at Burnham on Crouch. Her skipper and crew then moved into their home and have lived in her till they reached the West Indies. They spent the first winter at Wivenhoe on the Colne and the next year (1955) went over to Holland and up the Rhine to Dusseldorf. From there, they came down the Rhine again and along the Belgian and French coasts back to England and down Channel to Falmouth. Leaving Falmouth, they crossed the Bay of Biscay to Spain and Portugal, the total cruise adding up to some 2,000 miles to that point.

The following August, they got a lift aboard a steamer to Las Palmas in the Canaries from where they sailed across the Atlantic to Trinidad at the end of 1956.

James Wharram gives his opinion on the nature of the Ideal World Cruise as follows:

"Speed is a fine thing to have but the ease of rig handling and the comfort of the boat must not be affected. No matter how much speed you have, you cannot escape bad weather.

"I doubt if you can get bored by the sea but harbours can wear one down. One of the worst quarrels we had occurred in Oporto, after spending a week

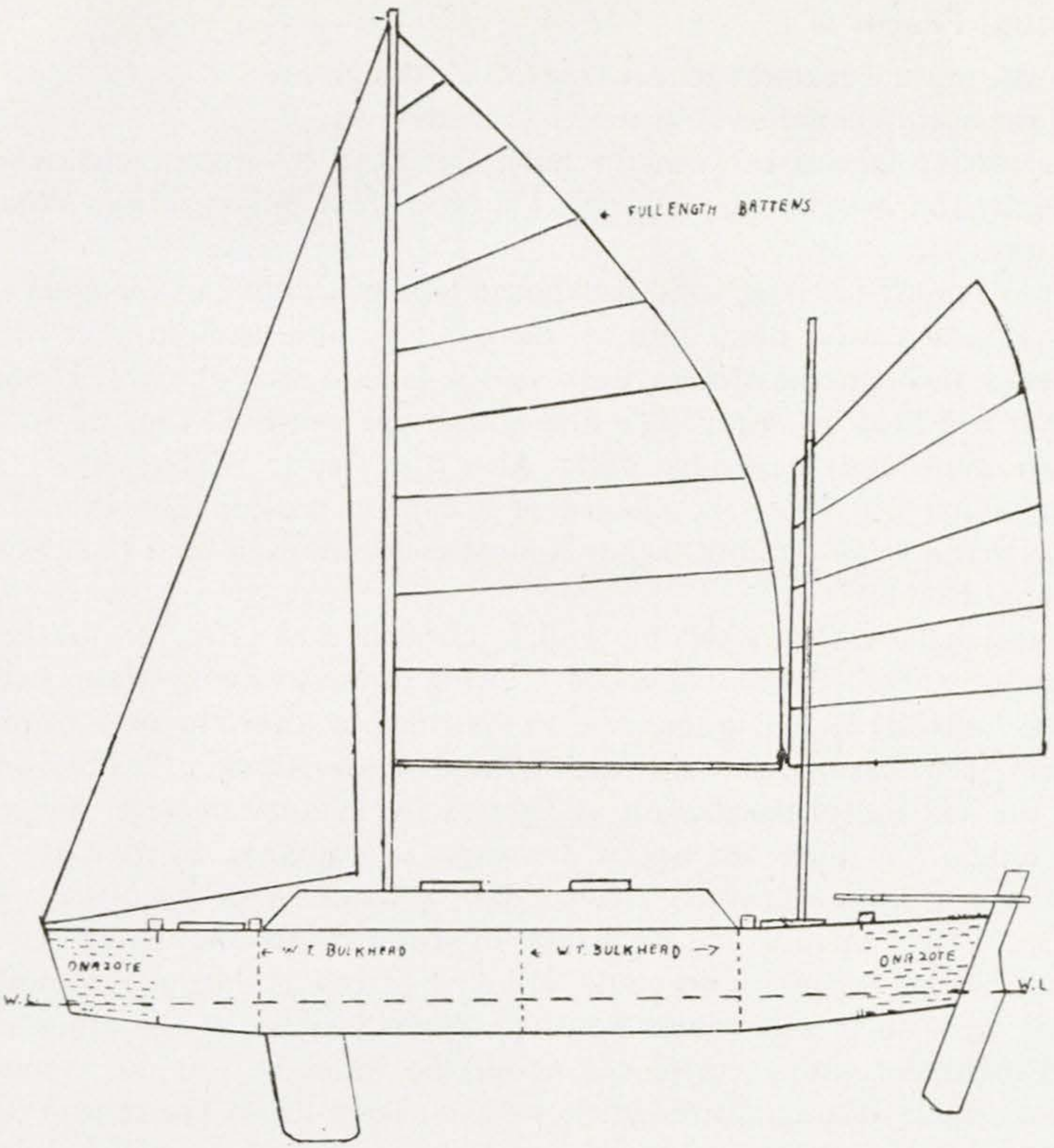


waiting for the weather to settle. Friction between the crew is the greatest danger on a long voyage. Here, the catamaran is very useful because being in different hulls means a chance to get away from the others, which is a good thing. A voyage such as ours is only possible if the crew believe that the ship, the voyage and the dream are more important than private egos.

"*TANGAROA* has been the home for the three of us for over a year now (written in 1956) in hot summer sun, continuous rain and snow. We have kept healthy and we are always glad to come 'Home' after a day away. That is what I want to stress to any who are planning a like trip. The boat must be a home. We have over 200 books and food and water for two months. We bake our own bread and cakes; make our own jam. If you leave England in a boat that is not a home, money will soon fade away. At every port, the crew will rush ashore to get a change. All that they find are bars and cafes. Money soon goes there."

The Design

Each of *TANGAROA's* hulls consists of a long parallel sided part with a flat bottom. Forward and aft of this, the side planking is brought together to the stem and stern and the bottom is rockered up a bit. This design was the result of much study of the Polynesian craft, chiefly from Hornell's CANOES OF OCEANIA, the parallel sides and blunt ends being a feature of many Polynesian boats. The blunt ends are necessary to prevent pitchpoling. However, the parallel sides were wrong on the *TANGAROA* with a length



TANGAROA'S Sail plan

to beam ratio of 8 to 1 for, at speeds of 4 to 5 knots, there is a distinct wave pulled up from the shoulder. The Polynesian craft with parallel sides had a length to beam ratio of 20 to 1. In profile, there is more rocker up at the stern than the bow. This is not only to allow the water to rise up after being pressed down but also to assist manoeuvrability. The vertical sides and the flat bottom made this hull very easy to build and to make water tight. James Wharram used galvanised nails and $\frac{5}{8}$ in planking on 2 in $\times$ 1 in frames, all touching faces of wood being glued with *Aerolite*. He says that without this glue, the boat would have fallen apart. In plan, there is the marked lack of flare in the topsides because it was feared that with a flare, she would be too lively. However, in a future design, James feels that flare would be better. He would also increase the beam of each hull amidships or lengthen the bows by 18 in to give an easier waterline. Two long rudders were used to provide lateral resistance and to prevent them losing grip of the water, when dropping over the crest of a wave.

Accommodation

There is a large deck, a separate galley and chart room, a double bunk on one side and a single bunk on the other; all one needs.

Unusual Features

The two unusual features of *TANGAROA's* design are:

1 All the accommodation is in the hulls themselves.

2 The torsion strains between the hulls are taken by crossed chains which actually run *beneath* the waterline. On both these points, James Wharram writes:

"I am against the large solid deckhouse type of catamaran for open ocean work. If ever a wave roars onto us, there is very little to hold it. It will just disappear through the slotted deck and I believe that the water pouring through will hold us steady. The deckhouse type can hold tons of water on that structure and the bridge deck. Also, the Centre of Gravity is much higher which will make the chance of a capsize greater. However, I now believe that a small steering shelter is most essential, even on a boat as small as *TANGAROA*.

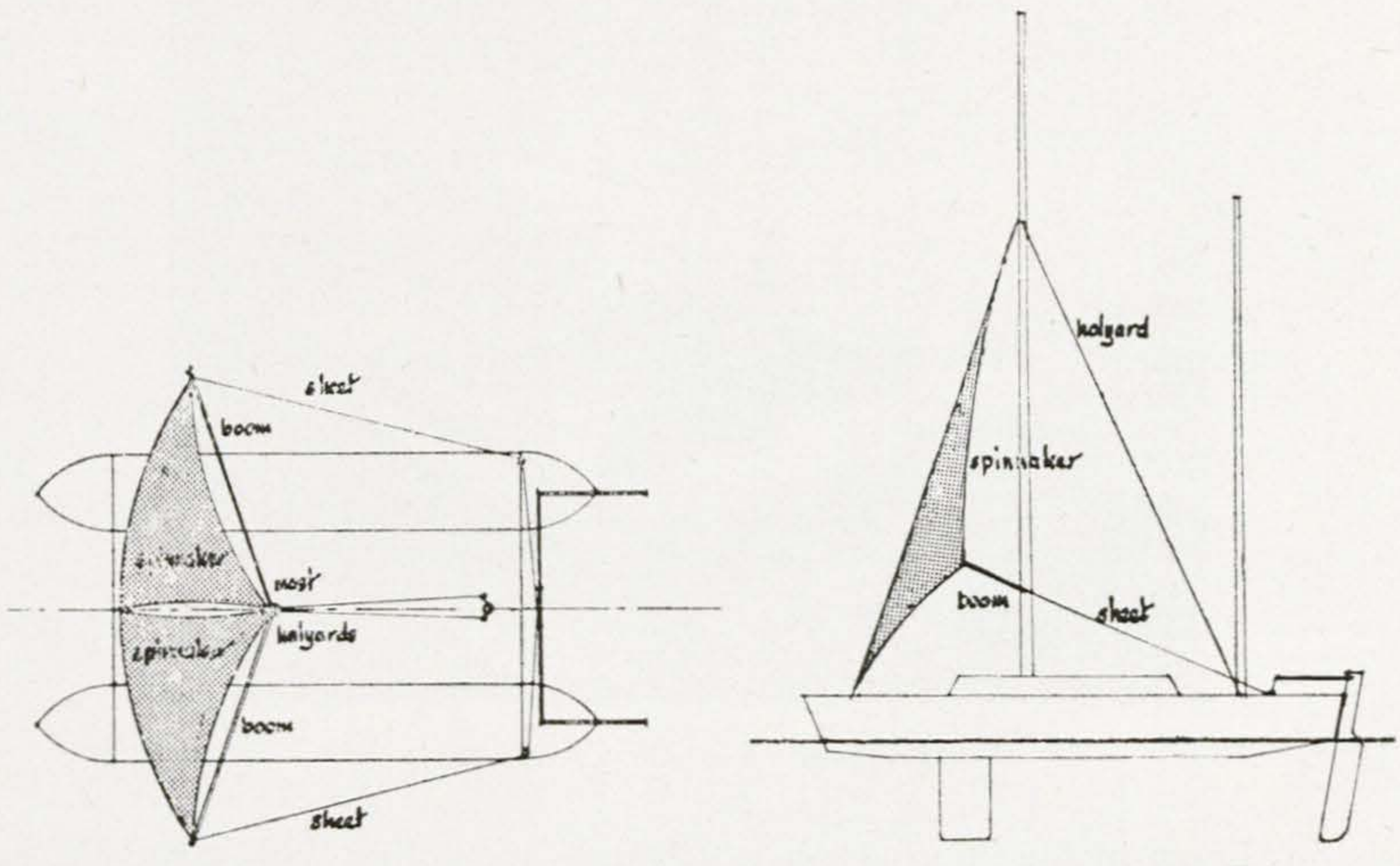
"I also believe that a flexible hull is cheaper and safer for the heavier voyaging 'Pahees' (Polynesian canoes), owing to the wringing strains between the two hulls. By fastening the hulls so that there is a certain amount of play between them, wringing strains are reduced. I also think a flexible linkage takes the jerk out of the motion. A light racing catamaran never has a very great weight but, once one begins a voyage, it is quite a different story. At the moment (in the Canaries) *TANGAROA* is loaded 2 in out of true. If she were built rigid there would be a built-in strain before the waves began to roar up. However, my chains could be better placed as they give a good deal of drag from their underwater position. When I arrive at the other side I shall experiment with them placed above the water but, at the moment, I know they give maximum strength so we leave them there. The central centre-board also causes water resistance and a dagger board in each hull would have been better.

Seaworthiness

TANGAROA sailed closer to the wind than expected, about 4 points, but she pounded. This caused me worry, but since talking to experienced sailing skippers, I find that very few sailing boats sail comfortably or efficiently close to the wind on a deep sea voyage. However, we ran in great comfort. For a small boat on a long ocean voyage, that is most important. In general, her behaviour was splendid. We have never had a solid wave on deck, but all too frequently on the Atlantic crossing, we took breaking crests which, due to the slatted platform, disappeared before reaching the cabin top proper. These crests were 2 ft to 4 ft high and seemed to burst from within, as distinct from curling over on the beach or the tops being blown off, as one would expect. They have burst underneath the boat, shooting straight through the deck soaking people amidships but leaving me prefectly dry at the stern, 8 ft away. Definitely on the Atlantic voyage, we had squalls of windstrength 8 and more. On the whole, *TANGAROA's* behaviour at sea is perfect. We have stocks of books resting on shelves, the oil lamp on the table and the Taylor paraffin stove is just on a ledged shelf. None of them has fallen but our alarmclock once fell on its face in the Atlantic. There is no other boat of her size which has the same comfort and stability. The newspaper account that she stood nearly on end at times which was quoted in publication No. 14 is not true.

The Atlantic Crossing

Twin spinnakers were used but with *Anhedral* and set to the forward main cross beam, instead of with 23° of *Dihedral* and set just forward of the mast as recommended by Frits Fenger. In fact, the system was very similar to that used by Marin-Marie but the sails had wire luff ropes. The head of the sail was fastened by two half hitches so as to be easily undone and the halliard was led through an extra large block (to prevent nip in the rope), back aft to the foot of the mizzen mast. The spinnaker booms were the oars with a gooseneck hammered into the loom, the gooseneck fitting being 3 ft off the platform. There were two nicks on the oar blade. The clew of the sail was lashed to one nick and the sheet to the other one about 2 in further in. The sheets passed outside the rigging to quarter blocks and then athwartships to about the middle of the tiller bar. The whole system worked perfectly. A catamaran has no roll, so there is no need for downhauls and various other guys. One rope to hoist and one sheet to the tiller and she steered perfectly in winds up to force 7.



TANGAROA'S Twins

The rudder rods were of mild steel and slightly loose in the pintals. The slight play caused them to crystallise due to the excessive movement caused through the strong winds. This crystallisation caused the rudders to break twelve times on the crossing. The first time this happened, *TANGAROA* broached-to (which probably would not have happened if the twins had had *Dihedral*) and the waves began to sweep over her but she took this without difficulty, though it was uncomfortable. James Wharram's note here is to have the rudder fastenings twice as strong as necessary and hand forged by a competent blacksmith.

Toredo worm caused a bad leak about half way across which gave some anxiety. This was due to the flat bottom which allowed the anti-fouling to be worn off. One should have good bilge strips and the bottom should be fibre glassed for preference.

Summary

The Atlantic can be crossed in a catamaran 23 ft long but one 30 ft long would give that extra stowage which every cruising yachtsman wants and there would also be extra freeboard to get above the breaking crests. Cooking and breadmaking were possible at all times and only on two nights was there a wet bunk. Surely, this proves the seaworthiness of the cruising catamaran to the hilt.

POSTSCRIPT

When *TANGAROA* was in Coruna, she was visited by Jose Jover Jover of Barcelona, the home of the *Patines a Vela*—a little rudderless racing catamaran. He was so pleased with her that he and some friends have built the six meter

Sgr Jover's 6-meter Catamaran

version shown in the photograph which they are sailing with great pleasure in the Mediterranean. This certainly looks like a fine ship. As compared with *TANGAROA,* her prototype, both hulls are rigidly attached together with no provision for flexibility.

CHAPTER XI

FLAMINGO

October, 1959

L.O.A.	36 ft	Displacement	4,000 lbs
Beam	15 ft 6 in	Headroom in hulls	6 ft 6 in
Draught	1 ft	Headroom in bridge	4 ft 4 in
Draught (C.B.)	4 ft	Sail Area	460 sq ft
		Genoa	270 sq ft

Designers and Builders: G. Prout & Sons

Owner: Don Robertson

After developing the *Shearwater* range of catamarans, it was only natural that Roland Prout should turn his thoughts to a cruising catamaran especially as the only catamarans prior to the *Shearwaters* were the large Hawaiian catamarans of Woody Brown, Rudy Choy and Hugo Myers with some of whom Roland corresponded before producing his *Shearwaters*. One can therefore say that *FLAMINGO* is the result of some three years' thought by Roland Prout. Because of this, Don Robertson, the owner, feels that there is almost nothing which he would like to alter were he having another one built. The report which follows is based on information supplied by Don after about half a season's sailing.

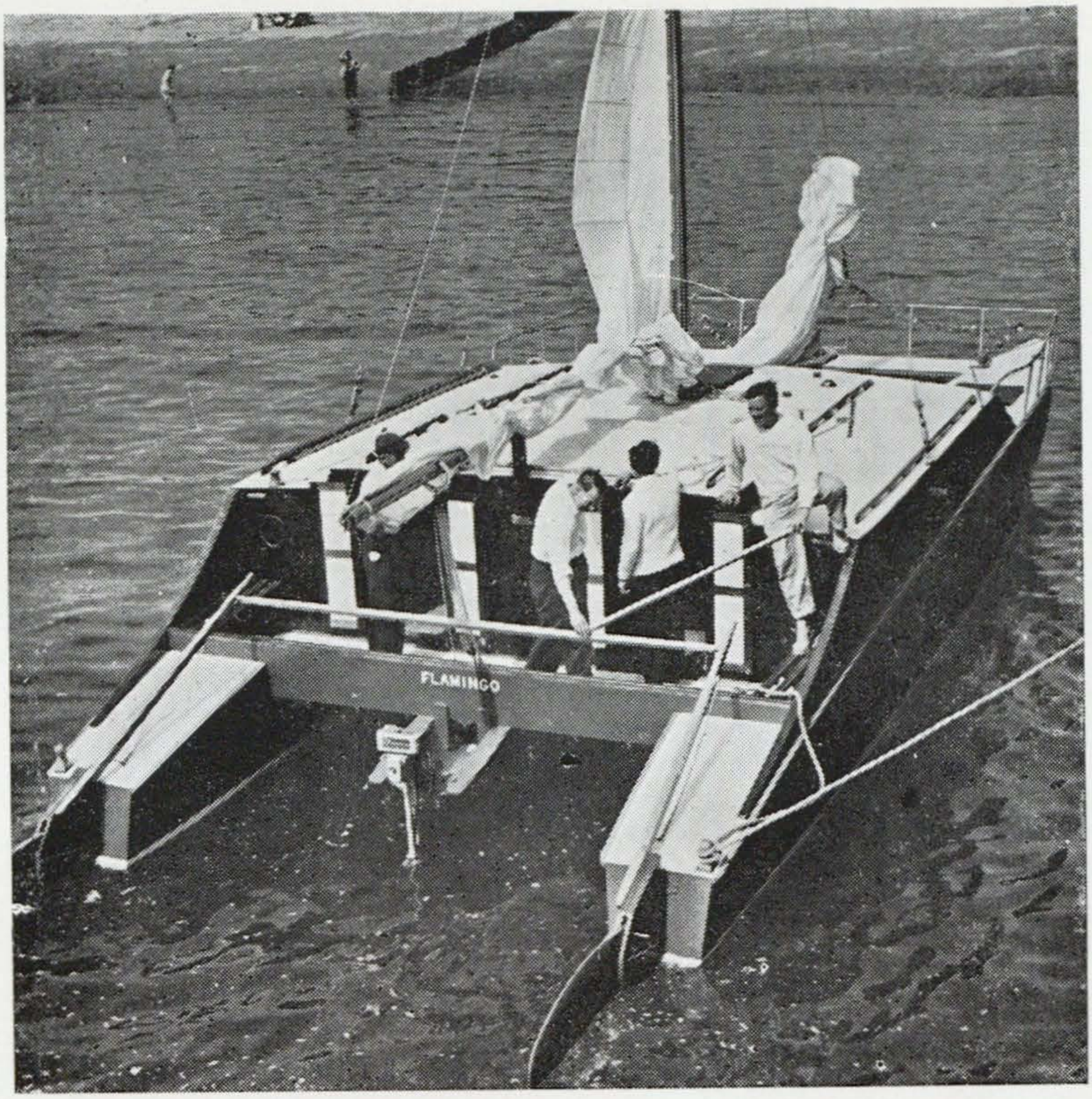
Performance

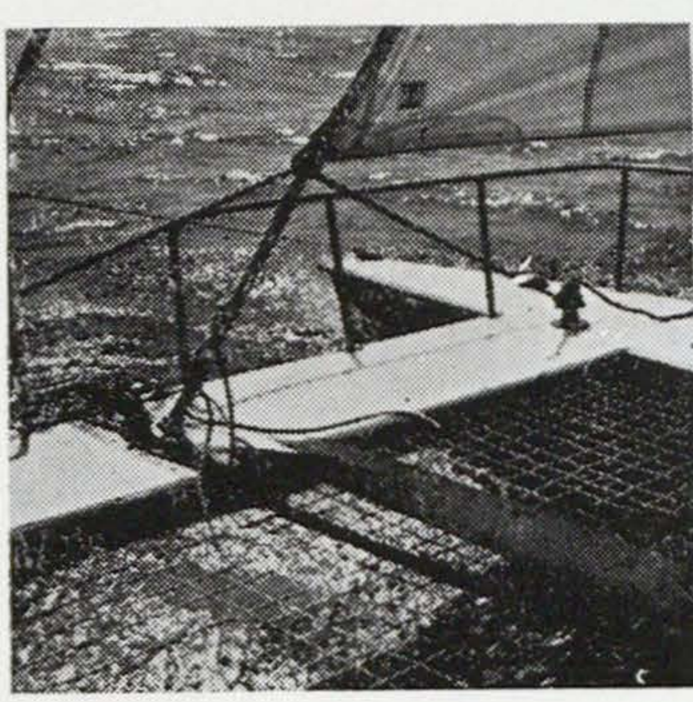
The speed around a triangular course is slightly greater than that of a *SHEARWATER III*. She is much faster to windward, about the same speed down wind but slower reaching. As befits a cruising boat, she is undercanvassed in light winds but is suitably rigged for heavy weather. It is obviously foolish ever to run the risk of lifting a hull with a cruising catamaran but there is plenty of evidence that she is being overpowered when the wind is strong for her and sail should then be reduced. For a trial, a hull was lifted on one occasion but this was hard to do and it was only managed by sheeting in everything tightly and bearing away in a puff.

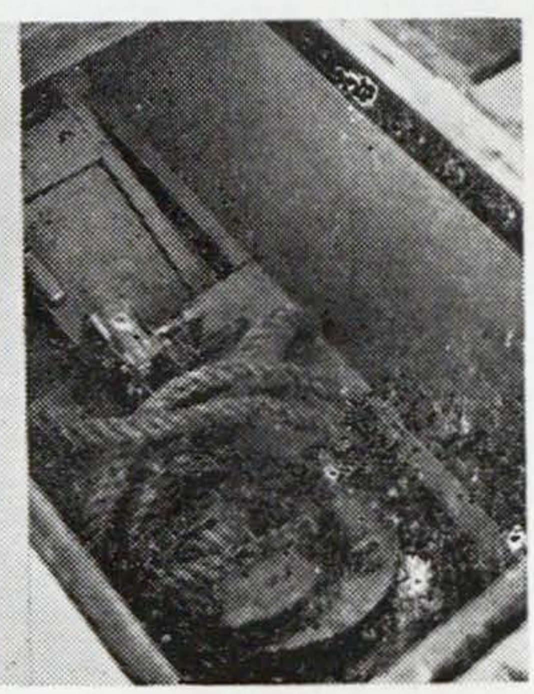
Seaworthiness

FLAMINGO is very seaworthy, being relatively dry due to her fine entry and very steady in roll. When meeting steep seas of a certain frequency she pitches violently due to the frequency of encounter equalling her resonance of pitch but this can be avoided by reducing canvas to slow her down. She is at her most comfortable motion when running when she is as steady as a rock.

There appears to be enough clearance under the bridge deck as seas seldom seem to strike there with any force.

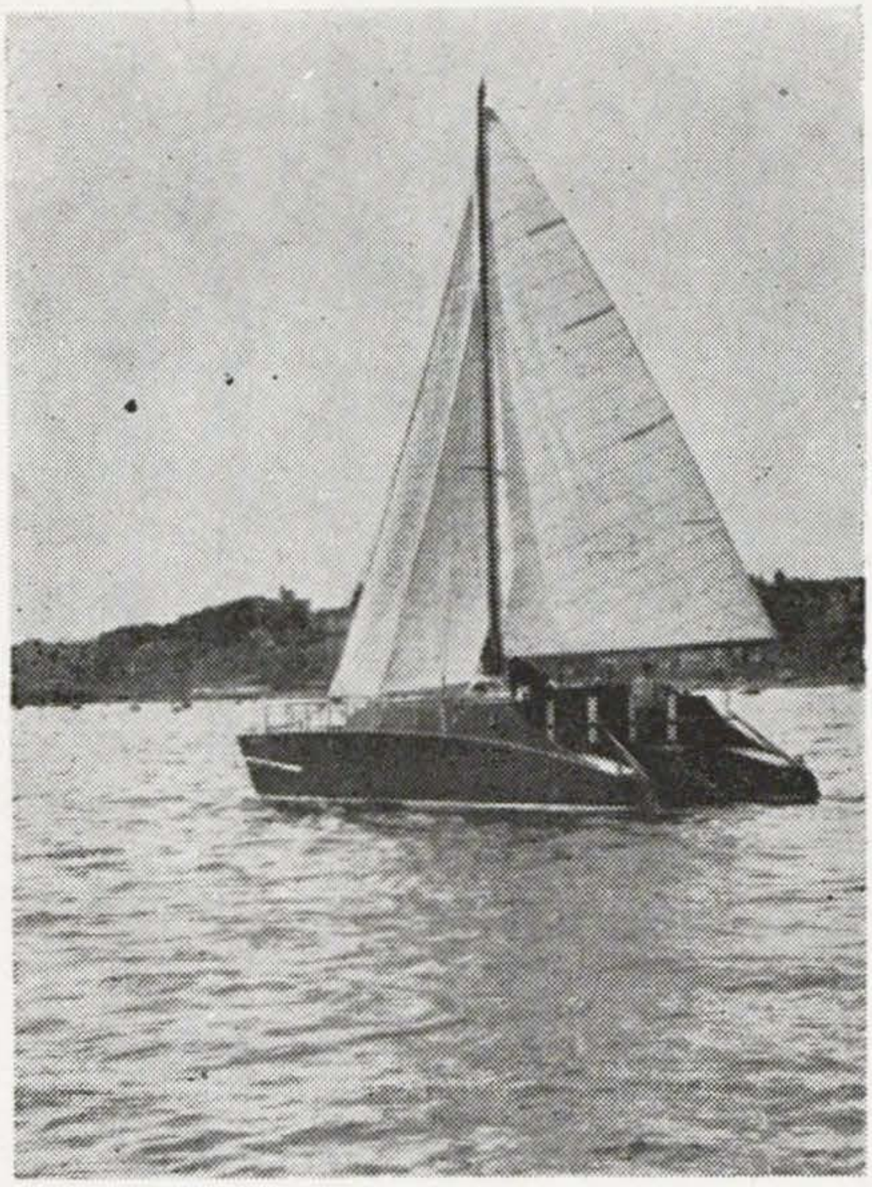


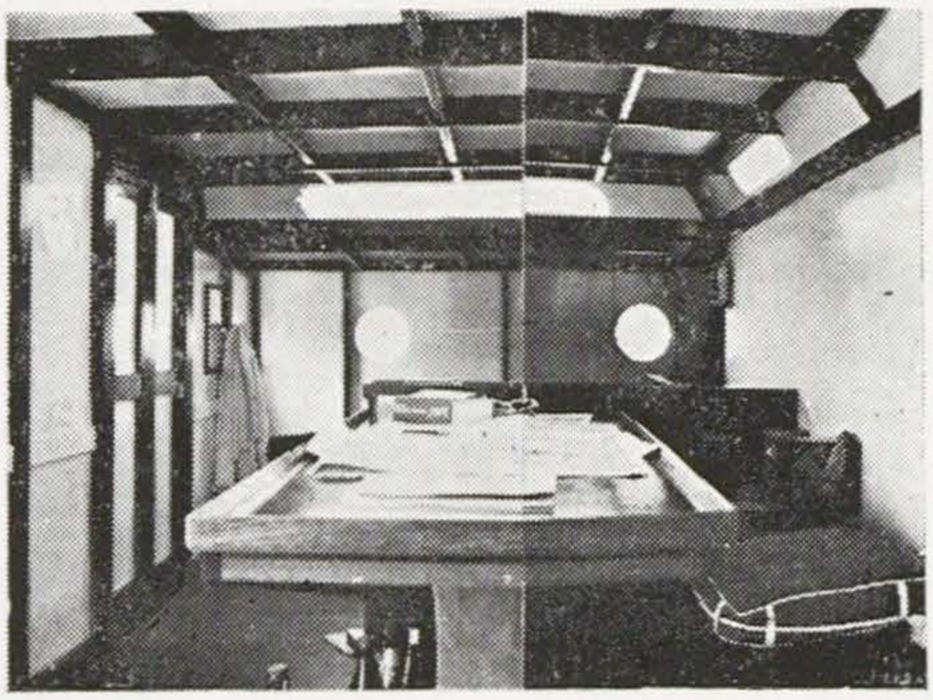




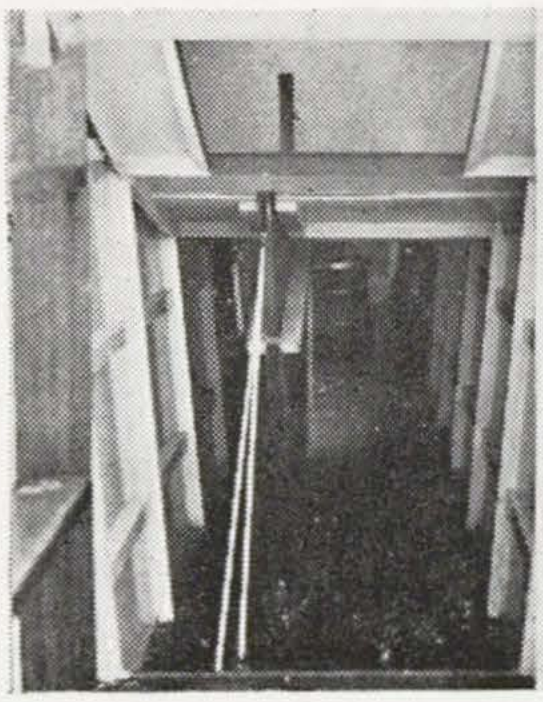
Accommodation

Six people have cruised comfortably in *FLAMINGO*. There are two double berths athwartships and two single cabins forward. As many as fifteen people have gone for a day sail in her so she is not lacking in room. The galley and saloon look most comfortable and the whole width of the ship aft of the cabins is the sailing cockpit.



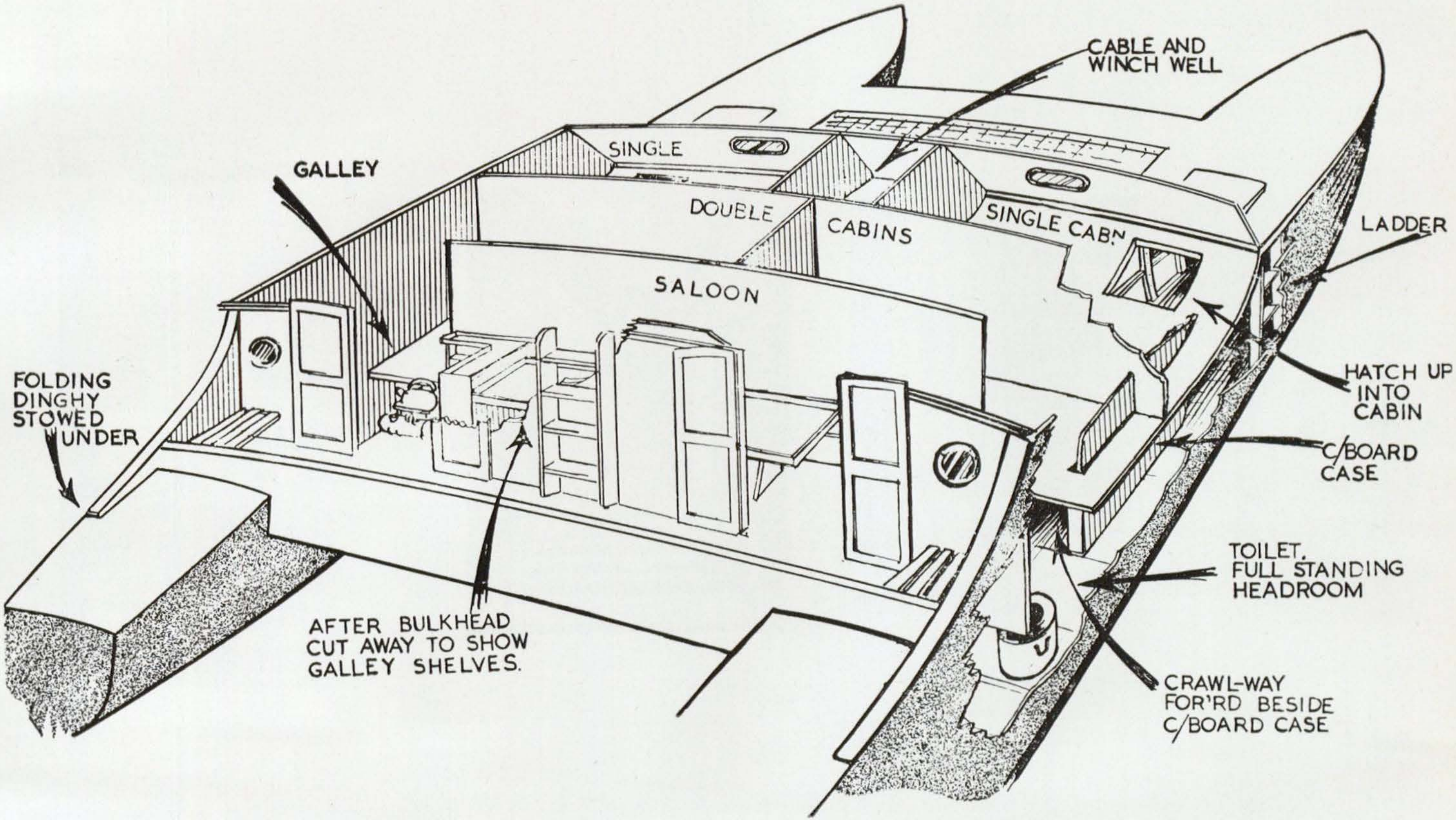


Saloon



C. B. Hoist

Locker


CABLE AND WINCH WELL
GALLEY
SINGLE
DOUBLE
CABINS
SINGLE CABN
LADDER
SALOON
HATCH UP INTO CABIN
FOLDING DINGHY STOWED UNDER
C/BOARD CASE
TOILET. FULL STANDING HEADROOM
AFTER BULKHEAD CUT AWAY TO SHOW GALLEY SHELVES.
CRAWL-WAY FOR'RD BESIDE C/BOARD CASE

Auxiliary

The motor is a 15 hp British Anzani which fits onto the sternboard at the back of the cockpit. It gives 5 knots at one third throttle.

The Best Run

So far, the best long distance run is from Folkestone to Aldeburgh, a distance of 65 miles which she did in 7½ hours, making an average speed of 6 2/3rd knots.

Summary

FLAMINGO appears to be a safe cruising catamaran with a higher speed than the majority of conventional cruising or racing yachts.

Acknowledgement

We wish to thank the Editor of Yachts and Yachting for the illustrations used with this article.

BEARKOK

October, 1959

L.O.A.	12 metres	Beam (hull deck)	0·90 metre
Beam, O.A.	4·5 metres	Beam (hull bottom)	0·60 metre
Draught	0·5 metre, and	Mast Length	12 metres
C.B.	1·6 metres	Sail Area	30 sq metres

Designer and Builder: O. Koch

Occasionally one meets with an act of exceptional quality in a person and I think the catamaran *BEARKOK* can only be compared to the original *MANU KAI* for the amount of work, thought and dogged perseverance which it has involved. To design almost without help and build a 40 ft cruising catamaran by one's own labours is quite some job.

Hull Design

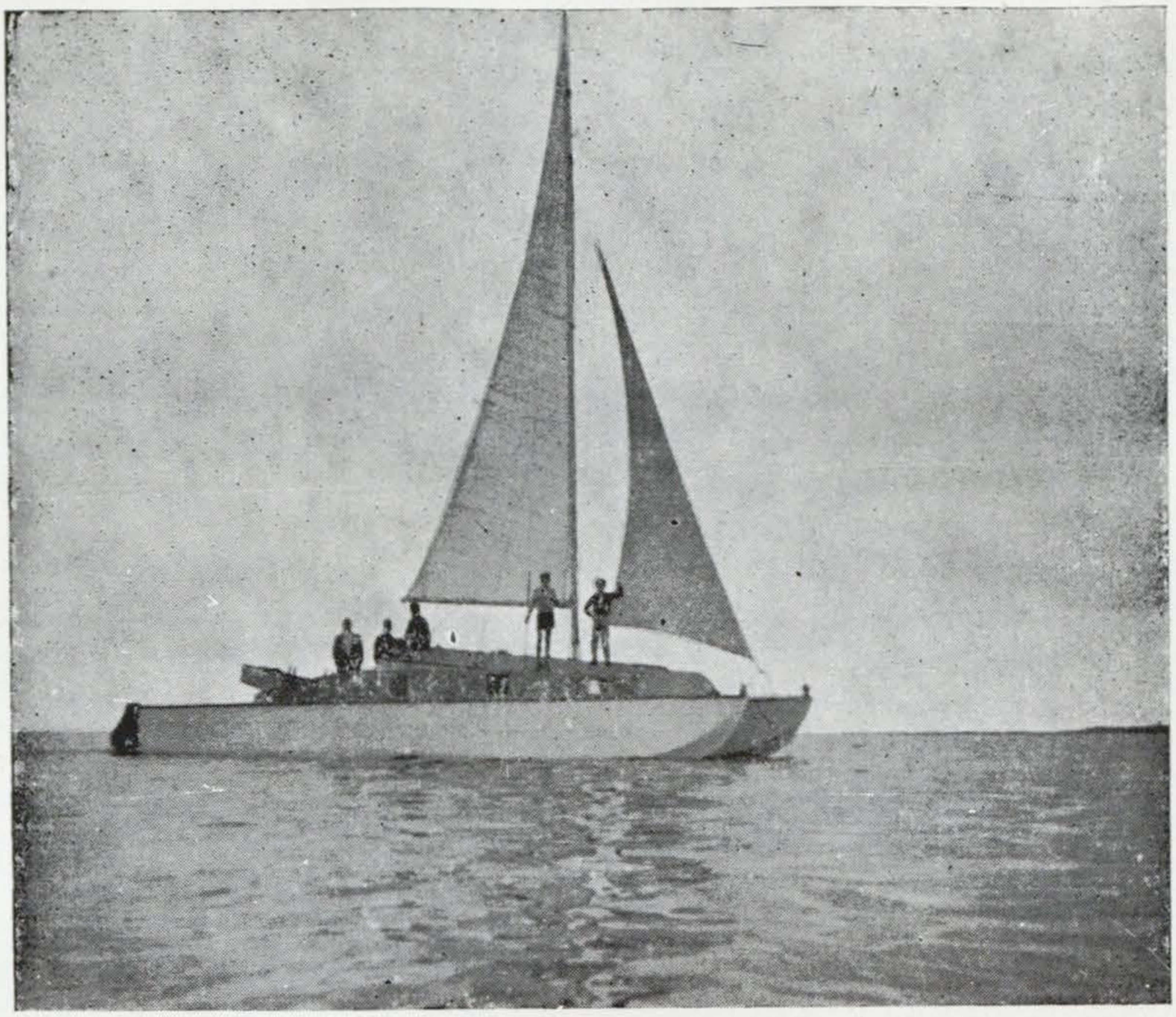
The hulls have a nice profile with a V bow transforming to a flat floor and box section amidships and aft. They are asymmetrical with the flat sides out and shallow draught rather like the hulls of Victor Tchetchet. They are covered with polyester-fibreglass.

Bridge Deck

This consists of a streamlined cabin about 3 ft in depth which will presumably have the berths which, with 6 ft of headroom in the hulls, will make very comfortable accommodation. Extra berths can be in the hulls.

The Assembled Craft

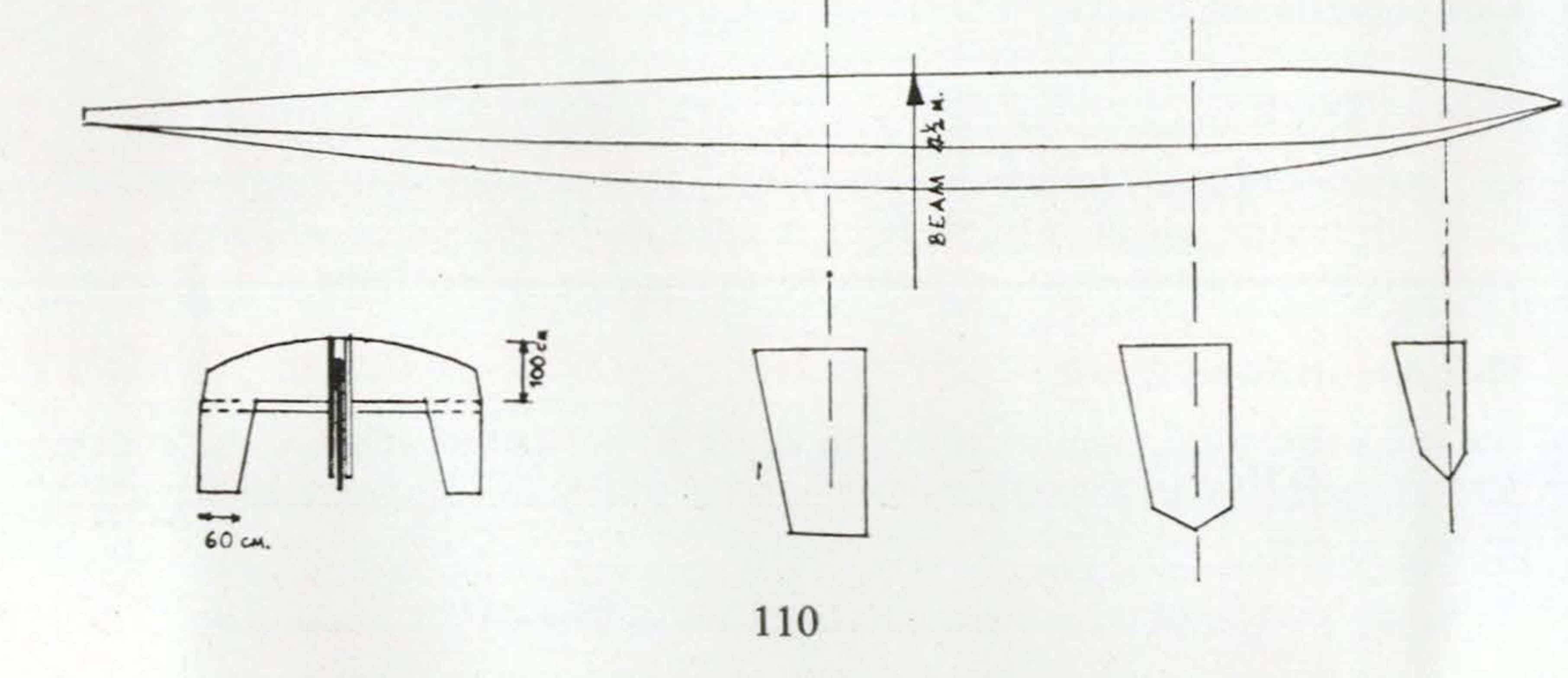
The hulls are close together and will cause some venturi effect with "rooster tail" at speed. A large centreboard is used which will improve the speed of putting about.



BEARKOK

Expected Performance

At this size, the accommodation can be easily carried and still give the ratio of sail area to weight needed to allow a catamaran its speed. The hull shape may not be ideal according to our studies but it is not so different that high



speeds cannot be obtained and somewhere about the 20 knot mark (possibly higher) may be made. Light wind performance is likely to be relatively poor.

The Sail Rig

With a mast only the length of the boat, capsize should be extremely difficult and large sails may be used in light weather.

Summary

BEARKOK is a large cruising catamaran of good conception which should have high speeds in strong winds and be almost immune from capsize.

Sailing Trials

Since writing the above *BEARKOK* has been launched and sailed. Despite the small sail area, the speed is equivalent to the fast dinghies but she is so stable that it is intended to double the present area of canvas by using a mizzen mast and increasing the length of mainmast. The shallow draught is a great boon on the tideless Baltic where she can nuzzle into the shore anywhere and, I should should think very useful to explore the islands where she sails. It is believed that she planes in strong winds but this indeed seems unlikely to me.

CONDA VISTA

October, 1959

by Douglas Glanville

80 Oxlade Drive, New Farm N.8, Brisbane, Australia

L.O.A.	23 ft	Draught	12 in
L.W.L.	20 ft	Weight	1,200 lbs
Beam	11 ft	Sail Area	263 sq ft
Beam (hull)	1 ft 6 in	Small Rig	179 sq ft

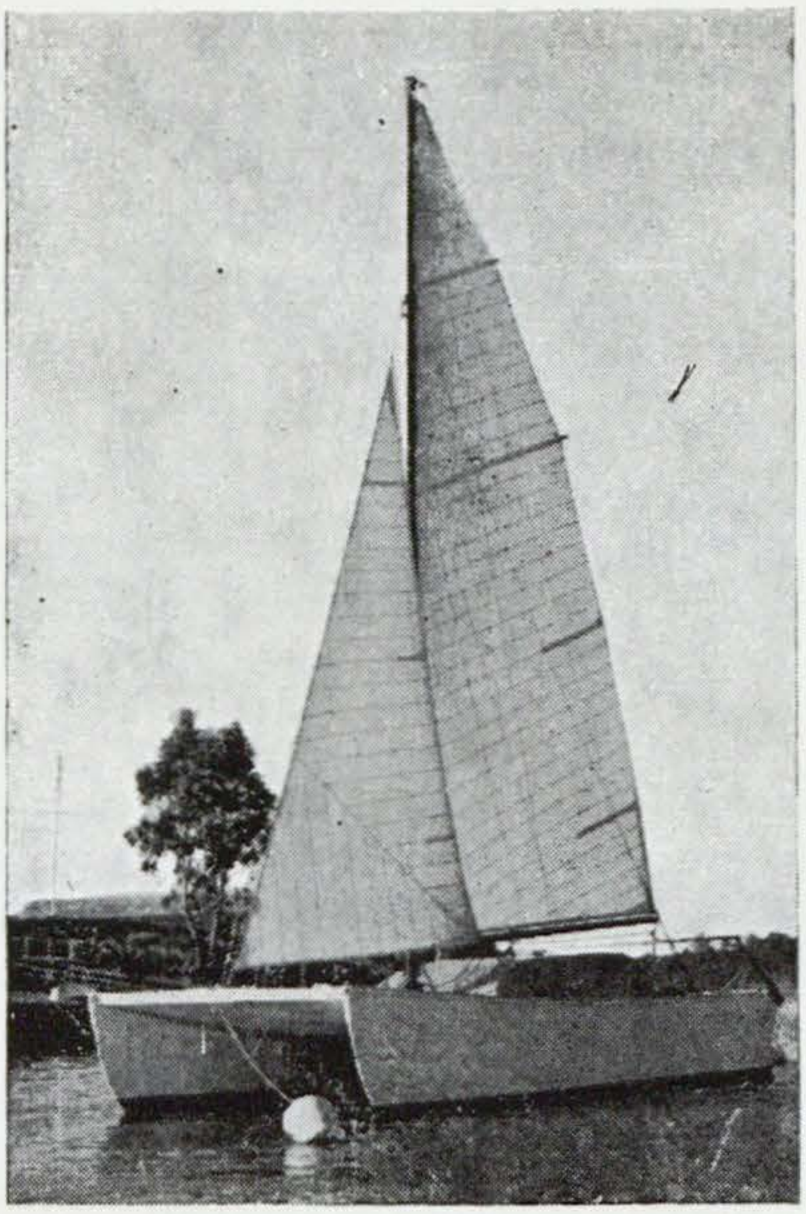
CONDA VISTA was designed at a time when there was no information available on catamarans. I wanted a cat with full headroom and accommodation and between 35 and 40 ft overall but, not wishing to have a failure at that size I decided to try out my ideas on a 23 ft boat first. *CONDA VISTA* has been so successful that I now wish I had made a 40 ft craft instead.

The Design

CONDA VISTA is a *Manu Kai* type with asymmetric hulls, simply made with deep box-like sections and fibreglassed to 5 in or 6 in above the waterline so she cannot leak. All the timber used is straight and fits together like a Meccano set.

The Asymmetric Hulls

These were chosen in order to avoid a C.B., keels or fins. The outside of the hulls are flat and create no bow wave. On the insides of the bows, waves form



and collide just aft of amidships and pass across to press against the sterns, partly regaining the energy lost at the bows. The section is near enough that used by Victor Tchetchet. One could suspect eddying flow around the chines but none is apparent on *CONDA VISTA*.

Water Flows around Hulls

4 *knots*. No wake or other disturbance is seen.

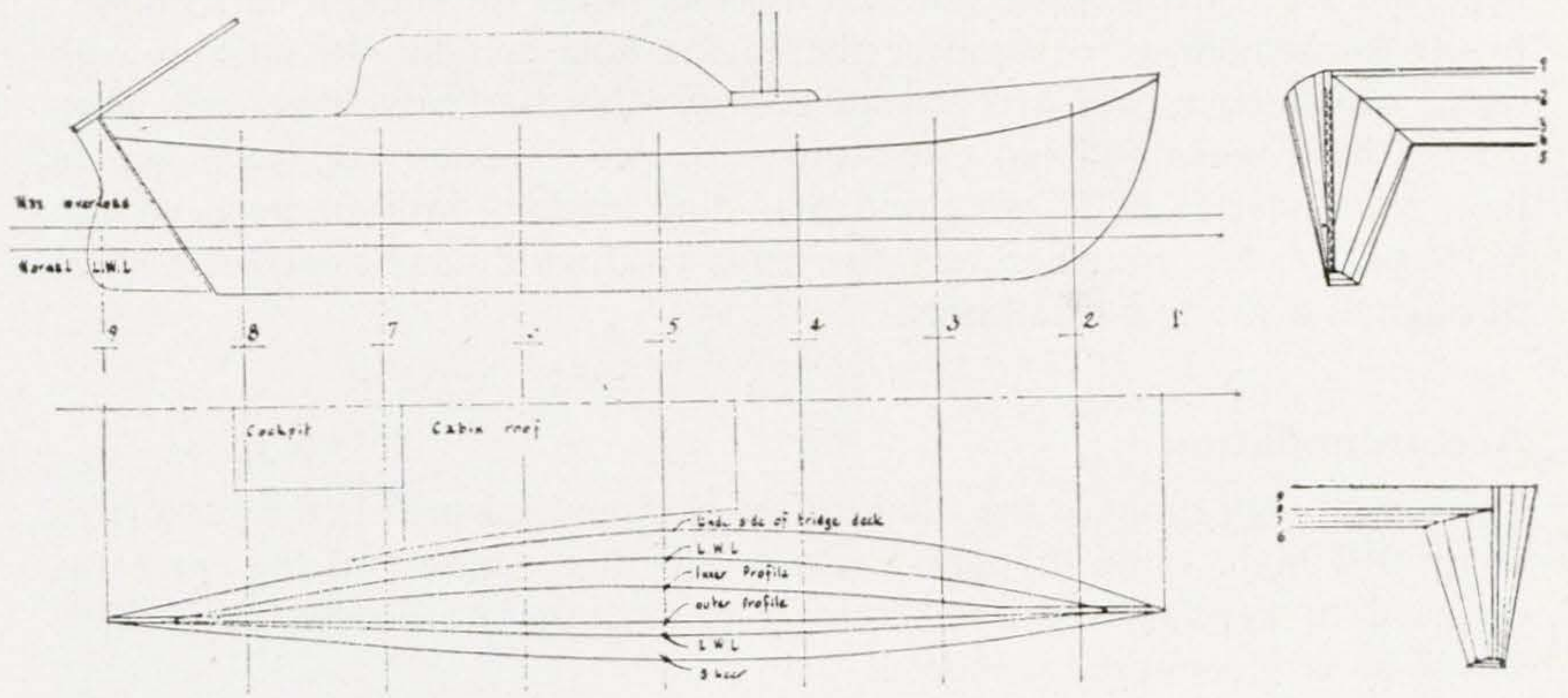
6 *knots*. The water flows beautifully along the waterlines and starts to show a build-up wave under the cockpit. Two feet in front of the rudders a wave, looking like a bow wave, starts to slide up the rudder and pours through the inch space between the sternpost and rudder, like a miniature waterfall. Small wakes are just visible.

8 *knots and above*. The waterfall increases to 9 in but not higher than that. On our fastest run, we took colour movies by hanging over the bows and even at this unknown speed (our speedo stops at 16 knots) the water flow between the hulls was unbelievably undisturbed till, near the stern, the rooster tail formed and was spurting 20 to 30 ft behind us.

At no time does *CONDA VISTA* show any broken bow waves or foaming water with seas less than 20 ft high. There is no illusion of speed as in the photographs of *SHEARWATER* and *GEMINI*. The feeling is that the water must be covered with oil, so perfect is the flow. I therefore consider it rather regrettable that these asymmetrical thoroughbred hulls have been given such a death sentence on page 13, AYRS No. 16.

Another thing which seems queer to me and has not been mentioned in magazines is the asymmetrical hull's ability to surf down the face of a wave in light winds. The hulls are so narrow that one would expect the wave to slide harmlessly under the boat, but it doesn't. My theory is that the venturi effect between the hulls gives the waterflow terrific velocity. The following wave tries to sweep through between the hulls but strikes the high speed water. There is a big wave build up and the cat is driven forwards by the wedge action on the curved insides of the sterns.

Quite often one reads that asymmetrical hulls tend to bear away in squalls and are therefore dangerous. This is definitely not correct. The boat turns up into the wind and handles the same as a perfectly balanced yacht, except of couse that larger turning arcs are necessary. Staying is slow but sure and even when deliberately put " in irons," it is no problem to run backwards, the rudders are reversed and the cat swings round like backing a car.



The Bridge Deck

The two hulls are bridged from bows to sterns. Few catamarans are built thus nowadays. The pro's and con's are as follows:

Disadvantage

Under heavy conditions close hauled into winds of 25 to 30 mph, the lift from the bridge is excessive and tends to lift the cat out of the water. This gives a capsizey feeling. To prevent this, I carry the outboard motor, spare sails, anchor and chain half way between the bows and the mast. Strangely, this extra bow loading in no way tends to make the lee bow dig in.

Advantages

1 Gives completely dry sailing deck.
2 Eliminates nose-diving or the hulls burying into the backs of waves after "planing" down a steep face. In dirty S.E.'s, we get very steep waves in the bay probably 5 ft high. The cat can then hurtle out into space with the hulls bare up to the mast. She then drops into the next wave. She rises fast but cannot clear the crest with buoyancy alone. The fore end of the bridge deck takes over and skids her over the top. Maybe, an inch or two of water splashes over the lee bow, just wetting the corner.

3 Gives approximately an extra 100 sq ft of usable deck space for changing headsails and setting spinnakers.

4 Lift from the bridge deck reduces wetted surface, gives a firm anchoring base for the jib and forestay. The jib can be set low to the deck and is dry after a sail. Close hauled, the jib is not affected by the "updraught" from the hull.

Freeboard

This is approximately 36 in and is thought by many to be excessive. However, we have had a few waves on deck and some have hit underneath. These last shake the catamaran from stem to stern and then up to the truck. The crash is terrific. One or two waves have hit together under the cockpit hard enough to lift the temporary cover over the engine hole and fill the cockpit with water which pours out at once, of course. This has only happened when driving hard under full sail into steep seas. An orthodox keel yacht would have been hove-to or flogging and pounding, making little or no headway. *CONDA VISTA,* with her very fine ends (prismatic coefficient 0·51) slices through at a steady 6 or 8 knots.

Accommodation

There is enough room in the cabin to crawl in and sleep. It is 8 ft × 5 ft × about 3 ft high. Little thought was put into this section and the craft was designed to develop a perfect cruising catamaran. At double the size, it would be very comfortable indeed.

Engine

This is a small local outboard motor with a Villiers 147 cc two-stroke motor and, with a small throttle setting, *CONDA VISTA* does 3 to 4 knots at around 20 miles per gallon. The cockpit floor is removable and the outboard drops through it. The engine must be removed before sailing as otherwise it swamps itself in the "build-up" waves.

Performance

Very roughly, we do 2/3rds the speed of the wind. In medium winds, this is about as fast as a *Dragon.* In a 30 mph wind, with the wind over the quarter, we must do 18 to 20 mph as we have averaged 13 mph across the Bay and quite a bit of the time were only clocking 10 mph. In no way do I want to give the impression that this cruiser is going to keep up with a *Shearwater* or *Yvonne* 20. The latter machine has been timed at 23 mph over three miles but the ride is like going over railway sleepers; wet is not the word and you have to sail every second or else feed the sharks. At all times *CONDA VISTA* sails on an even keel and ambles along around 12 to 15 mph, dry as a bone and we could, if we wanted to, have our lunch on the foredeck.

42 FOOT CATAMARAN MARARA

October, 1959

L.O.A.	42 ft 5 in	Displacement	7,000 lbs
L.W.L.	33 ft 3 in	O.A. Beam	14 ft
Beam each hull	36 in	Height keel to cabin top	8 ft
Draft, at present	30 in		

Designer, Builder and Owner: C. O. Walker

Keel length is 30 ft. They are straight on the bottom: laminated out of two 4 × 12 Douglas fir timbers for each keel.

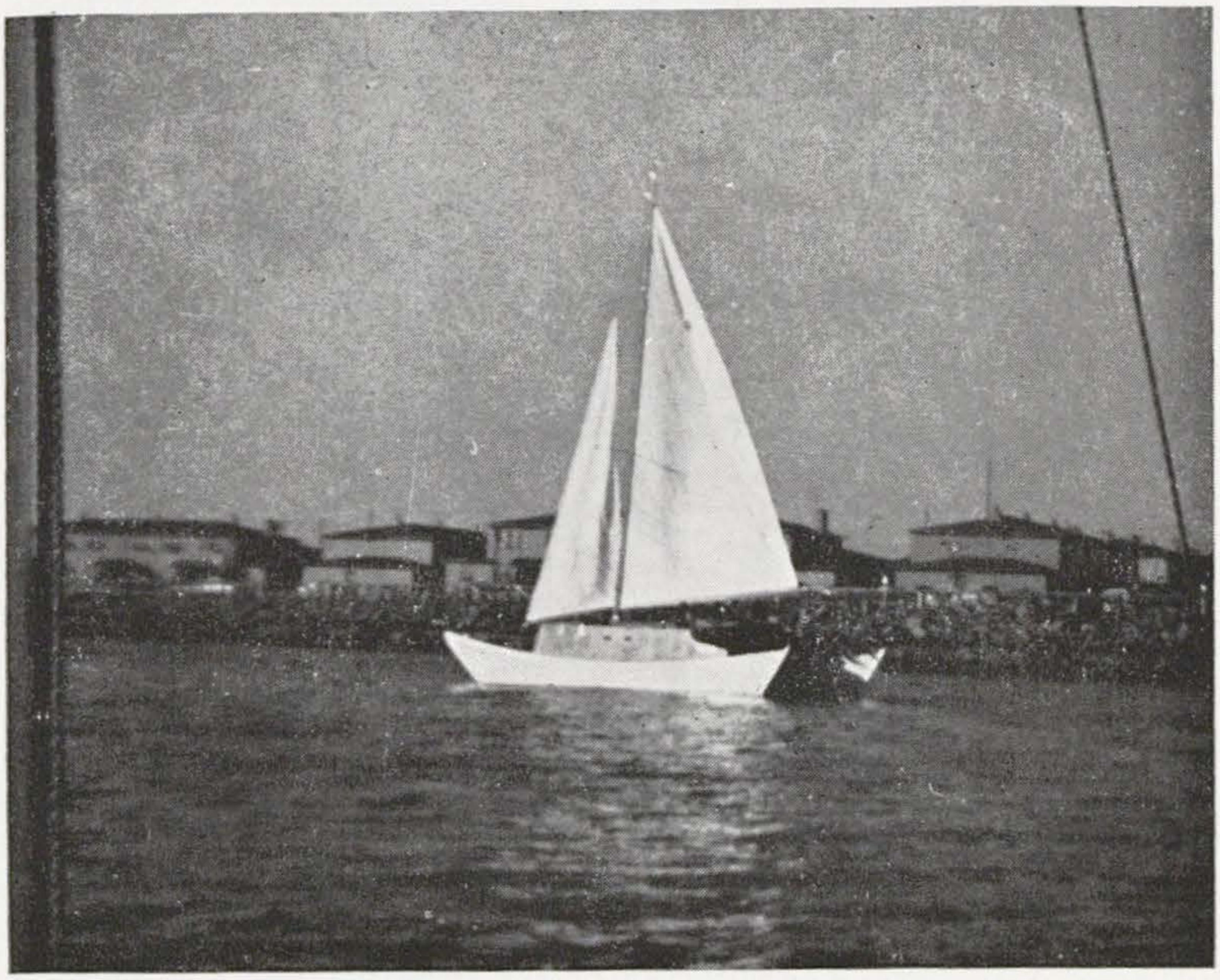
Frames are of $1\frac{1}{2}$ in × $1\frac{1}{2}$ in × $\frac{3}{16}$ in manganese aluminium alloy stationed on 16 in centres.

Gunwales are of $2\frac{1}{2}$ in × $3\frac{1}{2}$ in × $\frac{1}{4}$ in alum. angle: same alloy, as is used throughout.

Planking is $\frac{3}{8}$ in DFDPA plywood fastened with $\frac{1}{4}$ in aluminium rivets.

Completely fibreglass covered, with four laminations below waterlines.

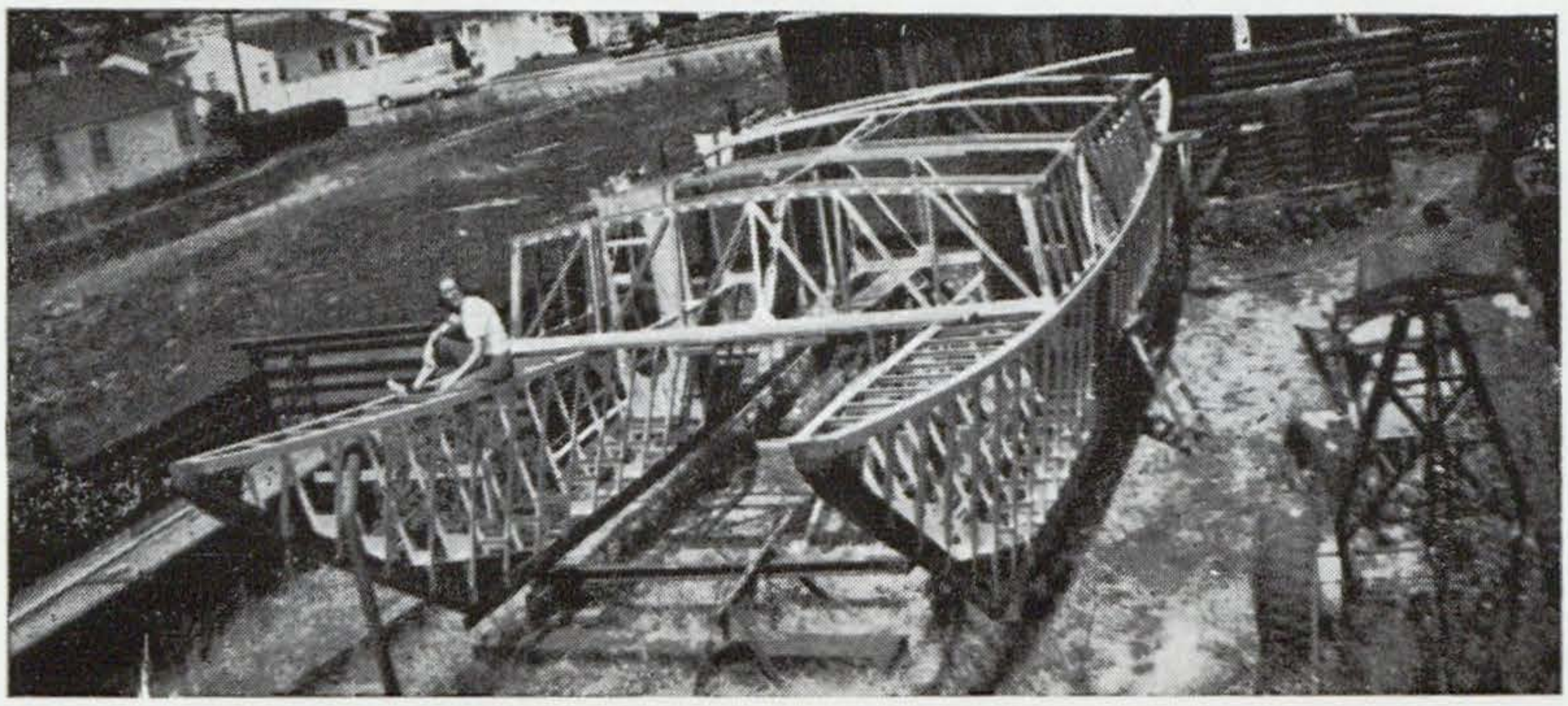
Wing section upper and lower decks doubleplanked with $\frac{1}{4}$ in plywood making $\frac{1}{2}$ in moulded thickness and glassed.



Watertight bulkheads; two in each hull, double $\frac{1}{4}$ in plywood, making three W.T. compartments in each hull. Cabin front or forward bulkhead is double planked $\frac{1}{4}$ in plywood, and as pictures show, all bulkheads joining the two hulls are heavily truss framed.

The boat was not constructed in the usual manner, as we started from scratch and had no previous boat building experience. However, I am experienced in steel fabricating and have also had some carpentry, so the craft is soundly constructed. We used good, large galv. fastenings, as well as stainless bolts and alum. rivets on the heavier alum. alloy angles.

We were somewhat handicapped tool-wise when we started, so progress was slow. No table saw, nor band saw; just a skill saw, an electric hammer, and few hand tools. Later on, we purchased an impact wrench for putting in the many screws, small and large, and self-tapping where we were unable to rivet. We then bought a router for most of the finish work. Since then, we've added a grinder for working on the customized fittings, etc.



We had sloop rig to start with. A 40 ft mast measured from the step on deck. Boom was 20 ft and our sails were re-cut synthetics totalling approximately 500 sq ft. Lacking for sail area, we then added a bridle from the two bows and rigged a flying jib of 120 sq ft. This, of course, helped and improved performance in two ways. Increased area helped in push, and moving the centre of effort from 10 per cent to 12 per cent lead, lessened the strong weather helm in stiff breezes.

Performance

In light airs; very poor, mainly due to lack of sail area. Wind 25 to 45 mph, performance excellent. Points very well. Moderate speed 6 to 10 mph with full main and staysail (no flying jib) and with wind velocity up to 45 mph, we have exceeded 12 knots in gusts in a broad reach. (We had excellent sailing on San Francisco Bay that afternoon. Conditions were also favourable as we had no seas running. Without the flying jib, however, the weather helm was quite severe, at times. After that sail, we have great confidence in *MARARA's* ability with the proper rig.)

We then tried one large masthead jib, and again noted an improvement in performance, in coming about and beating to windward. Also, the centre of effort was increased to 14 per cent lead.

We then tried an experiment with adding a bowsp'rit, and moved the centre of effort to 19 per cent lead. Experiment ended with the topping of our mast.

14 per cent lead was the best all-round performance.

She sails on all points with headsails alone far better than with main alone. This, to us, seemed unusual, and offers much in sail handling. We found that if the wind became suddenly violent, we could douse the mainsail completely and have excellent handling, especially if jib is of the overlapping type.

Coming about has been very poor, in fact, dangerously so in a narrow, gusty, channel, which the Oakland estuary is. Width is about ¼ mile wide, incoming tide makes a 3 knot current at times, and the prevailing wind is directly up the channel, with the incoming tide. These factors make it not too easy to navigate the big cat. Out in the bay, however, where we have ample room to enlarge our turning radius, she comes about slowly but easily.

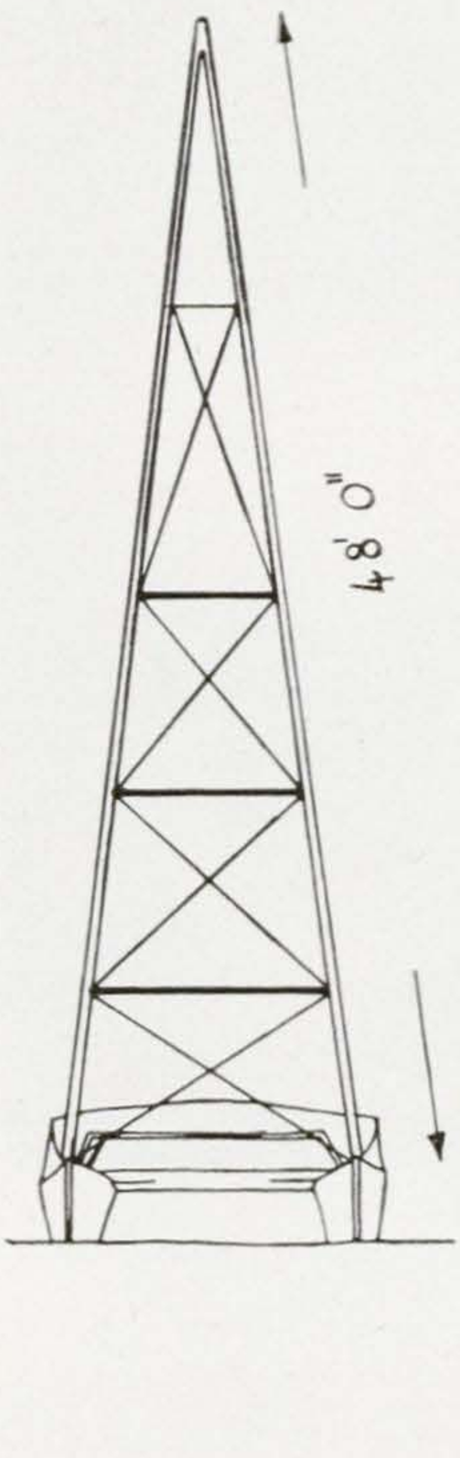
We have been planning on re-rigging with a 46 ft A-frame: double headstay, double backstay and luffwire for the main. Sail area: 800 sq ft.

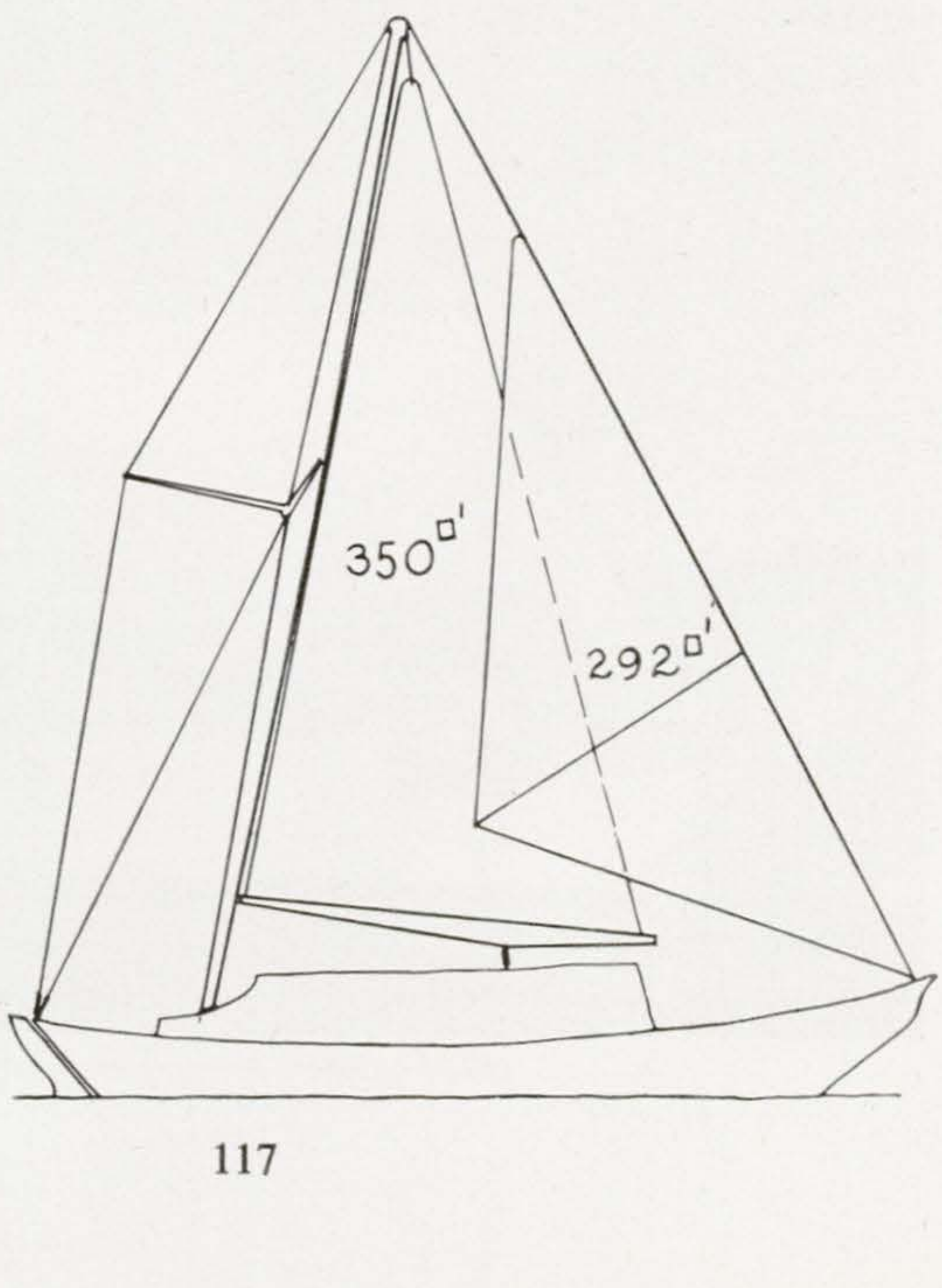
We are living aboard, and that, too, handicaps our research, especially with no auxiliary.

Am at present installing a Lister Diesel with drive unit which we can remove from the water while sailing. We will be able to be far more active than in the past 10 months.

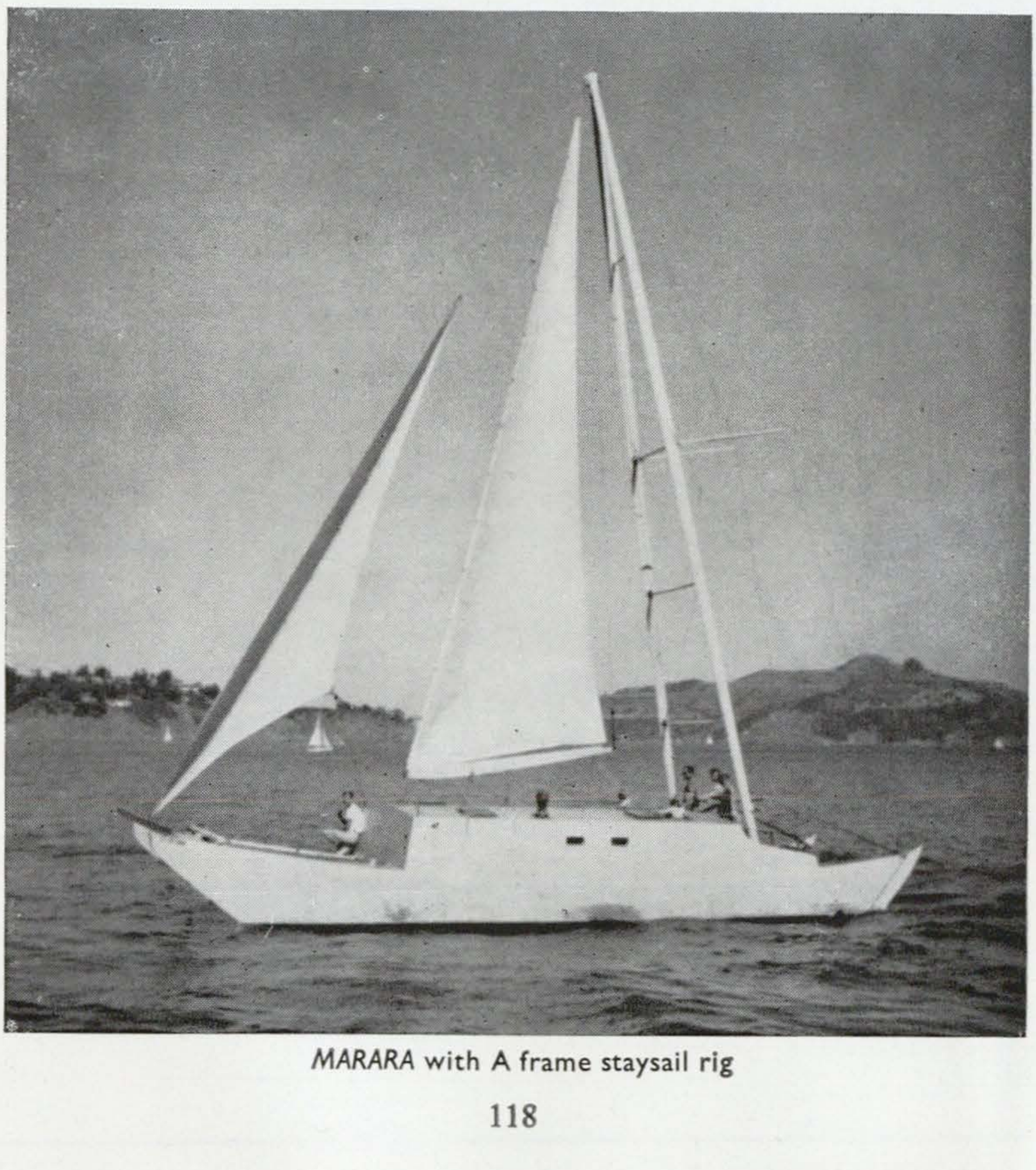
THE MAST-AFT RIG

The drawings show *MARARA's* rig and sail plan. The bipod mast aft seems to be the answer for her type of deep box section hulls. She now can be handled single handed, which has been one of the main reasons for trying this rig.





C. O. Walker's *A-Mast*



MARARA with A frame staysail rig

As I see it, the main objections to the mast aft rig are stress problems. However, with a catamaran's wide beam and the use of a bipod instead of a single mast, I believe stress problems can be overcome without excess weight or loss of streamlining. The best ratio of height to base seems to be 3 : 1. Because we could not use that ratio, our spreaders and X cables had to be made stronger than usual and, although our "A" frame, as we call it, weighs just a little over 300 lbs, it is only about 30 per cent heavier than I figured a sloop rig or single mast would weigh. And the weight is aft, where we want it, so that doesn't seem to be any problem.

CHAPTER XII

THE MALIBU CATAMARAN

October, 1959

L.O.A.	20 ft	Sail Area	225 sq ft
Beam	9 ft 9 in	Draught	10 in

The *MALIBU OVERNIGHTER* is a most delightful conception of a cruising catamaran sold commercially in California for $1745·00 F.O.B.

Malibu

The low cabin which appears to be about 1 ft 6 in in height gives sleeping accommodation for a family while it doesn't destroy the sailing performance. The spacious cockpit is ideal for day sailing and the small sail area must be very easy to handle. The toilet and galley are in the hulls.

Hull Design

This is the typical Hawaiian type catamaran hull with canoe stern which doesn't need a centreboard.

Summary

This type of catamaran daysailer-cruiser must be what many people want and it deserves to be far better known than it is.

MALIBU OVERNIGHTER

SEATONIC

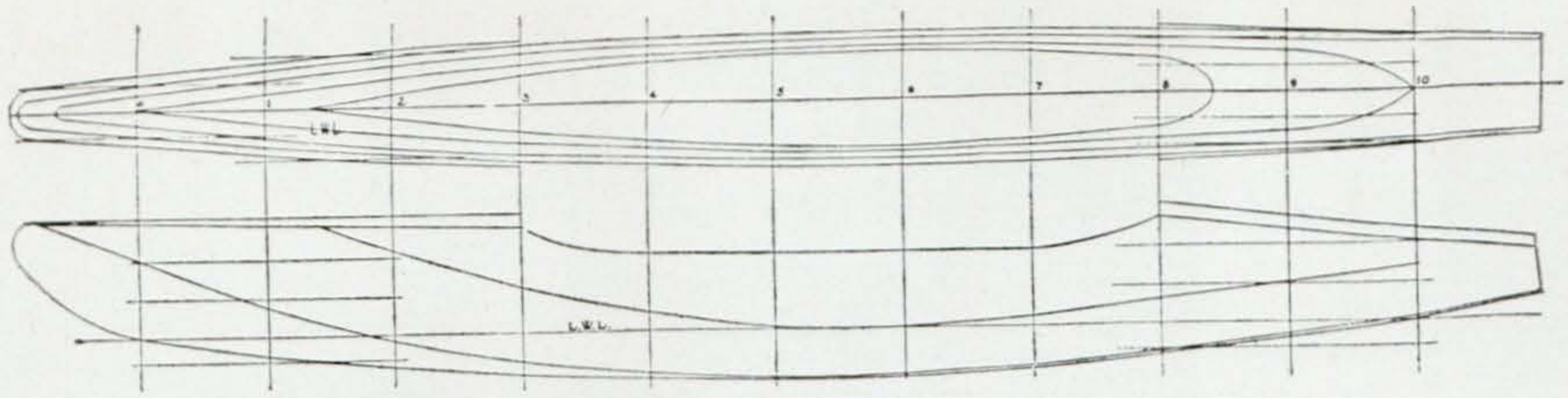
October, 1959

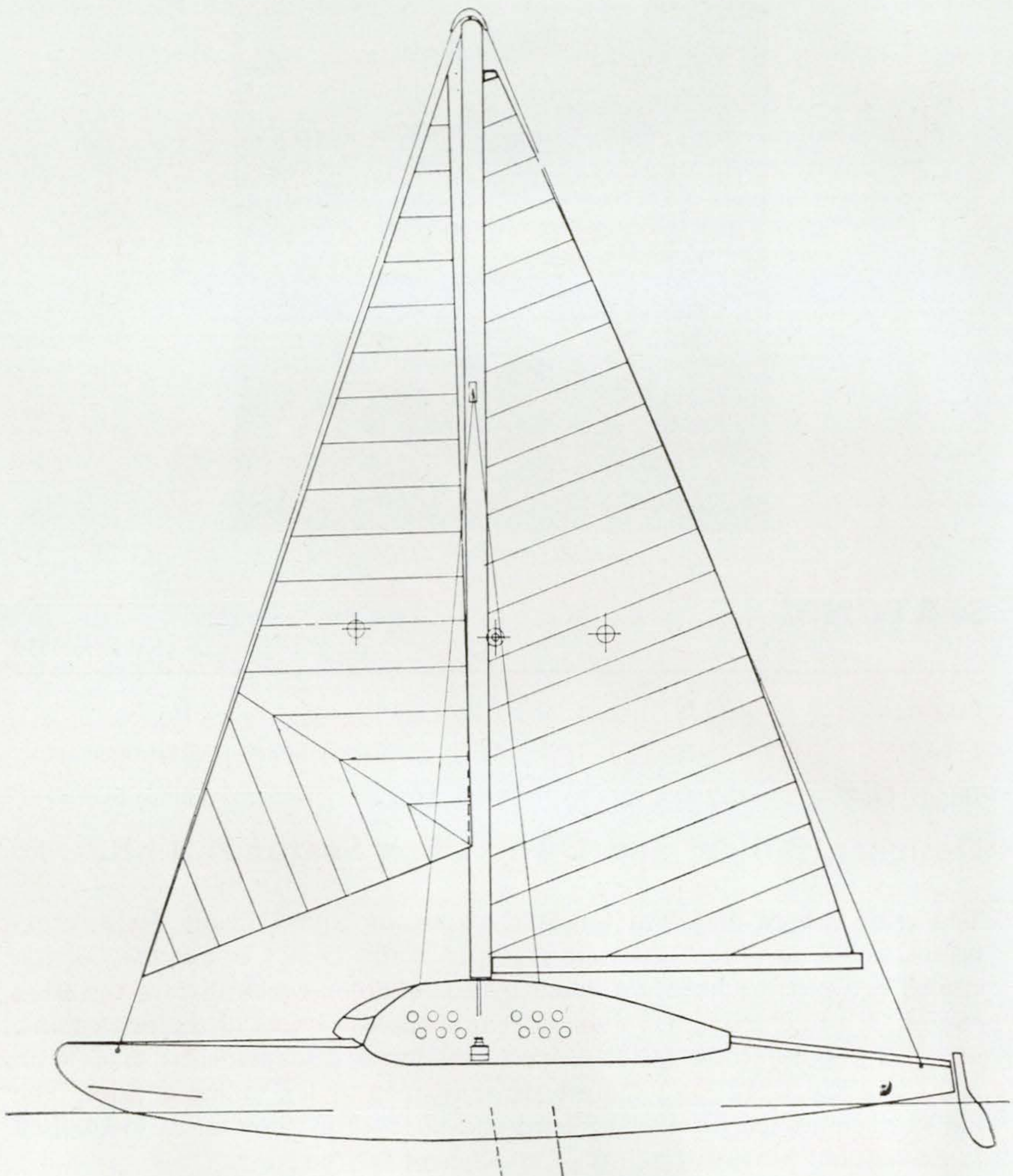
L.O.A.	30 ft	Beam (hull)	2 ft
L.W.L.	25 ft	Displacement	2,240 lbs
Beam, O.A.	12 ft 4 in	Sail Area	334 sq ft

Designer, Builder and Owner: Eric Seaton A.R.I.B.A.

This craft is built of 6 mm veneered mahogany with ¼ in ply decks, cross beams and wing sections, though the base of this is of 1 in boards. Torsion strains between the hulls are taken by an X girder which divides the wing section into four triangular shapes. Two of these are part of the two cabins, with 5 ft 9 in headroom at the deepest. The forward shape (a 7 ft triangle on plan) is a sail locker and the aft shape is open and a sailing cockpit. The hulls are connected together forward and aft by 2 in alloy tubes, eye bolted to frames and providing points of attachment for the stays.

The mast rests on a thrust race at the base of the wing section at the intersection of the X. It is fully revolving and is jacked up and down to dispense with rigging screws.





The bows are bull nosed at deck level and give buoyancy, minimum wind resistance and maximum water shedding properties on rising from a sea.

The following characteristics are taken from AYRS No. 18:

Single hull prismatic coefficient		·785
Single hull L/hull beam L.W.L.		12·5
Effective L.W.L. in feet		25·0
Spread of hull centrelines		·38
C.B. from bow % of L.W.L.		55%
Loaded weight in lbs (W)		2,240
Loaded weight in tons (△)		1
Wetted surface in sq ft (S)		93·75
Maximum speed by (K) formula K	=	2·75
Maximum speed 20·24 knots	=	$4{\cdot}0\sqrt{L}$

GOLDEN MILLER

October, 1959

by Michael Henderson

L.O.A.	21 ft	Draft	3 ft 6 in
L.W.L.	18 ft (R.T.)	Displacement	2,500 lbs
Beam, O.A.	10 ft 6 in	Sail Area	265 sq ft
		With light canvas	420 sq ft

There are, apart from questions of resistance and speed, two main problems to be solved in an offshore catamaran:

1 to prevent the thing falling apart from the large stresses likely to be encountered offshore and from the niggling, fatiguing little stresses set up when lying at moorings week after week in anything but dead smooth water, and

2 to provide full and adequate self-righting powers.

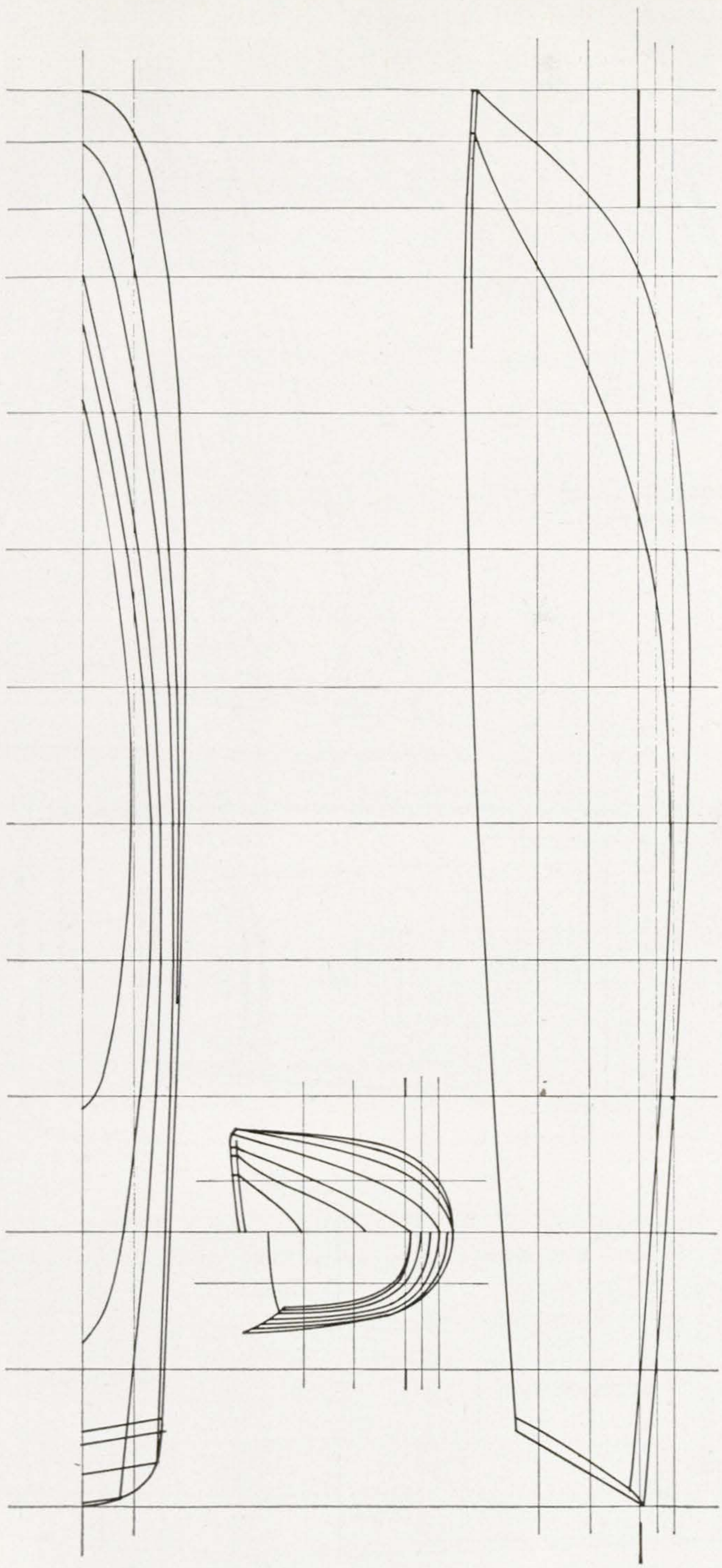
I've chosen to solve (1) by extending the deck and wing the full length and by incorporating four full and three part bulkheads along that length. This will tie the whole thing into a really rigid structure which, with reasonably careful attention to the construction, should be well able to hold together, while the extended deck and wing allow an ample platform for sails, anchors and warps.

(2) is solved in two ways; by carrying ballast on fixed fins and by having a buoyant lump at the masthead. This "flying saucer", a discus-shaped fibreglass moulding, provides about 300 lbs of buoyancy and can carry such things as a lightning conductor, navigation lights and a radar reflector, while twin racing flags, one for each hull may be flown from its extremities. These two devices together overcome the catamaran's main disability, namely, that she is as stable upside down as right way up. True, one might run into trouble if the mast went but that is a risk which must be accepted. It is a rather remote possibility as the mast and its gear must be very strong to cope with the

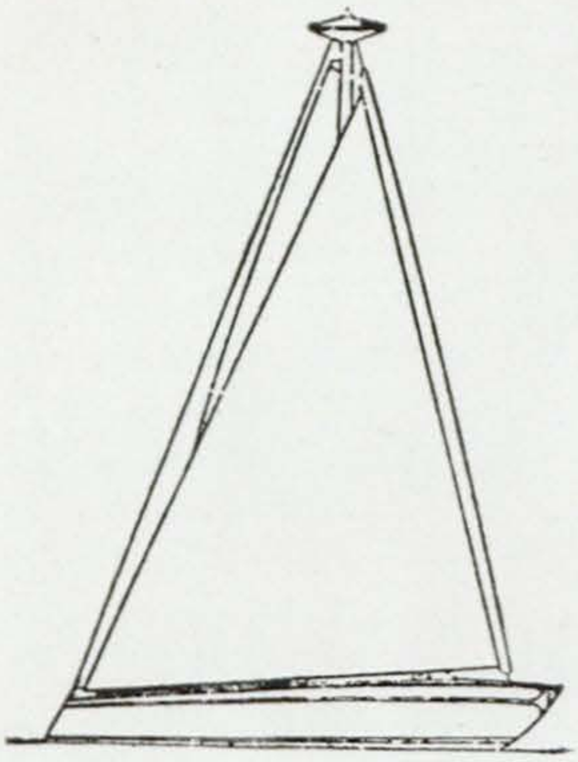
enormous power of the boat and the great beam allows a splendidly strong rigging layout.

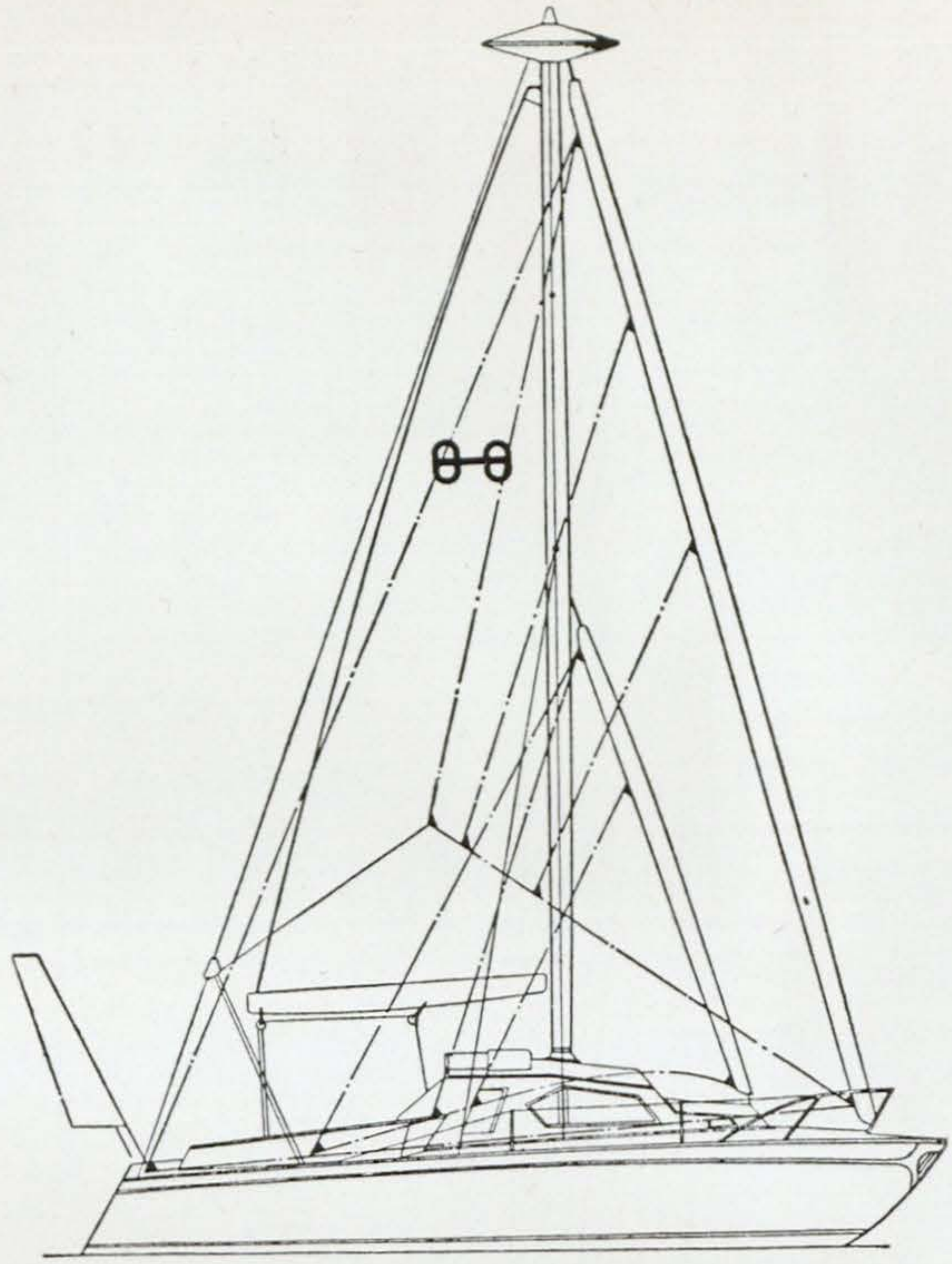
The stability curve shows that the righting moment reaches a first peak of some 8,200 ft/lbs at about 12° of heel (the weight of the crew not being taken into account). Stability then falls off until, at 90°, it has reached its minimum of 1,700 but picks up sharply again to its maximum of nearly 10,000 ft/lbs as the masthead float immerses. Thereafter, it falls away again until it reaches zero at 180°, but at no time is it negative. Thus, the boat is fully self righting.

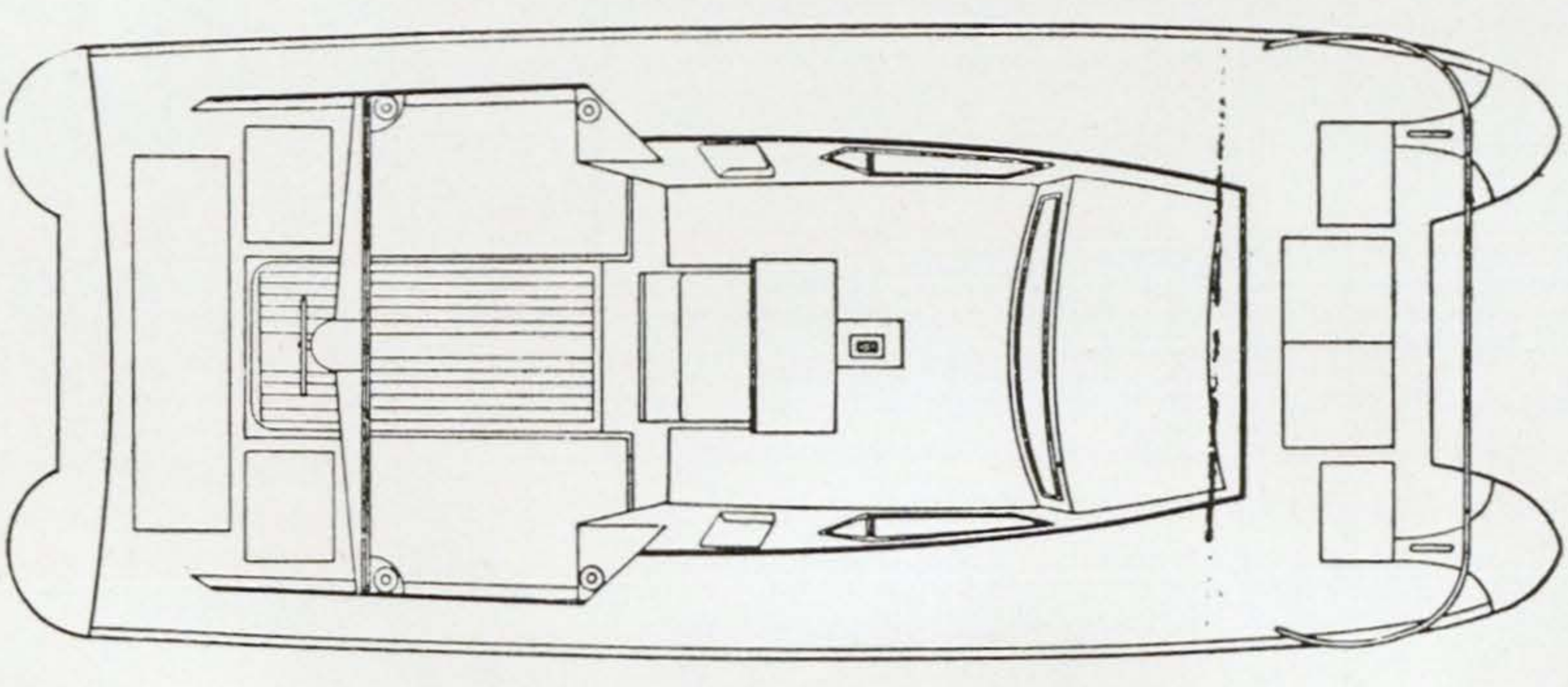
The hull form will, I hope, be suitable, tending to squat slightly at speed and having plenty of reserve buoyancy forward in full, rounded *MICK THE MILLER* type bows so as to counteract the tipping moment of the sail thrust. Cutter rig is shown with a very large *Genoa* whose clew comes nearly to the stern. With such a beautifully broad sheeting base, one can set such a sail to advantage and can attain something like 330 sq ft per ton displacement (400, including the Genoa staysail) without an excessively tall mast; and one can reduce sail in nicely proportioned lumps as the wind increases. Later on, I may try a more advanced sail plan, but first things first.

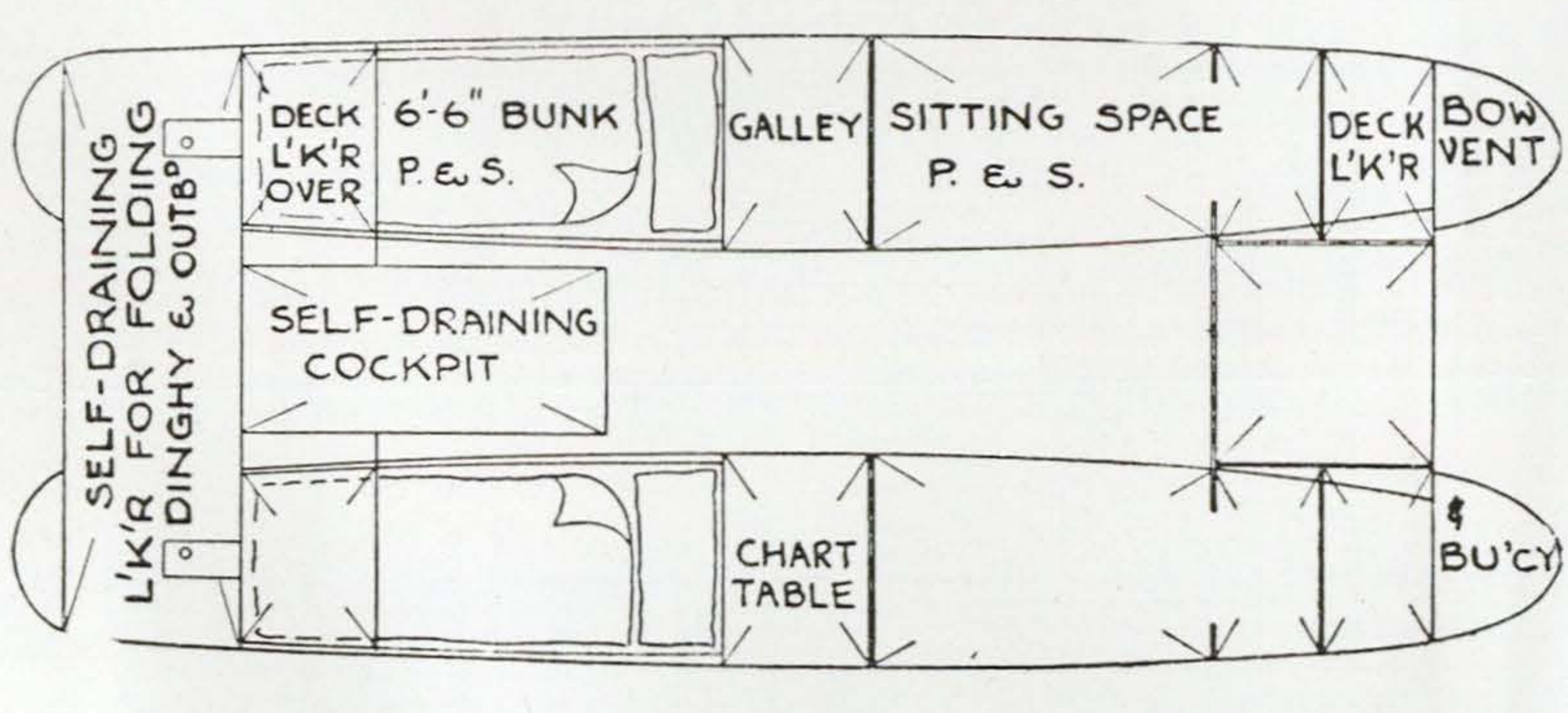


GOLDEN MILLER








SELF-DRAINING
L'K'R FOR FOLDING
DINGHY & OUTBD
DECK
L'K'R
OVER
6'-6" BUNK
P. & S.
GALLEY
SITTING SPACE
P. & S.
DECK
L'K'R
BOW
VENT
SELF-DRAINING
COCKPIT
CHART
TABLE
BU'CY

As to possible performance, it is very difficult to give a guess. Comparing with *MICK THE MILLER,* of the same length, the new boat has: 83 per cent of *MICK's* displacement; 140 per cent of the sail area; about the same wetted surface and just on five times the sail carrying power at the "best" angle of heel.

I hope to start building on these lines soon. The new cat will be named *GOLDEN MILLER* and I hope that she will be one of J.O.G. cat fleet—hence the sail markings shown.

Summary

An offshore catamaran has been designed for the Junior Offshore Group which will be *safe* and have a higher *average* speed than, for example, *MICK THE MILLER*. This will allow weekend cruises to be extended in distance and bring Continental ports into weekend range of the South Coast of England.

REPORT BY MICHAEL HENDERSON

The boat reached a speed of around twelve knots when the photograph was taken. Keith Beken was unable to catch her in his ten knot launch. Generally speaking, she has behaved exactly as predicted except that her top speed is somewhat more than I hoped for. Stability is fine—we have rolled her down both by crane and by sailing and she rights from 90° unaided, without putting the masthead float into the water.

This season has been mostly dogged by light airs as you know. The boat is a bit on the undercanvassed side and so can only sail at the same sort of speeds as similar sized single hulls, in light airs, but shows increasing advantages as the Beaufort numbers increase. As a cat should be, she is exceptionally good to windward in a blow and has logged six knots close hauled in a force six offshore with dryish decks and a heel angle of 10-15°. On the wind in a 3-4 breeze she will sail at four knots or so and occasionally reach five. Reaching, her speed is from six knots in a 3-4 to ten to twelve in a 6.

She's quite livable too, and shows a considerable improvement over *MICK THE MILLER* both in speed, space and comfort. We sailed, for instance, the J.O.G. West channel series this year, viz. Southsea—Cherbourg buoy—Dartmouth and Dartmouth—St. Peter Port, mainly in light airs and calms and in both cases were second boat home; and cruised on to St. Malo, returning thence direct to Cowes at an overall passage average of four knots, close hauled, most of the way in force 2-3. In all we sailed some 500 miles in six days of sailing.

Basically one can say that the boat sails as fast as, or perhaps a little faster than comparable single hull boats in winds up to force three, and is able to make more use of the available horse power in stronger winds. The motion, though more quick in both pitch and roll is definitely less sick-making than other boats and I believe that the small angle of heel is the most potent factor here. The helm remains light all the time, and the boat is nicely balanced at all angles of heel. The bridge slams a bit to windward—it's only 24 in clear forward and 9 in aft—but nothing serious and there have been no signs of failure in the structure.

I am now working up a larger version, 24 ft waterline and 30 odd overall (for my wife and I have decided that we are now a bit too old to go to sea any more in a boat without a proper lavatory). The new boat will benefit enormously from the experience I've had with G.M. and looks like being a honey—quite a near approach to the optimum pleasure vessel, which ought to be a comfortable houseboat that is a sparkling delight to sail and also fast enough under power for water skiing—a combination of characteristics that only the multihull can give.

I would say that G.M. has also shown that, with reasonably sensible design, weight need not be too much of a limiting factor. She displaces around 2,800-3,000 lbs in offshore racing trim with an 18 ft waterline so is by no means an ultra light.

MATANI

L.O.A.	16 ft 7 in	Draught	10½ in
L.W.L.	15 ft 9 in	Displacement	1,264 lbs
Beam, O.A.	7 ft 6 in	Sail Area	162 sq ft
Beam, hull	2 ft	Genoa	100 sq ft

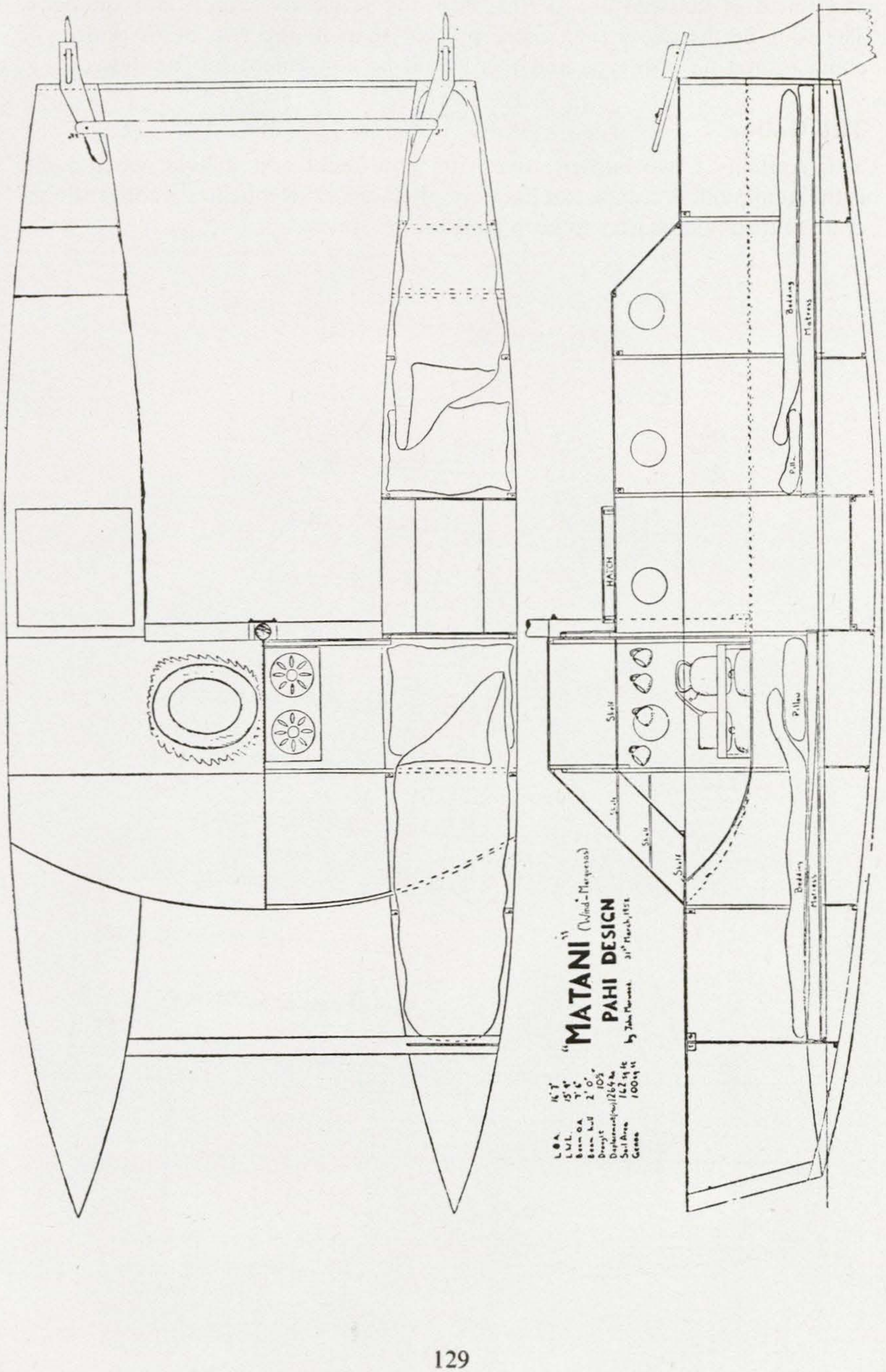
Designer: John Morwood

I started my yachting career at the age of 16 by designing and building a 20 ft four berth cruising canoe only 4 ft in beam. We sailed her for four years and had a lot of fun in her and, every year, three of four of us took a fortnight's cruise. We could not have had a better introduction to sailing.

This cruising catamaran is meant to be similar in concept to my original canoe as the cheapest possible cruising craft for four young men but it would also be suitable for a family man with two children.

The Design

This is basically my *TUAHINE* design but the bow sections are a little fuller above the waterline which gives a curve to the chine forward. One needs this extra room to get at the end of the forward berth and to give a little more reserve buoyancy in a sea. The displacement is double that of the *TUAHINE* design so great speeds cannot be expected but she will not be slow in strong winds and a mast head Genoa will pull her along when the wind is light.The windage of the bridge deck will affect her adversely, too, in a head wind. No centreboard is shown. This is because the extra depth in the water may give enough lateral resistance and the weight should take her from one tack to the other. The full Ackerman linkage on the tiller bar will help here.

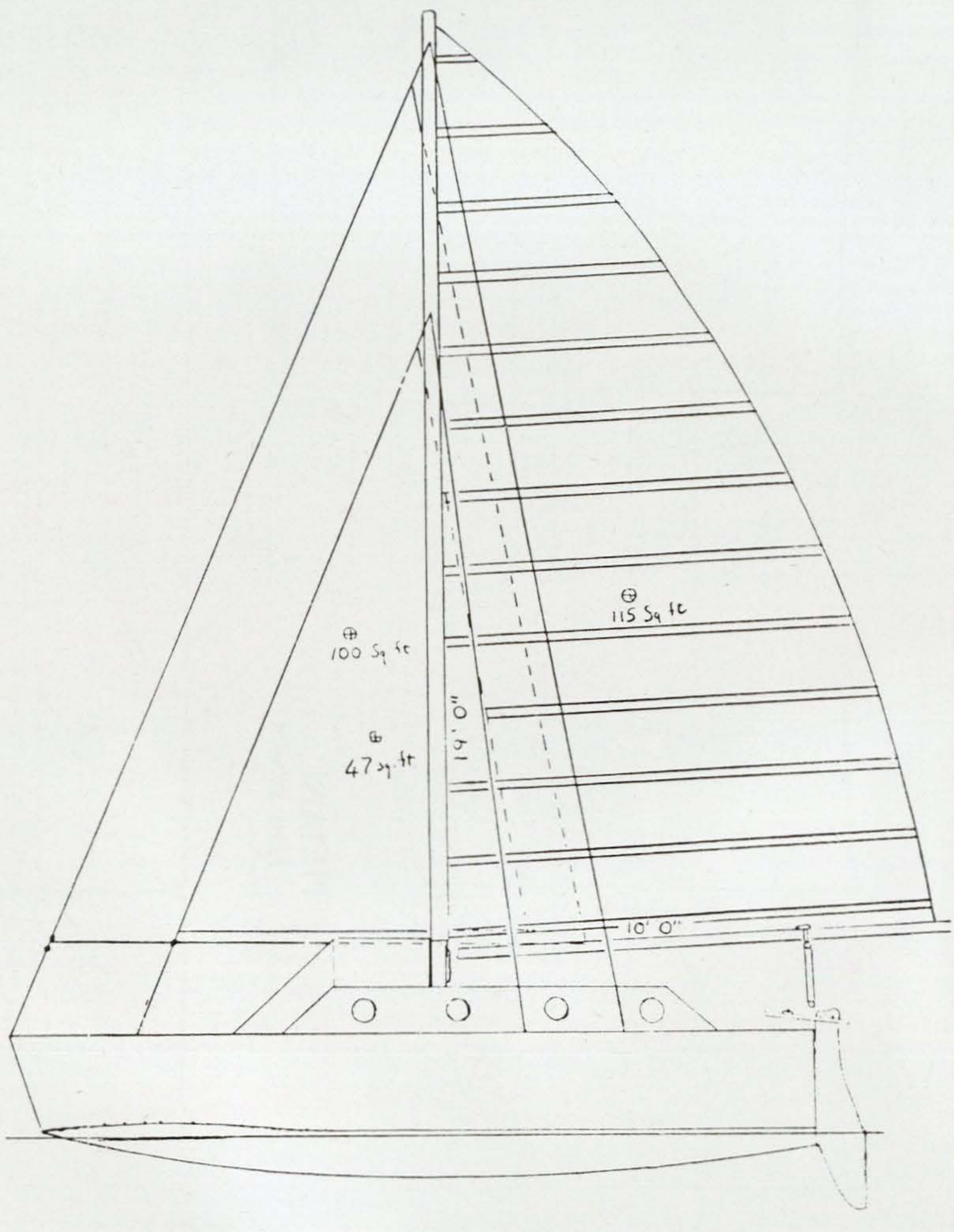

"MATANI" (Wind-Marquesas)
PAHI DESIGN
L.O.A. 16'7"
L.W.L. 15'4"
Beam O.A. 7'6"
Beam hull 2'0"
Draught 10½"
Displacement (lw) 1264 lbs
Sail Area 162 sq ft
Genoa 100 sq ft
HATCH
Shelf
Bedding
Matress
Pillow

Accommodation

This is the minimum possible for four people. Three foot of headroom is provided over the head of the berths with two feet at the feet. A foot well and hatch is between the berths, allowing space to wriggle out on deck. The four berths allow even more privacy than in the two berth cruiser of conventional fin keel type and this would be convenient for families.

The Galley

This contains a two burner stove with plate racks and shelves which again is the minimum. A catamaran does not pitch or roll as much as a conventional craft so it should be easy to keep pans on the stoves.



The Toilet

The catamaran is the one craft which needs no complex toilet. Indeed, the main trouble is to prevent continuous flushing while at sea. To this end, a baffle plate forward of the seat will do what is wanted and can be kept clean by spray action.

The Cockpit

This is large for comfort and to get the weight far aft with strong following winds. The heavy hulls may tend to stick in the water and bury their bows and provision for this must be present. The helmsman can sit either at the extreme stern and steer with the short tiller or, with a tiller extension can move farther forward to the cabin top which is rather far off the floor for sitting on, being about 2 ft high.

Auxiliary

An outboard of very small power would be strong enough to drive this cat along at a reasonable speed. When not in use, it could be stowed in a box at the after end of the cockpit where its stink would not affect the sleeping quarters.

Construction

This is well within the competence of the home boat builder and should be very little more complex than the chine built catamarans.

Summary

MATANI is the smallest conceivable four berth cruiser with adequate comfort and suitable for a small family.

CABINMARAN

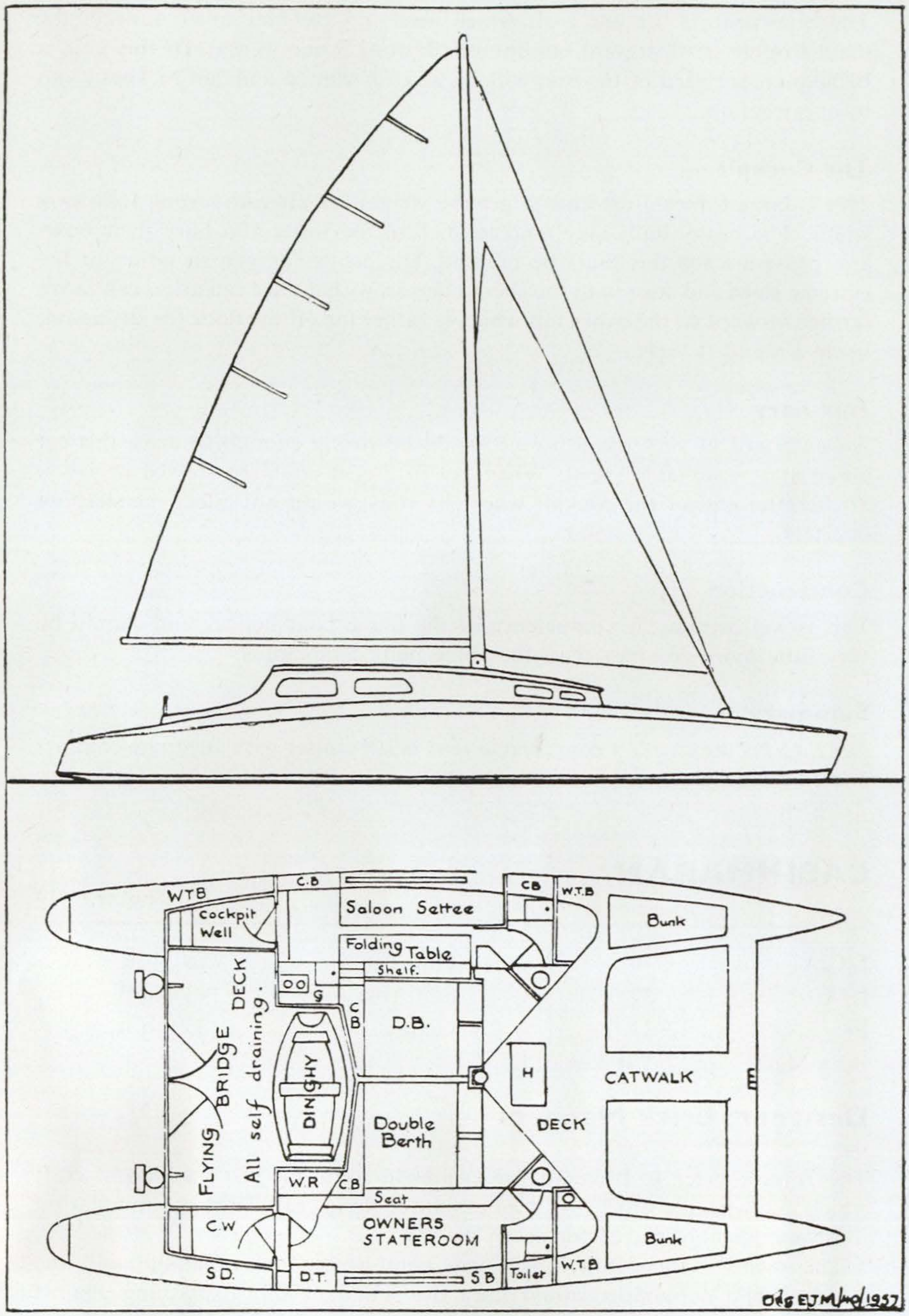
October, 1959

L.O.A.	40 ft	Draught	2 ft 4 in
L.W.L.	37 ft	Sail Area	435 sq ft
Beam, O.A.	21 ft	Genoa	250 sq ft
Beam, hull	5 ft 3 in		

Designer: Erick Manners

This reverse sheer 40 ft catamaran cruiser looks to me just the kind of craft which many people want. She is an elegant looking craft with accommodation most comfortably placed for seven people.

The owner's stateroom looks very comfortable, even palatial and the foredeck and cupboards would keep the sound of spray splashing against the forward end from disturbing the sleepers in the double berths placed athwartships.


WTB
C.B
Saloon Settee
CB
W.T.B
Bunk
Cockpit Well
Folding Table
Shelf.
G
C B
D.B.
FLYING BRIDGE DECK
All self draining.
DINGHY
H
CATWALK
DECK
Double Berth
W.R
CB
Seat
C.W
OWNERS STATEROOM
Bunk
SD.
DT.
S B
Toilet
W.T B

On the port side, there is another double berth and settee in the saloon for a guest family.

Two bunks with washing facilities are in the bows of each hull, which are separated from the main staterooms by watertight bulkheads. These bulkheads are a very sensible precaution in any catamaran as a blow on the bow with even a small piece of driftwood at speed can stave it in. Indeed, I would even go further and suggest flooring the forward compartment with solid expanded polystyrene buoyancy to above the waterline.

The galley is placed at the side of the bridge deck where the cook can be in contact with the other members of the party, potato peelers and others. This is mated on the other side with a chart and navigation room. This would reduce the room for the dinghy somewhat but both chart room and galley could be built out over the dinghy stowage space, if desired.

The foredeck is spacious and would most certainly be netted between the catwalk and the hulls for security in handling the foresails.

Hull Design

No lines or sections are given but from the slight overhang aft which could well be mated with a slight overhang forward it is assumed that it is intended to have fine ends and a relatively full midships section. This is the distribution which will give the greatest light wind speed and still give a good top speed.

The Profile

The deck and cabin top profile are very nice to my eyes and more elegant than the Hawaiian catamarans with their large, bulbous deck houses, even though these give full headroom on the bridge deck.

Summary

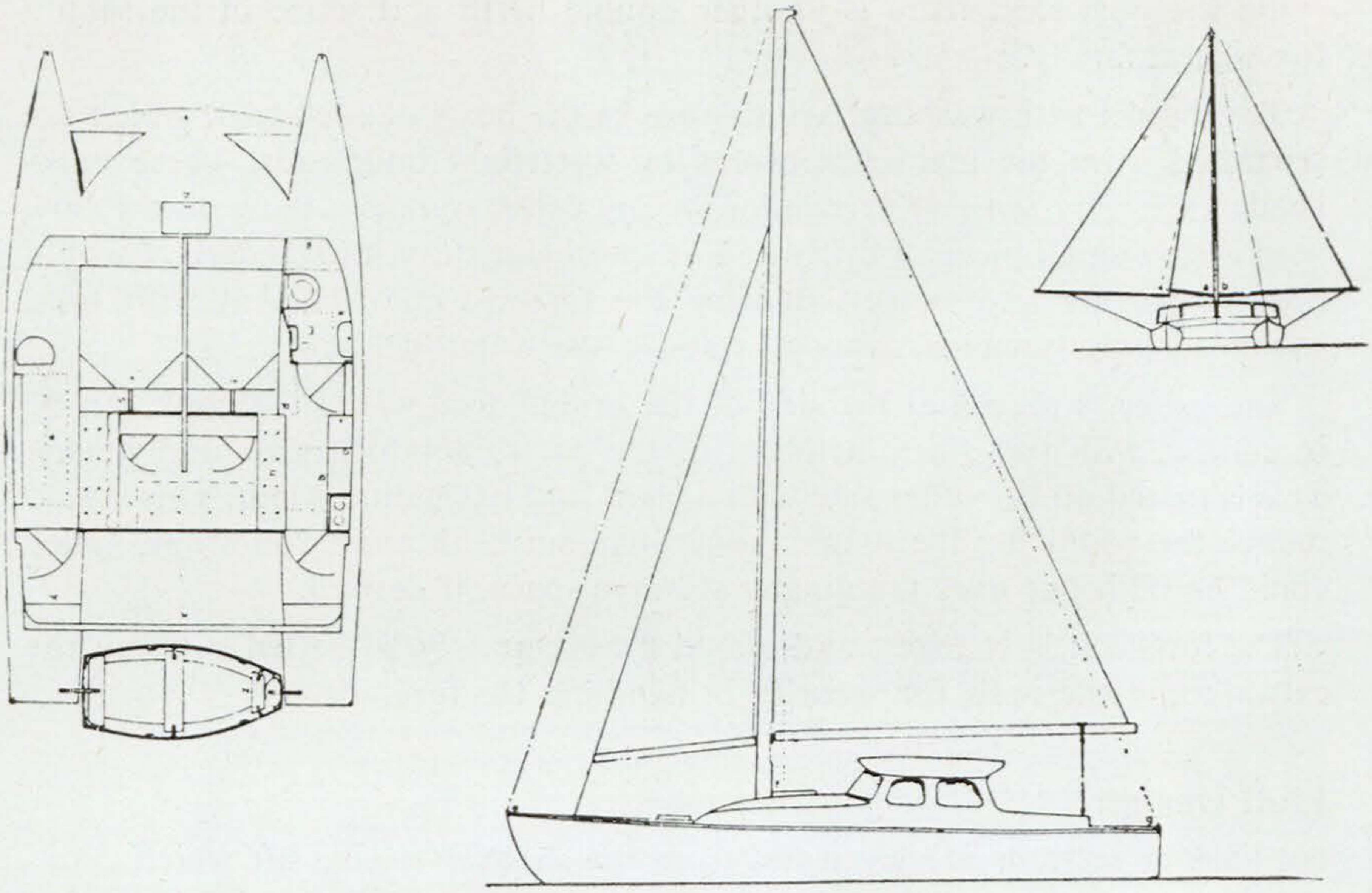
CABINMARAN is a nice looking craft with comfortable accommodation. If lightly constructed, and with a good hull shape, it should have a top speed well above 20 knots and do 10 knots in most ordinary weather.

27 ft. CRUISING CATAMARAN DESIGN

October, 1959

Designer: Erick Manners

This design by Erick Manners seems to have some excellent features and indeed appears to be about the best internal arrangement for the size. Two double berths on either side of the centreboard case forward use this part of the ship to greatest advantage and three single berths in the saloon and one in the port hull give a total sleeping space for eight people. The galley and toilet are in the starboard hull.



The Profile

No lines are given but these are of the usual round bilgeshape of this designer. The profile shows a pleasing shape with a good streamlining of the cabin which is very important on these cruising catamarans.

SHAMROCK

L.O.A.	22 ft 0 in	Sail Area	241 sq ft
L.W.L.	19 ft 3 in	(Main S.L. 144, Genoa 97)	
Beam, O.A.	12 ft 8 in	Displacement	1·3 tons
Draught	1 ft 4 in	Accommodation	4 berth

Designer: Bill O'Brien, A.I.N.A.

Makers: Hawker Siddeley Hamble Ltd.

This attractive hard chine catamaran is designed as a twin hulled motor sailer without a centreboard. Comfort and safety are given priority rather than speed but she will do her 10 to 12 knots in a force 6 wind with no tendency to lift the weather hull. However, all the weights are low down in the hulls and, should she be thrown over in a gale, she should right herself from a mast-horizontal position. The design is a reduction of a 26 ft catamaran which was originally designed for an AYRS member.

Accommodation

There are four berths but two extra can be slept, if necessary. The galley is 7 ft long with standing headroom in each hull. The toilet is a "Baby Minor."

SHAMROCK

Sailing

As in all catamarans, there is virtually no heel and this will be the main attraction of the craft. She tacks smoothly and quickly with the jib let fly in normal keel boat fashion. There is wheel steering coupled to tillers for ease of handling as she will stay on course when set. The absence of centreboard will be a great boon for sailing in shallows and it is one of the features of the hull shapes produced by Bill O'Brien that they have a surprising amount of lateral resistance compared to rounded sections. Drop rudders are used.

Motor

The 18 hp Evinrude gives 8 to 10 knots without undue noise and is easily retractable for sailing.

Photographs: TONY HOOK, SOUTHERN EVENING ECHO, Southampton.

Summary

SHAMROCK is about the right size, has wonderful qualities and no vices. She should be ideal for longshore sailing for a family man. There is a hatch in the bridgedeck floor and a keen angler can fish without even getting out of bed. What more could one want?

BLACK CAT

April, 1961

Designer: Erick Manners

L.O.A.	27 ft 0 in	Draught, O.A.	1 ft 8 in
L.W.L.	25 ft 6 in	Displacement	5,500 lbs
Beam	15 ft 0 in	Sail Area	350 sq ft

This is a handsome-looking catamaran with elegant and useful accommodation for five people. There is 6 ft 3 in of headroom in the hulls, beneath the cabin top but there is an air of spaciousness about the accommodation which is very pleasing. Four watertight bulkheads are fitted and a self draining cockpit. A dinghy can be carried in davits.

Hull Design

The hulls are of double skin moulded plywood construction. They are of a rather deep, fine section forward in order to give an easy sea motion and there is slight asymmetry. The after body comes up to a transom and the after sections are shallower than those forward to reduce wetted surface.

Performance

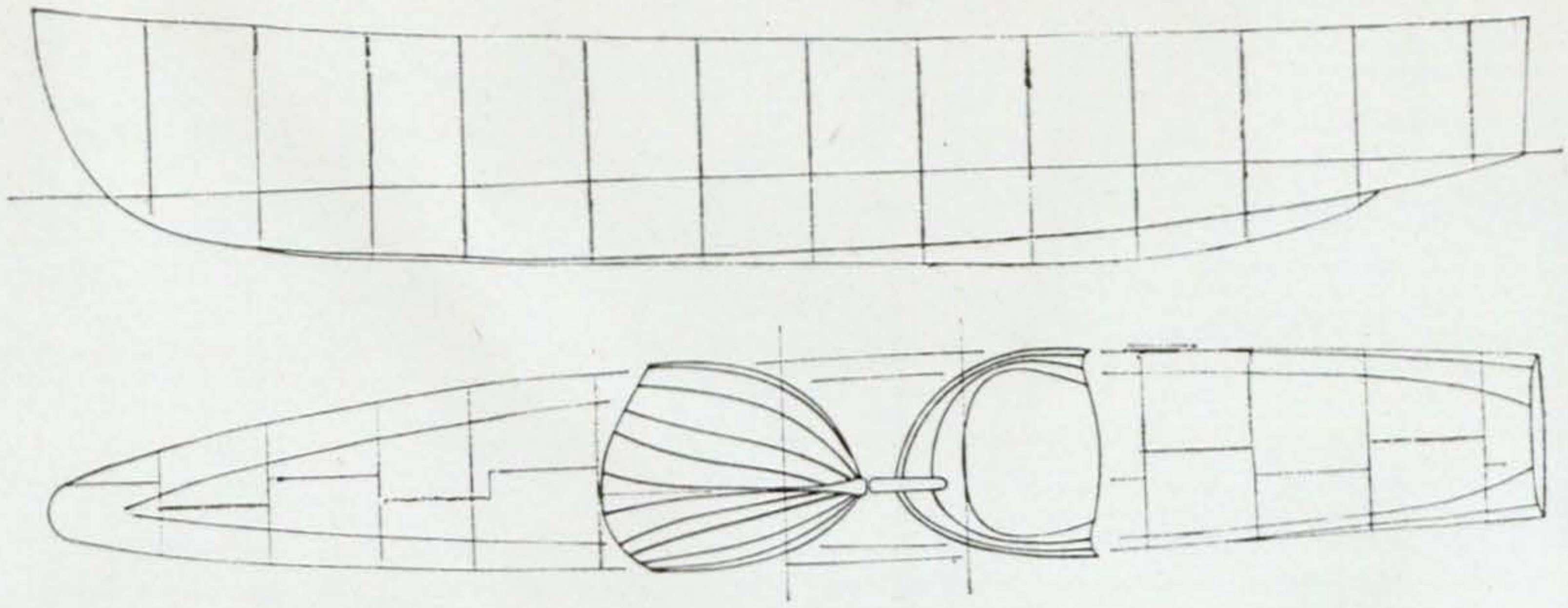
Designed in 1957 a *BLACK CAT* appeared for the first time at the recent London Boat Show. During sailing trials speeds up to 9 knots were obtained in a Force 3 breeze under sail. Under power an 18 hp motor at $\frac{3}{4}$ throttle gave a speed of 7 knots. A course of within four points to the wind was obtained when close hauled, which must be regarded as satisfactory for a catamaran without the nuisance of centreboards.

BLACK CAT

The Lines

These show a hull which is on the shallow side which experience seems to show is faster than the deeper hulls. But, at the same time, the curves of the sections are deepest at the keel which gives the appearance of a deeper hull than is actually the case. The entrance is a shade fuller than with the racing catamarans which is reasonable owing to the lower relative speeds at which a cruising catamaran may be expected to travel and the run ends at a wide flat transom—a feature again of the fastest craft.

There is slight asymmetry which should not slow her to any appreciable



The Lines

extent in light winds while giving some extra windward force when the craft is heeled slightly. The amount of asymmetry shown here (and its execution) appears to be very reasonable and capable of using the feature to its best advantage.

Summary

BLACK CAT is an elegant standard class catamaran with more accommodation and speed than a single hulled craft of similar overall length. In a lumpy sea with white horses, motion both in pitch and roll was easy and the course to windward was excellent.

CHAPTER XIII

ASYMMETRY

April, 1961

by Rudy Choy

It may be reasonably surmised that the rounded-section symmetrical catamaran may be better than the asymmetric catamaran to windward *in light winds only*. This is the only possible valid conclusion at this time. Since a cruising catamaran must perform well on all courses under all sailable weather conditions, the record substantiates that the asymmetric catamaran has the edge at this time over the symmetric-hulled catamaran in California. Both reaching and running, *AIKANE* has decisively defeated *DREAMER*. Also, until there is a race hard to windward in winds above 15 knots between these two catamarans, it is still a guess which one will be the victor. As I said earlier, at higher wind velocities the asymmetric design becomes efficient.

Also, our asymmetric hulls are not as deep as you probably believe. If they are deeper than the symmetrical-section, it is a matter of scant inches. I personally will accept the admitted design penalty of increased wetted surface area in order to gain the advantages of lower transverse wave-making at high speeds, softer riding in open ocean, less yawing, and a much drier ride. All these are qualities which a cruising catamaran should possess.

It has appeared to me that in rougher water the symmetrical hulls developed thus far are capable of bigger wave making and eddy creation than the asymmetric type. They are also wetter and rougher to ride.

It must be realized, in all fairness, however, that *DREAMER* does not have the complement of sails or equipment that *AIKANE* has available. It is also possible that she may be heavier than *AIKANE*. These factors complicate the issue of asymmetric hull versus symmetric hull.

At the present time in the U.S., the asymmetric catamaran *alone* has a history of successful long-distance ocean passages under very rigorous ocean-racing conditions. In the latest Trans-Pacific crossing, for instance, 3 were partially or totally dismasted, and more than a dozen conventional boats blew out all spinnakers (several lost up to 5 spinnakers) lost both spinnaker poles, cross trees were broken, and deck gear was shattered.

To date, the symmetrical-section catamaran has not demonstrated *by performance* either seaworthiness or sustained high speed under tough ocean-racing (and not cruising) conditions. We anticipate that one will come along soon which will make the long leap from theory to proven performance.

I hasten to add here that your day-racing symmetrical catamarans have certainly proven to be seaworthy and wonderful craft in the rough waters of the North Sea and English Channel. Therefore, their design evolution into sturdy and swift cruising catamarans appears quite certain. The questions that must be solved in design, however, are whether the much greater weight broader underwater surfaces, large transom sterns, and greatly increased stress loads upon hulls, spars and rigging will inhibit the achievement of superior cruising catamarans equivalent in technical excellence to such day racers as the *Shearwater*.

In this regard, one of the more important problems faced by all catamarans in general is to maintain high speed in up to 45-knot wind and sea conditions while off the wind. We have found that achieving over 20-knot speeds in the open ocean is easy, but that it is difficult to maintain such speeds for any appreciable distances. For instance, the best *average speed* that *AIKANE* has done for a measured distance of 30 nautical miles is 21 knots. To hope to maintain this speed for 60, 120 or 240 nautical miles would necessitate unusually steady winds and long seas from crest to crest. On this latter trip from San Pedro to Honolulu, *AIKANE* averaged slightly better than 10 knots for the 2,400-mile actual distance travelled.

We think it is easier to attain a higher average speed with a larger catamaran since size—up to a point—means more impunity to wind and sea conditions.

Peak speed is a very different matter from average speed. *AIKANE's* best peak speed thus far has been over 28 mph. *WAIKIKI SURF* achieved a peak speed of over 30 mph in 1955 in a roaring squall. All these speeds were registered in the open ocean under formidable wind and sea conditions.

The longer the course—in increments of 5 nautical miles—the more difficult it is to achieve sustained high speed e.g. It is not difficult to achieve 20 knots over a measured mile. It becomes difficult to sustain this over 5 nautical miles—and the difficulty becomes greater and greater with each additional mile.

If anyone definitely would like to prove that his catamaran or what have you is the fastest thing around, he will succeed in impressing us only if he does so over a measured course timed by a stop watch. Any other method is unreliable. I believe it would be most interesting if some group in England would establish measured 1, 5, 10, 25 and 100 nautical mile courses to be used for speed trials. Should one of your catamarans achieve a higher average speed than anything we have attained over here thus far, this would be a stimulating challenge and great fun for all hands.

SYMMETRICAL AND ASYMMETRICAL HULLS

April, 1961

by Hugo Myers

Those of us who take perverse pleasure in the pains of sailing catamaran design have agonized over the symmetrical—asymmetrical arguments almost on a continuous basis. Since the costs and problems in boats go up as the cube of the length, the intensity of my suffering during the design and construction of the 43 ft *DREAMER* in 1955-56 may be appreciated. Six years of study, sailing, design and construction, and four years of continuous ownership of a large catamaran have pounded some theory and experience into me, and I'm happy to have this opportunity to pass it on to the Amateur Yacht Research Society.

Fig. 1 illustrates the type of hulls to be considered. The symmetrical hull is representative of our 33 and 44 ft designs, now being built in the Santa

$$C_{W_1} = \pi R \qquad C_{W^2} = \sqrt{2} R \left[\frac{\pi}{2} + 1\right]$$

$$C_{W^2} \doteq 1{\cdot}16\, C_{W_1}$$

Thus, the wetted surface area of the asymmetrical shape is about 16 per cent greater. Also, the water line beam of the rounded hull, being $\sqrt{2}$ greater, will result in the symmetrical hull planing more readily, or at least getting more dynamic lift. Therefore, intuitively, one would expect that the symmetrical hull would be faster at low and high speeds—due primarily to less wetted surface area, and secondarily to greater dynamic lift.

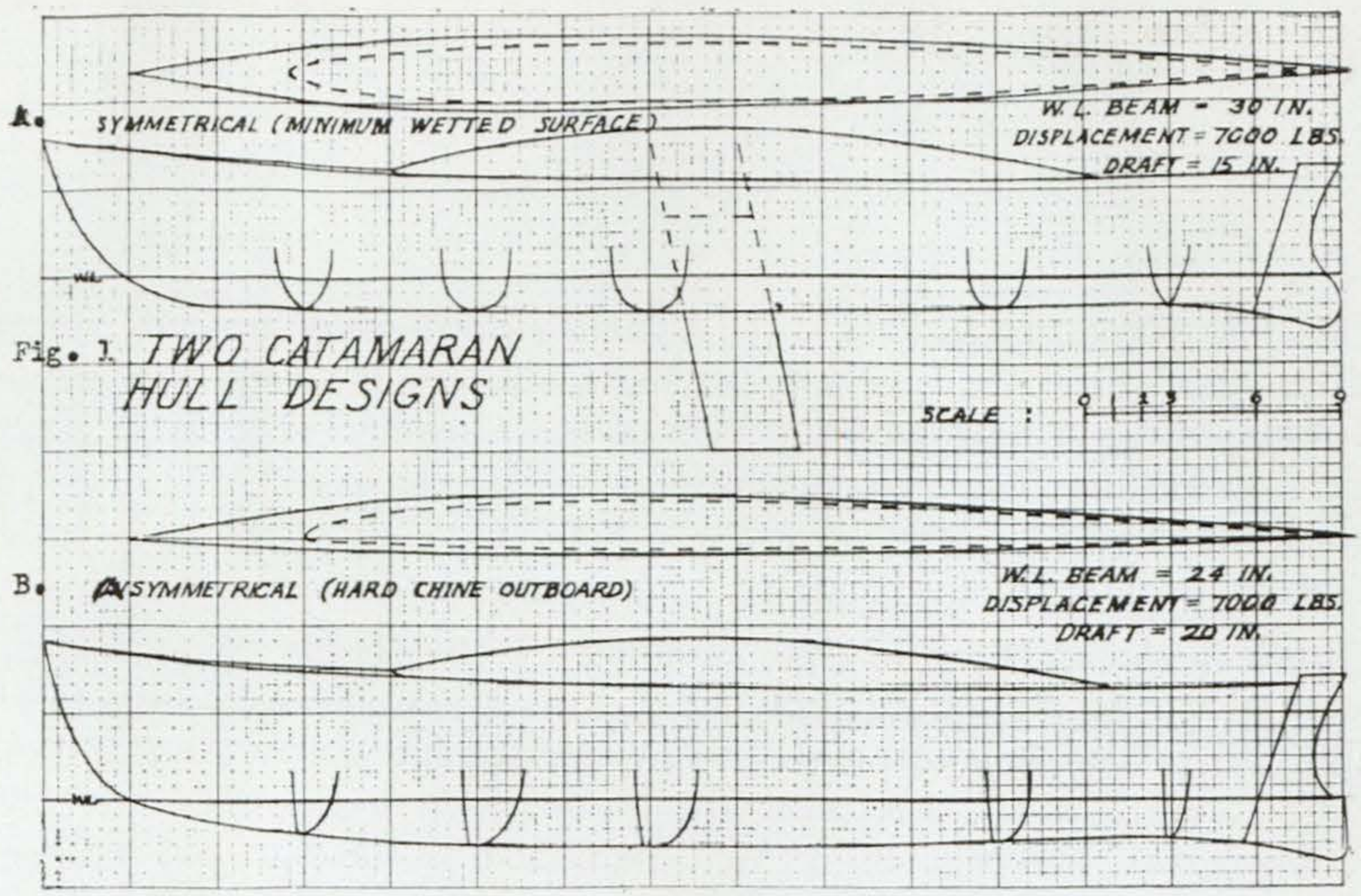
This in fact seems to be the case, as shown Fig. 3. These are approximate theoretical curves for sixteen foot hulls of the types shown in Fig. 1. The analysis is based on an article by John V. Wehausen entitled "Wave Resistance of Thin Ships," which was presented at the 1956 Symposium on Naval Hydrodynamics. The proceedings were published by the National Academy of Sciences in Washington D.C. This theory was modified slightly as the result of conversations with Dr. Alex Silverleaf, Associate Director of the National Physical (hydrodynamics) Laboratory, London, who is visiting the California Institute of Technology.

Fig. 3 illustrates the fact that at low speeds (less than $1{\cdot}5\sqrt{WL}$) and at high speeds (greater than $3\sqrt{WL}$) the symmetrical hull has about 15 per cent less drag due to the reduced wetted surface area. However, in the speed range from $1{\cdot}5\sqrt{WL}$ to $3\sqrt{WL}$ the increased wave resistance of the fuller hull compensates for the reduced frictional resistance, and in this range the total drags of the two hull types are approximately equal.

The historical facts bear out these theoretical results in an interesting manner. The Hawaiian (asymmetrical) approach is exemplified by hull shapes approximately similar to those in Fig. 1B. These early boats were designed primarily by Woody Brown, a champion glider pilot, and this analysis indicates that his approach was almost exactly correct for their purposes. For example, the Waikiki Beach cats were designed for commercial operation in strong, steady winds. These boats reach back and forth at speeds averaging ten to fifteen knots.

A glance at Fig. 3 shows that a 36 ft WL hull reaches her $1{\cdot}5\sqrt{WL}$ "hull speed" at 9 knots. *AIKANE* averaged about 10 knots in her Trans-Pacific races. Therefore, these boats could do little better reaching and running if they had the most optimum conceivable hull shapes.

However, for small racing catamarans, such as *Tiger* and *Cougar Cats*, the top speeds are over $5\sqrt{WL}$, and at these speeds the asymmetrical hulls cannot compete. This is amply demonstrated here in Southern California by the 18 ft 9 in *PACIFIC CAT* (symmetrical, rounded underwater section), which is faster than the larger asymmetrical hulls (with higher ratings) in good winds and protected waters. On the other hand, the larger asymmetrical hulls can take the *PACIFIC CAT* under other conditions, such as rough water.



Monica area and Hong Kong. By way of explanation, it should be noted that neither of these shapes is absolutely optimum from the purely drag point of view. There is too much wetted surface area towards the sterns, the rudders are not optimumly shaped, and the hull fullness should probably be further aft. In addition, Fig. 1B does not represent the latest practice in asymmetrical hull development. The evolution has been toward fuller hulls with small dagger boards.

However, these hulls are approximate sketches of good practice in large cat design. The skeg effect gives good rudder support, resists the tendency to broach in following seas, helps to keep the centre of lateral resistance aft for good helm characteristics, and reduces the damage in the event of striking submerged objects or reefs. The fullness forward of the mid section supports weight and storage forward and tends to reduce lee bow burying. There are many variants; more rocker aft, for better manoeuvreability, completely underwater rudders with through-hull rudder posts, and fuller sterns.

To get the analysis off the ground, the major symmetrical cross sections can be approximated by a semi-circle, as in Fig. 2A. The asymmetrical cross sections can be represented by a quarter-circle, as in Fig. 2B, which must then have a radius $\sqrt{2}$ larger in order to carry the same load.

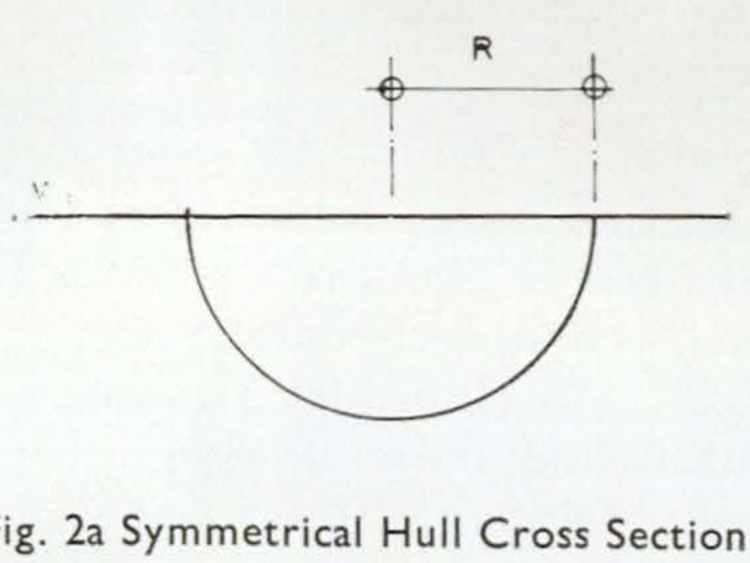


Fig. 2a Symmetrical Hull Cross Section

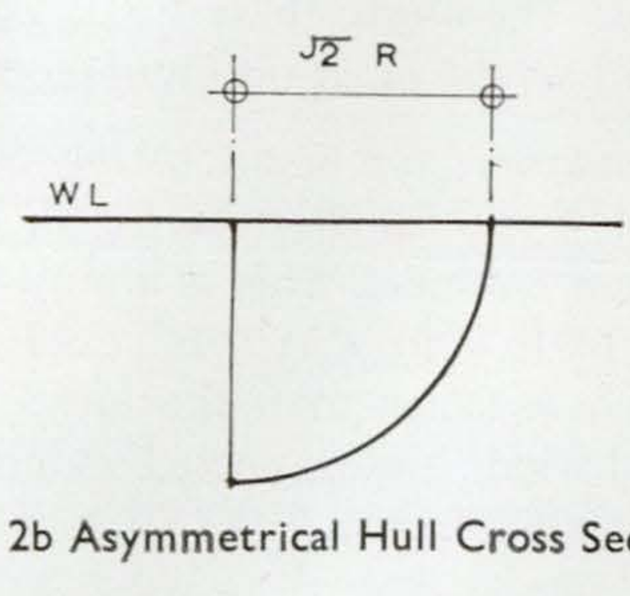


Fig. 2b Asymmetrical Hull Cross Section

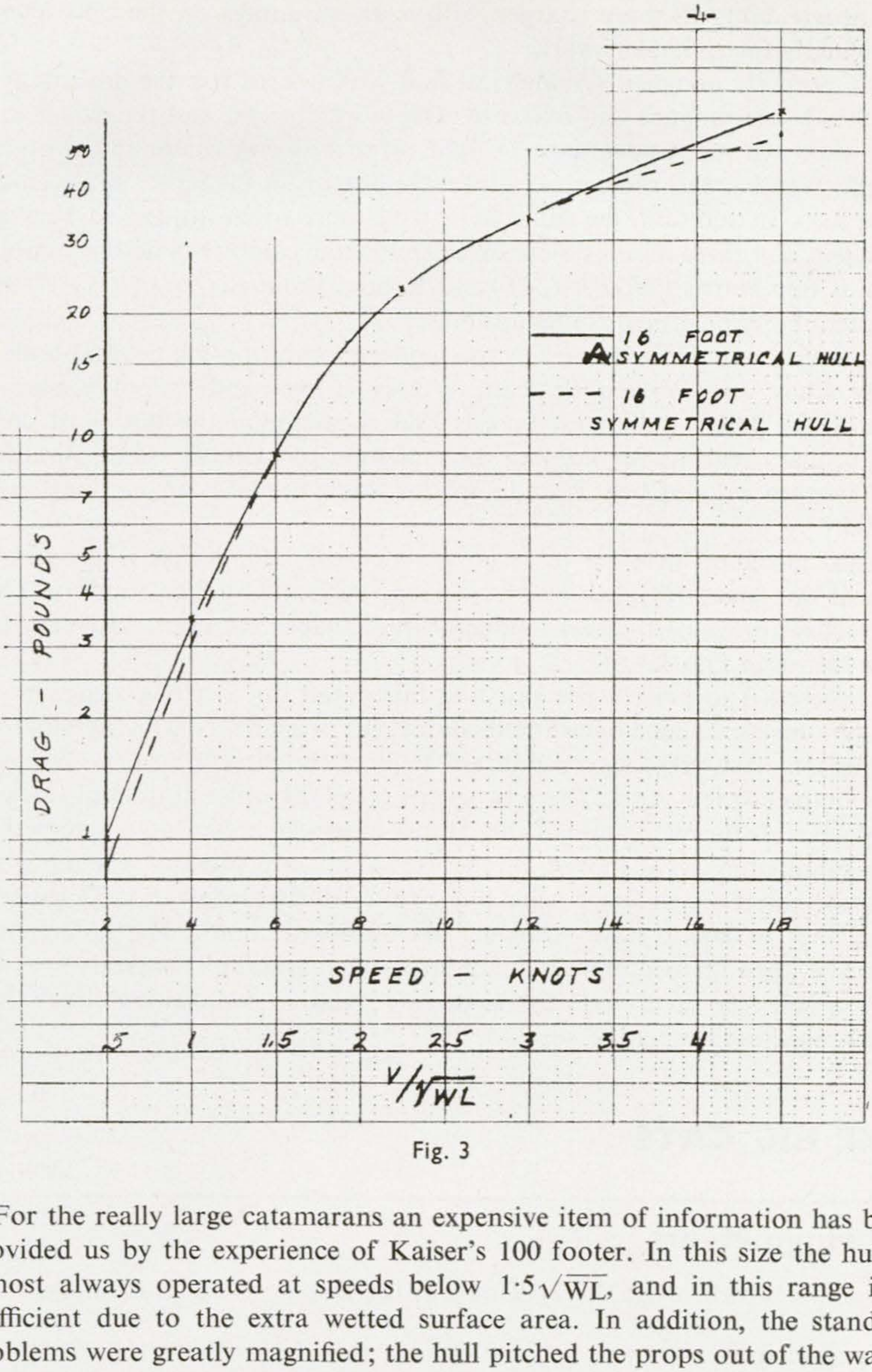


Fig. 3

For the really large catamarans an expensive item of information has been provided us by the experience of Kaiser's 100 footer. In this size the hull is almost always operated at speeds below $1{\cdot}5\sqrt{WL}$, and in this range it is inefficient due to the extra wetted surface area. In addition, the standard problems were greatly magnified; the hull pitched the props out of the water, made too much leeway, and was unmanoeuvrable.

To summarize the results of our theory and experience to date, the asymmetrical hull is probably adequate in sizes from 30 to 60 ft, particularly for reaching, running and cruising. The proponents consider it no more trouble to backwind the jib on every tack than to adjust the boards on every course, and they have saved themselves all the maintenance problems of boards and trunks—in the earlier versions. In addition, they claim that the very lack of manoeuvreability they are charged with is an advantage on the open ocean, particularly for spinnaker work.

The properly designed symmetrical hull with boards has the advantage of windward performance and manoeuvrability in all sizes, and the small sizes have shown a speed advantage in light or very strong winds and protected waters. Whether this theoretical advantage obtains in the larger sizes remains to be seen. In addition, the fuller hulls have more room inside and bury and pitch less. For these reasons most successful racing catamaran designers today, such as Bob Harris (*TIGER CAT*) and Roland Prout (*COUGAR CAT*) have adopted the symmetrical configuration.

However, as mentioned earlier, the modern trend in asymmetrical hulls by Rudy Choy and Warren Seaman, Woody Brown and Alfred Kumali is toward the fuller hulls with boards, but maintaining the outboard chine. The primary reasons for keeping the chine are to maintain some windward performance without boards and superior tracking ability in the long ocean races.

Also, the good practice in large symmetrical hull design is progressing toward fine exits, for reasons of tracking, trim and rudder support. Thus, the relative drags of the two "modern" hull shapes are even closer together than shown in Fig. 3.

I have tried to present the situation fairly, but for a strong argument for the asymmetrical shape one should contact the proponents. The asymmetrical enthusiasts have taken two significant steps in the direction of the opposing view in the last few years. These two steps are (1) beamier hulls, and (2) small dagger boards for racing. Meanwhile, those of us who prefer large, symmetrical hull catamarans have moved in the Hawaiian direction by designing fine exits for better rough water behaviour. Thus, all that is left of the arguments is whether or not to have relatively flat outboard chines. The difference in speed between the two more modern large catamaran hull shapes is probably only a few per cent, and similarly, the relative manoeuvrabilities have approached each other.

THE BIG CATS

April, 1961

by Hugo Myers

An article which originally appeared in the January 1960 MOTOR BOATING.

Introduction

Until recently, most experienced yachtsmen who had any contact at all with catamarans concluded that they were basically ungainly and capsizable, that they had awkward accommodations, poor windward ability, unreliable structural integrity and doubtful manoeuvrability—and that for all these reasons they were historically unsuccessful. Sailing cats have richly earned this unfortunate reputation over the last few hundred years because they were usually designed by enthusiastic amateurs who, of necessity, had little experience, poor materials, and a limited understanding of fluid dynamic theory.

In the last few years, however, both small and large catamarans have achieved notable successes. In 1956 in England one of Roland Prout's 18-ft cats beat all the racing class types by a speed margin of 25 per cent in a rough, windward cross-Channel race, and this success sparked the development of the *Shearwater III* series.

During the next two years the 46 ft *AIKANE* broke the course record in the 140-mile, 300-boat Newport, California to Ensenada, Mexico race and beat the fleet twice in the 2,225-mile, 40-boat Los Angeles to Honolulu race. In the 1959 Florida "One-of-a-Kind" series Bill Cox's 17 ft *TIGER CAT* and Prout's 18-ft *COUGAR CAT* were first and second out of all the small boat racing classes. Thus experienced designers, with improved hull and sail plans and modern materials have been able to develop some outstanding catamarans.

Here in southern California we have the unique opportunity to compare three seasoned cats in the 43- to 46-ft class which have been sailed extensively during the last three years, and which have significantly different hull shapes, accommodations, and sail plans. These are the 44-ft *ANUINUI*, designed and owned by Daniel M. Brown in San Diego; the 46-ft *AIKANE*, designed by Rudy Choy and owned by Ken Murphy of Los Angeles, and the 43-ft *DREAMER* in Santa Monica, designed and partly owned by myself.

ANUINUI

Dan Brown is an oceanographer with the Scripps Institute in La Jolla, California, and is the contented skipper of *ANUINUI*. Dan and his wife and one-year-old son live aboard at the Silvergate Yacht Club in San Diego.

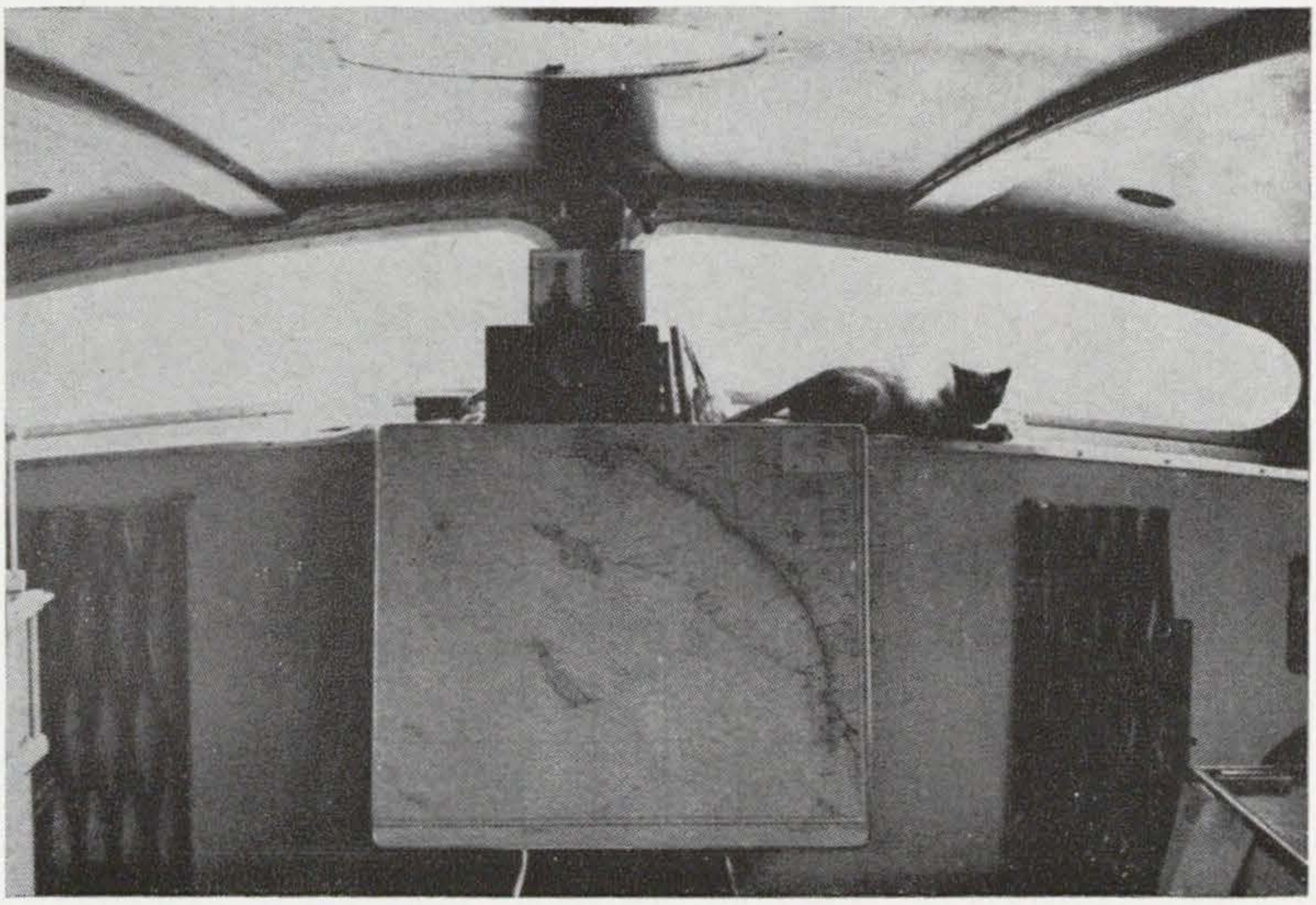


Fig. 1. Forward view of *ANUINUI's* cabin. Head is to port, galley to starboard. Cat lives aboard

Anuinui is the Hawaiian word for rainbow, so named because of her colourful sails. On close inspection she impressed me as being unusually handsome, seaworthy, and comfortable. From the sailing point of view she is distinguished by her conventional keel hull design and ketch rig.

Naturally, *ANUINUI* is best described in the owner-designer's own words: ". . . My boat was the upshot of experience gained from my earlier cat, the *LEAR CAT* which I converted into a cruising cat and first experimented with divided rig and inboard power.

"I was after three things when I had *ANUINUI* built, and the boat has more than lived up to my expectations. These were:

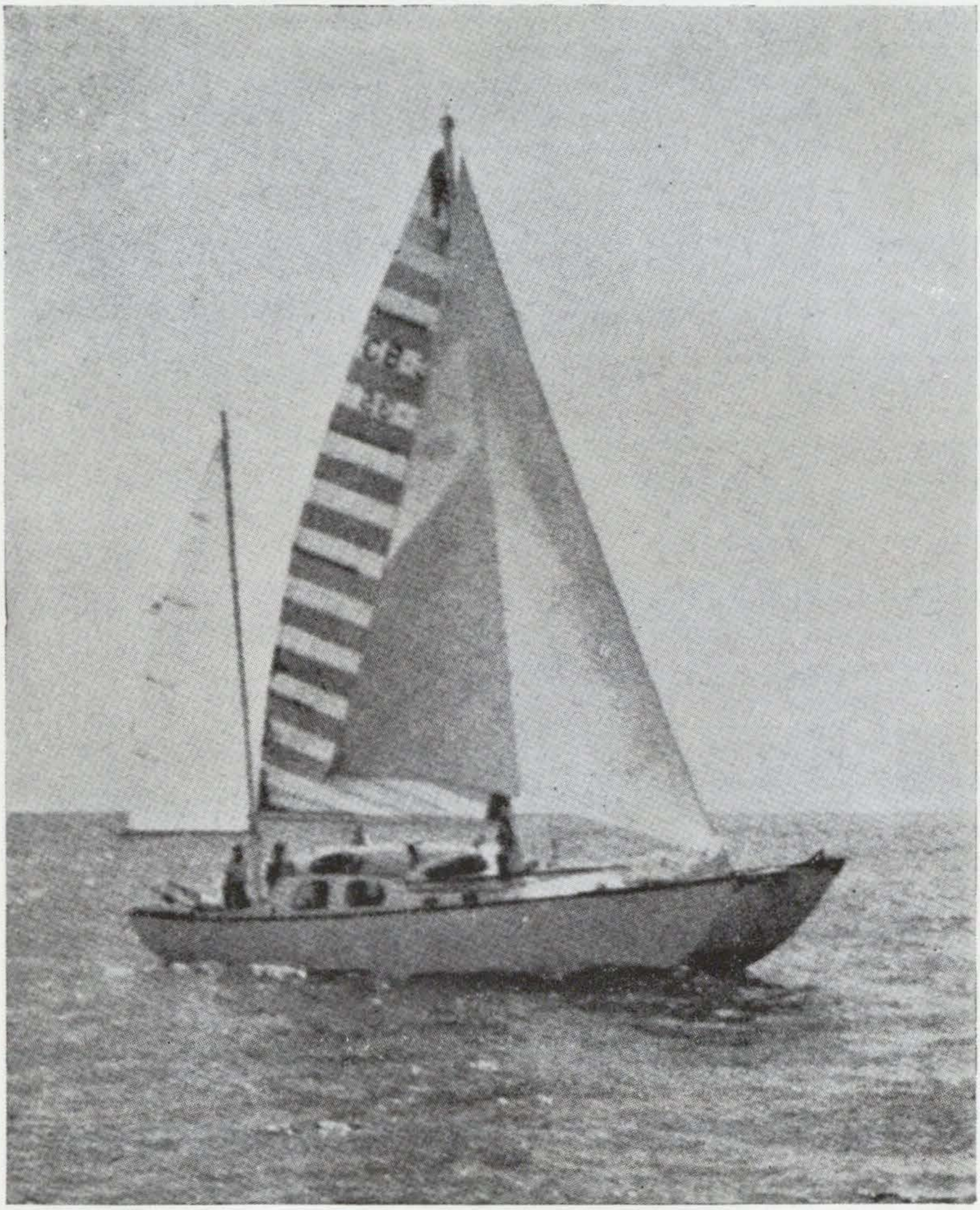


Fig. 2. *ANUINUI's* colourful striped sail inspired her name, Hawaiian for "rainbow." She has a short rig with sails Brown can handle himself in any weather. Her waterline is 32 ft

1 Speed—not racing cat speed, but at least the speed of a conventional ocean racer of the same size. The boat's performance has consistently been that of a PCC or 8 meter, but faster in heavy going.

2 Single handed sailing ability. This meant a short rig with sails I could handle by myself in *any* weather. Obviously a short divided rig is not efficient for racing, but by going to a cat I can have regular racing-boat speed with regular cruising-boat sail area. Along with easy handling was the necessity that the boat be manoeuvrable without having to back sails every time you have to tack. I have this too and have to back sails only under fluky light air conditions when I have little steerage way, a condition that plagues all sailboats sooner or later.

3 Room. I wanted roomy comfort and the necessary hull buoyancy to carry the weight that a live-aboard boat would have. Thus, to keep the boat within an economical and handy size, the hulls would have to be much fuller than a racing cat. Therefore I have a 32-ft water line length with a 4-ft water line beam and a $3\frac{1}{2}$-ft draft.

"These were the main objectives—speed, room and ease of handling—an impossible combination to achieve in a single hulled boat to the degree that *I* wanted these features. There were also other things that were necessary for a suitable cruising cat, such as reliable inboard power for auxiliary use and for supplying the lighting system. My Atomic 4 does the job nicely, giving me 8 knots with my cruising propeller and 6 knots with my folding racing propeller.

"I wanted the boat to look like a boat, and to that end I wanted the overhanging ends. The $\frac{7}{8}$-in strip planked hulls make for a low centre of gravity, and the wine glass section shifts the centre of buoyancy enough so that I can

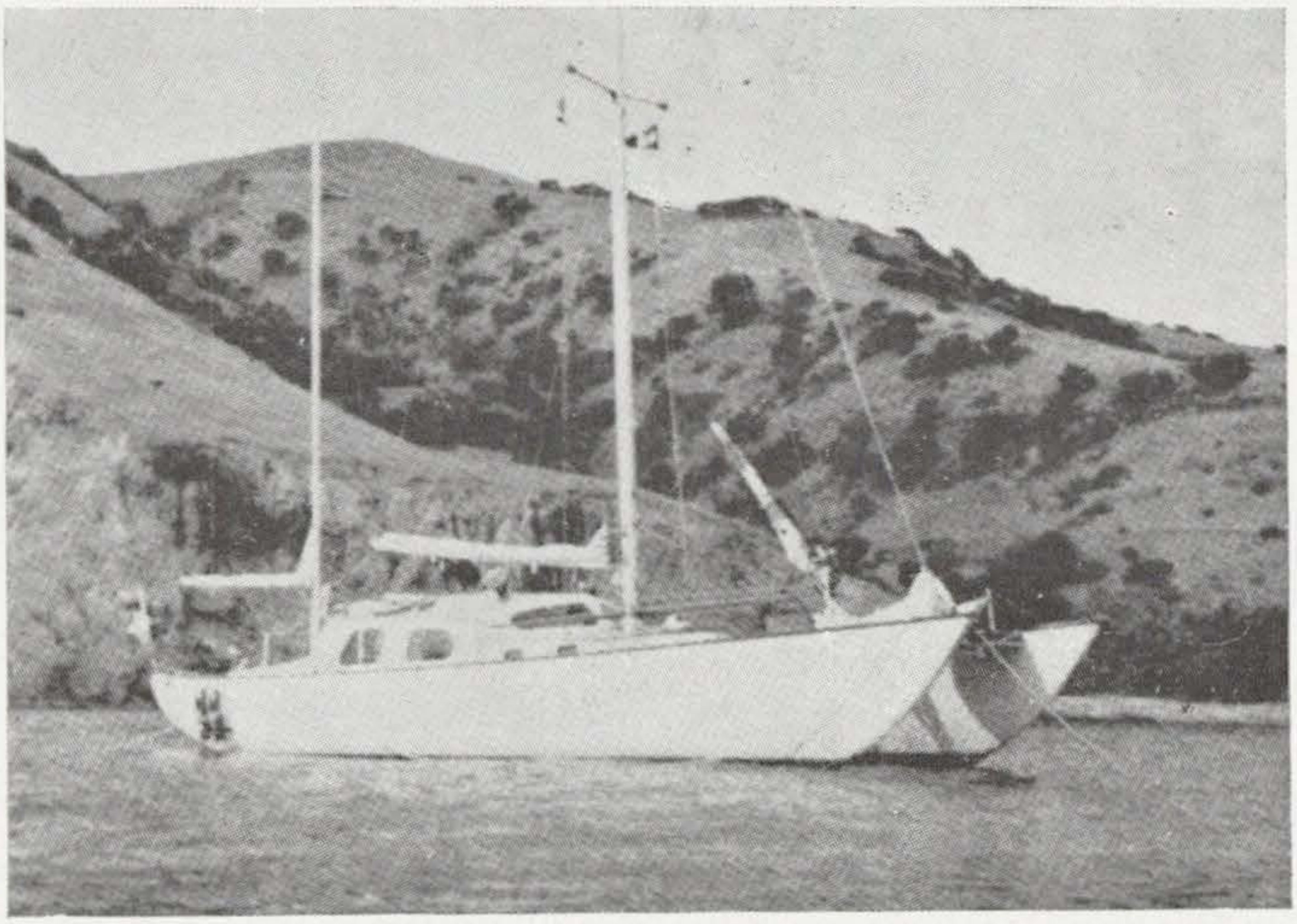


Fig. 3. *ANUINUI* anchored in Emerald Bay, Catalina. "I wanted the boat to look like a boat," her owner-designer, Dan Brown said, "and to that end I wanted the overhanging ends."

come back up from a flat out knock down. I am not non-capsizable, but when I can right myself from a point when the mast hits the water that's good enough for all practical purposes. The heavier hull protects me from temperature changes because of its thickness. The heavier hull also makes the boat much quieter inside and the overall weight eliminates the perpetual bouncing of the light racing cat when anchored in exposed coves . . ."

ANUINUI has a relatively conventional cockpit. The view forward is achieved through the wide cabin windows, shown in Fig. 1. A bunk and passageway to the head is directly to port, and there are settee berths just below the picture. The galley, complete with gas refrigerator and all the necessities for year around living aboard is directly to starboard. The dining-navigation table is folded against the forward bulkhead, and that's a real live cat living aboard this gracious catamaran!

The photographs of *ANUINUI* (Fig. 2 and 3) illustrate how successful Dan has been in achieving a "boat that looks like a boat."

AIKANE

Whereas *ANUINUI* was designed for permanent living aboard, *AIKANE* (Fig. 4 and 5) was designed to be an ocean racing machine. She has a relatively

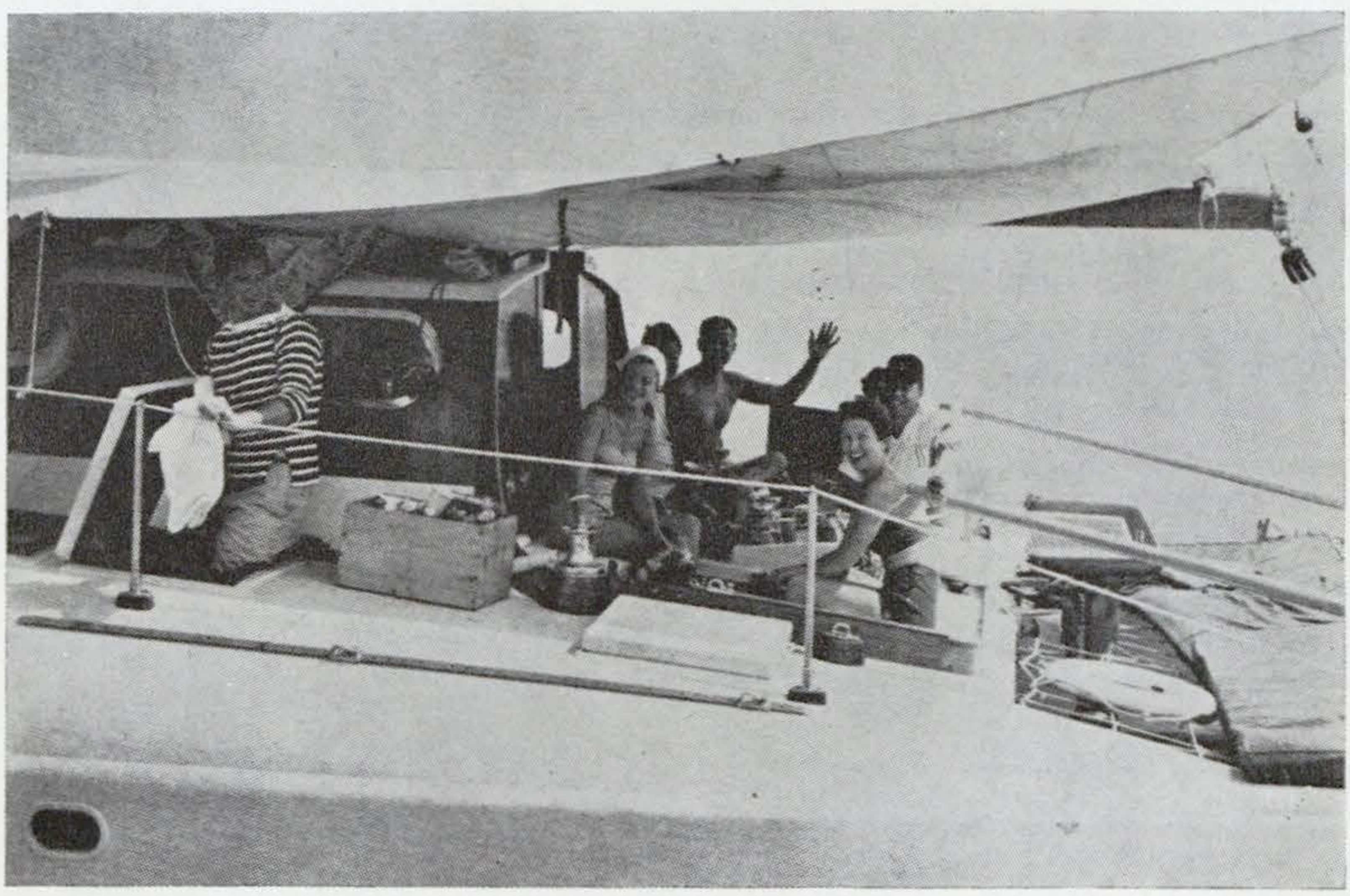


Fig. 4. Luau aboard *AIKANE*. She has a 54 ft mast, with roller reefing, and carries a 2025 sq ft spinnaker

narrow deck house so that the big genoa can be sheeted in flat, and the lovely curves of the deck serve the functions of 7-ft headroom in the hulls, reduced windage, and beauty. *AIKANE's* hulls have about 6 ft of freeboard at the bows.

Since Rudy and I have both written articles on *AIKANE* (MOTOR BOATING, January, 1958) I am limiting myself here to only a few shots taken at Parson's Cove, Catalina recently. Fig. 5, with the boom cover up and sail bag hanging

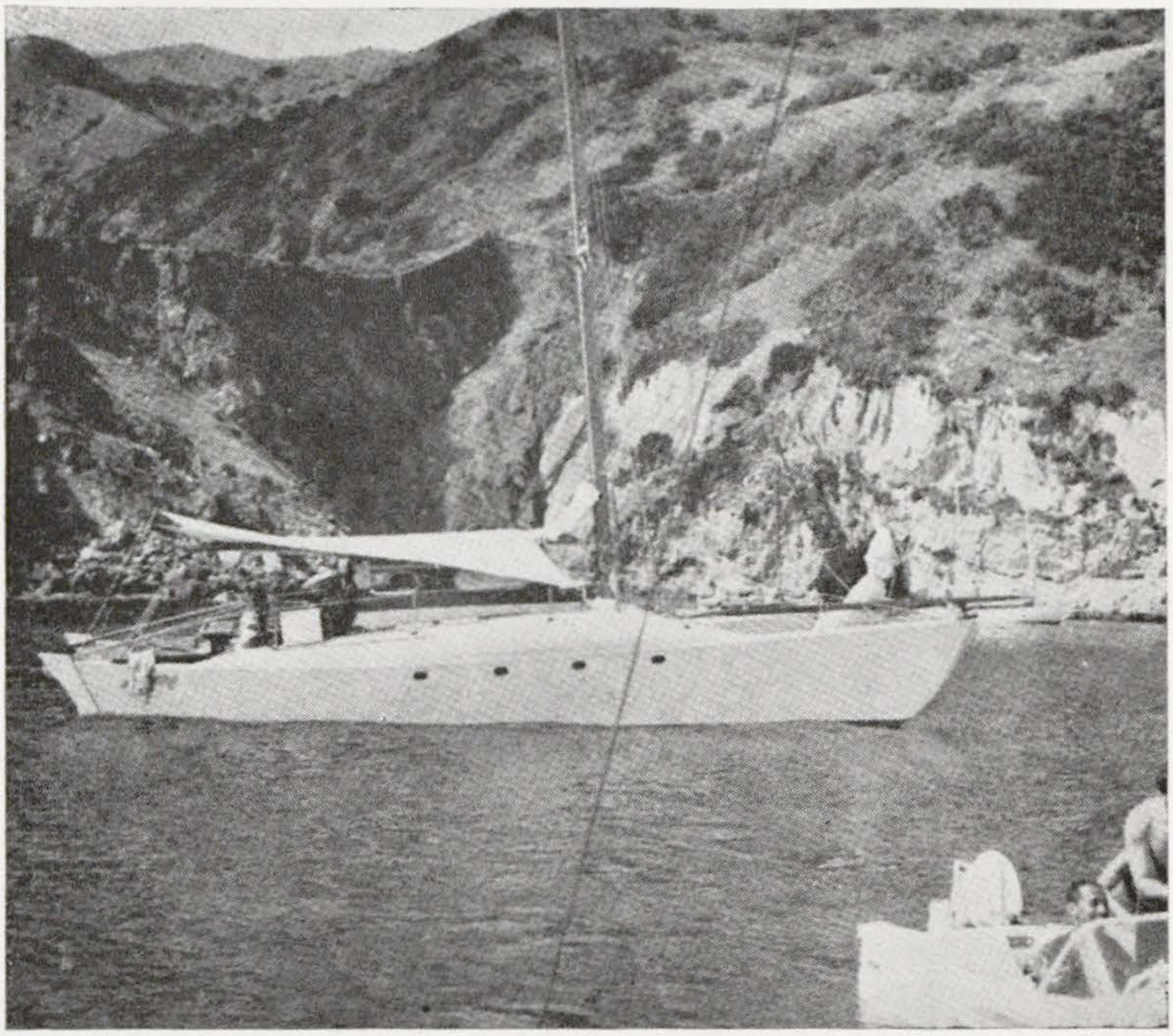


Fig. 5. *AIKANE* has extremely sharp and graceful hull lines, fuller in the forward sections in order to reduce the catamaran tendency to bury the slim bows. Hulls are flat outboard, curved inboard

over the life line dosen't really do her justice, but *AIKANE* is the world's most beautiful catamaran. I feel qualified to judge because of my worldwide contacts through foreign magazines, correspondence and some travel. Her crew reported that the sail bag couldn't be removed because someone was in it.

Fig. 4 shows the cockpit arrangements with Ken Murphy (striped shirt) and his lovely wife Joan (white head scarf) entertaining aboard. Rudy Choy is beside Joan and partially hidden by her.

DREAMER

The third largest active cat in southern California is the 43 ft *DREAMER* (Figs. 6, 7, 8). Her special virtues are stability, deck area, and speed to windward. Her stability results mostly from her 18 ft beam and her flared symmetrical hulls which give her great reserve buoyancy and carrying capacity.

Over the Labor Day weekend at Parson's Cove, Catalina, *DREAMER* carried, fed and slept 14 people for three days. She also carried two dinghys and towed a 16-ft runabout. *DREAMER* and her three tenders are shown in Fig. 6. One of the dinghys is on the forward net, and Hal Seyle, another member of the syndicate, is approaching in the second dinghy with his date.

In Fig. 7 the "cockpit" area, about 12 × 12 ft, is gracefully modelled by Sue Robbins on the return trip to Santa Monica. This area is used for

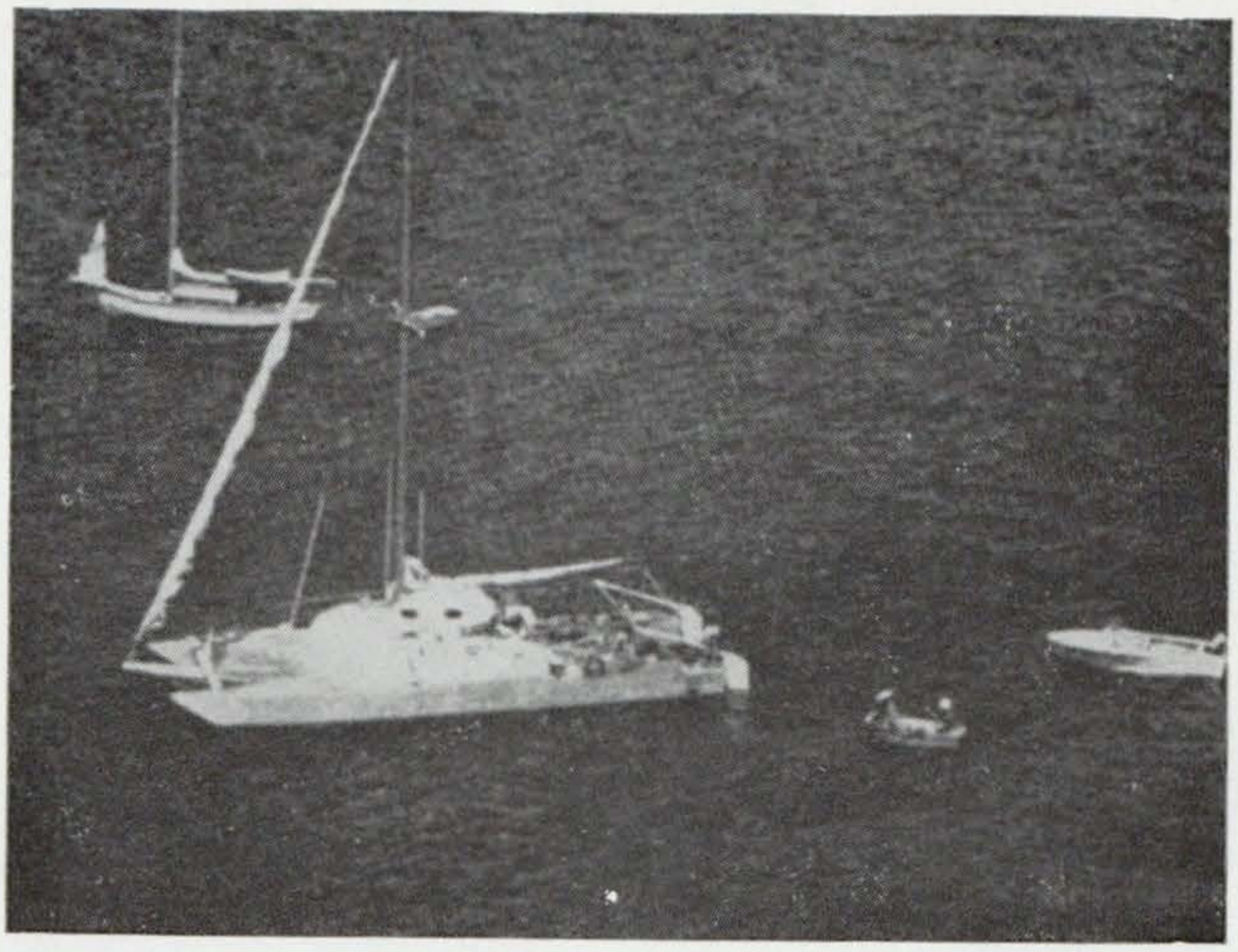


Fig. 6. *DREAMER* carries three tenders. Here at Parsons' Cove, one's off to starboard, one's approaching off the quarter and the third's nestled on *DREAMER's* forward net

barbecues on the habachis and outdoor sleeping for six under the boom cover. Our deck chairs and casual stowage of water skis and temporary gear always surprise single hull sailors, but these are the benefits of deck area and stability.

DREAMER's speed to windward is the result of her dagger boards and Watts racing genoa jib. The dagger board's favourable aspect ratio (depth/chord) provides efficient lift at low angles of attack just as does an airplane wing. Thus, when beating there is reliable manoeuvrability and little leeway even under unfavourable conditions. Off the wind the boards are raised to reduce the overall wetted surface area.

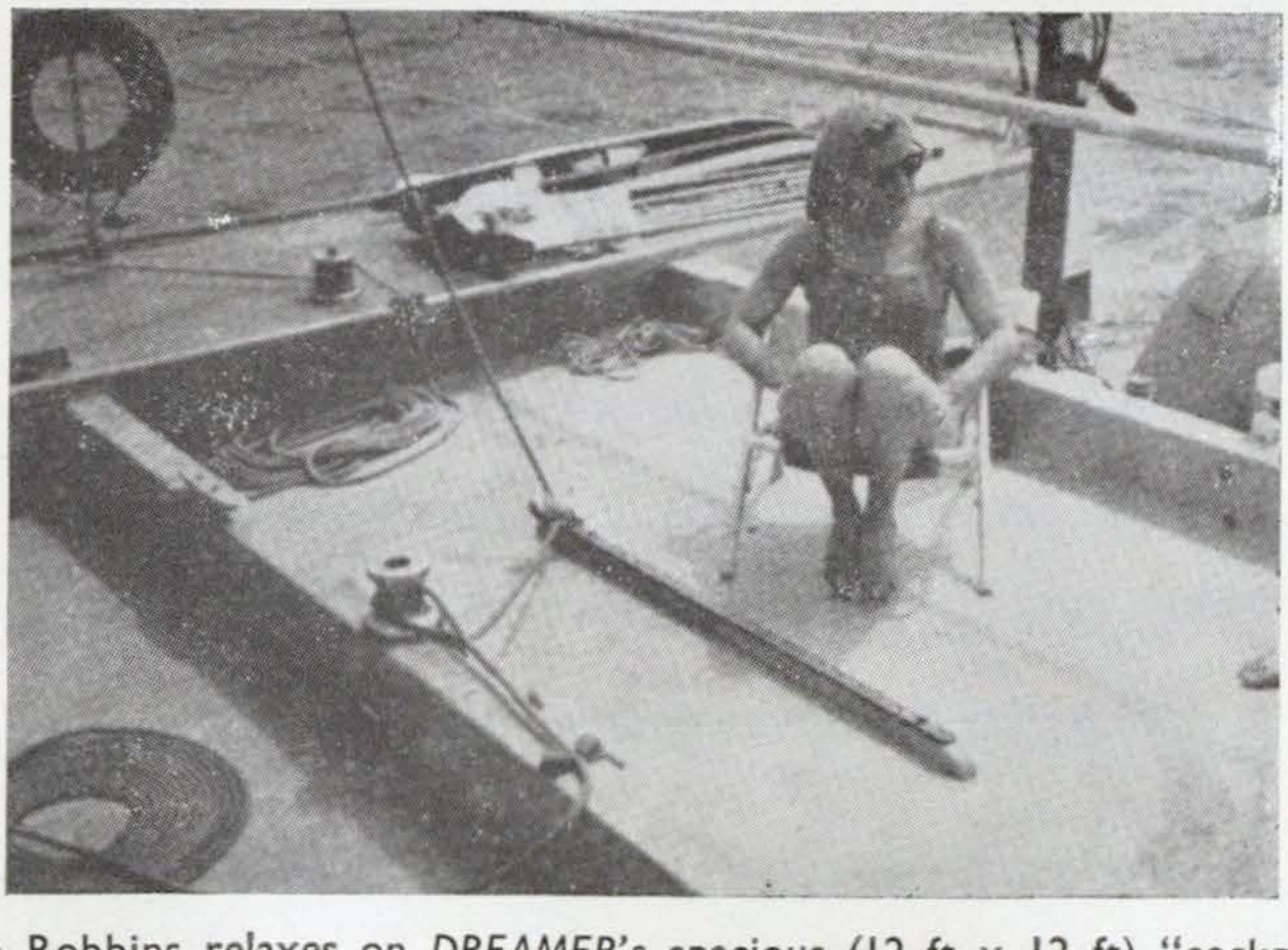


Fig. 7. Sue Robbins relaxes on *DREAMER's* spacious (12 ft x 12 ft) "cockpit" during recent return trip to Santa Monica

COMPARISONS

Varied as the differences are in these three catamarans, they have certain fundamentals in common. First, they are second or third generation designs. Dan Brown had considerable experience with the 35 ft *LEAR CAT* before he designed *ANUINUI*. Rudy sailed the 38 ft *MANU KAI* extensively and helped build and sail the 40 ft *WAIKIKI SURF* from Hawaii to Los Angeles before designing *AIKANE*. I studied catamaran theory and sailed with Prof. Arthur Locke, former head of the aeronautics department at Wayne University, in his 35 ft *TWEEDLEDEE-TWEEDLEDUM*.

Fig. 8. The 43 ft *DREAMER*, third largest active cat in southern California, has flared symmetrical hulls and 18 ft beam, giving her great reserve buoyancy and carrying capacity (she recently carried, fed and slept fourteen people for three days). Her dagger boards and Watts racing jib give her good speed to windward

Second, Dan, Rudy and I have professional backgrounds which contribute to our design experience. Dan is an oceanographer, Rudy studied boatbuilding and built a conventional 35 ft sailboat with Alfred Kumalii in Honolulu. I have two degrees in engineering and one in applied mathematics.

Third, good catamarans are not cheap, and the reverse is also true. *ANUINUI* with all cruising accommodations and expensive construction, and *AIKANE* with her 10 racing sails and improvements would both cost over $40,000 to build today. *DREAMER*, with her completely fibreglassed hulls, epoxy decks, stainless-steel rigging and dacron sails would cost perhaps $30,000. Actually *DREAMER* was built by members of the venture, and her materials investment to date is around $14,000.

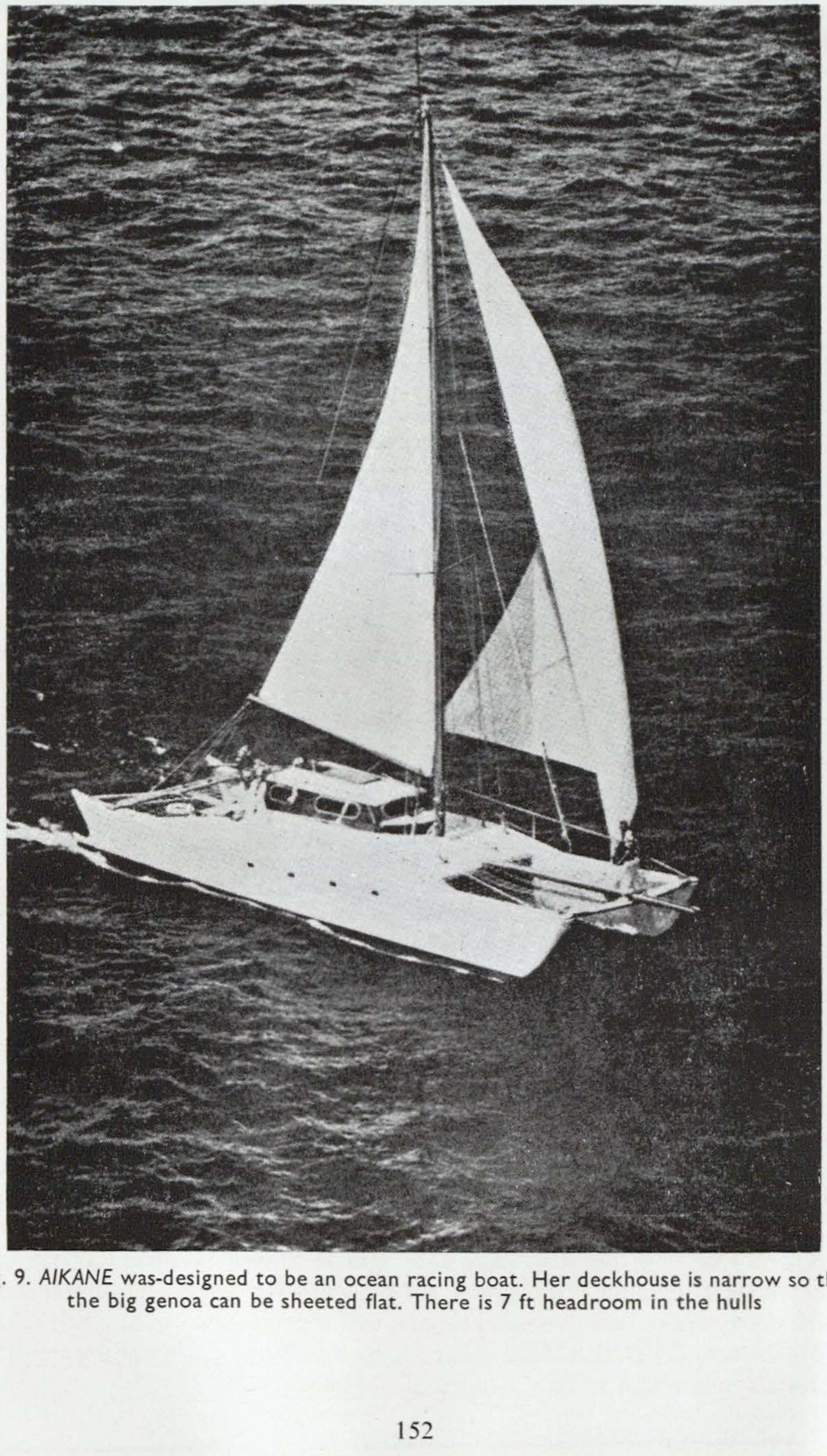


Fig. 9. *AIKANE* was-designed to be an ocean racing boat. Her deckhouse is narrow so that the big genoa can be sheeted flat. There is 7 ft headroom in the hulls

Finally, after several years of operation, no boat is better than her owner's care. *ANUINUI* is one of the saltiest, most seaworthy and shipshape craft around. Ken keeps *AIKANE* in top notch racing shape. And I must confess that what success *DREAMER* has enjoyed has been mostly due to the gang, who have suffered through our pains as well as our pleasures.

In actual racing here in 1959 *AIKANE* has been faster than *DREAMER* off the wind, and *vice versa* on the windward legs. Neither Ken nor I consider these results the final word, however. Ken plans to use a bigger genoa next year, and we hope it's feasible to put a big patch in our second hand spinnaker, to at least bring it up to the size of Ken's middle spinnaker. The *Aikanes,* the *Dreamers* and big cats, generally will profit from the competition, but only Ken Watts, sailmaker, will be able to measure the profit in dollars and cents.

As far as the future is concerned, Rudy Choy and Warren Seaman have designed, and Warren is building a 56-footer with twin diesels and probably hot and cold running wahinis. Bruce Ewing and I have designed a 44-footer for a customer in Santa Monica with four single and two double berths in four private staterooms, two settee berths in the lounge, two heads and full headroom all around.

Because capsizing is a problem a few facts should be considered. First, as catamarans increase in size the righting moment (weight times beam) increases approximately as the fourth power of the length whereas the overturning moment (sail area times wind pressure times the height of the centre of effort) increases as the third power of the length. Therefore the ratio of the righting to the capsizing moment increases approximately linearly with increasing hull length.

Thus, it takes about twice the wind pressure to capsize a 40 ft cat when compared with a 20-footer. Since the catamarans described here are over $2\frac{1}{2}$ times as long as the small racing classes, about that ratio of wind pressures would be required to capsize them.

The second fact to remember, however, is that regardless of the size of the boat, wood, line, cloth and metal do not increase in inherent strength. Since the forces increase as the second or third power of the length, the usual situation in *AIKANE's* and *DREAMER's* experience is that something else starts to go before the capsizing wind force is reached.

A third consideration is that although a few 40-ft day sailors have flipped in the past few years I have not heard of any of the larger, heavier cats going over. Thus actual practice substantiates the theory.

A fourth argument is that the pots should quit swearing at the kettles. The worst boat accidents, in order of their seriousness, are (1) sinking, because it often involves loss of life and boat; (2) fire, which often results in loss of boat and personal injury, and (3) capsizing, which normally involves some damage and exposure. Good catamarans are usually superior in the first two regards, because they can't sink, and fires or explosions are frequently due to dirty bilges and gas fumes in the hull. Many cats have their gas tanks in the wing section where any fumes or leaks cannot be trapped.

Finally, there are several ways to cure the capsizing problem. Dan Brown's approach is one, and he has actually tested it by having a crane pull him over.

Good sailing is another, as Rudy has pointed out. I favour a small (3 cubic feet) streamlined styrofoam float at the top of the mast which would serve the three functions of wind vane, radar reflector (enclosed), and safety device. This float would be augumented by two small egg-shaped ones at the spreaders which would also prevent serious genoa chafe. I am recommending this solution on our 44-ft plans, but we have not installed it on *DREAMER* simply because of the lack of any necessity for doing so.

CONCLUSION

I feel that the catamaran's success rests on speed, and to that end I would like to try to design the world's fastest sailboat—to windward or leeward under any conditions. To my engineering mind this means two centre- or dagger-boards for best windward performance and semi-circular underwater sections for minimum wetted surface area off the wind. Such a boat, incorporating years of big catamaran design and sailing experience, *combined* with excellent construction and great racing ability, could do the job, just as the small cats are beating all the other small classes.

If you would like further information from Dan Brown, his address is Silvergate Yacht Club, Shelter Island, 990 Yacht Harbor Dr., San Diego, Cal. If you are interested in further details about *AIKANE*, or would like to discuss other big cat possibilities, Rudy Choy would like to year from you. His address is 4357 Oxford Lane, College Park, Costa Mesa, Cal. Finally, if you are interested in *DREAMER*, or fast, big centre-board cat designs, I would welcome your correspondence. My address is 721 Mira Vista Drive, Huntsville, Alabama 35802, U.S.A.

CHAPTER XIV

DREAMER

April, 1961

by Bruce Ewing

L.O.A.	43 ft	Displacement approx.	10,000 lbs
Beam	18 ft	Headroom (cabin)	6 ft 6 in
Draught	2 ft	Sail Area	800 sq ft
		Genoa	800 sq ft

Designer: Hugo Myers

721 Mira Vista Drive, Huntsville, Alabama 35802, U.S.A.

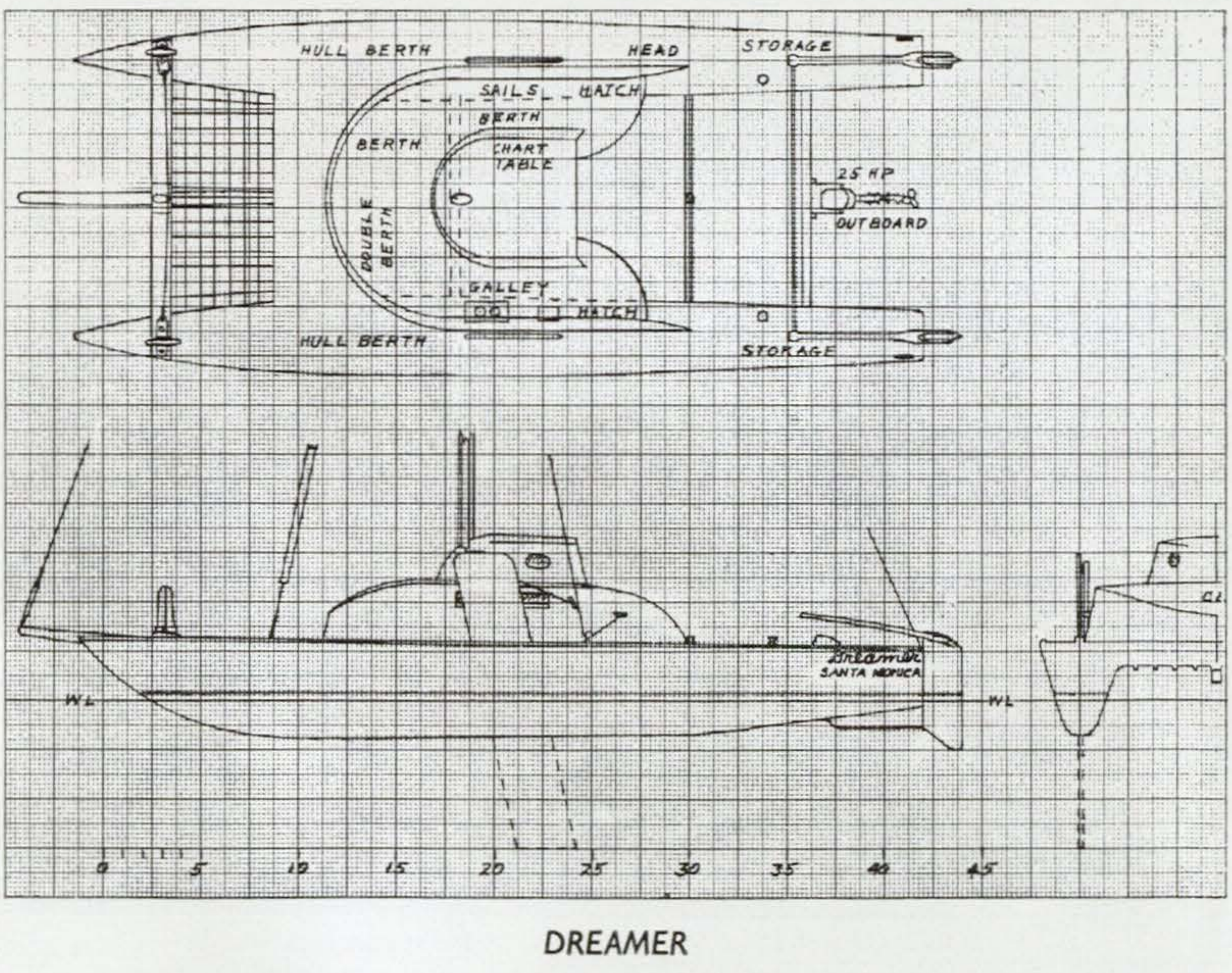
This boat was the product of six guys who decided to help an inland lake sailor build his first boat. He was taking the advice of a friend of his who said, "If you want a big boat, don't waste time with small ones". This boat was built primarily because none of us really had any idea how large a job it was to build a 43 ft boat in a vacant lot. None of us had been ocean sailing before but we had a feeling we would like it. After a year and a half of weekend labour we launched *DREAMER* Thanksgiving Day, 1956.

DREAMER

DREAMER has proven to be a successful cruising catamaran for seven neophytes to learn how to handle a large craft in the ocean. Last summer *DREAMER* came into her own as a racing catamaran with the help of a large overlapping genoa. We entered two races and gained first place on a handicap basis in both. We proved to ourselves the apparent superiority of the symmetrical rounded bottom hulls with centreboards over the asymmetrical hulls without centreboards on a beat to windward. Our proving board being the well known *AIKANE* (46 ft Hawaiian design by Rudy Choy). *DREAMER* definitely showed her superiority to *AIKANE* in beating to windward in both races. In a twenty-five mile race, the first half of which was a beat to windward, the other half being a broad reach, we crossed the finish line about twenty feet ahead of *AIKANE*. On the reach *AIKANE* proved to be slightly faster than *DREAMER*.

DREAMER is very seaworthy and extremely durable due to her relatively heavy construction. Even at her fastest speed of about 18 miles per hour, *DREAMER* has never lifted her windward hull out of water.

Her accommodations are not the best that a 43 ft catamaran can offer but she serves from six to fourteen people regularly each weekend during the summer when sailing to Catalina Island, a distance of 32 miles from homeport. She has made this passage a number of times in under 4 hours. *DREAMER* has two bunks forward in the hulls and sleeps six more on the broad decks within the cabin. When there is a crowd on board the broad decks of the cockpit will hold four more under a canvas stretched over the boom. The head is located aft in the starboard hull and storage in the aft section of the port hull. A galley and navigation equipment are located in the cabin. Auxiliary power is a 25 horsepower outboard which will push her along

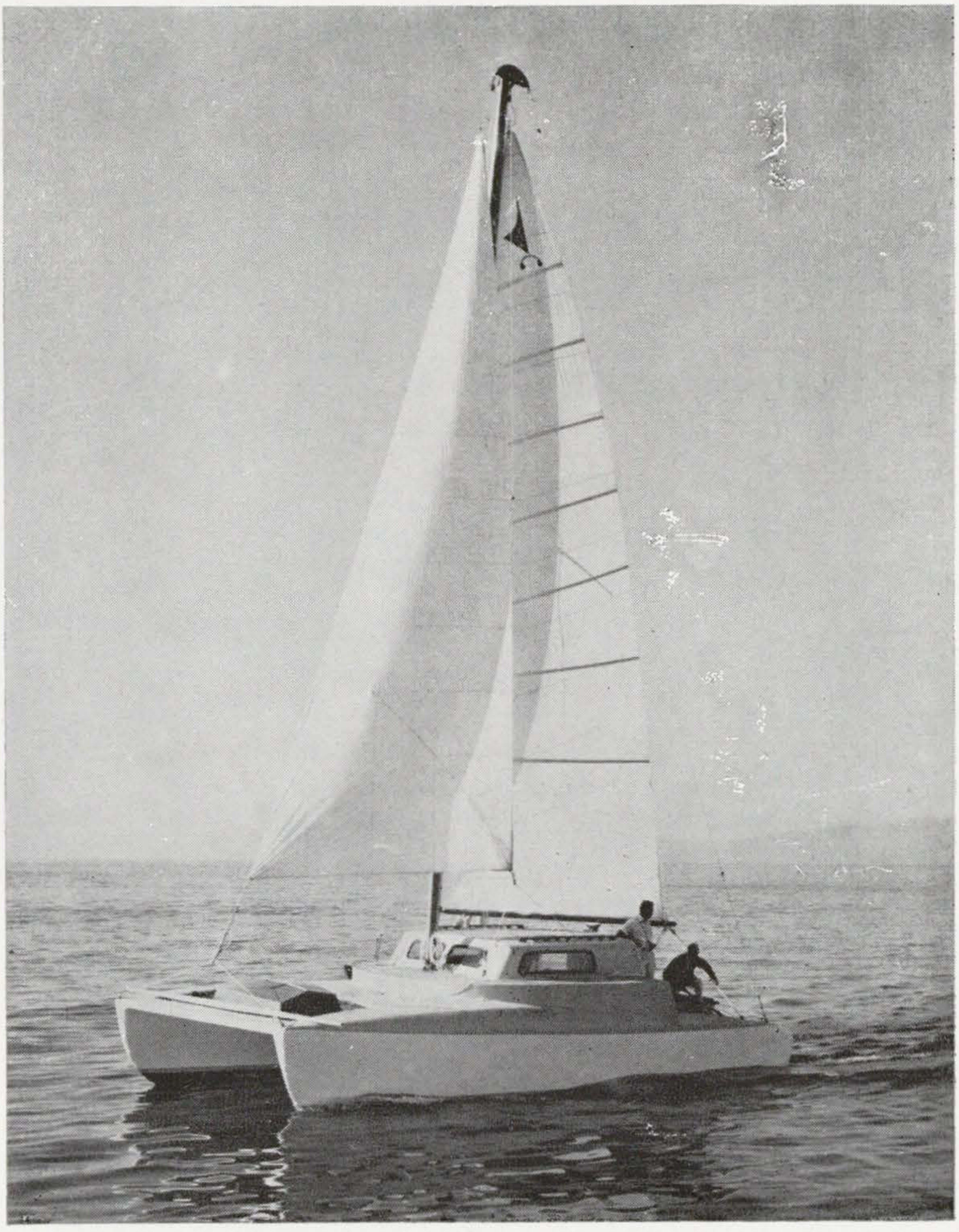


DREAMER

at 8 miles per hour. This is enough speed for a sailboat under power but more horsepower would improve the safety margin in manoeuvring in a high wind due to the excessive windage of a catamaran. I would therefore recommend a more powerful motor for a boat of this size.

DREAMER's construction is $\frac{1}{2}$ in plywood, fibreglass-covered throughout. The hulls are connected by 3 in $\times$ 12 in hollow beams spaced 6 ft apart. The hulls are an approximation of a rounded bottom being flat 10 in across on the bottom, then rising to an angle of 45° to the vertical for 10 in and continuing to the sheer line at an 18° angle to the vertical. This gives a symmetrical hull with a large amount of reserve buoyancy.

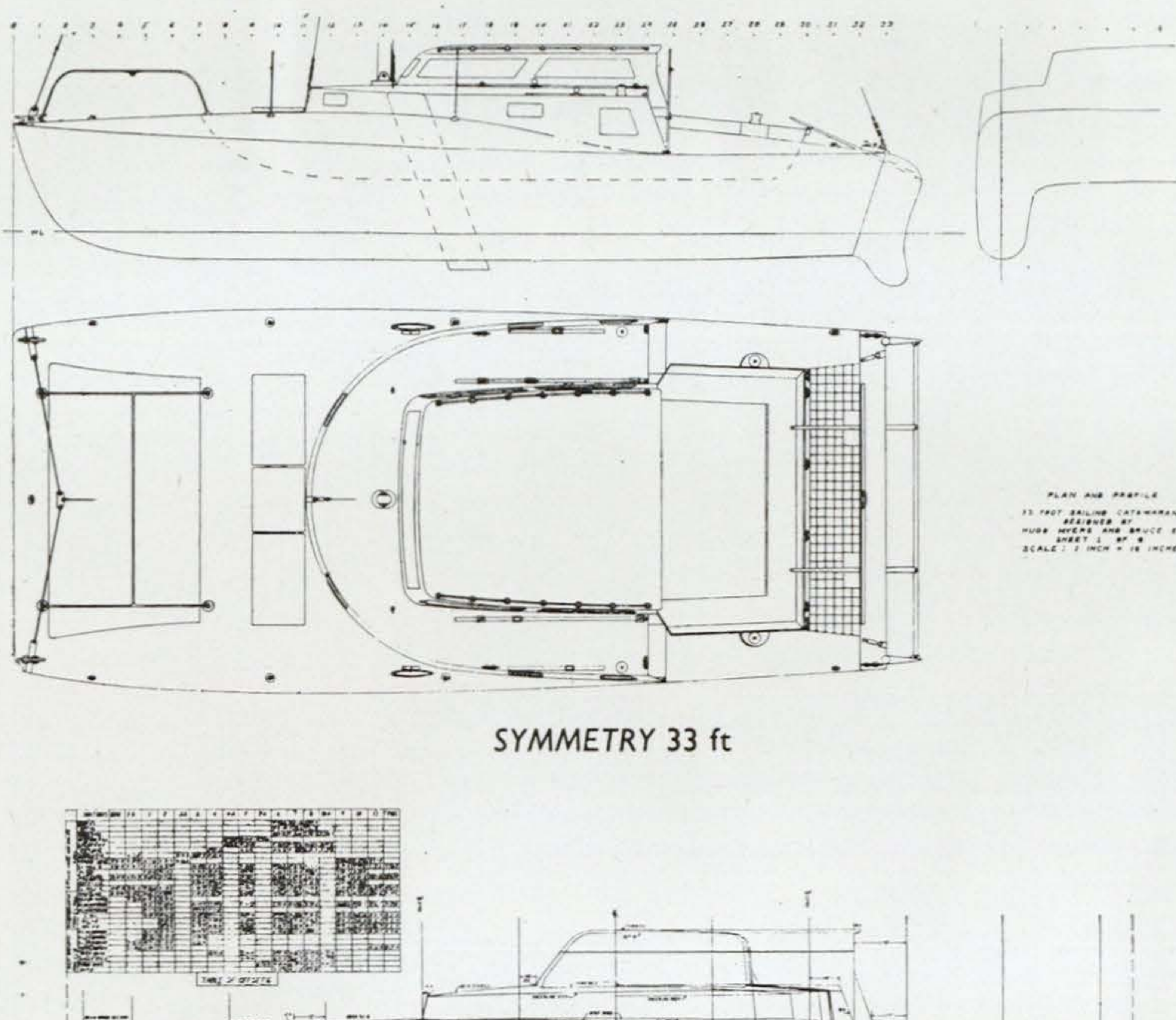
The centreboards are constructed of solid douglas fir each board having approximately 15 sq ft of area. With her boards down *DREAMER* can point



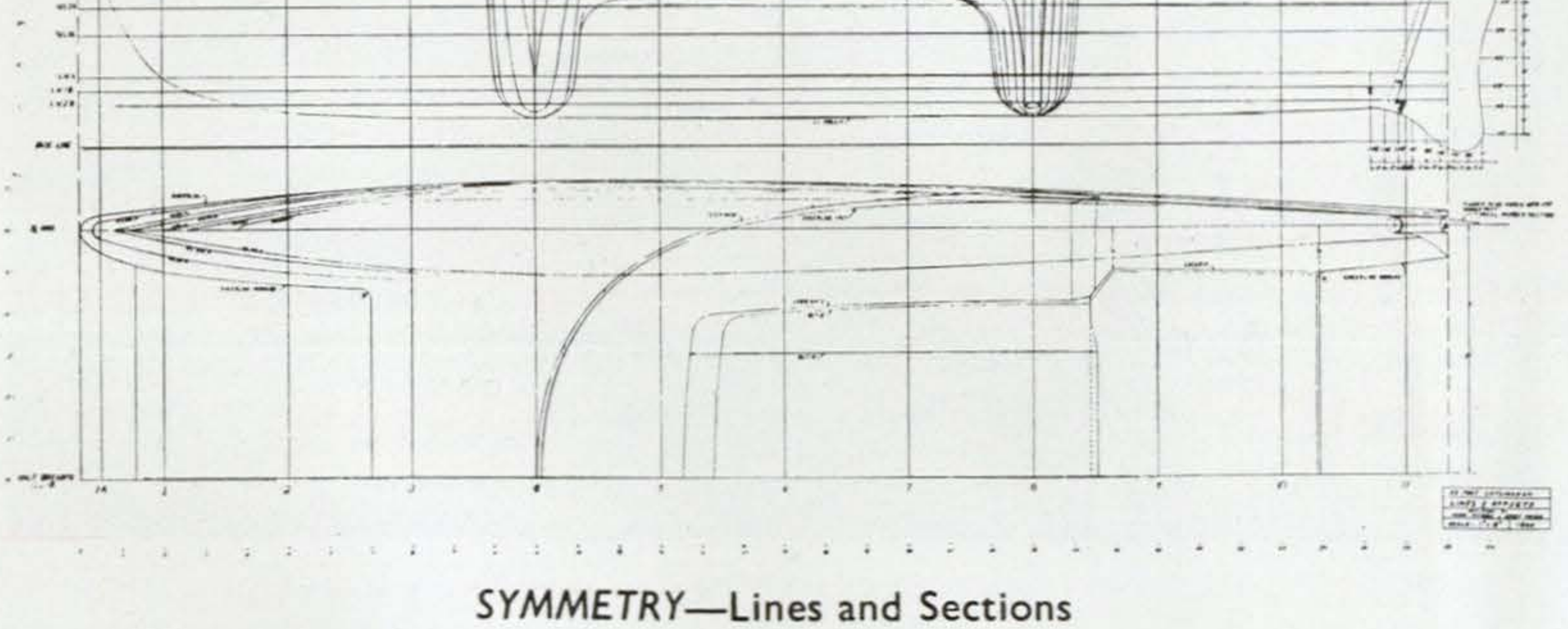
SYMMETRY

with the best of the conventional craft. Her ability to come about is very good owing to a rise both fore and aft in the keel and the centreboards acting as a pivot.

You might be interested to know the outcome of seven people owning one boat. The results have been highly successful owing to a joint ownership agreement which we all signed and adhere to. The boat is operated not on a friendship basis, although we all are very good friends, but on a business basis. We have a schedule of use in proportion to our percentage of ownership. We have a treasurer who collects monthly maintenance fees which are again based on the percentage of ownership. We heartily recommend this to those who would like to have a boat a bit larger than they can afford. It would have been impossible for any of us to own *DREAMER* alone and in fact we wouldn't



SYMMETRY 33 ft



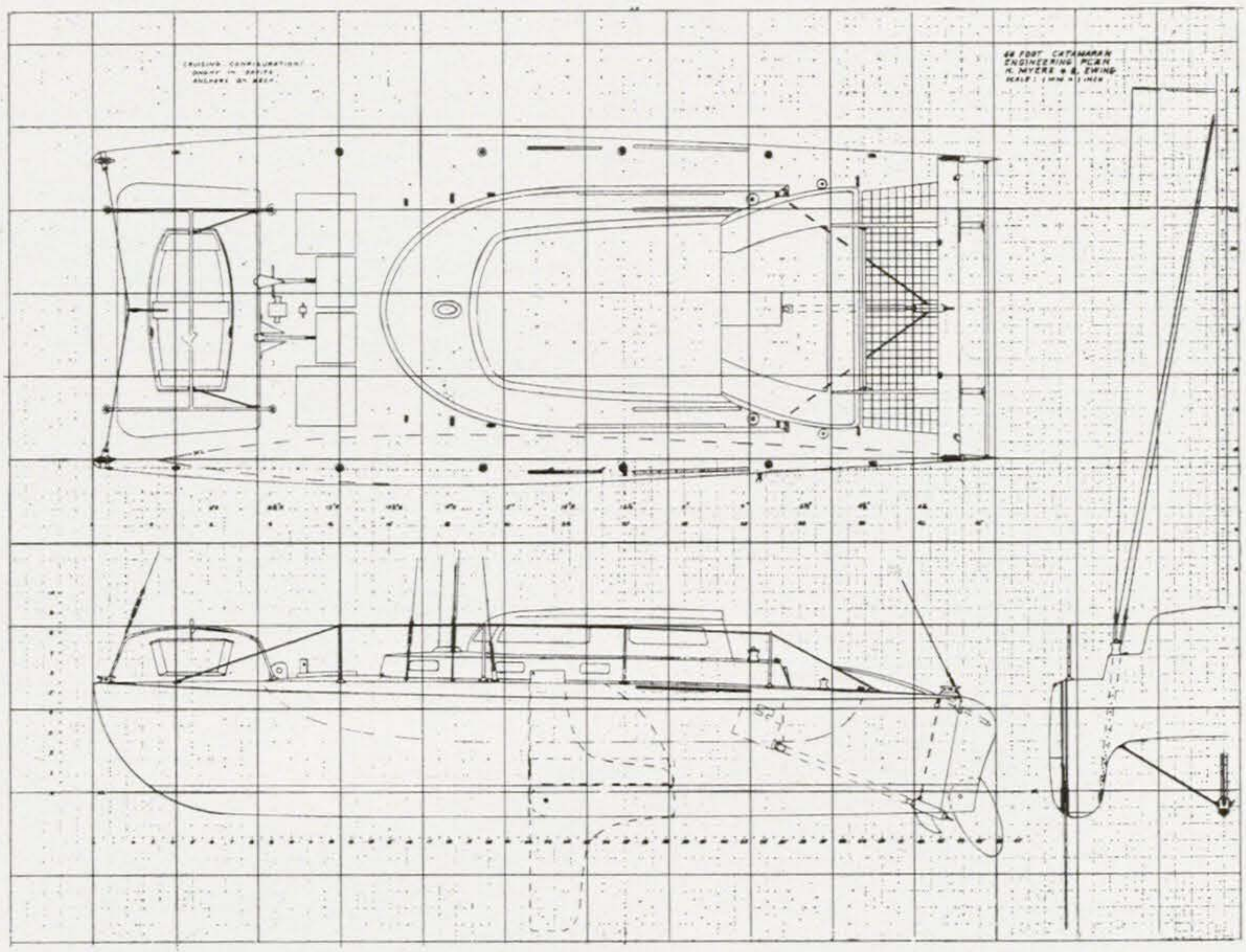
SYMMETRY—Lines and Sections

want to. The problems involved in owning such a large craft make it a burden instead of a pleasure for one individual. *DREAMER* is being used every weekend of the year. With a boat this is good because she is not being neglected. Small repair jobs are done and she is assured a cleaning once a week.

The designer of *DREAMER*, Hugo Myers, and myself have taken the lessons of experience from *DREAMER* and have recently completed the design of a 44 ft catamaran for a client in Santa Monica, California. We expect this new design to be superior to our first boat in all respects. At the present time we are concentrating our efforts on a 33 ft cruiser-racer design for another client.

SYMMETRY 33 ft CATAMARAN DESIGN

All we have of this design by Hugo Myers and Bruce Ewing is the drawing and photographs we show. One must agree that the cabin top blends very nicely into the hull, while allowing good sheeting for the Genoa. The gallows arrangement between the hulls forward is for the dinghy.



Myers-Ewing 44 ft Catamaran

44 ft CATAMARAN DESIGN

This design is also by Hugo Myers and Bruce Ewing and shows a craft of greater beauty than *DREAMER* but with canoe sterns to the hulls and revolving centreboards, instead of daggers. The canoe sterns are believed by the designers to give greater "tracking" ability which is certainly true at the lower speeds but has yet to be proved when travelling really fast.

A CATAMARAN DESIGN

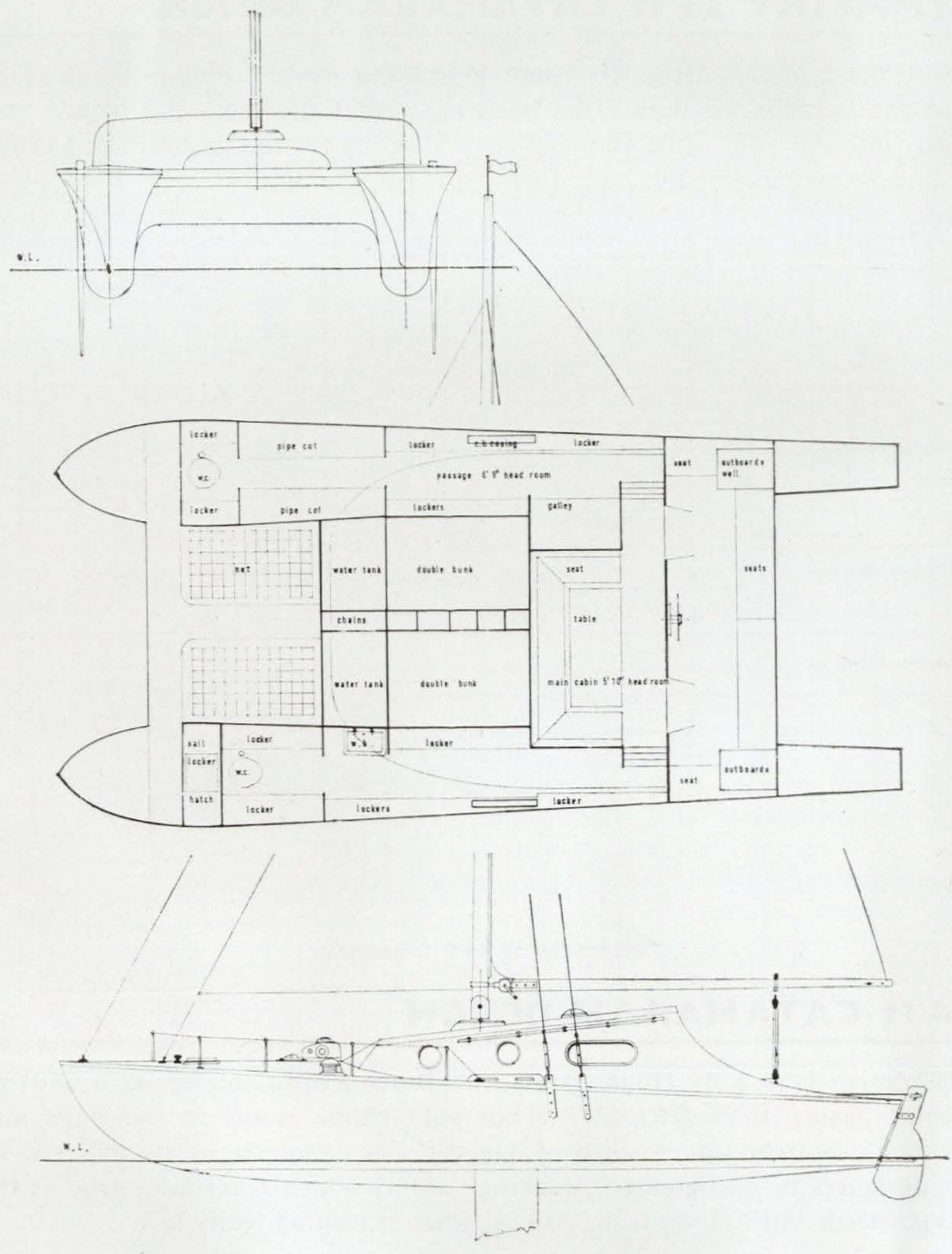
April, 1961

by C. T. Black

Constantia Flower Farm, Doordrift Rd., Constantia, S. Africa

L.O.A.	37 ft 10 in	Weight	4,500 lbs
		Sail Area	600 sq ft

The drawings show the catamaran which I am at present building. The boat is of a round hull section very similar to the *SHEARWATER III* up to the water line. The main difference is the sheer and the quite pronounced flare



to the bows. The construction is to be completely of fibreglass with the exception of bulkheads and internal fittings.

Two wells are provided in the hulls to take two 5 hp *Seagull* outboards with the large hydroplane prop which I estimate will give a speed of around 7 knots, for getting in and out of harbour. The lower ends of the wells close when the outboards are lifted by sliding hatches.

Owing to the fibreglass construction, it is not necessary to deck the boat right across the two hulls which means that one can utilize the hulls as passage ways. This allows for considerable accommodation. There is a main cabin which measures 9 ft × 6 ft and has 5 ft 10 in of headroom. The hulls are then used as passage ways with the owner's cabin on the port side which has a double bunk, plenty of lockers, wash-basin, head and shower. On the starboard side are a galley, double bunk and two pipe cots as well as a head and plenty of locker space. This has all been made possible by the strong girder construction which is incorporated as the cabin top which is also of fibreglass. This girder bridge joins the two hulls and also forms a very strong base for the stepping of the mast.

It looks to me as if fibreglass construction is the only way to get very strong construction in a light boat, which is very important. It has taken me six months of work to make the male moulds and Frank Lawrence is at present making the female moulds in fibreglass. Lawrence has had considerable experience in this work so his help is greatly appreciated.

May I say here how greatly I have been helped by the AYRS publications. The information given in them has helped me tremendously in designing this boat. The whole thing now is how the prototype will sail when completed at the weight of 4,500 lbs, with nearly 600 sq ft of sails which works out at approximately 8 lbs per sq ft. She should perform quite well but I shall be well satisfied if we get 15 to 16 knots out of her—anyhow, here's hoping.

PROUT 19 ft CABIN CATAMARAN

April, 1961

L.O.A.	19 ft	Cockpit	3 ft 4 in × 8 ft 9 in × 1 ft
Beam	9 ft	Headroom	4 ft 9 in (roof up)
Weight approx.	800 lbs	Sail Area	220 sq ft

Designers: Prout Brothers

The Point, Canvey Island, Essex

This boat is designed to sleep a family of four. It has a lift-up cabin top (which takes only 30 seconds to put up) to reduce weight and windage when sailing and her performance is equal to that of a *SHEARWATER III* which speaks for itself. Her appearance under sail is pleasing and her small draught and general manoeuvrability make her an ideal family cruiser.

Prout 19 ft Cruiser

Hull Design

The run is flatter than the original *Shearwater* so manoeuvrability will be good—apart from the value of the extra weight and size which helps in any case.

Construction

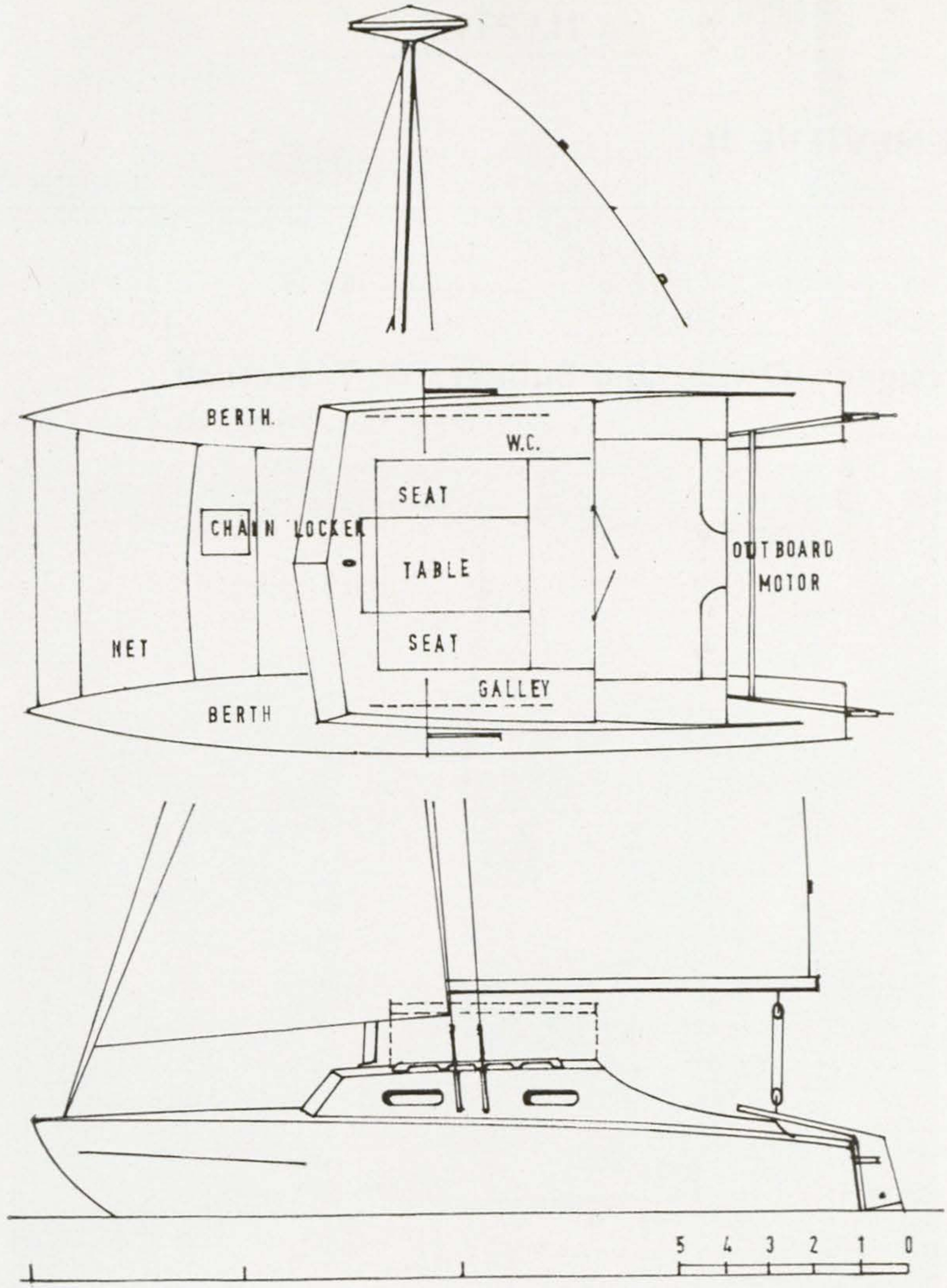
The hulls are $\frac{3}{8}$ in moulded plywood with BSS 1088 marine plywood, silver spruce and hardwoods elsewhere. There are substantial oak skids, protected by brass for grounding. The rudders are of the lifting type with light alloy blades. All the decks are non-slip and handrails are provided for going forward.

Auxiliary

A 3 to 5 hp outboard motor gives ample power and this size of motor can be easily stored out of the way in the after part of one of the hulls.

The Possibility of a Capsize

A capsize with this craft should be extremely unlikely. The greater beam and weight as compared to a *SHEARWATER III* will make this a very difficult feat to accomplish but, naturally, it is an eventuality which should be kept in mind, both by sailors and builders. Prouts have very wisely used a "Henderson" float at the masthead to prevent the craft going upside down and have designed the craft so that she only draws 6-8 inches when on her side which puts the cabin door as much as 3 ft above the water level.


BERTH.
W.C.
SEAT
CHAIN LOCKER
TABLE
OUTBOARD
MOTOR
SEAT
NET
GALLEY
BERTH
5 4 3 2 1 0

CHAPTER XV

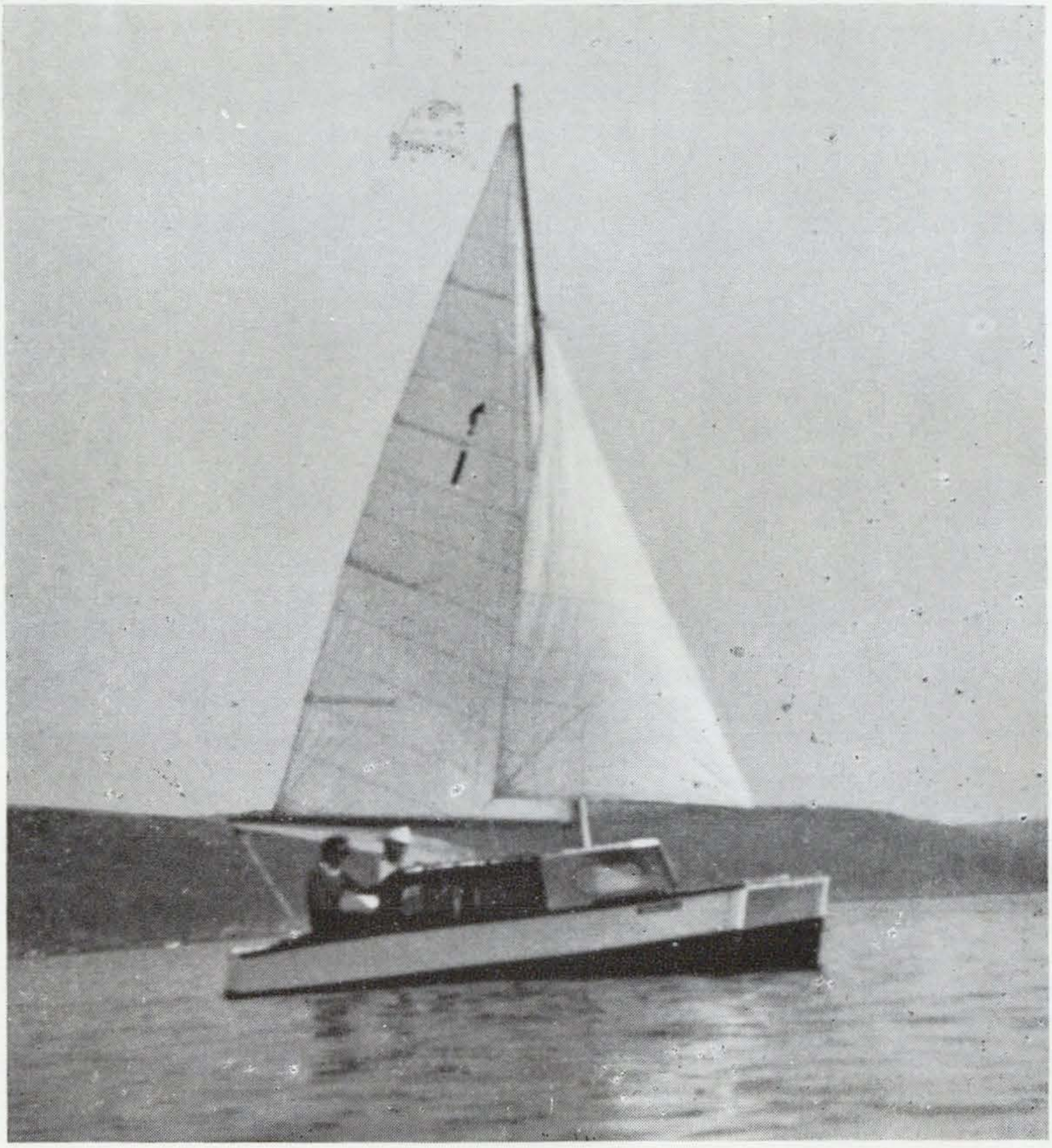
GENEVIEVE II

April, 1961

L.O.A.	16 ft 0 in	Draft	8 in
Beam	7 ft $1\frac{1}{2}$ in	Draft with C.B.	3 ft 6 in
Weight	800 lbs	Sail Area	120 sq ft

Designer, Owner and Builder: W. F. Metcalf

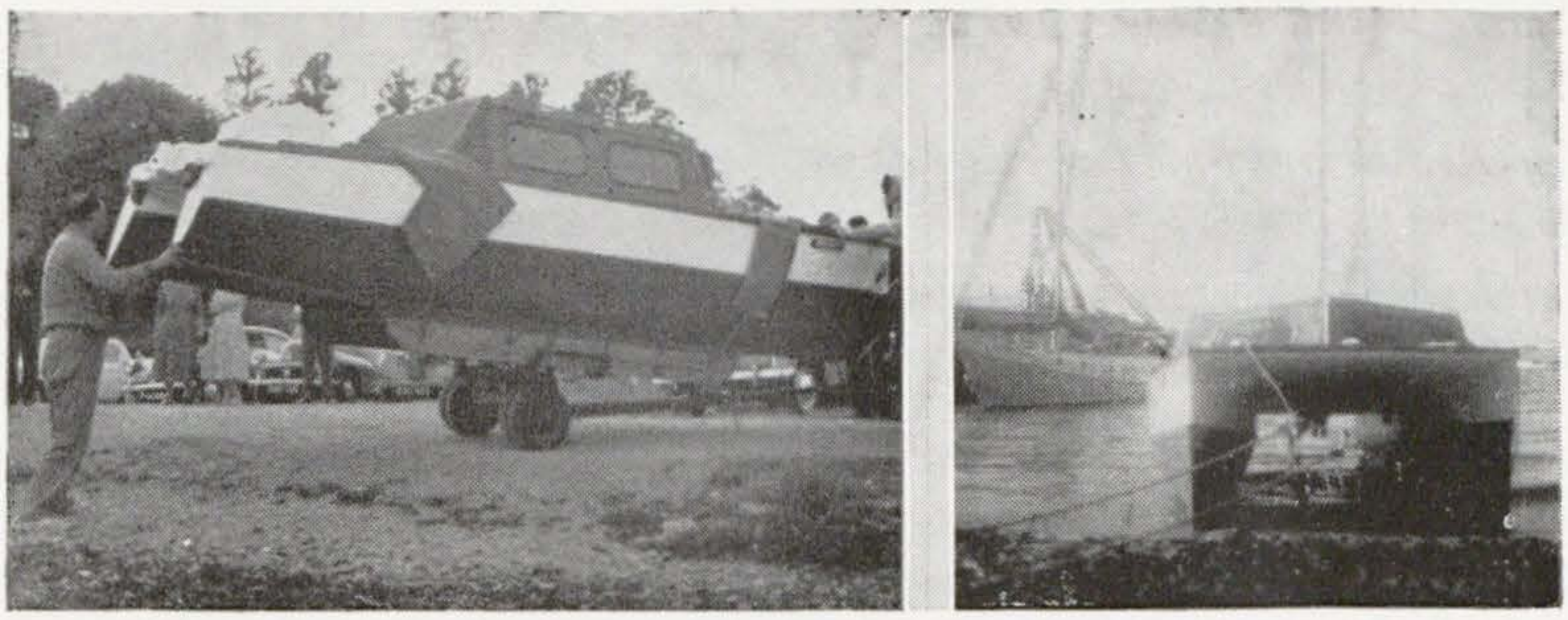
1 Holywell Road, Playing Place, Truro, Cornwall



GENEVIEVE II

GENEVIEVE II was made by trial and error so no real plans were made, as such, just rough working drawings.

She is a very dry, extremely comfortable boat to sail and, with her weight, reasonably fast. I made her of double skin 3 mm marine ply with fibreglass



GENEVIEVE II

sheathing below the water line. She sails best on a reach but also runs well. She goes about quite well, too, and is not often caught in stays.

The bunks are in the hulls and are most comfortable, being 6 ft 3 in × 2 ft. The halyards are internal of nylon rope and the centreboard is also operated through the mast step up into the cabin, a system which works very well, all lines being operated from the open cockpit.

The hatchway aft is to accommodate the auxiliary, a 4 hp Seagull. *GENEVIEVE II* has wheel steering which serves well under power but is not good enough to sail by, so this winter, I shall arrange tiller steering to the twin rudders.

MORIMA II 40 ft CATAMARAN

January, 1962

Length	40 ft	Beam	18 ft
Sail Area	1,010 sq ft including large Genoa.		

Designers and Builders: G. Prout & Sons

The Point, Canvey Island, Essex

MORIMA II was completed and launched on June 17th, 1961 and sailed by a Mr J. Fenwick, a professional yacht deliverer from Canvey Island around the coast, across the Bay of Biscay and into the Mediterranean to St Tropez in the South of France. Upon arrival at St Tropez she was immediately entered for a race from Toulon via Corsica to St Remo in Italy.

During the passage and the race *MORIMA II* encountered four gales, one very severe, the worst encountered in the Mediterranean last year. She weathered them all very well and without trouble or undue anxiety. Jack Fenwick who has had a great deal of experience delivering many types of yachts all over the world said afterwards that he considered the cat as good in gale conditions as many boats of her own size, with apparently some comfort advantages when hove to or lying a "hull". *MORIMA II* during this delivery trip made some fast passages, the best being a 100 mile run across the bay of Lyons in 8 hours.

MORIMA II was designed with a very spacious cockpit measuring 10 ft × 14 ft wide and was fitted with a shower, two toilets and two refrigerators.

Her owner, an experienced sailor, intends to race her extensively in the Mediterranean next year.

MORIMA II

SNOW GOOSE

January, 1956

L.O.A. 36 ft.

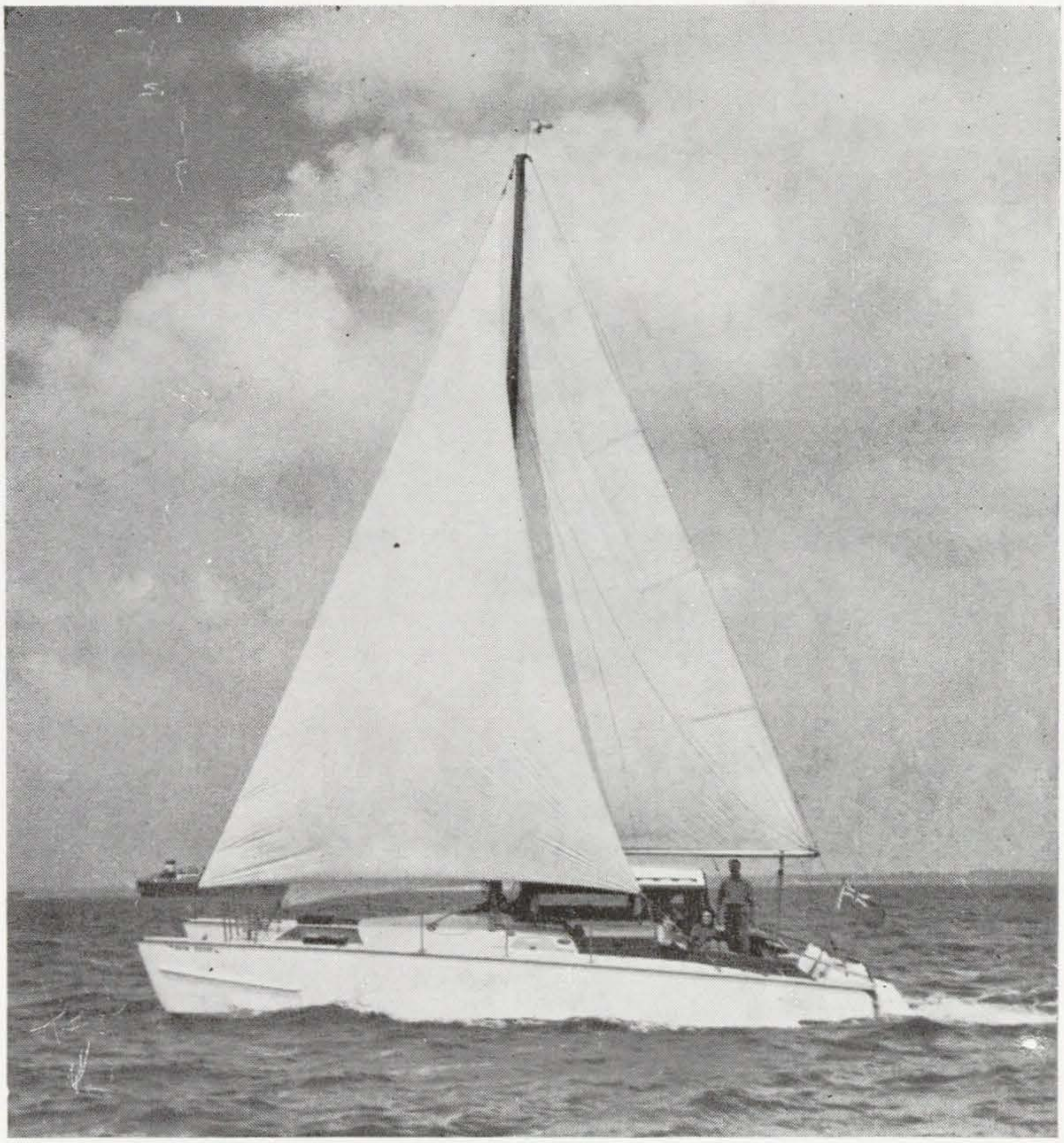
Designer and Builder G. Prout & Sons

Canvey Island, Essex

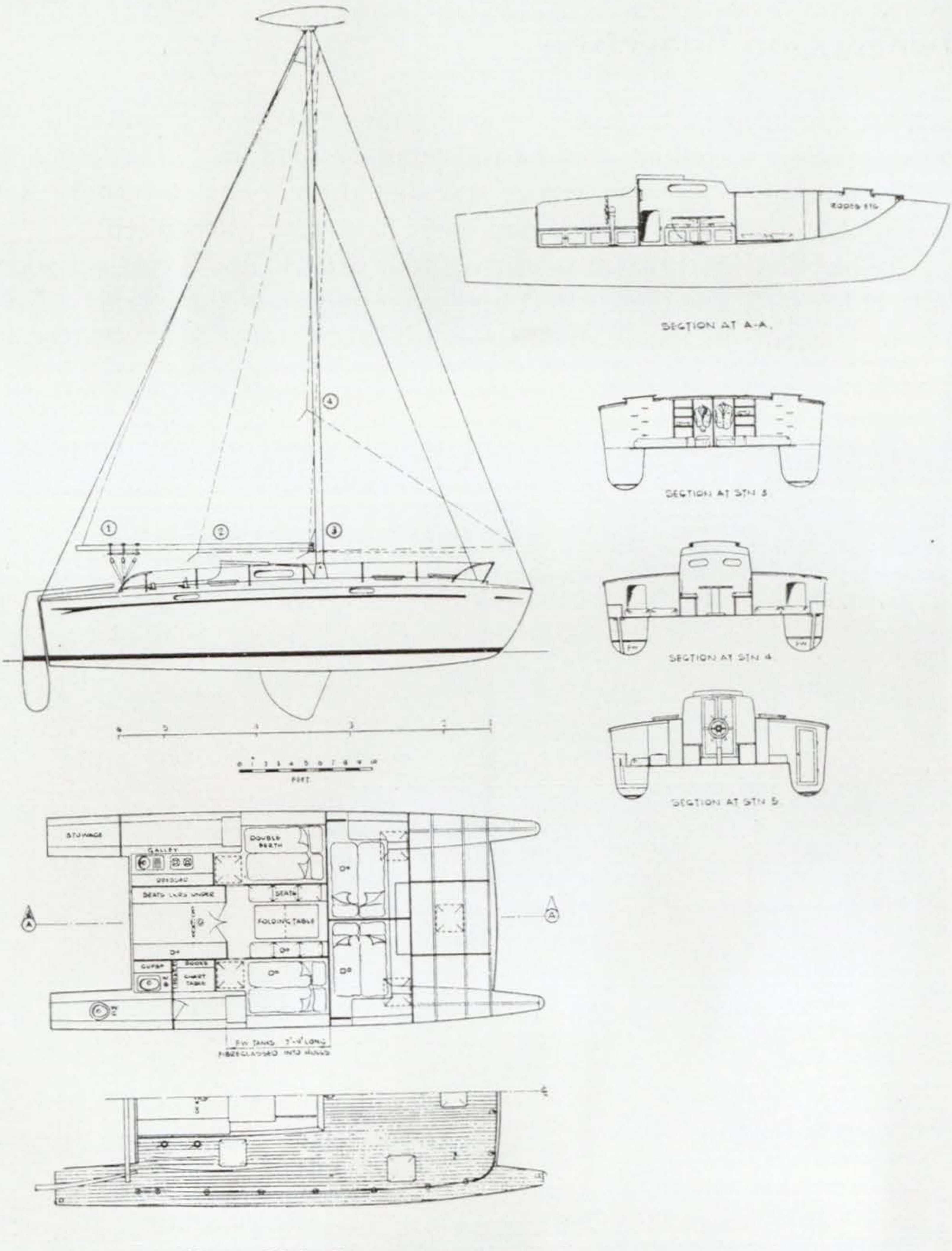
Owner: Don Robertson

Hulls are moulded in six layers of mahogany, making $\frac{3}{4}$ in hulls thickness. Hull sides above waterline, decking and cabin, are built in $\frac{3}{8}$ in mahogany-ply. Main beams, ply with solid spruce spacing. Mast hollow spruce 39 ft tall. Other timber, mahogany, spruce and other hardwood as required.

A double berth is situated in each of four cabins. The cabins are situated two in either hull, and there is 6 ft headroom in each of these cabins. A door leads to a cabin on the starboard side aft where toilet and wash basin is situated.



SNOW GOOSE



Prout 38 ft Catamaran—latest production design

In the centre of the craft is situated the cockpit and seating saloon. This cabin has seating for six, around a table, and commands an excellent view all around the craft while sailing.

The central cockpit is large and comfortable providing dry sheltered seating and fine visibility all round the craft. A sliding panel or window is situated over the galley cabin which leads direct to the cockpit, and can be used as a serving hatch into the cockpit.

Auxiliary power is by outboard motor, which is permanently kept in a compartment outside the cockpit, and can be lowered into the water when required. A 15 hp motor has been used and speed of approximately 6 knots is usual with this motor. With a Johnson 40 hp motor, a speed of 8 to 10 knots is obtainable. A more powerful motor could be used to give higher speeds if desired.

Drop centreboards are fitted which are easily hoisted and lowered, and provide very efficient windward sailing and manoeuvrability.

Many notable cruises and races have been achieved by our large catamarans. One has sailed from the Thames around Spain and Portugal to Corsica and Nice in the South of France, and the racing and cruising exploits of the 36 ft catamaran *SNOW GOOSE* are well known. Perhaps her most famous exploit was joining in the around the Island Gold Cup race when she beat nearly 300 of the best ocean racers, and came in over three minutes earlier than the 12 metre yacht *FLICA* to create an all time record for round the Isle of Wight.

This craft is fitted out with all rigging and sheets. Galley is fitted with two burner Kerosene stove.

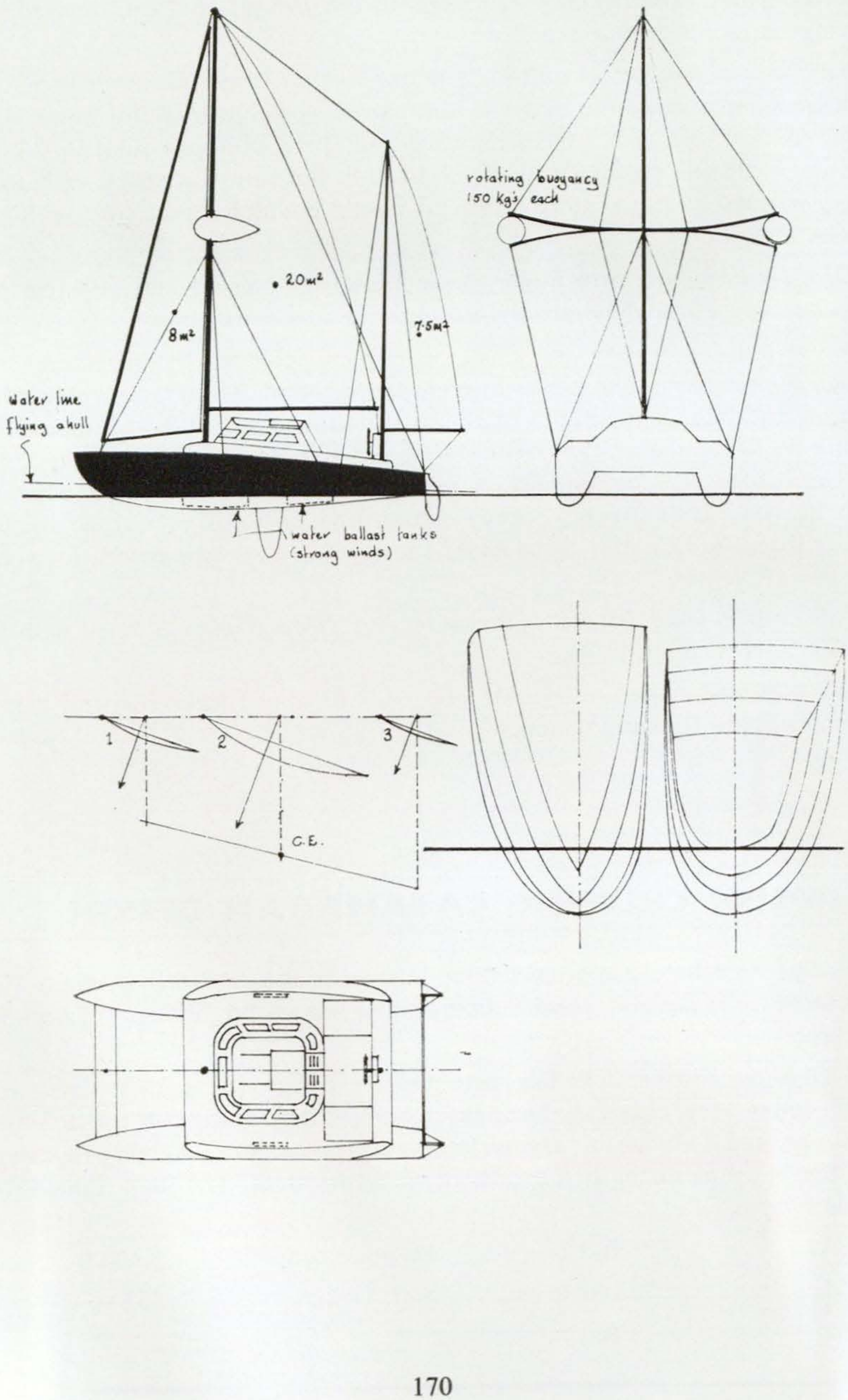
The moulded hulls are moulded up to 7 in above waterline and can be supplied ready for completion.

A POLISH CRUISING CATAMARAN DESIGN

Recently, there has been considerable interest in the AYRS in Poland. They also seem to be designing and building some fine yachts, though information is scarce.

Wladyslaw Koziorowski has sent me this design for a 26 ft catamaran which looks very pleasant. The two main features which call for comment is the very small amount of asymmetry on a very fast and seakindly hull shape and the buoyant floats at the ends of the cross trees. The main dimensions are as follows:

L.O.A.	26 ft 3 in	Displacement	2,200 lbs
L.W.L.	23 ft 7 in	Sail Area	382 sq ft
Beam	13 ft 1 in		



water line
flying ahull
8m²
20m²
7.5m²
water ballast tanks
(strong winds)
rotating buoyancy
150 kg's each
1
2
3
C.E.

STARLIGHT

January, 1963

A 26 ft AUXILIARY FAMILY CATAMARAN

Designers: MacLear and Harris

Dimensions

Length overall	26 ft	Beam, extreme	13 ft 8 in
Length datum waterline	23 ft 6 in	Draft, board up	1 ft 3 in
Beam each hull	3 ft	Draft, board down	4 ft 0 in
(at counter line)		Displacement, half load	3,000 lbs

This design was prepared in answer to an ever increasing number of families seeking an inexpensive, simple family auxiliary cruiser with the following requirements:

Higher speed under sail and power	Light displacement
Shoal draft	Large deck area
Beaching ability	Simple, economic rig
Variety of auxiliary power options	Safety, stability, seaworthiness
Sleeping accommodations for 4-6	Enclosed head and simple galley

The sailing speed made good to windward of this 26 footer will average out at approximately 10-40 per cent faster than a monohull centreboard of equal length, depending on wind velocity, and she will reach from two to three times faster.

She will be capable of speeds under power similar to semi-planing monohull power boats given as much power. Her ability to maintain a higher sustanied cruising speed up-wind in choppy water will be markedly better than that of the monohull.

Headroom

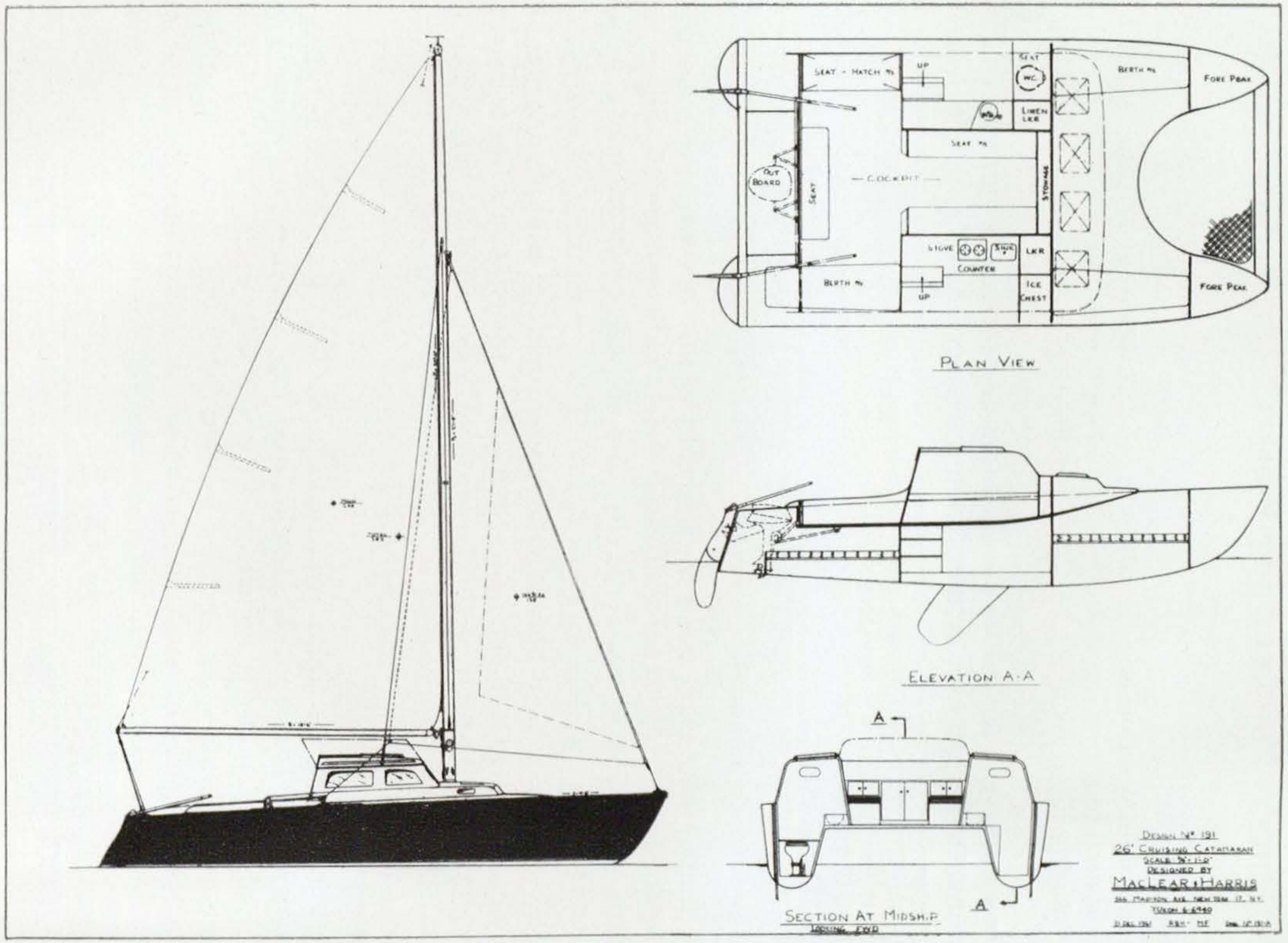
5 ft 9 in in each hull under twin cabin trunks. The seating area between the trunks may be covered with a folding navy top, and converted easily to twin or double bed sleeping, or left open for one large cockpit seating area. In addition to this, a boom tent may be used for further protected sleeping on the cockpit seats. The navy top may be left up under sail, allowing sleeping accommodations underway from 4-6 persons and 8 in port with the boom tent.

Auxiliary Power

Outboard or inboard-outboard (Z drive) from 10-100 hp. Batteries are charged from the propulsion units in the usual manner.

Nylon Webbing

Between the hulls forward makes an excellent place to lounge in fine weather and serves as a vented deck area from which to handle headsails and ground tackle.


SEAT - HATCH
UP
SEAT
W.C.
LINEN LKR
SEAT
OUT BOARD
SEAT
COCKPIT
STOWAGE
BERTH
FORE PEAK
STOVE
COUNTER
LKR
BERTH
UP
ICE CHEST
FORE PEAK
PLAN VIEW
ELEVATION A-A
A
A
SECTION AT MIDSHIP
LOOKING FWD
DESIGN Nº 191
26' CRUISING CATAMARAN
DESIGNED BY
MACLEAR & HARRIS
YUKON 6-6940

Anchor

Will stow neatly up into the underside of the leading edge of the wing between the hulls, thus eliminating one of the most irksome stowage problems on the monohull.

POLARIS

by Captain Dario Salata

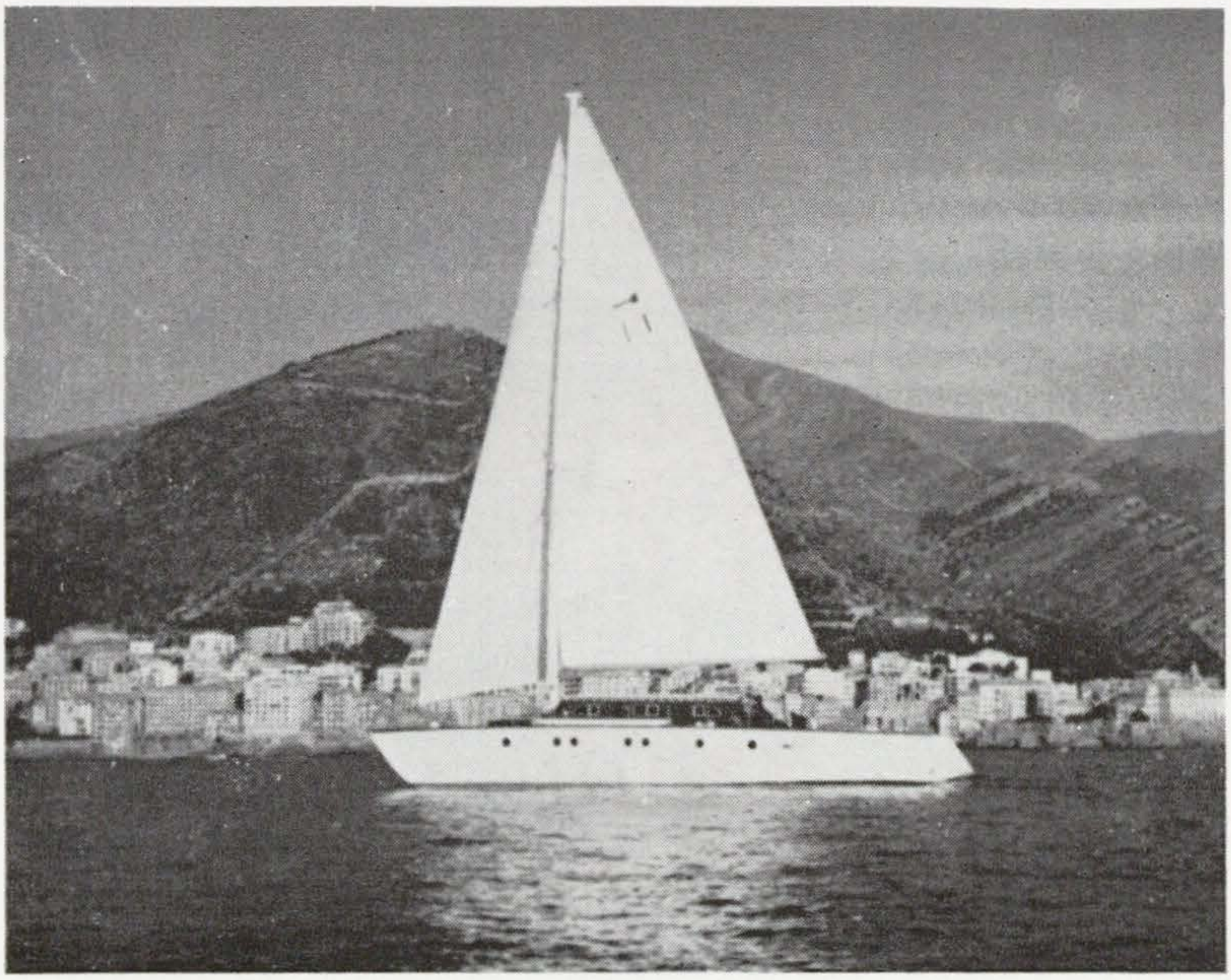
Rapallo, Piazzale Funivia, Italia

L.O.A.	60 ft	Sail Area	2,100 sq ft
Beam	20 ft 6 in	Engines, two Diesels of 35 hp each	
L.W.L.	47 ft	Speed under power	10 knots
Displacement	11 tons	Speed under sail	18 knots

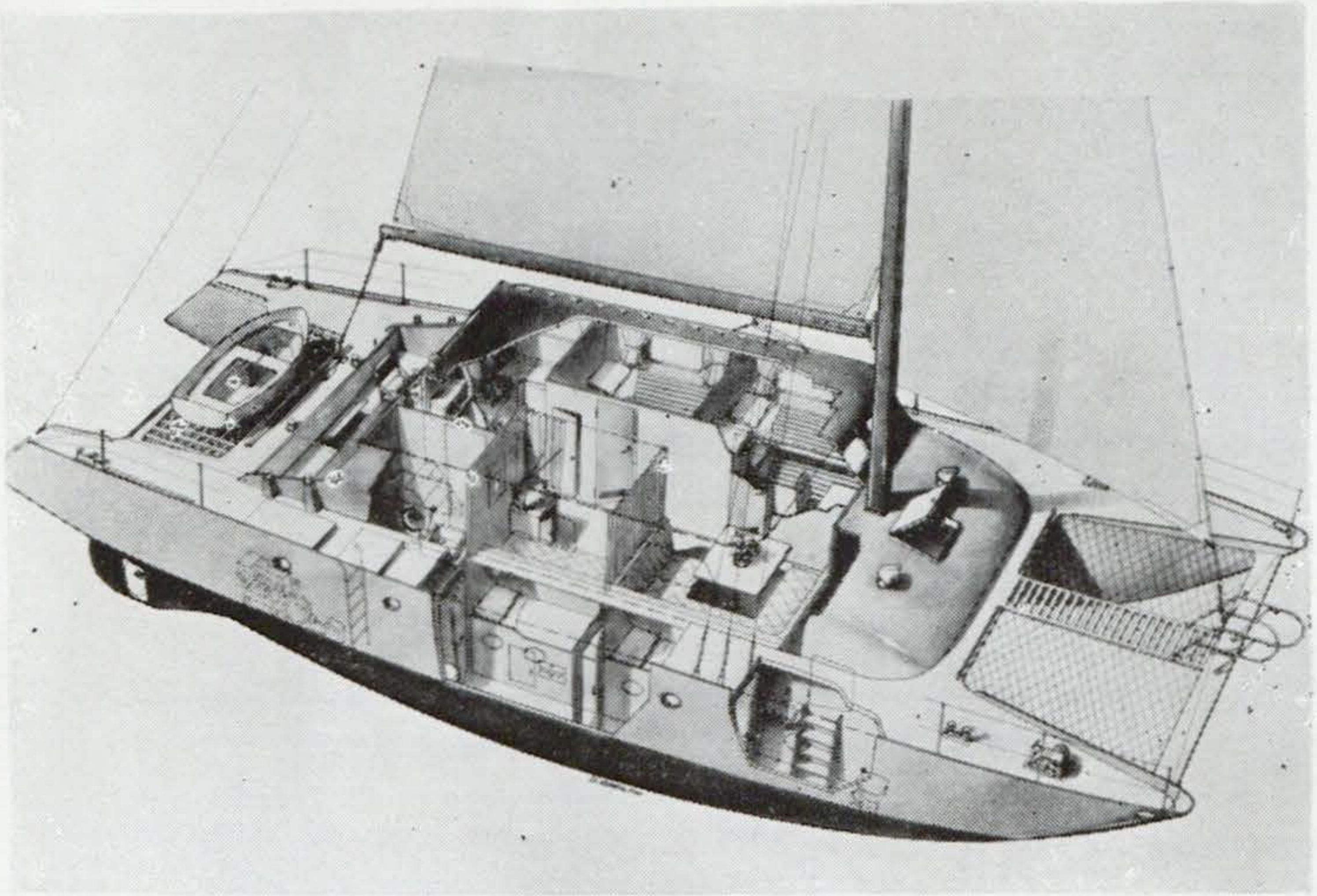
Designer: Captain Dario Salata

I think this is one of the biggest catamarans in the world. *POLARIS* has two two-berth cabins, four single-berth cabins, three toilets, one dining room, one drawing room in which two persons can sleep and a large galley and plenty of room for sails, storing, etc.

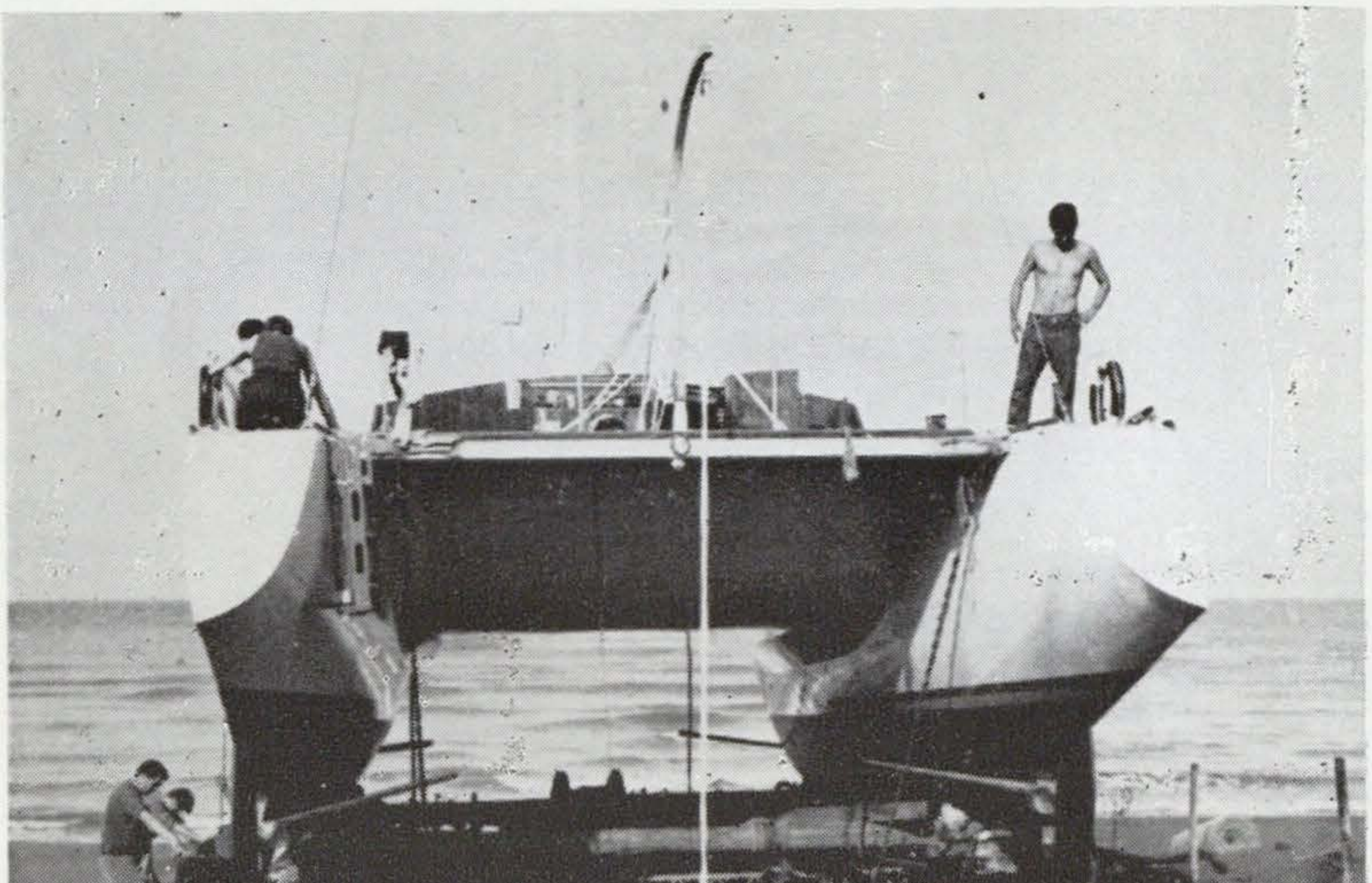
I have designed the *POLARIS* after having studied for a long time the shape of the hull (particularly the asymmetrical shape), the construction and



POLARIS



POLARIS



POLARIS

all the other things which are especially important in so big a catamaran. The appearance of the boat is very agreeable and the cabin is not too prominent, though the height inside is 6 ft 6 in.

Performance

POLARIS can be easily steered and can reach very high speeds. Her performance is much better than in an ordinary single hulled boat. She is an excellent racing boat with all the comforts of a very fast motor sailer.

POLARIS is seaworthy. The tendency to pitching is normal and not at all excessive. If she were smaller, however, this might be greater but with her L.W.L. of 47 ft, and with the distribution of weight and the shape of the hull, it is easy.

Owing to the shape of hull, putting about is easy and when sailing to windward, she has reached a speed of 10-12 knots with a real angle from the true wind direction of 46°. The wind speed on this occasion was 12 meters per second (24 mph).

POLARIS is faster than racing and cruising single hulled boats both close hauled and reaching. She has a very big spinnaker of about 2,600 sq ft which gives her good performance running.

The mast is an aluminium spar made in Italy. The construction is in a special laminated wood and plywood planking.

POLARIS was built by Cantiere Navale di Doncratico (Livorno). The sails are, of course, Salata Sails.

BLUEFIN

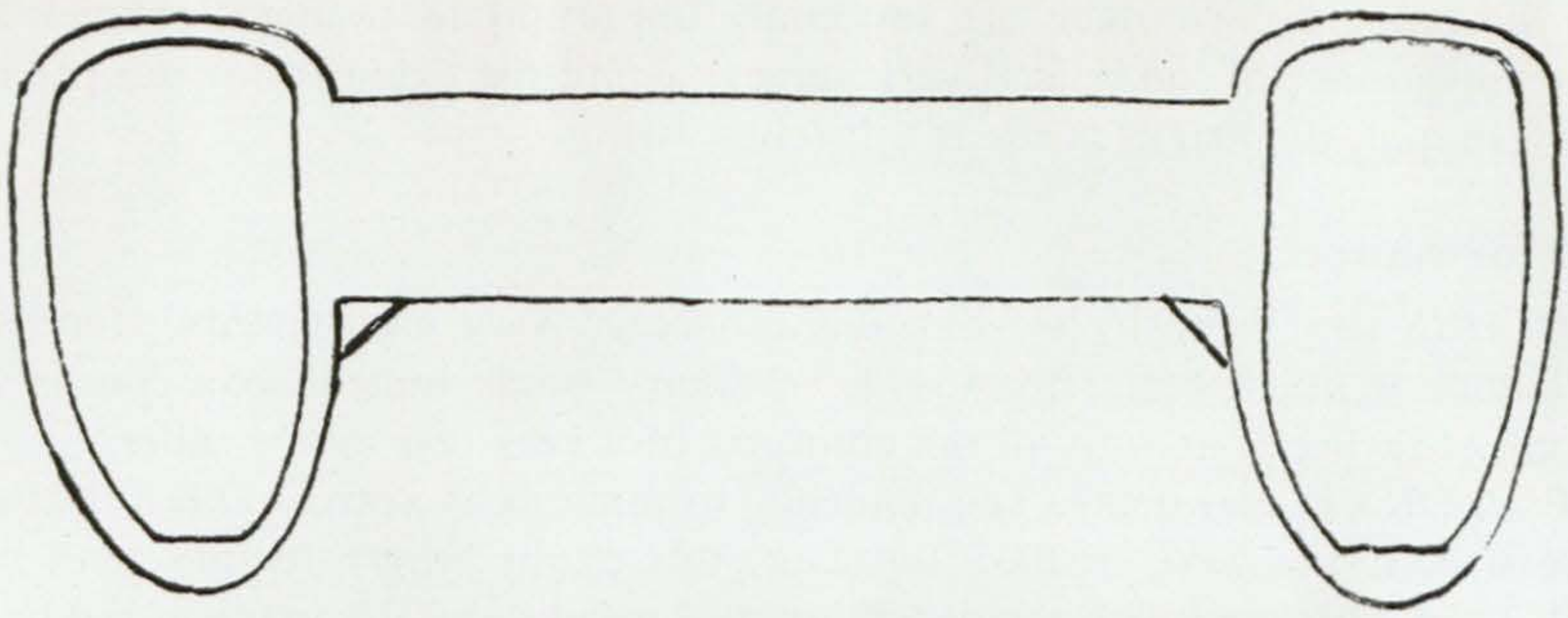
January, 1963

Designer, Builder and Owner: Tom Dowling

L.O.A.	29 ft 3 in	Draught with C.B.	5 ft 10 in
L.W.L.	28 ft	Clearance of centre section	2 ft 2 in
Beam	14 ft	Weight empty	3,400 lbs
Beam on W.L.	2 ft 1 in	Rig: Masthead Bermudian with Genoa	340 sq ft
Breadth between centrelines	10 ft 6 in	Mast height above deck	38 ft
Draught light	1 ft 1 in	Speed under power on measured mile	7 knots
Draught loaded	1 ft 4 in		
Engine	Johnson 10 hp		

Construction

Moulded fibreglass hulls 5 mm thick with compound curvature virtually throughout, offered up to sandwich construction beams of fibreglass on Onazote, six in number, each being one piece from side to side as in the drawing. These allow unobstructed hulls throughout the length. There is local stiffening to the hulls in the form of shelves, furniture or battens throughout. The deck is an Onazote plywood sandwich between centrelines in the centre section only.



Hull Form

The entry is very fine running into a "Sewer section" and out into a flattish run off aft. The transom is a semi-oval below. The deepest part of the keel line is 11 ft aft of the bow.

The centreboard is hung in an open support work below the centre section. It is pivoted and when lowered, the upper end rises in a keel-box in the centre section to the level of the deck.

Accommodation

The hulls are separate to keep the height and windage down and to leave a large unobstructed deck and cockpit area between. There is headroom in each hull, where the entrances from the cockpit are and for 2 ft forward of this, giving headroom for cooking and navigation. Each hull has a bunk in the stern. The port hull has the galley which is placed in the bridge deck. The cook stands in the hull with the working area (4 ft 3 in × 3 ft 3 in × 2 ft 2 in) towards midships. Forward of this are folding tables and seats for eating. The next bay forward of the galley is storage and in the bows is a bunk.

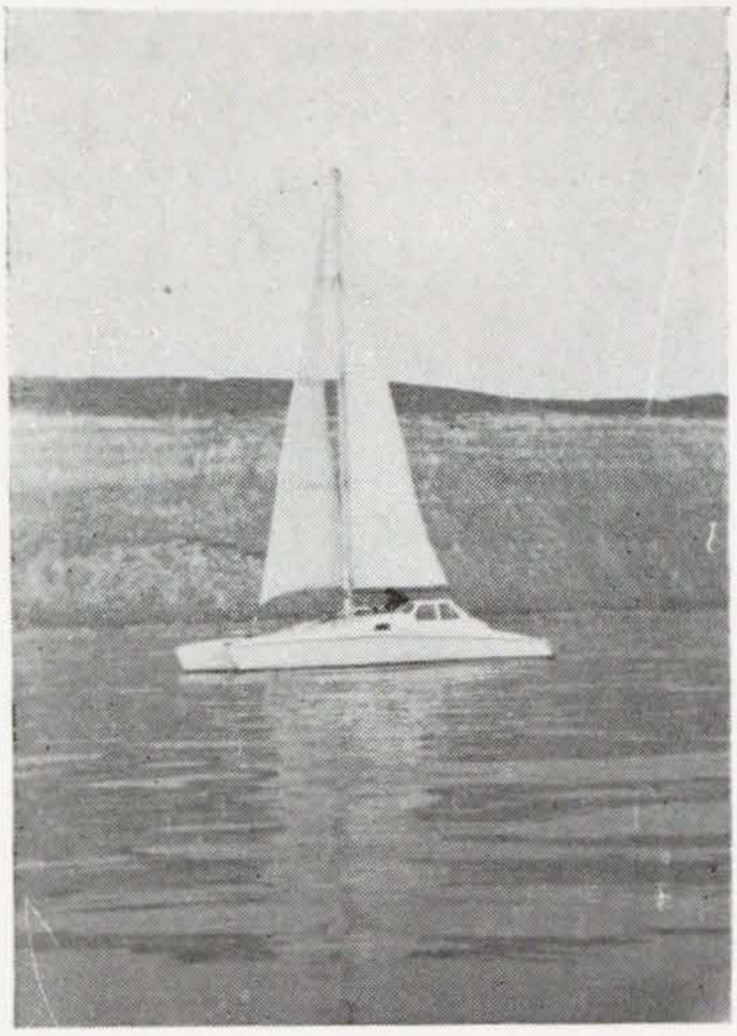
On the starboard side, opposite the galley space is a chart table convertible to a double bunk athwartships with access forward underneath. Forward of this is the sail locker, heads and stores.

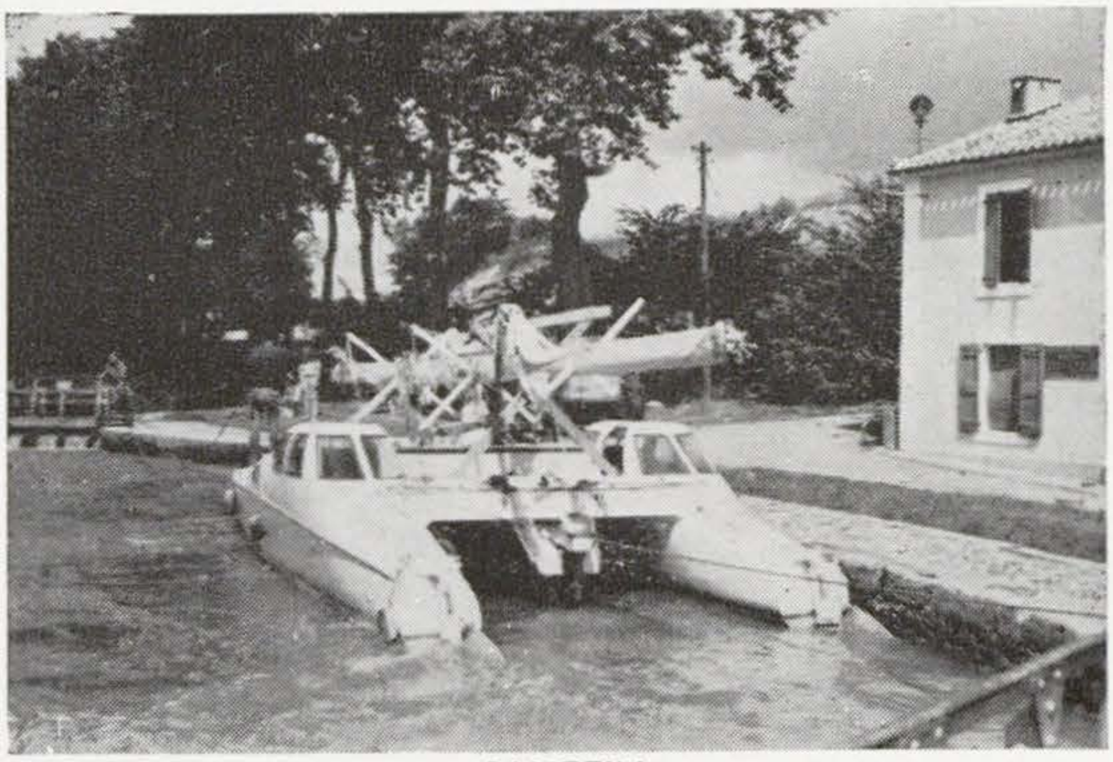
History

Designed and built by the owner in Malta as a fast cruiser, she was finished last year but too late in the season to get further than St Tropez. She was therefore pulled up on the beach for the winter during which modifications were made to the keel. This spring, she made the passage to the U.K. via the Midi Canal and Bordeaux without incident. The crew varied between solo (for 220 miles) and five, but three or four are found to be best. The motor was never used at sea.

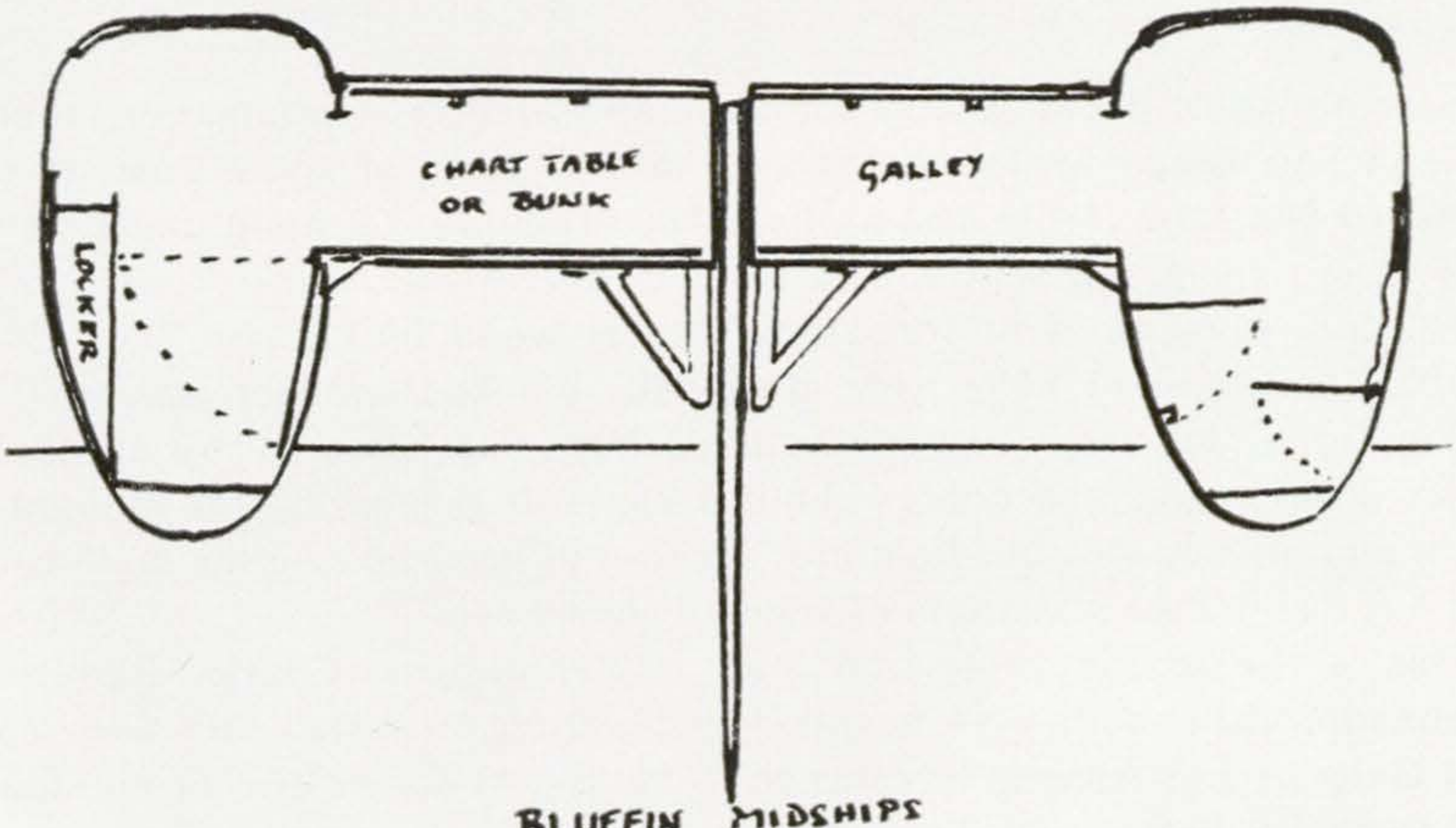
Performance

Maximum speed so far is believed to be 15 knots. The windward performance is much the same as a normal yacht up to 50 square meters, better in a lop.





BLUEFIN



Ed: Two points are of a great interest in BLUEFIN. The first is the efficiency of the roller reefing gear which allows the whole sail to be set from the stowed position in half a minute or less. The sail can be reefed or stowed in even less time. The second point is that the original mast 38 ft long and 1 ft in fore and aft length by 2¾ in thick was a good enough aerofoil to sail the boat on a beam course without any sail whatever being set. Onlookers thought that there was an inboard engine. The value of this is that aerofoil masts can be of value if only slightly larger than the one used here.

Letter from: Norman A. Cross, 4326 Ashton, San Diego 10, Calif.

Norman Cross' 36 ft Catamaran

Dear Sir,

Here are some drawings and a photograph of a 36 ft catamaran sailboat built in San Diego by Frank Perugini in two years of spare time. It was launched last June (1961) and we have been running it around under power only. The rigging and sails will be installed this winter.

The hull is made of fir frames, fir and plywood bulkheads. The skin is double ¼ in plywood 12 in wide, diagonally planked and fibreglassed. This makes for a nice easy compound curved hull. She has an 8 hp air-cooled Lister diesel engine and cruises about 6 knots. It is amazing the amount of room and privacy that this boat has. Six foot of headroom in the main cabin and 6 ft 6 in in each stateroom of which there are four.

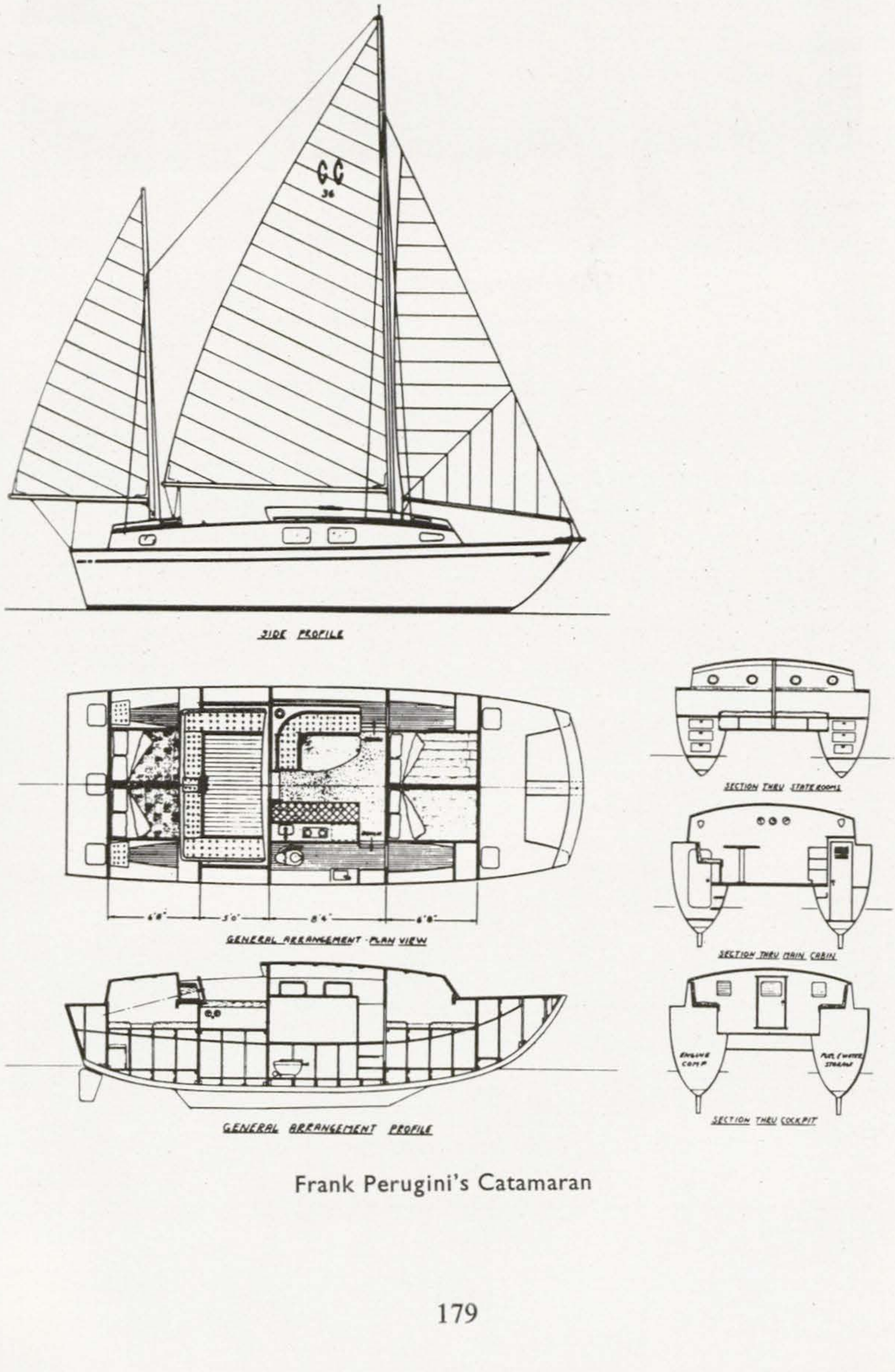
This is the second catamaran built to my designs. Charles Barrett of Coronado, Calif. built a 44 ft and is just waiting to install sails and mast. Gill Galer of Los Angeles has started to build a 41 footer also of my design and there is a 26 ft cat on the board now.

I enjoy designing catamarans and would like to attempt a trimaran. I had a chance to buy a 24 ft Piver trimaran last spring which was a year old. It has the old style outriggers on it which I hope to change this winter.

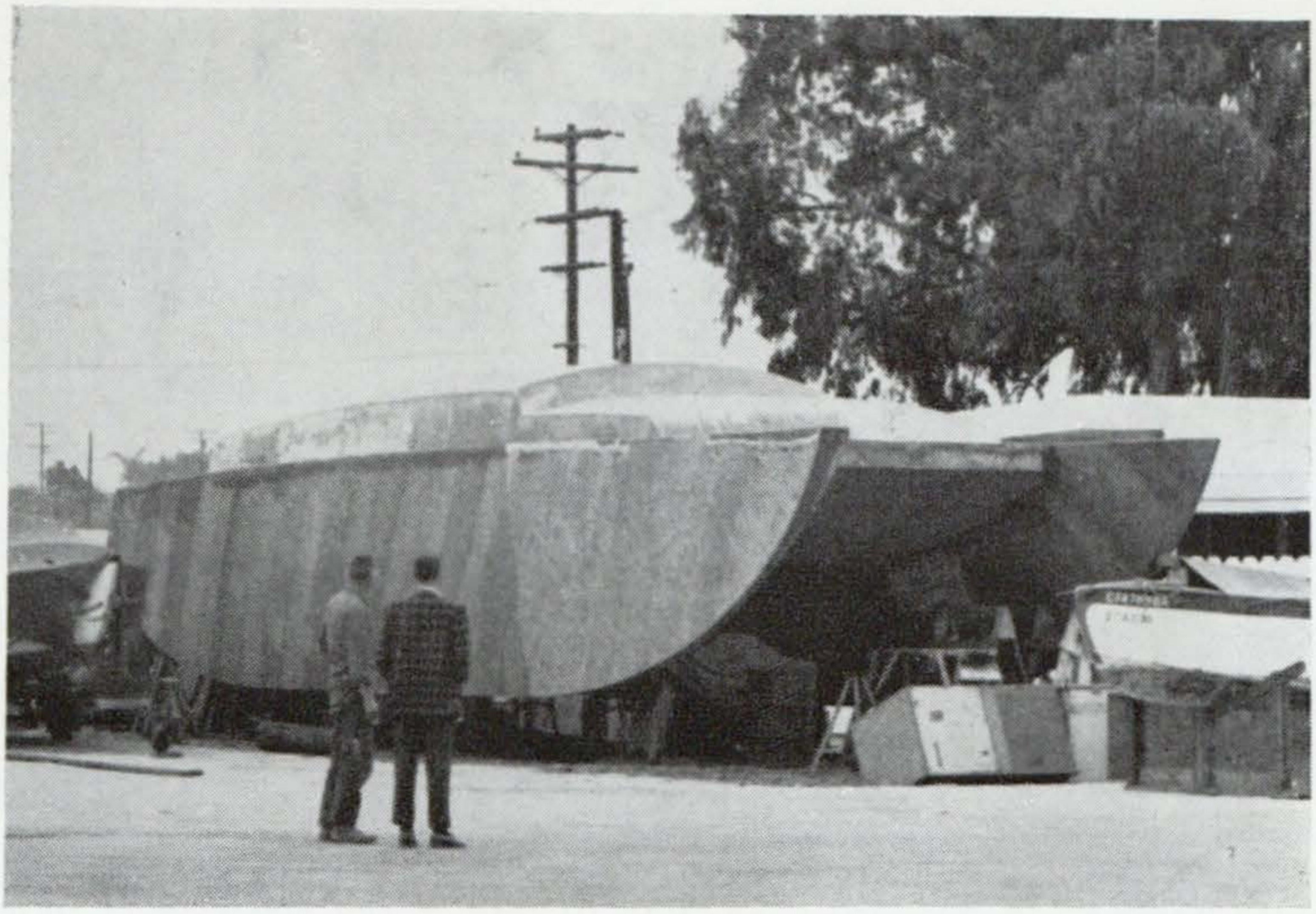
I have really enjoyed and have benefited greatly from all the AYRS publications.

Norman A. Cross

Ed: Note low A.R. keels.



Frank Perugini's Catamaran



Frank Perugini's Catamaran

CHAPTER XVI

RUNNING RESISTANCE VERSUS SPEED OF SAILING MULTI-HULLS

October, 1963

by Edmond Bruce

Lewis Cove, Hance Road, Fair Haven, N.J., U.S.A.

Introduction

Now that AYRS has a laminar towing tank of its own, near headquarters, it seems appropriate that data on measurements should be presented for some easy to duplicate models which will permit the various similar tanks to compare and equalize results. These data also should be of considerable interest to designers of multi-hulls. With this in mind, I am providing data from my N.J., U.S.A. tank on what one might call a "multi-hull reference series." In addition, several variations from these reference forms will be studied.

There are at least two optional systems of employing models to obtain predictions of the performance of full size hulls. In the writer's article in AYRS No. 30, a laminar variation of the "absolute" or quantitative system was described. This system was devised by William Froude who first proposed separating a *single* model's frictional and pressure components of resistance and separately scaling them to full size, where they were recombined.

In the above process, Froude used the frictional resistances of flat surfaces to represent those of rounded three-dimensional surfaces of equal area. He also treated frictional and pressure resistances as if they were directly additive without mutual relationships. These last two devices have caused some controversy among theoreticians, but they have survived, since experimentally this works quite well, even if over-simplified in concept.

Practical experimenters have on occasion used a second "comparative" or qualitative system. Here, *two or more* different models of the same weight are compared as to total resistance. No separation of component resistances are attempted. The assumption is made that the better model hull would also be qualitatively better at full scale. Theoretically, this seems reasonable with a possible reservation of judgment when the total resistances are nearly equal. If the wetted areas should be the same, no doubt exists. Usually, a designer is satisfied to know definitely that one shape is better than another even if the degree is approximate.

In the following discussions, the comparative system is being presented as a demonstration of the method. It is simple and effective. It may become popular for this reason. However, if one desires more accurate quantitative answers, the model's wetted areas will be stated so that one can transform the results of a final selection to full size resistance magnitudes by the skin or frictional resistance corrections described in the writer's article in AYRS No. 30. As the model speeds will extend into the transitional range, above

Reynolds' Numbers of 3×10^2, the frictional coefficient may be considered constant in this range. However, it does not matter greatly since the pressure resistances dominate at these high model speeds.

Whereas mono-hull sailing craft are restricted to hull designs which provide good lateral stabilities, by virtue of geometric form or by low centres of gravity, multi-hull sailing craft do not have these restrictions. For their ability to carry sail to windward, multi-hull craft rely on combinations of spaced hulls to give the necessary lateral stabilities.

This article will discuss model measurements made in the laminar flow towing tank of total running resistances without leeway. These will be stated as a function of speed, for various shapes of an individual hull, of a multi-hull configuration, without regard to its lateral stability.

The writer has a "reference series" of models of low lateral stability. This series does not necessarily possess the best shapes possible. It is intended to provide easily constructed comparison forms which are not only low in resistance but are of such a simple shape that their displacements, wetted areas, prismatic coefficients, etc. can be calculated readily from their dimensions. These models can be turned in a lathe with the aid of a profile template. If a proposed form is not at least as good as its equivalent reference form, in resistance characteristics, the wisdom of its construction at full size is doubtful.

Reference Series

The well known "Taylor Standard Series" of models is of little interest to the designer of multi-hulls. Taylor used mid-sections which were more or less rectangular with slight rounding at the lower corners or bilges. This shape was essential to give lateral stability during broadside gun-fire on naval ships. They also provide usefully shaped cargo spaces in merchant ships.

The multi-hull designer need not worry about lateral stabilities of the individual hulls. For this reason, he can achieve less wetted surface and the resulting lower friction by discarding lateral stability. This leads to the semi-circular cross-sections, below the water-line, which are so much in vogue. This shape encloses within its plane, the greatest buoyancy area for any given wetted perimeter. Because of this, the reference series uses semi-circular wetted sections throughout its length.

The reference series also uses submerged profiles which are portions of a circle. In fact, if a segment of a circle is rotated by a half-revolution about its chord, as an axis, the under-water reference form is generated. Various models in the series differ only in their water-line length-to-beam ratios. All reference models are of such a size that their displaced volumes and total weights are equal. All have good prismatic coefficients. All have beam-to-draft ratios equal to 2·0.

The partial-circular profiles were selected since hull resistances are the result of the rate of acceleration or deceleration of masses of water. A gentle curvature, having the greatest possible radius, stretches the work timewise and causes the least acceleration.

The above profile proposal is a good first approximation to an ideal shape. It is also a form which can be steered readily to obtain rapid turning or tacking. It may require modification due to such factors as the shape of the hull's surface waves generated alongside at some particular speed. Also, the "stalling" angles of all portions of the wetted hull's after surface, in respect to its direction of motion, must be considered. For simplicity, the reference series employs only profiles which are circular segments. Other profiles employing modifying factors are studied separately in a series of experiments.

Five reference models have been built as illustrated in Fig. 1. All are ballasted to weigh 110 grams which gives the desired displacement. This ballast is located amidships and low so as to give some small degree of gravitational stability to enable the testing of single hulls. These models differ only in their length-to-beam ratios which are 3, 5, 8, 12 and 16. The models will be referred to by these numbers in the discussion which will follow.

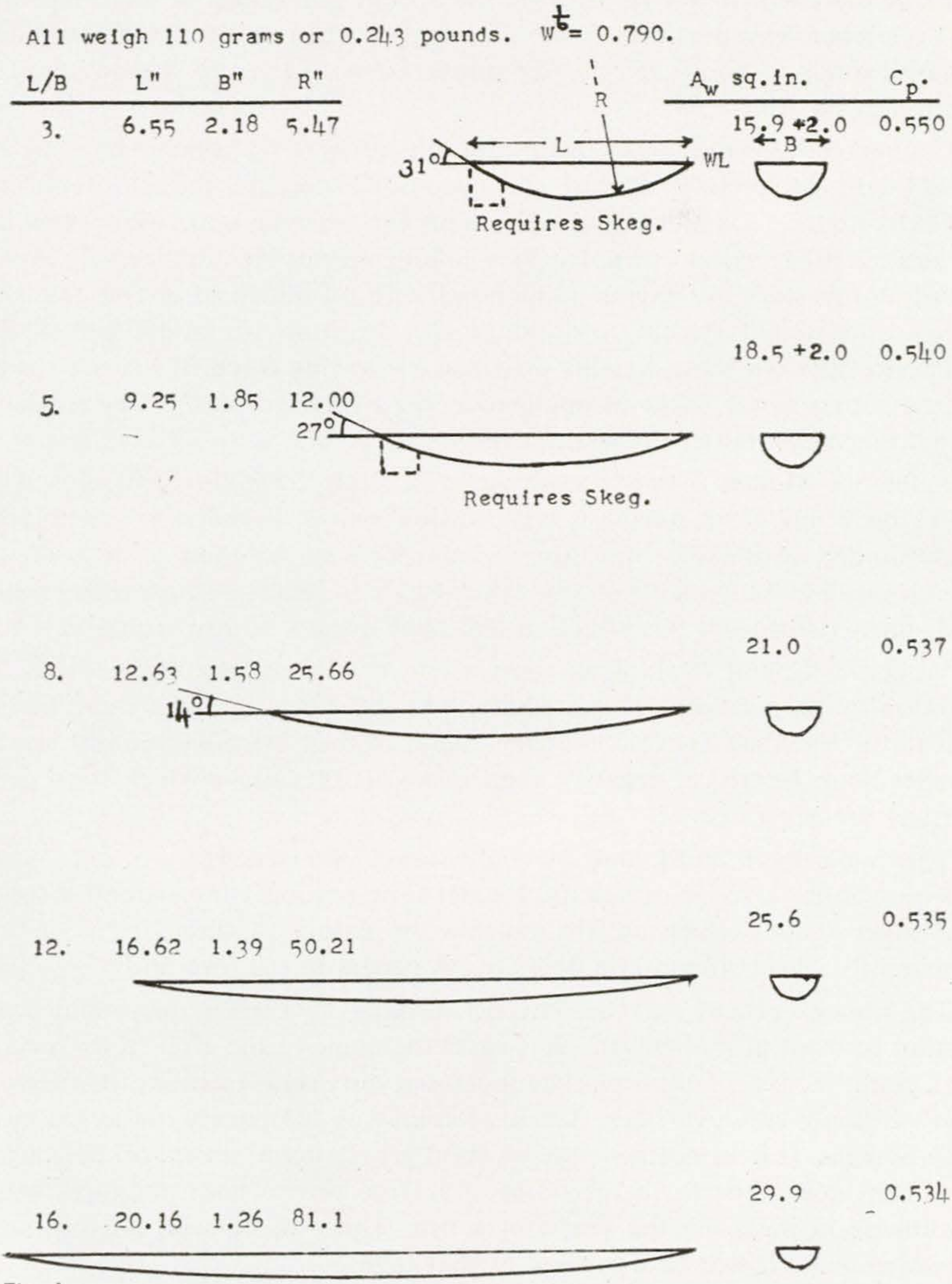


Fig. 1

The Stalling Angle

Why does a flag flutter in a breeze? It is for the same reason that so many dinghies and sailing hulls snake back and forth like a fish's tail when one tries to tow them with a power boat. These are all unstable forms.

In order to damp out the described fluttering motion, skegs, keels and centreboards are usually used. As a last resort, rudder action is additionally employed. Such counter-measures are down-right bad design. It is generally much better to eliminate faults at their source rather than to counter-act them. The mentioned measures do not get rid of the causes of this excess resistance and unstable turbulence.

The faults in the above craft are called "stalling" which is well known to airplane designers. These result from the abrupt generation of whirling water vortices when any portion of the after-body wetted surface area exceeds a negative angle of about 15° plus or minus a few degrees to the direction of motion of the hull.

Commercial towing tanks with multiple restraining attachments to the model hull, from an overhead carriage, often obscure the nature of the difficulty under discussion. Chapman, in his early towing tank, used a tow-line through a pulley system actuated by a falling weight. He undoubtedly experienced flutter since his layout is pictured with an added after-end tow line, pulley and weight system to stabilize the direction of model travel. The difference between these weights provided his towing force. It takes a towing means with a single point of application on a forward part of the model to reveal the vortex flutter under discussion.

Reference Models 3 and 5 both suffer severely from this difficulty. They snake back and forth during a tank towing test. It is necessary to stabilize these models with skegs, one square inch per side, on their after bodies to obtain speed measurements of any value. I hate to reflect on how many sailing craft must suffer from this affliction and their owners do not realize it.

Models 8, 12 and 16 show no signs whatever of fluttering when towed. No stabilization appendices are necesssary. The difference between these models and those described above is that the angles of their stern wetted surfaces are smaller than the critical negative angle of about 15°, above which stern water vortices are generated.

The book by Prandtl and Tietjen entitled APPLIED HYDRO AND AERO-MECHANICS has a series of beautiful water-flow photographs around a sphere and other shapes which clearly indicate the nature of these stern vortices. Apparently, clean stream-line flow always occurs in the fore-body.

The above vortices may be why fish usually have their maximum cross-section forward of mid-length. This eases the angle of the after-body surfaces with the direction of motion. The increased curvature resulting in the fore-body does not cause vortices. A fish, of course, is completely immersed in it's environment. It does not generate harmful gravitational waves on the surface as a boat does. Due to the presence of surface waves, boat designers would be unwise in imitating the shape of a fish. This will be seen later in some measurements. It will be discussed at that time.

Returning to the problem of stern vortices affecting the behaviour of a boat, cut-and-try experiments over many years have revealed that performance is somewhat improved by broadening and flattening the after-body on many boats. In the writer's opinion, one of the reasons this is helpful is because this is a fortuitous method of reducing the angle of the surface to the direction of motion. Beware of double-enders which have low length-to-beam ratios!

Multi-hull designers seldom use low length-to-beam ratios, therefore the flattened stern trick may need further investigation in their case. We will examine this subject later.

Comparison of Reference Series

Before presenting the measured data of resistance versus speed, the dimensionless coordinates used in its graphs should be reviewed briefly. In AYRS No. 36, the writer described how the speed-length ratio $V/\sqrt{L}$ and the speed-weight ratio $V/W^{\frac{1}{6}}$ were equally good for scaling so that the model's pressure resistance-to-weight ratio R_p/W applies likewise to the hull at full size.

Displacement hulls, particularly at low length-to-beam ratios, meet a squatting "hull speed" barrier which begins at $V/\sqrt{L} = 1{\cdot}34$ and peaks at 1·78. At 1·34, the length of the wave of water, generated alongside, just equals the waterline length of the boat. At 1·78, three-fourths of the length of a water wave equals the length of the boat. If this speed barrier is dominating, it seems quite proper to designate speeds of various sizes of boats, with the speed-length ratio as Froude proposed. Most bumps and hollows in resistance curves are due to the relation of boat length to the length of its formed water waves. This will be demonstrated later using measured data.

For planing hulls and for hulls having a high length-to-beam ratio, the "hull speed" barrier can be penetrated by extreme power or because of low amplitude waves, respectively. For these higher speeds and also for the low speed range, it is quite unfair, as will be shown later, to make comparisons of the merit of boats based on the same value of $V/\sqrt{L}$. This penalizes length even in those cases where excess length, resulting in too much wetted surface, is not effective in producing speed. For this reason, the writer prefers the speed-weight ratio $V/W^{\frac{1}{6}}$, which is also used in the British "Circular Unit System" as "circular K," except that pounds will be used for small boats rather than tons for ships. This is particularly accurate when all models have the same weight. This is the case for the models to be discussed. Using the speed-weight ratio, it is the designer's free option how he distributes a given weight of material. The data will be presented in this form as well as with the conventional speed-length ratio.

Since water resistance curves are more or less square law with speed, the steepness of such curves tends to conceal small variations which may be of interest. Thus by using the graph coordinates, as presented, and saying that the ordinate $R_t/W\,\%$ is a function of the abscissa squared, that is $K_t\,(V/W^{\frac{1}{6}})^2$, one gets the simply derived and proper total coefficient $K_t = \dfrac{R_t/W\,\%}{(V/W^{\frac{1}{6}})^2}$. This is sensitive to other than speed variations. It is much easier to use this coefficient than the conventional coefficients which are related to wetted surface areas. These are hard to determine when rough wave profiles are generated or when any degree of planing or squatting is involved. When speed is related to weight, one is dealing with a fixed quantity which is easily measured.

The measured data on the five reference models, whose dimensions are shown in Fig. 1, are given in Table A, so that the reader may compare with them or employ them as he chooses. The static wetted areas A_w and the prismatic coefficients C_p also appear in Fig. 1. Graphs have been drawn to help analyze these data.

MEASURED TOTAL RESISTANCES FOR MULTI-HULL REFERENCE MODELS OF FIG. 1.

All Models:

Weight = 110·0 grams or 0·243 pounds. $W^{\frac{1}{3}} = 0{\cdot}790$.

Fresh Water. Temperature 55°F. $\mu/\rho = 1{\cdot}30 \times 10^{-5}$.

L/B	Symbol	Rt/W%	1·10	1·69	2·51	3·66	5·07	6·74	8·83	11·4	16·5	23·2
3	○	V knots	·577	·680	·811	·930	1·01	1·07	1·12	1·18	1·28	1·40
5	□	,, ,,	·681	·847	1·00	1·12	1·20	1·28	1·35	1·47	1·83	2·51
8	△	,, ,,	·750	·976	1·15	1·33	1·48	1·65	1·78	2·05	2·60	3·21
12	×	,, ,,	*·814	1·01	1·23	1·48	1·72	1·90	2·11	2·47	2·96	3·53
16	●	,, ,,	·770	*1·02	*1·24	*1·52	*1·78	*2·07	*2·37	*2·66	*3·11	*3·65
3	○	$V/\sqrt{L}$	*·781	·922	1·10	1·26	1·37	1·45	1·52	1·60	1·73	1·90
5	□	,,	·777	*·965	*1·14	1·28	1·37	1·48	1·54	1·67	2·08	2·86
8	△	,,	·735	·957	1·13	*1·30	1·45	*1·62	1·74	2·01	*2·55	*3·15
12	×	,,	·690	·858	1·04	1·25	*1·46	1·61	1·79	*2·09	2·51	2·99
16	●	,,	·595	·788	·958	1·17	1·38	1·60	*1·83	2·05	2·41	2·82
3	○	$V/W^{\frac{1}{6}}$	·730	·861	1·03	1·18	1·28	1·35	1·42	1·49	1·62	1·77
5	□	,,	·862	1·07	1·27	1·42	1·52	1·62	1·71	1·86	2·31	3·18
8	△	,,	·949	1·24	1·46	1·68	1·87	2·09	2·25	2·60	3·30	4·07
12	×	,,	*1·03	1·28	1·56	1·87	2·18	2·40	2·67	3·12	3·75	4·47
16	●	,,	·976	*1·29	*1·57	*1·92	*2·25	*2·62	*3·00	*3·37	*3·94	*4·62
3	○	K'	2·06	2·25	2·34	2·54	3·06	3·66	4·34	5·07	6·21	7·32
5	□	,,	1·48	1·47	1·56	1·81	2·20	2·56	3·02	3·30	3·09	2·52
8	△	,,	1·22	1·11	1·18	1·30	1·45	1·54	1·74	1·69	1·52	1·40
12	×	,,	*1·04	1·03	1·03	1·04	1·07	1·17	1·24	1·17	1·17	1·16
16	●	,,	1·15	*1·02	*1·02	*·993	*1·00	*·982	*·982	*1·01	*1·06	*1·09

TABLE A. $Kt = \dfrac{Rt/W\%}{(V/W^{\frac{1}{6}})^2}$. Since weights are equal, $V/W^{\frac{1}{6}} = 1{\cdot}256\ V$.

*Note: *indicates fastest in group.*

Fig. 2 is a conventional plot of R_t/W versus the speed-length ratio $V/\sqrt{L}$ for all five reference models. It gives the impression that, at middle and the higher speeds, it is hard to choose between Models 8 and 12 as being best. The advantage alternates back and forth at various speeds. At the lower speeds, Fig. 2 and Table A show that lower length-to-beam ratios are preferable. This is due to smaller wetted areas as will be seen by referring to Fig. 1. It would be still more marked if Models 3 and 5 did not suffer from stern vortices and require skegs. This region is the weakness of many multi-hulls. It is further emphasized by having the wetted surface inefficiently distributed among several smaller hulls rather than on one larger hull of the same displacement. At high speeds, multi-hulls are in their glory but they need wind. For good performance over a wide spectrum of speeds, the writer would choose Model 8.

Another comment about Fig. 2 is that if one is required to design to some particular length, a high length-to-beam ratio will force a very light displacement and can be used only for frail racers. For comfortable cruising displacements and roominess, there is no alternative to choosing a lower length-to-beam ratio. Here again Model 8 seems a good answer.

If one is not racing under some speed-length rule but ardently wants the fastest boat, for a given displacement, a different choice of models might result. This may be seen by comparing the speeds V in Table A. When these are graphed in terms of the speed-weight ratio, in which weights are equal, Fig. 3 shows the results.

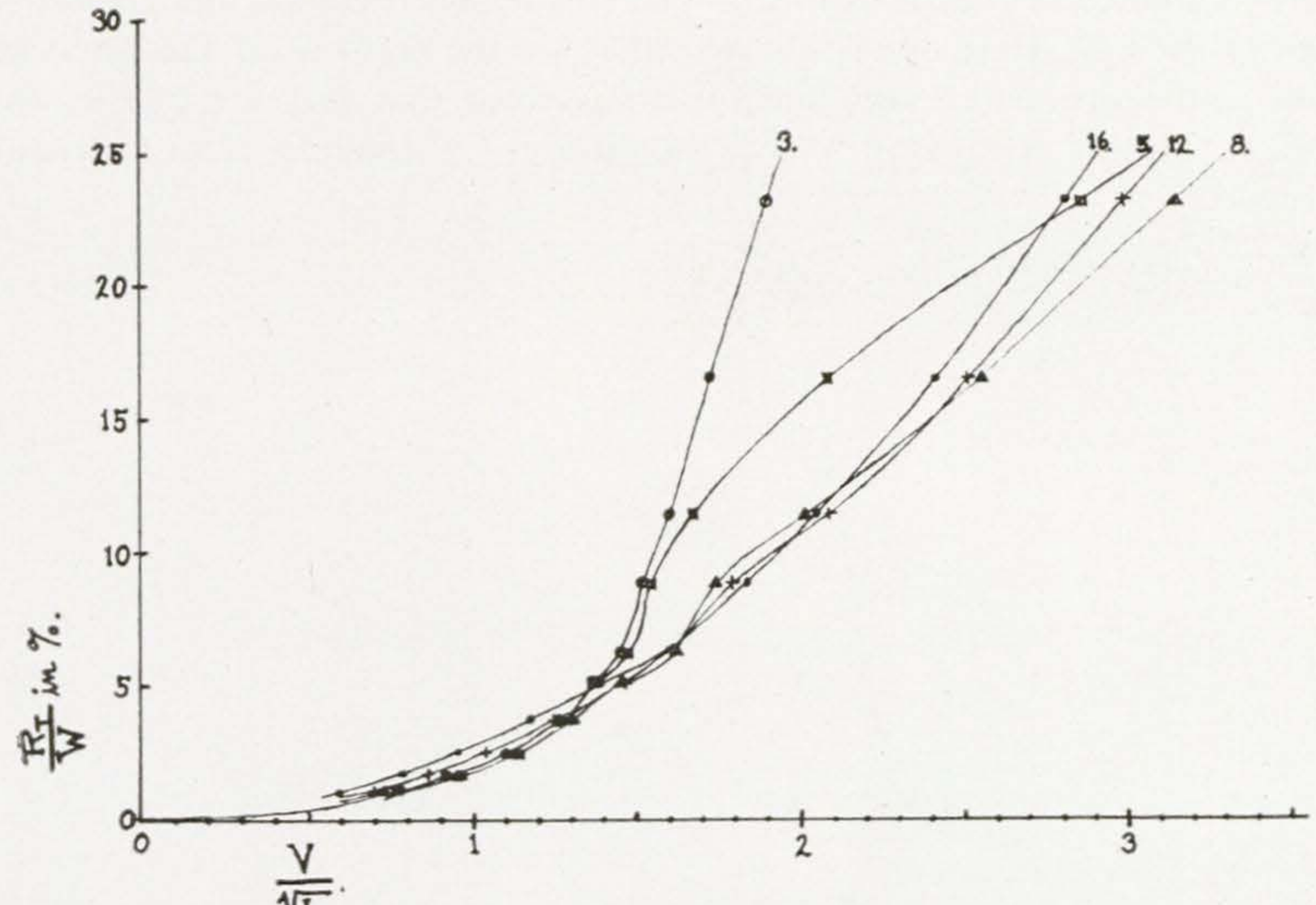


Fig. 2

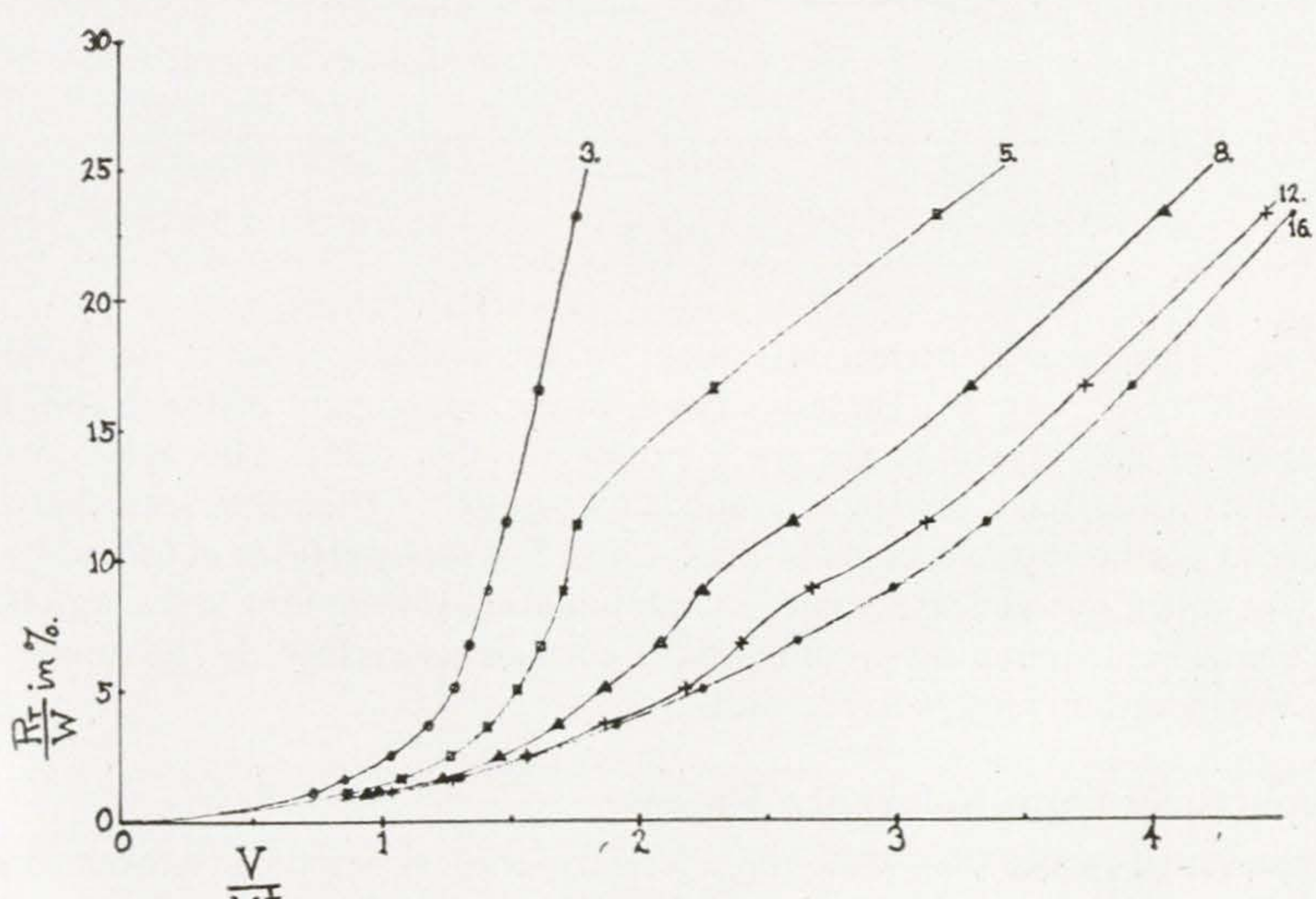


Fig. 3

In Fig. 3, Model 16 is fastest in the middle and upper speeds. At low speeds, Models 8 or 12 would be preferable. For a fast boat, the writer would choose Model 12 as a compromise since light air is so often encountered. In strong winds, the high potential speed of Model 16 may not be a wise choice because rough water usually accompanies strong winds and may force discretion.

As was stated previously, one gets a more sensitive or a "blown up" view of variations, other than speed, when the total resistance coefficient K_t is examined. In Fig. 4, it is plotted against $V/W^{\frac{1}{6}}$. This graph confirms the merits discussed in regard to Fig. 3. The smaller K_t becomes, the greater the merit of the hull. Here one might ask what are the reasons for the coefficient peaks in the various curves? Since it is suspected that they are due to wave profiles, plotting K_t against $V/\sqrt{L}$ should give information. This was done in Fig. 5.

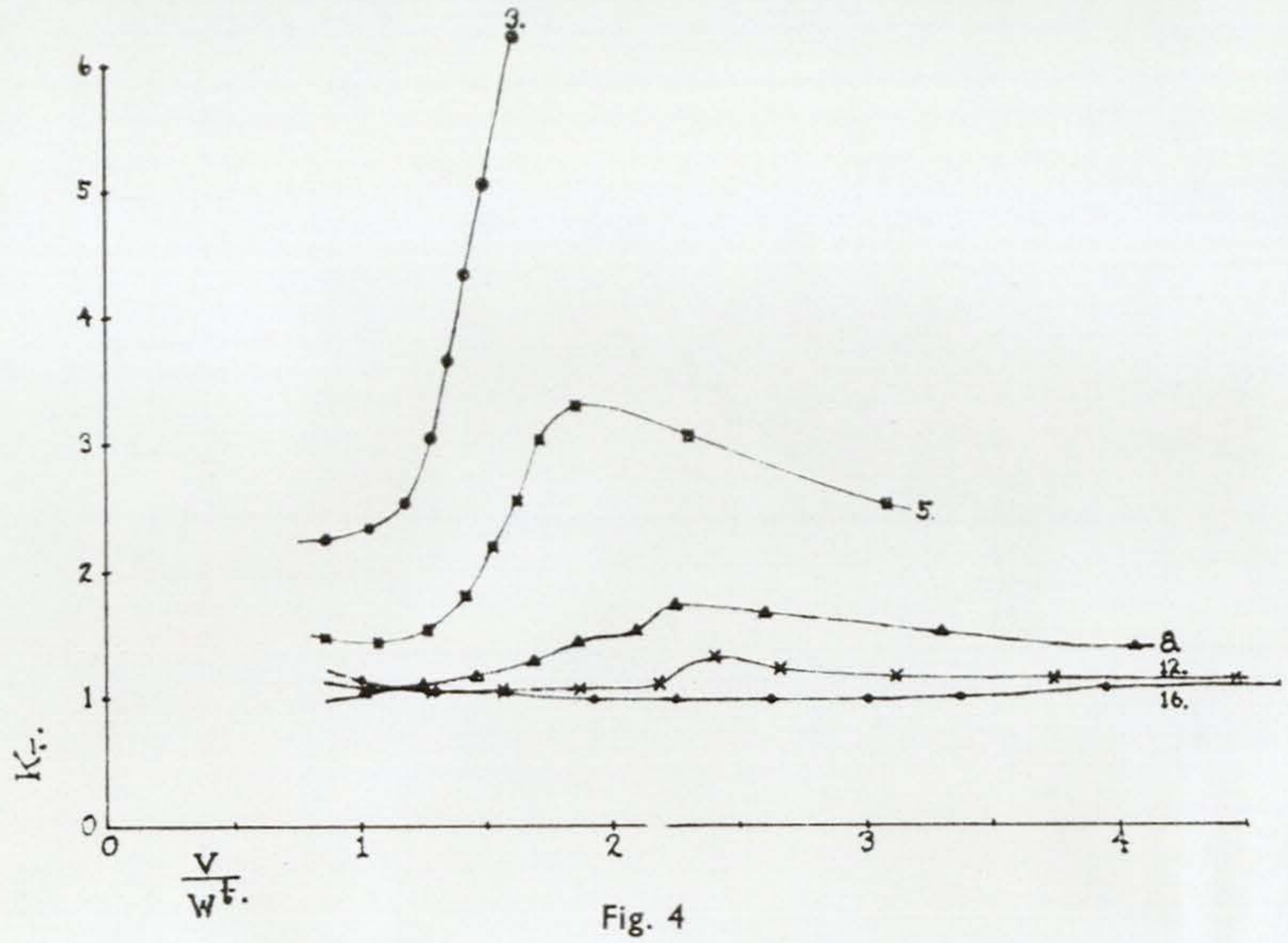


Fig. 4

Fig. 5 produces a perfect alignment of the resistance peaks of K_t at a speed of $V/\sqrt{L} = 1{\cdot}78$. There is drawn, in the upper right of the graph, the relation of hull length to the wave profile for this value. This relationship produces an extreme tendency to squat by the stern. Thus it is seen that the study of coefficients, as shown in Figs. 4 and 5, is a powerful tool for analysis. In fact, when one gets experience in manipulating towing tank data, a preference may be acquired for employing the coefficients exclusively in comparing the merits of differently shaped hulls.

Departures from Reference Shapes

It was stated earlier that while the reference series' geometry produced forms of low resistance, compared to many other forms, certain departures from the reference shape might produce further gains. Some of these possibilities now will be examined.

First, a study will be made of the effects of placing the maximum immersed cross-section at points other than mid-length. To avoid an extreme value of L/B, Model 12 will serve as the reference. A model was constructed which was the equivalent to Model 12 in all respects except that the maximum section was shifted to a point at one-third the hull length. By towing this model both forward then backward and comparing with Model 12, Fig. 6 was produced. Here the abscissa is again $V/\sqrt{L}$ to study wave relationships Since the length is unchanging, this speed-length ratio is now proportional to speed so direct comparisons of merit can be made. Note that the scale of K_t now has been magnified 10 times to prevent crowding and to make the conclusions easier to determine.

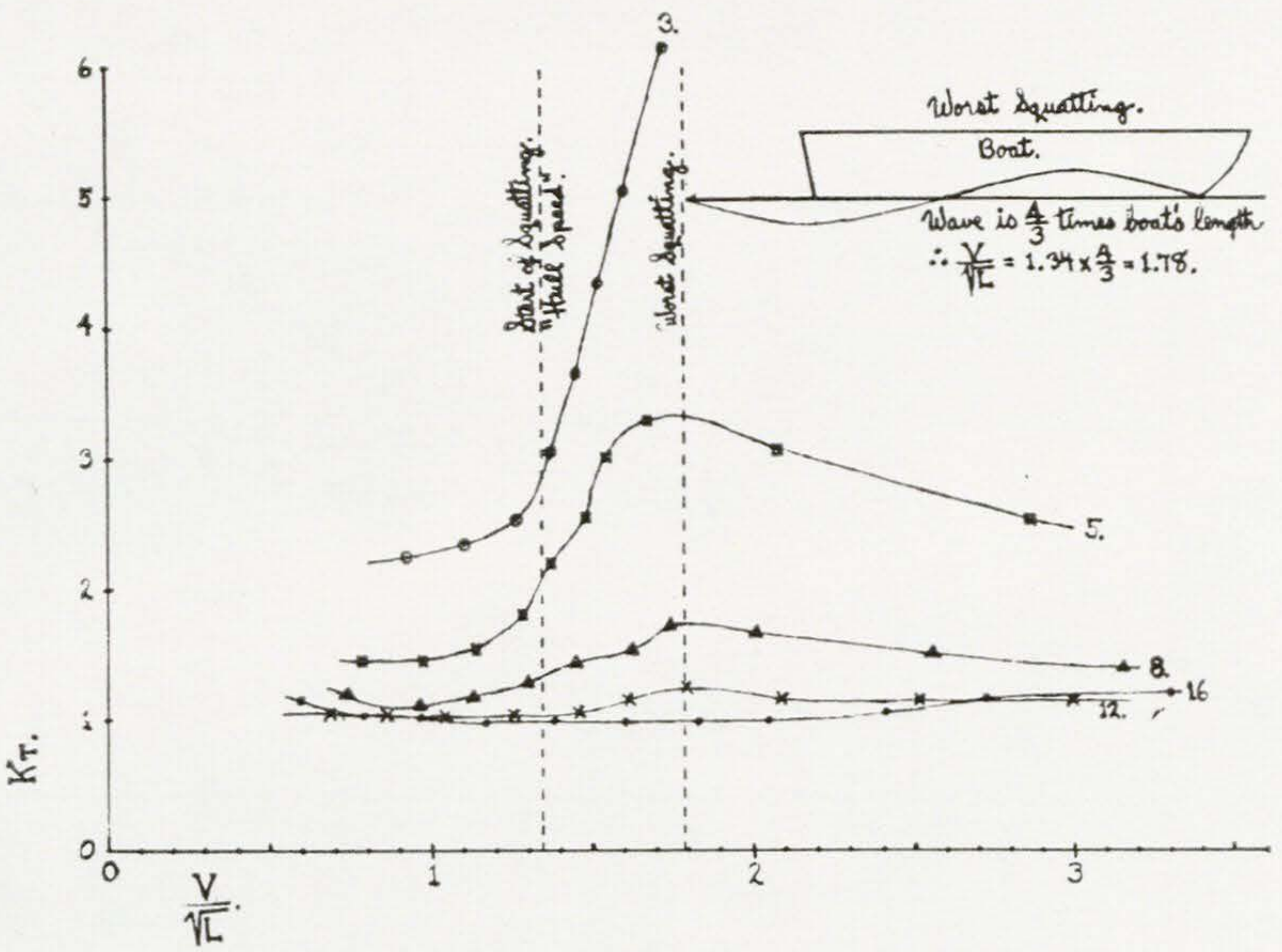


Fig. 5

Fig. 6 shows that moving the maximum section forward and more nearly aligned with bow wave crests, is harmful at all speeds compared with a mid-length location. Moving the maximum section aft helps at intermediate speeds because it becomes more adjacent to wave depressions. However, the trend is unfavourable at very high speed and it becomes definitely worse at low speeds. The writer is not in favour of adversely affecting the low speed range, since this is already a weak point for this type of hull.

Since K_t has been magnified 10 times in Fig. 6, compared to Fig. 5, a new curiosity has come into view. It is the hollow that has appeared in the co-efficient curves at $V/\sqrt{L} = 1{\cdot}07$. Here again wave profile is the explanation. The relationship of hull length to this wave profile has been drawn in the upper right of the graph. Note that the stern is fully supported by a wave crest. If the wave crest moves either slightly forward or backward, some degree of stern squatting will appear. Apparently, this satisfactorily explains the locations of these troughs in the curves of the coefficients.

If each cross-section of the after half of Model 12 is broadened and its draft flattened, so as to keep the section area unchanged at each station, the displacement and prismatic coefficient would be unchanged. Such a model was built and tested. Its performance is shown in Fig. 7 together with that of Model 12 as a comparison. Note that the broadened stern areas become somewhat better aligned with wave hollows in these ranges of speed. Evidently, this is a measure whose adoption might be considered. The performance is improved except at extremely high speed, where a wave crest moves well aft, and at low speeds where its greater wetted area becomes noticeable in the performance.

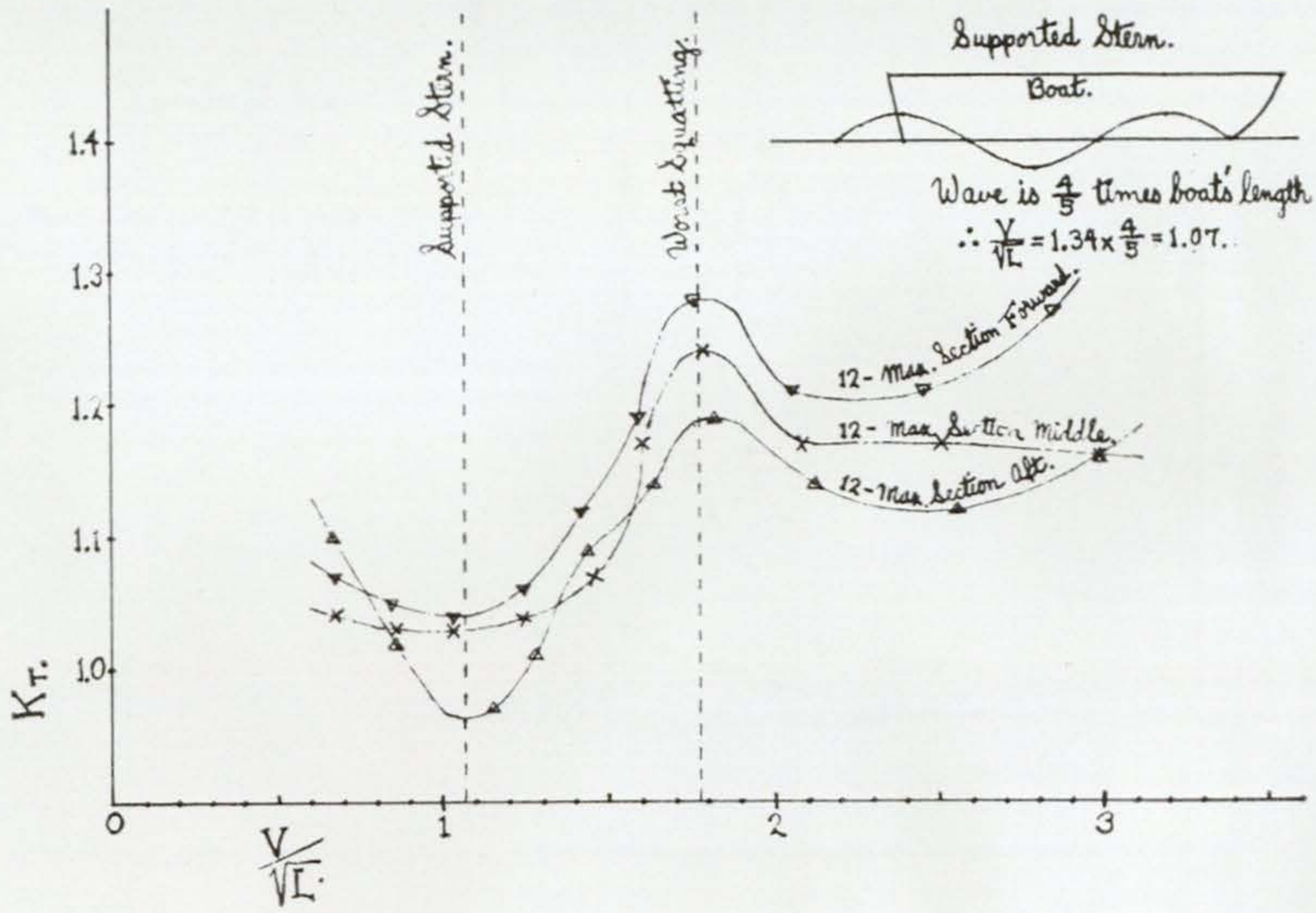


Fig. 6

I have read where stern flattening was employed in the hope of reducing "hobby-horsing." I believe it may be a beneficial alteration, but not for that reason. All the longer models prove by test to be highly damped as to pitching oscillation. This is because of the great height of the longitudinal metacenter represented by the centre of radius R in Fig. 1. It is only necessary to keep the centre of gravity reasonably low to achieve this.

A way to produce a slight flattening along the entire length of this reference hull shape is to lift it partially out of water. Since it was desired that all models weigh the same, a new model was built which was patterned after Model 8, as a good cruising choice, but with all linear dimensions increased by 10 per cent. It was provided with reduced ballast to equalize its weight with the others. This resulted in a beam-to-draft ratio equal to 2·7 instead of 2·0. The length-to-beam ratio is reduced very little. Its performance is indicated in Fig. 8 together with Model 8 as a comparison. In spite of a slight increase in wetted surface, the improvement in reduced pressure resistance is appreciable at and each side of the worst speed-length ratio for squatting. This results from the lower area of cross-sections, due to less draft with little change in beam. Note that the maximum cross-section is in the vicinity of the crest of

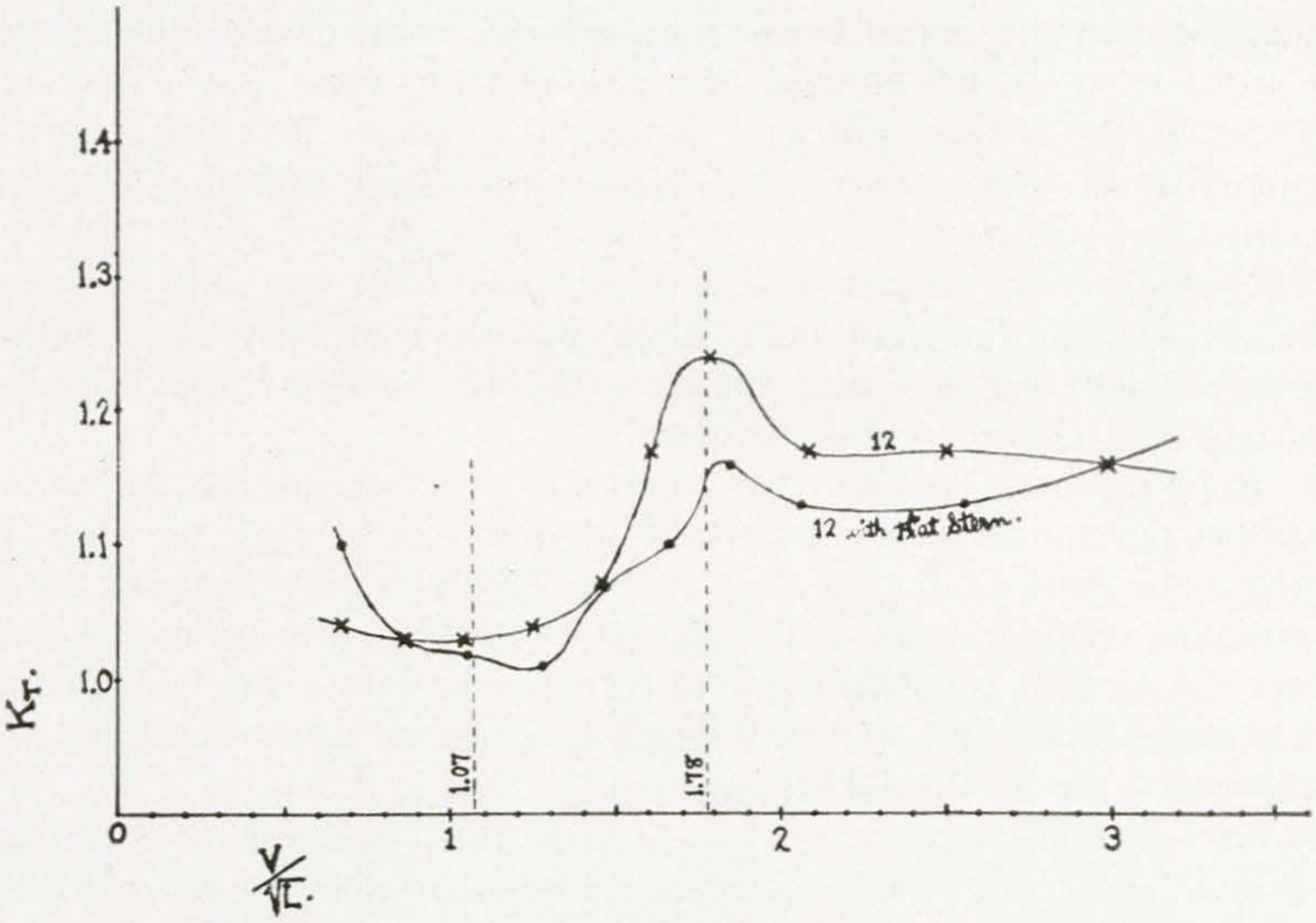


Fig. 7

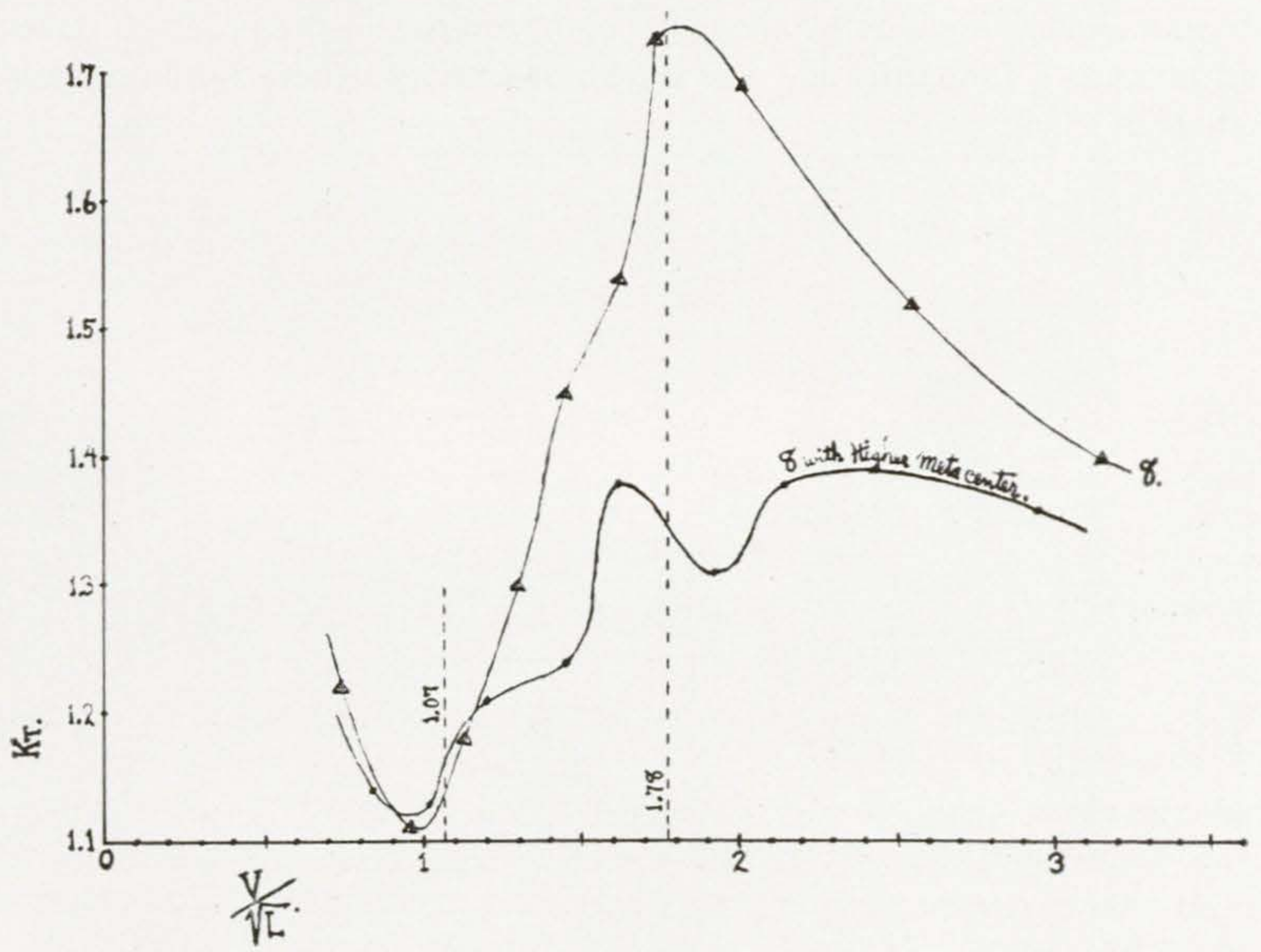


Fig. 8

the bow wave, for these ranges of speed-length ratios, as appears in sketch on Fig. 5 for the particular speed of $V/\sqrt{L} = 1{\cdot}78$. For this reason, the smaller cross-section, due to less immersion and greater length, would be expected to help.

Final Remarks

While the characteristics of multi-hull running resistances have been discussed somewhat at length, in this article, the writer was really trying to demonstrate the value of the small laminar flow towing tank which was described in AYRS No. 30. It was built as a recreation to occupy some evenings one winter, that of 1946. The results were so stimulating that this hobby has persisted ever since.

The subject of running resistances of individual hulls may seem moderately well worked over. For multi-hulls, simply add the resistances and weights of individual hulls for a widely spaced multi-hull configuration. For closer spacings, separate tests should be made.

It is in the area of simulated windward performance and its required stabilities that the tank experiments are proving to be in virgin territory. This region is the most exciting of all. Here may be found such things as fast but non-heeling configurations. Also, answers to the controversies over rounded versus vee sections for hulls come to light. I wish that many laminar tanks would share in this work and that descriptions of their results would be freely exchanged in the AYRS publication.

It takes a cooperative mass-attack to make rapid progress. Secrecy causes stagnation. For every idea donated to the common pool by one individual, he may get a dozen ideas, unthought of, in return.

If need be, let the secrecy of competitive racing and commercialism be restricted to the judicious balancing of compromises in the practical development of known fundamentals. Let pure research into these fundamentals be amateur in spirit.

CHAPTER XVII

47 ft CRUISING CATAMARAN

January, 1964

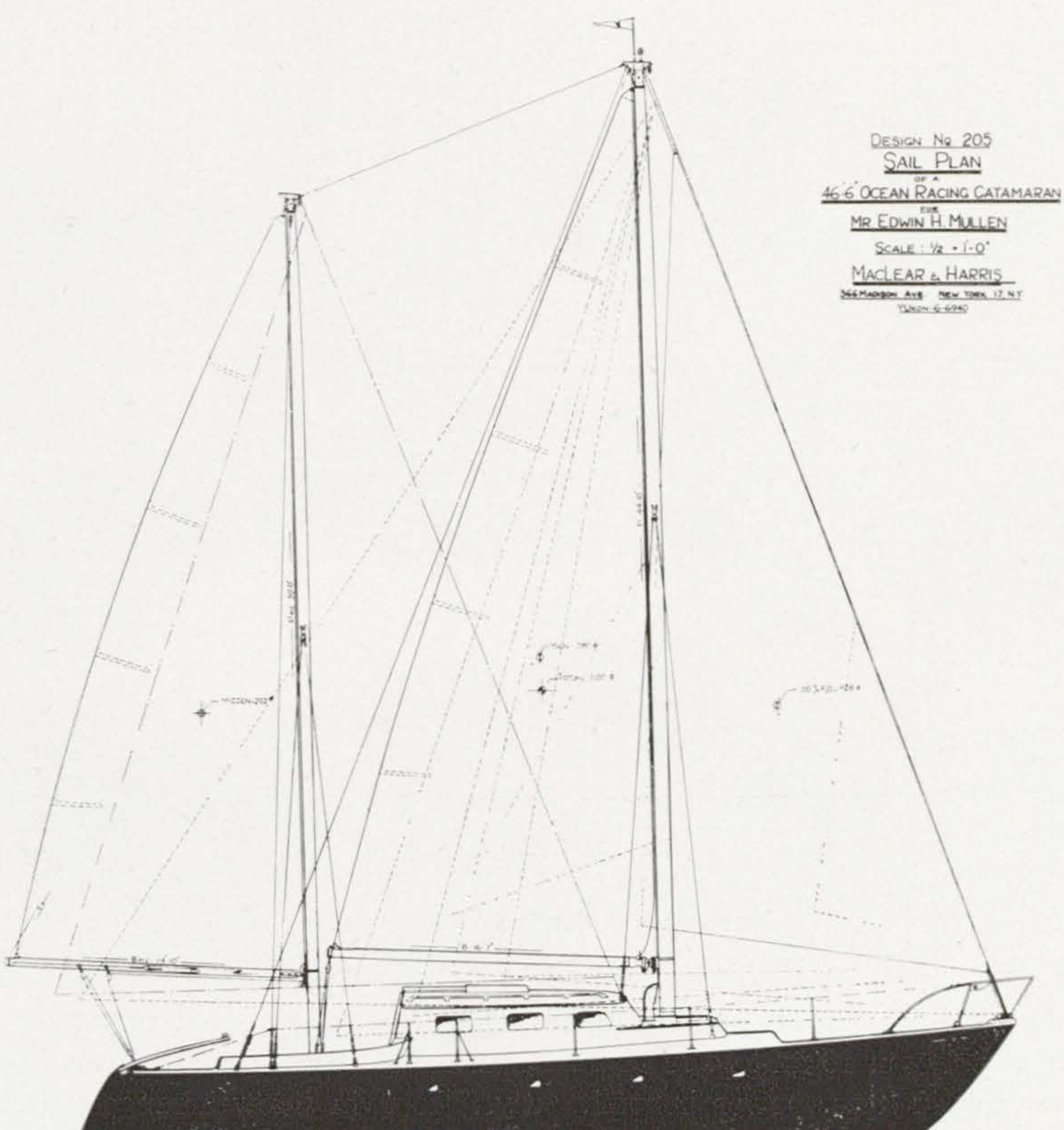
Designers: MacLear and Harris

L.O.A.	46 ft 6 in	Beam, O.A.	20 ft 5 in
L.W.L.	40 ft	Draft, C.B. up	2 ft 3 in

Owner and Builder: Mr. E. H. Mullen

Connecticut

This 47 ft catamaran is the second largest of a series designed by MacLear and Harris. Eight 37 footers have been built and two 41 footers are under construction. This 47 footer is commencing construction in Connecticut at the present time. She is ketch rigged to make her easy to handle and safe.



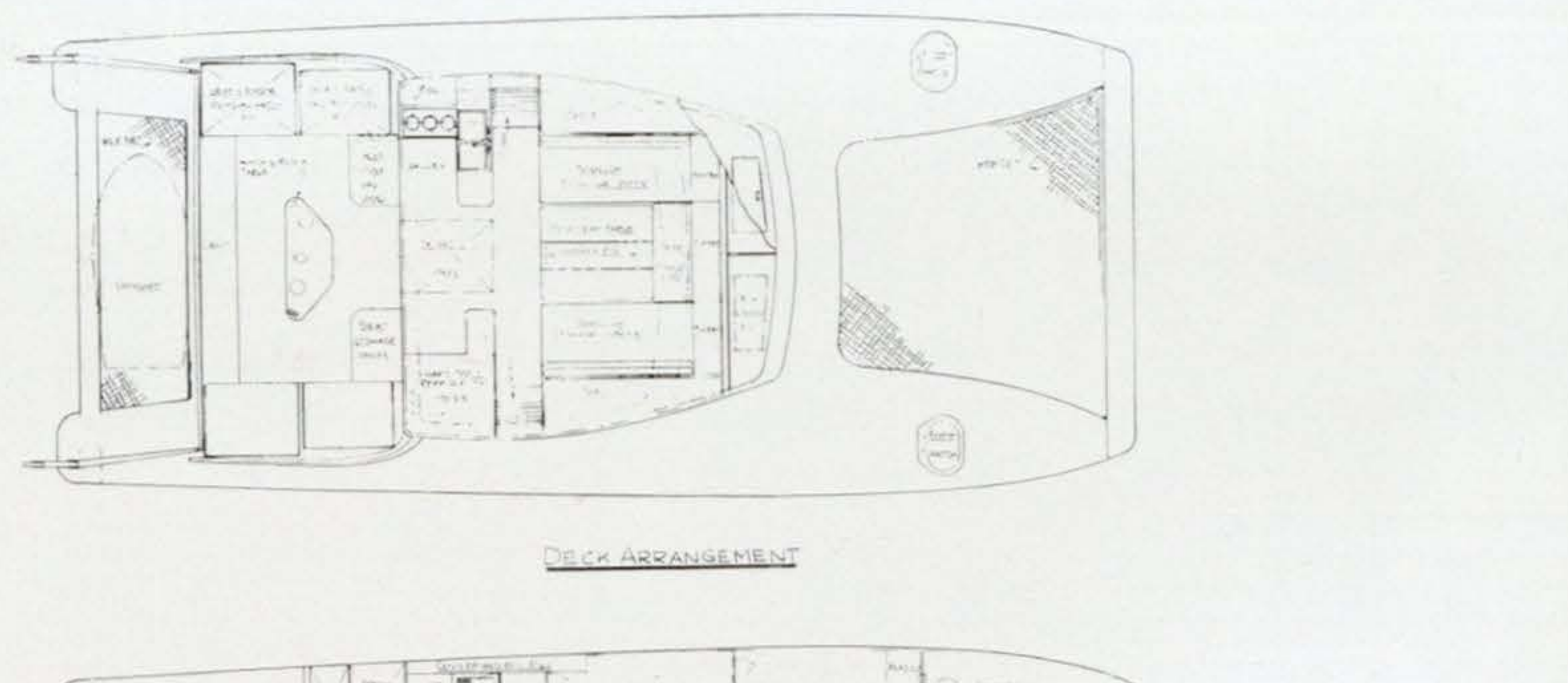
MacLear and Harris 47 ft Catamaran

While a catamaran of this size can easily sleep ten, the present owner only wishes accommodation for six. It is interesting to note that these six people are sleeping in five distinct and private compartments.

Other unusual features of this craft that are seldom found on single hulled sailboats of 47 ft are: two bathrooms, twin screw power, and a large comfortable chart table One of the most interesting advantages of catamarans over ordinary boats is the tremendous outdoor lounging space in the cockpit and on the foredeck, and the generous space in the doghouse.

The large expanse of foredeck that consists of netting made of nylon webbing, greatly facilitates changing headsails. When one goes forward instead of finding the ever narrowing deck of a single hull boat, one is confronted by a large and spacious platform with elastic spring which is completely self draining. At speeds below 12 knots, this net provides an excellent hammock for siestas, but over this speed, a supine crew member would receive an invigorating spray bath.

The twin MerCruiser drives can be swung up completely out of water, thus not leaving any underwater appendages to impair the boat's high speed under sail.



MacLear and Harris 47 ft Catamaran

The twin Westerbeke diesel engines specified, are expected to power the craft at between 10 and 14 knots. Each diesel delivers 30 continuous horsepower, or 40 horse-power intermittently. The twin screw arrangement will permit the craft to be turned in her own length, and to be very manoeuvrable at all times. Since the Z-drives, the rudders and the centreboards are all retractable, the craft can be beached readily. She can sail or power in water of only 3 ft of depth, and can anchor in still shallower water.

The owner of this boat, Mr Mullen, has owned several catamarans before, most of them built by himself. This boat will be built under his supervision with the help of some professional boat-builders, near his Connecticut home.

One of the unusual features of this boat's rig, is that she does not have any upper shrouds as such. The twin permanent backstays however, have enough spread to not only act as backstays, but also as upper shrouds. Thus the craft has no spreaders, and large genoas can be trimmed as flat as the skipper desires. The absence of upper shrouds and spreaders will also facilitate tacking since the overlapping headsails will have far less drag in coming from one side of the mast to the other.

One advantage to the catamaran configuration is that the cockpit sole and the main cabin sole are on the same level, and one can walk from the cockpit to the galley to the chart table to the main dining table without going up or down steps. It is like single level living with two basements.

The ketch rig is favoured by the designers because of its versatility and many sail combinations. Since catamarans tend to draw their own wind more than single hulled vessels, it becomes particularly advantageous to shorten down when going to windward. Conversely, as one runs off the wind, the catamaran is so fast in running away from the wind, it reduces the relative wind velocity and the boat requires as much canvas as one can physically hang up. With this in mind the design called for a large mizzen staysail as well as a huge overlapping reaching jib, that hoists on the fore stay and trims to the end of the mizzen boom. The foot of this sail is longer than the catamaran itself, and constitutes a tremendous light weather sail. All sheets lead to winches and then to jam cleats so that any sail can be quickly released in the advent of a sudden squall.

One great advantage of catamarans is that they heel very little and sail on an almost even keel, thus facilitating the daily chores and making it easy to move around even when the wind is quite fresh and the boat is sailing at speeds in excess of 18 knots.

It is believed that this cruising ketch catamaran with her generous diesel power can make faster passages under sail and power than any single hulled auxiliary or motorsailer up to 100 ft in length.

HIGH SPEED CRUISING KETCH CATAMARAN

DESIGN No. 182

L.O.A.	36 ft 11 in	Draft, cbd up	1 ft 6 in
Datum W.L.	32 ft 11 in	Draft, cbd down	5 ft 7 in

Designers: MacLear and Harris

This high speed cruising catamaran was designed by MacLear and Harris for persons who want to increase their cruising range on weekends by going faster.

In all but adverse conditions, the craft is expected to average well over 10 knots under either sail or power.

In light and ghosting weather, they are faster than the fastest monohulled cruising boats of her size, although not as spectacularly so as when it breezes over 12 mph. The sailplan calls for a gigantic nylon reacher which tacks down at the bows and trims to the end of the mizzen boom. With this sail no other sail need be carried, and the craft can go from very close reaching to very broad reaching.

The first of these boats was built in Santa Barbara, California and others are under construction in Sweden, South Africa, and Lebanon. There is also the possibility of some others being built on the East Coast of the United States as well as Bermuda.

MacLear and Harris 37 ft Catamaran

Some of the craft are powered by Volvo Z-drives and others by Porsche engines through an extended shaft Eaton Z-drive. Still others have extended shaft outboard motors.

Plans exist for either wooden or plastic sandwich panel construction. This latter specifies polyurethane foam board to build the boat. The foam boat is then covered inside and out by glass cloth and resin. The wood model has plywood sides and strip planked wooden turn of bilge.

The craft's rig was designed for ease of handling. To come about, the helmsman simply puts the helm down and she is about. No running back stays, no genoas—everthing is self trimming. The high aspect ratio makes the three lowers easy to furl. The boat balances well under jib and mizzen alone or under main alone. The main roller reefing and the mizzen and club-footed jib each have deep sets of reef points, so that shortening down is a very easy matter. The main sheet is double ended with one end going to a conventional drum winch while the other end goes to a specially re-worked halyard reel winch with a high speed break lever. This friction break can be set to release manually or automatically at any specified tension. The rig is somewhat unique in that it has no spreaders because the boat's beam is so large.

Accommodation

The spacious accommodations on this 37 ft catamaran are greater than on the average 45 ft single hulled vessel. She can sleep 7 to 9 persons and she could sleep three more in the cockpit under a mizzen awning if necessary. The cockpit will seat 11 persons while the boat is at anchor or at a slip (under way this could be excessive because of stern trim).

The bow and stern netting are excellent for sun bathing. Built-in spray steps of generous size will reduce spray greatly and provide substantial lift to the lee bow at speeds over 12 mph.

The boat is believed to be capable of speeds in excess of 20 mph in ideal conditions. She can be beached readily having swing up rudders and centre-boards (two of each). With these partly raised she can sail in 2 ft of water, and can even go to windward.

In summary we think that it is safe to say that this boat opens up several truly new dimensions in sailing. She has a high speed potential. She is tremendously roomy. She is exceedingly shallow of draft with boards and rudders up, and can negotiate very shallow bars and anchor close to shore, or be beached like a landing craft.

We think that she is a significant step in a new era of sailing and may point the way to the true potential of cruising catamarans.

PROUT 27 ft CRUISING CATAMARAN

Designers and Builders: G. Prout & Sons

1 The Point, Canvey Island, Essex

L.O.A.	27 ft 3 in	Sail Areas:	Main	207 sq ft
Beam	12 ft 6 in		Jib No. 1	64 sq ft
Draught with C.B.	4 ft 0 in		Jib No. 2	130 sq ft
Draught ex C.B.	11 in		Genoa	212 sq ft

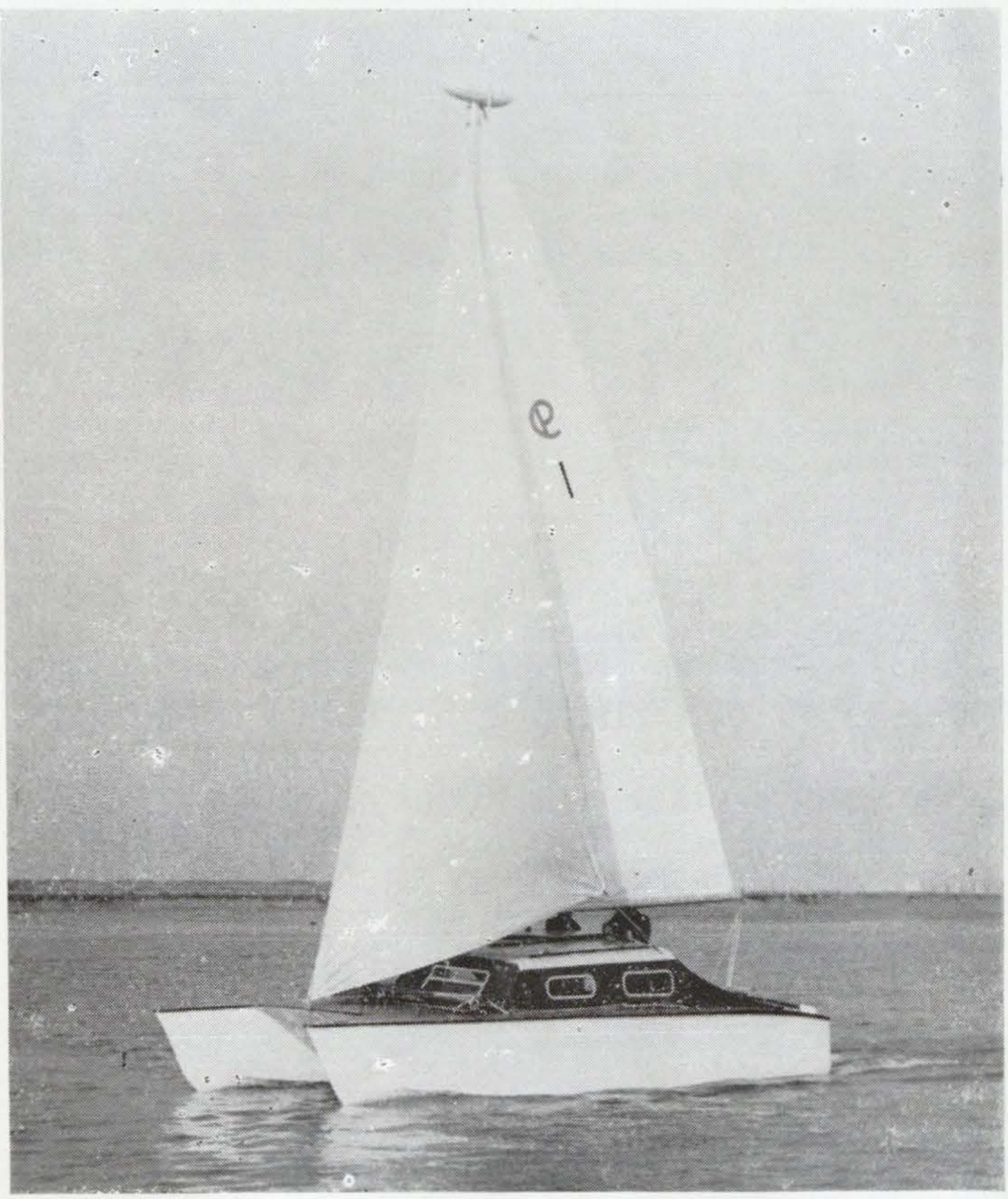
27 ft CRUISER TEST REPORT

This Cruiser designed by the Prout Brothers was launched in December 1962 and trials were carried out in the Thames Estuary.

We were delighted with her performance in the conditions prevailing at the time. It was fortunate that during this period the winds varied from strong to light so we were able to find out her characteristics under varied conditions. We were extremely pleased by the way she handled. She seems to be perfectly balanced and was light on the helm whether the Genoa, working foresail, or storm jib was used.

On one of the days when it was blowing very hard we reefed the mainsail down to the bottom batten and put the storm jib up. Snugged down like this she was comfortable and easy to sail. We beat up river for a while and her windward capabilities in this strong wind were very pleasing indeed. Running was as we had anticipated very good.

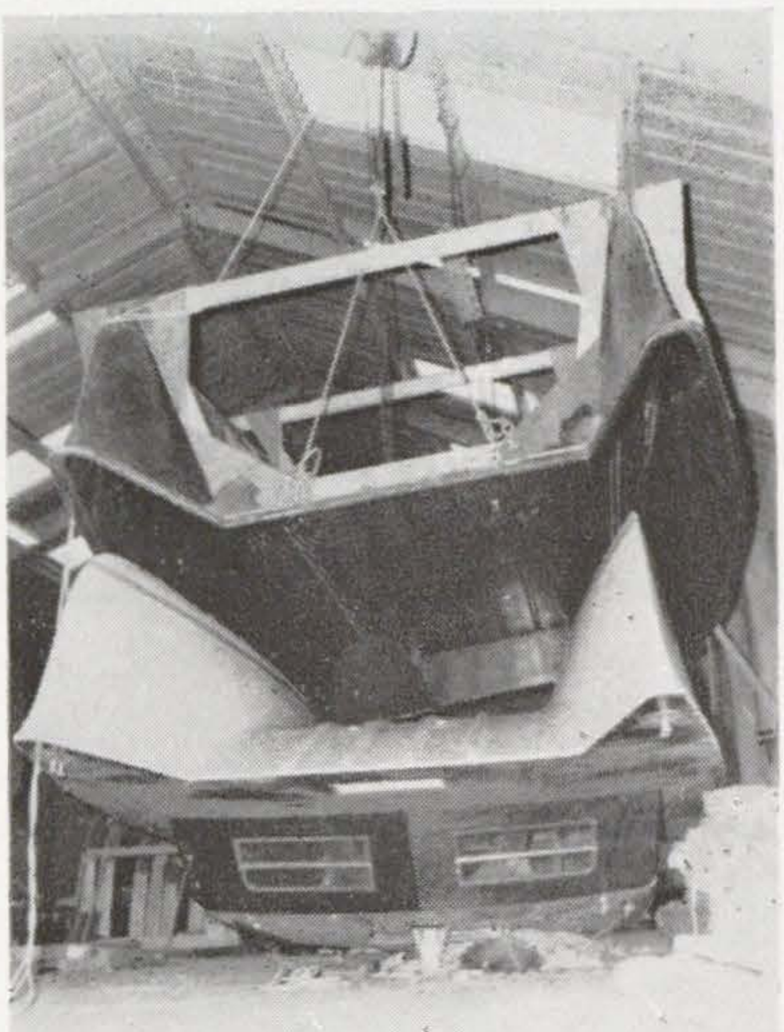
In the lighter winds on one day in particular we had a most exhilarating sail and were able to try out our Spinnaker. This proved very easy to handle on the broad fore deck. There is a separate halyard for the Spinnaker so one can set it before removing the Genoa.



Prout 27 ft Catamaran

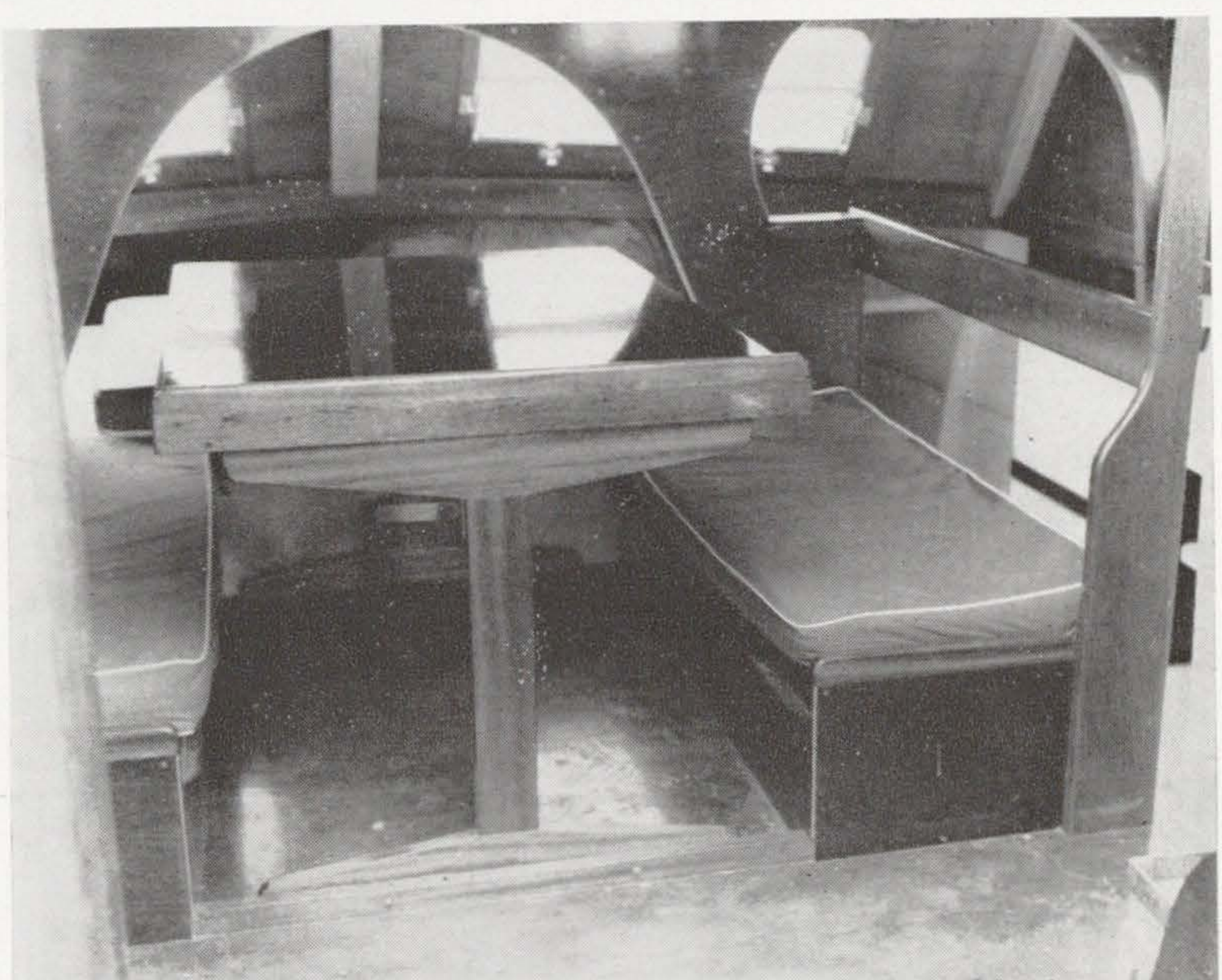
Reaching in this light air was great fun and the way the boat smoothly and quietly planed at what seemed to us around 9 knots was truly a delight.

Coming about was as we knew it would be, very quick and positive, even in the very strong winds.



Lifting off the mould

The Galley



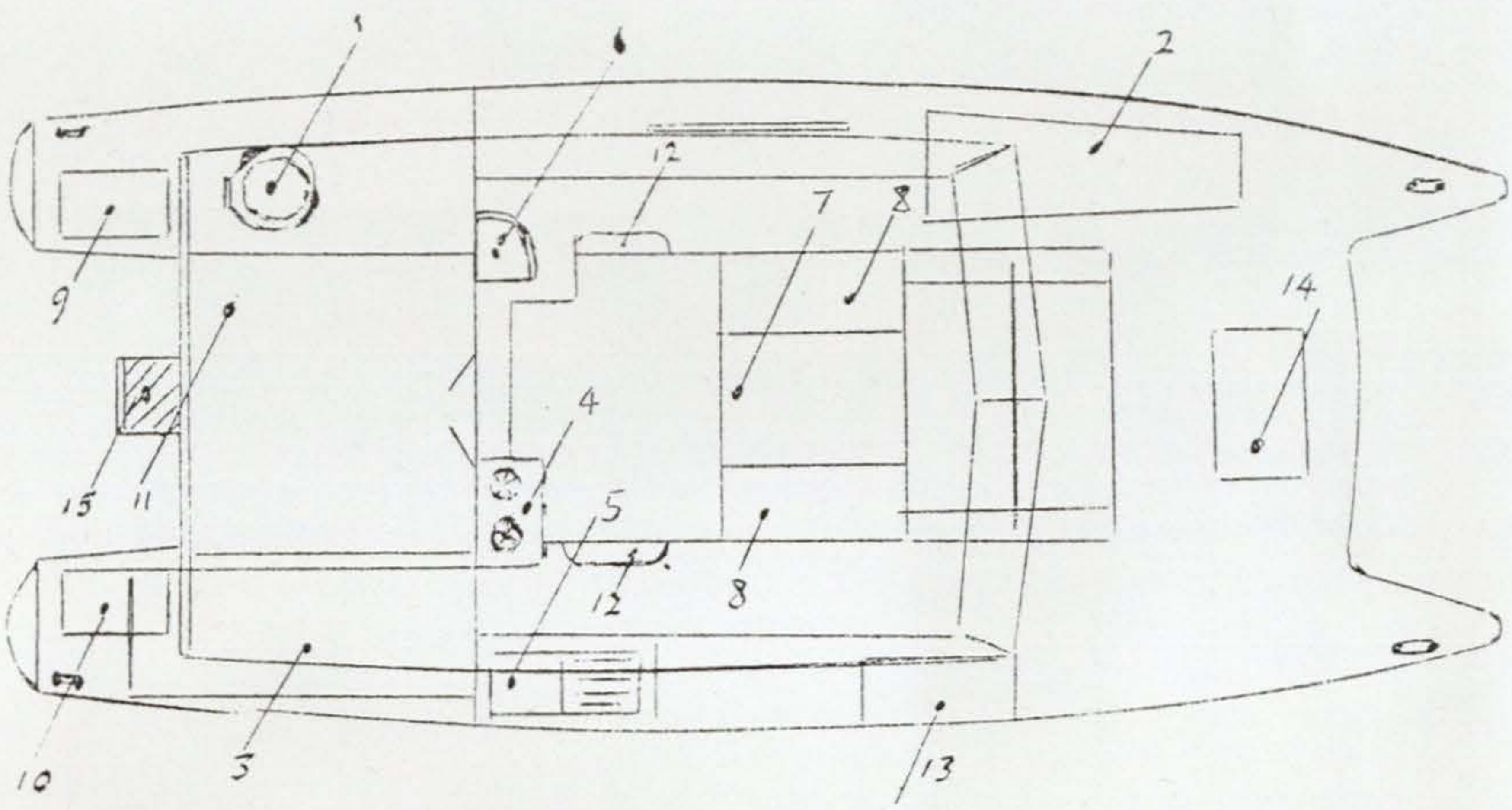
Inside the bridge deck

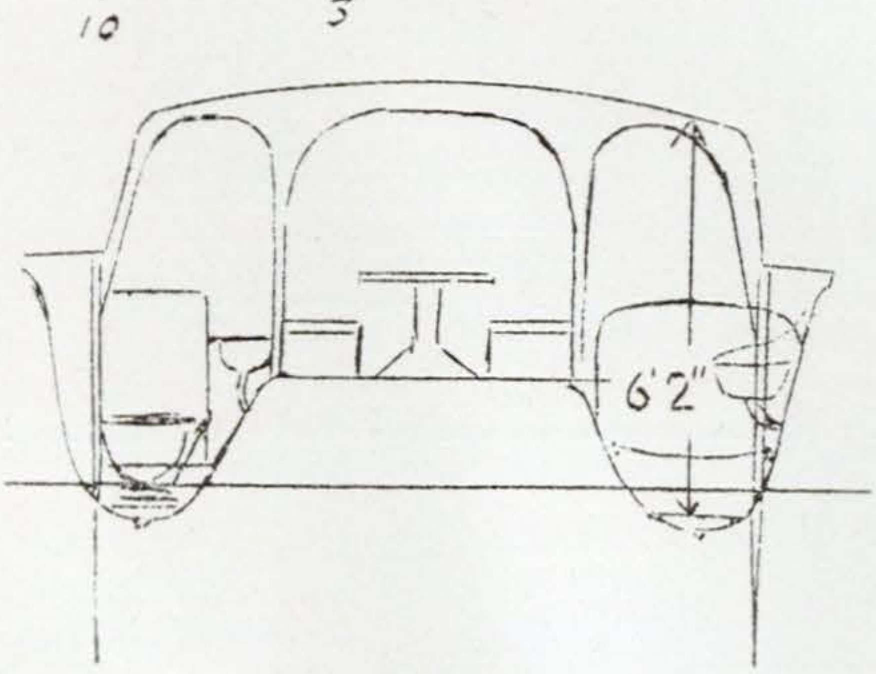
For auxiliary power we took along our Crescent 8 hp outboard motor and we could not wish to have anything better. This little motor pushed the Cat up our creek against a force 6 wind and against a Spring Tide ebbing at its strongest. The motor is mounted on an attachment which is retractable. It enables one to use a standard short shaft motor which is very useful if one wants it for the dinghy too. When retracted and tilted the motor is well clear of the water.

We feel that owners will find the accommodation very good. There is standing head room in the hulls, so when washing, dressing, cooking, etc., it is easy and comfortable. The separate compartment for toilet has standing headroom and there is plenty of space. The berths, two aft and the double forward are very comfortable, giving a width of 2 ft 3 in in each of the single berths. The double berth which is formed by lowering the table is wide and long and should be comfortable even for the largest of persons.

The table is large and four can sit comfortably with plenty of elbow room.

As will have been noted earlier this cruiser will be produced in all fibreglass construction top and bottom with wood trim and wood furniture, lockers, galley units etc.





1. Toilet.
2. Forward Pipecot 6ft 3 in × 2 ft 3 in wide
3. Aft Pipecot 6 ft 3 in × 2 ft 3 in
4. Calor Gas Two-Burner and Grill
5. Sink with compartment for water under
6. Wash Bowl
7. Table (Down for Double Berth)
8. Seats with Cupboards and Locker under
9. Hatch and Locker
10. Hatch and Locker for Gas Bottle
11. Self draining cockpit
12. Steps
13. Cupboard
14. Locker for anchor and warp
15. Retractable Outboard Bracket

Prout 27 footer—Accommodation layout

WIND SONG

January, 1964

by L. G. Dawson

71 High Street, Castle Donington, Derby

Designer: Myers and Ewing

As you will see from the photograph, *WIND SONG* is an extremely attractive catamaran—fairly large 36 ft overall length, 31 ft on the water line. The mast is 47 ft above the deck. The beam of each hull is 28 in, length/beam ratio being 13·3. The weight empty 7,200 lbs and the total beam of the whole ship is 16 ft. The hulls are laminated and covered with a layer of fibreglass afterwards. All the catamarans in California are sheathed in fibreglass and it gives a very durable finish, the wood laminating construction allowing considerable flexibility in the design. The sails on *WIND SONG* are impressive. The genoa is 500 sq ft, the mainsail 400 sq ft and she sets a 1,400 sq ft spinnaker.

On arriving at the marina I was very pleased to see the first thing Hugo Myers did was to leave a very large American outboard behind. Every now and again his old Great Lakes dinghy sailing instincts come to the fore and he thinks going sailing with an engine is not a gentleman's occupation.

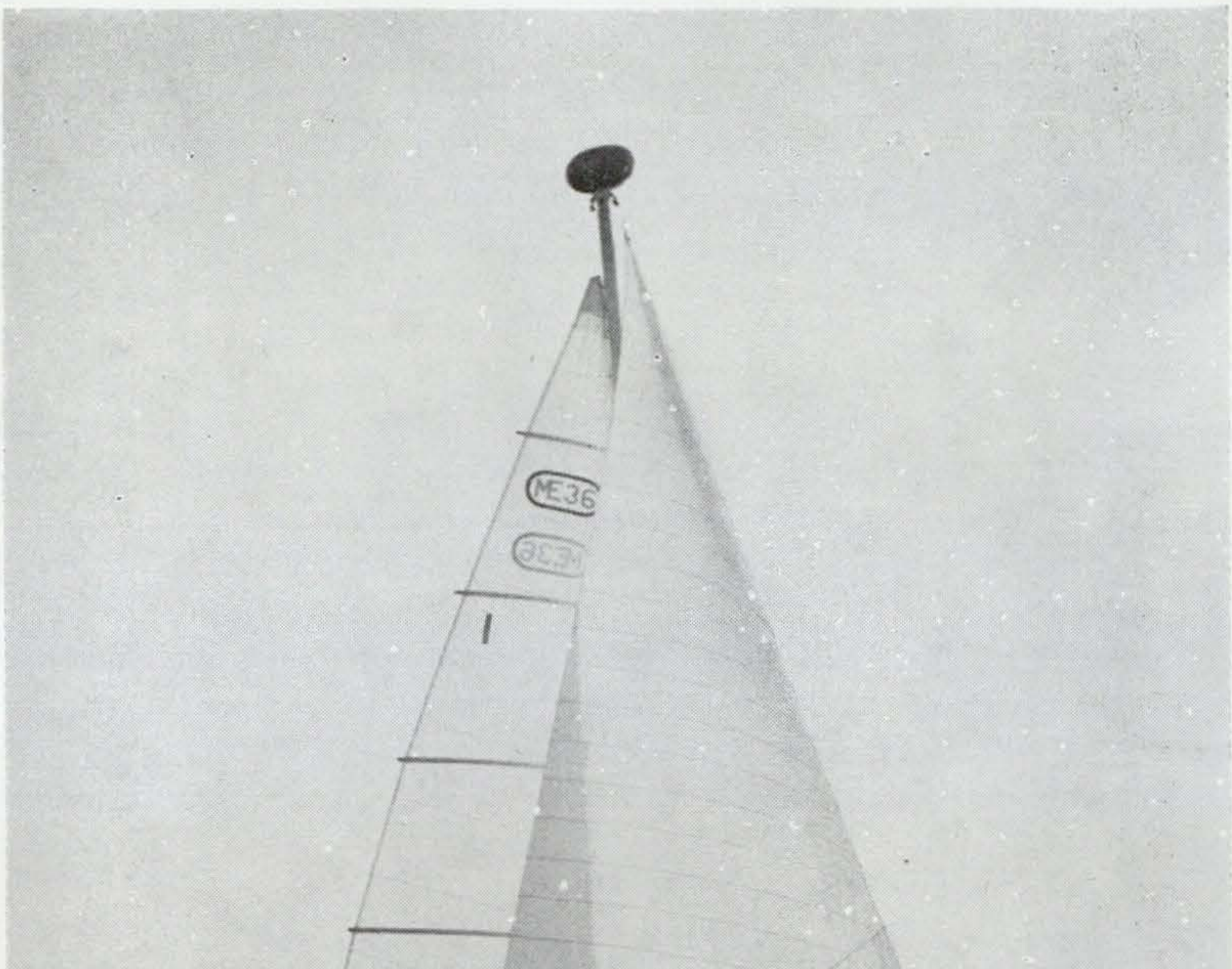
While the sails were being hoisted I had a chance to look at the accommodation; there was a head and large double bunk on the port side, galley on the starboard side and a single bunk forward on the port side. Pipe cots will be fitted into the forward end of the two hulls. As one can sleep in the saloon as well there is plenty of accommodation.

The saloon is extremely pleasant, light and airy. The headroom is 5 ft 6 in at the centre, low enough to make a tall man bend and know that he cannot stand upright, and high enough for a small woman or girl to stand upright.

We got away from the dock without any difficulty and set off from the Playa del Rey Marina, not far from San Pedro. An interesting feature of this new marina is that it generates a sizeable swell in the entry. Although it was a calm day, as we were sailing out this swell was very noticeable. We tacked several times, the handling was easy and the boat very controllable.

The steering arrangements are ingenious, the rudders are submerged beneath the stern and are worked by cables and pulleys. In the centre of the cockpit is a post on the aft face of which is a small steering wheel. This post can be rocked to port or starboard or can be locked central. By this means one can stand in the centre of the aft cockpit and steer with the wheel or if you want to sit you can release a catch and rock the post with the wheel to port or starboard and steer from that position. The mechanism needed a little development, but there isn't any doubt, that it can be a very satisfactory method of steering the boat.

I spent some time at the helm. One of the most interesting features of this boat is that when going to windward she is almost self-steering. You can take your hands off the wheel and she will sail straight, while close-hauled, for long periods of time, something up to three or four minutes and then only needs very slight correction. The sails are impressive. Personally, I have not seen a 1,400 sq ft spinnaker set before. It was an ideal day for it. One noticeable



WIND SONG—Myers and Ewing

thing is that it was possible to take out sixteen people on this trip without inconvenience. She is so big and the considerable deck area means that you can take out a large party of inexperienced people for an afternoon sail without them getting under the crew's feet.

WIND SONG to some extent shows her Californian ancestry. I think a similar boat built for the English Channel would have to be "beefed up" in places. Her designers know this, they have designed for the lowest possible weight and obviously were making the boat for their local conditions. I beleive later makes of this boat will be strengthened in places.

One of the most impressive things was the way Hugo docked the boat with no assistance whatever in relatively confined waters. The last thing which should be said is that both Hugo Myers and Bruce Ewing carried out the whole of the design work in their spare time. Let's hope their efforts may be rewarded by sister ships of *WIND SONG* being ordered. The favourable price at which these boats can be built in Japan, and cheap sea freight, makes this very likely.

CHAPTER XVIII

PETANQUE

January, 1964

L.O.A.	23 ft 6 in	Draft	1 ft (Boards up)
L.W.L.	20 ft 6 in		4 ft (Boards down)
Beam, O.A.	11 ft 6 in	Displacement	3,150/3,650 lbs

Designer: Michael Henderson

Builder: W. A. Souter

This is Michael Henderson's latest catamaran, in which he has not used the ballasted fin keels of *MISTY MILLER* and *GOLDEN MILLER*, as the ability to sail in shallow water was important. Instead, as a compromise, he uses 300 lbs of righting ballast on a spar slung under the bridge. In the case of a knockdown, the boat rests in a stable attitude with her masthead supported by the masthead float first suggested by Michael himself. The spar is then extended and rights her, being hauled up into this stowed position afterwards.

The Lines and Sections

These show a sweet shape of hull with very easy lines fore and aft. Forward, there is the knuckle bow which was found so useful on *MISTY MILLER*. This is, in some respects, a built-in spray deflector and was first suggested for use on catamarans by Derek Norfolk in AYRS No. 16, although in *PETANQUE* its function is to provide adequate reserve buoyancy above water to resist excessive pitching while at the same time retaining the fine sections below so necessary for good resistance characteristics.

The transom is immersed by 4 in on a level keel, which is more than on any other catamaran. This gives easier underwater lines and tank tests indicate that on this type of fairly heavily loaded hull it improves resistance, especially in the difficult "hump" speed region.

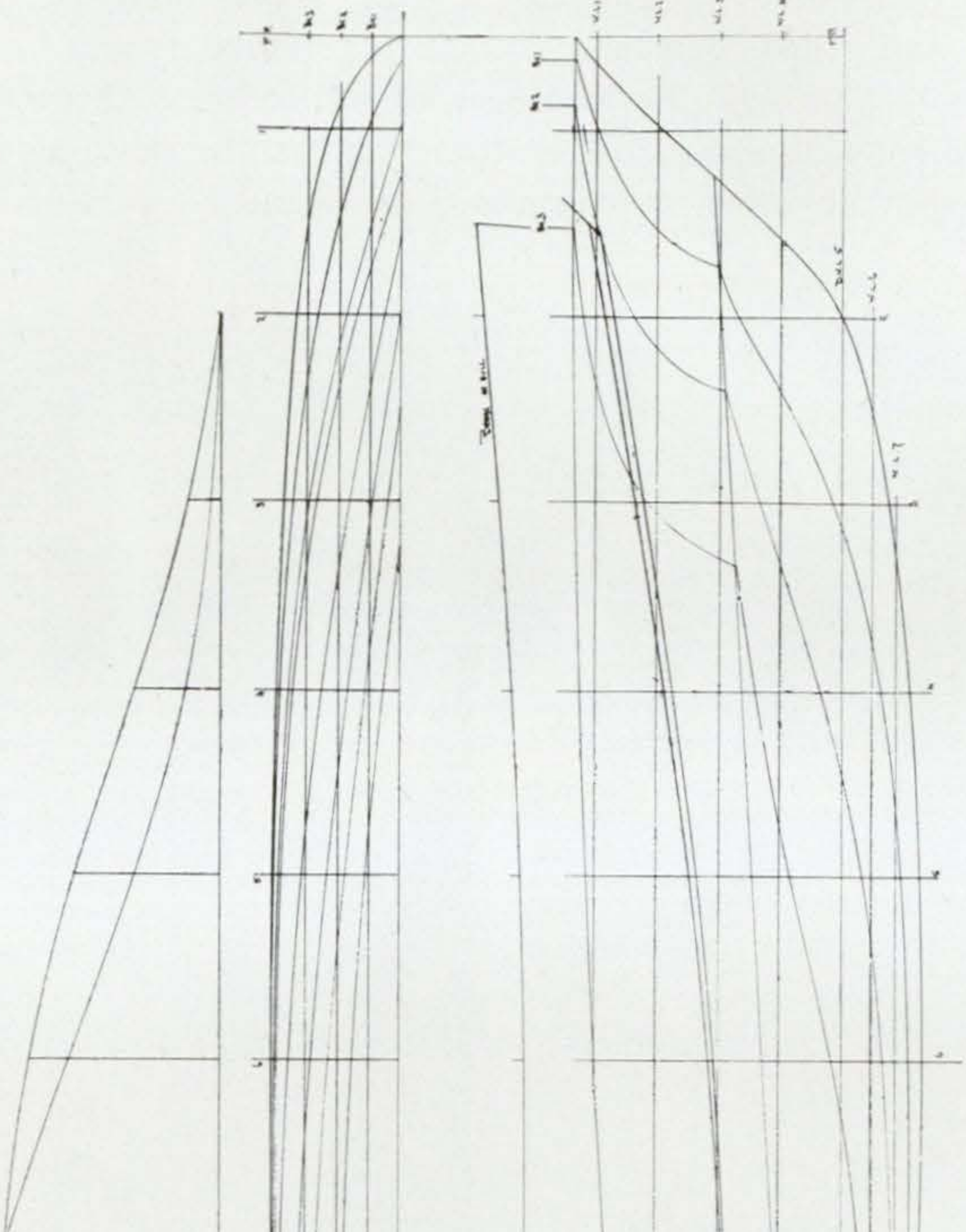
Accommodation

The boat is described as a "Daysailing Cat" and the internal arrangements are spartan in the extreme. Nevertheless, they give four dry bunks, a galley, a chart table, a W.C. and sitting space, with reasonable stowage lockers as well. Three people have carried out some quite lengthy cruises in the boat this year, and of course a considerably larger cabin top could be fitted if the additional windage was acceptable, giving better accommodation if it were wanted.

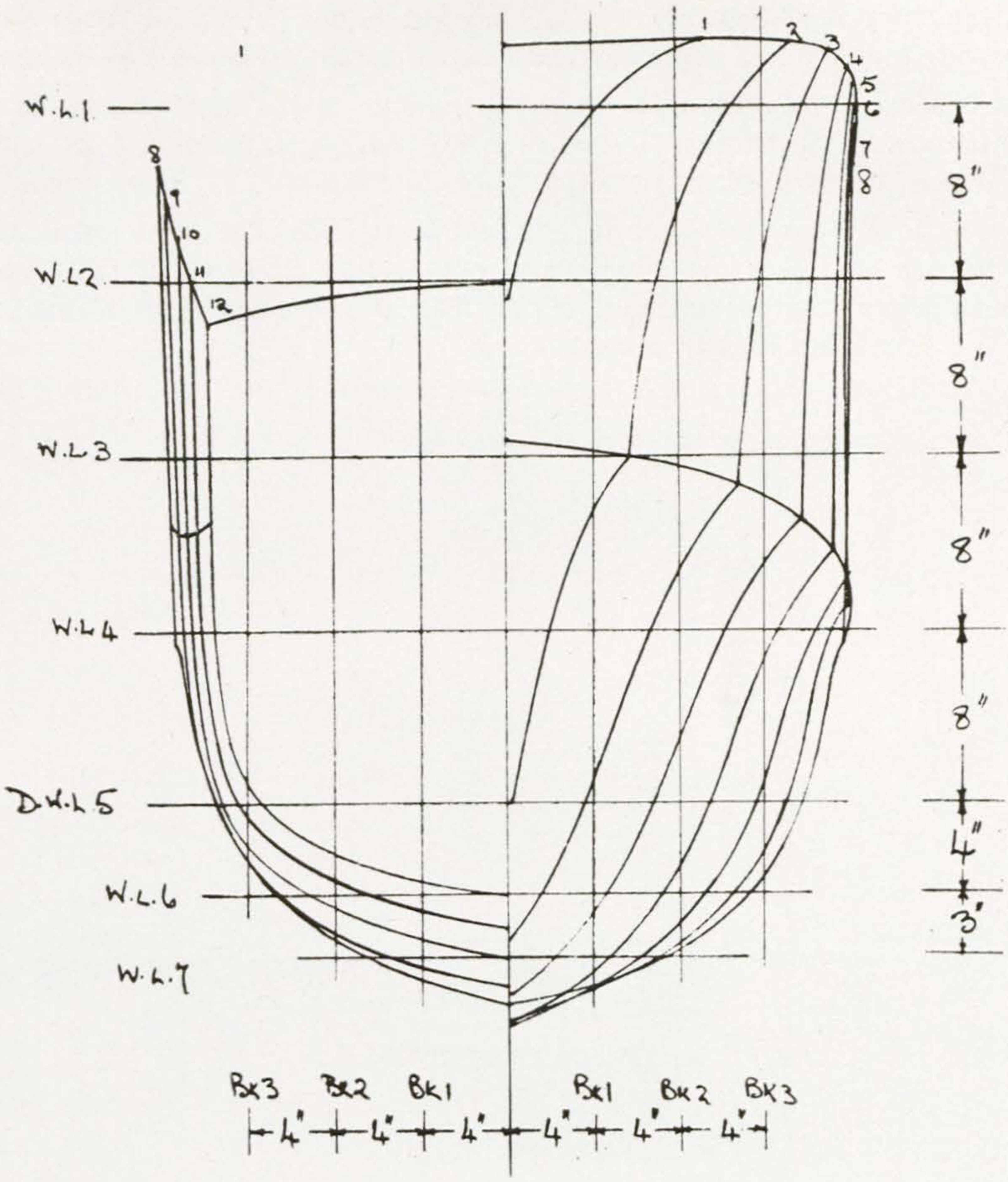
Summary

Michael Henderson has designed a very pleasant and fast catamaran. One suspects it of being a scale model for a much larger boat. It is interesting to see how one man's ideas can be modified to produce a boat to fit a given set of requirements, and how the free flow of information throughout the field of design coupled with close cooperation between the designer and an owner who knows what he wants can improve the breed.

PETANQUE



Lines of *PETANQUE*



PETANQUE's Sections

HOLGER TORNOE

January, 1964

by T. Engsig-Karup

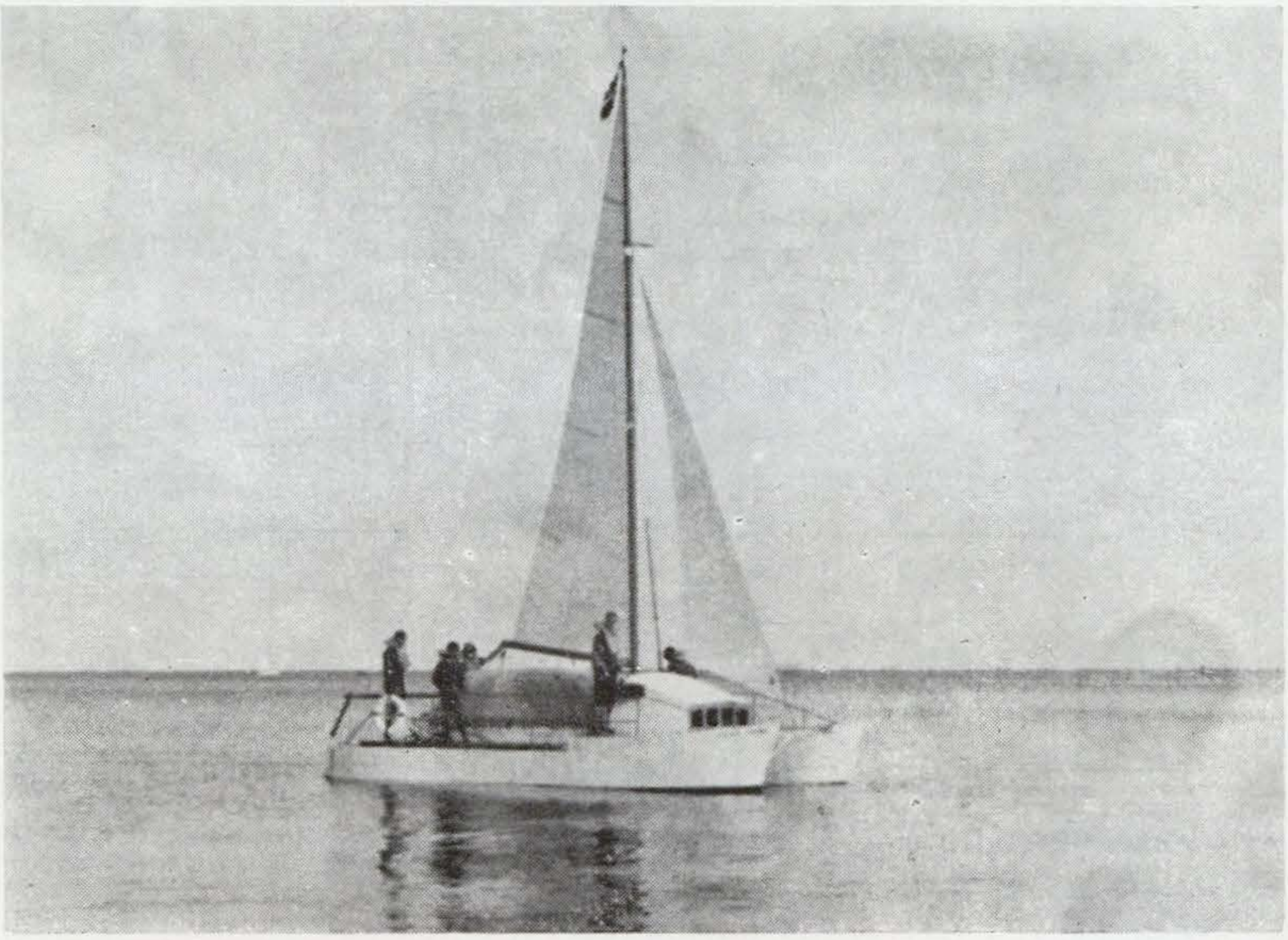
The Frivilligt Drenge-Forbund catamaran. A Danish catamaran for a boys' organisation.

For youngsters, it is of great importance to take part in different kinds of sports. In recent years, the understanding of this need has led to a large number of youth organisations of which "The Boys Brigade" (the "B.B.") is well known in the United Kingdom as a Christian boys organisation.

In Denmark, a similar organisation is known under the abbreviated name "FDF". FDF works according to the same principles as the B.B. and to some extent as the Boy Scouts. However, going out on bikes along the roads with a growing motor traffic is not the same adventure as it was some years ago.

Consequently, we thought—in our company—that it might be an idea to go out sailing. So, during 2½ years 6-12 boys have been building a catamaran of which everthing except the mast, boom and the sails, is "home made".

HOLGER TORNOE is 30 ft long and 10 ft wide. The mast top is 35 ft above sea level. The maximum speed obtained so far is about 12-13 knots which is not very exciting but we find that, with a capacity of 12 men, we have a safe boat rather than a quick one.



HOLGER TORNOE

The demands for this boat were set to be (1) safety, (2) big enough to house 12 men, (3) independent of harbours, ie, capable of landing on beaches.

The catamaran did not go into the sea until late in the summer of 1962. We have not got very much experience as yet. But already we have made some nice trips. On week-end trips we do not spend our time in the harbours or on the beaches. We sail!

We are still training our boys. We find it a very good way of keeping them busy. It is remarkable to see their friendship without any quarrelling even if they are tired and without sufficient sleep. They do their job; they are eager to learn and they are becoming men.

A BIPLANE CATAMARAN

by Walter Castles Jnr.

1350 Riverview Road, N.W., Atlanta, 5, Georgia

L.O.A. = 20 ft, L.W.L. = 17 ft, Beam = 11 ft, Draft = 18 in, Design Displacement = 1,800 lbs, Distance between keels = 7 ft 4 in, Distançe between centres at deck = 7 ft, Clearance over water = 15 in, Weight empty = 1,200 lbs, Total Sail Area = 220ft^2, Mainsail = 70, Jib = 40, Geometric Aspect Ratio of each set of sails = 2·33, Effective aspect ratio of combination about 2, Lateral area of each hull about 24 sq ft, wetted area of each hull about 52 sq ft, hull waterline sections are N.A.C.A. 16000 series symmetrical airfoils with the thickness tapering from 9 per cent at the waterline to about 3 per cent just above the keel line, berth in each hull, head in port hull, 3 ft 6 in headroom in deckhouse, aluminium masts with tops 27 ft above water, parachute spinnaker = 160 sq ft.

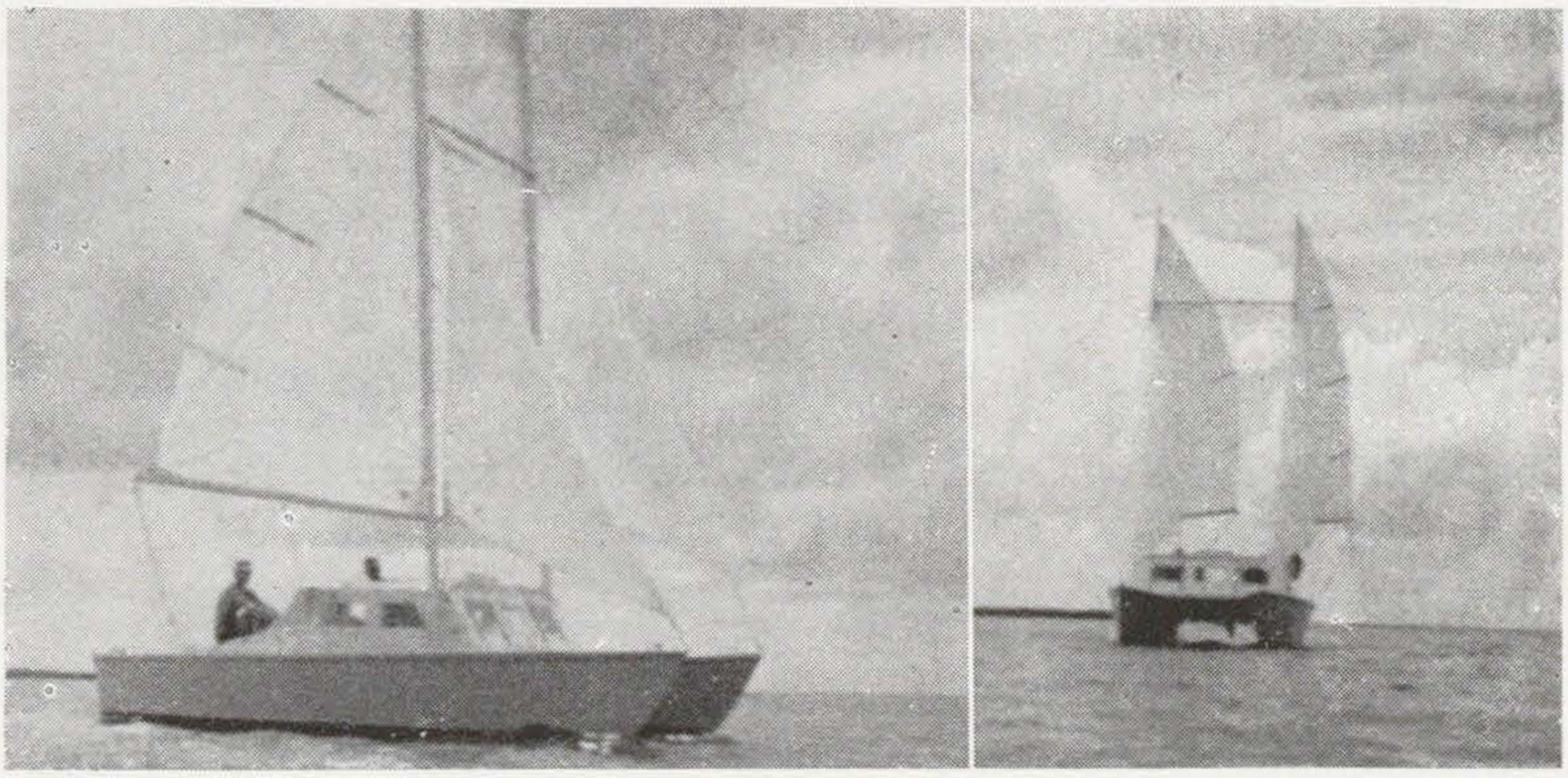
The design, which was done seven years ago, was in the nature of a quadruple experiment. I was interested in trying out the following:

1 A really good two dimensional hull shape (that is one in which practically all the water goes around the sides and almost none around the bottom).

2 The effectiveness of rudders which are an integral part of the hull shape and have covered slots.

3 Rudders which can be differentially deflected for brakes and differentially set to make the boat self-steering (the tops of the rudders extend well above the waterline so that as the boat heels one rudder becomes more effective and the other less effective. Thus with the rudders cocked in a few degrees, the boat will theoretically steer itself on the wind and vice versa off the wind).

4 A biplane rig with its possible advantages of low centre of effort, ability to wing and wing with sails (main) ahead of the masts to make the boat self steering on down-wind courses and the structural advantages of having



Walter Castle's Biplane Catamaran

the masts stepped on the hulls and eliminating the big download on the bridge connecting the hulls. This made it easier to make the centre 3 ft section of the bridge removable for trailering.

I have sailed the cat now for five years, first on a large lake near Atlanta and for the last two years down in the Florida Keys at Big Pine. In retrospect I would evaluate the experiments as follows:

1 The hull shape is lacking in pitch damping and is too sensitive to changes in trim for small cats. Also, with its relatively large wetted area it is very sensitive to surface condition (fouling). Pitch dampers were added in the form of streamline horizontal plates located about 8 in above the waterline at the inboard of each hull. This cured the pitching troubles when underway but not at anchor. When the hulls are clean the cat will sail about as close to the wind as a *Thistle* in spite of the excessive cabin air resistance. In light and moderate winds the cat was about 20 per cent slower than a *Thistle* when hard on the wind, about the same speed on crosswind courses and faster running before the wind when we sailed on the lake. In the often steep chop off the Florida Keys the cat is dry and comfortable.

2 The rudder design was an unqualified success. There is a large difference in the ease with which the cat will come about with the rudder slot covers on versus with the slot covers off.

3 The automatic steering works fine on the wind and cross-wind. The rudders are built with about 5° twist—out at the bottom trailing edge. On downwind courses the cat will not steer itself unless the mainsails are wing and wing out ahead of the masts.

4 The biplane rig works fine but requires a little different technique. For example, the points of attachment of the main sheets to the bridge are somewhat inboard of the line of the masts so that in tacking the "lee" main will be trimmed in closer than the "windward" main on coming about with the sheets cleated. On courses where the relative wind is aft it is necessary to wing and wing the mains to keep both jibs full. On downwind courses I usually tie the clews of the jibs together. In shortening sail it is well to take in the jib on one side and the main on the other. With this combination the cat will come about in either direction with no trouble and the sails appear to be more effective. One unexpected advantage of the biplane rig was the ease of leading all the sheets to the helm without running them across the decks or cockpit. In jibing, one main will always go first which relieves the shock and gives a more gradual change in trim. The only real disadvantage to the biplane rig is that it is expensive.

If anyone knows of a good way to mount an outboard on a cat so that its propeller will stay submerged without having five extensions in the lower housing I would like to find out how it is done.

MIGA

January, 1964

by Joâo Mendonça

Nacala-Porto, Portuguese East Africa

L.O.A.	4·75 m	Displacement	(a) designed 0·542 ton
Beam	2·40 m		(b) actual 0·600 ton
Sail Area	18 sq m		

Designer, Builder and Owner: Joâo Mendonça

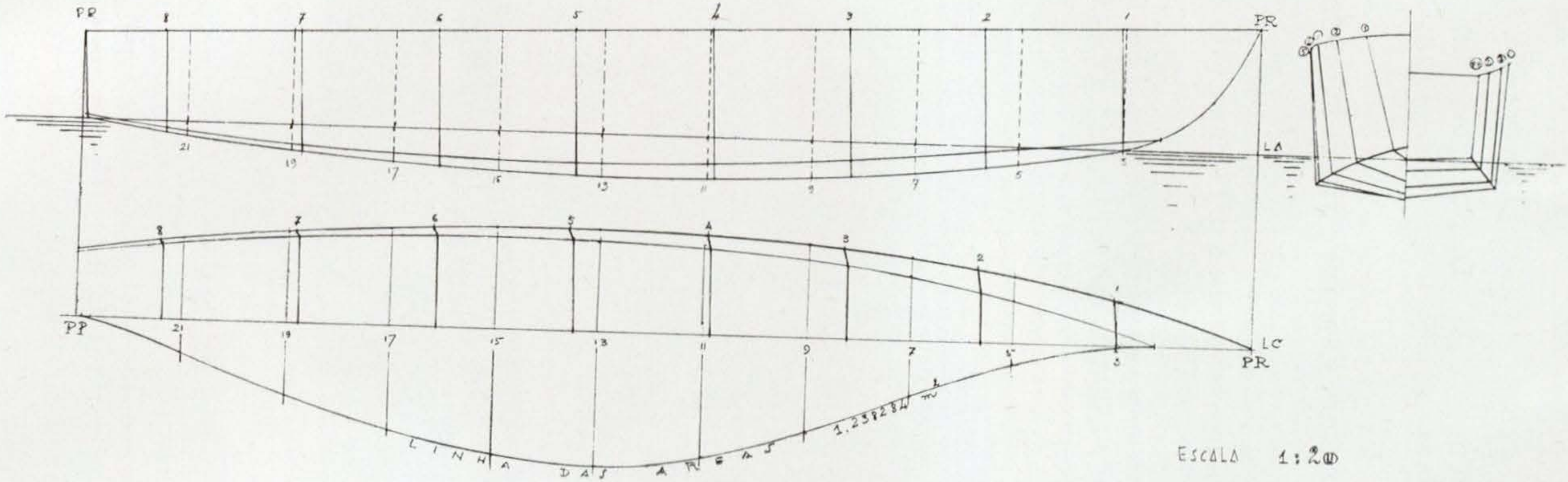
I finally finished, launched and sailed my catamaran *MIGA* on 20th November, 1962 and in the first month have sailed it 19 times with winds from force 0 to force 6.

MIGA is a small catamaran not intended for speed but for coastal cruising with comfort. Originally, I had designed her with a L.O.A. of 3·99 m (13 ft and 1 in) but my wife insisted that I redesign her to the full length of the 16 ft length of the plywood board.

MIGA

The hull lines show a very flat bottom of V section and the beam was calculated to give the necessary space inside of 0·8 m. I used ¼ in marine plywood, glued and screwed, the final weight being about 1,000 lbs, without crew. The bridge deck extended right from the bows to the sterns because I wanted plenty of space and a dry cat.

The proud moment of her contact with the wind and water was wonderful and I was happy with everything. Firstly, there was the pleasure of sailing a catamaran of my own design, the second I had seen and sailed (the first was



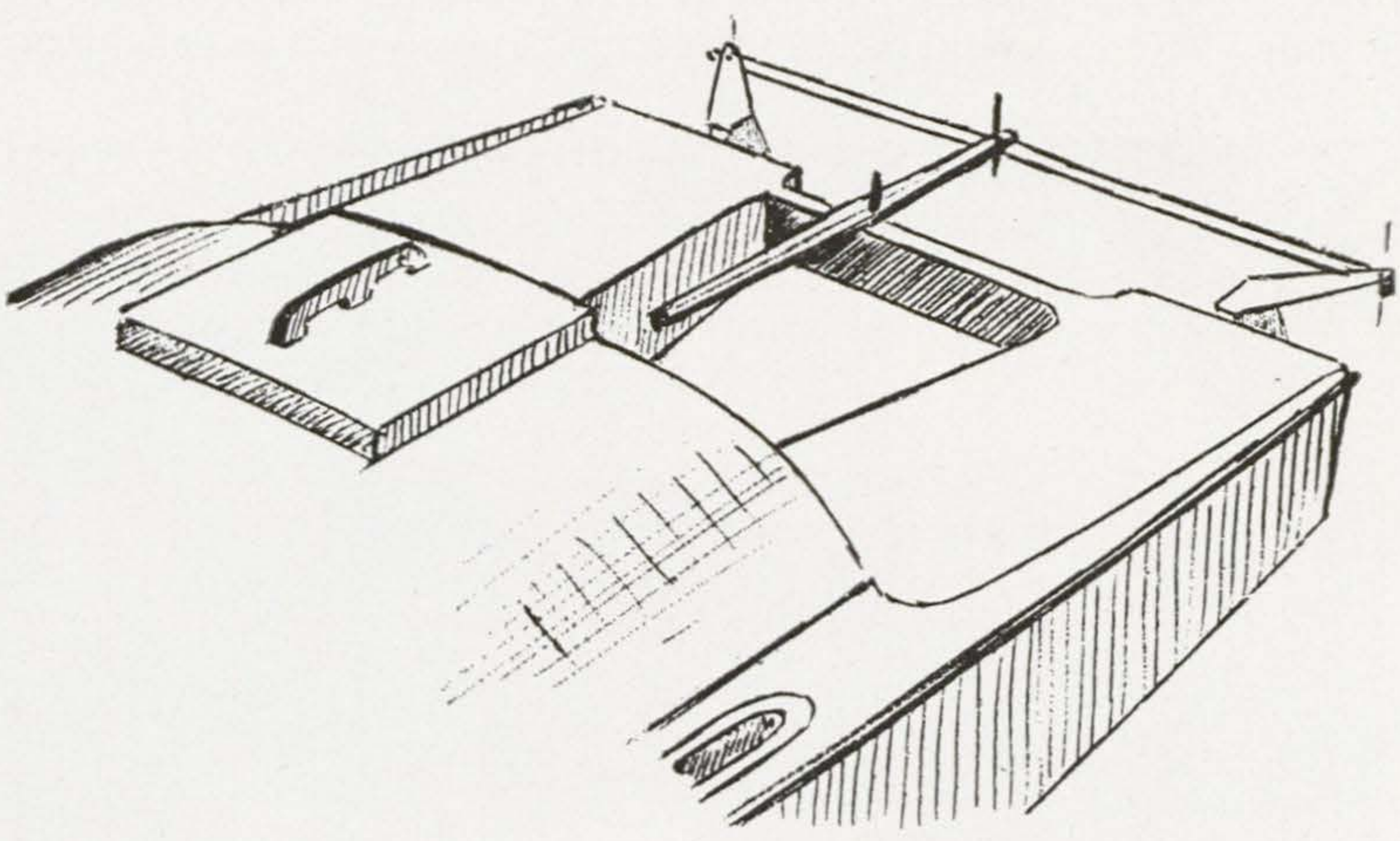
MIGA—Lines and sections

to my design, too, and it was wrecked 3 years before in the night); Secondly, I was not disappointed with anything at all.

The speed was good for such a boat; she *Planes* with winds of force 4. The lateral stability is enormous. She tacks in 2 or 3 seconds because of (a) the weight, (b) the big beam of each hull and (c) because I put the centre of lateral resistance 10 per cent back to obtain an exaggerated Ackermann effect. The weather rudder brakes somewhat and helps the cat to go about quickly.

On the second day, I had a strong wind of force 6 and I was forced to reef the mainsail not because of the stability but because I was afraid the mast might break. The fore hatches were not well closed and some water got in but when sailing free, we met one wave into which the bows dived till the fore deck was covered with water about 1 ft deep. But the cat recovered very well and we have never done the same since.

I have never measured the speed but I suppose that when planing *MIGA* reached the modest but good speed of 10 knots for short periods.



MIGA's Cockpit and Tiller

MIGA is very dry. The spray deflectors work well. The bottom of the bridge only occasionally is touched by waves. When close hauled, with foot high short waves, the motion is smooth, I suppose because of compressed air under the bridge. Her course, close hauled is very good, too, at 45° from the wind.

There is plenty of space for 5 adults, or 9 children but the ideal is 2 or 3 adults only.

The only bad thing I found in *MIGA* is that it was a very expensive boat to build, £300. I suppose with the same money, I could have built a small coastal cruising boat (one hull) of 20 ft or a trimaran of 24 ft.

If my official life goes as I hope, in October next year I will sail with *MIGA* to Lourenco Marques, 1,500 miles away.

Ed: We include this trimaran as being the origin of the line of thought which ultimately resulted in the central "Pod" for catamarans.

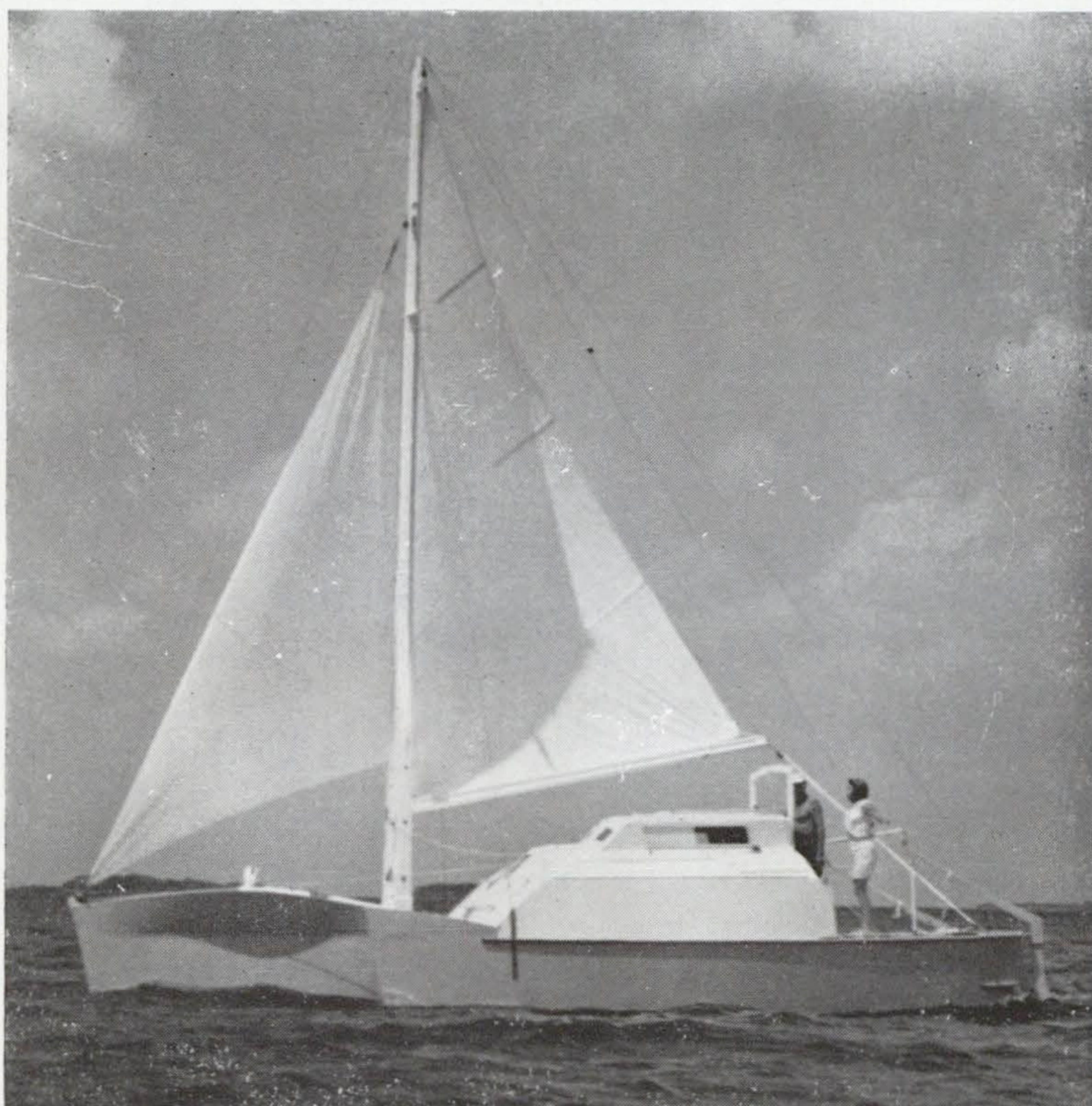
L.O.A.	31 ft 6 in	Length main hull	24 ft
Maximum beam	13 ft 0 in	Length outer hull	22 ft
Main hull beam	2 ft 7 in	Draft	14 in
Displacement	4,000 lbs	Sail	315 sq ft

Designer and Builder: T. C. Burnham

P.O. Box, 156 Allapattah, Miami, Florida

Case for the Tricatamaran

The common idea of a trimaran is one of a central hull and two outside hulls of lesser depth and overall length. Departures from this idea range from outer hulls of nearly equal length to the central hull, and depth below the L.W.L. from minus zero to several inches submersion. It is usually accepted that the



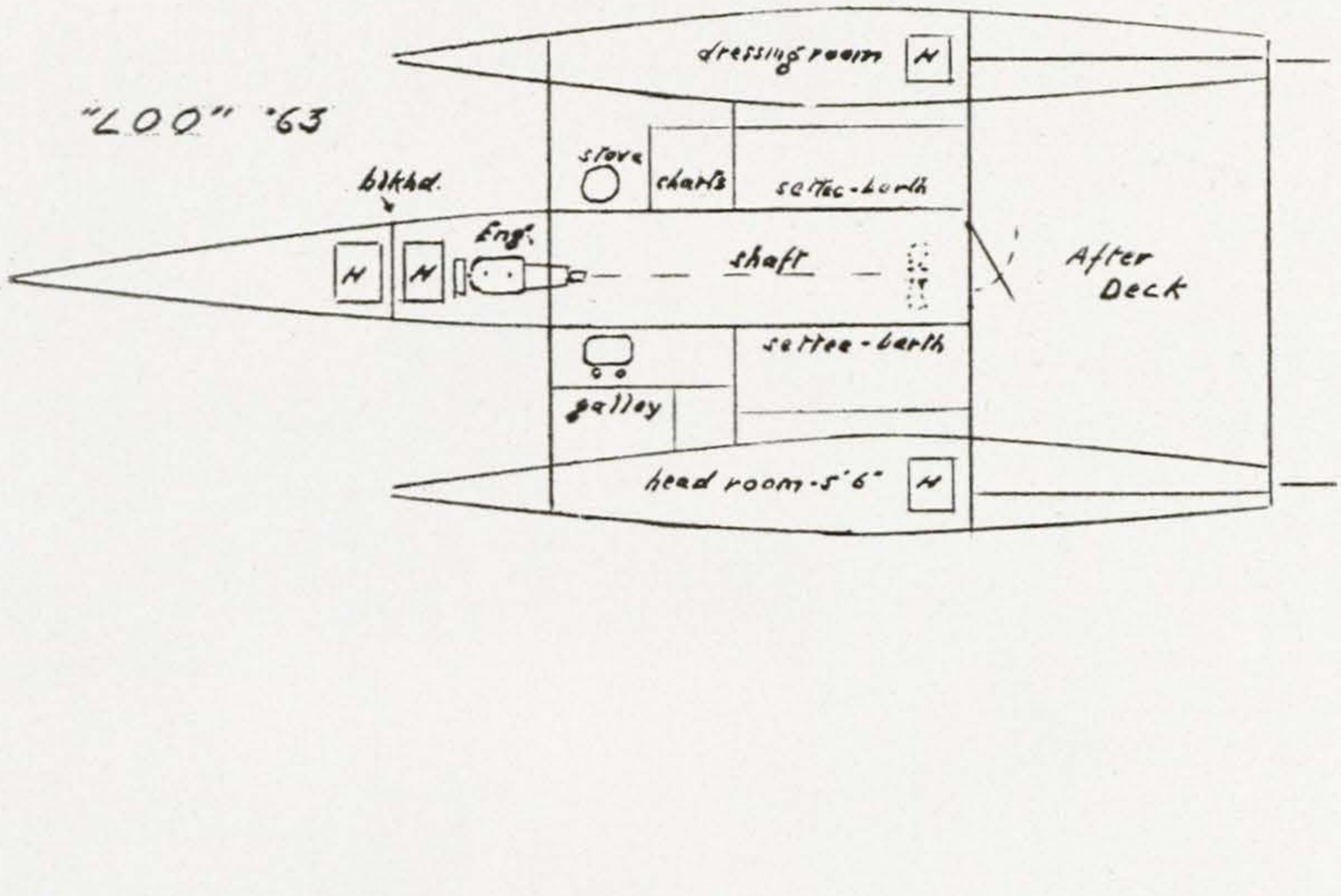
LOO

weather hull should be flying, except when running off. But why not have the outer hulls of nearly the same depth as the central hull, thus changing the loading, and keeping all the hulls in the water, catamaran style?

The disadvantages are more wetted area and three wave patterns instead of two. These effects tend to slow the speed, but on the credit side there is less windage of the weather hull, and a shallower depth on the lee hull when heeled. In addition there are benefits, such as a lesser angle of heel, less pounding from the weather float, greater initial stability and therefore less transverse movement in a chop.

Following these ideas, *LOO* was designed in 1962 and built in 1963. Although not fully proven, this "tricatamaran" auxiliary sailer is showing promise. The benefits described above have materialised, and the disadvantage of a higher wetted surface has been tolerable. High speeds have not been reached, but this is probably due to the complex cruising rig, windage from the rather high cabin trunk, and lack of adequate centre plates.

On its maiden voyage, *LOO* was taken to sea on a cruise of 200 miles without proper trials, and heavily laden, surviving a furious squall of 35 minutes duration on one occasion.



CHAPTER XIX

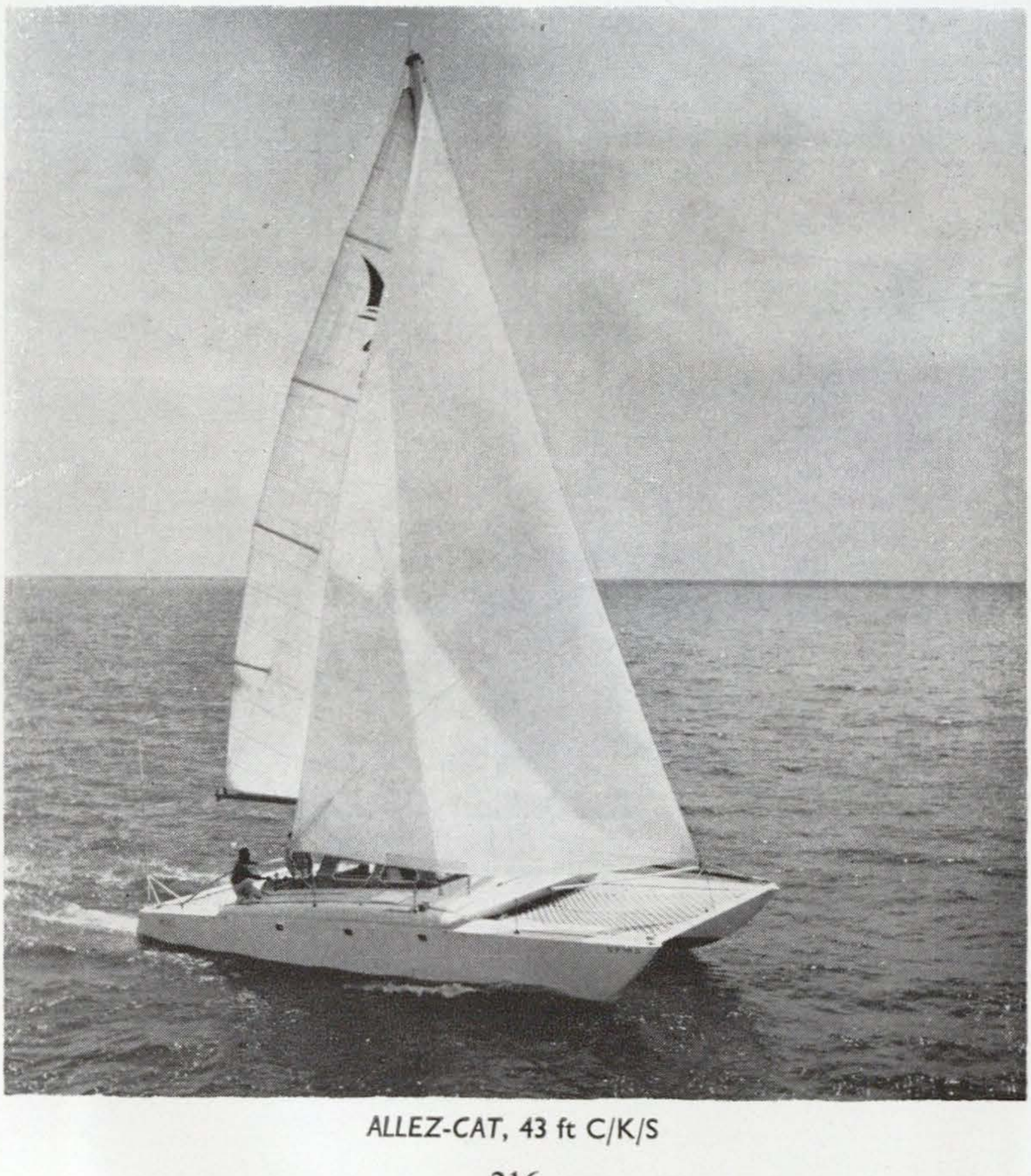
ALLEZ-CAT

January, 1965

This 43 ft ocean-racing catamaran was designed and built for Mr and Mrs Robert E. Jones of LaCanada, California. She was built by the C/S/K boatyard in Venice, California and launched in July, 1963. Specifications are:

L.O.A.	43 ft 6 in	D.W.L.	35 ft 6 in
Overall beam	17 ft 6 in	Draft	18 in
Working Sail Area	754 sq ft	Draft-daggerboards down	4 ft 6 in

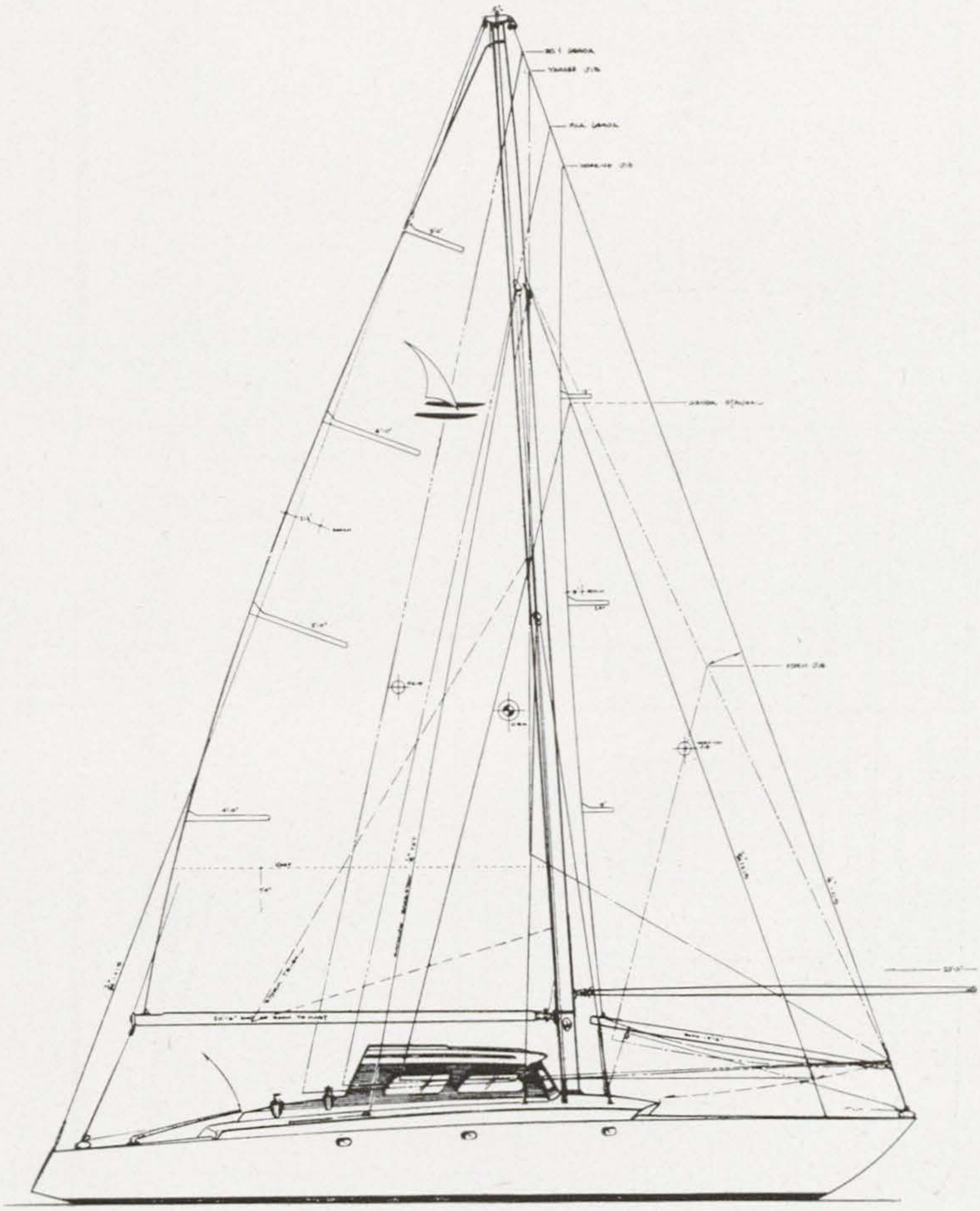
The owners' requirements called for a catamaran suitable for family and friends cruising to the offshore islands of California and ocean racing anywhere such events are held. Mr Jones expressed a special interest in high performance at sea and was willing to make some concessions in order to



ALLEZ-CAT, 43 ft C/K/S

attain this primary objective. Despite these concessions, *ALLEZ-CAT* is very comfortable.

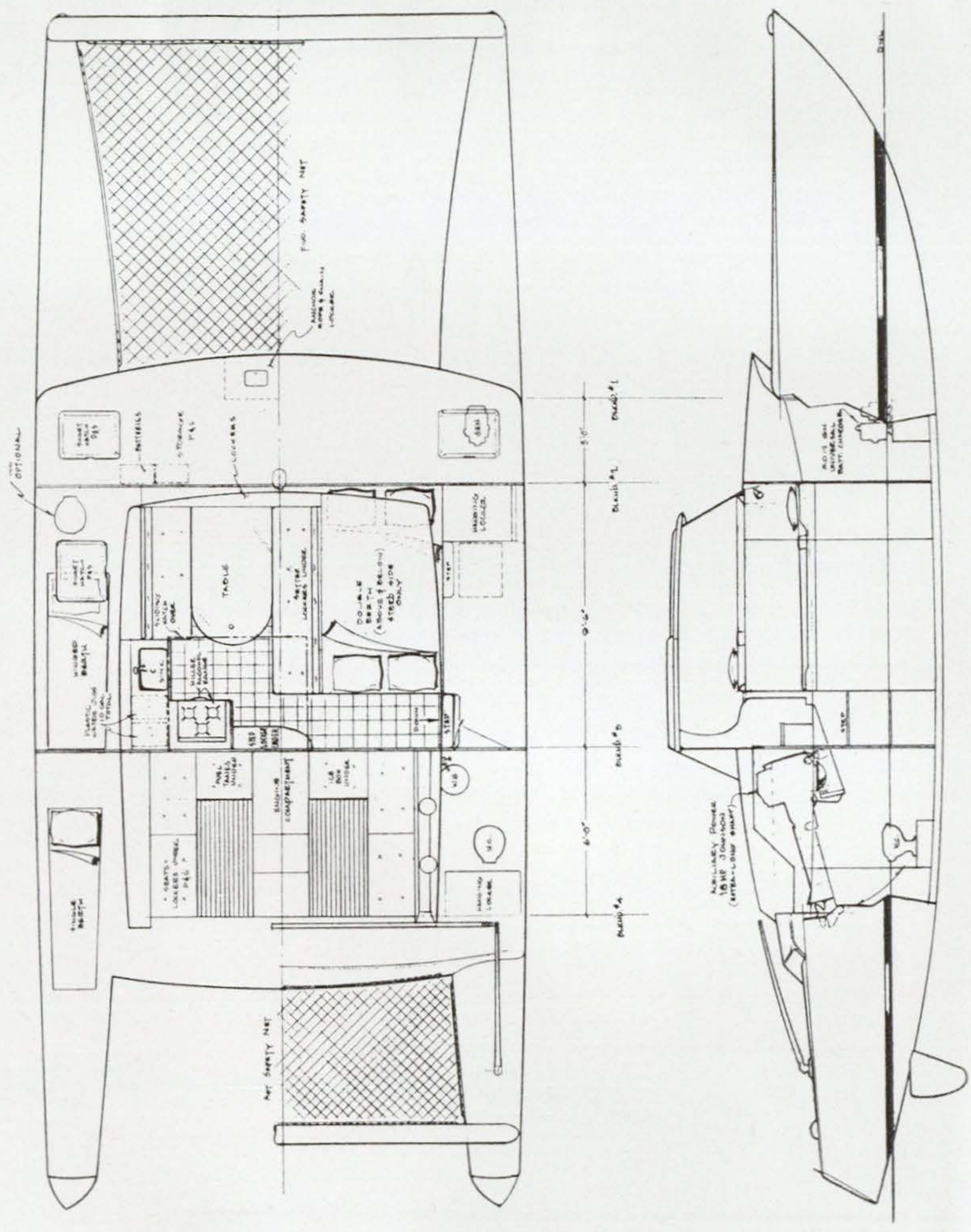
Both the designers and the owners agree that all primary design objectives have been attained. In the field of performance this objective has been exceeded. After one tune-up race, *ALLEZ-CAT* showed her ocean-racing ability. In the Newport Ocean Sailing Association-sponsored, October, 1963, Alamitos Bay Argosy, *ALLEZ-CAT* was first elapsed time on both days. She averaged nearly 8 knots in an equal amount of wind velocity where over 90 per cent of the course was to windward. In the first of the two-day races, *ALLEZ-CAT* beat the fastest CCA 50-ft ocean racer by 38 minutes, the second fastest ocean racing cat by nearly 15 minutes, and the fastest stock day-racing catamaran in the world by over 50 minutes, boat-for-boat. In an informal match race on January 25, 1964 against one of the newest aluminium 73-ft



ALLEZ-CAT

CCA-Rule ocean-racing yachts, *ALLEZ-CAT* was faster on all courses in a force 4-5 wind. To windward, *ALLEZ-CAT* sailed approximately 1 knot faster while pointing 2° higher. On a reach, she maintained between 14-16 knots while the 73 footer was moving at 11 knots. Downwind, *ALLEZ-CAT* was as fast under Genoa as the 73 footer under spinnaker. *ALLEZ-CAT* is capable of sailing at speeds in excess of 25 knots in the open ocean. In the designers' opinion, the *ALLEZ-CAT* is the fastest catamaran they have ever designed.

In 1964, the first, official, biennial Trans-Pacific Race from California will be held. As one of the four entries to date, *ALLEZ-CAT* is regarded by catamaran experts as a supreme threat to the supremacy of the 46-ft catamaran, *AIKANE* in Trans-Pacific ocean racing.



ALLEZCAT

As is customary with all C/S/K designed ocean-racing catamarans, construction specifications demand the best available materials in order to withstand the stress of high-speed sailing in the open ocean. She is built of: spruce frames, keels and stringers; marine plywood planking bonded by resorcinol-resin glue; fibreglass over all exterior surfaces; aluminium mast and spinnaker pole by Sparcraft of Costa Mesa, California; Merriman, South Coast and Mariner marine hardwear; stainless steel and dacron rigging, nylon webbing safety nets; and special hardware fabrication by Sasine Machine Works. All sails are by Kenneth Watts, Torrance, California. Auxiliary power is one 18 hp modified Johnson O/B motor which provides a cruising speed of 7 knots.

This design is not available for amateur construction. At present, she may be built only by C/S/K's own yard in Venice, California. However, the designers are considering releasing this design to three other selected and supervised builders in the country. Study plans are available for a nominal fee. Address all inquiries to:

Choy, Seaman & Kumalae, 2602 Newport Boulevard, Newport Beach, California.

IMI LOA (Distant Traveller)

January, 1965

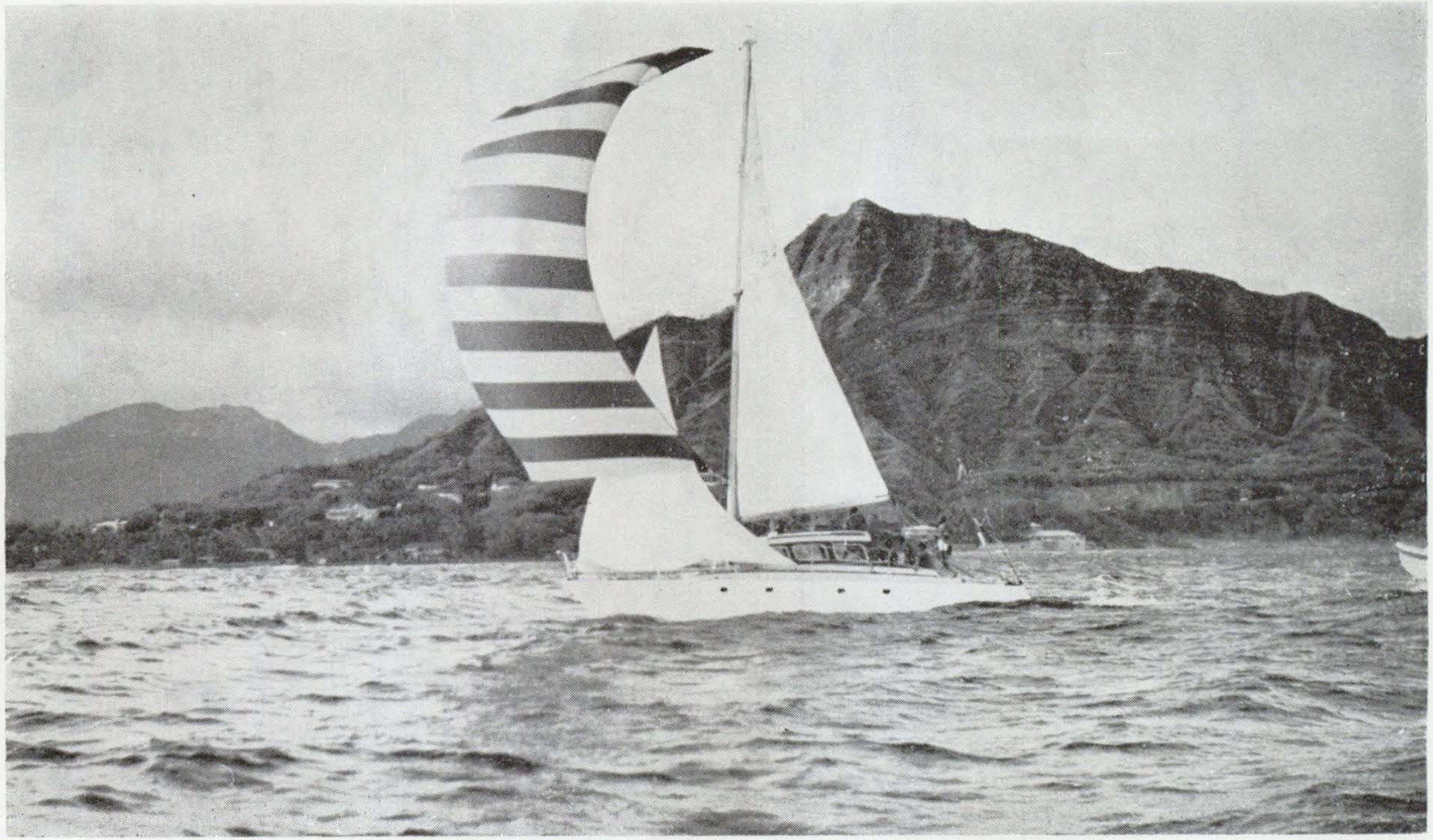
The 42 ft 6 in length overall cruising catamaran, *IMI LOA* was designed for Dr A. Victor Stern and Mr Freeman Odlum of Long Beach, California. She was built by the Choy, Seaman & Kumalae boatyard in Venice, California and launched in March 1963. Specifications are:

L.O.A.	42 ft 6 in	D.W.L.	33 ft
Overall beam	16 ft 6 in	Draft	22 in
Working Sail Area	676 sq ft		

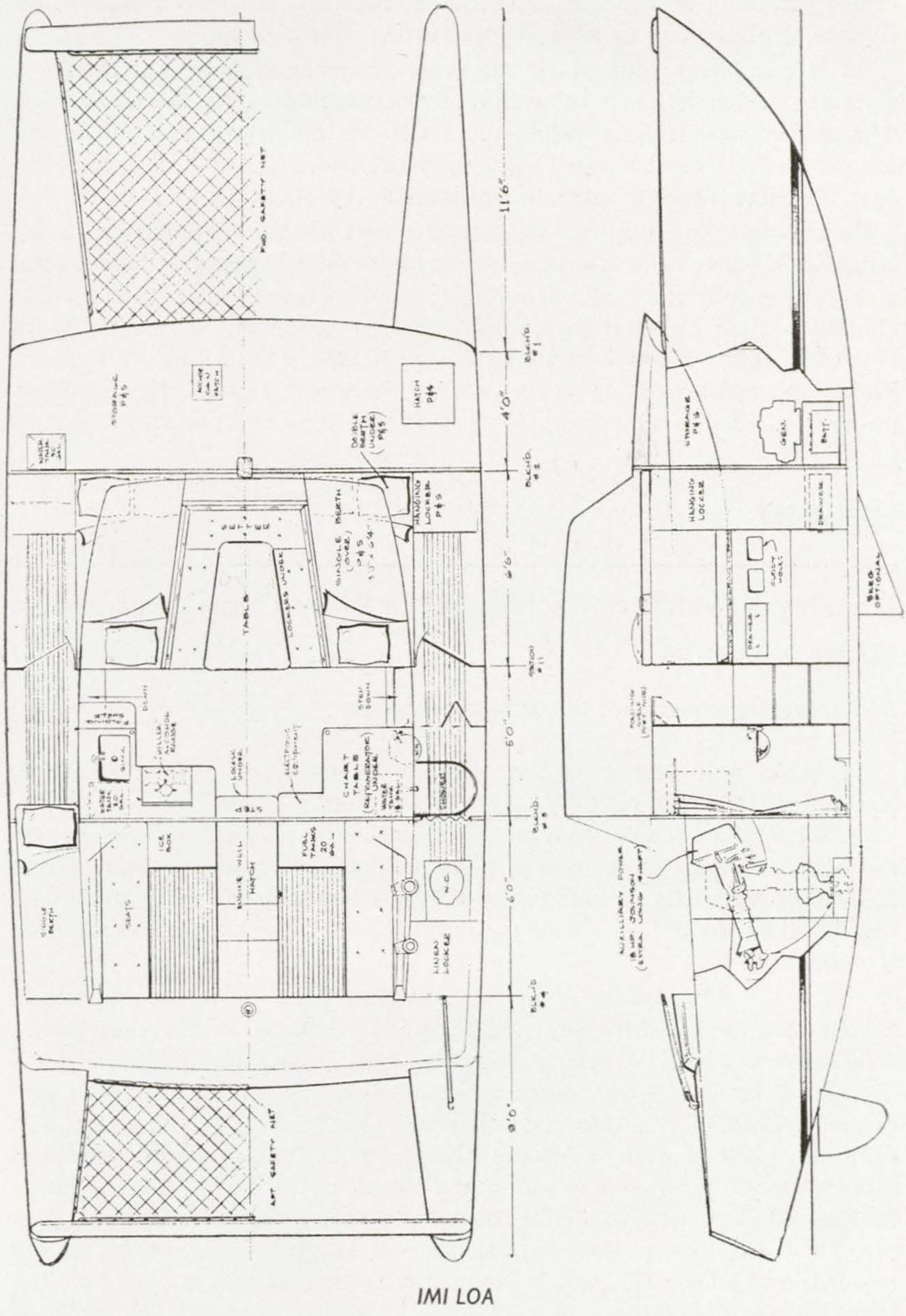
Messrs Stern and Odlum requested a catamaran suitable for both family weekend cruising and long-distance ocean racing and cruising with a crew of seven. Shoal draft was an imprtant design requirement since future plans include a long cruise through the South Seas where many a fine yacht has been lost because of the treacherous coral reefs and unchartered currents. Ease-of-handling and unusual comfort for weekend cruising or with passage sails were also primary design requirements.

A season's cruising in offshore Southern California and Mexican waters has shown that *IMI LOA* meets every requirement asked for or encountered to date. In the several ocean races that *IMI LOA* has entered, she has displayed good performance, even against high-performance ocean-racing catamarans. In the 1963 Newport-Ensenada Race of 125 nautical-miles length, *IMI LOA* would have probably been first, corrected time, in the multi-hull class except for a navigational error. She took third place behind two other C/S/K designed catamarans.

All-round performance has lived up to expectations. *IMI LOA* cruises at 10 knots under power and is capable of a top powered speed in excess of 12 knots. Under sail, she has a top speed of more than 22 knots. *IMI LOA*



IMI LOA, 43 ft "Cruising Catamaran" crossing Diamond Head, Hawaii 10 days 9 hours for 2,000 nautical miles



IMI LOA

demonstrates good weatherly ability and excellent manoeuvrability at all times. Her unusually-high bridge clearance allows her to be driven at top speed to windward and all other courses in rough water without any fear of bridge pounding in any way. The leading edge of the C/S/K raised-bridge concept also serves as an efficient spray deflector at high speed.

As is customary with nearly all C/S/K catamarans, the hull design is asymmetric. The designers believe that for seaworthiness, weatherly qualities, high-performance and soft-riding characteristics, the asymmetric-hull design has conclusively demonstrated superiority over other possible hull shapes to date. The actual record seems to substantiate this claim.

Construction specifications demand the best special materials, such as: cedar keels, frames and stringers; marine-plywood planking; resorcinol-resin glues; fibreglass over all exterior surfaces; extensive teak trim and bright work; aluminium mast by Sparlight Ltd of England; Merriman, Mariner & South Coast Hardware; stainless steel and dacron rigging, dacron sails by Kenneth Watts, and nylon-webbing safety nets by Nielson & Helson. Her auxiliary power is privided by a modified Homelite 55 hp 4 cycle O/B motor.

HELANI

January, 1965

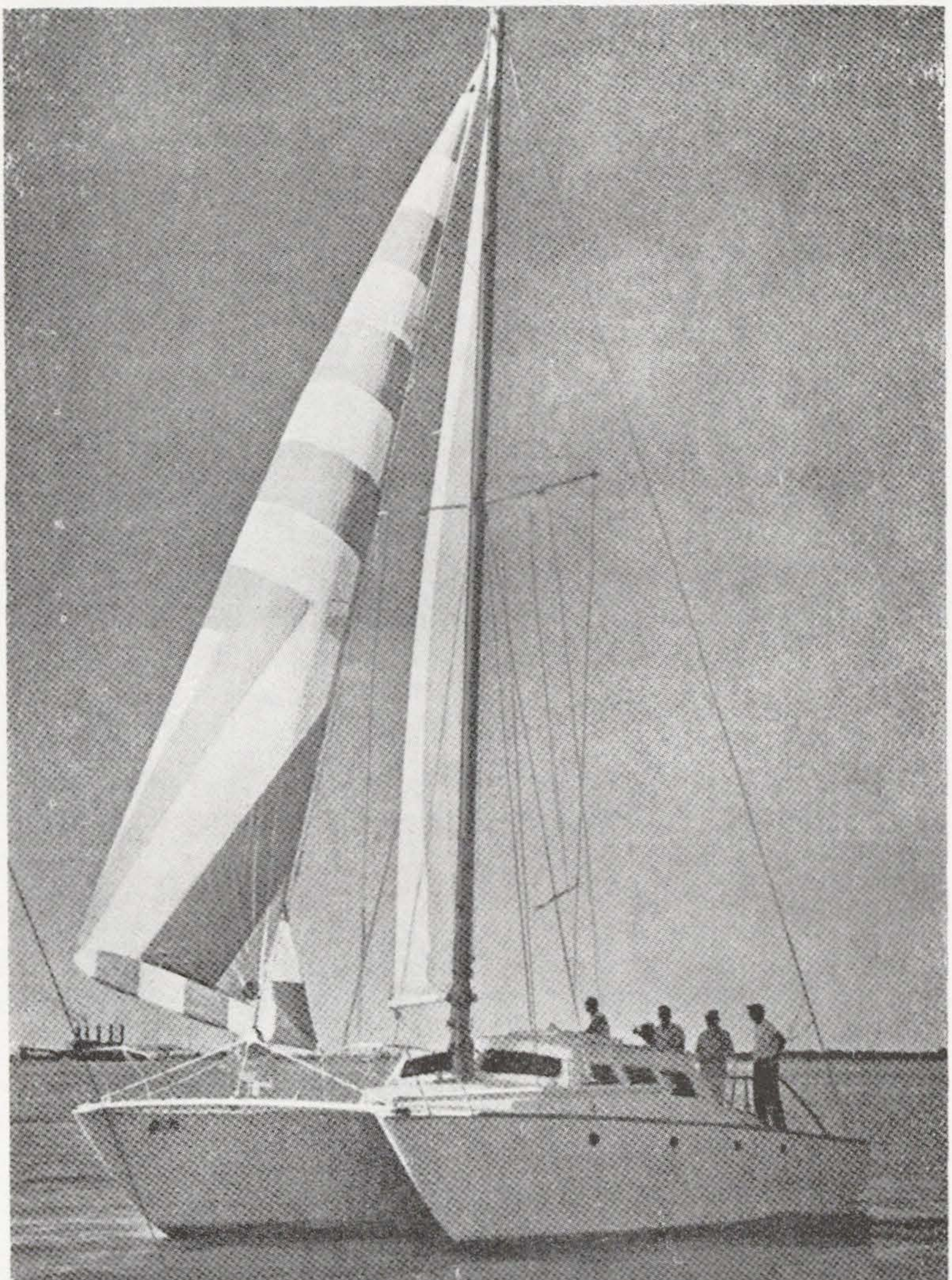
Charley Kretschmer's New 42 ft Rudy Choy Catamaran by Al Peloquin

Article originally published in LAKELAND BOATING.

They blink—and take a second look—when they first spot Charles H. Kretschmer, Jr's new *HELANI* at its mooring at Saginaw Bay Y.C. at Bay City, Mich. With reason, too, for *HELANI* is the only large catamaran in this area, and she's probably one of the swiftest sailing yachts on the Great Lakes. The name? Its a combination of Helen, Kretschmer's wife's name, and the Hawaiian word "lani," meaning beautiful. Mrs Kretschmer and the boat both qualify.

HELANI is 42 ft overall, sloop rigged, with a beam of 16 ft. Gross weight is 7,800 lbs. Designed by Choy, Seaman and Kumalae, of Newport Beach, Calif., she was built by veteran Bay City boat builder Ben Huskins, at his Saginaw River yard. The catamaran's two asymmetrical hulls are of monocoque (stressed skin) construction. The hulls, each 3 ft 7 in wide × 6 ft 3 in deep, are planked with mahogany plywood over framing of plywood and Sitka spruce. The plywood is $\frac{1}{8}$ in on the outside of the hulls, while the rather bulbous inboard sides are double diagonal planked with two layers of $\frac{3}{16}$ in ply. There are no butt-blocks in the hull, for all plywood joints are scarfed (spliced) and glued. The hull is fastened with glue, staples and screws. The three watertight bulkheads in each hull are made of spruce. The hulls are covered with fibreglass cloth and plastic for added strength and protection, with double cloth below the waterline. The catamaran draws only 3 ft, including the fin keel under each hull. The keels, made of a tough alloy plate, taper from nothing to a foot and are 4 ft long. They were designed as a pivoting point for coming about.

The catamaran's large, light and airy main cabin, which measures 12 ft × 14 ft, rides between the two hulls. With about 6 ft of headroom, the cabin contains the complete galley, a dinette-lounge, a chart desk and two large berths. From the main cabin there are companionways to staterooms in the two hulls, both with over 6 ft of headroom. The head is in the starboard hull and there's stowage and space for a future shower in the corresponding space



HELANI

to port. Aft in each of the hulls is space with a pipe berth, with access through hatches from the deck. This makes a total of six bunks.

Kretschmer feels that the catamaran's roominess is one of its main advantages. The usable interior space in the 42 footer is probably greater than that of most 50 footers. There's more space on deck, too, for *HELANI's* roomy cockpit will accommodate a good-sized party. In addition, the nylon web safety net forward will hold four to five persons, and it's a thrilling place to ride when the big cat is boiling along in a good breeze.

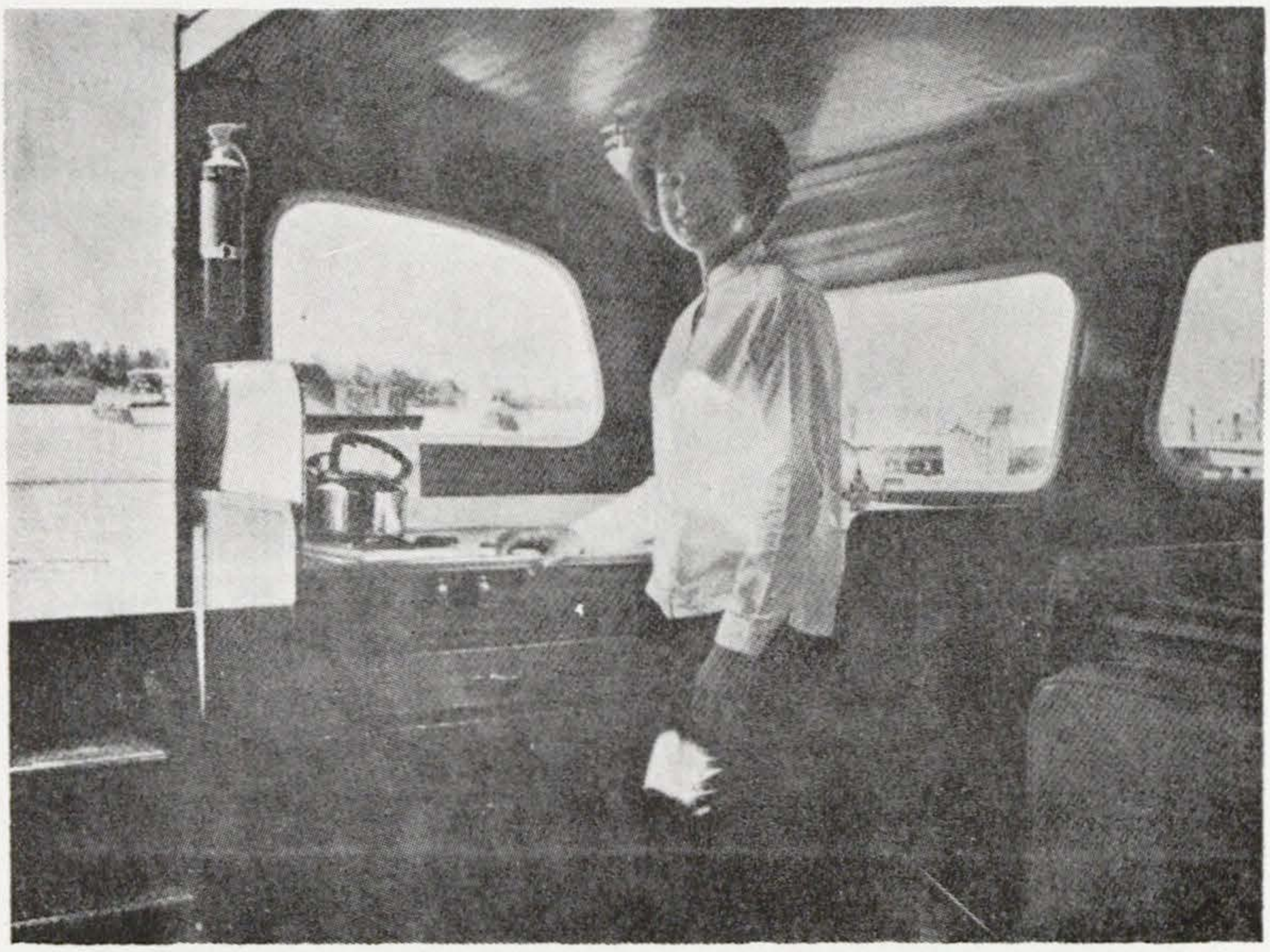
Dinette-lounge at fore end of main cabin

The sloop carries 600 sq ft of sail in her masthead rig. The aluminium spars, made in England by Ian Proctor, who made the spars for *SCEPTRE*, the America's Cup challenger, towers 49 ft above deck. Kretschmer has a jib, main, storm jib, jenny and huge spinnaker, all by Watts. The catamaran is extremely fast and Kretschmer is confident that she has sailed as fast as 25 mph and even more because the Airguide jewel movement speed indicator showed 25 mph, at a time when the instrument registered zero when the boat was travelling 4 to 5 miles per hour.

For auxiliary power, the catamaran carries a 28 hp Evinrude, mounted under a box in the cockpit. The extra-long lower unit was made by putting three 5 in extensions from Evinrude. The shaft was made locally. The motor easily drives the big cat with a top of 8 mph wide open and 6 mph at half speed, according to Kretschmer.

Kretschmer's first sailboat was a 20 ft Highlander sloop, which he bought in 1956. It was while on vacation in Hawaii four years ago, that Kretschmer saw his first large catamarans under sail, and the germ of owning one took seed. "Then I began reading more about catamarans in the boating magazines, and found out about Rudy Choy," he explains. "I began corresponding with him, and placed a few phone calls to Newport Beach. Pretty soon we had agreed on general plans, and he began drawing the plans and specifications."

Kretschmer first met Choy in November 1961, when the designer came to Bay City to check on construction just started at the Huskins yard. Choy returned last June when *HELANI* was launched in the Saginaw River, and sailed on her first trial runs.



Galley at aft part end of main cabin

"A catamaran makes a lot of sense to me," said Kretschmer, adding that *HELANI's* performance was all he had expected, and even more. "The catamaran has a great deal more potential as to speed, since it is not confined to a hull speed. It's much lighter, rides more level and is a lot more comfortable."

"It seems like you're sitting in somebody's basement when you're in the cabin of a conventional sailboat, down there at the waterline. In *HELANI*, we're almost 3 ft above the waterline, and we have all kinds of room in the cabin, and big windows to see out of, instead of tiny portholes.

"Besides *HELANI's* construction makes her unsinkable. There's no 10-ton hunk of lead underneath her, she's made of wood and we've three watertight bulkheads in each hull, to boot. With my family of girls sailing aboard her, that's probably one of her most important features."

The new cat proved her speed this summer in several races, the longest SBYC'S traditional 60-mile Gravelly Shoals Race. She finished about an hour and a half ahead of the second finisher, but was knocked into second place by her handicap. The rating of "52," which meant a handicap of three minutes per mile, was taken "out of thin air" by the SBYC race committee, "just to encourage me to race." Measuring and rating catamarans has provoked some bitter arguments between catamaran owners and enthusiasts and skippers of traditional sail yachts. Some traditionalists insist that a 42 ft catamaran should be rated on the length of her two hulls, so that she would race under a rating approximately that of an 80 footer.

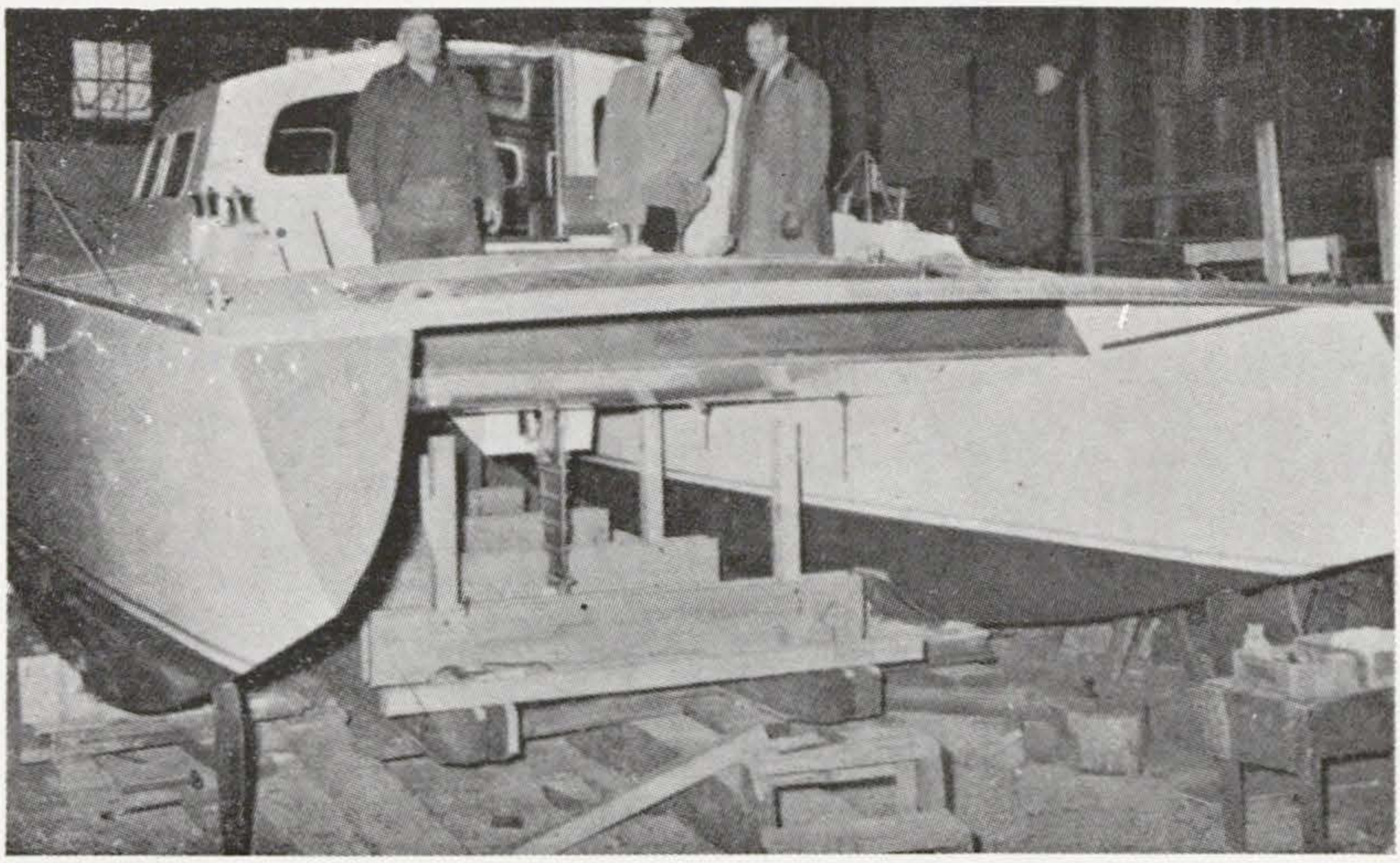
HELANI, 41 ft 6 in

Equipment aboard includes a 700-watt, 30 amp, 12-v Universal generator that charges batteries and provides current for the galley refrigerator. Galley cooking is on an LP gas stove. The only electronic equipment aboard now is a Multi-Elmac "Sea-Deep" depth sounder, but Kretschmer is planning to install a radiotelephone by next season.

The stability of the catamaran is one of the features Kretschmer is most pleased with. In a 30-35 mile blow, he said, the angle of heel was only 10 to 12°.

Some of the smaller catamarans have been known not to point too well into the wind. Not so with this Choy design, according to Kretschmer. "We have on one occasion beaten to windward with other boats that are considered to be high pointing and passed them on their lee side and then proceeded to cross their bow," he related, adding "I'm confident that a Choy designed catamaran can point as high as the average high pointing conventional boat, at the very least."

Inside *HELANI's* Starboard hull during construction



HELANI during construction. Note the sterns

"It's quite a jump from a *Highlander* to *HELANI*," Kretschmer observes, adding that he still must get the feel of his fleet charge, "but, by next year, we hope to cruise the Georgian Bay area, and to sail along in one or both of the Mackinacs as an observer." (In the past race officials of both the Chicago and Port Huron Mackinacs have not expressed enthusiasm over entries by catamarans, trimarans and even some single hull light displacement types).

The family shares Kretschmer's enthusiasm for this newest $35,000-plus addition. Mrs Kretschmer and the four girls have all crewed in Saginaw Bay races aboard the *Highlander*. The girls are Helen Louise, a teacher in Detroit; Kathleen Ann, student at the Chicago Art Institute; Christine Marine, at Madonna College, Livonia, Mich. and Cynthia, a high school sophomore.

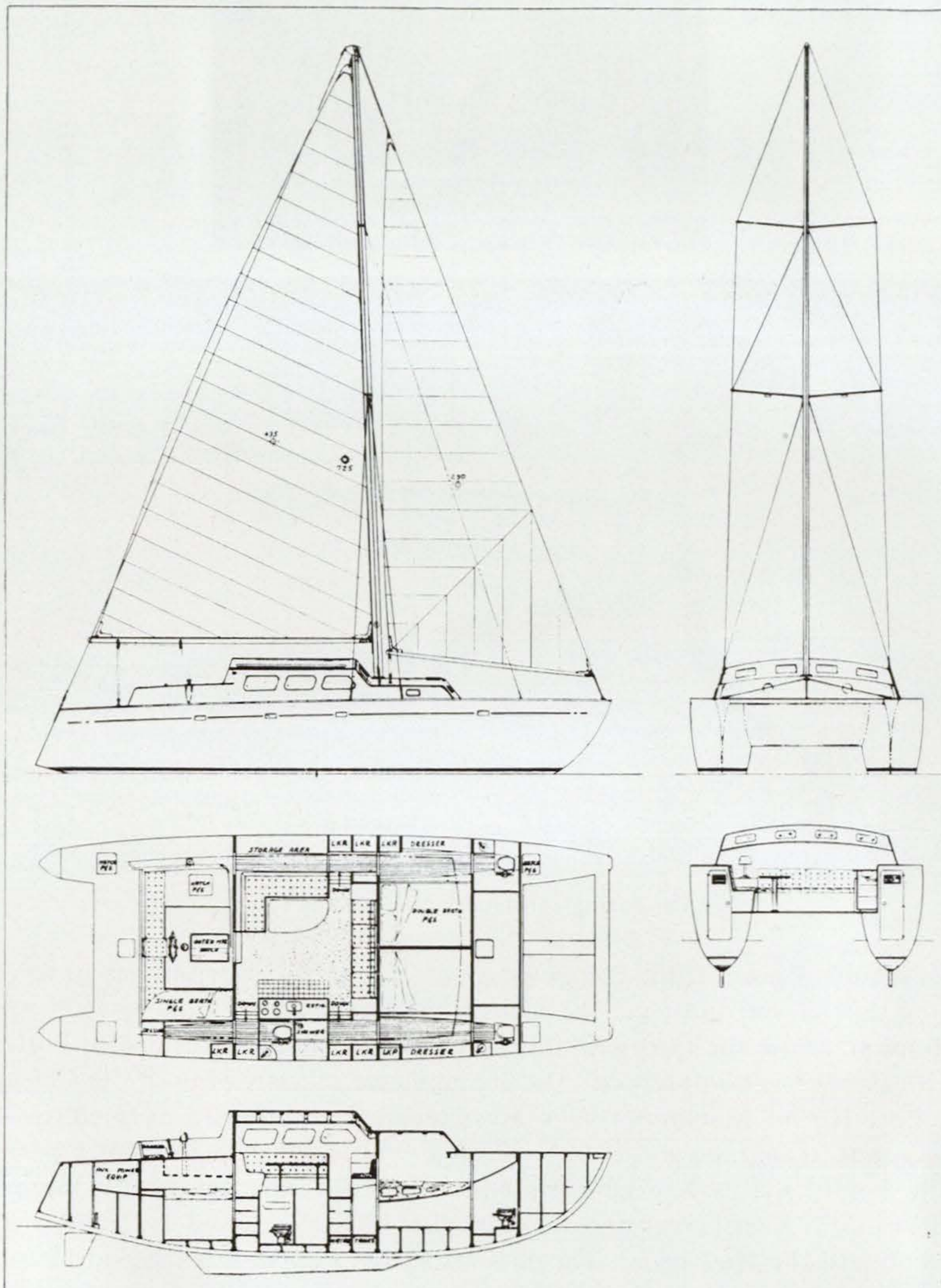
41 ft NORMAN CROSS CATAMARAN

January, 1965

Designer: Norman Cross

4326 Ashton, San Diego, 10, California, U.S.A.

L.O.A.	41 ft	Draft	3 ft 4 in
L.W.L.	34 ft 2 in	Sail Area	725 sq ft
Beam, O.A.	18 ft	Displacement	14,000 lbs



Norman Cross Catamaran

The Hull Design

The profile is reminiscent of the Choy catamarans but the hull is symmetrical and the depth is not as great. The result is an interesting synthesis of various designs. It may well be easier in its motion than the beamier Prout cruisers while the extra lateral resistance makes the use of centreboards unnecessary. However, a 14 ft length of keel is used to take the ground, give lateral resistance and a pivot point to make tacking easier.

Accommodation

This does not try to put berths in every conceivable place but gives an air of spacious living for two couples, while two extra could sleep in the saloon.

The Sails

The snug rig and working foresail show that this boat is designed for easy sailing and pleasant living which, oddly enough, is what makes many people own yachts. Not everybody is keen on "Ocean bashing" or keen racing. This boat will be fast when the wind is strong but will give easy handling under light or heavy conditions.

Ed: Note the low A.R. keels.

CHAPTER XX

TWO SPECTACULAR YACHTS

January, 1965

52 ft CRUISING CATAMARANS

L.O.A.	51 ft 7 in	Beam Hull at L.W.L.	5 ft 5 in
L.W.L.	43 ft 4 in	Draft C.B. up	3 ft
Beam Extreme	21 ft 3 in	Draft C.B. down	7 ft
Sail Area	1,441 sq ft (5,000 sq ft with light sails)		
Power	Two (2) Mercedes-Benz Diesel Engines. Model OM 321 100 hp at 2,800 rpm		
Drives	Two (2) MerCruiser 2 Stern Drive Units		

Designer: MacLear and Harris

11 East 44th Street, New York 17

Owners (Wood boat): Mr Alden Smith and Mr Compere Loveless

Builder (Wood boat): Abeking & Rasmussen

Lemwerder, Germany

Owner (Aluminium boat): Mr Robert C. Graham

N.Y.C.

Builder (Aluminium boat): Robert E. Derecktor Inc.,

Mamaroneck, N.Y.

Two powerful ketch rigged catamarans designed by MacLear & Harris were launched this year (1964). These exceptionally large auxiliary catamarans are sisterships in every respect except construction materials. One is an aluminium catamaran being built by Robert Derecktor's yard in Mamaroneck, N.Y., while her double planked mahogany sistership is being constructed by Abeking & Rasmussen in Germany.

Both boats will be sailed on the East Coast of the United States and the Caribbean. The German built wooden boat plans to cruise the Mediterranean this coming summer before her transatlantic passage to the United States via the Canary Islands and the Antilles, in the winter of 1964-65.

The word "powerful" is employed in describing these vessels because they will have exceptionally large diesel power plants as well as generous sail plans with large sail inventories. Each craft will have twin 100 hp Mercedes-Benz diesel engines for a total of 200 hp for each boat. The vessels will thus be *twin screwed craft* with engines aft, *driving through the transoms* with Mer-Cruiser zee drives.

Both boats will have central *air conditioning and heating*. There will be *four private bathrooms* each with shower. Sleeping accommodations for seven in the owner's party and four in the crew will be available, although the vessels will seldom have this number of persons aboard. Alternatively, they could sleep nine in the owner's party and two in crew.

Still another unusual feature about these catamarans is that they will have *two sportfishing chairs* mounted on the sterns, and the mizzen standing rigging will serve as fishing outriggers. They will have *live bait and fish wells,* as well as iced bait boxes and fish boxes. Galley *deep freezes* will be convenient for preserving generous quantities of fish and other frozen foods.

A glass bottomed panel will be provided to permit passengers to *view fish life and skindivers in action* in the clear tropical waters where the boats will cruise every year.

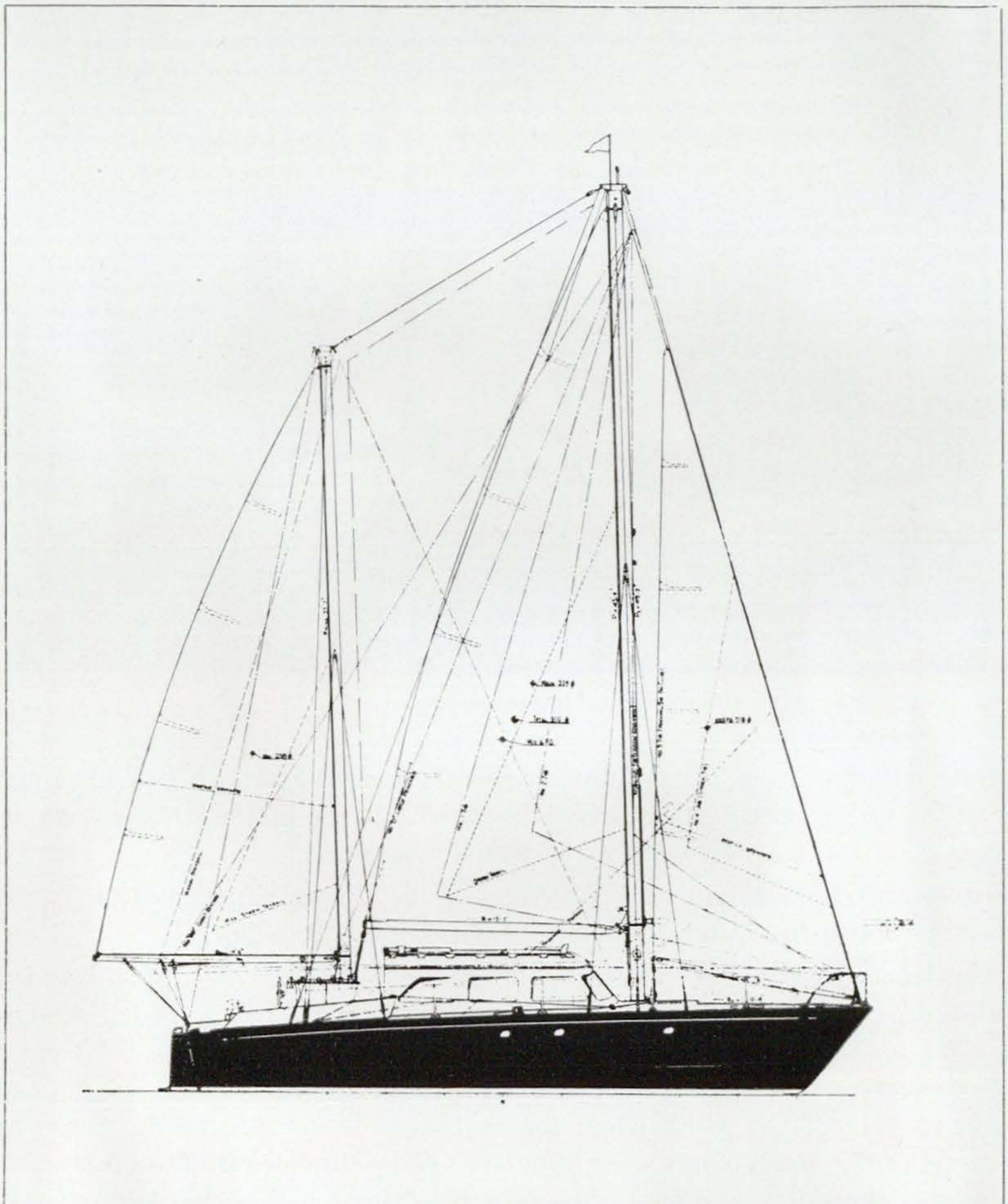
BAHAMA 37

Both catamarans will have tape recorders and hi-fi sets to provide music. Powerful radio transmitting sets will enable communication over long distances. The 150 watt sets will carry twelve channels.

There will be *wall to wall carpeting* in the "wing" (that portion of the structure above the water connecting the two hulls together).

The *ketch rig was chosen* because of its convenient division of sail and the multitude of sail combinations it allows. It is particularly suited to large catamarans because they require far less canvas to go to windward than off the wind. This is because of the speed of the catamarans which substantially increases the relative wind when the real wind is forward of the beam and decreases the relative wind when they are sailing downwind. *The large mizzen staysail* is the quick and easy way that this canvas will be put on and taken off to suit the point of sailing. A "mule" can also be set on either backstay to add to the boats' sail area. When their light canvas is set these boats will be able to carry 5,000 *sq ft* of nylon sail cloth. The two boats will only draw 3 ft of water when their centreboards and pivoting rudders are retracted. They will thus be able to enter shallow harbours where the average auxiliary sail boat and motor boat will have no access. In deeper harbours they will have the advantage of being able to anchor closer to shore than other boats of their size because of their shallow draft. In calm waters they will be readily beachable.

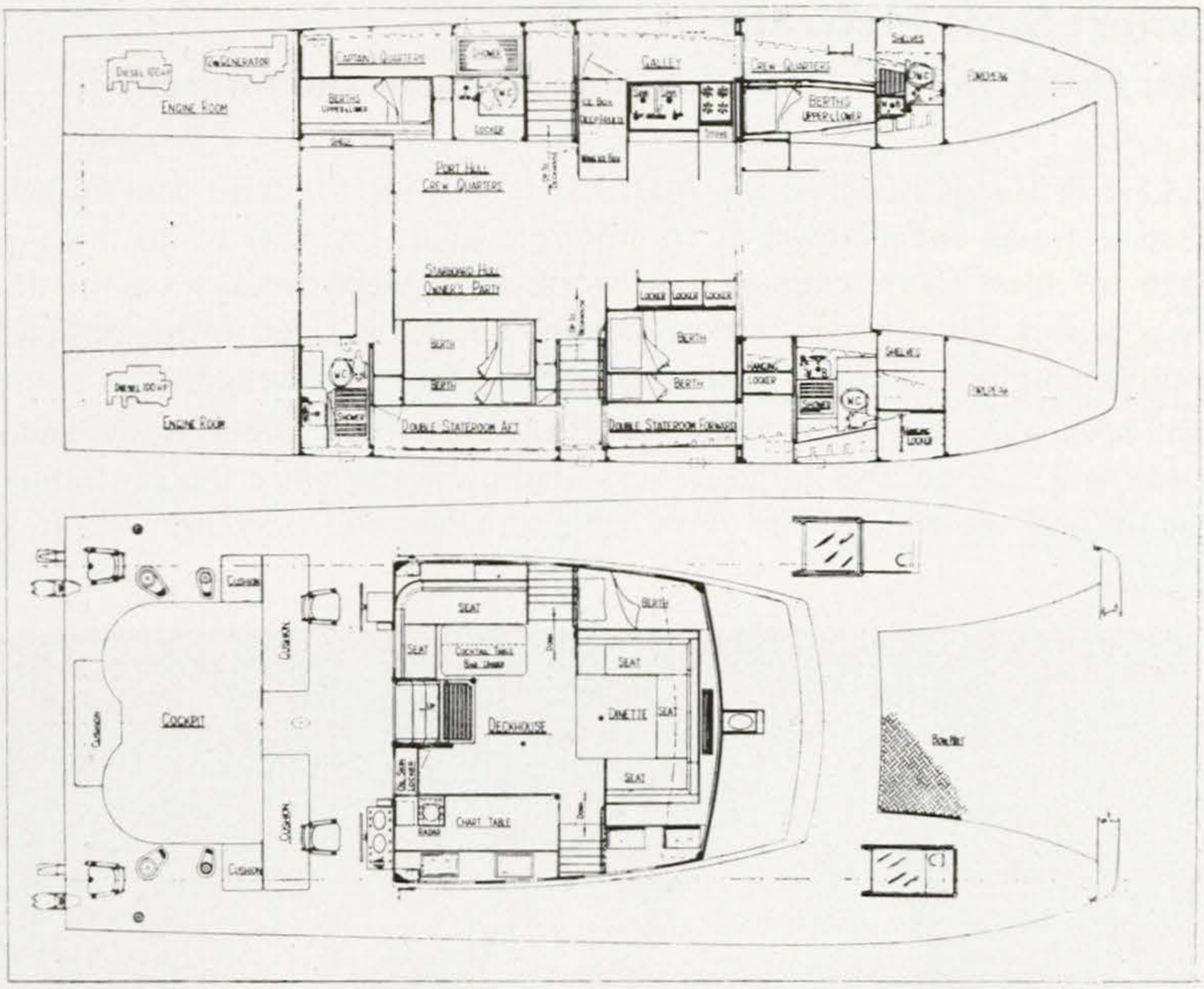
Their average angle of heel will be less than 5° and they will be capable of making *fast passages under sail or power*. They are expected to make passages in 15 to 25 per cent less time than conventional sail boats or motor sailors.



MacLear and Harris' 52ft. design

These two boats are expected to attract considerable attention and to substantially demonstrate the multiple advantages of multihulled boats. They will be in commission 12 months in the year and will be available for charter at certain times. This should permit quite a few curious as well as sceptical yachtsmen to evaluate this type of catamaran. The designers, MacLear and Harris of New York, believe that many more large catamarans will be built in the next decade as yachtsmen gradually become aware of the potential of catamarans.

The aluminium boat took 20,000 lbs of Alcoa marine aluminium to build her. It is understood that she is now available for charter in the Caribbean in the winter and in New England in the summer.



MacLear and Harris' 52ft. design

BAHAMA CAT '41'

January, 1965

Length Overall	40 ft 11 in	Draft, C.B. up	2 ft
Length Datum Waterline	35 ft 7 in	Draft, C.B. down (approx.)	6 ft
Beam, Extreme	17 ft 6 in		
Power	Pair of 225 hp MerCruiser Z-Drives + 450 hp Total		

Designer: MacLear & Harris

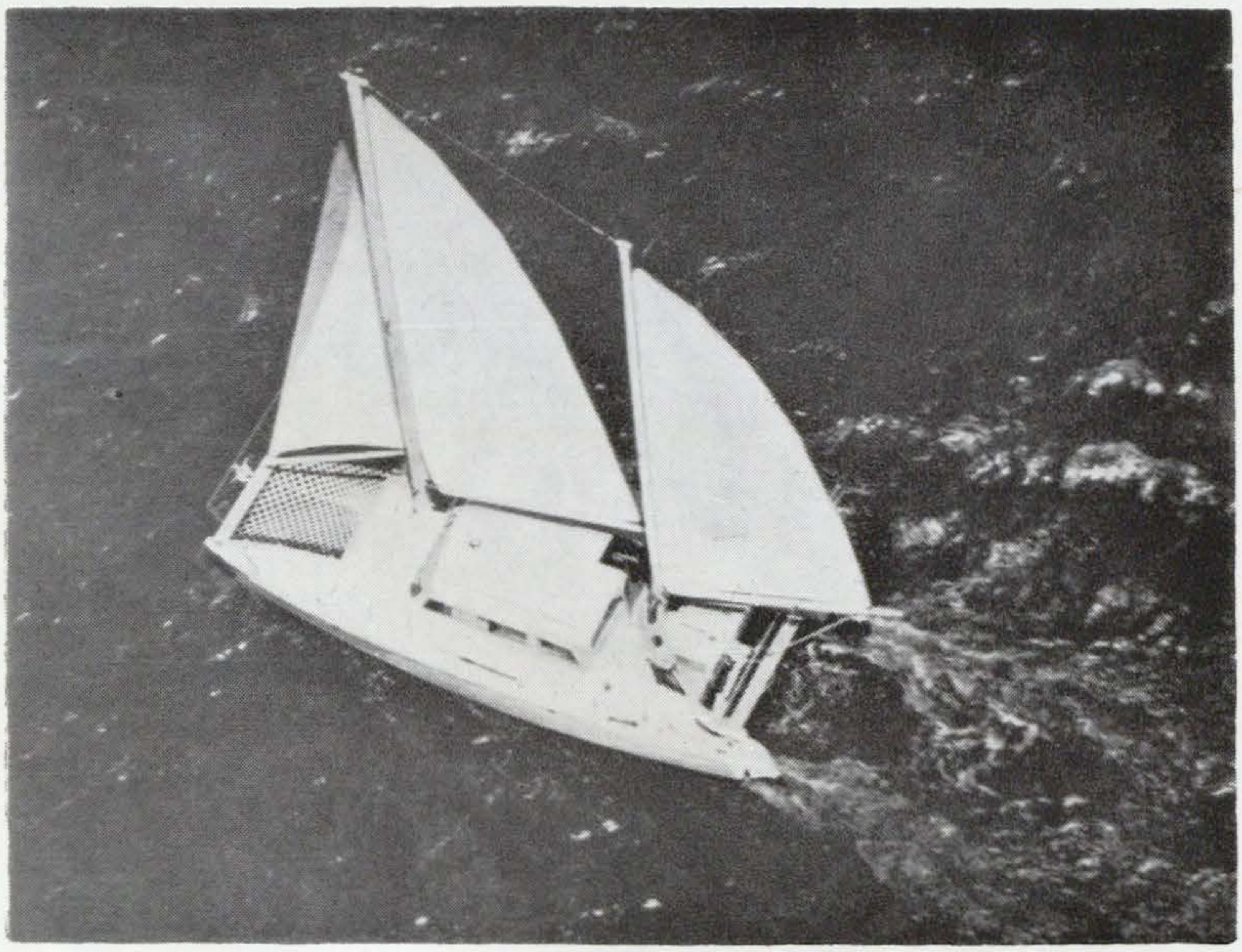
Builder of No. I Boat: Bristol Boat Div. of Allen Quimby Veneer Co.

Owner: Sims McGrath

Sails: Hood. Rig by: Hood (aluminium main and mizzen)

MacLear & Harris designed the *BAHAMA* "41" for Mr Sims McGrath who wished to travel under power at 16 miles per hour. In order to do this a pair of 225 hp MerCruiser engines driving through MerCruiser transom drives were specified. Total power is thus 450 hp. The plans refer to this design but the photographs are of the *BAHAMA* "37" of similar design.

The boat will not only be able to cruise at high speed under power and sail but she will also be able to go in very shallow water since the centreboards pivot up and the rudders are retractable and her hull only draws 2 ft. She

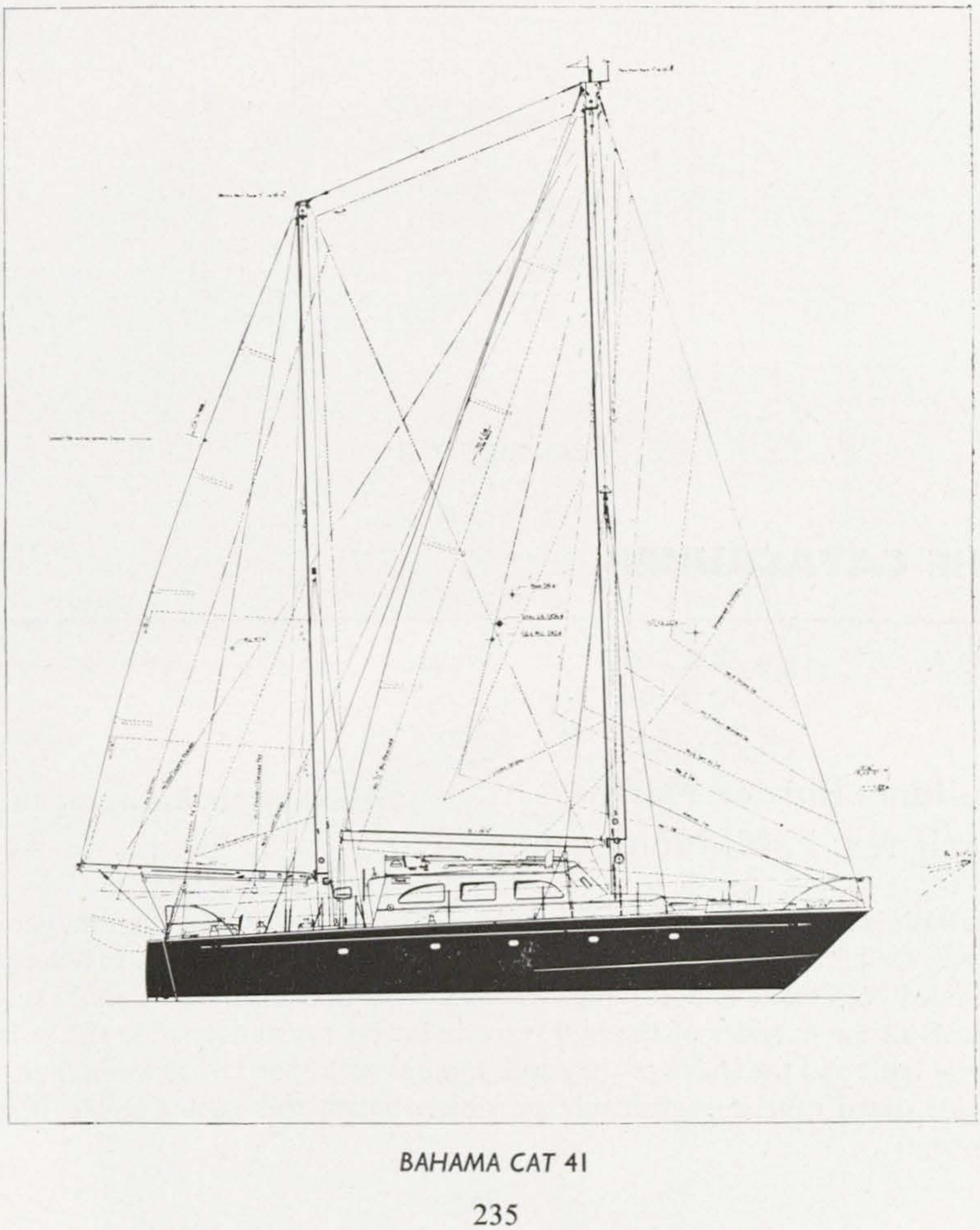


BAHAMA 37

should thus not only be able to reach ports and harbours that are farther away than is normally possible with a slower boat, but she can also go in to snug shallow coves where sailboats of this size cannot even think of entering.

In a quiet harbour both of her bows may be beached and the crew can have a beach party or camp ashore as well as using the boat's own ample cruising facilities.

The boat has tremendous deck lounging area and the bow trampoline is excellent for sunbathing or lowering and furling large jibs without letting them fall overboard. The breadth of the boat between her two bows provides a marvellous working platform for handling spinnakers and taking down large spinnaker staysails to windward or leeward of the centreline. Because of this large working platform forward and the large sheeting base aft it is customary on catamarans of this type to carry spinnakers that are far larger on the foot than is normal in single hulled boats. In addition to oversized spinnakers this



BAHAMA CAT 41

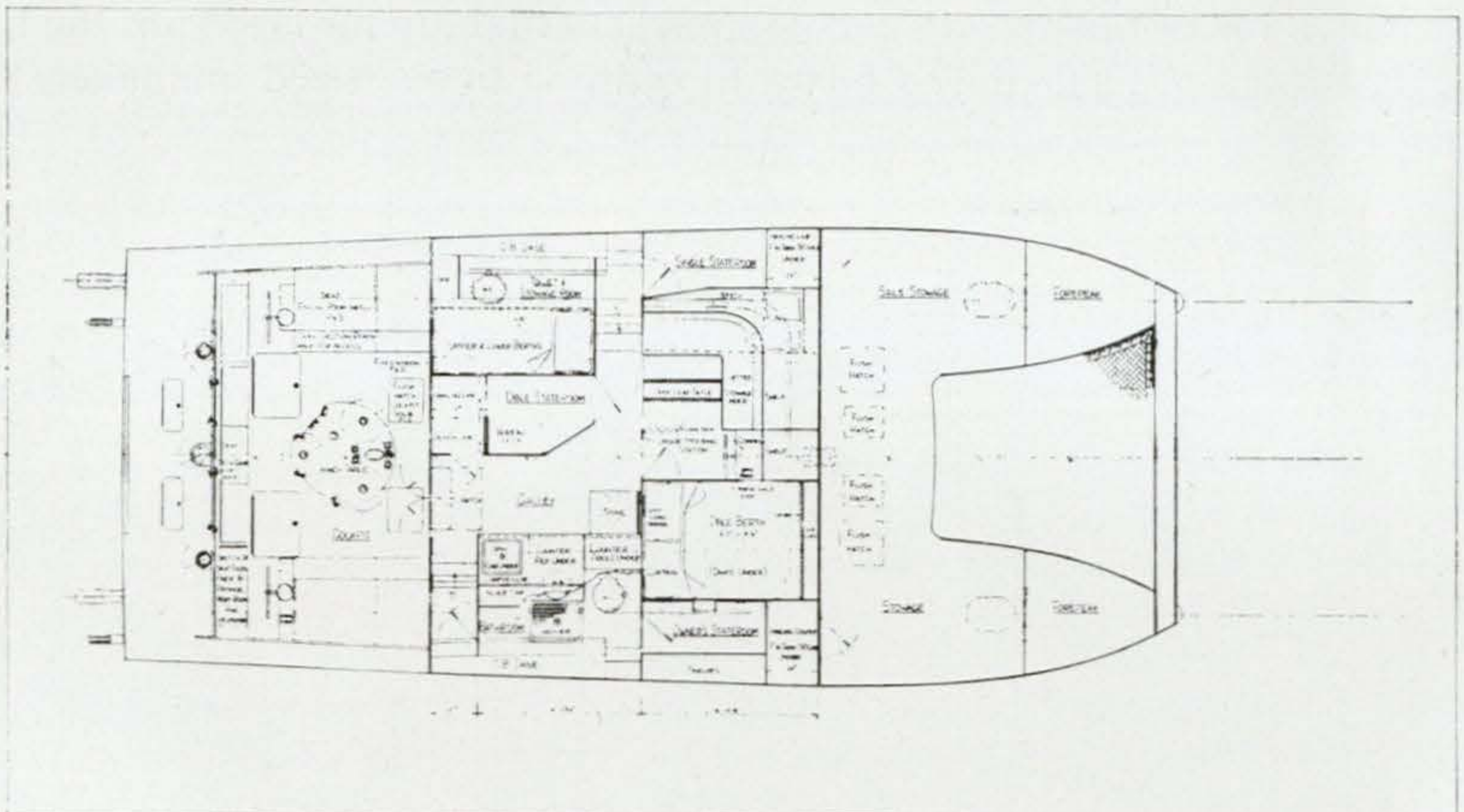
ketch rigged boat carries a very large mizzen spinnaker thus increasing her speed potential off the wind.

Other unusual features in a sailboat of 41 ft include a rectangular double berth and three private staterooms, two of them with private bathrooms.

Still another novelty is the three alternate steering positions, one from each side of the cockpit and the third one below decks for powering during bad weather.

A winch table surrounds the after part of the mizzen mast so that the main sheet or mizzen sheet can quickly be eased in case of strong wind gusts.

In summary, the more unusual features are: twin screw sailboat, inside steering sailboat, shallow draft, speed under either sail or power, privacy at night, roominess at all times.



BAHAMA CAT 41

THE CATACRUISER

January, 1966

L.O.A.	34 ft 0 in	Weight	6,800 lbs
Beam	12 ft 10 in		
Sail Area	510 sq ft		

Builder: Border Marine Greenwich Road, Berwick on Tweed

Designer: F. M. Montgomery

The basic idea with this catamaran is different from all other cruising catamarans in that the hulls are not used for accommodation. Indeed, they are of a deepish rounded V section and completely filled with polyurethane foam. Dagger boards at the outsides of the hull provide lateral resistance while the weight of the hulls and the shape of the cabin top are such that self-righting from an upside down capsize is probably possible, though this is not stated in the literature.

PROTUS

The Accommodation

This is all placed in the bridge deck, thus avoiding the "upstairs and downstairs" procedure of other catamarans, but, at the same time needing the greatly arched cabin top for head-room, which is mostly 6 ft but rises to 6 ft 4 in in the centreline. Four to six berths are provided with the usual offices, as well as a large cockpit of normal size.

Summary

The *CATACRUISER* is a pleasant and fast cruiser with comfortable accommodation in the bridge deck. This accommodation plan will suit many people.

CATACRUISER DESIGN

If you set out to design a drinking vessel such as a fine brandy glass, you can be fairly sure that not too many people will buy it to use instead of an enamel tea mug.

Not so with a sailing vessel—you can design a feather-light craft to skim at high speed on an almost waveless lagoon and be sure that some buyer will want to weather a typhoon at the Cape of Good Hope, with four times the load you intended!

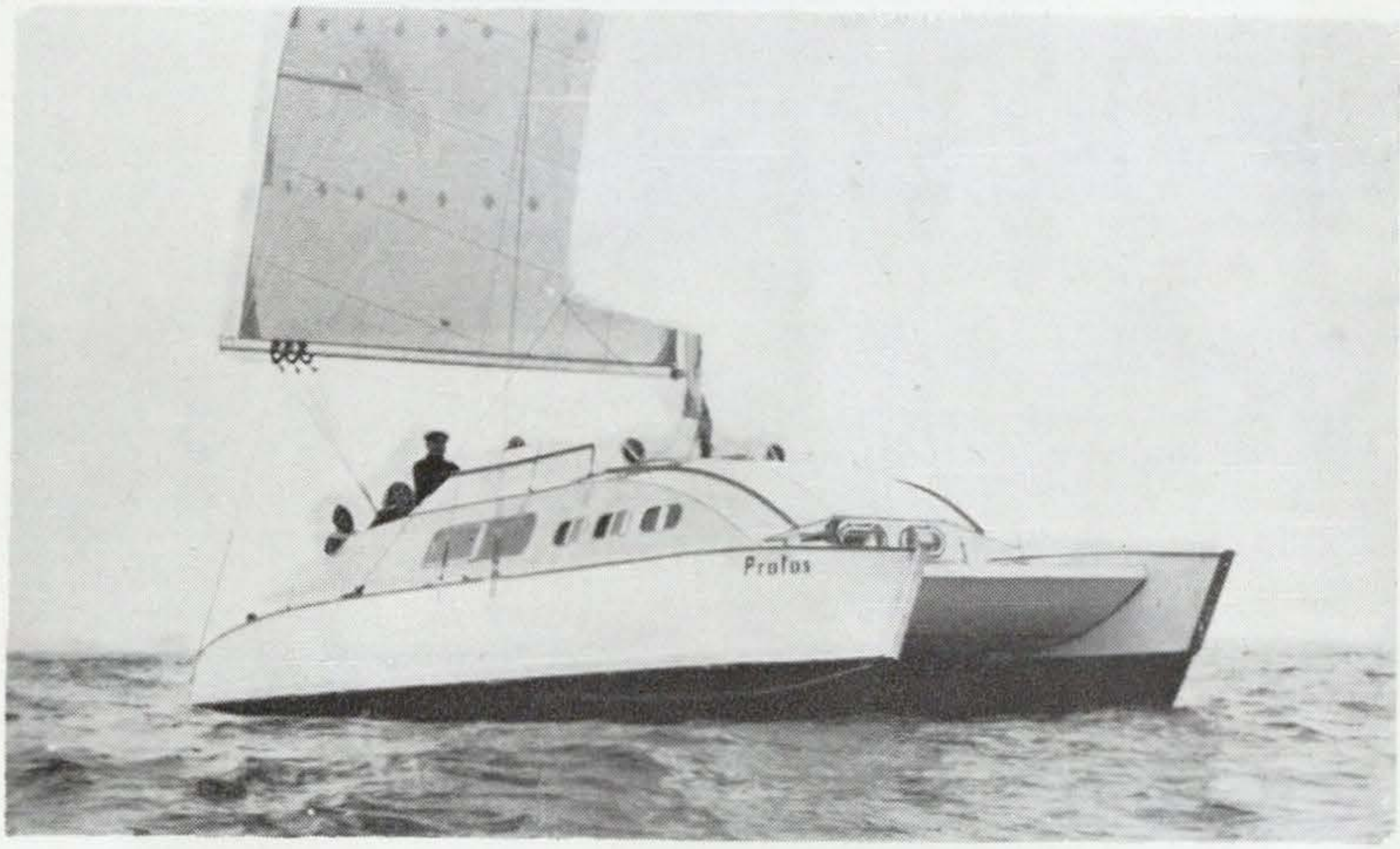
When the design for 10 metre CataCruisers was in embryo, one of the listed requirements was that the design should be capable of reasonable expansion to other purposes.

Other listed requirements were:

1 Easy manufacture in limited space.

2 Easy transportation.

3 Easy building by amateur craftsmen.



PROTUS

4 Easy winter storage.

5 Easy repair and maintenance.

6 Really comfortable living accommodation.

However, no requirement was to take priority over safe, fast, comfortable performance which, above almost everything, demanded a very high strength/weight ratio.

The only design that deemed to meet all requirements to a reasonable degree was something entirely novel and thus opened to attack by all the conservative sceptics, who can only think of what Grandad did.

It was with some mental reservation, therefore, that the CataCraft design team went ahead and produced a yacht made from "bolted together" units, none of which exceeds 8 ft × 13 ft, except for the hulls themselves, which are full length.

The forward unit includes a massive, tube shaped, hollow beam, some 30 in in diameter, to withstand the torsional stresses of the bows in a lumpy sea and the battering of solid green water hurled at high speed at the wing and hull joints.

The "berths" unit contains two separate, double berth compartments, each with private basin, also a W.C. on the port side and a shower room on the starboard side.

The central unit houses the galley and dinette to seat six, a 48 in × 32 in chart table and room for an optional extra berth, as well as the one or two berths that convert from the dinette settee. This central saloon unit, 13 ft wide × nearly 8 ft long, has an arched roof of enormous strength and gives head-room of over 6 ft in the middle, a feature found on few catamarans of under 40 ft.

The spacious 13 ft × 6 ft 6 in cockpit unit enables up to six people to sit in comfort and enjoy the sun, well protected from the flying spray.

The hulls are made of expanded "Clocel", manufactured by the Baxenden Chemical Company, sheathed with "Thames" serayah marine ply, which, in turn, is sheathed with "Cascover". This results in a very light, very strong, unsinkable structure.

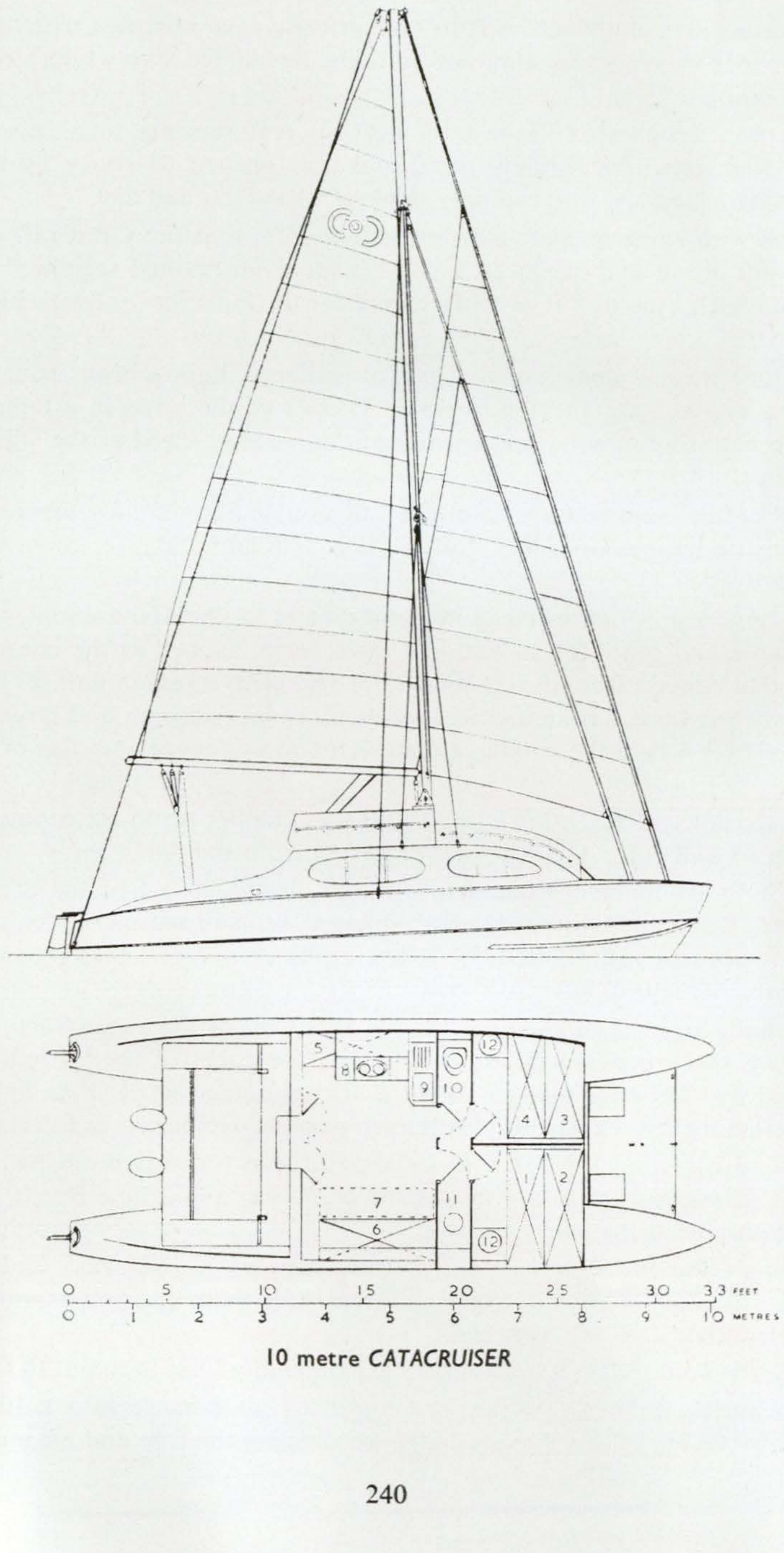
The hulls are decked and thus totally sealed below the superstructure and there is a space between the hull decks and the floors of the superstructure units, so that not only does any water that might enter between the hulls and superstructure drain away aft, but the entire superstructure is self draining.

On one occasion, the hatch cover blew off the forward beam hatch and gallons of water started to enter as the craft tore along in a rough sea—it simply ran out at the back.

Most of the problems we anticipated, such as leaking rain and spray between the units, have still to appear after three years and you cannot solve a problem that does not appear.

Since the first design, however, the "expandability" has been put to the test.

R. Wayte, a keen AYRS fan, has converted his 8 metre into a 10 metre simply by taking off his 8 metre hulls, lengthening the fore and aft units and



10 metre *CATACRUISER*

bolting on a pair of 10 metre hulls (his 8 metre hulls are for sale, cheap, if anybody wants them).

Another increase required has been the extra load of some additional 4,000 lbs of fresh water and fuel for two independent amateur builder crews, each of whom are planning to encircle the earth and thus need enough supplies for 3/4,000 mile legs between the east coast of America and the Pacific Archipelagos.

One unexpected advantage of the design has been pointed out by hire fleet operators, namely that if a yacht is badly damaged in an accident, it can be back in service almost within hours by the interchange of a new hull or superstructure unit, held in stock to service the fleet. Price, too, is an attraction when a complete new hull—ready to be bolted in place—costs less than £200.

Amateur construction is made easy by the self jigging design and the extremely detailed drawings and cutting list, which includes the dimensions of every piece of wood used.

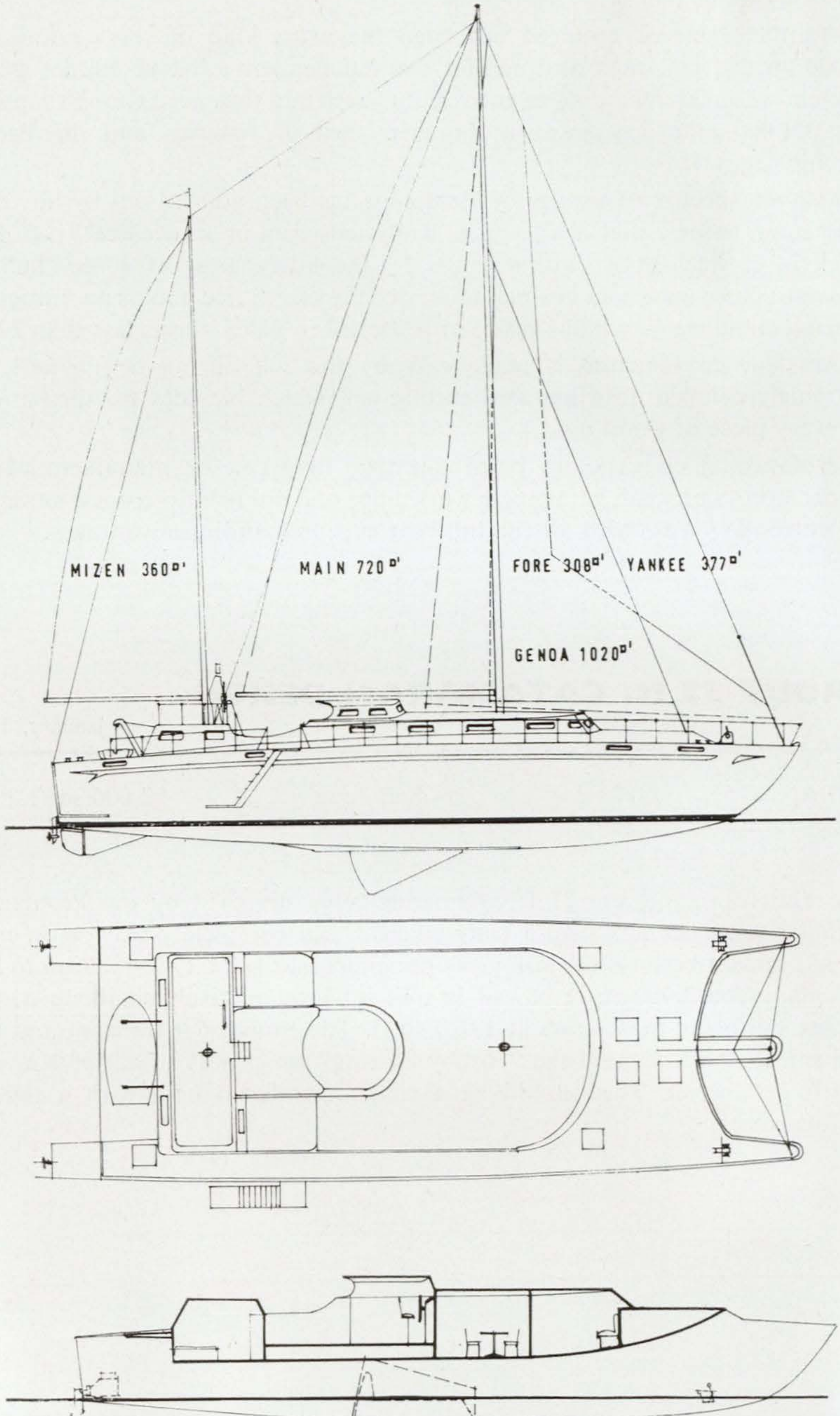
Professional constructors point out that they can be manufactured on upper storeys or small garage size workshops and are therefore not committed to waterside yards, with all the inherent expenses and disadvantages.

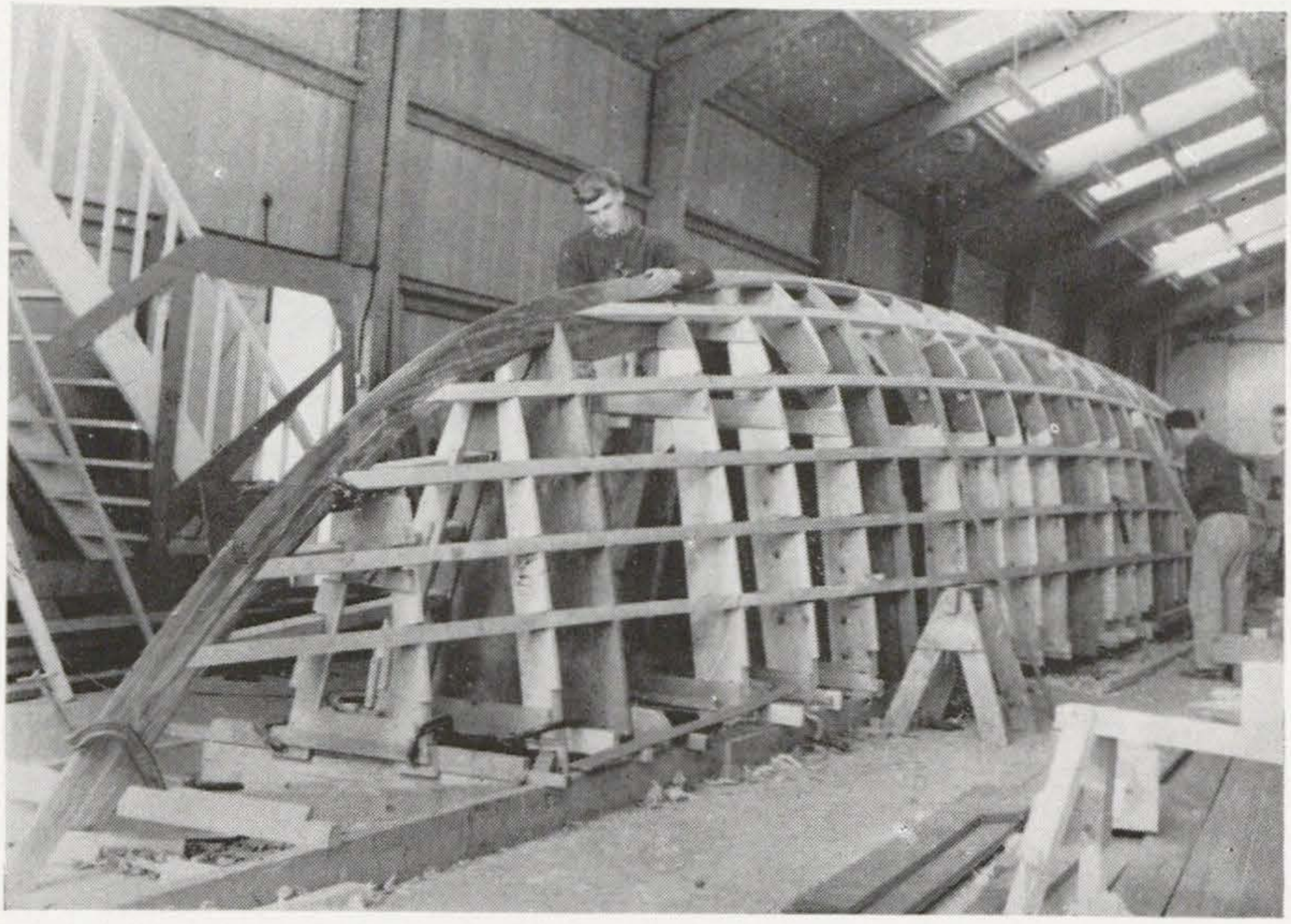
PROUT 77 ft. CATAMARAN DESIGN

January, 1962

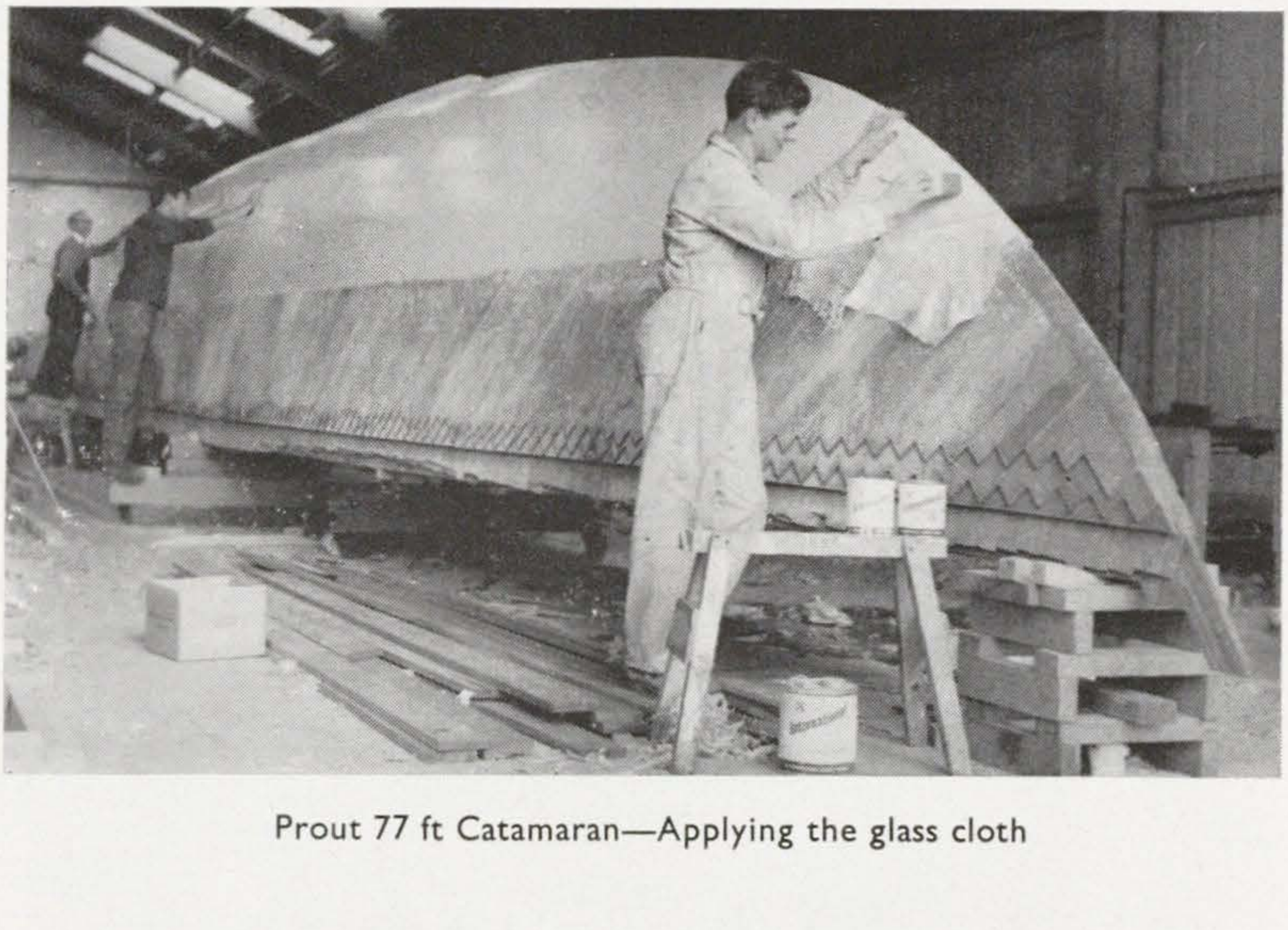
L.O.A.	77 ft	Sail Area	2,000 sq ft
Beam	24 ft		

The drawings show the 77 ft catamaran being designed by the Prouts for building soon. At this size, a truly efficient and completely seaworthy craft should appear because the size gives her enormous stability in relation to her sail plan. The 2,000 sq ft of sail is split up into relatively small units, the largest sail being the Genoa at 1,020 sq ft. The broad, flat transom and the fine entrance will prevent the "Hobby horsing" which was a fault of Kaiser's 100 ft catamaran. This should be a truly magnificent boat with a terrific performance.


MIZEN 360□'
MAIN 720□'
FORE 308□'
YANKEE 377□'
GENOA 1020□'



Prout 77 footer—Skeleton



Prout 77 ft Catamaran—Applying the glass cloth

TSULAMARAN

January, 1966

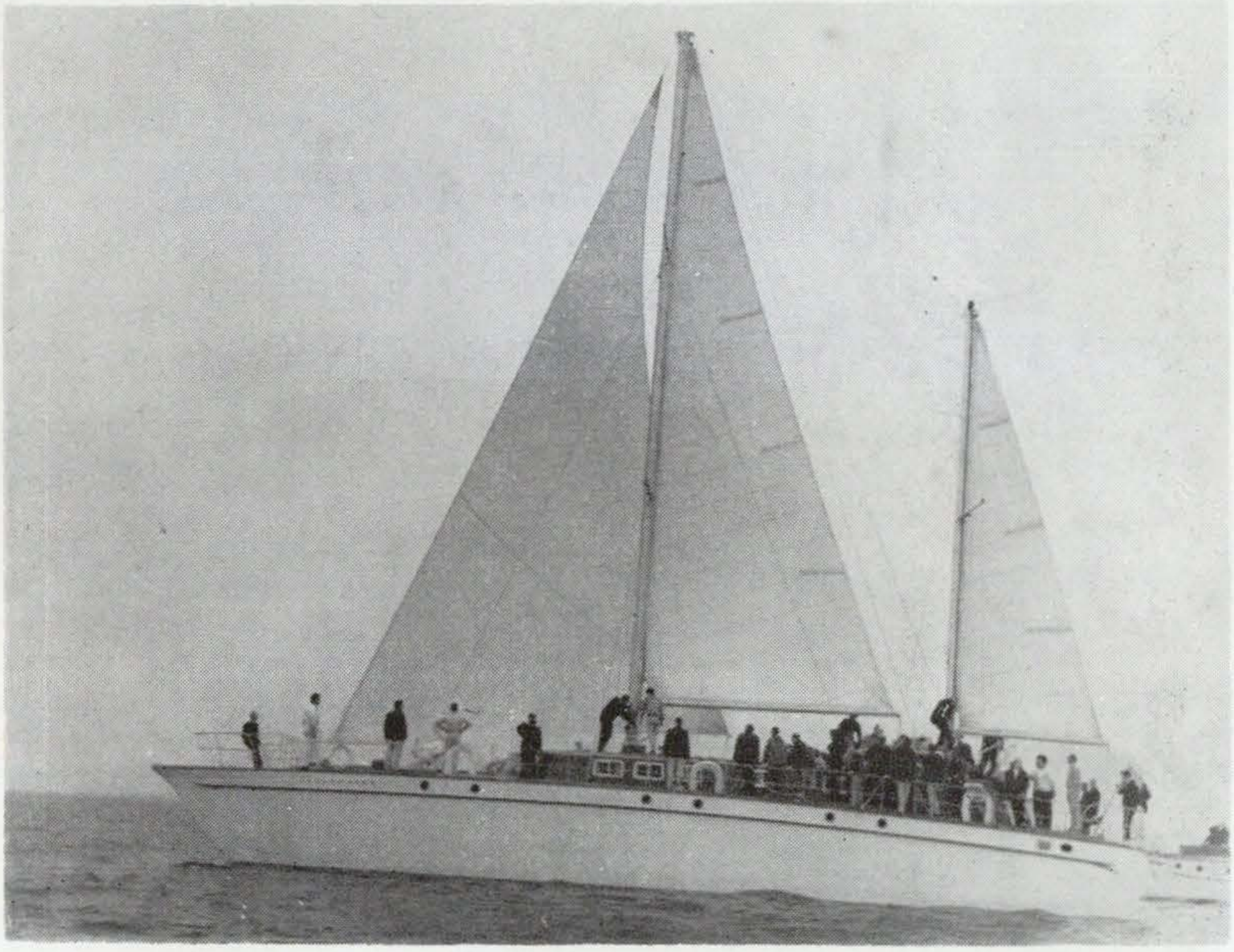
J. B. Moore looks at, and photographs, the 77 ft Prout-designed and built cruising catamaran

(Ex-Yachting Monthly, September, 1965)

On 14 July at Small Gains Creek, Canvey Island, the largest catamaran to be built in Europe was launched. 77 ft L.O.A., 70 ft L.W.L. with a beam of 24 ft minimum draught of 2 ft 10 in and 6 ft 6 in with plates down, she is undoubtedly one of the most interesting craft to be produced in this country in recent years. She has been built to the special order of Mr Patrick Hall of Longford in Shropshire, a well-known industrialist who spends his free time on Anglesey where he has kept a series of catamarans in the last few years.

TSULAMARAN is really a very large sister of the *Shearwater*, having twin transom-hung rudders and twin centre-plates housed in the hulls. The aim of the design, into which a great deal of original thought has obviously gone, is ocean cruising, particularly in tropical waters and the Mediterranean. This accounts for the extensive use of 2 in thick polystyrene insulation on the walls and ceilings and the installation of air conditioning equipment in the main cabins.

The hulls are wood with fibreglass sheathing to 2 ft above the waterline. Five laminations have been used, the inner one being ¼ in vertical teak overlapping, then ¼ in diagonal teak, ½ in cedar fore and aft, ¼ in vertical teak and

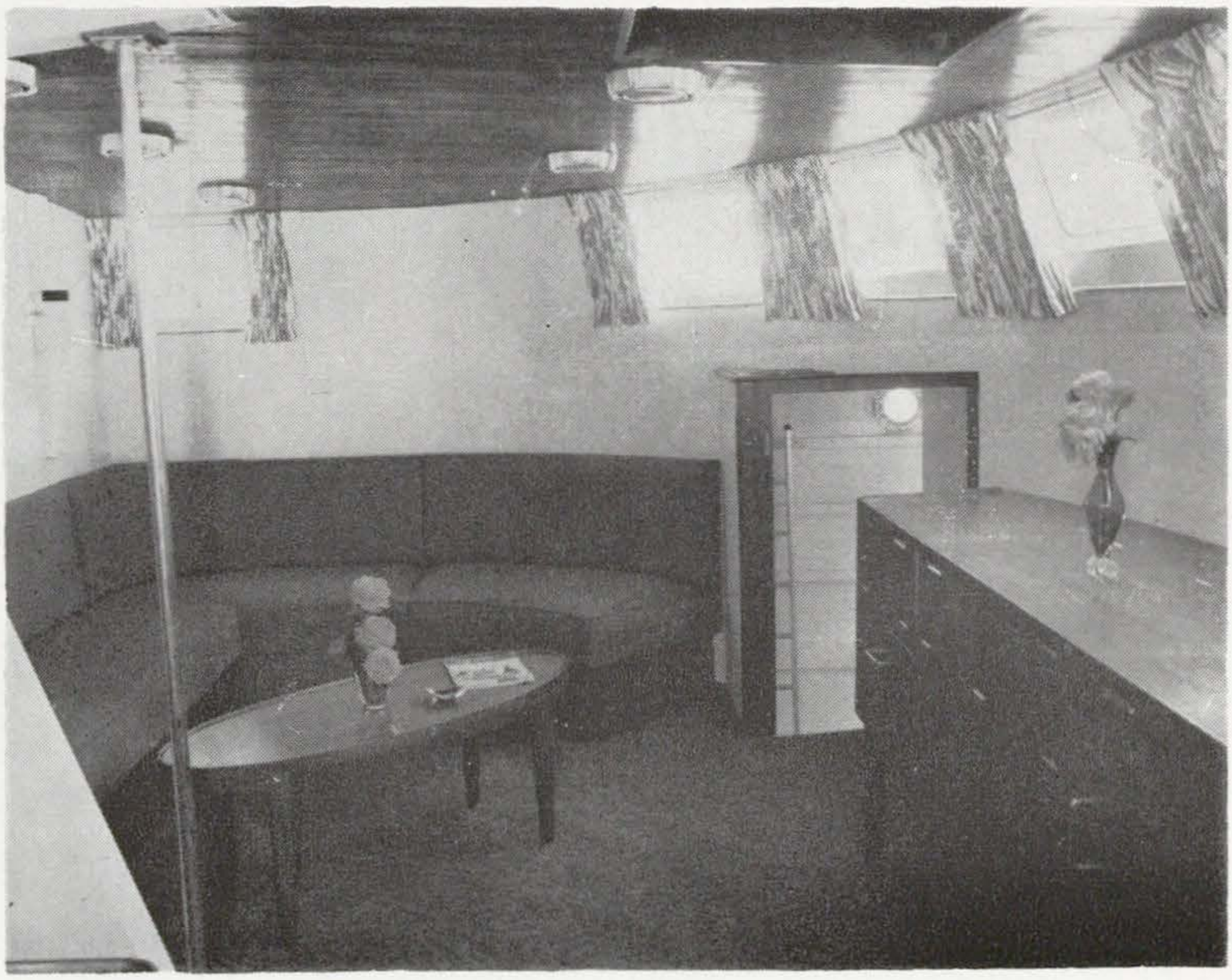


TSULAMARAN—Prout

finally a skin of $\frac{1}{4}$ in diagonal mahogany, the latter wood taking the paint better. The paint finish, which is remarkably good, has been applied by a firm of coach painters, J. Payne & Co of Canvey Island. No less than 30 gallons of white top coat alone were used. All decks are solid laid teak over $\frac{1}{2}$ in ply.

Built into the superstructure on the bridge deck is the most spacious and airy accommodation, the main saloon, 20 ft $\times$ 10 ft, extending full-width across the forward end. It is striking in its contemporary elegance, the teak furniture and ceiling contrasting well with the peacock-blue upholstery and fitted carpet and the silver-grey fabric wall covering. There is an L-shaped cosy corner with coffee table to port, a large dining table to starboard and a sideboard and cocktail cabinet athwartships on the forward bulkhead. Access to two single-berth cabins in each forecastle is by companionways from the corners of the saloon. The owner's (port) and guests' (starboard) staterooms, which open off from the corridor leading aft from the main saloon, are very tastefully furnished in solid elm, the owner's with bathroom and w.c. attached. Both have two low berths with drawers under, beside tables, wall reading lamps and full-height wardrobes. There is a second bathroom adjacent to the guest cabin.

Moving farther aft on the port side there is the galley, more like a small kitchen in a flat. It is equipped with teak drainer sink, ample drawers and cupboards, a stainless steel oil fired range and a refrigerator. A second fridge is cunningly fitted above the companionway to the starboard engine-room.



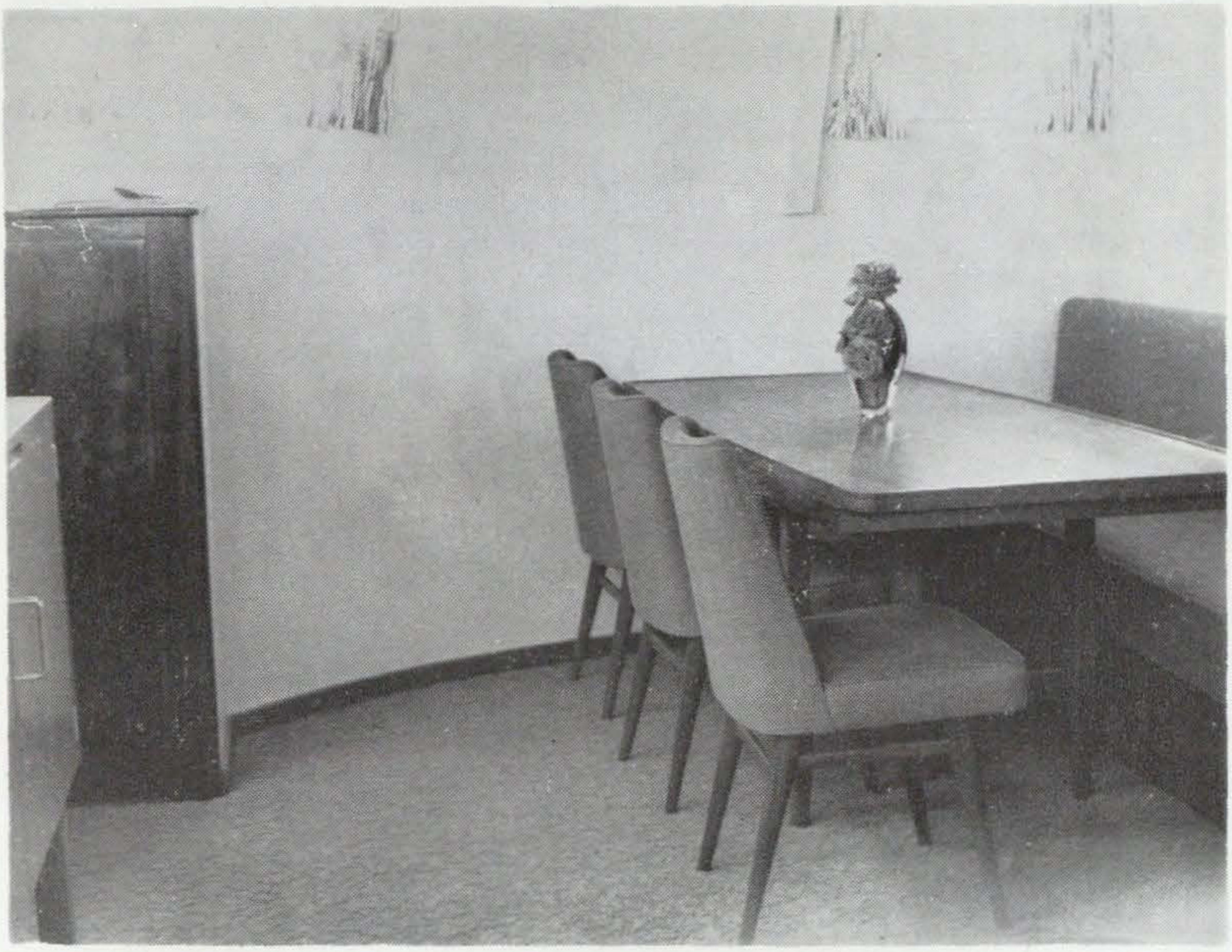
Saloon

Opposite the galley is the chartroom which also accommodates a good many of the navigation aids. *TSULAMARAN* is particularly well equipped in this respect, having a Woodson radio and telephone, Decca navigation unit, depth sounders, Brookes & Gatehouse speed indicator and distance log and Jib Master wind indicator. To assist in smooth operation under way she also has Tannoy intercom throughout with loud hailers on the deck fore and aft.

The bridge, running full width of the ship aft of the main accommodation, has the wheel and control panel to port, but there is a second steering position on deck on the starboard side. Immediately aft of the bridge is the skipper's cabin to port, well fitted out in mahogany and reminiscent of an officer's cabin on a freighter. To starboard is the crew's washroom with shower and w.c. A wide poop deck opens out beyond this.

Power is provided by two Mercedes-Benz diesels each of 94 hp with Mer-Cruiser outdrives, giving 12 knots. The engine rooms, with full standing headroom, are aft and adjacent to the crew's quarters, which both have two pipe cots. A diesel generator set is also installed, providing 24 volt lighting and power throughout, even to the windlass. There is also a 240 volt circuit with power points for shore leads. A water pressurisation system ensures instant hot and cold water in all cabins and bathrooms. The main fuel tank of 1,200 gallons gives a cruising range under power of 2,000 miles. The fresh water tanks in the centre section of the hulls hold 600 gallons.

For ease of handling a ketch rig has been chosen but she can be cutter rigged with a 720 sq ft Yankee jib. Masts are by Sparlight, the main being 64 ft high and the mizzen 40 ft. A total sail area of 2,000 sq ft can be carried



Dining area

the largest single sail is a genoa with an area of 1,120 sq ft. She can expect sailing speeds of up to 20 knots. All the rigging is stainless steel with nylon and terylene ropes, the fittings are stainless steel, Tufnol or bronze.

A 14 ft motor launch is carried aft of the mizzen mast.

Altogether a most luxurious craft, beautifully built and one of which the Prouts can be justly proud. She has already occasioned a great deal of favourable comment among the many local people who have watched her with interest during the two years she has been building. After cruising to Ireland and Scotland she will be stationed at Anglesey until her owner decides to go foreign.

EUNIKE

January, 1966

An Exercise in Mathematical Hull Design

L.O.A.	46 ft 0 in	Sail Area	735 sq ft
Hull characteristics:		Genoa	765 sq ft
Displacement	9,600 lbs	Spinnaker	2,000 sq ft
Draught	2 ft		
Beam at L.W.L.	2·5 ft		

Centre of buoyancy 25·4 ft from the bow

Designers: Myers & Ewing

Mathematics is a wonderful subject. If one is knowledgeable enough, one can produce wonderful things with it, even hull shapes as offset figures. No doubt various hull shapes can be produced by mathematics but Myers and Ewing have produced their very pleasant and seakindly hull shape by using the following formula:

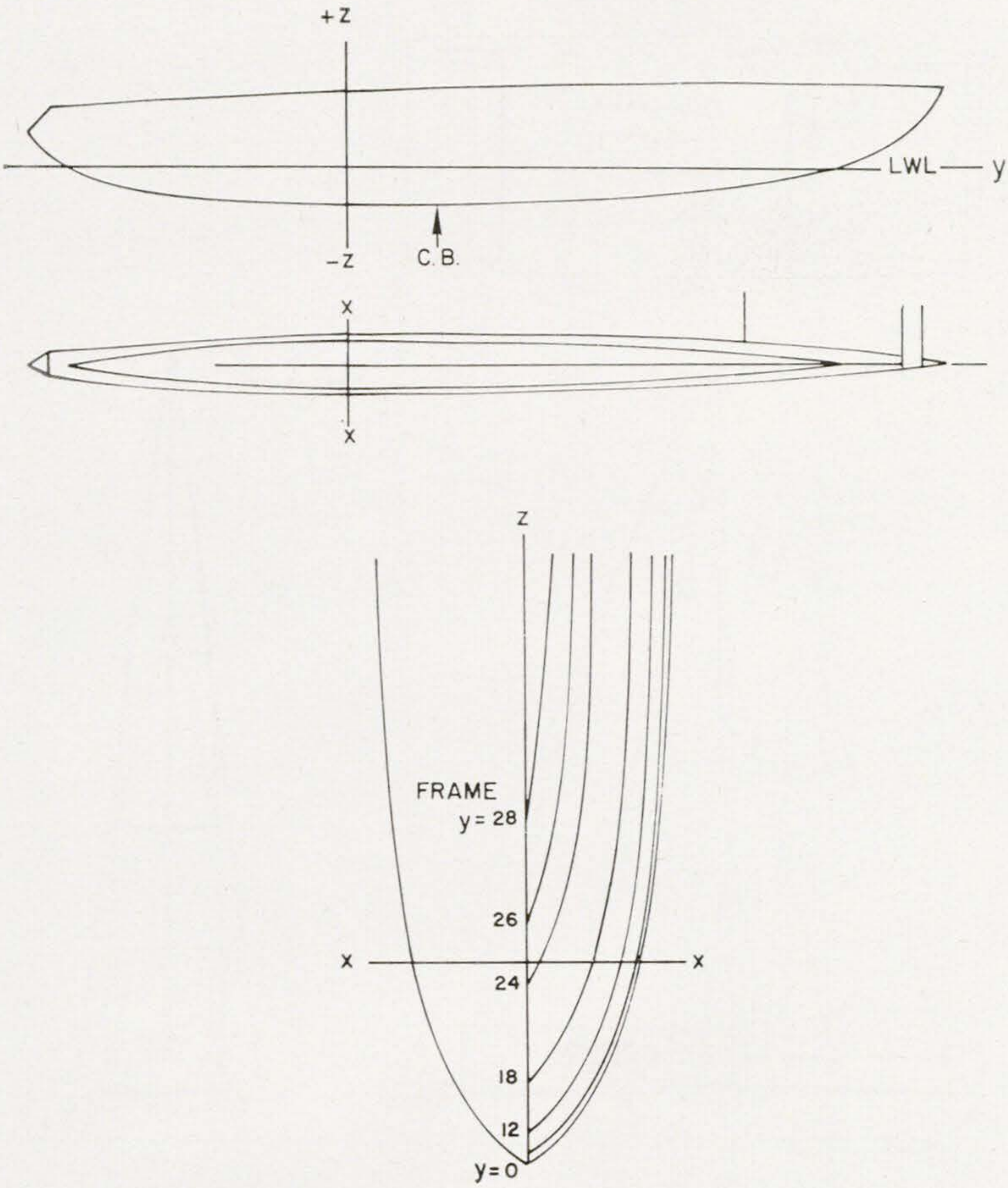
$$Cx^2 + Dx + Gy^2 + Jz^3 + Lz + 1 = 0. \text{ Where } x = \text{Beam}, \; y = \text{Length}, \; z = \text{Height}$$

The designers say "The offsets obtained by solving the equations at the desired stations lie on gentle, perfectly fair lines. The result is a beautiful hull for which full scale lofting is not required. In addition, the curves are so gentle that single sheets of plywood can be bent around them, eliminating the tedious and expensive laminating process."

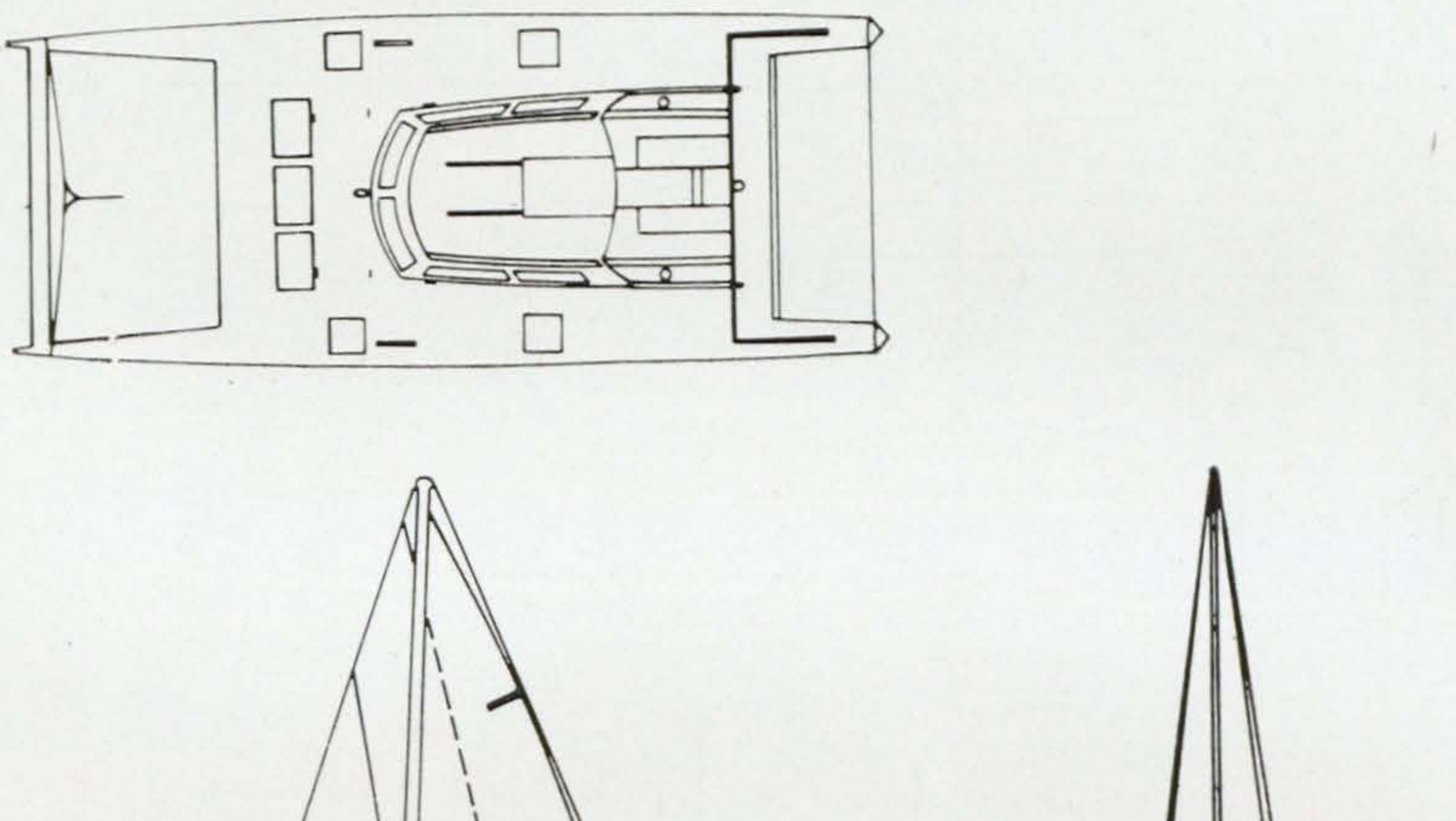
The end result of this process is *EUNIKE*, whose lines and sections sail plan and photograph we show. The general hydrofoil shape of the hull will be noticed but this doesn't apparently give enough lateral resistance as boards are needed, though low aspect ratio keels might be just as good.

Ed: The small "Pod" in the middle of the bridge deck should be noted.

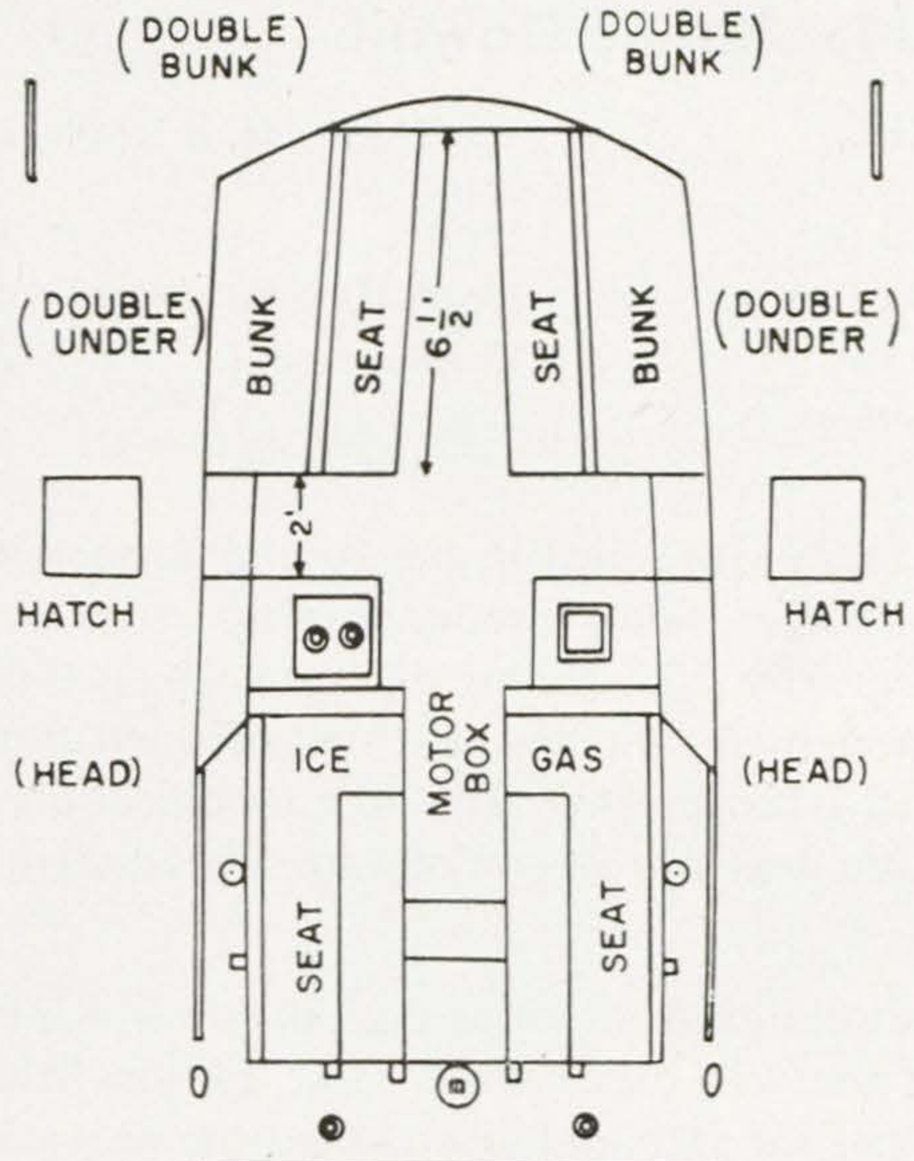
EUNIKE—Myers and Ewing

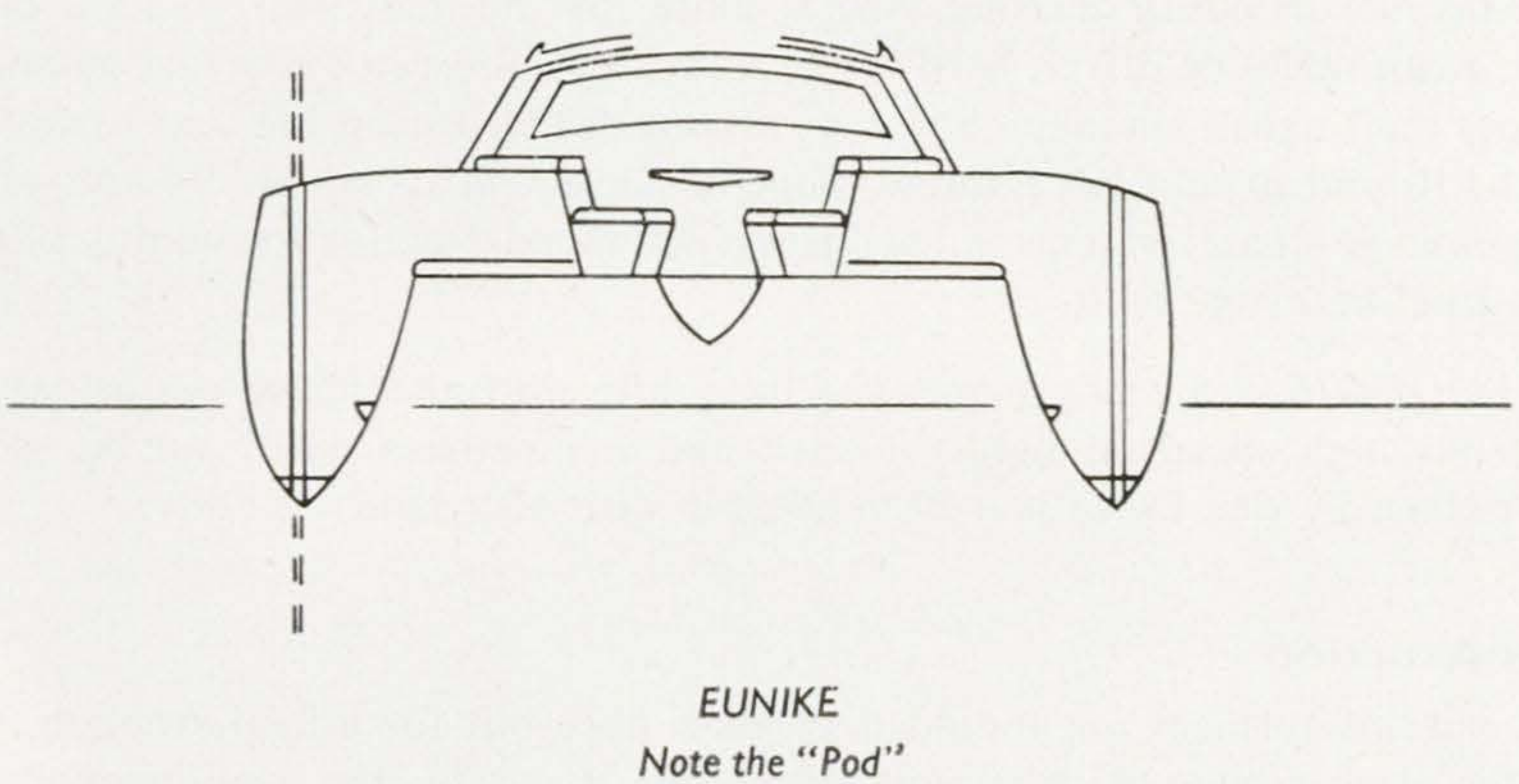


EUNIKE's lines and Sections



EUNIKE





EUNIKE
Note the "Pod"

CHAPTER XXI

IROQUOIS

January, 1967

Designer: Rod MacAlpine Downie

Builders: Sail Craft Ltd., Waterside, Brightlingsea, Essex England

L.O.A.	30 ft	Draft	11 in
L.W.L.	26 ft 6 in	Draft (boards down)	4 ft 6 in
Beam	13 ft	Displacement	2 tons
Sail Area	396 sq ft		

A production *IROQUOIS* was sailed in the Round Britain Race in 1966 by Mike Ellison and his brother. Some interior furniture was, however, removed to compensate for the extra 50 fathoms of chain which the rules required. She came in third on elapsed time and first on corrected time, thus proving herself a very fast boat when pressed. The only modification, apart from the removal of the furniture, was a provision of a mast head Genoa for extremely light conditions.

IROQUOIS was not designed for more than the usual coastal cruising and it is noteworthy that the very experienced Mike Ellison held the mainsheet in his hand for much of the race and also shifted the heavy weights into the weather hull. One doesn't therefore recommend *IROQUOIS* to be driven at full throttle in ocean cruising. She is more for the man who wants a boat which can really be driven hard for short periods and can make fast passages across the English Channel. She has without doubt proved her seaworthiness in the Round Britain Race and was one of the few boats which did not suffer any damage whatever. This in itself is a recommendation for the quality of the construction of the craft.

IROQUOIS is a really handsome boat with an outstanding performance. She has high speeds if lightly loaded and manoeuvres easily on her twin centreboards. The cabin is well ventilated with all round visibility.

Construction

All exterior surfaces are moulded in glass fibre but for added strength, the bridge deck, superstructure and decks are made by the new method of sandwiching end grain balsa wood between layers of glass fibre.

Summary

IROQUOIS is a delightful cruiser for cross-channel and longshore voyages.

IROQUOIS

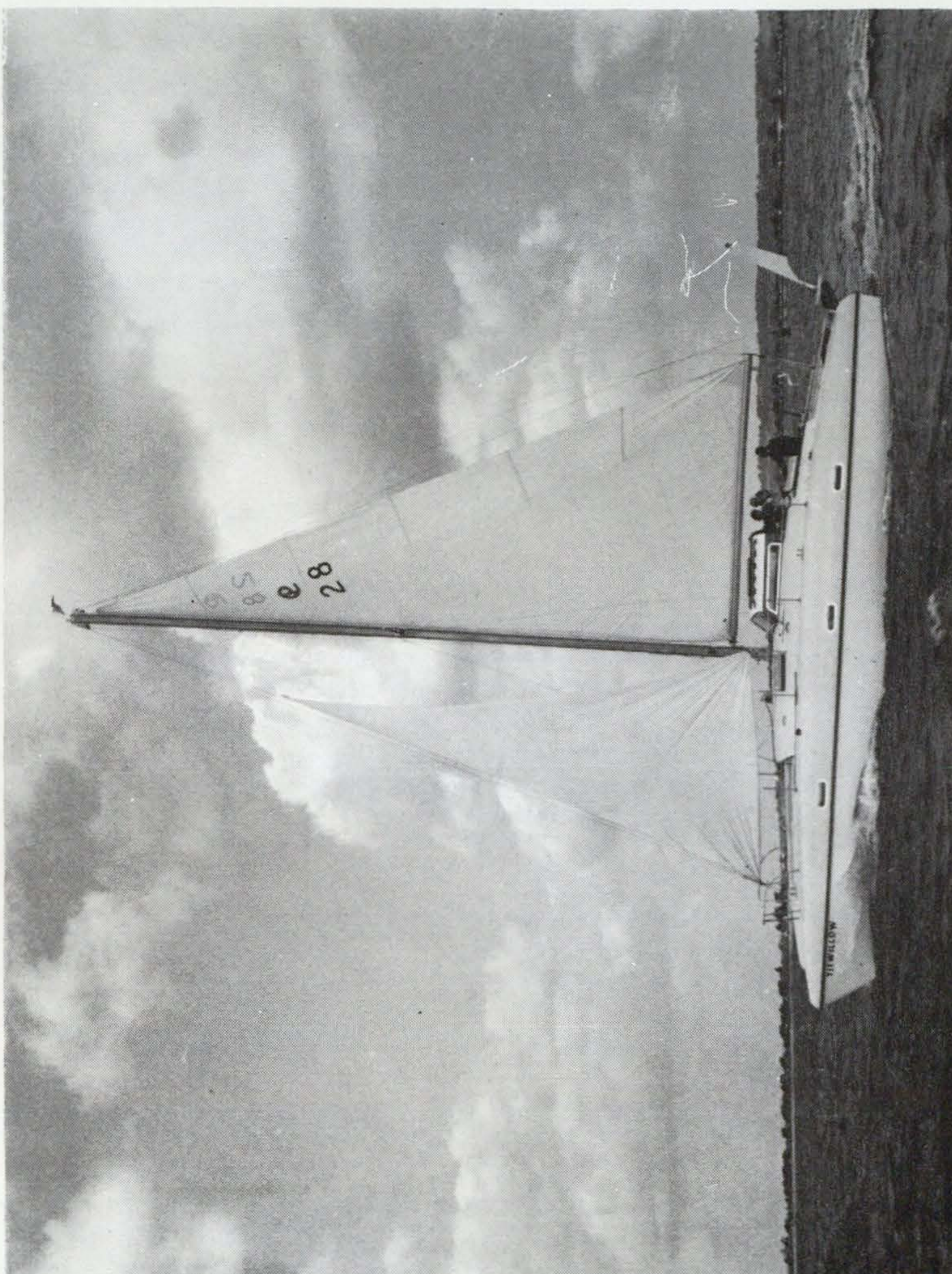
PROUTS OCEAN RANGER

January, 1967

Designers: G. Prout & Sons

The Point, Canvey Island, Essex, England

L.O.A.	45 ft	Headroom (Hull)	6 ft 2 in
L.W.L.	42 ft	Headroom (Deckhouse)	5 ft 4 in
Max. Beam	20 ft	Draft	2 ft 9 in
Hull Beam	6 ft	Mast height	48 ft 6 in
Hull Beam, L.W.L.	4 ft 6 in	Sail Area (with Genoa)	1,010 sq ft
		Displacement	6 tons



Prout's *SEA RANGER*—45 ft Catamaran

This design is characterised by rounded decks and hence low windage and, I think, an improved appearance. There is, of course, an increase in headroom in the hulls as a result which can be of great importance to the taller man.

The second, and more exciting feature of the design is the use of low aspect keels with, it is claimed, an improved windward and reaching performance. These keels are 20 ft long and 2 ft deep and thick enough to carry 75 gallons of water in each. They are attached by careful fairing into the hulls which have a waterline beam of 4 ft 6 in and a draft of only 9 in. This is a greater waterline beam to depth ratio than would ever be used for a purely racing craft but it does give very roomy accommodation in the hulls at only slight sacrifice of speed (or increase of sail area).

Construction

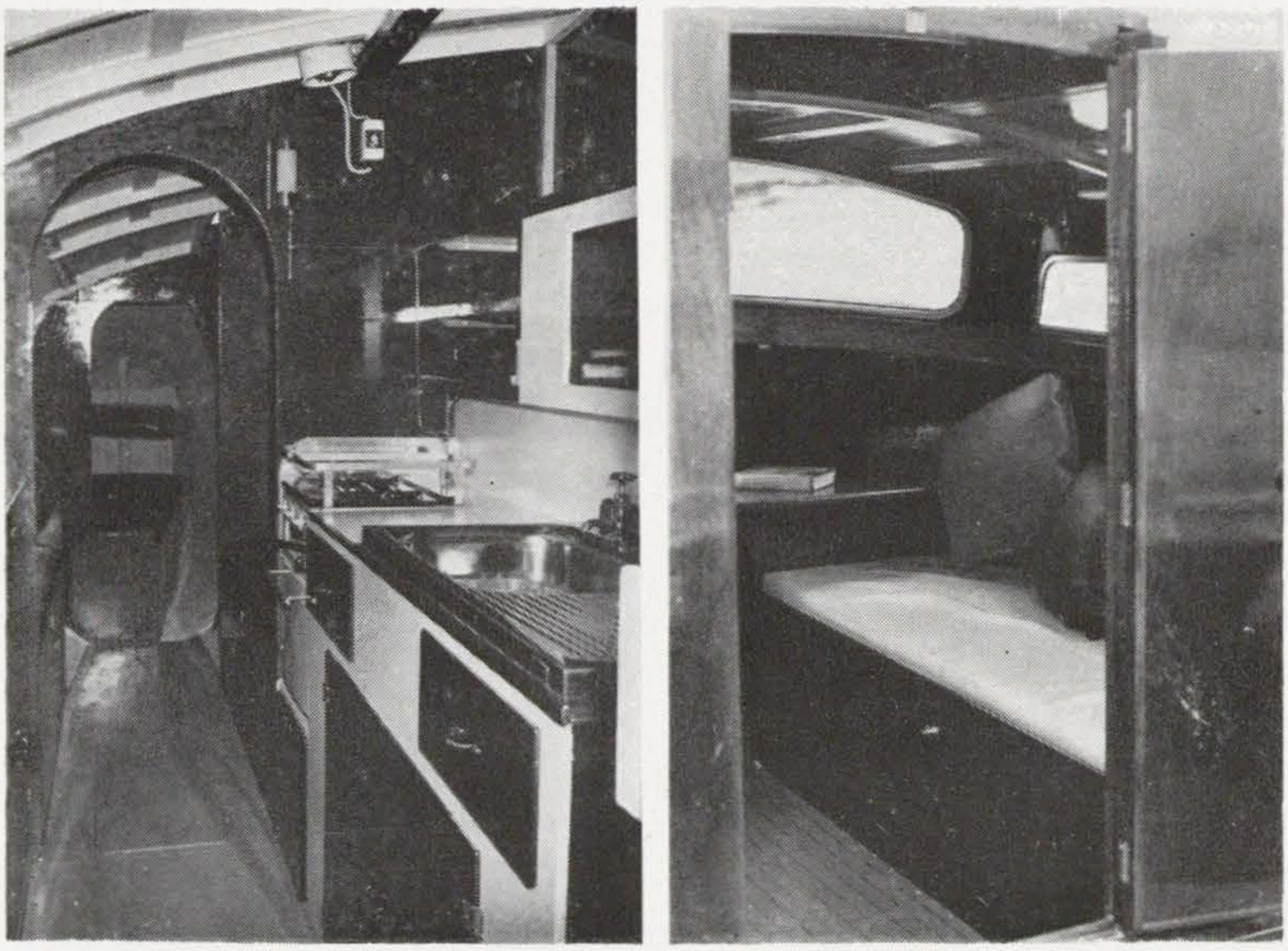
This is in fibre-glass. All the features of the modern yacht are present and pleasantly arranged.

CRUISING TRIALS FOR NEW PROUT 45 FT OCEAN RANGER

During the month of July daily trials and finally a cruise from Canvey to the River Blackwater and back completed the trials with the new Prout all glass fibre 45 ft *OCEAN RANGER*.

The trials proved highly successful, and the boat proved herself to be an extremely fast well balanced and exceptional sailing boat.

All conditions were encountered from light force 1 to 2 winds to force 7.

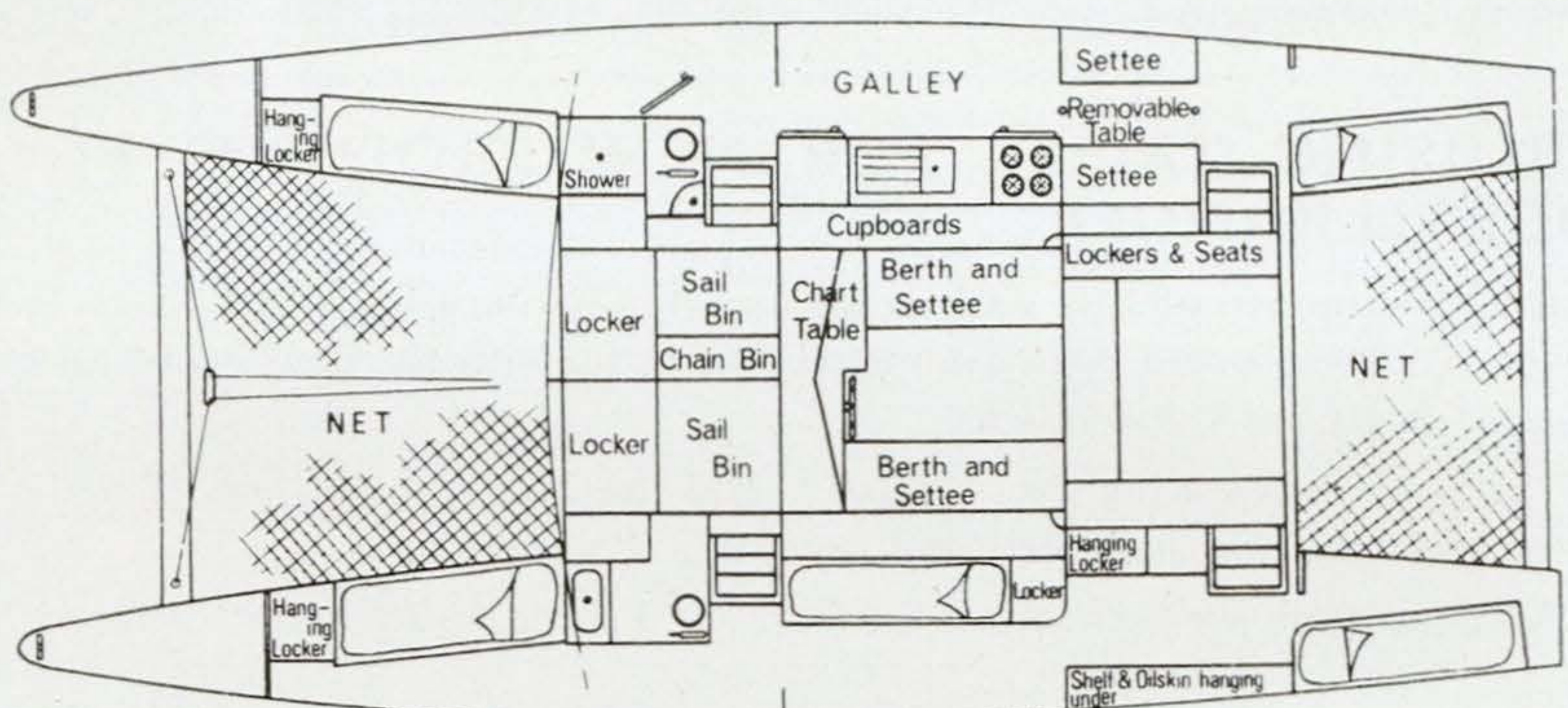


SEA RANGER—Galley and Bridge Deckhouse

The *OCEAN RANGER* which is claimed to be the largest all glass catamaran in the world weighs approximately 6 tons and is built for comfort, strength and tough sea going seaworthiness, rather than speed. Her apparent exceptional speed comes as something of a bonus for the Prout Brothers design though of course with 45 ft overall length and 1,010 sq ft of sail very good multi-hull speeds were expected.

Perhaps the greatest feature apparent from the two weeks trials is the craft's exceptional performance to windward and an easily obtainable speed of 9 to 11 knots in winds of only 10 to 12 mph.

The ability to point very high is attributed to cleanliness of design reducing windage to a minimum and the 2 ft deep and 20 ft long keels moulded into each hull, which replaces the centreboards previously fitted to Prout's large Cruisers.



Accommodation plan

SEA RANGER's Accommodation plan

The keels give the boat a 2 ft 9 in draft, but the inconvenience of this slightly greater draft is more than compensated for by the fine directional steadiness the keels give and the extra space it allows in the cabins. A 75 gallon water tank is built into each keel under the cabin floor.

During trials in the stronger winds, speeds of 16 to 18 knots were attained in force 6, with full main and working jib. Quite obviously the boat has far greater potential speed than this, and over 20 knots can be expected in certain conditions.

Auxiliary power is by a 50 hp Penta electric start outboard motor with remote controls near the steering position, and handling and control under motor is excellent. Cruising motoring speed with this motor is approximately 8 knots.

The builders and her owner Dr Pugh are more than delighted with the fine performance this boat is showing and it is certain that many passages in complete comfort can be expected at an average speed exceeding 10 knots.

Her strength and weight give this craft tremendous power and stability, and in force 6-7 gusts experienced in early trials the *OCEAN RANGER* heeled little more than 2 or 3° with tremendous reserve of stability left. The total beam is 20 ft.

The cabin accommodation in the hulls consists of six berths in separate cabins, two good sized wash rooms each fitted with a toilet, and in the starboard hull a large galley with oven, cooker, refrigerator, large household size stainless steel sink and ample cupboard and locker space. Also in this hull is a six people dining area with more lockers, settee and book shelf above.

The bridge deck has a large cockpit with seats and lockers, the central cabin measuring 8 ft × 8 ft has a chart table, two settee berths and inside steering wheel. Large windows in this cabin allow for all round clear vision of the whole boat and ahead, so there is no need to move outside to take sights and watch the heading of the boat.

A self-steering vane is fitted and although it is only the same size as is fitted to Prout's smaller Cruisers, it has proved just as effective owing to the light balance of the tiller.

Forward and aft between aluminium beams which are located at the extreme ends of the craft, there is a strong net giving approximately 12 ft × 10 ft working area fore and aft. On the aft net a 10 ft dinghy can easily be stowed.

The mast is an International alloy spar 48 ft high, and stayed with twin forestays and twin backstays, top side stays and fixed lower stays instead of runners.

Hull beam at the waterline is approximately 4 ft 6 in on a waterline length of approximately 42 ft. Hull beam inside cabins at 3 ft above floor level is 6 ft and headroom in central and fore cabins just under 7 ft.

Two things seem to have been apparent from this new design.

1 The wider beam hulls do not seem to have detracted from a fast performance.
2 The long shallow keels seem to give a better windward performance, and certainly a better reaching performance than the centreboards fitted to previous Cruisers.

Ed: One of these hulls would be excellent for a trimaran.

VOLADOR (Flying Fish)

January, 1967

A 31 ft CATAMARAN CABIN SLOOP

Designer: Ralph Flood

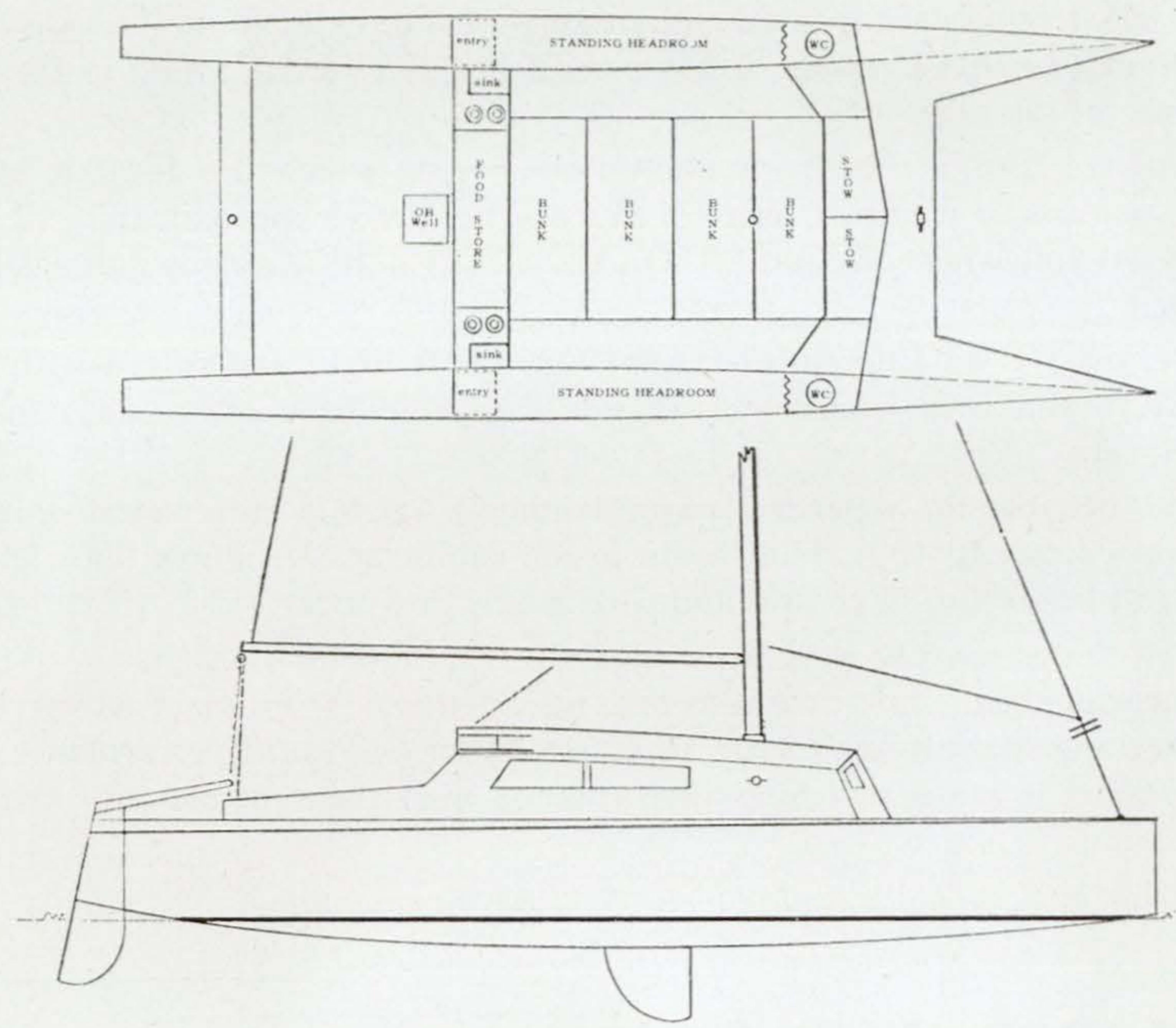
3883, Sunbeam Drive, L.A.65, California

L.O.A.	31 ft	Weight	2,300 lbs
Beam	12 ft	Sail Area	350 sq ft

The design objectives in developing the *VOLADOR* were simply to make available a cabin sailer that would out perform most cruising sailers under 40 ft, be exceptionally easy to build and low in cost.

To qualify the performance objective, an extensive study of race result data was made. This data indicated that the Catamaran (double hull) type boat usually out-performs other boats of similar size. This kind of boat can cost less to build than a quality ballasted keel boat; and since the Catamaran hull configuration is a comparatively easy shape to build, the double hull boat was then selected as the type of craft which could best meet the design objectives.

The *VOLADOR* design stresses easy handling and is especially suited for the skipper who likes to spend a comfortable weekend cruising around the local islands or just day-sailing along the coast.



Special features are: standing headroom in both hulls for the length of the cabin; two heads with curtain partitions for privacy; cabin accommodations arranged so that the crew weight is always properly distributed for best sailing trim; a sail plan employing roller furling of the jib allowing this sail to be completely controlled from the cockpit, and a mainsail fitted with roller reefing to cope with strong wind conditions.

THE DEL REY TRI-CAT

January, 1967

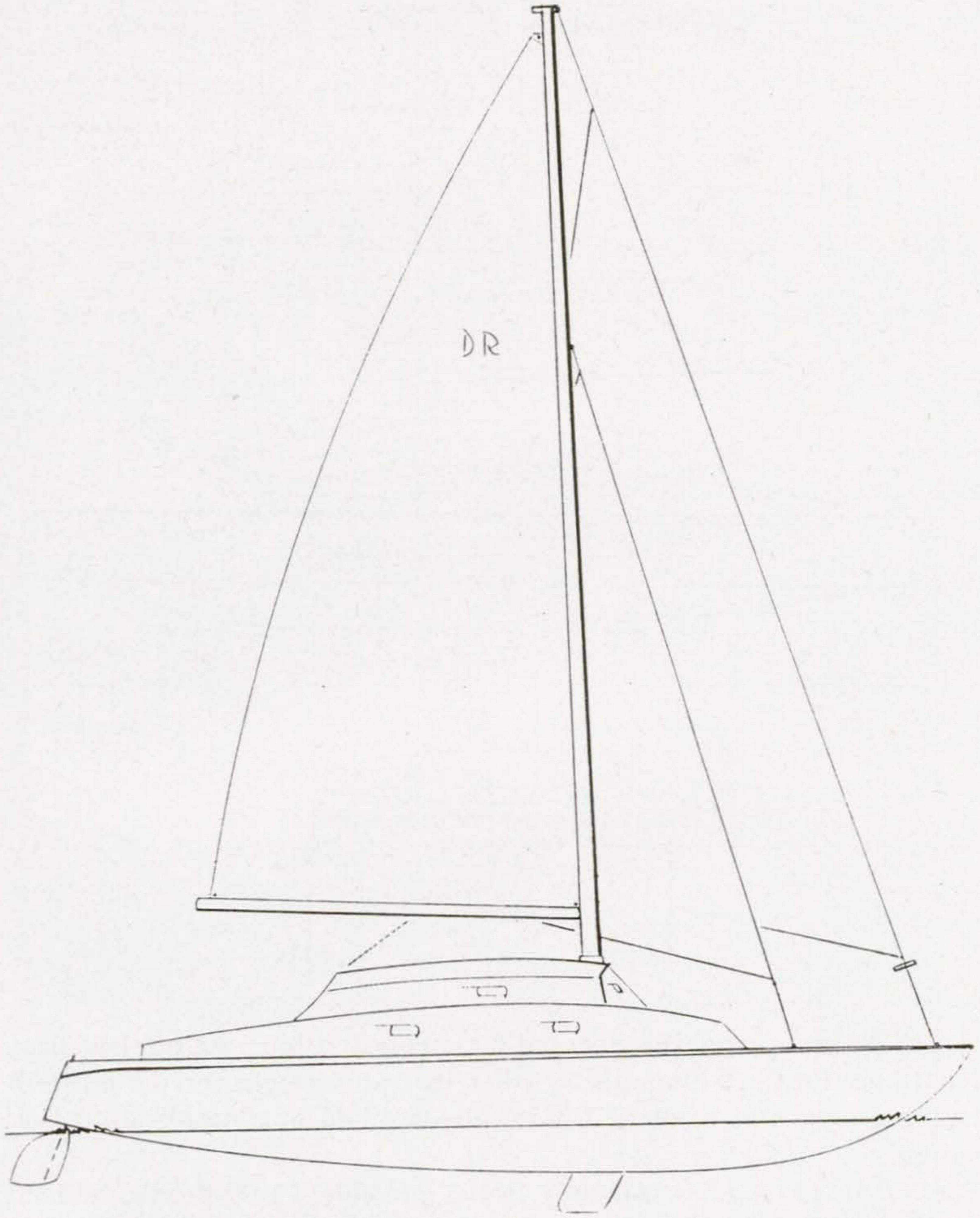
A 38 FT CRUISING SAILER
Designer: Ralph Flood

3883 Sunbeam Drive, L.A.65, California

Length	38 ft 6 in	Weight	7,800 lbs
Beam	18 ft 3 in	Sail Area	750 sq ft

Ed: This is the first fully developed "Pod" of which we know.

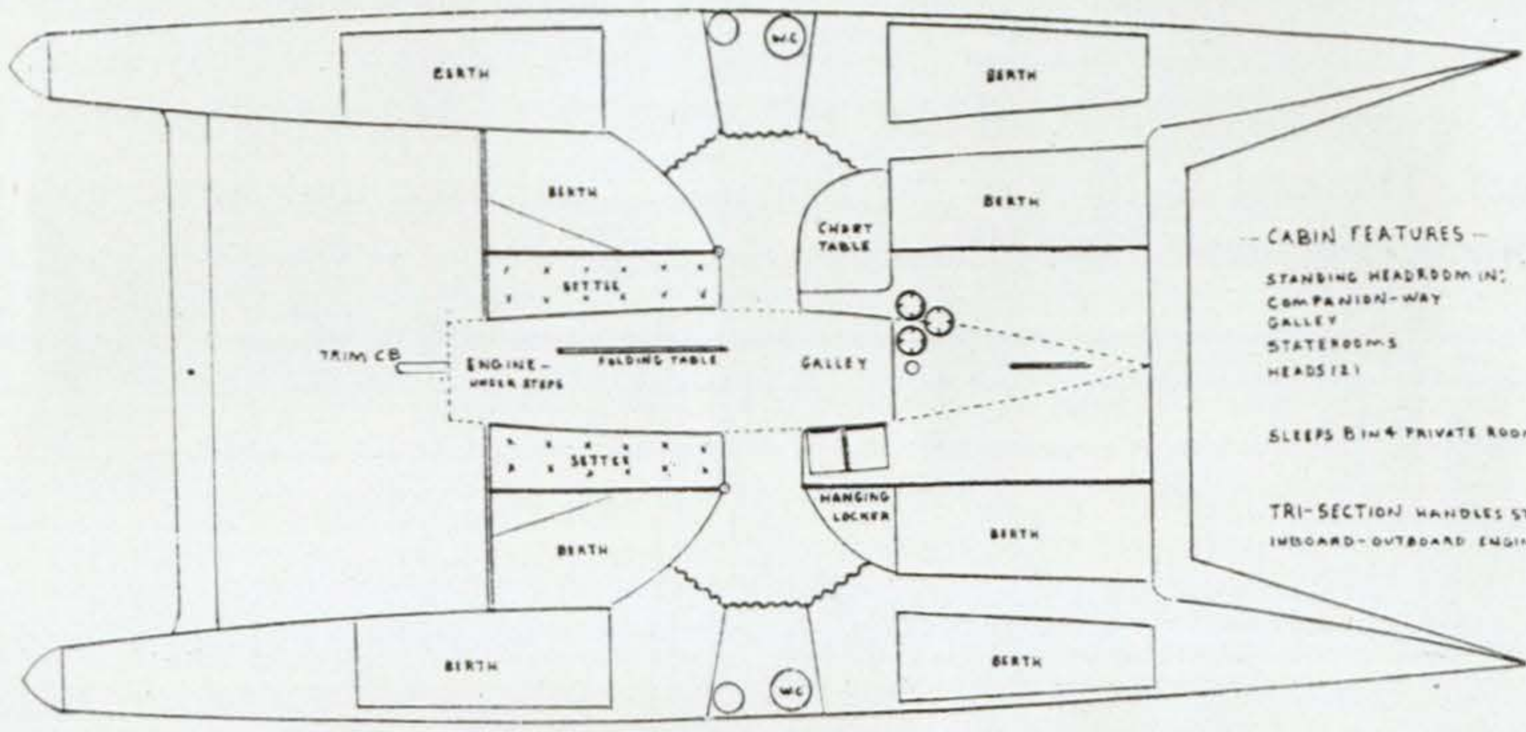
It took several years of multi-hull design research to produce the *TRI-CAT* concept. The best features of the trimaran, catamaran and single hull were combined to achieve this.



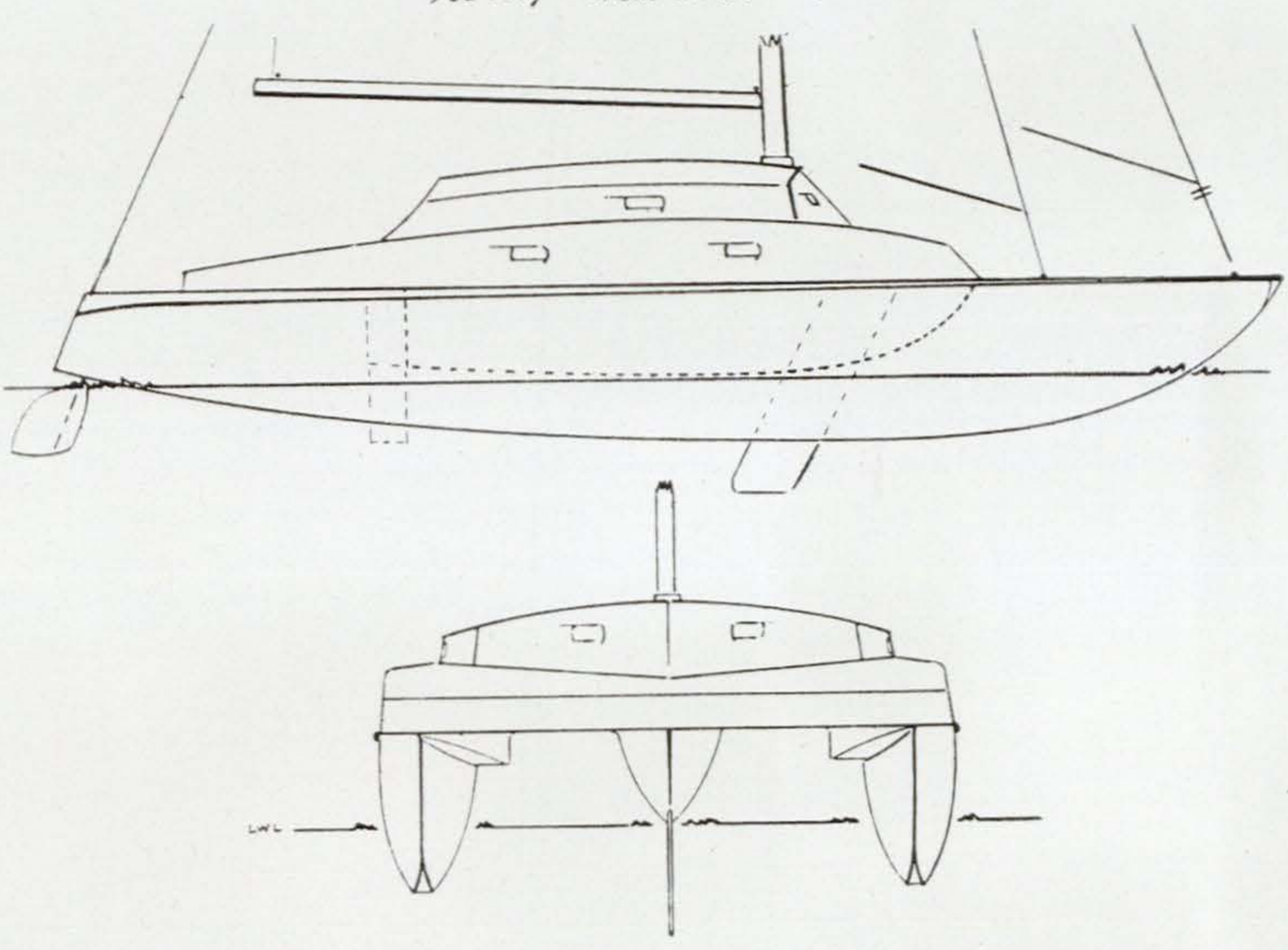
DEL REY Tri-Cat

The designer's observation of multihull development since 1953 has led to the conclusion that the catamaran (double hull) configuration out-performs all other hull types; and this conclusion is substantiated by the vast majority of race result data.

In addition to the superior performance, catamarans in the 30-40 ft length range have potentially more interior living space (as illustrated) and obviously a great deal more cockpit space than other types of sailers. Prior to the introduction of the *TRI-CAT* design concept, the problem of achieving



Del Rey CABIN LAYOUT (STOWAGE NOT SHOWN)



sufficient headroom in the catamarans' central cabin section has been a difficult one. Previous attempts to lower the cabin height for the purpose of reducing weight and windage has usually resulted in a stoop and crawl-in situation.

The *TRI-CAT* concept not only makes possible a low profile catamaran without sacrificing headroom but also permits the use of standard inboard and outboard engines where previously an awkward long shaft outboard has been the only practical auxiliary power. Normally, the *TRI-CAT* centre hull is entirely above the water's surface but when an occasional large wave does build up under the bridge deck over a ton of additional buoyancy is provided by this hull to cope with the situation. A centreboard to increase sailing efficiency can be installed if desired without obstructing interior accommodations and without the danger of water leakage into the hulls.

Another outstanding *TRI-CAT* feature is the appendages incorporated onto the inboard side of the main hulls. These appendages help lift the bows over awkward seas, control spray, and permit easier access into the staterooms and heads.

The *DEL REY* was given a cutter type rig (double foresails) as this rig is not only more seaworthy in strong winds than the masthead single foresail rig, but is more efficient on the reaching points of sailing as well. The *DEL REY's* masthead staysail utilises a roller furling system which permits the crew to increase or decrease sail area instantly by merely pulling on a line led to the cockpit.

The *DEL REY's* accommodations include eight permanent berths in four private staterooms. Add to this the craft's superior ocean going performance and you have a boat equivalent to a larger, high-performance single hull craft costing several times as much to build.

THE TANGAROA DESIGN

L.O.A.	34 ft	Draft	1 ft 6 in
L.W.L.	28 ft 6 in	Weight	3,000 lbs
Beam, O.A.	15 ft 6 in	Load capacity	2,000-3,000 lbs
Beam hull	5 ft 6 in	Sail Area	400 sq ft

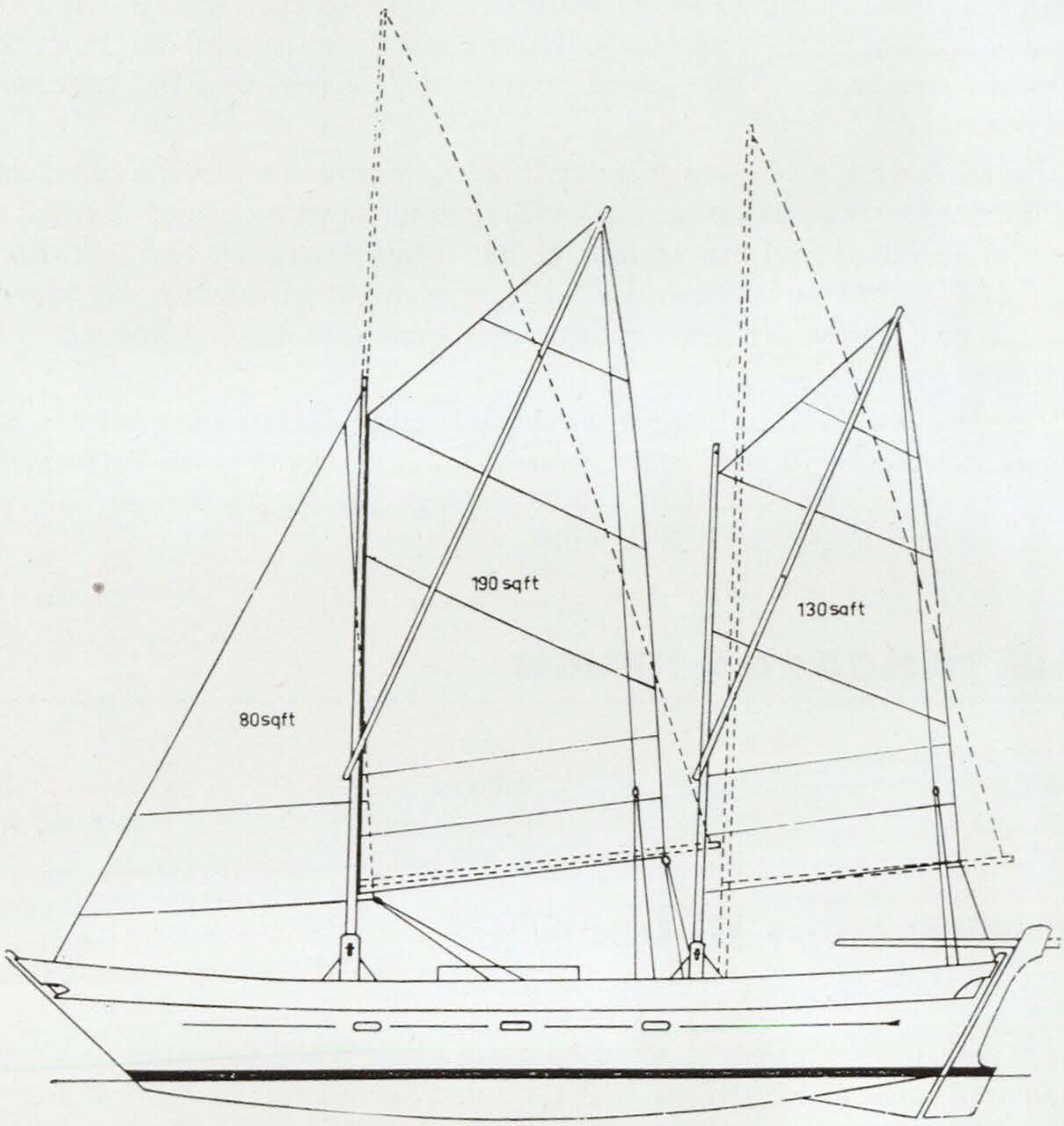
Designer: James Wharram

The Long House, Milford Haven Dock, Pembs.

Jim Wharram was an early friend of the AYRS. While voyaging in his first catamaran, also called *TANGAROA*, from England to the West Indies, he met one of our earliest members, Signor Perez in Portugal and learned of us. He and I then had a long correspondence. Unfortunately, Jim took exception to our earlier editorial policy and we lost contact, though he in the meantime had built another catamaran *RONGO* in which he has sailed three times across the Atlantic, which made him the catamaran pioneer of the Western Ocean. Now, having patched up our rather technical quarrel, we have pleasure in publishing this design of a completely new *TANGAROA* which has appeared in the Australian magazine SEACRAFT.

The Overall Design

This catamaran is genuinely a twin hulled craft. Two identical, long narrow hulls are tied together with four 6 in × 3 in cross beams which are decked but have no "house" built on them. All the accommodation is therefore in the hulls for sea-going while in harbour, a spacious tent can be erected for cool living in the Tropics or lounging space in cooler waters. He therefore achieves the best of both worlds at the minimum expense. There is the best and safest sea-going catamaran with the least windage for windward work while there is far more accommodation with full headroom while in harbour.

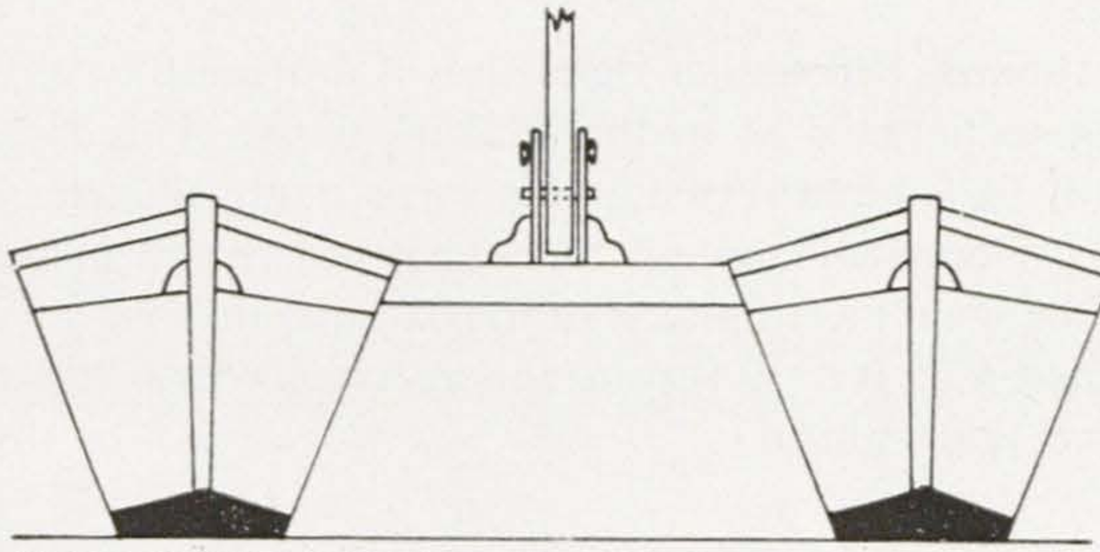


Sailplan

SEACRAFT, January,

Hull Design

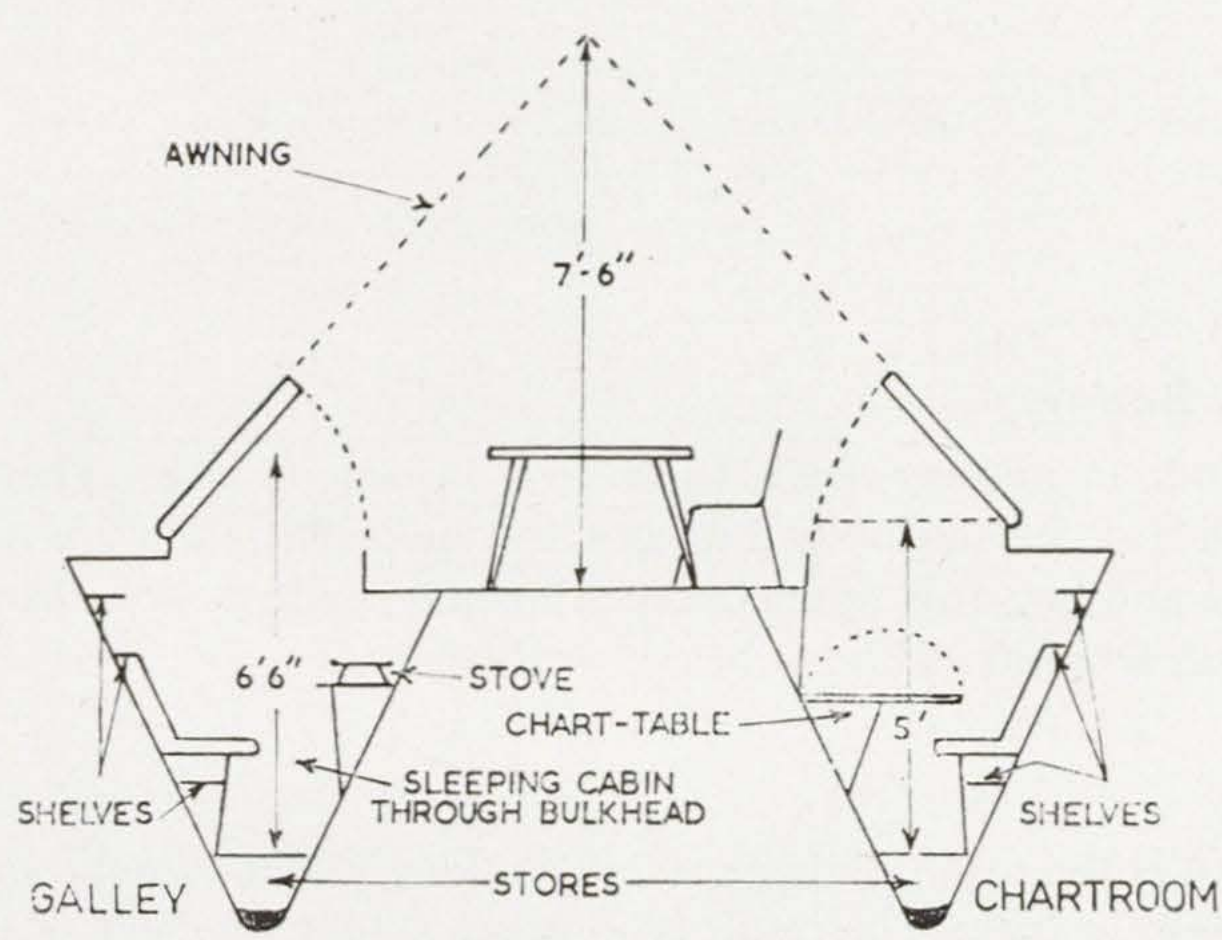
Members will know that I am an exponent of the right angled V underwater section. It now appears that a low aspect ratio fin keel, as opposed to a centreboard, on such a section will give good windward performance. The logic of this design feature will then lead us to an underwater V of less than 90° and *TANGAROA* has a V of just slightly less than 60°. However, the combined keel-keelson is about 6 in wide, giving a rounding to the section at the bottom. The even rounded curve of the keel line fore and aft should let the boat put about easily and the skeg aft should make steering in quarterly seas easy. With a hull waterline length to beam ratio of 14 : 1, a transom should not be necessary, for speed, though Jim gives the reason for this as follows: "A sea-going catamaran must sometimes ride out a gale. The best way to do this is with a drogue over the stern. The transom stern is very dangerous under such conditions, as the owners of transom-sterned catamarans will find out." It is not necessary for us to deal with this time-honoured argument here of transomed versus canoe sterns as it is not relevant.



NOTE: PLATFORM HIGH OFF THE SEA TO AVOID POUNDING
NO DECK CABIN REDUCES WINDAGE

Cockpits

The cockpits are not self-draining, In really bad gales, the unused one is "hatched" over. Standing in the other cockpit with a "poncho" over, blocks it up like a paddling canoe. The water-tight bulkheads will stop any serious flooding. A canvas footwell can also be used. All this saves difficult, water-tight cockpit building.

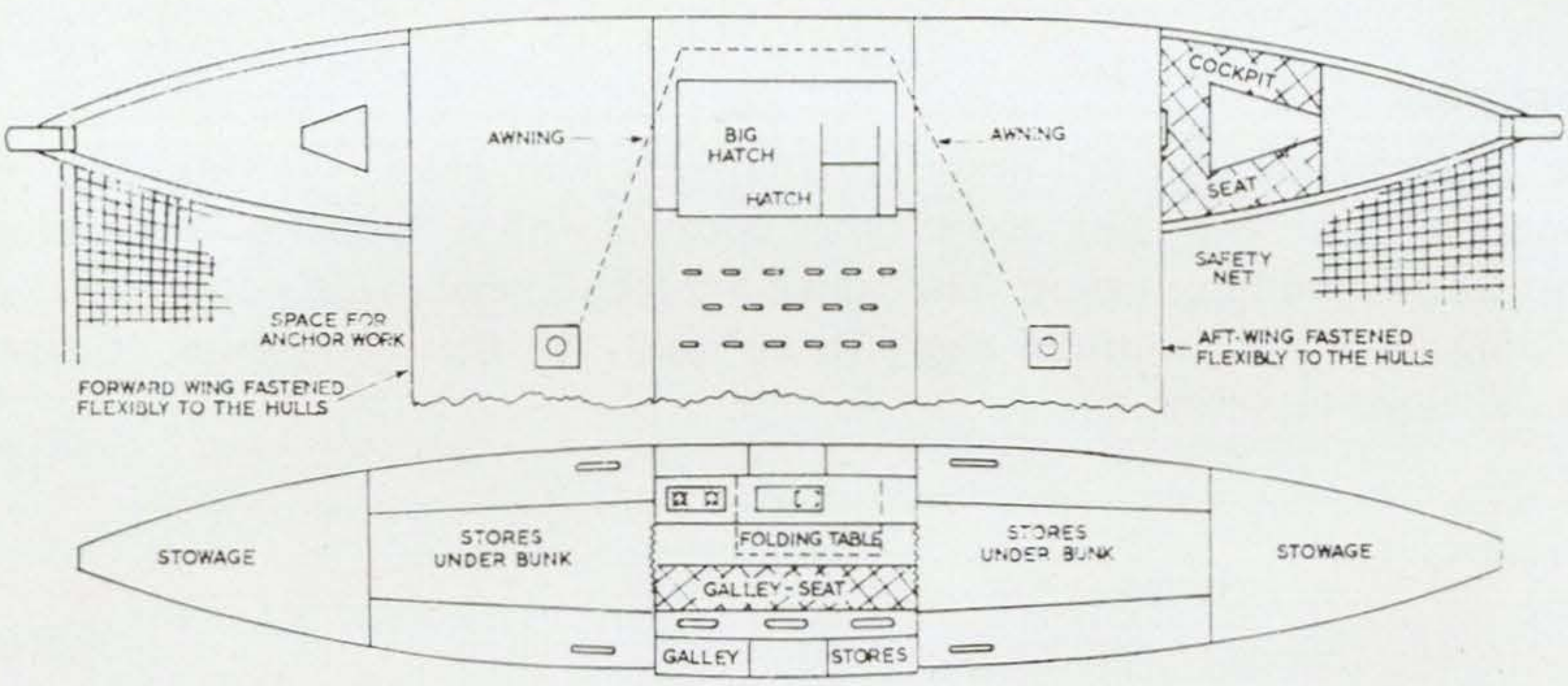


Accommodation

In keeping with the general philosophy of this catamaran, the sea-going accommodation is rather Spartan. In the middle of each hull is a 6 ft length of seating, with galley and dining table to port while the chart table and head are to starboard. An alternative and more private head is in one bow. Fore and aft of these living spaces are 7 ft bunks which fill the beam of the narrow hull and are thus about 3 ft in width. Fore and aft of the bunks is storage space which is divided from them by water tight bulkheads. In harbour in the Tropics, one would sleep and live in the deck tent. Large hatches over the living spaces can be raised under the tent for full headroom in that part of the hulls. Deep bulwarks and netting fore and aft between the hulls must give a nice secure feeling on deck.

The Rig

Though the orthodox Bermudian rig is shown dotted, Jim Wharram prefers the spritsail rig with brails as in the Thames barge. This is a cheap rig to make. It is easily furled and reefed and is surprisingly efficient, even to windward, especially if boomed, though a boom is not shown in this design. Jim feels that with the wide sheeting base of the catamaran, a boom is not needed. I made and sailed a 25 ft × 9 ft centreboard cruiser with this rig for several years and found it delightful.

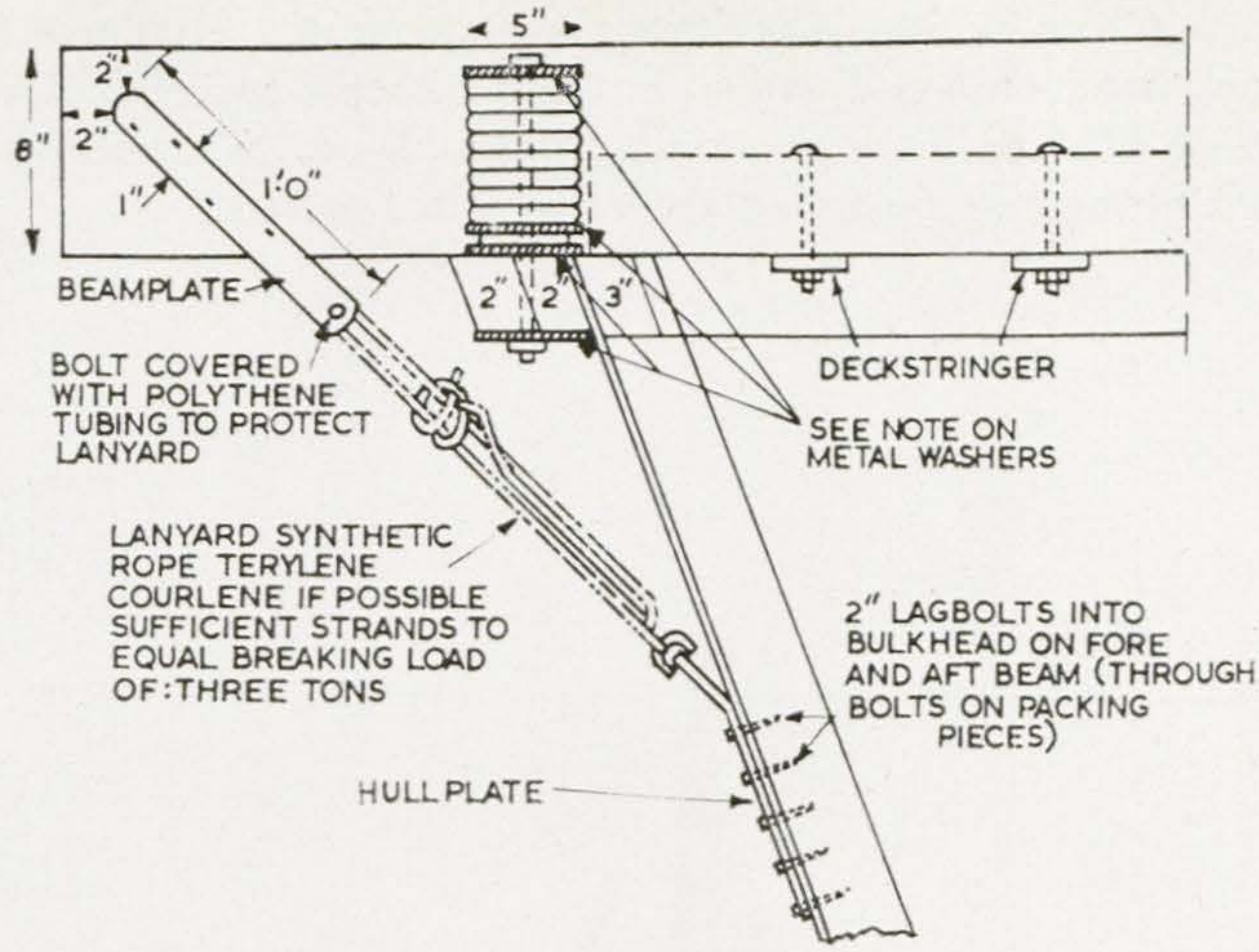


The Cross Beams

These are four in number, each 16 in × 3 in, set on edge. These, on their own, will give some flexibility between the hulls but they are attached by special bolts and lanyards to encourage this independent movement and each hull can pitch 6 in out of line in heavy weather.

Summary

TANGAROA is the result of 12 years of thinking about catamarans and four ocean crossings in them. The result is an ocean sailing machine of the greatest possible safety, security and speed with adequate accommodation though not luxurious. In harbour, however, with her awning set, she blossoms out into a comfortable and cool palace with full headroom in the deckhouse. Her cost to build would be less than £600 Sterling and her speeds across the oceans could be an average of 6-8 knots with peak speeds of 10-15 knots. These were the speeds achieved by Jim in his Trans-Atlantic crossings in his *RONGO* of similar design.



DIAMOND 24 ft

January, 1967

L.O.A.	24 ft	Sail Areas:	
L.W.L.	22 ft	Main	160 sq ft
Beam	12 ft	Jib	96 sq ft
Draft	2 ft	Genoa	140 sq ft
Displacement	2,500 lbs	Storm jib	35 sq ft
Berths	5/7		

Designer: Ernie Diamond

34 Roa Island, Barrow-in-Furness, Lancs., England

The *DIAMOND* 24 is a direct development of *SHEERCAT*, a very successful 20 ft coastal cruising cat, the sail numbers of which are now approaching 20. After sailing and racing *SHEERCAT* for three seasons it was felt that a bigger version would provide more comfortable accommodation and possibly a little more speed. No improvement in seaworthiness could be hoped for, except that the additional length would help her over the short steep lop which builds up in the Irish Sea in heavy weather.

The hard chine construction of the *DIAMOND* 24 is almost identical to that of *SHEERCAT*, being plywood planking over ply bulkheads with Columbian pine frames and stringers and sheathed to the waterlines with glassfibre. All joints were glued with Aerolite and nailed using Gripfast nails, and none are beyond the skill of the average handyman.

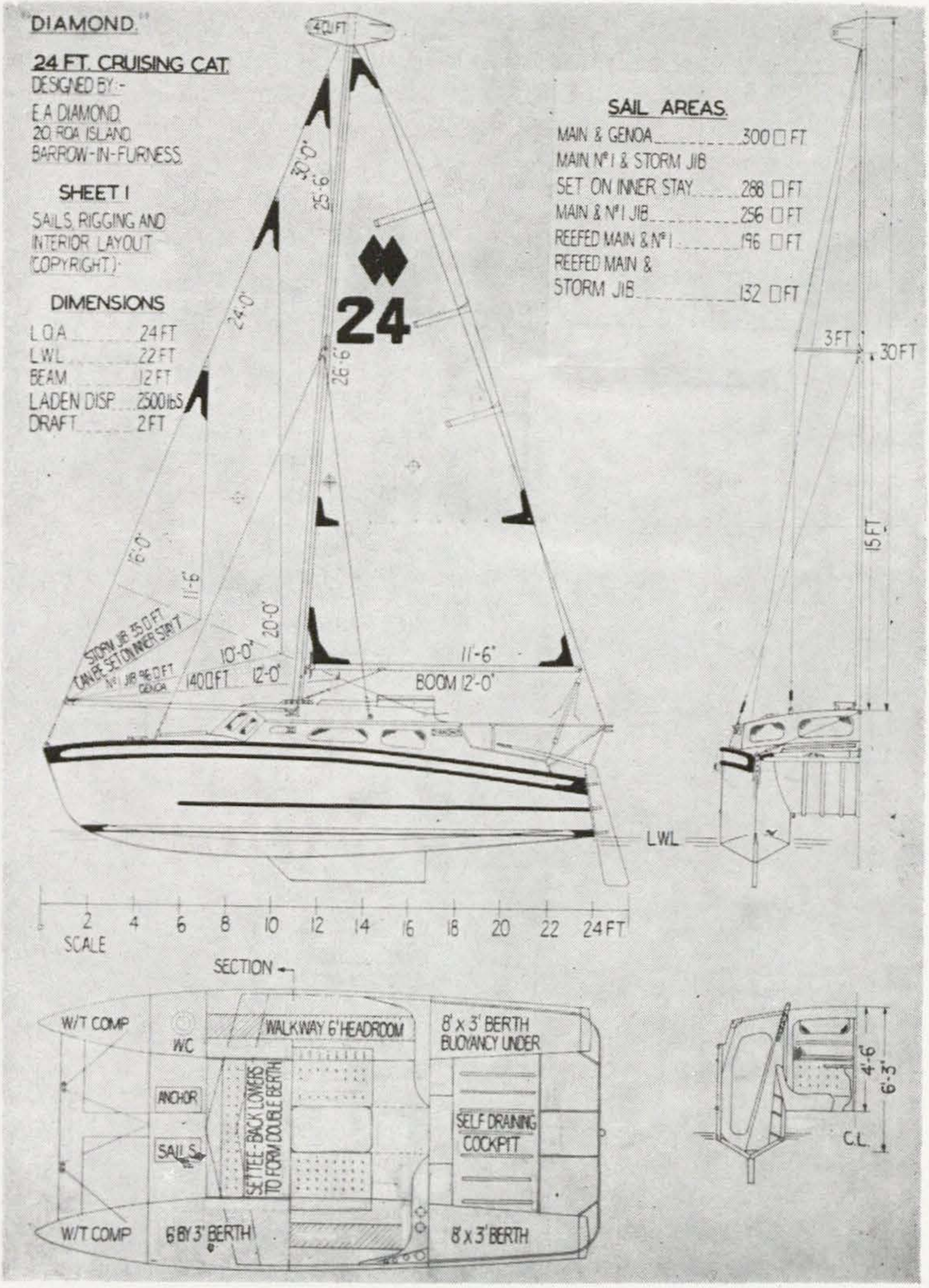
After six months really hard part time work by an amateur builder, the prototype could have been launched and used as a powerboat, and the cost of the basic hull was under £300. As the boat was built out of doors, winter slowed down the fitting out, and the total time taken from laying the keels to launching was fifteen months. The fittings costing another £100, new sails £60, and a second-hand outboard at £40 brought the cost to £500. It would be possible to go £100 or more either side of this figure by careful buying of second-hand fittings, or by fitting the boat with luxuries.

DIAMOND 24

On *SHEERCAT*, leeway was counteracted by using self-operating leeboards hinged under the bridge deck. These were very efficient, but after drying out in several harbours around Morecambe Bay, it was felt that the bottoms of the hulls could be damaged if there were protrusions on the harbour floor. The 24 footer consequently has low aspect ratio fins acting as both skegs and as keels. Whereas it would have been difficult to capsize *SHEERCAT* because of her shallow draft, it was felt that these fins increased the tripping effect, hence the masthead buoyancy on the bigger craft.

Twin spinnaker poles are shown on the drawings serving also as a pulpit, mast raising sheerlegs, and self righting gear as they can be clipped to eyebolts beneath the bridgedeck to form a lever on which the crew or water filled dinghy could be hung to right her from a partial capsize. This latter use of the poles is unlikely to be required but would be a reassuring thought in mid-ocean.

Sailing trials showed that the boat would be quite fast, and in a subsequent race over 19 miles, *SHEBA*, as the prototype was called, won on both elapsed and corrected times. On a Portsmouth Number of 86, she beat the second boat which was also a multihull by 19 minutes and was about an hour and a half ahead of the first keelboat.



Isolated bursts of speed have been estimated at 18 knots without cruising gear aboard, though her best authentic speed by speedometer was 12 knots on a dead run. In gale conditions (30 to 35 knots by Ventimeter) she was reefed right down, and went to windward at 6-7 knots without fuss. Under normal conditions she comes about readily, but in rough water it was necessary to sail her round sheeting in as she turned. The bridge deck is only one foot above water but little slamming occurs except in short steep seas.

In flat calm conditions she makes just 5 knots with a Crescent 4 outboard (70 cc), but this is not sufficient power to drive her against winds stronger than force 4. The ideal motor would be about 10 hp, which would give 8 knots in a calm and sufficient power to manoeuvre in gale conditions.

Five permanent berths are shown on the drawings, and seven could sleep comfortably with a slight rearrangement. It is felt however that this number would be reasonable for weekending only. For serious cruising a crew of three plus all their gear would be about right, while for ocean passages two persons plus the food and water necessary would just about fill the boat comfortably. As with all multihulls, overloading will reduce the seaworthiness and performance of the boat, and a sense of weight consciousness should be developed.

Both the *DIAMOND* 24 and the *SHEERCAT* 20 have been designed for amateur construction. Plans and further details are available from P. Patterson, Foss Quay, Millbrook, Plymouth.

CHAPTER XXII

MYERS 36 ft CATAMARAN

January, 1967

Designer: Hugo Myers

Members will remember a very pretty catamaran designed by Hugo Myers called *WINDSONG*. This is a 36 ft catamaran but the plans have now been completely revised for improved combinations of seaworthiness, speed and comfort. For example, the wing now clears 2½ ft for comfortable performance in rough seas.

The revised accommodation plan is shown on page 270.

THE POLYNESIAN CATAMARANS

April, 1968

Designed by: James Wharram

James Wharram's whole design philosophy can be summed up as "producing safe, cheap-to-build, load carrying, shallow draft, fast catamarans". He now has sold plans *AND HAD BOATS BUILT* in such numbers that it appears his designs are exactly what very many people have been waiting for. The reasons for this are:

1 They allow a man to get sailing at the least possible expense in work and money;

2 They give him a little more speed than conventional yachts of the same length and fantastically greater cost;

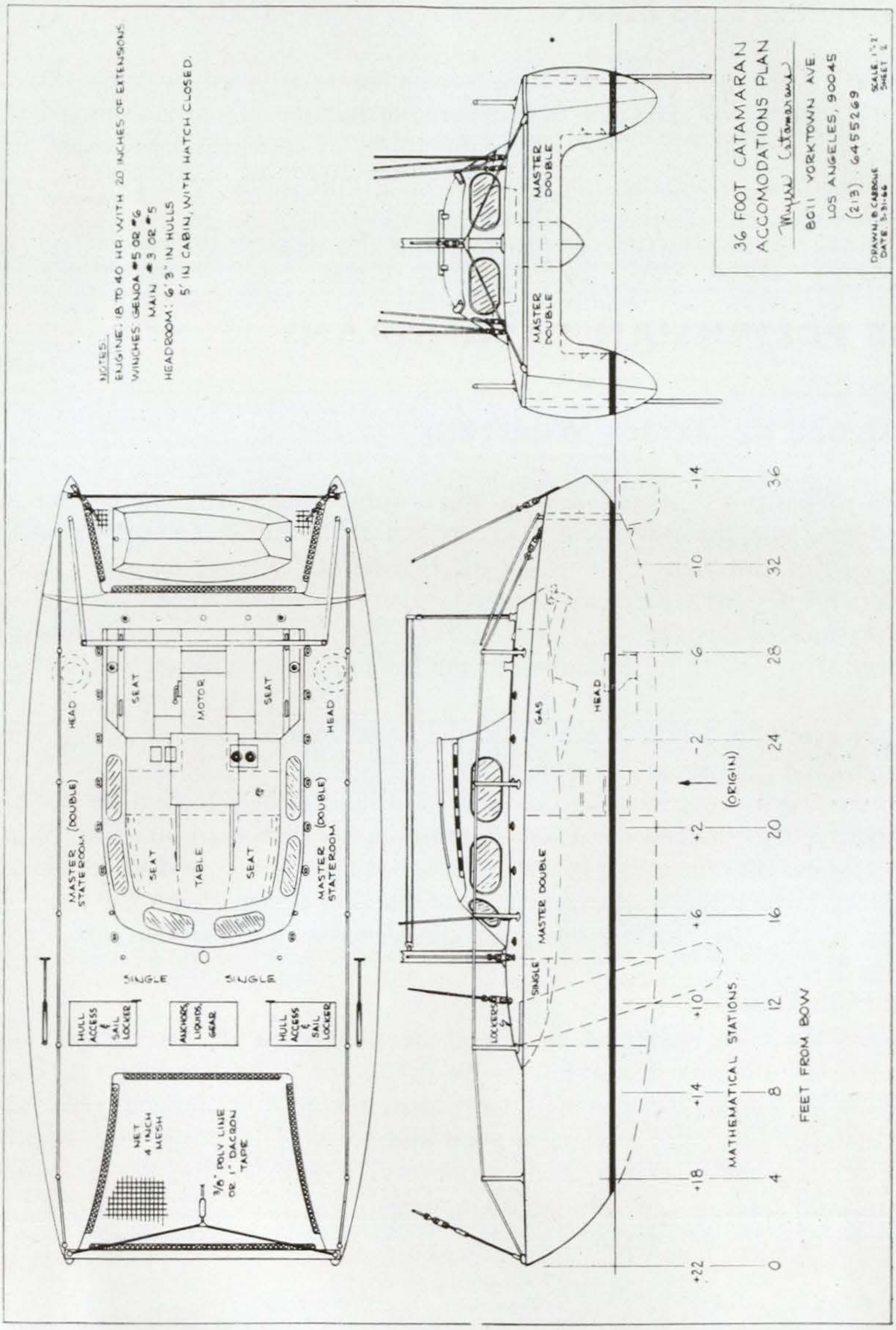
3 James is still living with his family aboard his *RONGO* so that his designs will have had the benefit of female criticism and hence are likely to please the ladies. Of course, his ocean voyages with his family and his projected voyage around the world show people that Jim designs from the point of view of the deep sea and this gives confidence as nothing else can.

The Hull Design

This has the same shape for all James' catamarans within the constrictions of relatively differing displacements. In other words, he has found a shape which is sea-kindly, has enough lateral resistance without appendages in the way of boards or low aspect ratio keels and is fast. Obviously, he would be unwise to change it, except to fit in more or less displacement as required for an individual design. The accommodation and constructional details of course vary with each design.

The Rigs

James favours the spritsail rig or, as with the *ORO* design, the native Polynesian sail. Both have brails which furl the sail quickly and easily and this must be a Godsend for an ocean cruiser, though useful any time. However, people will insist on the fractionally faster modern rig with which they are familiar, though the *ORO* rig must be excellent in view of our knowledge of the performance of the *WISHBONE* Rig.



MYERS 36 ft. Catamaran

ARIKI

April, 1968

L.O.A.	45 ft 6 in	Sail Area	700 sq ft
L.W.L.	37 ft 6 in		(40 ft mast)
Beam	20 ft 0 in	Displacement	$3\frac{1}{2}$ tons
		Sail Area/Weight Ratio	200 sq ft/ton

Designer: James Wharram

ARIKI was designed for an Australian to build for himself for the 1968 Single-handed Trans-Atlantic Race, though it was not finished in time. The expected cost of materials is £1,000. The builder has insisted on the high aspect ratio Bermudian rig in place of Jim's fully battened ketch and this should certainly give the boat an excellent performance, though I think a "Ghoster" would be badly missed if not used. There must be few things more aggravating than sitting alone in the middle of the Atlantic in a very light air wishing one had spent the extra money on such a sail.

ARIKI cannot expect to have a very high top speed owing (dare I say it?) to her canoe stern squatting though this doesn't show in any of the sailing photographs I have seen. Jim thinks she will do 15 knots at full tilt and he may well be right. Where she will score will be at the lower speed range (where her canoe sterns will help her) and this will help her average speed which Jim thinks will be in the region of 10-12 knots. If she averaged 10 knots across the Atlantic, she would cross in $12\frac{1}{2}$ days but she would not have been likely to do this to windward in the Single-handed Trans-Atlantic Race.

HINA

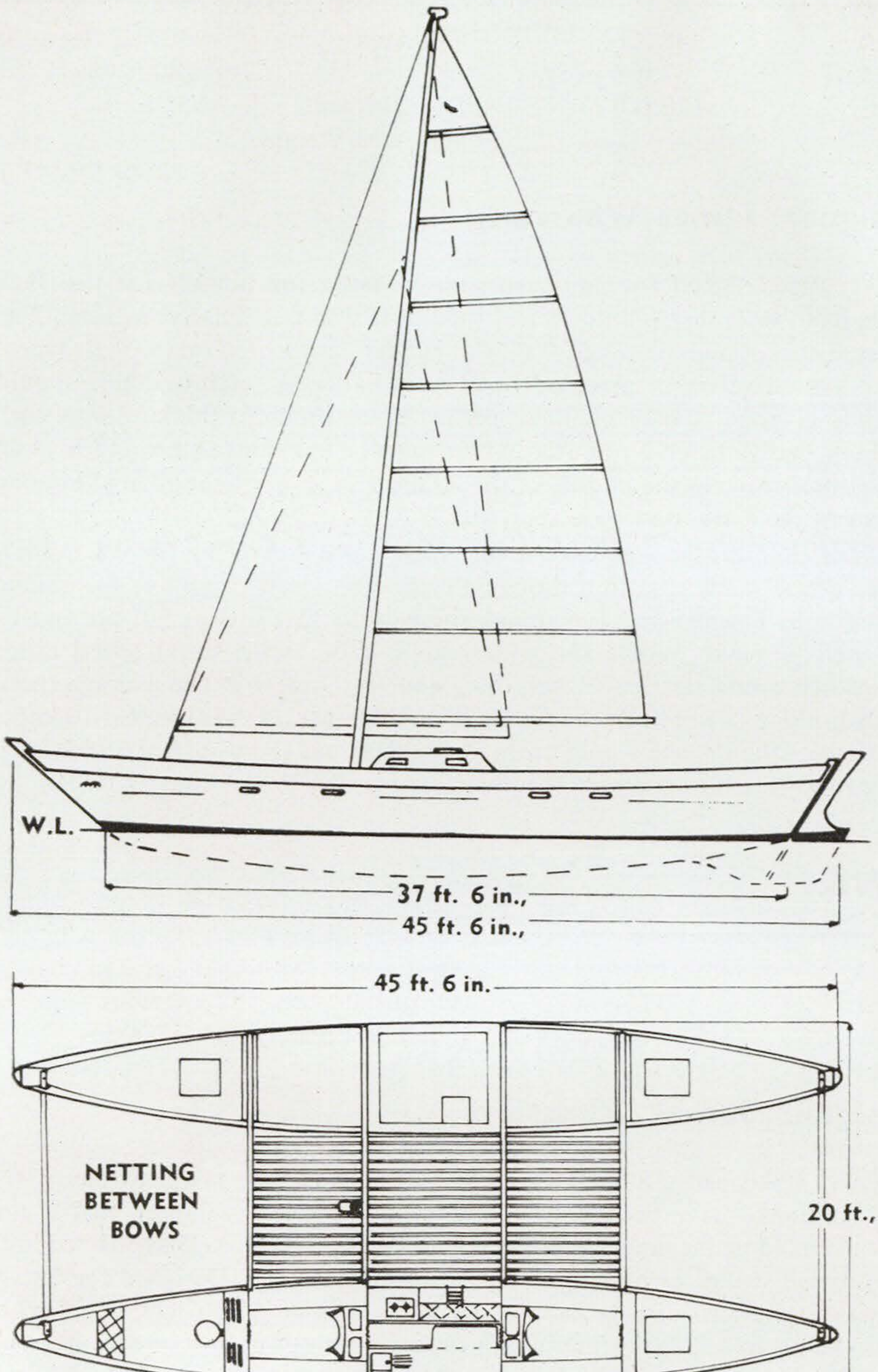
April, 1968

L.O.A.	22 ft 0 in	Draft	1 ft 0 in
L.W.L.	18 ft 6 in	Weight	700 lbs
Beam	10 ft 0 in	Loading capacity	1,000 lbs
Hull beam	2 ft 6 in	Sail Area	173 sq ft

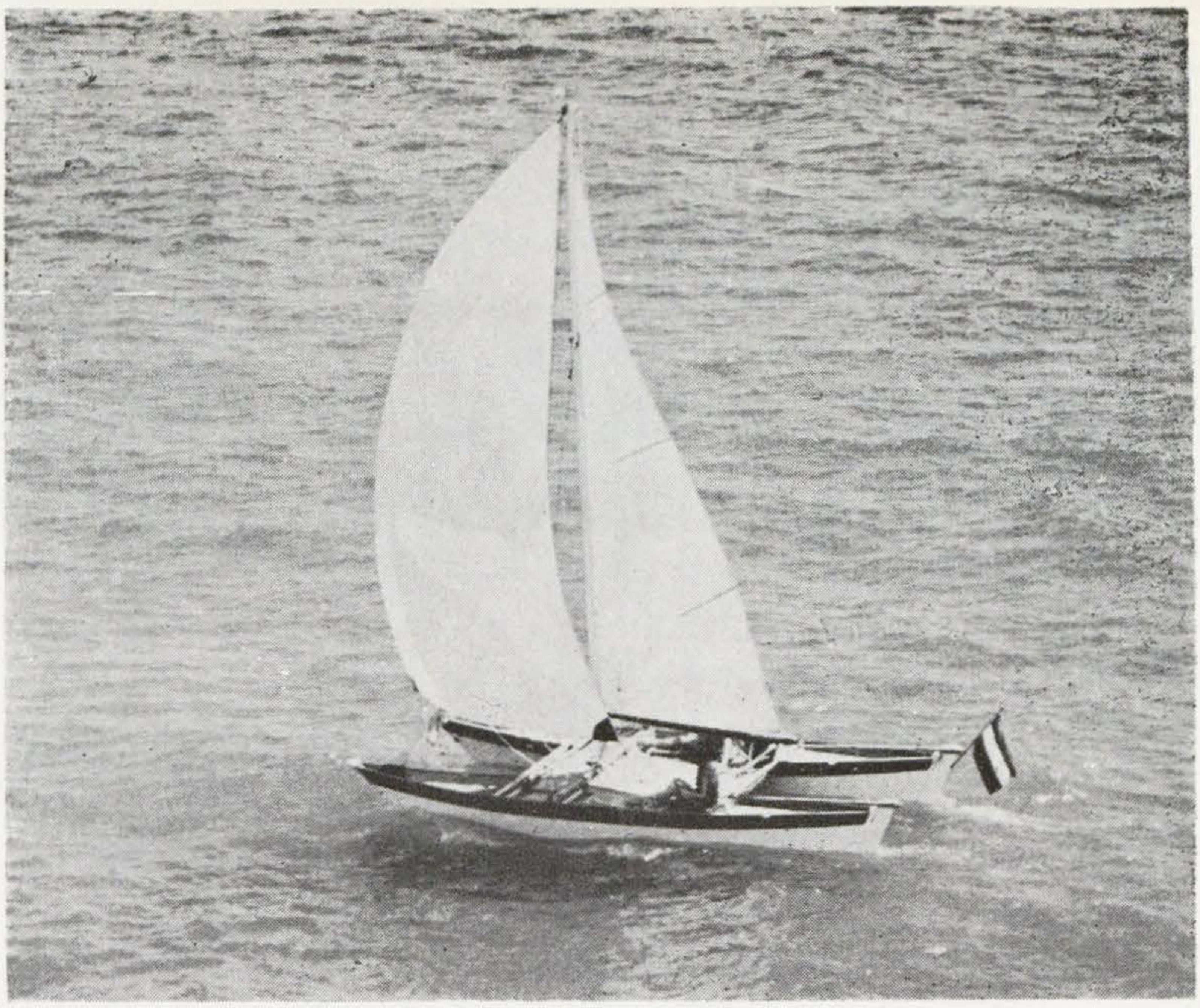
Designer: James Wharram

HINA is a day-sailer and "Overnighter" which can be taken to pieces for trailing. Bunks have been built into the hulls by some, though this is not recommended by the designer. Instead, a canvas or Terylene (Dacron) "cuddy" can provide shelter or a tent can be put up for sleeping. Designed for family sailing, coastal cruising or fishing, *HINA* is a boat which will be an ideal introduction to sailing for any youth or any youthful person of any age who has the capacity to use his hands to build her and thus learn the "feel" of the boat herself, as well as the "feel" of sailing.

Cost of materials, including sails: £120-£150. Building plans: 8 guineas. Study plans and photos: 50p.

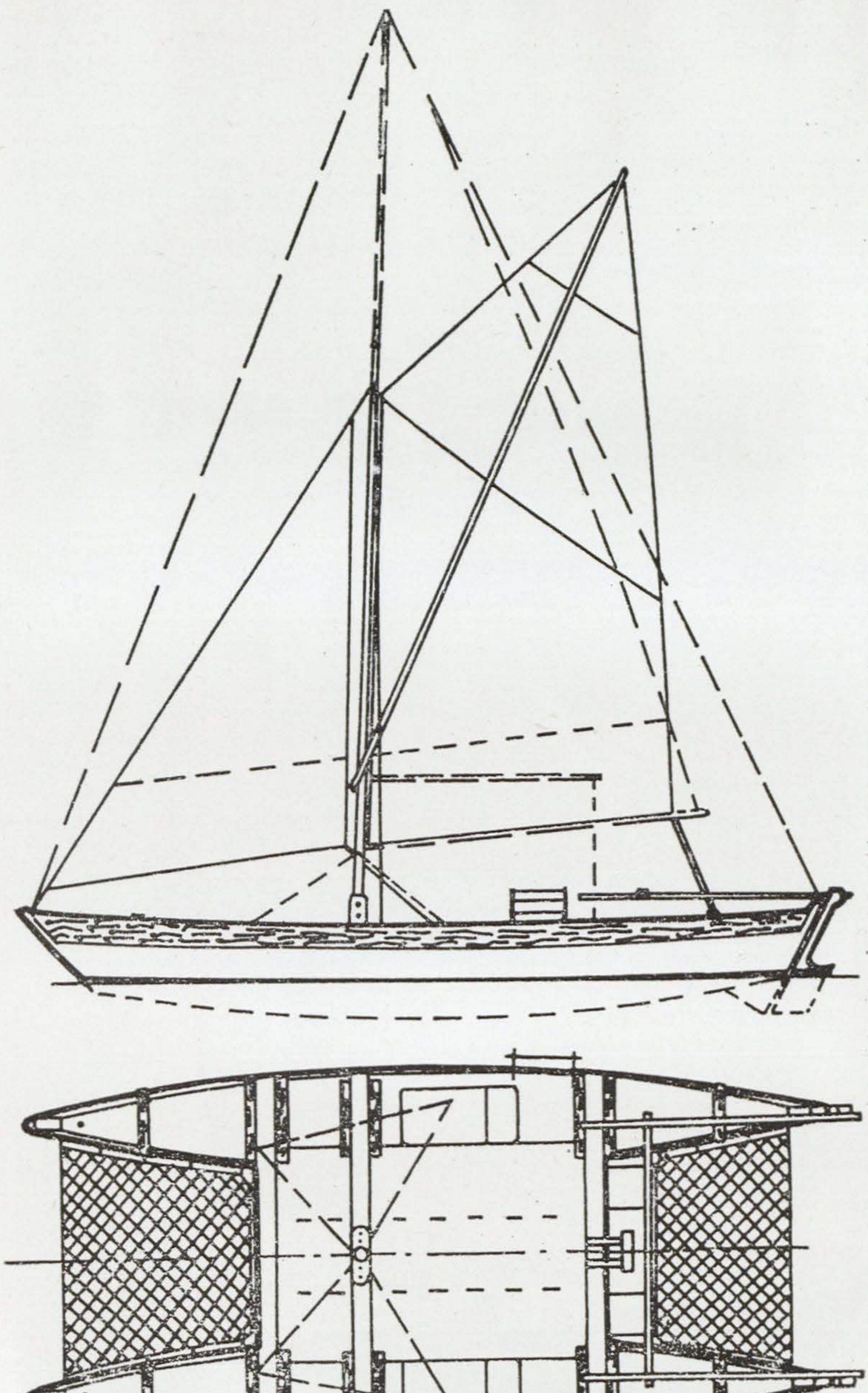


ARIKI



HINA—Bermudian rig

HINA—Sprit rig



HINA

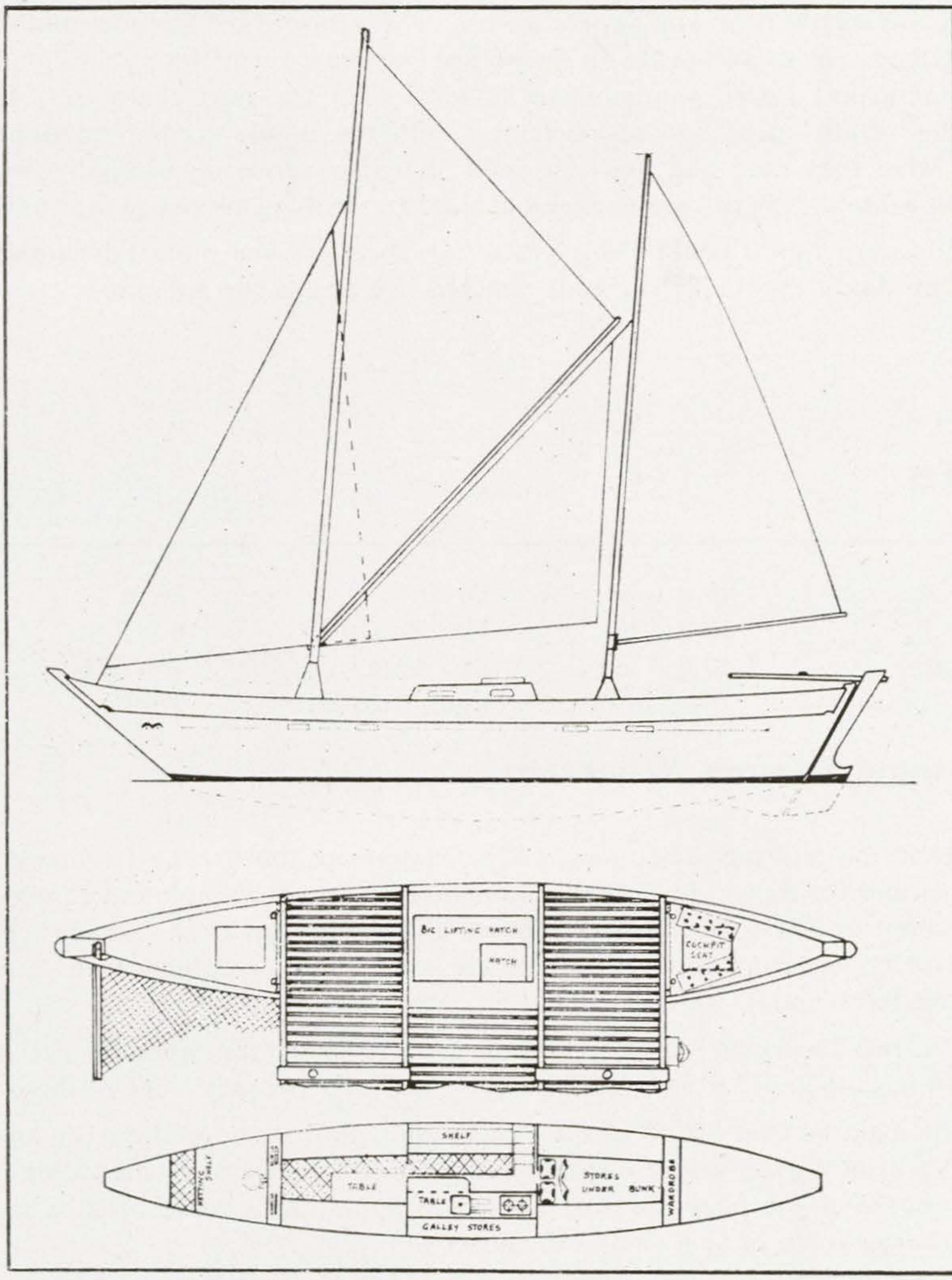
NARAI

April, 1968

L.O.A.	40 ft	L.W.L.	32 ft
Sail Area	600 sq ft		

This design replaces the 40 ft *RONGO*, being easier to build and faster to sail.

She is suitable for family ocean cruising, weekend cruising for 8 or racing, depending on the rig chosen.



NARAI

TANE

April, 1968

L.O.A.	27 ft 6 in	Hull beam	3 ft 0 in
L.W.L.	23 ft 6 in	Draft	1 ft 3 in
Beam	12 ft 6 in	Sail Area	227 sq ft

Designer: James Wharram

In the Thames Estuary and, I should think in many other places as well, there are several men who appear from nowhere during the Summer and sail small boats from anchorage to anchorage, meeting up in the public houses for company. *TANE* would make an ideal boat for such characters. The shallow draft, speed and seaworthiness with the simple accommodation is just what they need and one can easily imagine such a pipe-smoking man coming into the "hard" at some remote place and making his way to the "pub".

However, *TANE* could easily cruise far afield for the more adventurous and no doubt eventually someone will sail one across the Atlantic.

ORO

April, 1968

L.O.A.	46 ft 0 in	Draft	26 in
L.W.L.	35 ft 3 in	Headroom	6 ft 7 in
Beam	20 ft 0 in	Sail Area	750 sq ft
Hull beam	7 ft 0 in	Load capacity	3 tons

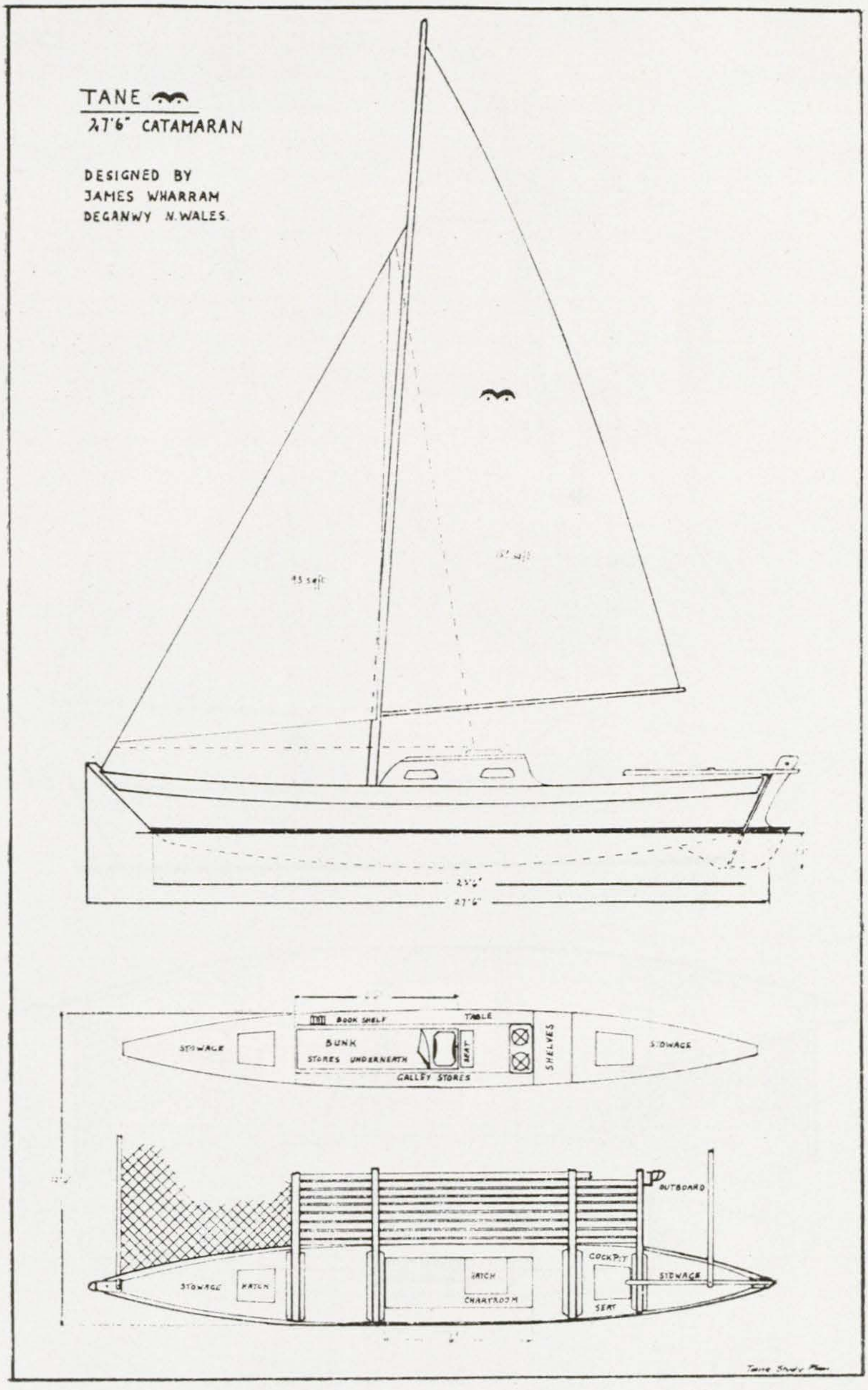
Designer: James Wharram

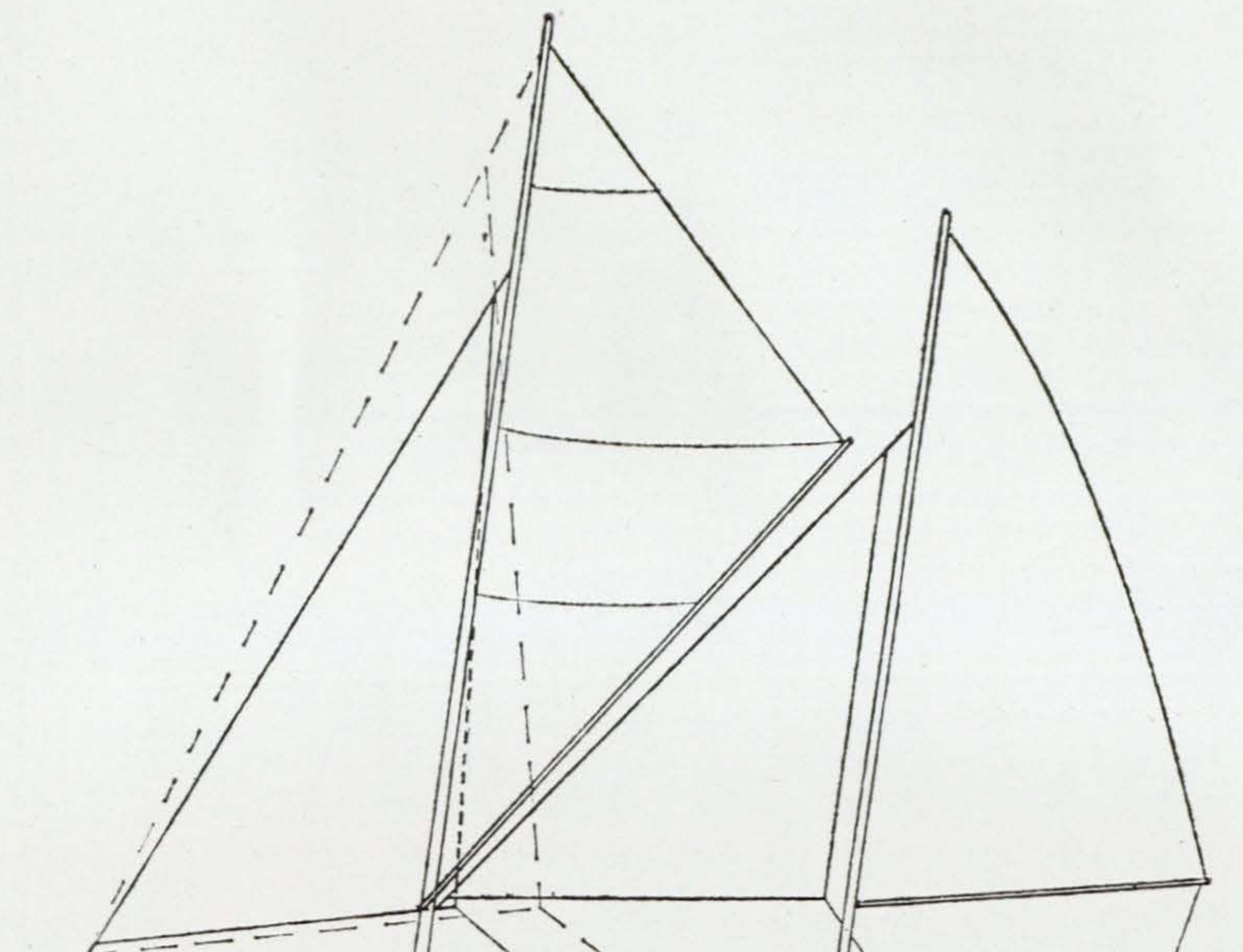
ORO is the cruising version of *ARIKI,* described above. The freeboard is higher and the rig will be far easier to manage. She can be built and equipped for about £1,000 in 1,000 working hours and should sail at an average speed of 8-10 knots across an ocean. There are 4 private bunk cabins, each with a double bunk and an 18 in deep and 6 ft wide wardrobe.

The two "working" cabins, with galley and chartroom/library/office are 7 ft 6 in long and 7 ft wide at deck level. Extra people may sleep in these.

The main hatches lift off as on a cargo ship, so that sun and air can enter the yacht in warm weather. Designed for fast all-weather weekend sailing for 6-8 people or 4-6 people during ocean voyaging, *ORO* could also be used for charter work or as a small expedition ship.

Building plans: 60 guineas. Study plan and photos: £1·50.


TANE
27'6" CATAMARAN
DESIGNED BY
JAMES WHARRAM
DEGANWY N. WALES
BOOK SHELF
TABLE
STOWAGE
BUNK
STORES UNDERNEATH
SEAT
SHELVES
GALLEY STORES
OUTBOARD
COCKPIT
HATCH
CHARTROOM
SEAT



ORO

PELINDABA ex EBB AND FLO

April, 1968

by P. A. Woods

Atherfold's Boatyard, Quay Lane, Gosport, Hants.

In the late winter of 1966 *EBB AND FLO* came into my hands in very poor condition and trailing an unenviable reputation.

Working on hearsay of previous performance I decided that drastic changes were necessary apart from the work to "reconstitute" the structure.

Mr Morwood confirmed the benefits of low aspect ratio keels and his suggested position, well forward, was the one in fact adopted. This has proved a happy choice, as, apart from sailing efficiency, harbour and anchorage problems are greatly simplified. Leeway is negligible both in a sea and in quieter water. Directional stability is excellent but in spite of this she turns like a dinghy when the helm is put down. Balancing the rudders has helped greatly in this. The only snag which appears insuperable and will have to be accepted is an insistence on shuttlecocking head to wind as soon as the way is off with no sail up. This trick, once realised, can be overcome by quick work with the stern line on those occasions when it is necessary to come alongside with an offshore wind.

The twin masts seemed unnecessary weight and windage so I dispensed with one and planned a rig giving a high headsail proportion. To take the new stresses a spar was made up of the discarded hollow box section booms which were glued either side of a solid beam. This formed a base on which to stand the mast and a spar to take the compression strains imposed by the four 10,000 lb breaking strain rods completing a triangulation to support a 5 in steel tube, transmitting the mast thrust through the bridge deck. The loading of this structure at the ends comes directly to the inboard gunwhales and is thence evenly dispersed in the hulls.

In this planning and that of the extra steel bracing which gives much needed ties between hulls and wing I was greatly helped by Mr Marshall, of Marshal and Nicholson the original builders, who in a most delightful manner shot down my wilder flights of fancy and passed only ideas which would feasibly work. He really has to take the credit for the fact that the structure stays together and looks likely to do so for some years to come.

The interior had to be altered to suit the work of sail training and this was done with a total weight saving of 420 lbs. Mast, boards, cases, superfluous water tanks, pumps and piping account for a balance to make a total saving of 2,030 lbs leaving a final weight of under five tons ex. stores, crew and baggage.

Sail area remained at 1,000 sq ft giving a very satisfactory power to weight ratio.

The dinghy type rudder blades were given a 3 in leading tab so that when lowered they are in pivotal balance.

PELINDABA ex *EBB AND FLO*. Note jib on port hull

Performance

The first sail looked like disaster. The yard launch towed *PELINDABA* to clear water where she proceeded to sit sullenly—a lifeless collection of sticks, string and rag.

I was towed back ignominiously and replaced the patent steering system, which I had dreamt up, with her original rudders.

The second sail we pushed out to clear water with the rubber dinghy—repeat performance.

Desperate, I scooted her off with the dinghy and she suddenly came to life flying off at a huge rate and controlling like a thoroughbred—until we came about and had to start all over again.

This obviously wasn't going to do for sail training or any other kind of cruising.

Back to base again. This time I centralised the swinging bowsprit and fitted a strop and strut to carry the headsails 18 in further forward. This worked and she could be put about with exact attention to the foresheet handling.

Still not good enough for the purpose. Experimental tab to balance the rudders was all I had time for before the first customers arrived.

Fortunately they were old hands from other cruises and they carried me through a very shaky first week. We consolidated the rudder experiment and changed the mast spreader arrangement. We then cleared out of Poole to make a 10 hour passage in light winds to Alderney.

From then on we never looked back and I dropped into the seasonal routine, crossing the channel once a fortnight and making my usual rounds of the islands and various ports of the Bay of St. Malo and the Cherbourg Peninsula. I covered some 2,000 miles in all conditions of sea and wind with crews of varying competence and strength.

Passage time were much the same as they had been in my 60ft monohull and occasionally there were bursts of high speed. I had obviously to "nurse" her because of the nature of the work.

Stability was fantastic and never once did she show the least tendency to lift a hull.

Once while surfing against a full spring ebb in the Alderney Race I pulled her away out of sheer funk at the chasm ahead. This was entirely unnecessary as I later proved she could ride these waves until they subsided.

In September the time had come to push her and while steaming past Calshot in a force 7, the bow strut—a beautiful hollow spar—disintegrated.

This forced me into trying a double headsail rig, unbalanced and of a very "lash up" nature.

The results were startling as she suddenly became a most good natured boat, tacking 90° with the sureness of a dinghy, sailing 10 knots to windward with no sense of strain and going very fast on all points of sailing.

I don't know why—it looks all wrong—but that is how she is going to be next season, without the "lash up".

CHAPTER XXIII

SEA BIRD

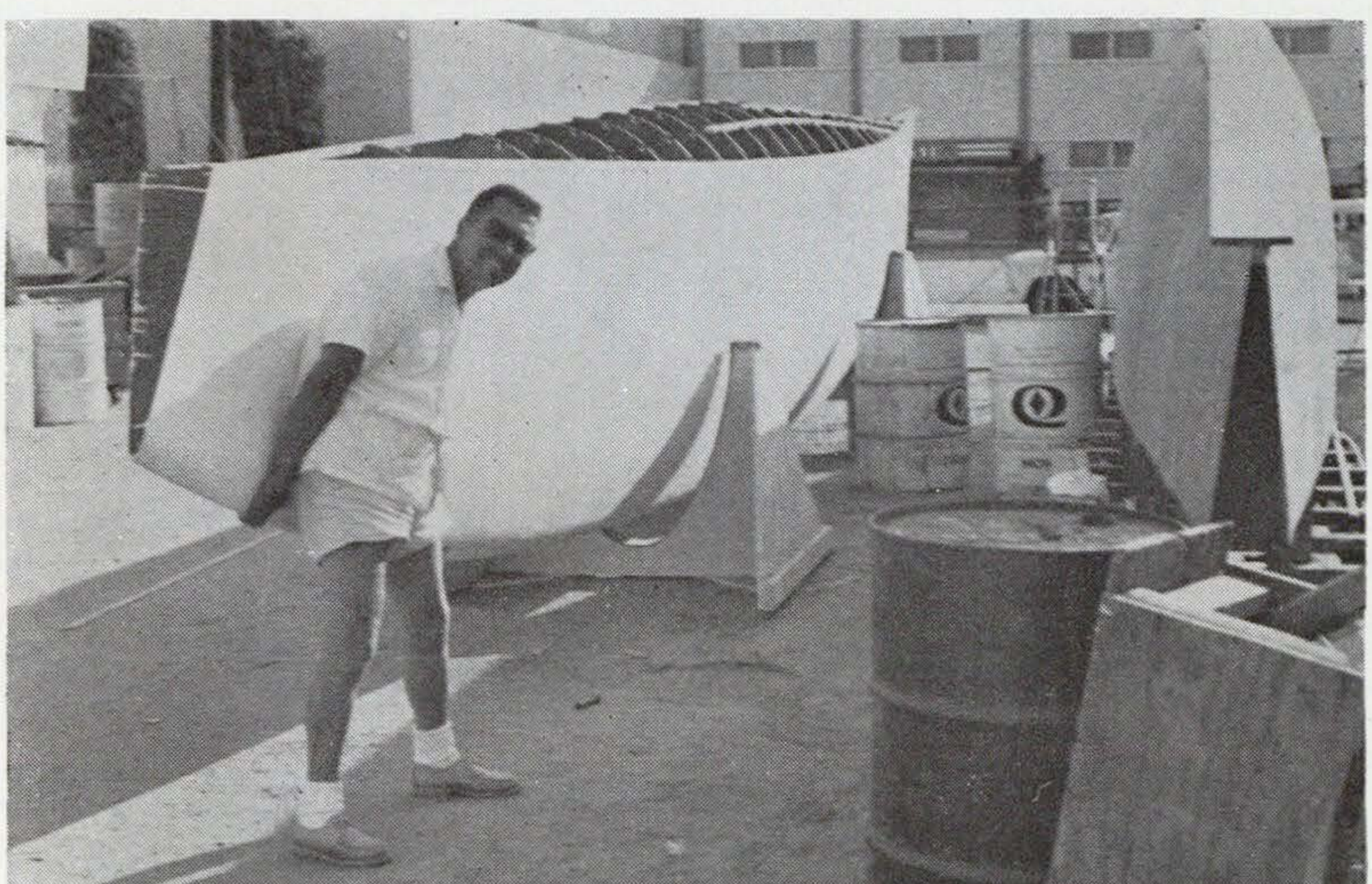
April, 1968

L.O.A.	44 ft	Sail Area	1,020 sq ft

Designer: Hugo Myers

I have before me two papers by Hugo Myers: "Tank Test Results for Fine Exit and Full Stern Light Displacement Hulls" and "Theory of Sailing—With Applications to Modern Catamarans". These are both excellent papers and, doubtless, members can get copies from Hugo if he has them. What they show, however, is that there is little to choose between various catamaran hull shapes, though this is discussed in greater detail later.

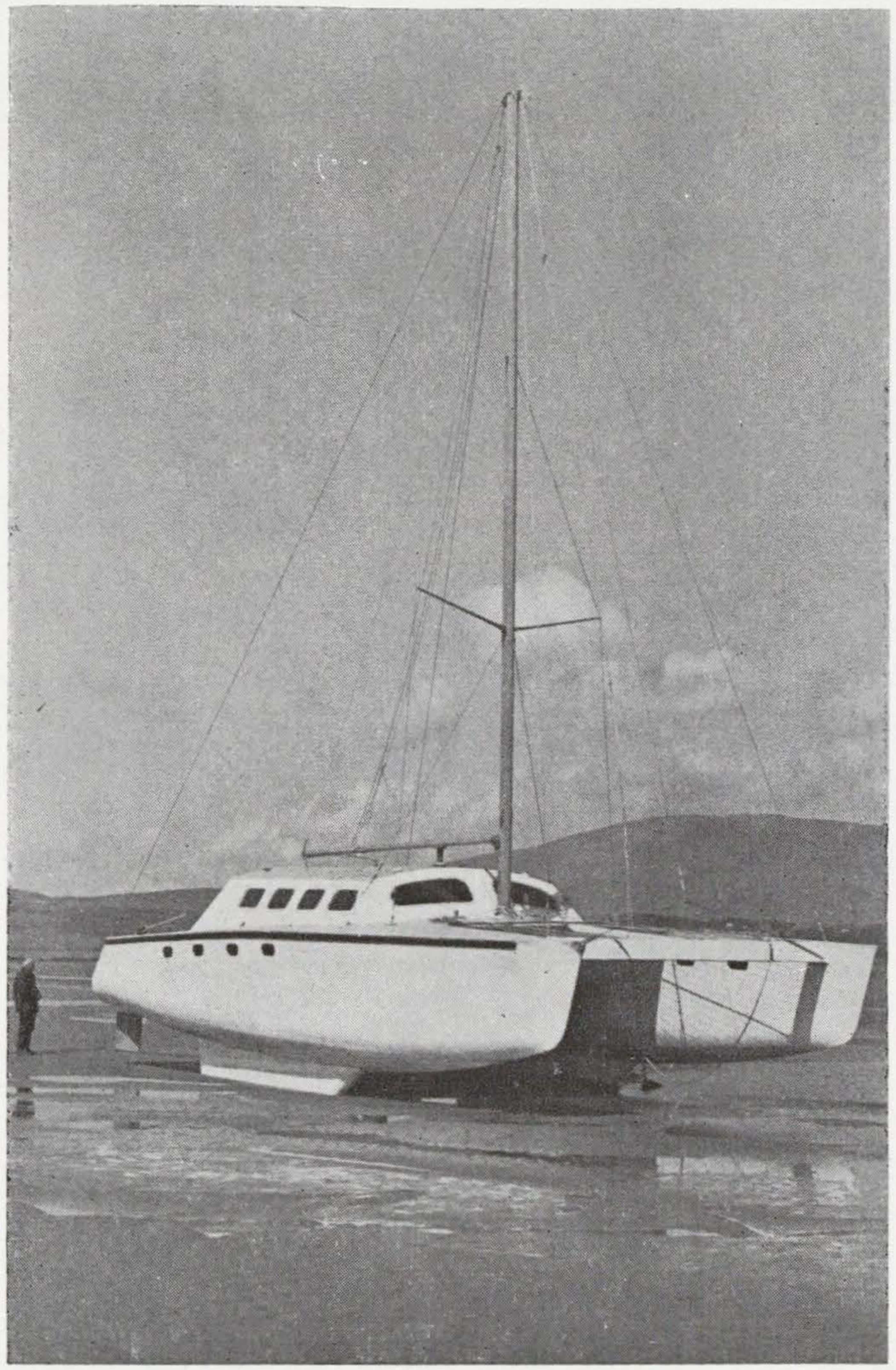
As a result of these tests, Hugo has designed *SEA BIRD* as an all out racing catamaran with the only accommodation a little cuddy amidships. The design is of the usual West Coast style which has been shown to be very fast indeed when built very lightly and raced hard. It is odd, however, that the British and American East Coast shape, which is very different, also seems to be very fast. It is a great pity that tank tests between the two hull forms have not been done.



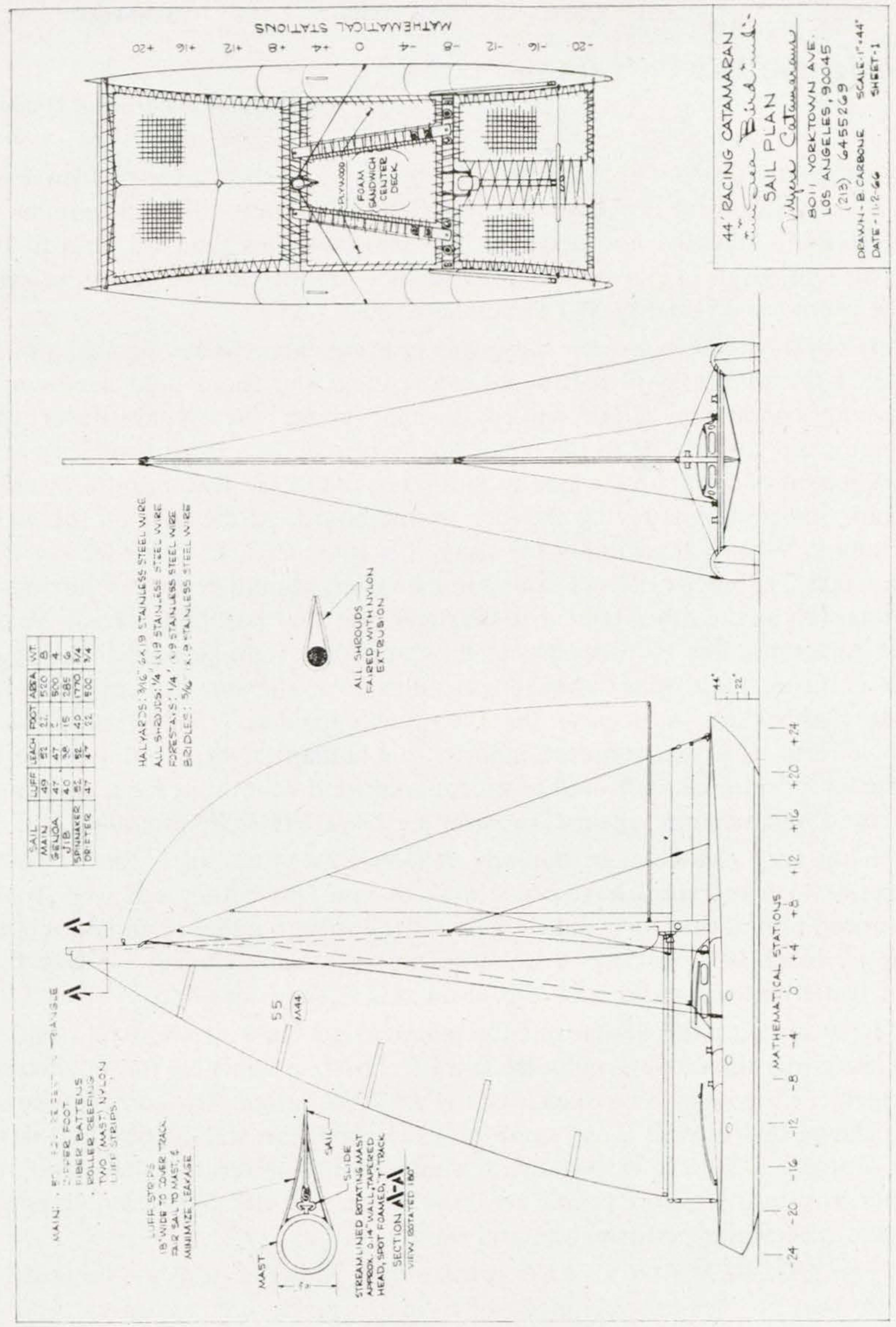
SEA BIRD hull being lifted to show light weight spill the wind by luffing. Once you start flying a hull, you have to act at once and this is quicker than trying to free the sheets.

"Cats make jolly good motor boats. In fact, I think they make better motor boats than sailing boats. I wonder how much longer it will be before this is generally recognised?"

Ed: The vertical after ends of the low aspect ratio keels catch the mooring rope and Pat feels that they would have been better sloped up instead. My feeling is that they should also have been sloped more forward—about 20° from the horizontal—and rather more pointed in longitudinal section.



ICONOCLAST—note keels



ICONOCLAST

April, 1968

L.O.A.	42 ft	Beam	20 ft
Draft	3 ft	Sail Area	640 sq ft

Designer: Pat Patterson

Foss Quay, Millbrook, Plymouth

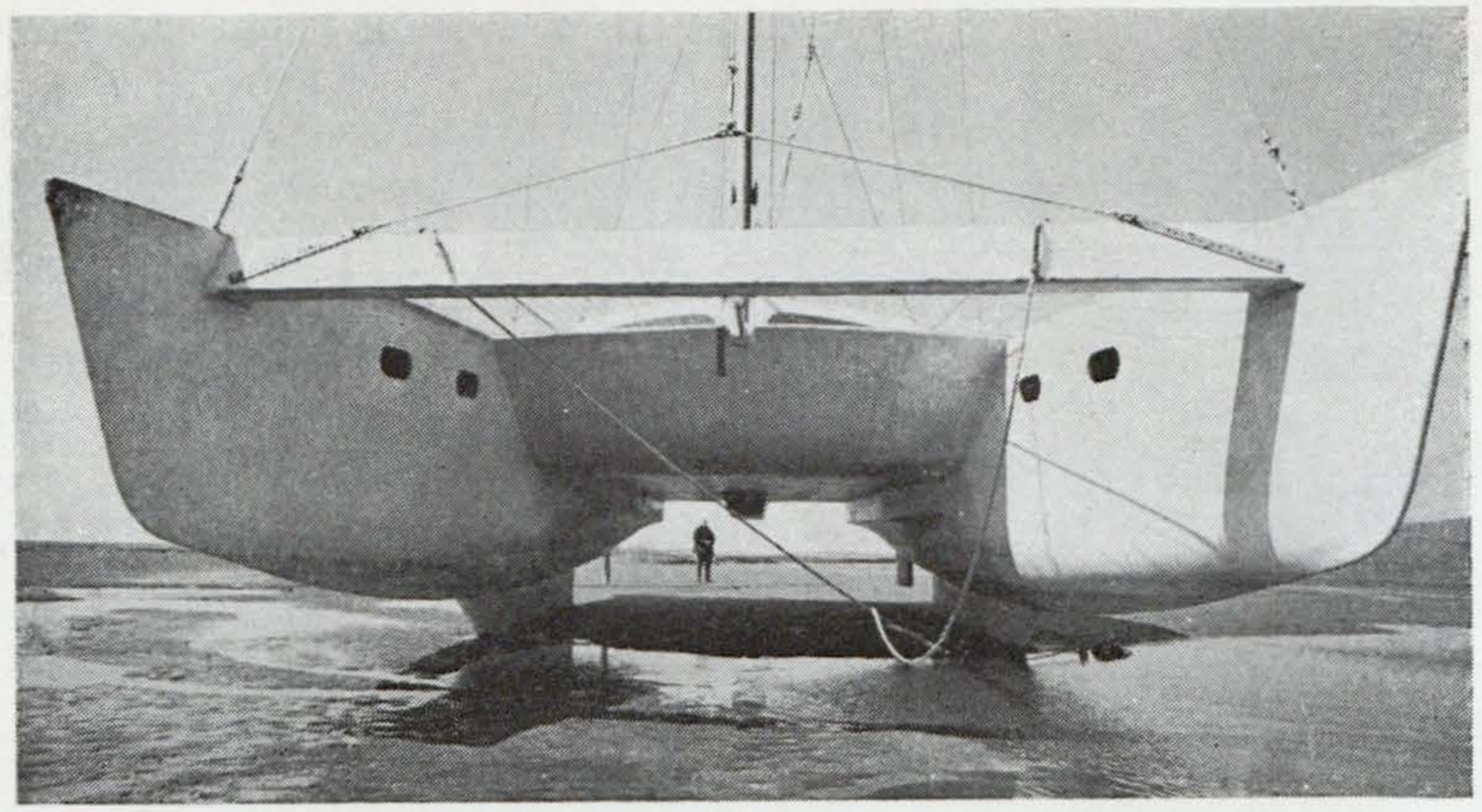
The original *ICONOCLAST* was built by Derek Kelsall of expanded PVC foam sandwich with fibreglass to the *TORCAT* design with hulls similar to his *TORIA*. Actually, nowadays all hull shapes of this type are built to the suggestions given in our publications so they are all more or less alike with little room for originality. Pat Patterson writes:

"*ICONOCLAST* is a very successful cruising boat. Sailed against a good Class I Ocean Racer—9 ft draught, 56 ft long, she could hold her own in reaching conditions. Close hauled in light going, the Ocean Racer was superior, possible owing to the better sail wardrobe. In a force 4, on a 14 mile beat in a bit of a lop, up the loch to Stranraer, the Ocean Racer got in 1¼ miles ahead. She could just lay up the loch on the board, all the time on the verge of luffing. When I tried to lay the loch with *ICONOCLAST*, her leeway was too much. Paying her off and sailing much faster, she did better but obviously not as well as the other boat. I understand that that particular Ocean Racer cost something like 10 times as much as mine but I am so used to being as fast or faster than others that it was quite an eye-opener to sail against a boat of this class. As regards the 1968 Single-handed Trans-Atlantic Race, I have formed the opinion that, ignoring the human factor, it will have to be quite an exceptional multi-hull or exceptional wind conditions for a multi-hull to stand much chance against Tabarley's *PEN DUICK III* monohull.

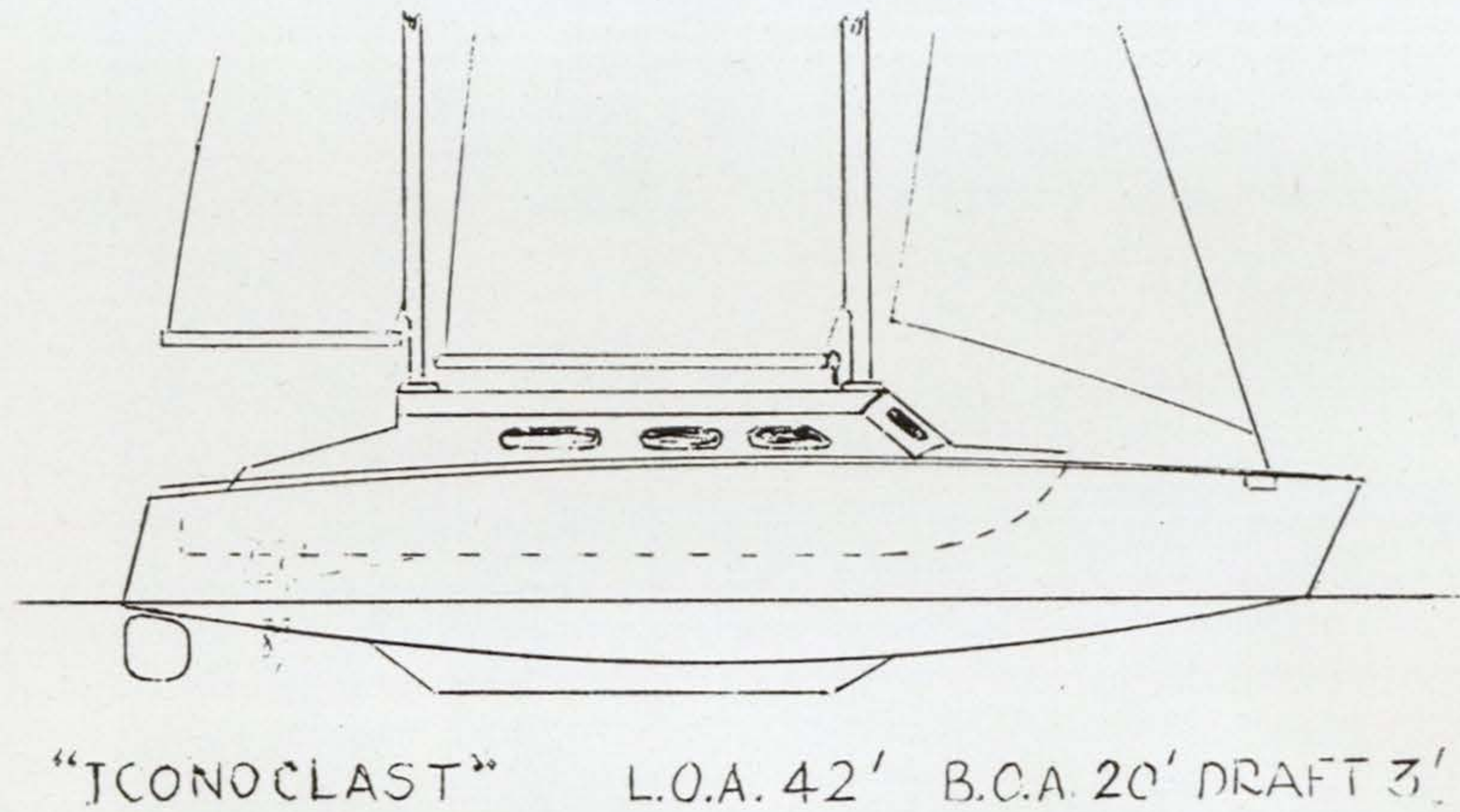
"I am very pleased with the way *ICONOCLAST* handles. She is vastly superior to trimarans I have sailed and, as you know, they sail well. I was surprised to find that she would stay in a wind force 6 under main and mizzen (the jib block had broken). A trimaran normally has so much windage that it is usually necessary to back the jib in this strength of wind.

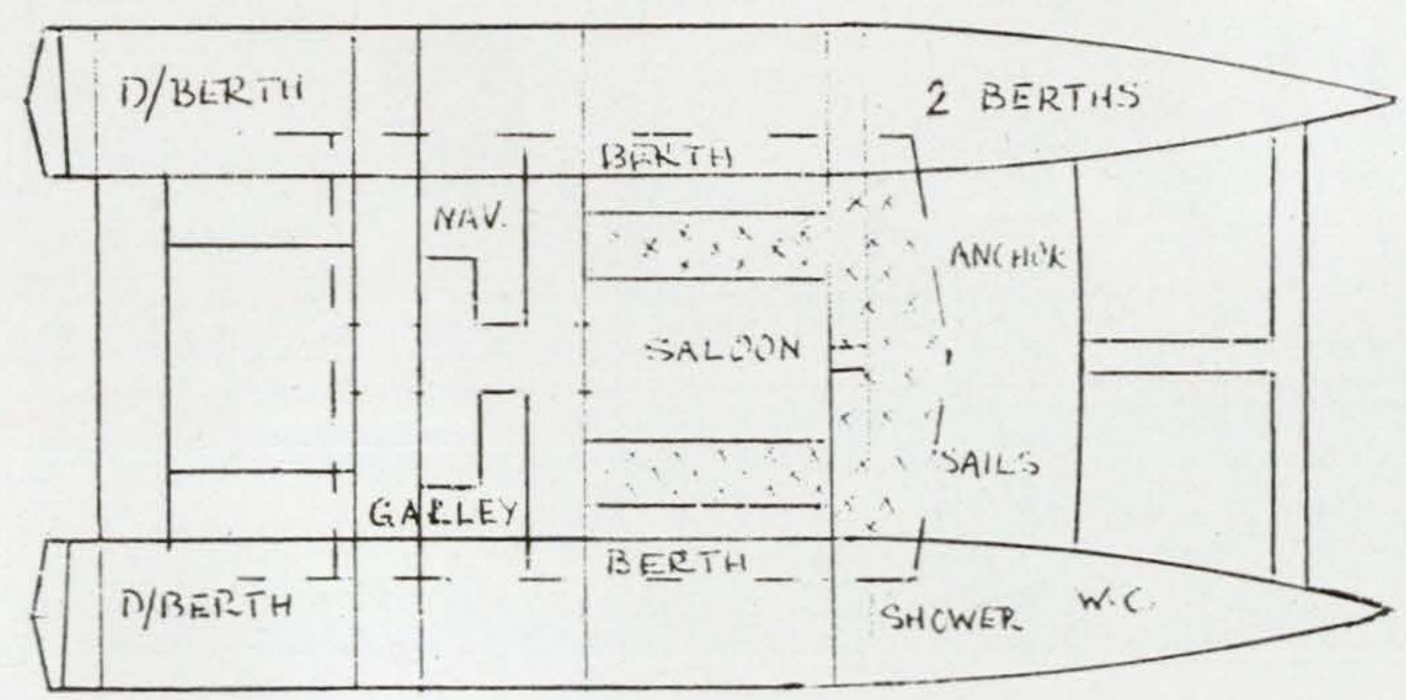
"I am drawing the design out for amateurs to build of sheet ply. This is far less costly than foam/sandwich, and I feel more practicable for an amateur to tackle. I also enclose a sketch of my *LOTUS* design. My correspondence has shown that there is a real need for a cat about this size suitable primarily for amateur builders. Personally, I would like to lower the sheer and the cabin. However, cruising people are more concerned with the accommodation than a spectacular performance, and rightly so.

"The *GOLDEN COCKEREL* capsize was rather a tragedy for cats. I notice that no mention was made of trying to gently luff her up as soon as she started to lift a hull. The only time I have been in this condition was in a *Diamond* 24 and this is what I did and she came down again very nicely. If one is over canvassed then, when on the helm, one can bear off to a run and loose the wind out of the jib if one has the wind fairly free. Otherwise,



ICONOCLAST





ICONOCLAST

April, 1968

(Plywood version)

Plans copyright: P. & E. Patterson (Trimarans & Catamarans),
Foss Quay, Millbrook, Plymouth

The prototype was launched in 1967. Plans drawn only after 1,000 miles of test sailing. The layout has been slightly improved. There is 6 ft head-room in the hulls, and 5 ft 6 in in the bridge deck area. 8 berths are shown, and there is room to sleep 3 more in the saloon. Even though she is such a large boat, the designer has sailed her several hundred miles single-handed, and several hundred with just his wife and two young children. (On passage, the children played hide and seek!)

While performance is good on all points of sailing, she is rigged as a safe cruising boat, and is not intended to be an Ocean Racer. At some sacrifice to the accommodation in one hull an inboard engine could be fitted.

It is possible to build this boat using ply planking fibreglass sheathed, at a material cost of under £2,000.

Derek Kelsall (of *TORIA* fame) helped considerably in the design and building of this prototype. Hull beam has now been increased to 4 ft 6 in. Ketch rig is employed as it is felt that this is the best cruising rig, particularly when short handed or Ocean sailing.

LOTUS

April, 1968

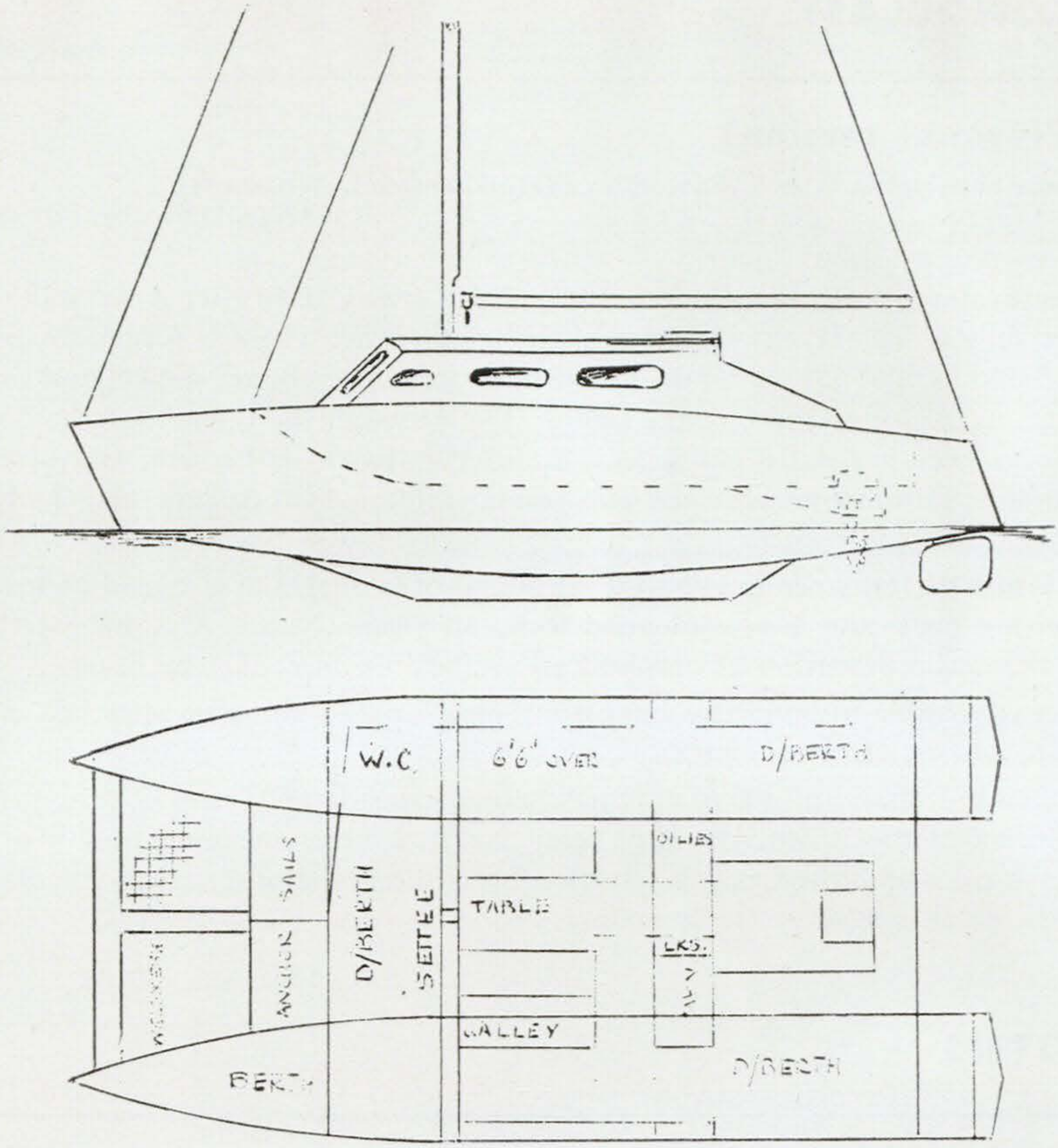
L.O.A.	31 ft 9 in	Beam	16 ft
Draft	2 ft 6 in		

Plans copyright: P. & E. Patterson (Trimarans & Catamarans),
Foss Quay, Millbrook, Plymouth

This is a cruising boat design. Emphasis has been placed upon good load carrying and a windward performance comparable with a modern 30 ft cruising sloop. As she has seven full size berths, she is designed to sit seven in the cock-pit and also around the saloon table.

The hulls can be built separately, upside down on a strong-back, righted, lined up by the keels, joined by through bulkheads and the underneath of the bridge-deck. The hulls are glass fibre sheathed with 6 oz woven roving. The space forward of the bridge-deck is covered with "Weldmesh" galvanised steel wire net, and used as a working platform. Maximum head-room in the saloon is 5 ft and 6 ft 6 in in the hulls. Beam of the hulls is 4 ft.

There is more living room on a cruising cat than any other type of boat. Thought should be given to openness and space and NOT on filling up every available nook and cranny.



LOTUS

OCEAN PRINCESS

April, 1968

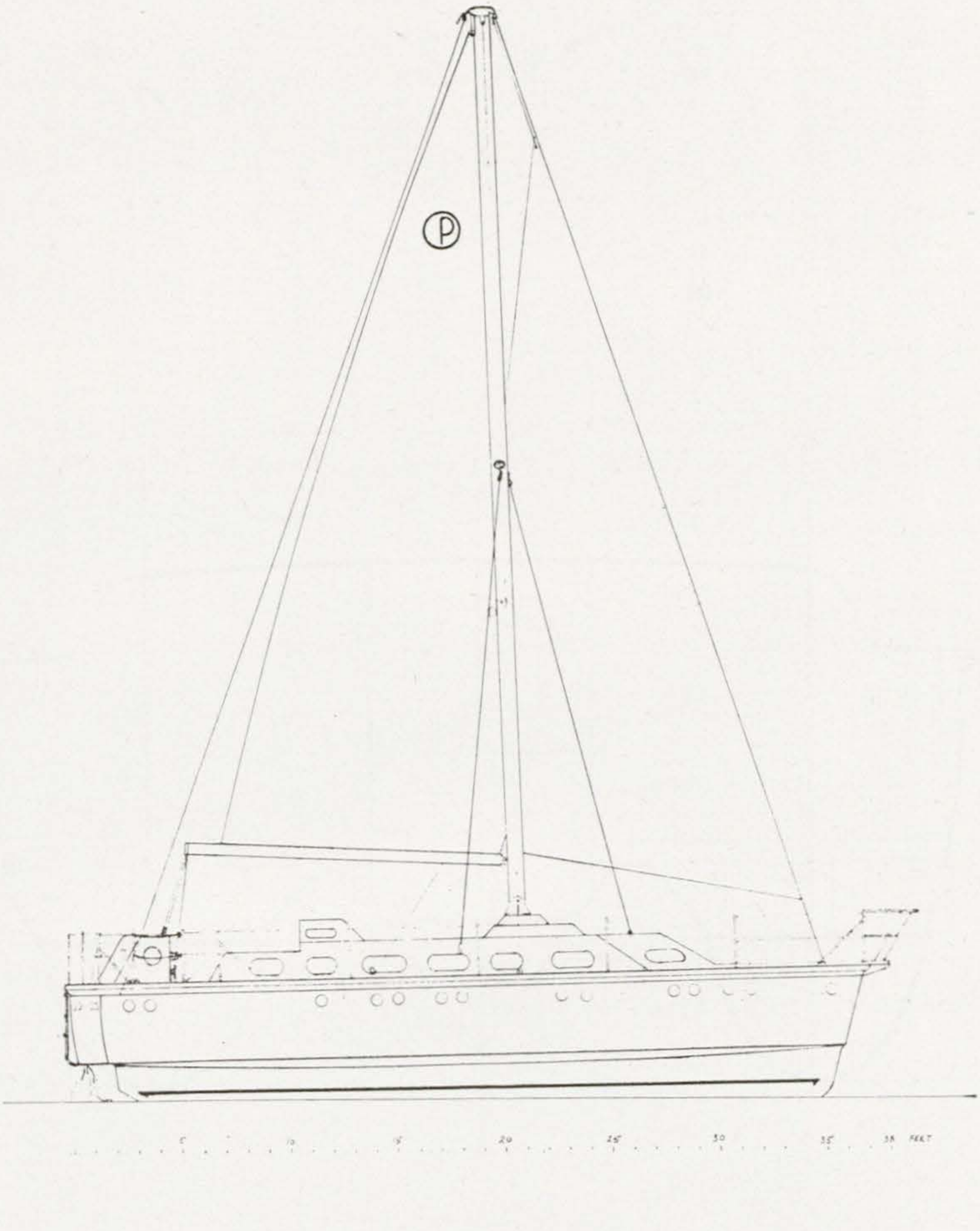
Designed by: F. M. Montgomery

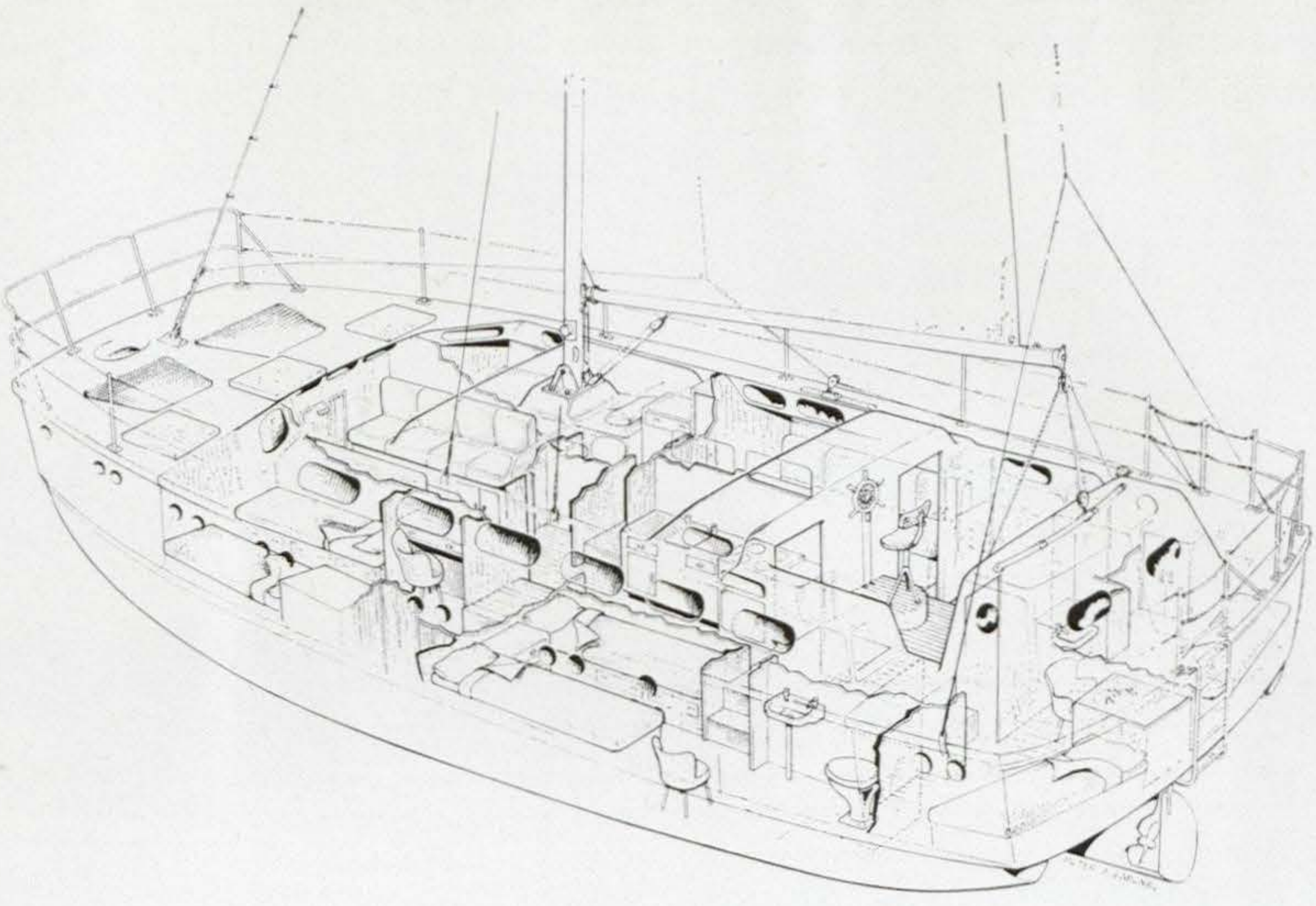
77 Melvill Road, Falmouth, Cornwall

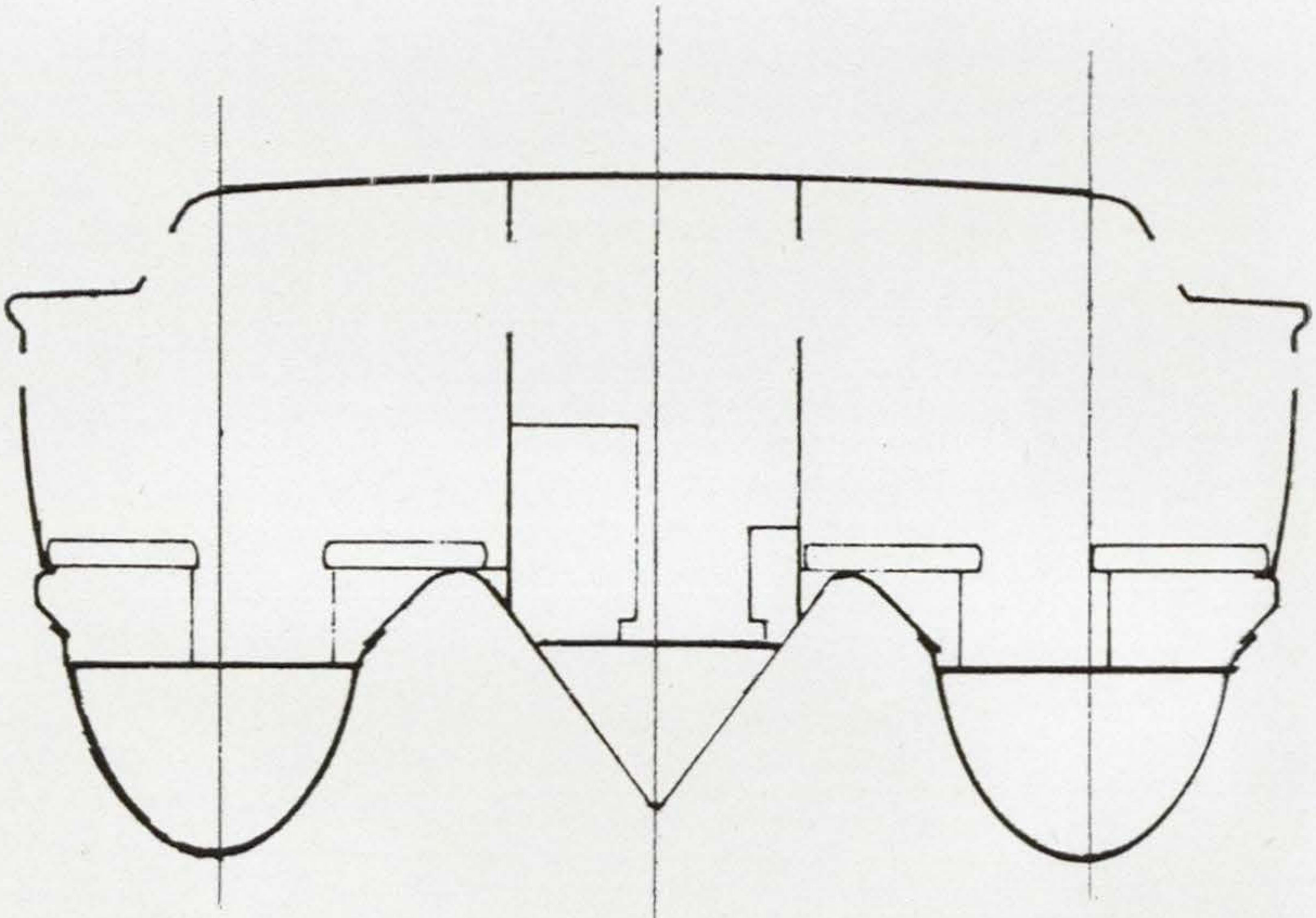
L.O.A.	36 ft	Sail Area	443 sq ft

This is a great big palace of a boat, designed on the "Tri-catamaran" principle. The two outer hulls have a round bilge section while the centre hull between them has a broad V section. The middle hull has been put in to give lateral resistance and to house the engines below the accommodation.

This boat has been designed for permanent living as well as coastal cruising. It has everything needed for comfort and convenience. Obviously, owing to the weight resulting, the performance under sail will be modest but a powerful engine is intended. Many people seem to buy large fast cruising trimarans and catamarans and then insist upon powerful engines which ruin the sailing performance. One wonders if they had not better buy a boat like this which is designed for them.







THE TRI-CAT CONCEPT FOR CRUISING CATAMARANS

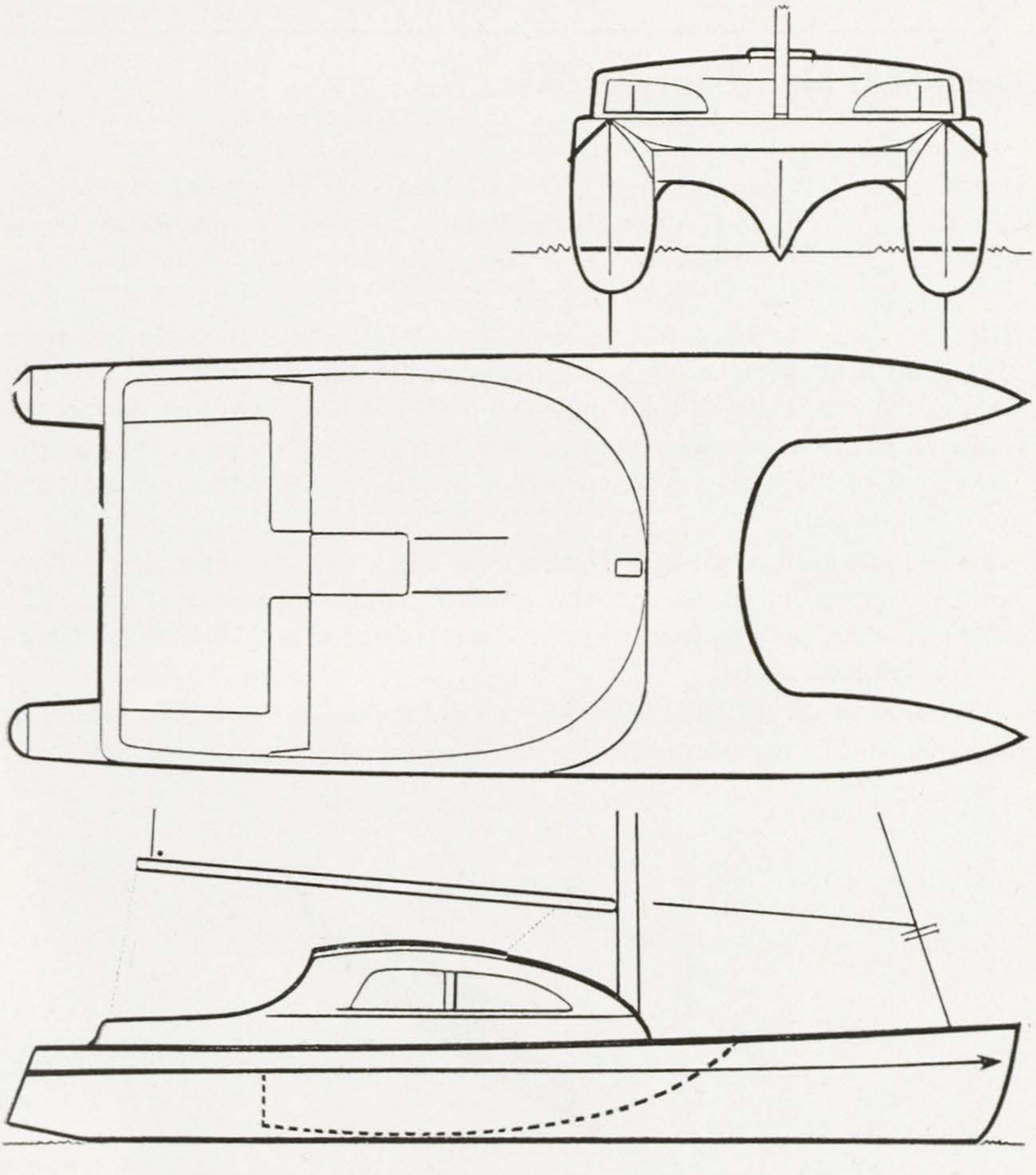
January, 1969

Designer: Ralph Flood

3883 Sunbeam Drive, Los Angeles, California, U.S.A.

L.O.A.	34 ft 5 in	Beam	14 ft 3 in
Weight	4,900 lb	Sail Area	525 sq ft

The catamaran (double hull) configuration has certainly proven to be the most efficient sailboat shape yet devised. In the daysailer type boat this fact has become so obvious in recent years that the cat is slowly but surely gaining major prominence.



However, the catamaran as a cruising sailer has limitations in lengths under 30 ft which may present it from seriously competing with a good single hull or trimaran as far as popularity is concerned. In lengths over 30 ft the catamaran could achieve considerably more acceptance if such things as the central cabin headroom, engine accommodation, and pounding of the central underbody problems could be solved.

The Tri-Cat hull configuration was conceived to eliminate these problems without adversely affecting the superior performance of the modern catamaran. Several years of study and model testing indicate that the Tri-Cat shape can do the job. There is now good reason to believe that the most popular cruising cats of the future will incorporate the Tri-Cat principle.

DACAPO 24: A family cruiser from Sweden

January, 1969

Designer: Heinz-Jurgen Sass

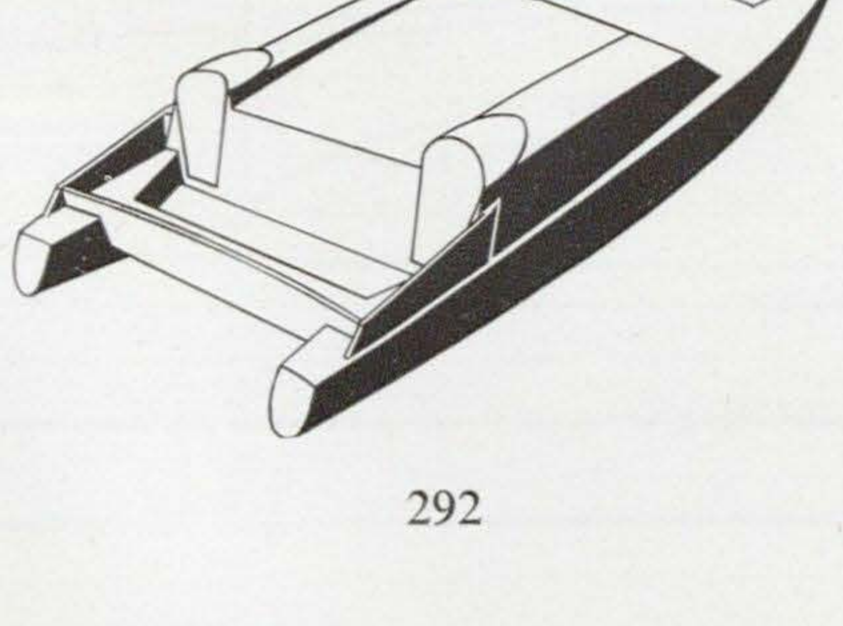
Eriksövägen 23, Vaxholm, Sweden

L.O.A.	28 ft 5 in	Sail Area	387 sq ft
L.W.L.	24 ft 8 in	Weight	2,910 lbs
Beam	14 ft 2 in	Displacement	4,260 lbs

DACAPO 24 is the latest in a series of four boats which range in size from 23 to 35 ft. It has been designed to provide enough room for a family of 4 to 6. To give the boat pleasing lines the coach-roof has been kept low. In fact the roof is so low that the helmsman can see over it when sitting in the cockpit. The centre of the roof is planked with $\frac{1}{2}$ in teak to give added strength and more "eye-appeal".

To get full head room in the galley and chart room a "plexiglass" dome is fitted over each, or alternatively, sliding hatches can be provided. The chart room has space for extra storage and it is fitted with a table large enough to take unfolded charts.

The boat is divided in the middle by a longitudinal bulkhead which at the same time is the centreboard case. Forward in the starboard hull is an



extra bunk, and aft of this there is a settee with a folding table to make a dining quarter. Situated by the hatch is the large galley with plenty of storage space. Two cabins are situated on the forward part of the wing and each includes a double bunk. Aft of the main cabin is the toilet, complete with lavatory, wash basin and hanging locker/s.

The cockpit extends across the full width of the boat. Use is made of the rear constructional beam by incorporating seats with built-in lockers.

The centre locker contains safety equipment and opens outboard so that it is easy to reach in the event of a capsize.

The centreboard is placed in the longitudinal bulkhead to get simple and effective construction. Advantages of this centreboard are: an effective plan with high aspect ratio, no long openings in the hulls, low weight and easy handling.

The lines of the hulls were drawn to get a low wetted area with a nearly semi-circular section. When fully loaded the transom is slightly beneath the water line. At low speeds this may not be so good but at high speeds and in open waters it is advantageous. The spray deflectors (knuckle type) and the wide transoms should prevent pounding. Plastic foam buoyancy is placed in the extreme ends of both hulls. A low sail plan is used to produce a safe boat for family sailing. The alloy mast is rotating. A genoa can be sheeted to a track on the outside of the coach roof.

Hulls are GRP and all other parts are of wood to keep down weight and costs. The GRP hulls will be available to amateurs for home completion.

PEROUN—a cruiser from the Ukraine

January, 1969

by J. Perestyuk

Vishchdubechanska 41, Flat 207, Kiev-140, U.S.S.R.

PEROUN was launched on the 11th June 1967 and it has already had a test-run on the route Kiev-Odessa-Kiev. It was brought ashore for the winter and at the moment is preparing for a longer voyage, this time to Batumi (this is a Black Sea port in Georgia, not far from the Turkish border).

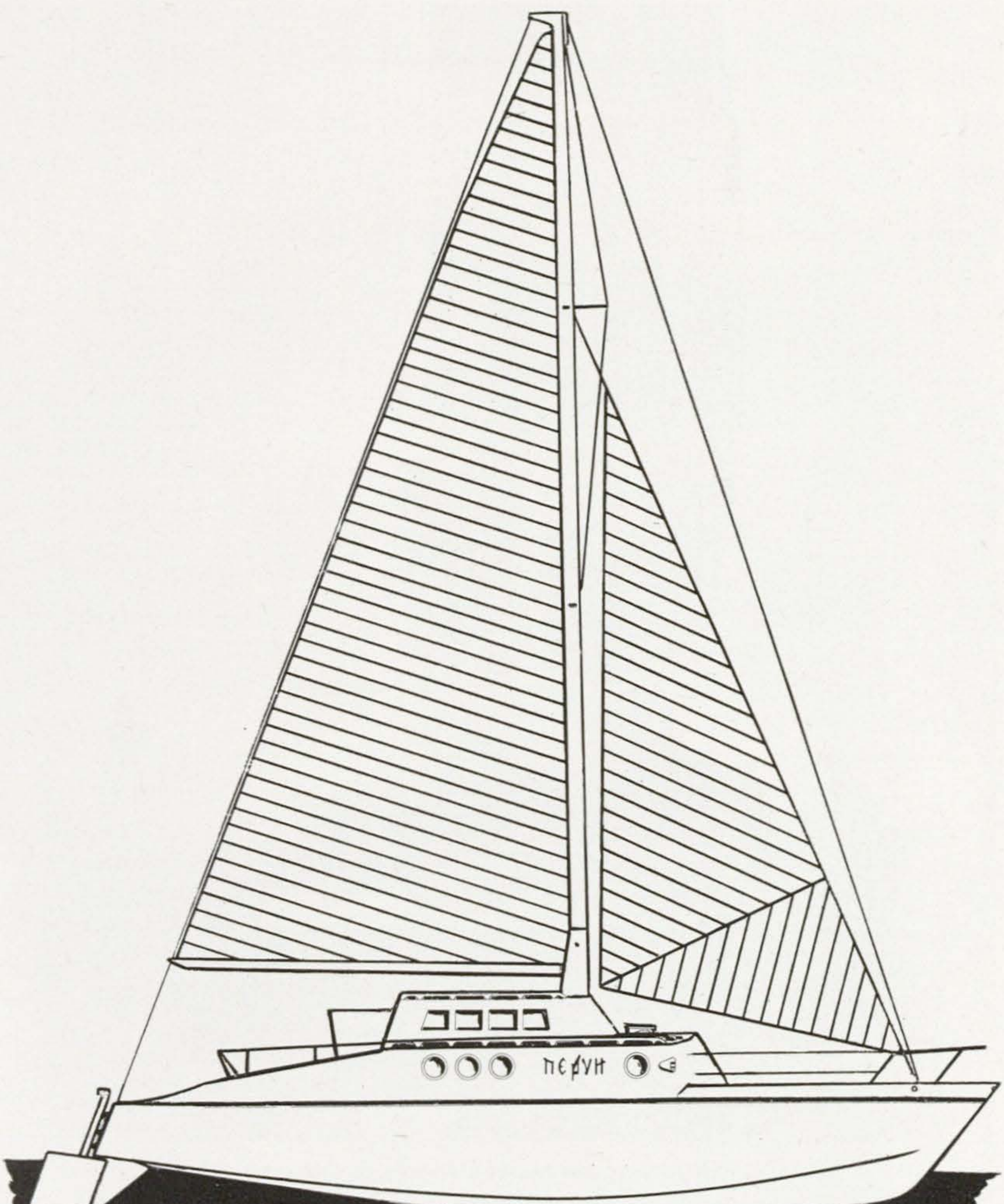
PEROUN was designed using as prototypes the best foreign two-hulled sailing boats. However we often had to find new solutions because we did not have drawings or detailed data about these boats, and also because of the technological limitations such as difficulty with the welding of thin sheets of light alloy. In deciding the lines of the hulls, for example, we had to go for a less than optimum shape, a hard chine with a 105° angle V for the 'midship underwater section. This shape made it possible to avoid the stamping out of shaped frames and, most important of all to dispense with the problem of bending the plates into compound curves. However it was very difficult to avoid welding deformation on the flat smooth surfaces of the shell. We had to recourse to heating to correct the errors, but of course this did not give the best result.

The catamaran is wholly made out of the AMg-5B alloy. The framework was made up of elements of standard shapes, or else elements were stamped out with a press.

The basic measurements were chosen according to statistical data: 13·2 metres maximum length; 5·8 metres wide. The hulls at the middle point measure 0·7 metres across at the waterline and 1·0 metre at deck level, and the distance from the bottom of the "bridge" to the water level is 0·6 metres.

There are 11 berths on the catamaran, most of which are situated in the deck house on the bridge. In the front part of the hulls you have the captain's cabin and that of his second in command, and in the back parts a toilet and the galley. We carried a full crew when we sailed, and we can categorically state that there was no reason to complain of being cramped. Of course the warm weather meant that we could stay on deck the greater part of the time, but when we sat down to eat in the deck-house, there was room for everyone at the table.

The catamaran performed well on the water. The first joy it gave us was when after launching, it floated exactly on the waterline which we had calculated. We did not test it in stormy weather if only because during the voyage the wind did not reach Force 5 more than once or twice. But apart



from that we had our sails to worry about, for they would not have stood up to the first fresh gust. The catamaran rises on to the waves well but the waves knock under the bridge section.

Manoeuvrability of the craft was satisfactory. Coming about can be carried out relatively easily even in a weak wind, although then you have to hold the foresail aback. The speed and gliding qualities of the catamaran were undoubtedly affected by the low quality of the sails, both the material and the sewing. But all the same at Force 3 or 4 we easily outdistanced a *Flying Dutchman*.

In this year's sailing we intend to test the craft in more various conditions, and, most important of all, with good sails.

PEROUN on her maiden voyage to Odessa

QUICKSTEP II

January, 1969

Designers: MacLear & Harris, Inc.

11 East 44th Street, New York, NY, USA

L.O.A.	72 ft 4 in	Fuel	1,200 gallons
L.W.L.	60 ft 0 in	Water	1,200 gallons
Beam, extreme	30 ft 0 in	Cruising speed	12 knots
Beam, hull	7 ft 0 in	Generator	Onan 14KW
Draft, boards up	5 ft 6 in	(2) 32 v alternators	
Draft, boards down	11 ft 6 in	Air Conditioning	3 tons Grunert
Sail Area	2,800 sq ft		
Engines	(2) GM Diesels	Heating	Reverse cycle
	130 hp each	Radar	Decca RM 314

Steering stations, port and starboard

QUICKSTEP II is a 72 ft × 30 ft of beam twin screw sailing catamaran and is among the biggest and most luxurious in the world. This cat draws five and a half feet compared to seven to ten feet in a keel boat of the same length.

QUICKSTEP II was built in Taiwain (Formosa). She will be deck cargoed to a Florida or Gulf port and towed to a Florida yard where she will have her engines installed and her rig stepped.

This large catamaran is basically a three level craft. The deck is single level (except for the cockpit well). Three steps lead down to the deckhouse level and from the deckhouse one can go down to the lowest level which is in each hull.

There are two engine rooms, one in each hull. In addition to the two propulsion diesels there is a third diesel engine for generating electricity. A work bench and fairly complete set of tools will be handy when in isolated crusing areas.

QUICKSTEP II is an enlarged version of two existing 52 ft catamarans that have been in commission for three years. They are heavy enough to have tremendous stability and their chance of capsizing is less than the chance of overturning a train.

Accommodation

While the craft has thirteen bunks she would normally have about ten persons sleeping aboard on a two week cruise. Six in the owner's party and four in crew might be average although eight and five are possible. There are four complete toilets, each with shower. Hanging lockers and drawers are very generous. Bunks are long and wide.

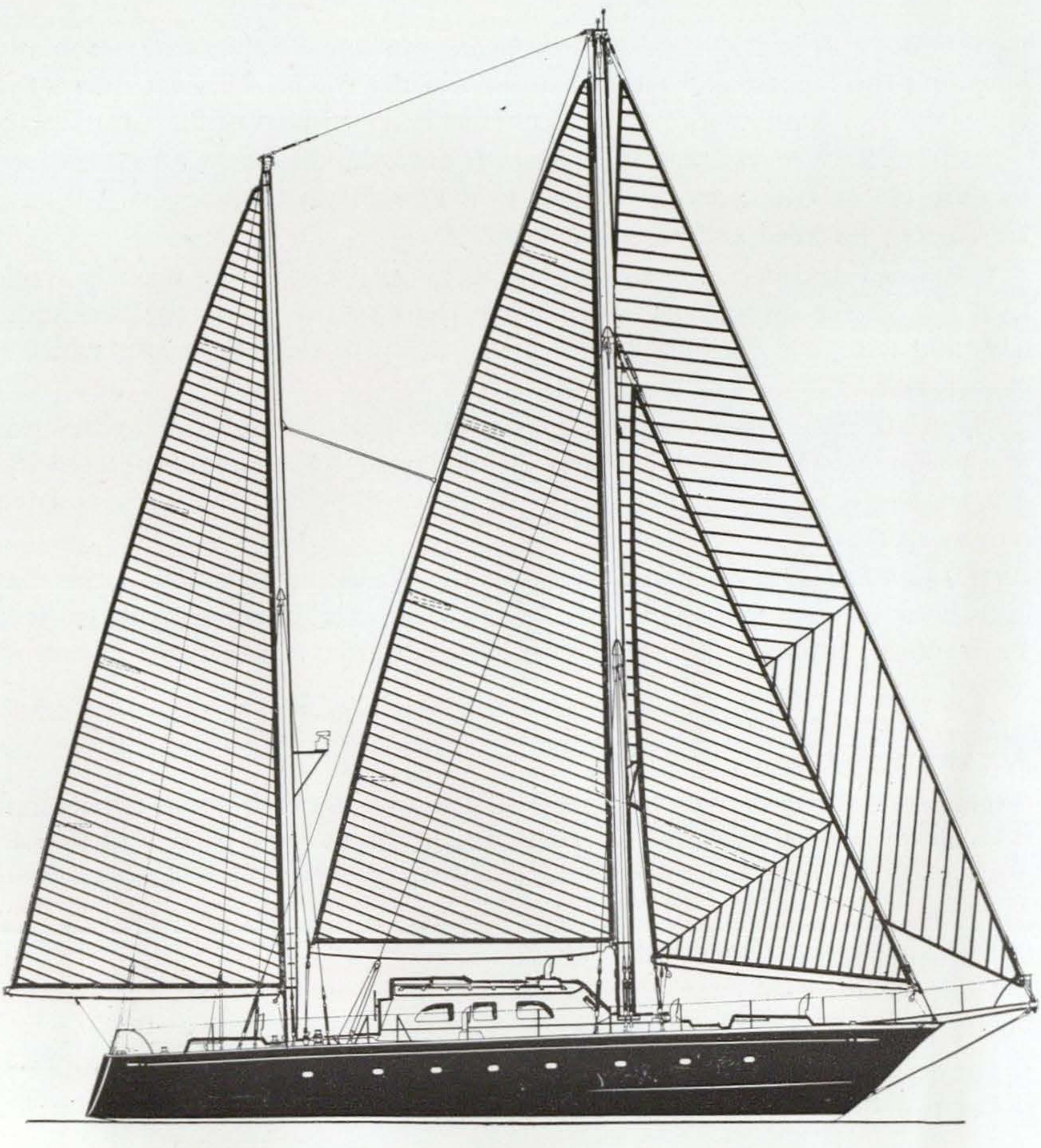
The crew and galley are in the port hull and the owner's party occupies the starboard hull and the deckhouse.

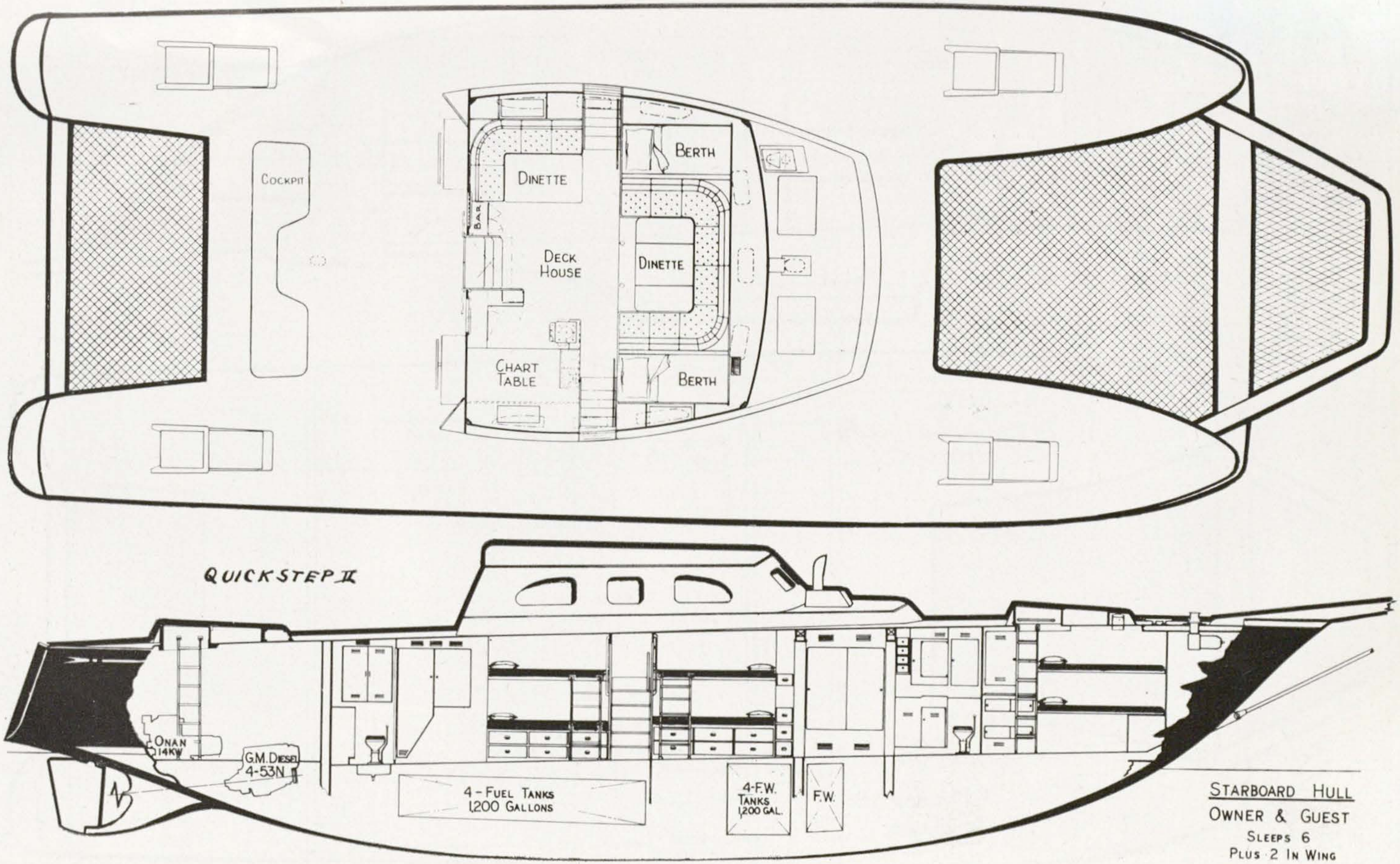
The deckhouse has windows or ports on all four sides and is light and airy. It has two dinettes, a large chart table, a bar, and two comfortable bunks.

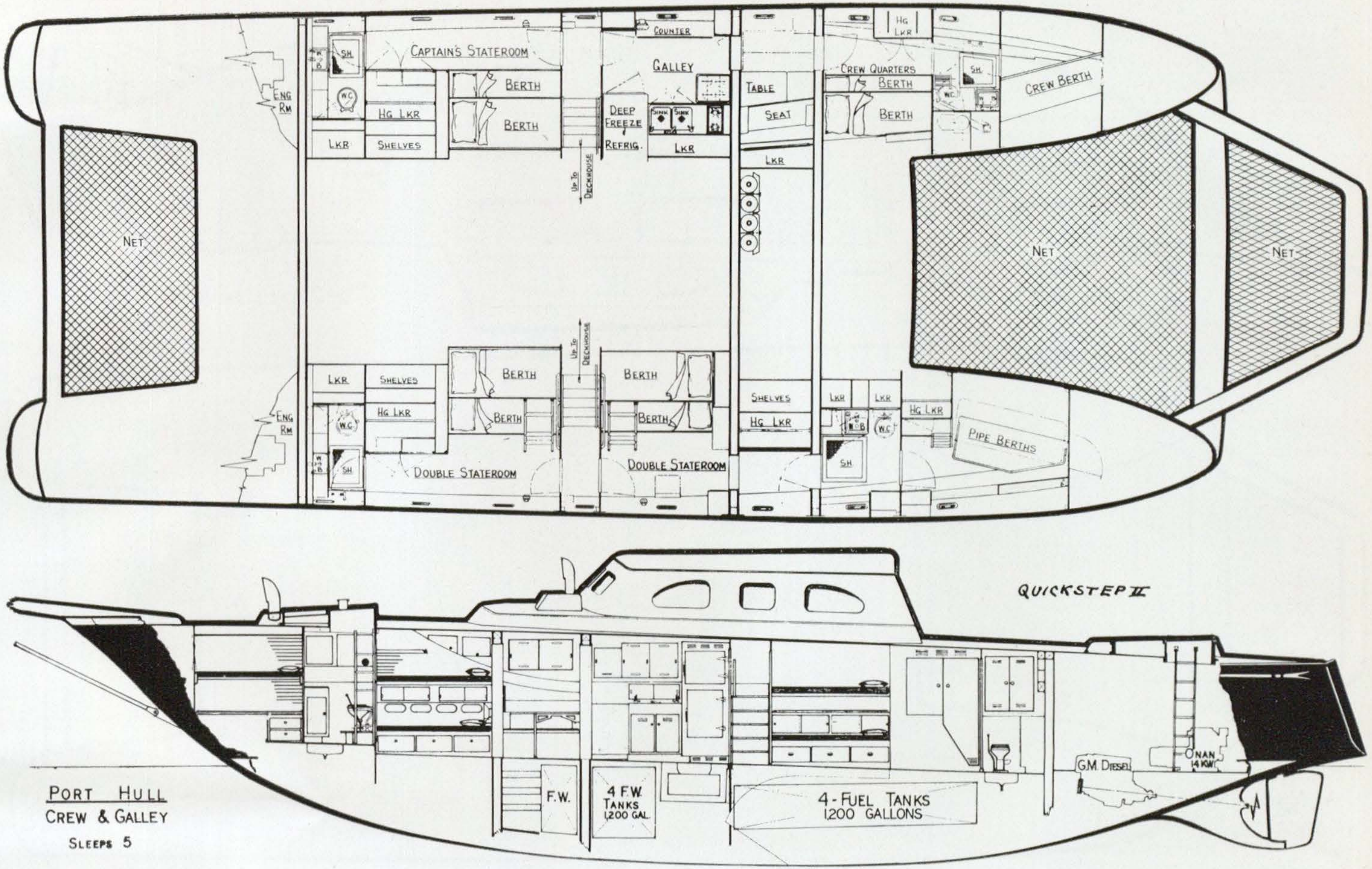
The two berths and the large dinette can be closed off by a curtain across the deckhouse to form a private stateroom at night. There is a ladder on each side of the deckhouse leading down into each hull.

Speed

QUICKSTEP II will be exceptional because of her long cruising range and fast passage making ability. Her average cruising speed under sail or power is expected to be between 10 and 12 knots whereas a single hulled auxiliary of the same length when bound on long passages would be lucky to average 8 or 9 knots. Whether the catamaran can average 10 per cent or 20 per cent faster depends on the loading of the craft in question, as well as the point of sailing. For example in a following sea *QUICKSTEP II* can surf for a minute or two at a time at 12 to 22 knots. A single hulled 72 footer might hit 11 to 14 knots for 15 seconds. Under such conditions a heavy cruising catamaran can average 20 to 30 per cent faster. On the other hand in light




COCKPIT
DINETTE
BERTH
BAR
DECK HOUSE
DINETTE
CHART TABLE
BERTH
QUICKSTEP II
ONAN 14KW
G.M. DIESEL 4-53N
4 - FUEL TANKS 1,200 GALLONS
4-F.W. TANKS 1,200 GAL.
F.W.
STARBOARD HULL
OWNER & GUEST
SLEEPS 6
PLUS 2 IN WING



PORT HULL
CREW & GALLEY
SLEEPS 5

weather going to windward a single hulled ocean racing boat with big genoas might be faster at speeds below 6 knots. At such times this type of generously powered cruising catamaran can turn on both engines and maintain a speed of over 11 knots. Thus *QUICKSTEP II* is a fast passage maker that can average faster than an ocean racer and go further than a power boat of comparable price and size.

QUICKSTEP II will be available for charter in the Caribbean for many of the winter months, so quite a few pople will be able to test her.

CHAPTER XXIV

MULTIHULL TRANS-PACIFIC RACE 1968

by J. Stanley

Eight official entries crossed the starting line on the 4th July, the fleet consisting of seven catamarans and one trimaran, all built as ocean racers. The boats, with their respective overall lengths, are listed below in order of corrected placing:

1 *POLYNESIAN CONCEPT* 35 ft
2 *SEASMOKE* 58 ft
3 *LANI KAI* 46 ft
4 *MANU IWA* 49 ft
5 *GLASS SLIPPER II* 49 ft
6 *IMI LOA* 43 ft
7 *AURIGA* 37 ft trimaran
— *ILLUSION* 43 ft (retired)

One additional catamaran, *SEA BIRD* (see page 282), sailed the course unofficially. She had been considered unproven by the race committee and was refused official entry.

The start of the race in Los Angeles Harbour is organised by the Seal Beach Yacht Club, and the finish in Hawaii is taken care of by Waikiki Yacht Club. Most of the competitors average a sailing distance of 2,400 nautical miles from start to finish.

Winds averaging 8 knots lasted for three days and so removed any chance of breaking the Trans-Pac Record. The Tradewinds never blew stronger than 20 knots, and then only occasionally, except for a few squalls with 24-knot blasts which were all too brief. Sea conditions were always smooth.

The only true catastrophe of the race occurred shortly after the start when *ILLUSION* was dismasted approaching Catalina Island's West End. Her brand-new wooden mast was either defective or was poorly tuned. About this time the mainsail of *IMI LOA* parted at two low seams; the sail was quickly reefed as a temporary measure. During the night the sail was lowered and repaired by hand-stitching and contact cement. The following night, both *IMI LOA* and *GLASS SLIPPER II* had their big spinnakers blow out in gusts of a minor squall. Later on, *SEASMOKE* blew out her large spinnaker, but with an electric sewing machine aboard it was repaired in a few hours. Finally, towards the end of the race, *MANU IWA* also blew her big chute.

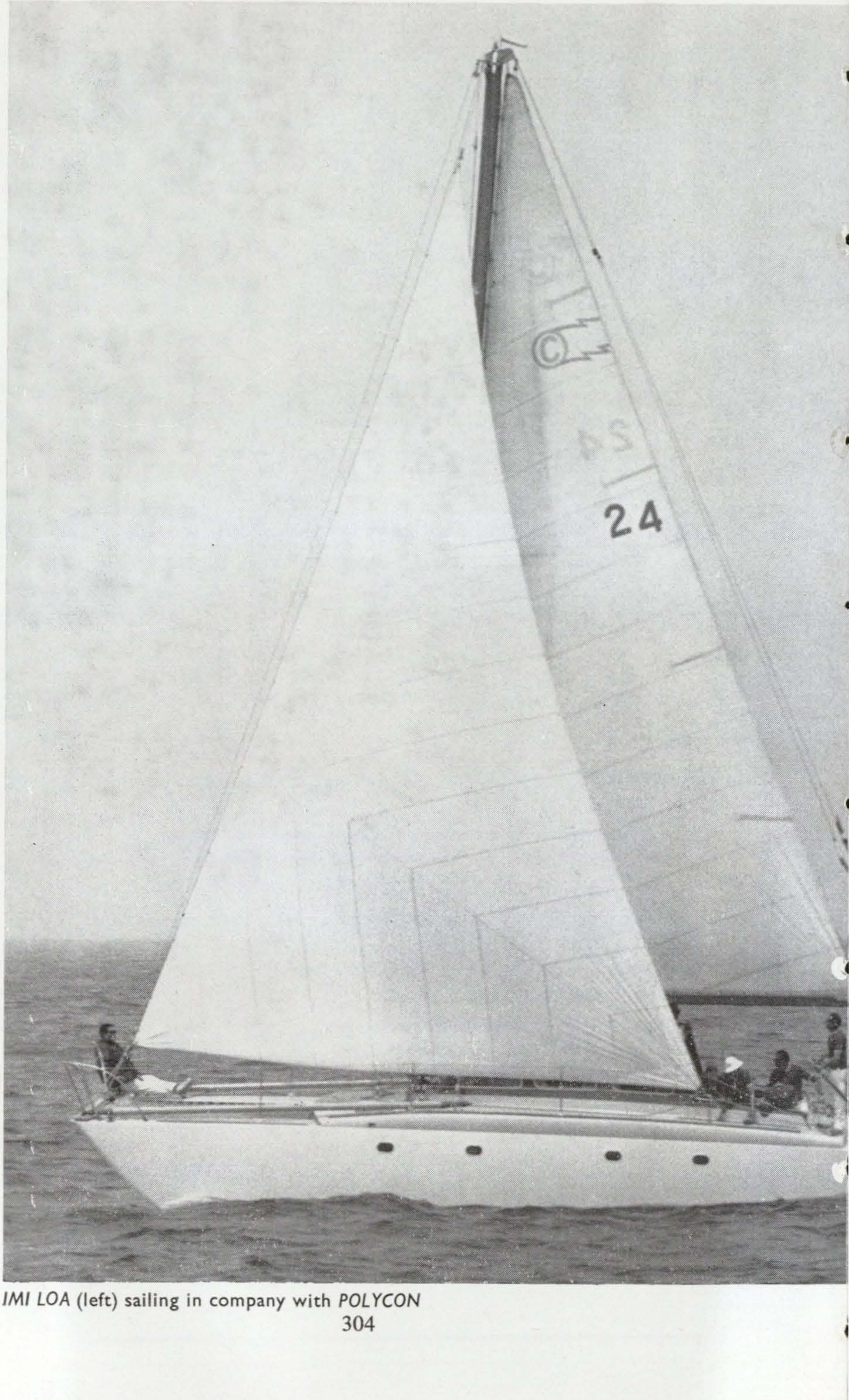
First to finish, and second on corrected time, was the largest boat in the race, the 58 ft *SEASMOKE*, while second to finish and first on corrected time was the smallest boat, 35 ft *POLYNESIAN CONCEPT*. Third, on both elapsed and corrected time, was the oldest boat, *LANI KAI*. This unique group are all designs from the well known C/S/K partnership.

SEASMOKE and POLYNESIAN CONCEPT

SEASMOKE completed the race in 10 days 9 hours 0 minutes 23 seconds. This reduces by 52 minutes 52 seconds the Multihull Trans-Pacific Race

Record of 10 days 9 hours 53 minutes 15 seconds set by *IMI LOA* in 1964. With the light winds of the 1968 race *SEASMOKE* had little chance to beat the official course record of 9 days 13 hours 51 minutes 2 seconds, made by the monohull ketch *TICONDEROGA* in 1965. However *SEASMOKE* has the potential to make an estimated 8 days 10 hours crossing as the following figures help to show. During one rare Tradewind squall, the needle on the speed indicator was pegged against the stop at 30 knots for one minute. For the final hour, to the finishing line, she averaged a steady 20-to-25 knots, with *IMI LOA* 500 miles (2 days) behind. When travelling at a speed of 20 knots, there is no spray on deck!

SEASMOKE



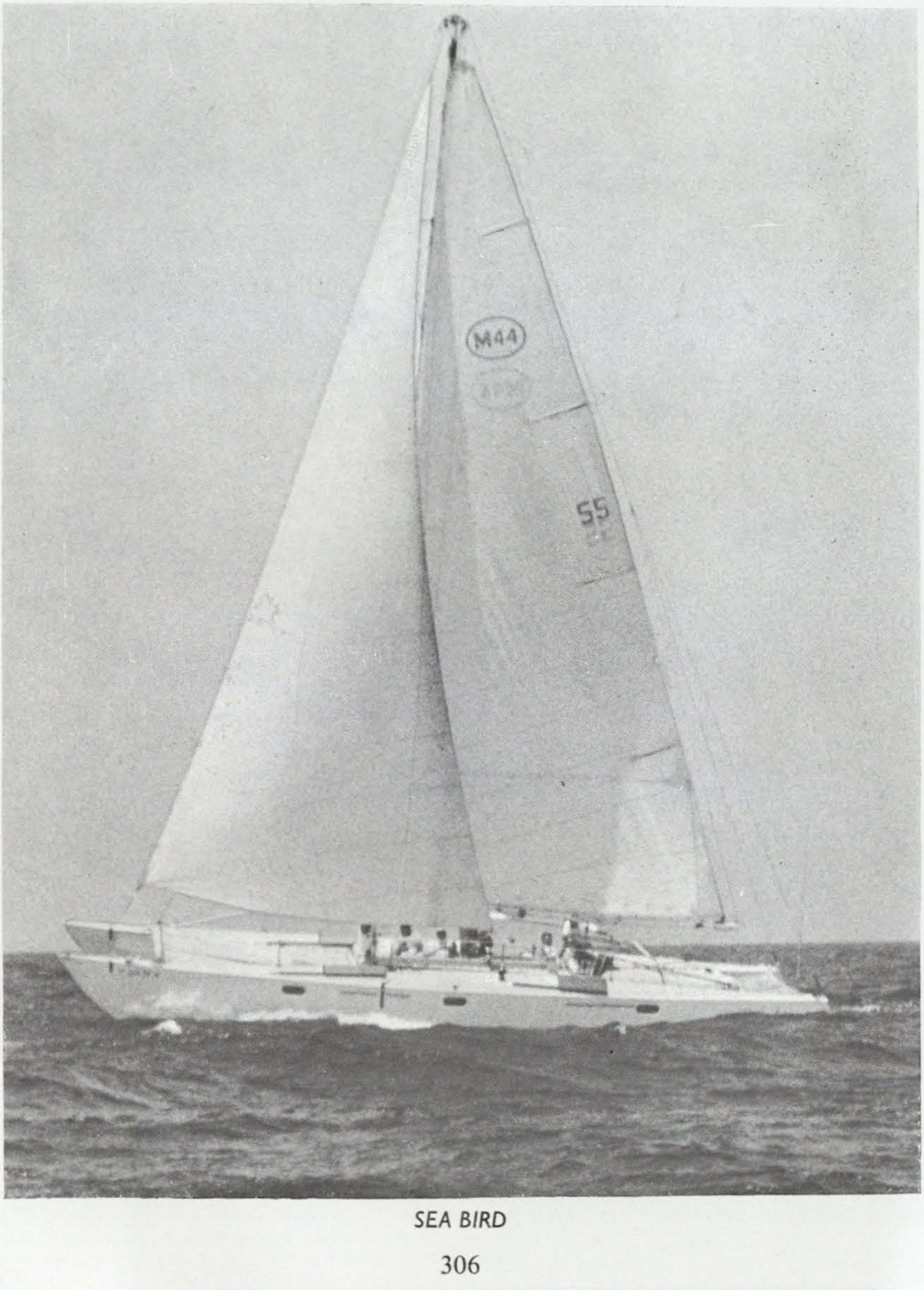
IMI LOA (left) sailing in company with *POLYCON*

Photo: Beckner Photo Services

POLYNESIAN CONCEPT, known as *POLYCON*, finished 29 hours behind *SEASMOKE*. The usual C/S/K boats have asymmetrical hulls but *POLYCON's* are symmetrical.

SEA BIRD

Designed by Hugo Myers, the 44 ft *SEA BIRD* is a high-performance experimental catamaran. She crossed the starting line soon after the official fleet had cleared the area and maintained a second-place position behind *SEA-*



SEA BIRD

SMOKE. Unofficially *SEA BIRD* finished second, 21 hours behind the new pace-maker *SEASMOKE.*

The first two nights were sailed with a reefed main and jib, because three of the crew of six, were not experienced catamaran helmsmen. Duties were rotated with two men on and four off.

SEA BIRD has no between-hull cabin, the bunks, toilet and galley are all located in the hulls. Her design incorporates a rotating mast and double-luff mainsail to gain maximum windward performance.

During the race she logged two daily runs of 250 miles—good going for a new boat that was being "de-bugged" as it raced along.

When about 800 miles from the finishing line the rudder posts began to work and one rudder was lost. The boat had to be eased up and the race was completed on spinnaker alone and the remaining rudder.

Commenting on the race Hugo Myers said, "I've been in boating for many years, and owned and designed boats for about 12-14 years, and I can easily say that this was the greatest adventure of my sailing career. In the long Trans-Pac race its mental, physical, and emotional effort over a sustained period makes it such a great challenge. It's been many years since I had so many peaks of excitement and depths of depression in the months leading up to and during the race. I'd highly recommend it to anyone to experience the joys and disappointments people used to have when they lived a more physical sort of life."

SEASMOKE

April, 1970

by Rudy Choy

C/SK Catamarans, Newport Beach, California, USA

L.O.A.	58 ft 0 in	Beam	23 ft 0 in
D.W.L.	49 ft 0 in	Draft	2 ft 6 in

This 58 ft ocean-racing catamaran was designed and built for Jim Arness, T.V. Star of "Gunsmoke". She is, to ocean-going catamarans, what 73 ft CCA yachts like *STORMVOGEL ONDINE* and *WINDWARD PASSAGE* are meant to be for monohulls.

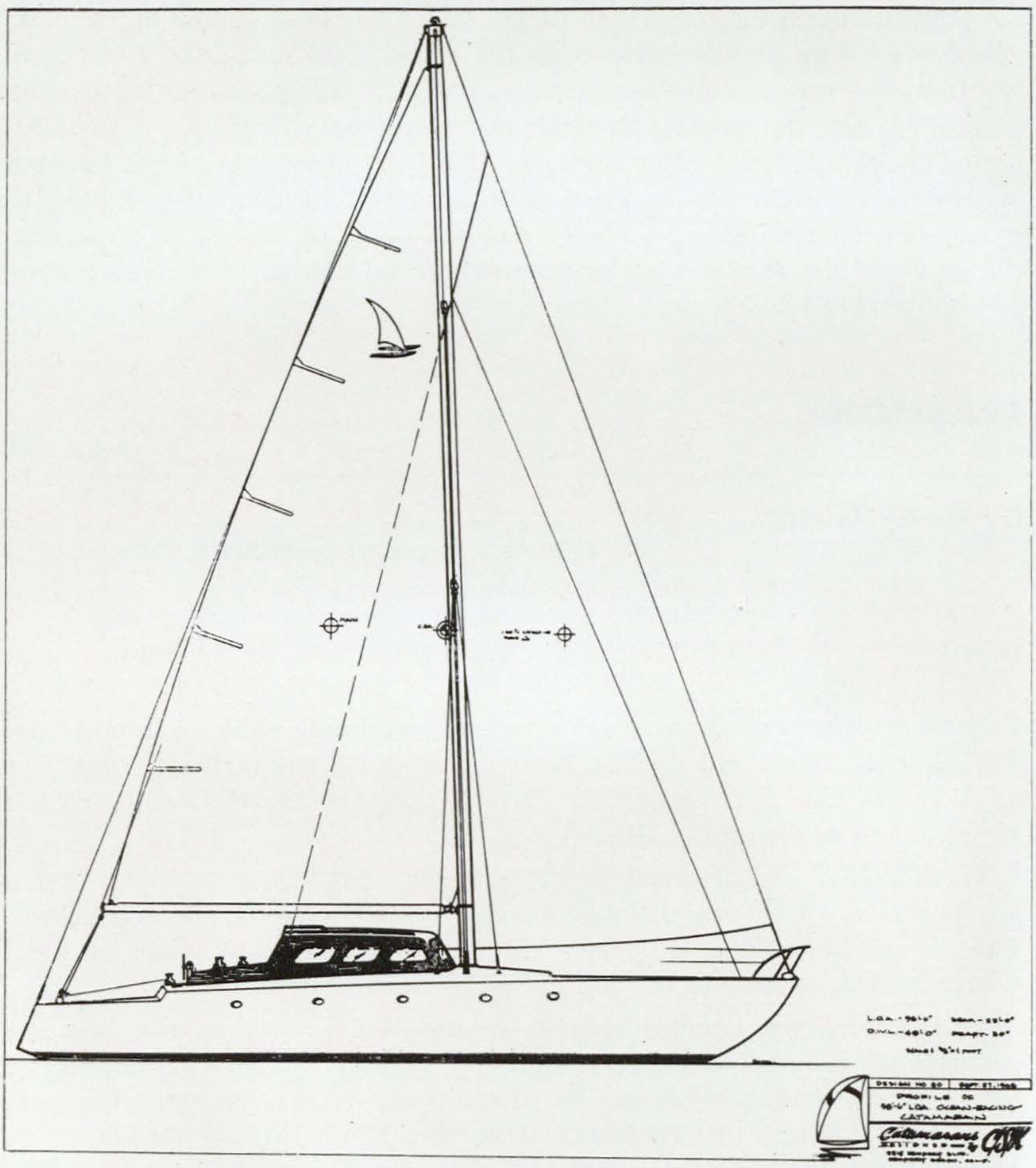
SEASMOKE was designed with the express purpose of finishing first in any ocean race over any distance against any competition afloat anywhere. This design objective also means the implicit potential to make or break course records when and if wind conditions are favourable.

SEASMOKE was launched late in August, 1967. In one year, she has participated in ten ocean races, finishing first in every race. Among the major races she has swept across first are the NOSA Newport-Ensenada International Race, the Tri-Island Race, the San Clemente Race and the Multihull Trans-Pacific Race. She has also saved her time in three of these events to take first, corrected.

Though weather conditions have not been favourable so far, all evidence shows that *SEASMOKE* has the complete ability to fulfil her potential.

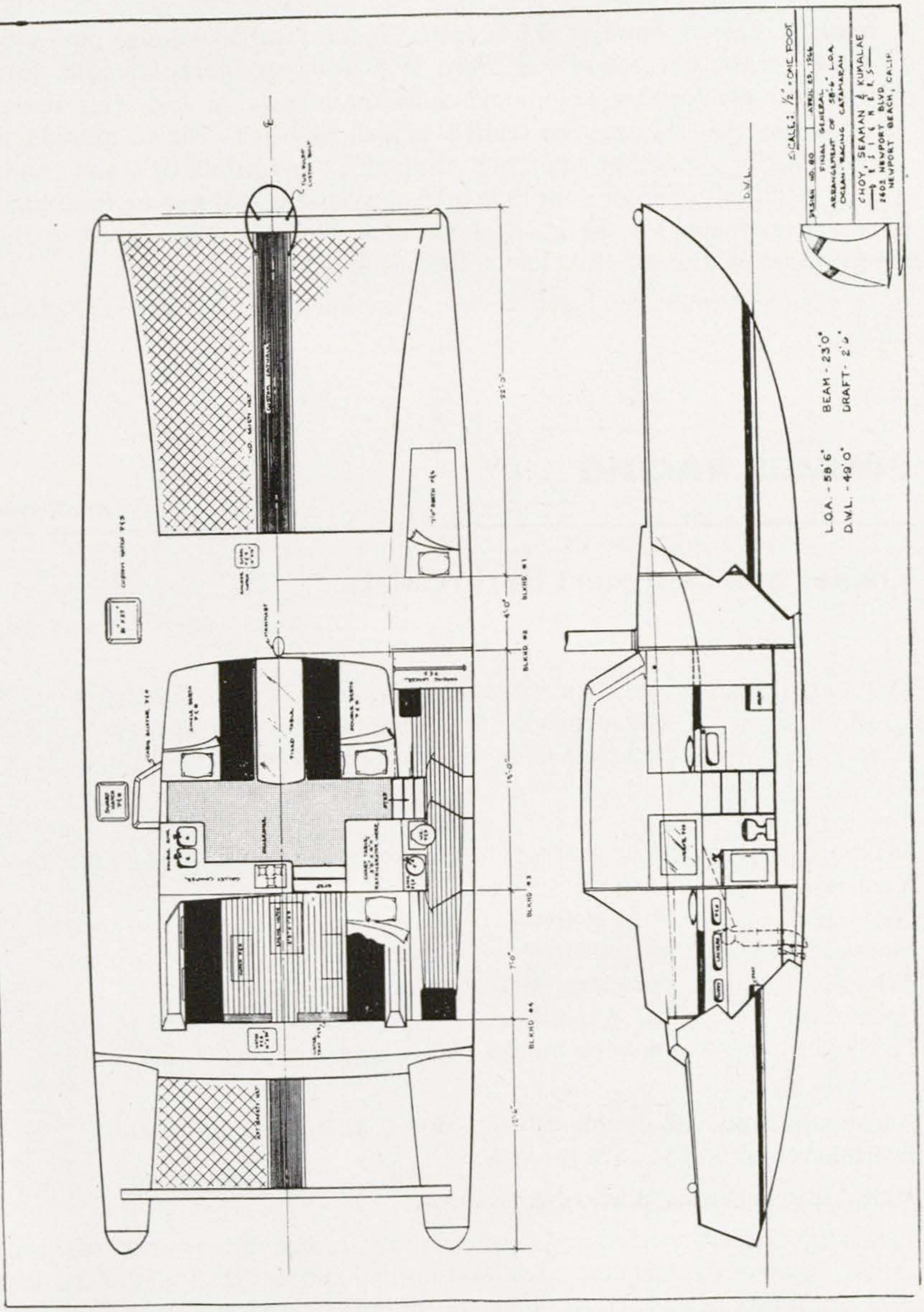
The evidence is, as follows:

1 *SEASMOKE* sailed the 2,400 nautical mile Trans-Pacific Race in 10 days 9 hours. When she finished this race of light-winds in July 1968, all others were still far out at sea. Among them was *IMI LOA*, a 43 ft Trans-Pac. veteran, which had made a 10 days 10 hours crossing in 1964 under average conditions. This year, *IMI LOA* was over 500 miles at sea or two days behind. Such comparison seems reasonable proof that *SEASMOKE* is able to speed Trans-Pacific in 8 days 10 hours!



SEASMOKE

2 During one rare Tradewind squall, the needle on the speed indicator was pegged against the stop at 30 knots for one minute. During the final hour, to the finish line, *SEASMOKE* indicated a steady 20-to-25 knots leaving a small, welcoming armada of Hawaiian catamarans and power boats floundering in her streaming wake.



SEASMOKE

3 *SEASMOKE* has defeated the fastest day-racing catamarans in California in smooth water.

4 *SEASMOKE* has outsailed with ease on all points the largest conventional yachts so far. She has shown outstanding ability to windward against the most weatherly yachts afloat in California waters in addition to her proven off-the-wind performance.

In many respects, however, *SEASMOKE* is comparable in design philosopy to CCA yachts. Great care was taken to provide structural strength, crew shelter and comfortable accommodations for a crew of ten. This design creed means that she may be cruised as well as raced. The temptation to improve performance even more by "stripping", "optimizing rig", and "minimizing facilities" were set aside in favour of reliability and a more traditional approach as better for the good of yachting. One delightful result of this credo is that at a speed of 20 knots, there is no spray on deck!

This pace-setting ocean racer has the finest equipment available for yachts today.

POLARIS RACING

April, 1970

Owner and Designer: Dario Salata

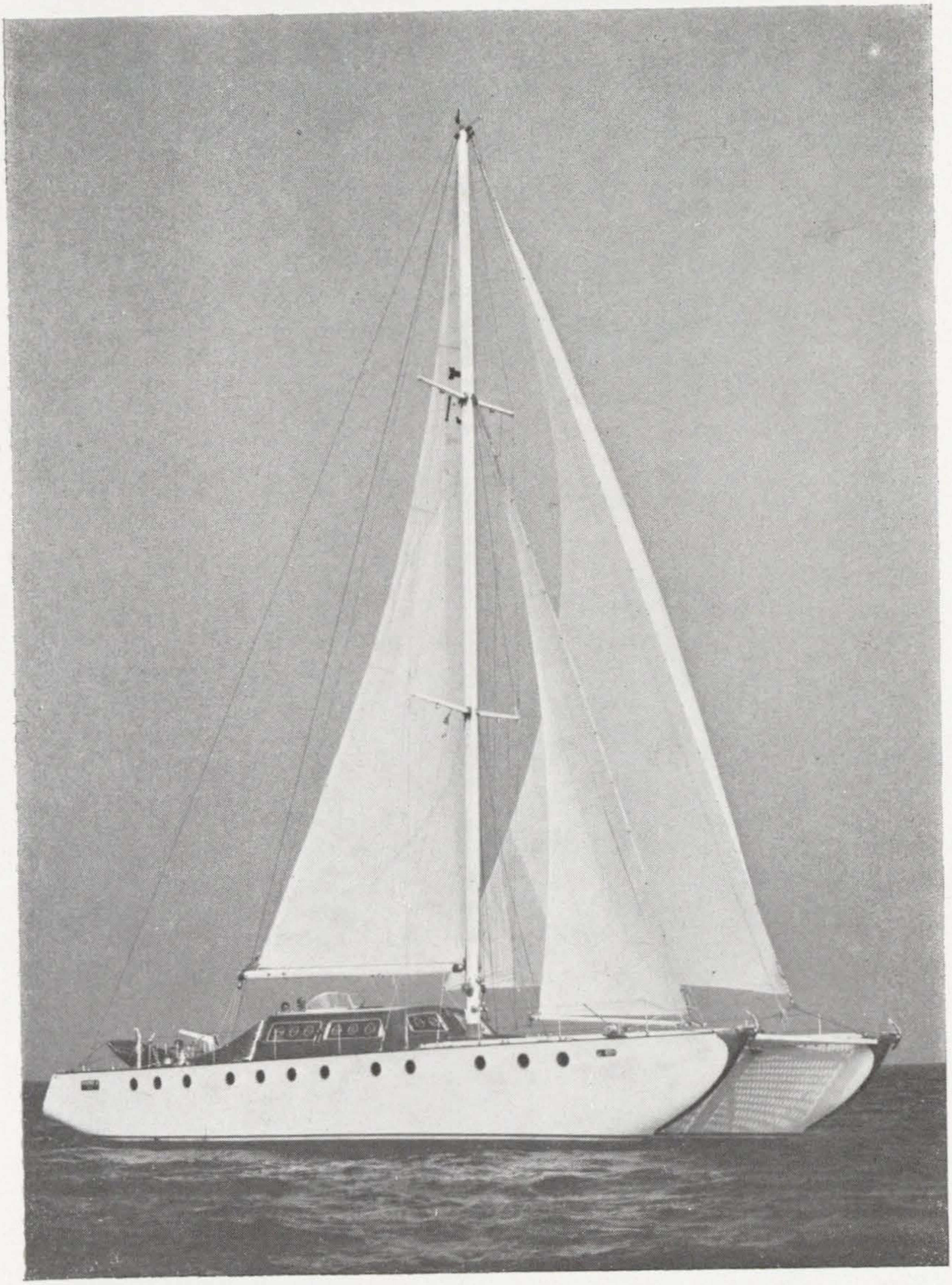
16035 Rapallo, Piazzale Funivia, Italy

L.O.A.	21 metres	L.W.L.	15 metres
Draft	1·50 metres	Displacement	16 tons
Beam	7·50 metres		
Sail Area:			
Mainsail	94 sq metres	Genoa	152 sq metres
Yankee	62 sq metres		
No. 1 Jib	84 sq metres	No. 2 Jib	61 sq metres
Staysail No. 1	36 sq metres	Staysail No. 2	26 sq metres
Trysail	28 sq metres		
Spinnaker	450 sq metres	Flat Spinnaker	280 sq metres
Powered by two 65 hp diesel motors.		Speed under power	12 knots

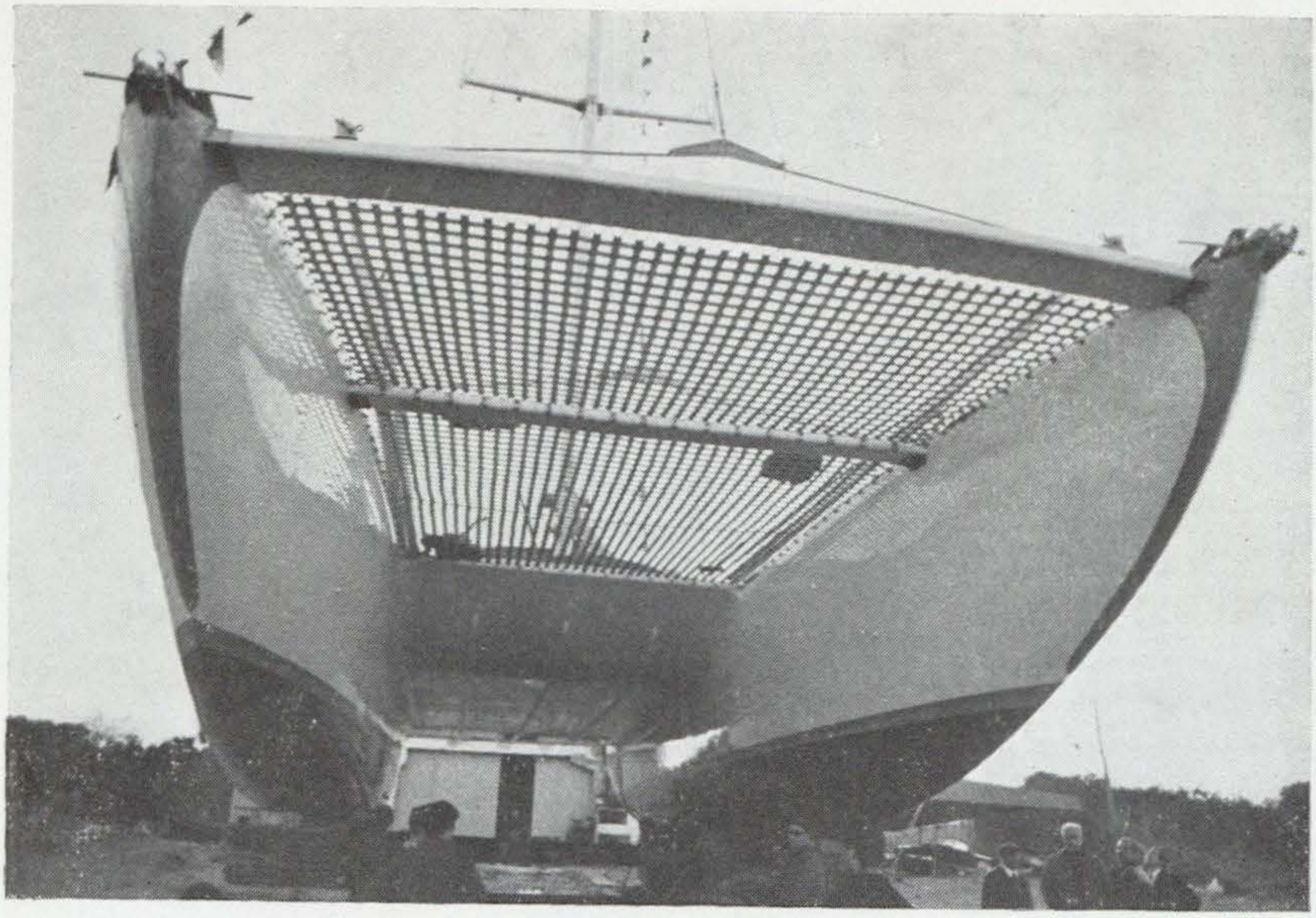
Accommodation: Six double cabins, saloon, galley with fridge etc. two toilets and vast storage for sails.

Hulls are symmetrical and are very round.

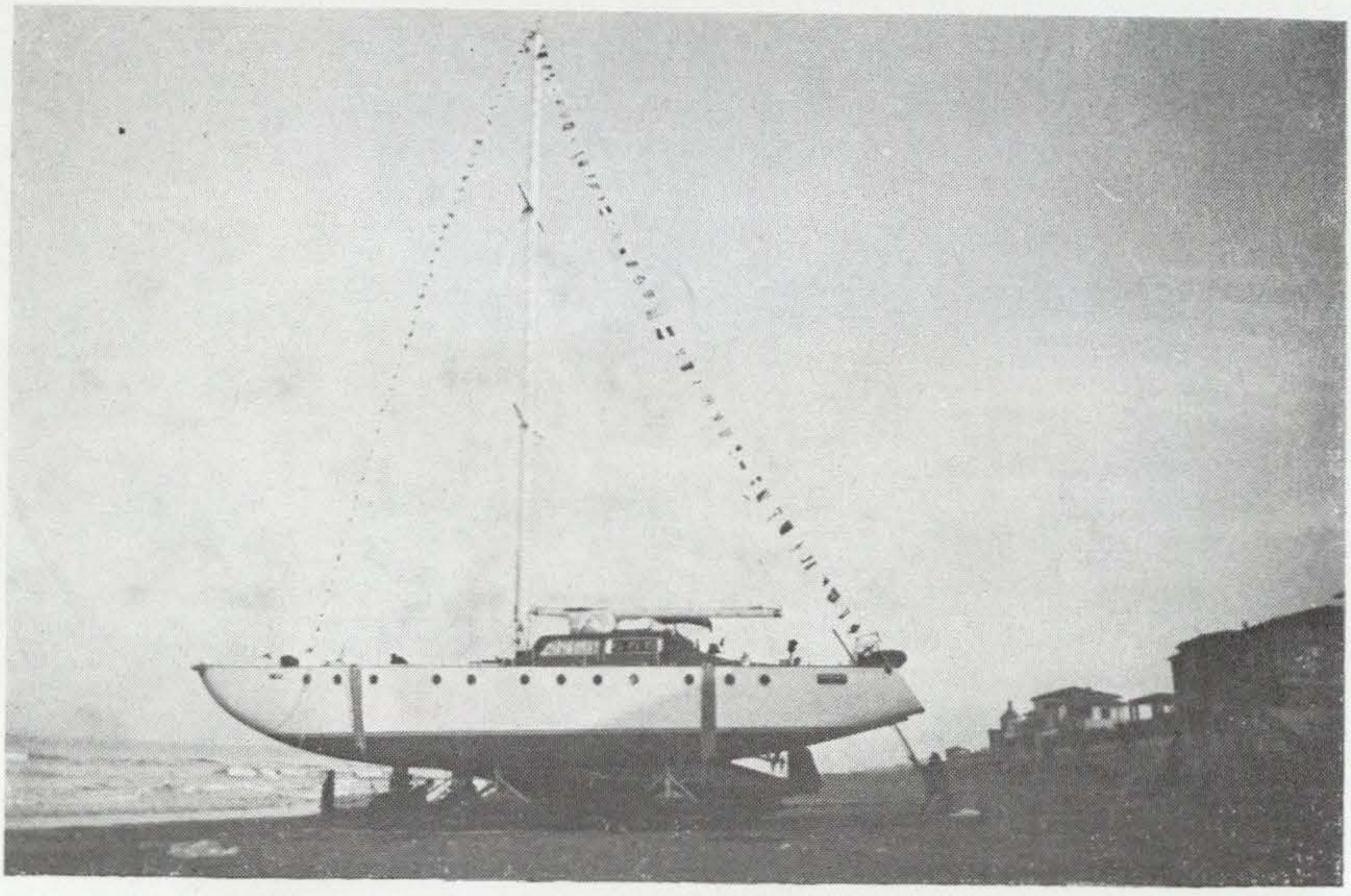
POLARIS is easily steered and can reach high speeds. She is seaworthy and for the shape of the hulls the pitching is normal and less than that of the first *POLARIS* (see page 173), the sails are, of course, SALATA sails.



POLARIS racing—Dario Salata



POLARIS racing—Bow view



POLARIS racing—Note low A.R. keel

KELSALL 50 ft CATAMARAN

April, 1970

Builders and Designers: Derek Kelsall Ltd.

Sandwich Marine, Sandwich, Kent

Described by John Morwood

L.O.A.	50 ft 0 in	Beam	20 ft 6 in
L.W.L.	43 ft 1 in	Draught	2 ft 6 in
Sail Area	925 sq ft		

Derek Kelsall must surely be one the most fortunate yacht designers of all time. Not only is he capable of designing excellent, and often pretty, yachts but he can design and build a single hulled yacht as well as a trimaran, a catamaran or a proa. Moreover, his technique of building in PVC foam and fibreglass sandwich (in the town where the Earl of Sandwich produced the original invention of bread and beef) and his business acumen have allowed him to build yachts of all kinds. His *TORIA* and *TRIFLE* are his best known trimarans, while he built *SIR THOMAS LIPTON*, though she was designed by Robert Clark.

After the main bulk of this publication had been prepared by Dudley Soulsby, he and I went over to Derek's yard. We first saw the Proa hull which at some 50 ft in length can be lifted by two men. This proa, of the "Cheers" principle, will have a smaller float than the main hull and is intended for the Round Britain Race in July. She is for Derek's own use and he describes her as "a trimaran with only one float".

We also saw a very sleek trimaran which again is intended for the Round Britain Race. At 44 ft in length and of definitely a racing character, though not quite so "Minimal" as *TORIA* when she raced, she should be very fast indeed. This is called "Thunderer" and is owned by Philip Weld.

Finally, we found ourselves wandering in a broad tunnel which turned out to be the underside of a large catamaran whose hulls and bridge deck had been completed. We climbed the inevitable ladder to the deck. The main bulkheads were in place and the "furniture" was being put in.

The drawings show the main features of the design. The main thing of note is that there is full standing headroom in the main saloon. Forward of this is the dining space with good sitting headroom. In the profile drawings, these deck houses do not look unsightly to me.

Hull Design

This is pretty orthodox. The L.W.L. crosses the midships section of the hulls just below the centre of radius of the semi-circle and the lines show a fine bow, with plenty of above water buoyancy, sweeping to the semi-circular midships sections and then on to the narrowish transom sterns.

Dagger boards are used to combat leeway, instead of the low aspect ratio keels. This reduces the hull draught but means that the skeg and rudder are the deepest parts of the boat.

Engines and Propellors

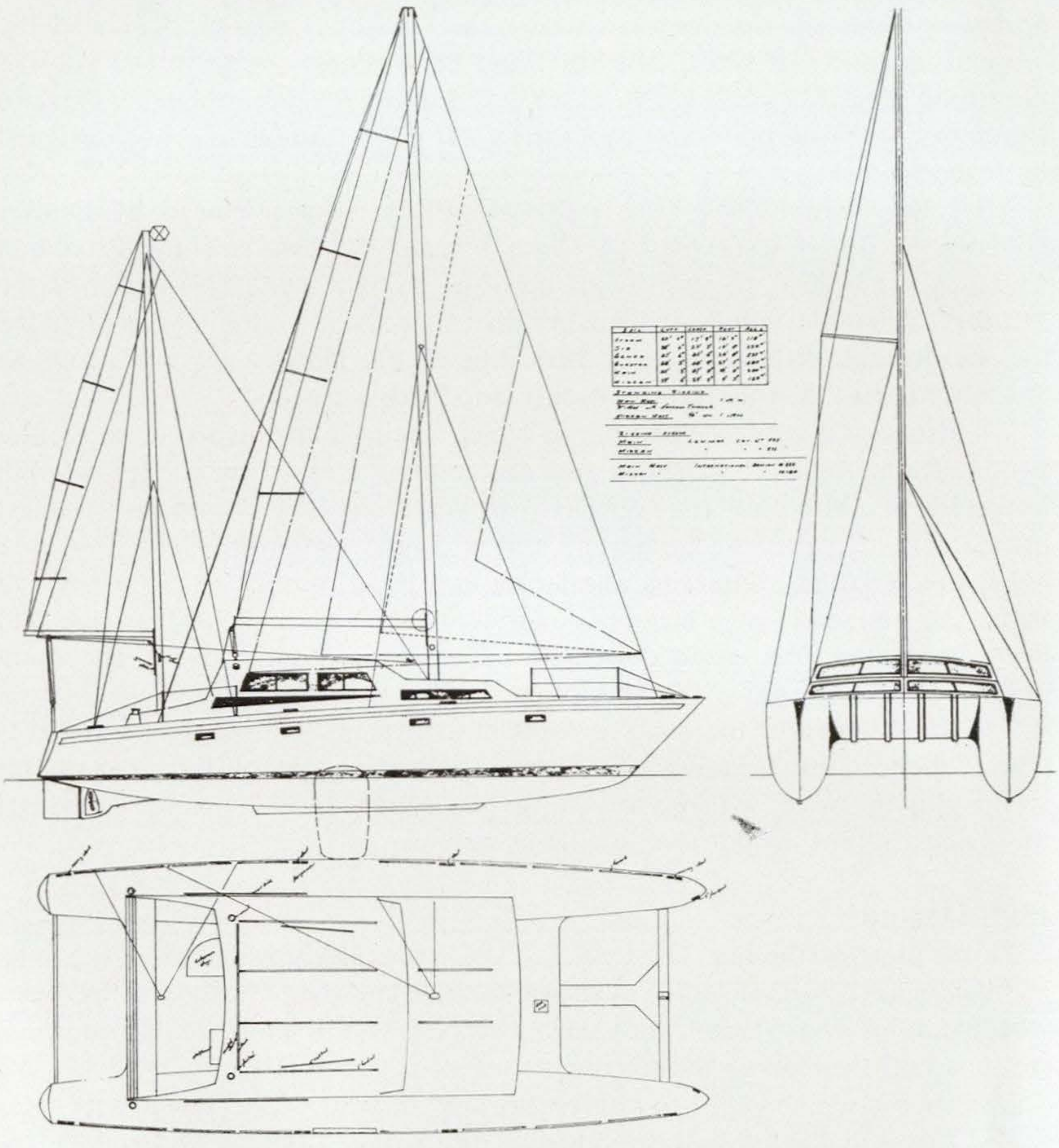
Twin 40 hp Mercedes engines are likely to be installed and these should give a speed of 10 knots. The propellors are fixed-bladed which will be a considerable drag when sailing but the smallish sail area and ketch rig make one think that she will be more used as a "Motor-sailer" than as a pure sailing yacht.

The Rig

The low ketch rig with a good wardrobe of headsails will make her easy to handle and she should be fast on all points of sailing. The "Walkway" to the forestay, when fitted with lifelines is essential to all cruising and racing cats of this size.

Summary

This catamaran is designed for comfortable living and comfortable cruising. She should achieve just that.



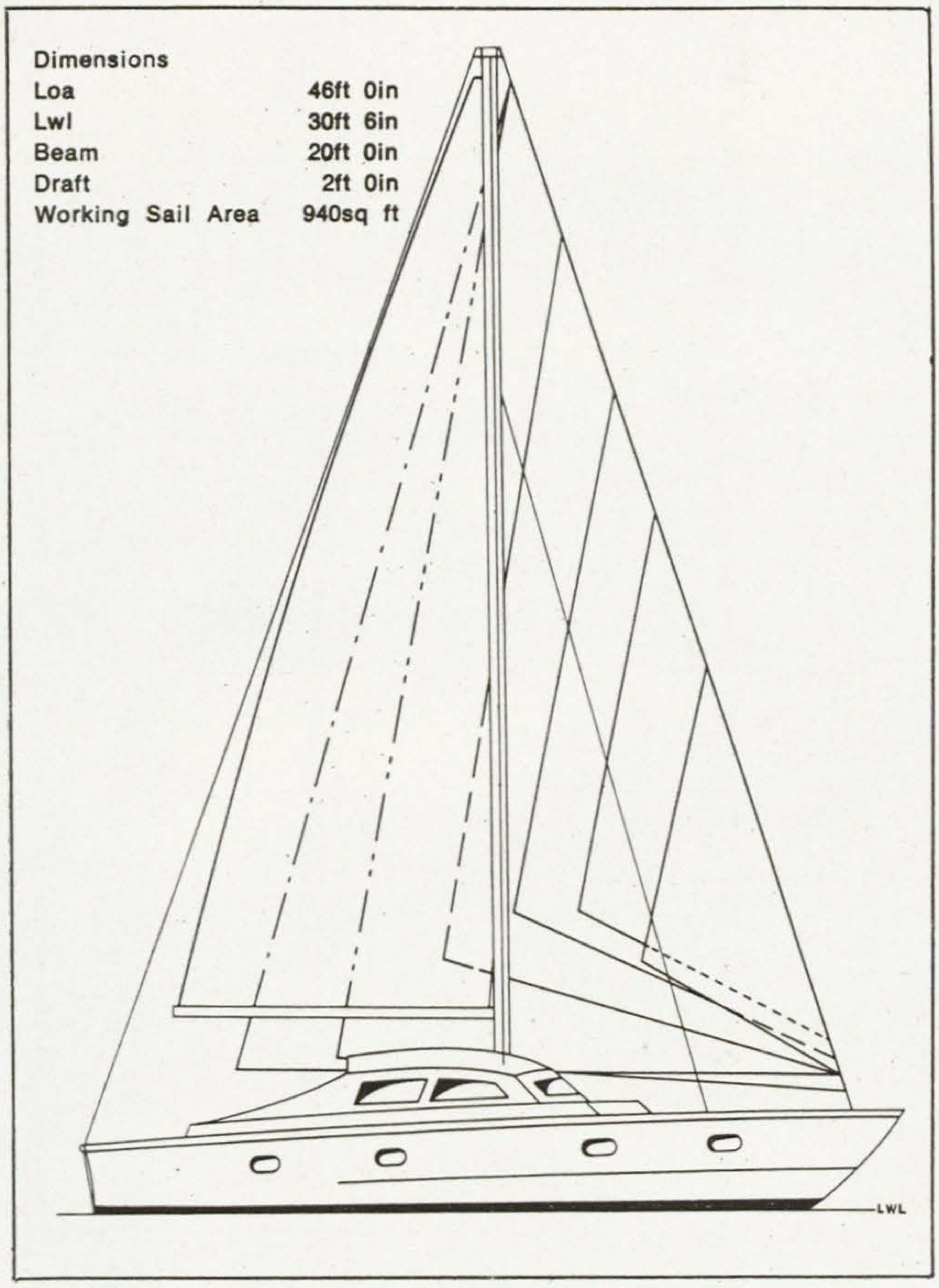
NAVAHO

April, 1970

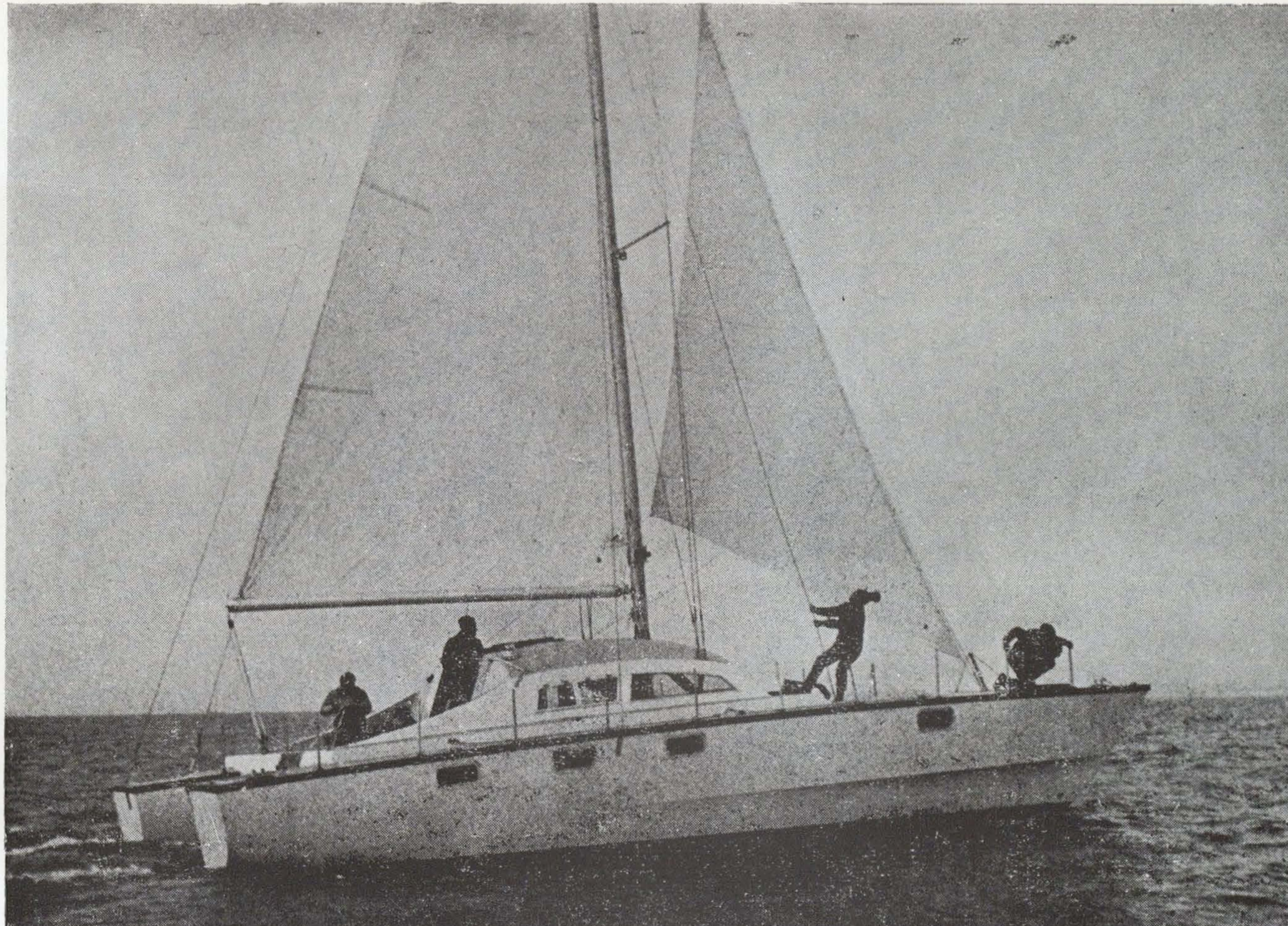
L.O.A.	46 ft 0 in	L.W.L.	30 ft 6 in
Draft	2 ft 0 in	Beam	20 ft 0 in
Sail Area	940 sq ft		

The 46 ft *NAVAHO*, designed by J. R. MacAlpine-Downie and built by Sail Craft Limited, Shipyard Estate, Brightlingsea, Essex, is a really advanced cruising catamaran similar in appearance to her smaller sister—the 30 ft *IROQUOIS.*

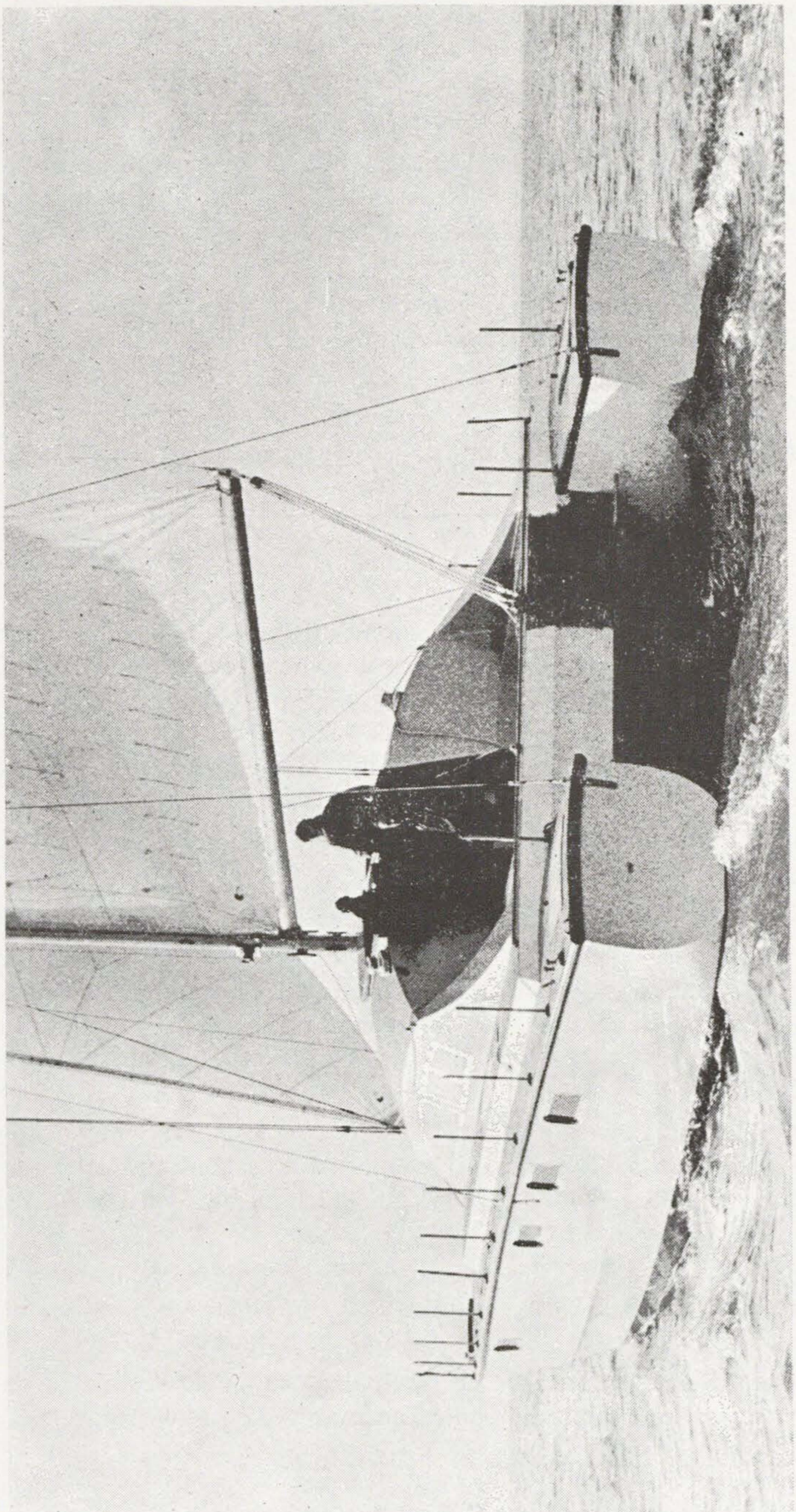
The hulls are glass fibre-balsa sandwich construction which is rigid as well as being lightweight. The balsa also acts as sound and temperature insulation. With full standing headroom throughout and eight to twelve berths she makes a handsome and practical family boat.



NAVAHO



Rod Macalpine-Downie's 45 ft *NAVAHO*



NAVAHO

Her sail plan incorporates a mast head rig and a wide range of foresails are available, therefore enabling the prospective owner to choose a sail plan to suit his individual requirements.

The 57 ft alloy mast is supplied sound-deadened. This is achieved by a synthetic rubber-like coating on the interior walls of the mast which also helps to reduce corrosion. Stainless steel fittings are used throughout to reduce maintenance costs. The alloy boom is of similar quality to the mast and is fitted with heavy duty roller reefing gear, main and jib halyard winches are also supplied as standard.

The interior of the boat is finished to owners' requirements and a final price can be decided according to the type of fittings and extras required.

APACHE

April, 1970

L.O.A.	40 ft	Beam	19 ft 6 in

The *APACHE* designed by J. R. MacAlpine-Downie as a 40 ft cruiser racer is a development produced after several years experience with cruising catamarans by Sail Craft Limited which all started with the *IROQUOIS* also designed by MacAlpine-Downie, which later developed to a Mk.II and Mk.IIA version. *NAVAHO* a 46 footer, by MacAlpine-Downie/Sail Craft Limited, also led to what must be the best 40 ft catamaran produced.

Her hulls and bridge deck are moulded in one piece and joined to the all fibreglass cabin top and deck, also moulded in one piece.

She has that well known MacAlpine-Downie attractiveness and must be the longest all glass catamaran produced which is also attractive in itself.

Her rig is masthead sloop which has proved itself time and time again to be the most practicable rig for a catamaran of this size. Full head room throughout is maintained with the exception of a small area of the main saloon on the bridge deck.

APACHE's spars are by Sail Spar and contructed in alloy using all stainless steel fittings. The mast is supported by stainless steel 1 × 19 standard rigging. Deck fittings are all manufactured by well known British firms such as Lewmar, Gibb.

Obviously on a boat of this size some special fittings are necessary and these are manufactured by Seatech Limited of Brightlingsea, specialists in stainless steel and alloy welding and fitting manufacture.

Her leeward drift is counteracted by tipping centreboards situated on the outboard side of each hull and controlled from the cockpit area.

The *APACHE* is also available in shell kit form.

APACHE SUNDANCER

IROQUOIS MK II

Data of *MK II*

L.O.A.	30 ft 6 in	Rig: Bmu Sloop Masthead rig:	
L.W.L.	26 ft 9 in	Main	202 sq ft
Beam	13 ft 6 in	No. 1 jib	160 sq ft
Draft:		No. 2 jib	95 sq ft
Centreboards down	5 ft 4 in	Storm jib	56 sq ft
Centreboards up	1 ft 4 in	150 per cent Genoa	273 sq ft
Headroom in hulls	6 ft 5 in	180 per cent Genoa	342 sq ft
Headroom in centre section	4 ft 6 in	By Seahorse, Total working sail area	362 sq ft
Size of cockpit	5 ft 6 in × 4 ft 0 in	Recommended wind force to start reefing	Force 5
Displacement	2½ tons		

Builder: Sailcraft Ltd.

Waterside, Brightlingsea, Essex

Designer: Roderick MacAlpine-Downie

The following extracts are taken from a test report by Patrick Boyd (who built his own *IROQUOIS MK I* from a kit) which appeared in YACHTING MONTHLY.

Certain necessary changes have been made between the *MK I* and the *MK II OFFSHORE IROQUOIS*.

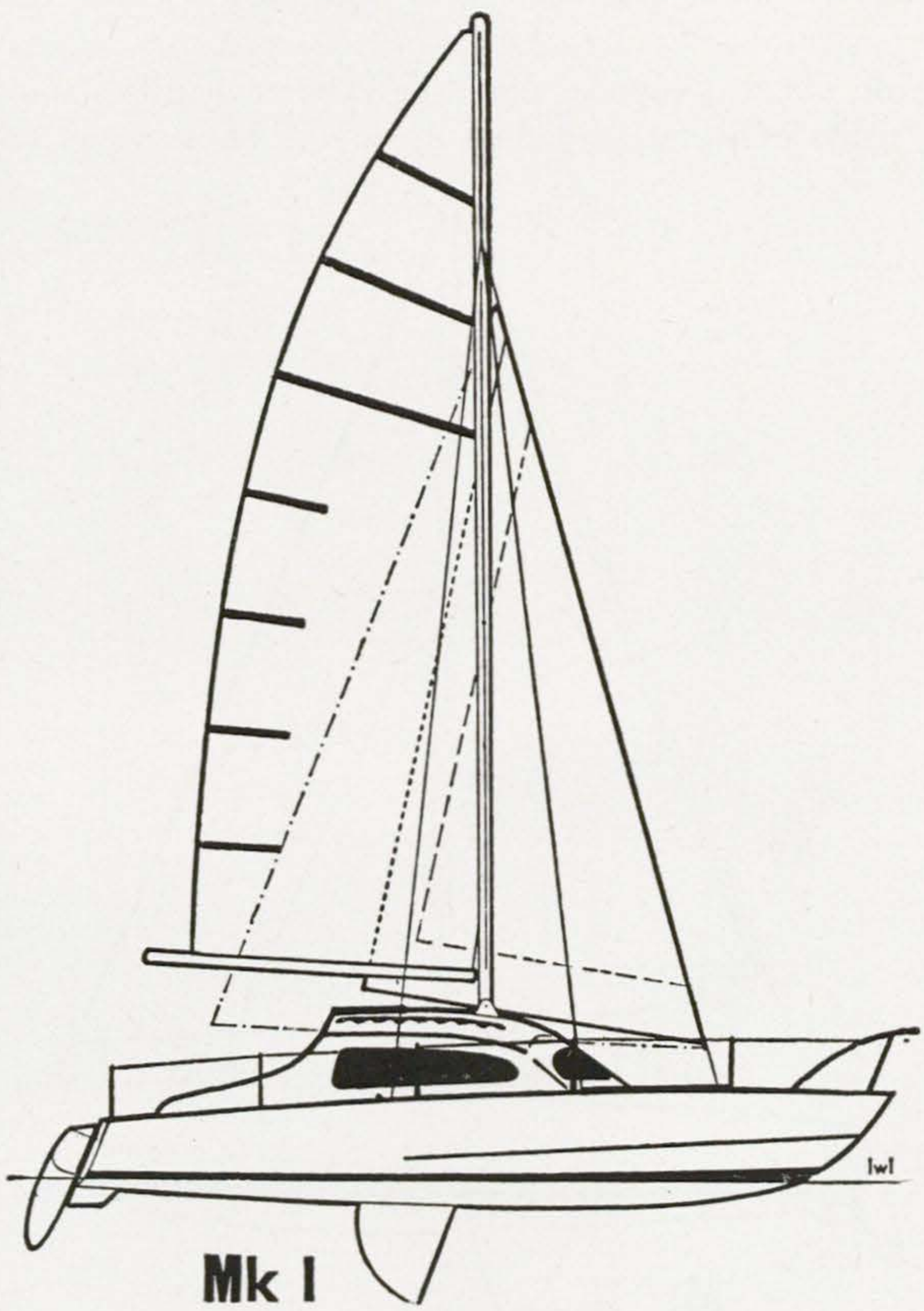
The main object behind the changes was to create a potentially safer boat without sacrificing too much speed. The time for any alterations in the design was appropriate last autumn because the original moulds were almost worn out and new ones would have to be made in any case.

IROQUOIS I is a frighteningly fast catamaran and if it can be kept light there is nothing to touch it for its size. This is the problem. Even a racing crew needs a great weight of stores, food, fuel, water, instruments and tools —to say nothing of the incredible mountain of kit needed by the average family for its annual cruise. A greater load-carrying capacity was required and so 3 in of extra beam was given at waterline. A lower rig with 100 per cent foretriangle is expected to give more drive with less inclination to overturn. A practically straight-cut roach is necessary to accommodate the standing backstay required by the masthead staysails. The mainsail is smaller—202 sq ft instead of 256 sq ft and there is a choice of genoas—the 150 per cent one of 273 sq ft and the 180 per cent of 342 sq ft mainly for the man who wants to go racing. The bridge deck is higher out of the water to prevent pounding and the cockpit is slightly smaller and much deeper. There is less solid foredeck but a trampoline covers the area between the hulls almost to the bows and a light alloy pulpit surrounds the whole area. The forepart of each hull is now divided from the rest of the hulls by a watertight compartment accessible only from the deck via large hatches. These compartments, large enough to accommodate all the sails, are self-draining as the lower part is full of foam buoyancy to above the waterline. On the foredeck amidships is a small locker just the right size to take the anchors and anchor warp and no more.

The cockpit gives a greater feeling of safety and there is a large locker at the forward end where the water tank and bottled gas lockers used to be. The two large lockers right aft are still there but rather inaccessible now that the cockpit sides and particularly the after end of the cockpit have been raised.

Ventilation has been tackled with vigour and common sense. Expensive metal windows with sliding panels give a greatly improved current of air, and Reg White swears that they are the best obtainable.

Arrangements inside the hulls remain substantially the same. Double berths aft in each hull and singles right forward. The saloon table is still in the fore and aft line and the whole lot turns into a double bunk. You can therefore sleep eight adults, or with the addition of a couple of inflatable mattresses, ten—but believe me for a weekend of anything but unbroken sunshine six is the maximum, and for a month's cruise I would prefer five.



Mk I

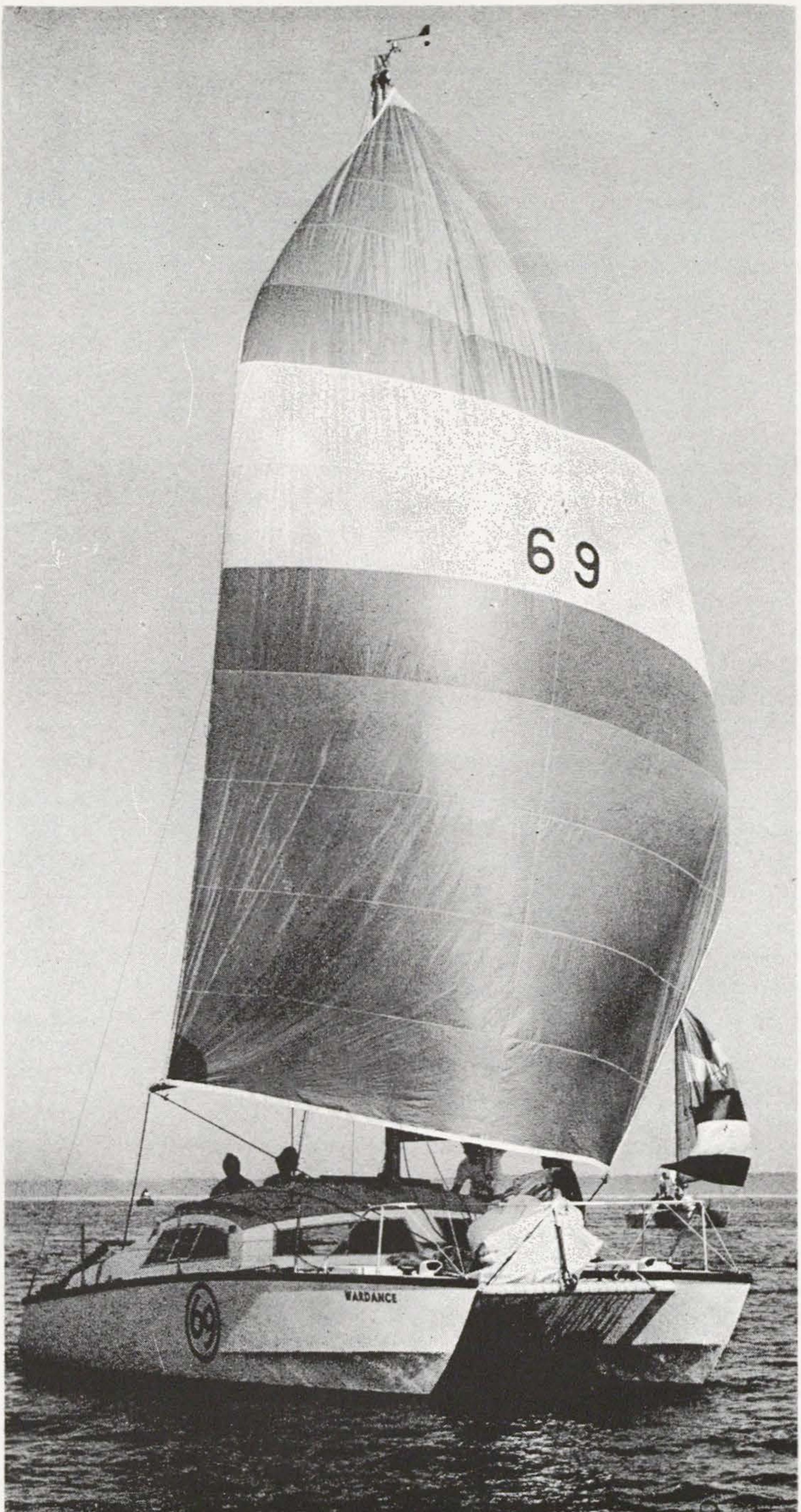
The main companionway is offset to port thus giving a large navigation area to starboard. The chart table, a large business-like job incorporates the Boyd modification, that is to say, the table is hollow to take Admiralty charts laid flat. It folds up out of the way when not in use and the area is then used as a lounge, with a very comfortable double seat one side and a single on the other. The saloon table is of adequate size although the new mast supports do intrude into the area. The main support is a full-size mast section and this makes a family lunchtime conversation somewhat hazardous as you can't actually see your opposite number at table and I also imagine the sauce bottle would be forever lurking behind the mast. Surely there must be a way of producing some support to the deck without that enormous chunk of metal?

Sailcraft have now dished the bridge deck down the centreline to provide better room for the feet of people sitting at the table and because the under-deck clearance is greater there will be even less chance of waves slapping the *MK II IROQUOIS* underneath.

Water storage is better placed. Two 25 gallon plastic tanks are stowed under the heads of the stern berths keeping the weight low down and practically doubling the water capacity. (Only one of the tanks is supplied as standard).

Centreboards, which I suppose could be better called lee-boards, are now $1\frac{1}{8}$ in thick, made of wood, and float up in the boxes when released. The

Mk II



IROQUOIS Mk. II

centreboard boxes are wider than this except right at the bottom, where the support is necessary, so that if stones get trapped between board and box they will automatically find their way into the wider part of the box where I suspect they will rattle. A small price to pay though for a non-jamming centreboard.

A choice of engine is offered now that Johnson and Evinrude can provide a long (sic) shaft as well as the lighter Penta power plant. These are now mounted on a Trojan outboard bracket which pivots the engine up out of the way and entirely eliminates prop drag.

To sum up, Sailcraft have altered the aim for the *IROQUOIS* from racer/cruiser to cruiser/racer and in so doing have made many improvements which will make a lot of *IROQUOIS* owners envious (Changes which some of us have made to our *MK Is*.). By so doing they have increased the load-carrying capacity to somewhere near the average owner's requirements and made *IROQUOIS* more foolproof. From a personal point of view I think that she has lost a lot in looks. The long low greyhound look has gone, together with the distinctive fully-battened mainsail with the pronounced roach. The sweetly curved line of the windows is replaced by the square outline of the new metal opening windows.

Reg White and I eventually dragged ourselves out to the cold harbour and aboard *MK II*. The sails were up in a trice and Reg took the helm while I blew on my fingers—then we reversed roles. The wind blew nicely up to Force 3 and she started to reach out to sea. It soon became apparent that the lower rig was going to be every bit as efficient as the old one. More so in some respects. Reg at one stage, dropped the main and we continued to beat an even tack under small genoa alone, a most impressive demonstration. She pointed higher too—this was because with the shrouds now attached well inboard, the genoa could be sheeted flatter. The demonstration model, it must be said, had no skegs in front of the rudders which certainly helped in going about quickly and I found the helm almost too sensitive. I also found it difficult to hold a course without constant adjustment to the helm. Frozen though I was, I was almost reluctant to turn for home. *IROQUOIS MK II* is certainly a winner.

CHAPTER XXV

ARISTOCRAT 30

April, 1970

Aristocrat Marine Ltd.

Avon Works, Bridge Street, Christchurch, Hampshire, U.K.

Dimensions:		
L.O.A.	30 ft 6 in	9·260 metres
L.W.L.	27 ft 7 in	8·375 metres
Beam	14 ft 0 in	4·250 metres
Sail Areas:		
Main	220 sq ft	20·4 sq metres
Jib	150 sq ft	13·9 sq metres
Genoa	250 sq ft	23·2 sq metres
Spinnaker	560 sq ft	50·2 sq metres
Storm jib	50 sq ft	4·64 sq metres
Construction:		
Hull	Glass fibre	
Bridge Deck	Glass fibre/Balsa sandwich	
Deck and Coachroof	Glass fibre/Balsa sandwich	

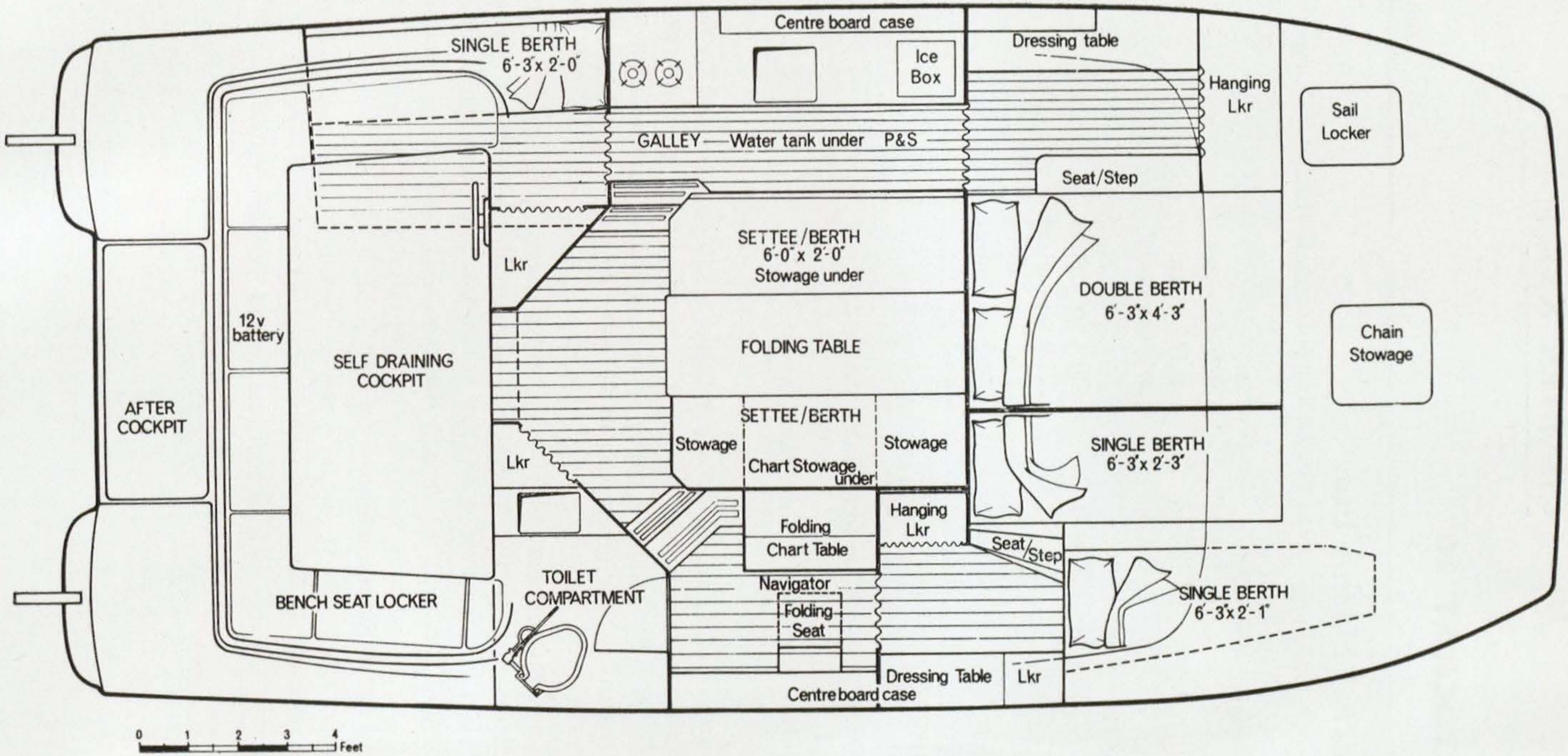
The accommodation comprises a comfortable saloon with seating for eight. Seats convert to two single berths. A folding canopy gives full headroom amidships. A fully equipped galley with standing headroom. Two separate cabins forward each with dressing table and hanging locker. Port-side cabin has a double berth; starboard two singles.

A toilet compartment with W.C., wash basin and space for shower. Abundant storage space. A practical chart table which folds away. All completed in luxurious satin finished hardwood and washable Vinyl.

A spacious foredeck for dinghy stowage and sunbathing. Roomy self-draining cockpit for family safety. Glass fibre construction with oiled hard-wood trim for minimum maintenance.

The *ARISTOCRAT* 30 can be powered by inboard or outboard engines, single or twin installation, to customers' requirements.

Metal mast in tabernacle. Roller reefing and Terylene sails.



ARISTOCRAT 30

THE CATALAC 28

April, 1970

Sales are handled by: Tom Lack Catamarans Ltd.,
Flagstaff House, Mudeford, Christchurch, Hampshire, U.K.

This design by M. G. Duff & Partners has resulted in a very original craft, which makes the 28 ft *CATALAC* one of the most attractive Cruising Catamarans on the market today.

With hard chine hulls and plenty of natural ballast below, safety and comfort are assured. The well balanced sail plan, giving 425 sq ft makes for an excellent turn of speed. Spinnakers, genoas and storm jibs are readily available. The unique layout of the self-draining cockpit gives plenty of

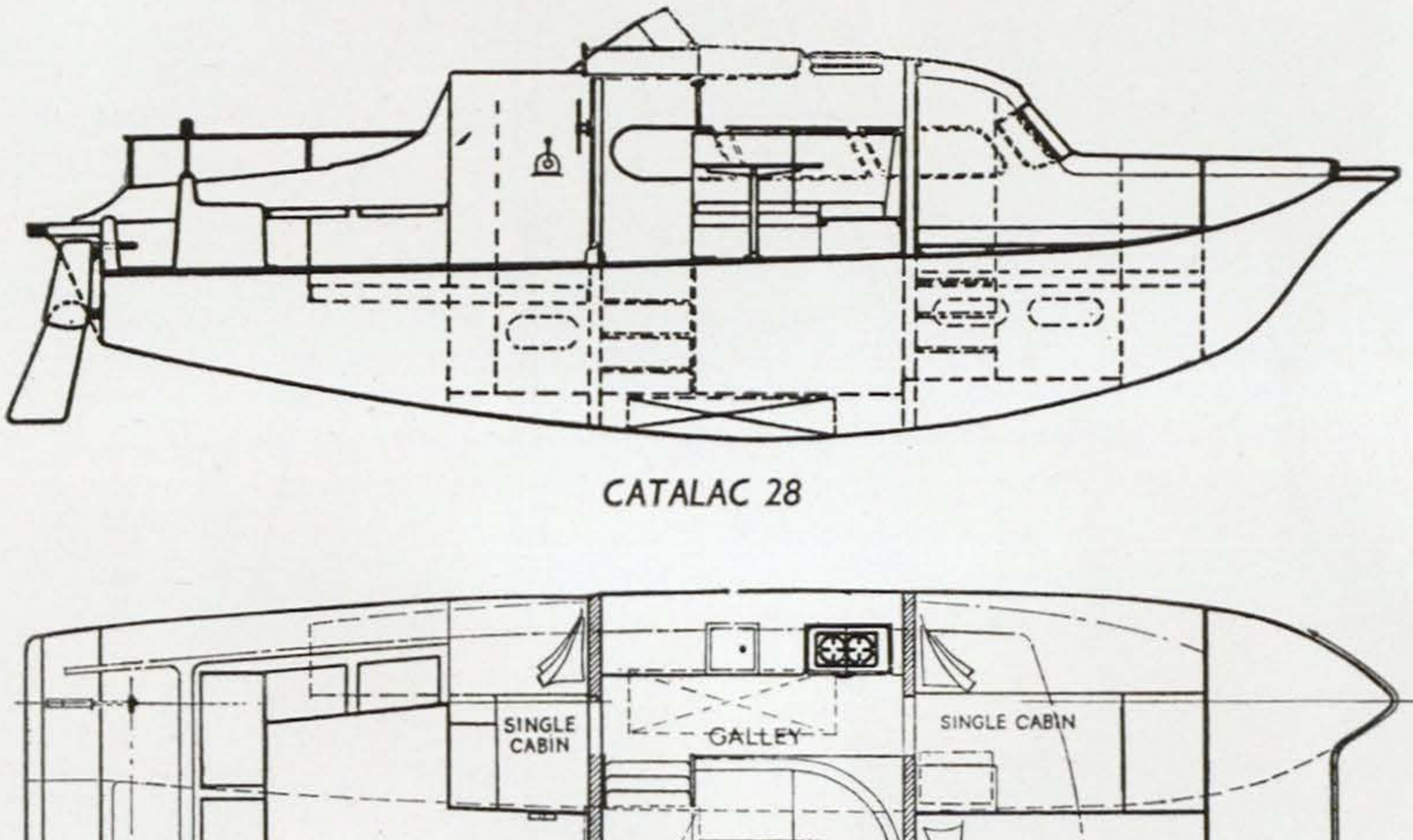
CATALAC 28

elbow room for everyone on board and the generous foredeck makes crewing a real pleasure.

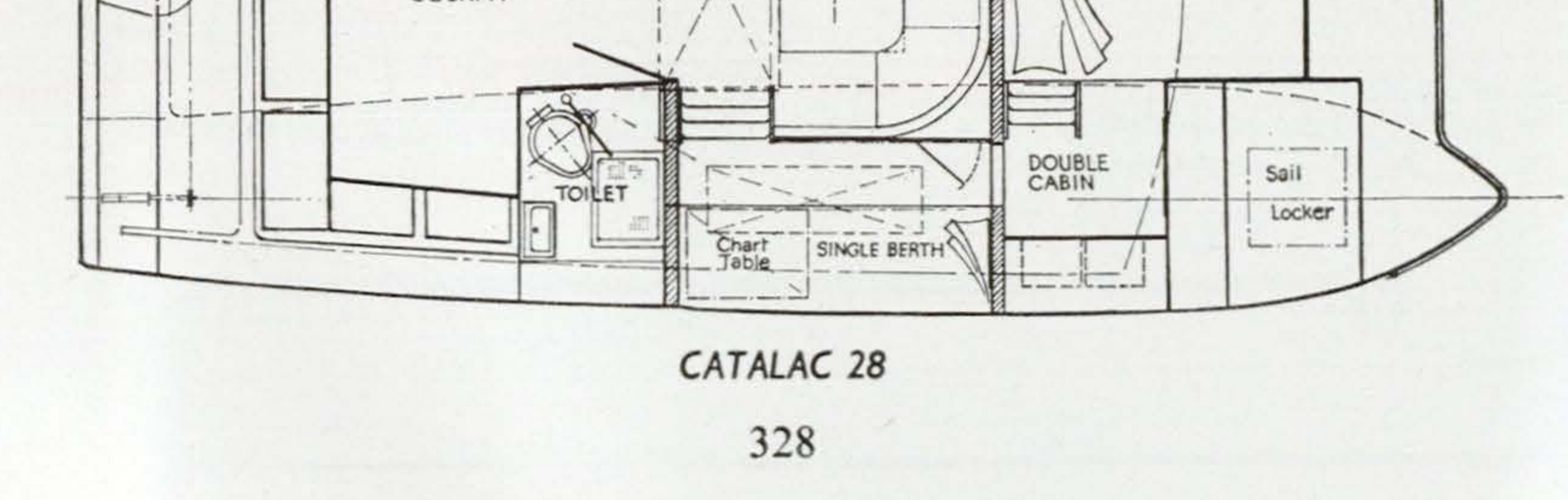
Hulls will be available in kit form.

The ingenious interior layout plan is worth particular attention by all of those looking for a really comfortable cruising boat which seldom heels, but offers abundant accommodation for family and guests. The owner's Cabin forward is entirely private and boasts a 6 ft 2 in × 4 ft 9 in double berth, dressing table and hanging locker. There is also ample stowage space. In the port hull forward is a single private Cabin with a 6 ft 2 in × 2 ft 3 in bunk with the same generous locker space for clothes and gear. Amidships in the port hull, the Galley is equipped with a cooker with twin burners, grill and oven, a sink and draining board and plenty of working space into which a cold box can be fitted.

The Saloon is one of the special features of the craft and has a distinctive seating plan, normally associated with very large yachts. The table is removable and lowers to form a large double berth when more than five are to be accommodated. Another single berth aft of the galley is tucked very neatly in its own separate Cabin. The seventh berth is situated amidships in the starboard hull and is also 6 ft 2 in × 2 ft 3 in. Ample hanging and locker space is close at hand. A standard chart table is fitted over the end of this bunk, with chart stowage below.



CATALAC 28



CATALAC 28

A separate compartment houses the flush W.C. and wash hand basin. There are also facilities for fitting a shower.

The novel Cockpit layout provides the helmsman with full protection in all weathers, as the "Wheelhouse" can be completely covered by a pram hood type dodger. The position of the wheel enables the crew to handle the sheets without getting in the helmsman's way. The Cockpit is surrounded by excellent bench seat lockers and special attention has been paid to the siting of the fuel lockers.

HIRONDELLE

April, 1970

L.O.A.	22 ft 8 in	L.W.L.	20 ft 0 in
Draft	1 ft 3 in	With C.B.	4 ft 0 in
Beam	10 ft 0 in	Sail Area	250 sq ft
Genoa 150%	120 sq ft	Displacement	2,300 lbs

An extremely pretty catamaran moulded by Robert Ives of Christchurch and marketed by B.C.A. Marine Development and Pennington Yachts at 10 Stem Lane, New Milton, Hants. The complete boat costs in the region of £2,645 according to requirements but kits are available in limited numbers as follows:

Supplying one *HIRONDELLE* with hulls and bridgedeck bonded together. Fitted with teak rubber strake and toe rails. Floor bearers bonded in. Hull centreboard cases bonded in and sealed. Perspex windows fitted. Ply bulkheads bonded into position. Ply floors bonded in forward self draining lockers and after lockers. Sliding hatches fitted to coachroof. Mainsheet traveller complete with slide fitted. Sink Unit fitted together with water carrier moulds. Washboard keeps supplied. All stainless steel stem head fittings and chain plates fitted. Pulpit fitted. All chain plates fitted. Interior stanchions fitted. Exterior stanchion bases fitted.

£1,395·00 ex yard New Milton

Mast and boom £165·00

Rudder boxes complete with blades and centre boards, not varnished

£93·00

Standard and running rigging

£50·00

Set of internal furniture cut to size but not varnished or fitted

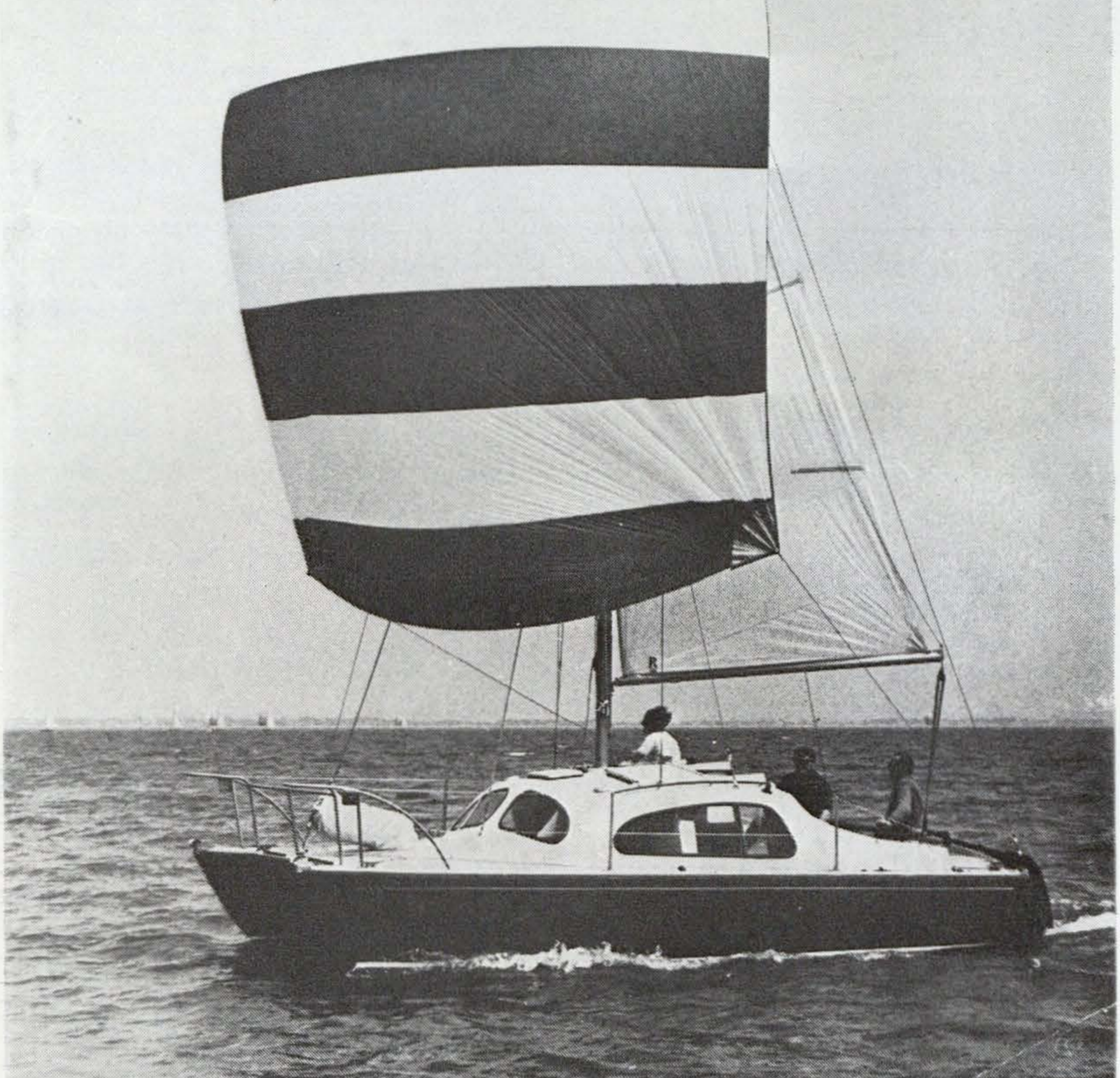
£85·00

Set of internal cushions Standard—dark blue

£70·00

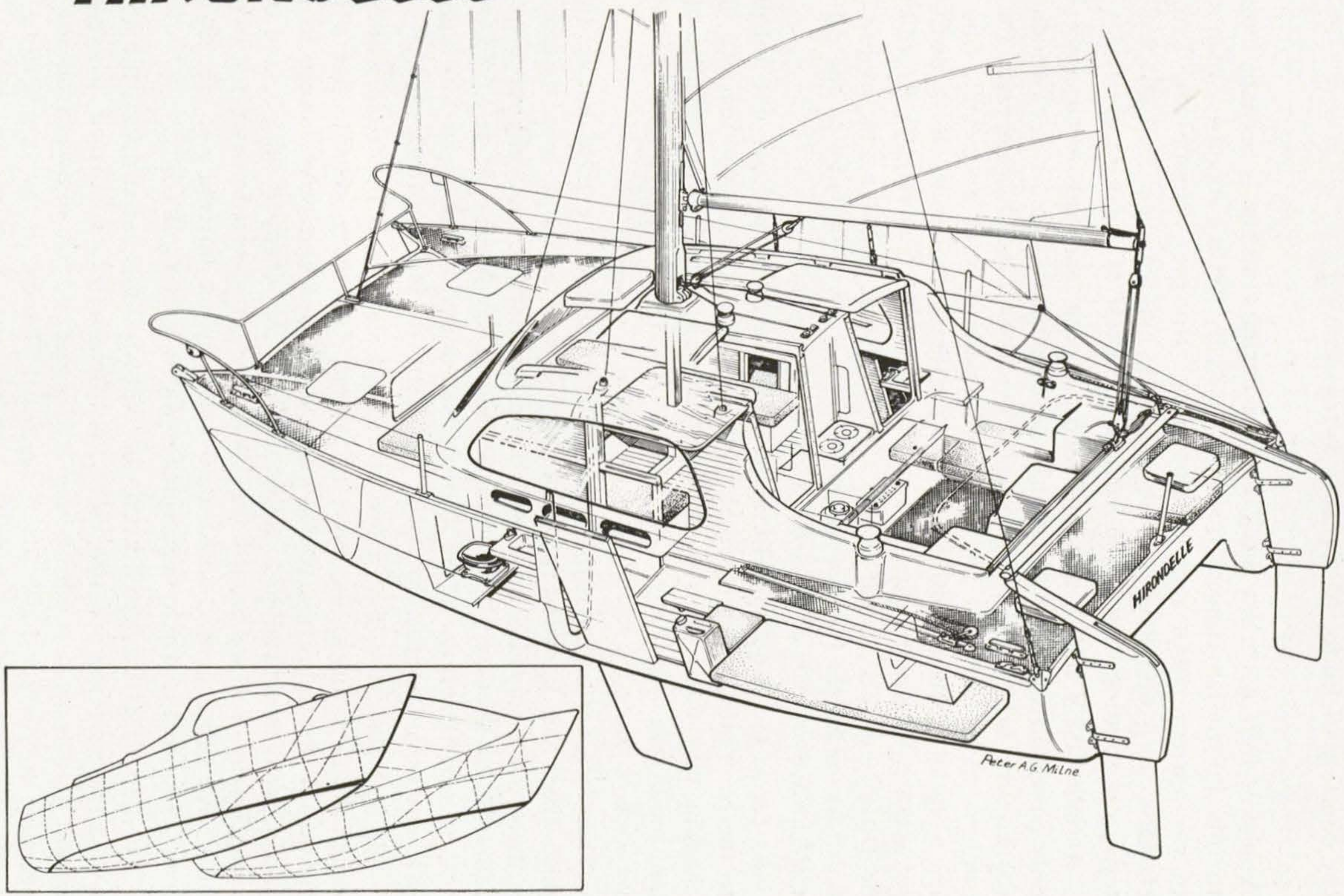
Full set of drawings supplied for the internal furniture.

All prices are ex yard New Milton.



HIRONDELLE

HIRONDELLE 5 BERTH CRUISING CATAMARAN



SEA BIRD Flight to Hawaii

by Hugo A. Myers

(by courtesy of Editor MULTIHULL INTERNATIONAL)

A new *MANU KAI* (Sea Bird) is in the Pacific, and she is perhaps closer to the old Polynesian concept of hulls joined by flexible members than many of the current ocean racing catamarans. However, aluminium, titanium, stainless steel, fibreglass, marine plywood, mathematical hull shapes, tank tests, and rotating mast make her one of fastest of ocean racers.

Actually, *SEA BIRD,* although incorporating many advanced concepts, is only competitive with international devolopments. She is very much like the English *MIRROR CAT* designed by MacAlpine-Downie, with the aluminium cross members and the accommodations in each hull. She also has a rotating mast—nothing new to smaller catamarans—flush decks and retractable rudders, nothing new to the famous 73 ft *ONDINE, BLACKFIN,* or Dick Newick's elegant design *CHEERS* that was the first multihull to finish in the Single Handed Trans Atlantic Race. Compared to the 2,500 lb *CHEERS,* the 5,900 lb *SEA BIRD* is an ocean liner.

As far as the Multihull Honolulu Race was concerned, we did not object to the committee's decision that the boat was not ready for the race. Their deadline was about three weeks before the race, and we were still building and modifying everything. Like *MIRROR CAT* in the Round Britain Race, we were building the morning of the race.

Therefore, we did not really "race" to Honolulu, in the sense that we did not push the boat, knowing full well her newness and our own inexperience with her. We stayed a mile away from the starting line and more or less followed the fleet over to Catalina. Then James Arness' 58 ft *SEASMOKE* and *SEA BIRD* left the rest of the fleet "sail-down" on the horizon by nightfall. We were nowhere near the rest of the yachts during the whole race.

We had given the boat a few severe but short tests in strong winds and rough water prior to the race, of course. One time, outside Santa Rosa Island off the California coast, where the winds and waves sweep in from Japan, we experienced 40 to 50 knot winds. We dropped the jib, and under reefed main only we pinned the 20 knot electric speedometer for over an hour. We subsequently added a 30 knot version but did not see anything over 20 knots the whole race, since it was a light wind year.

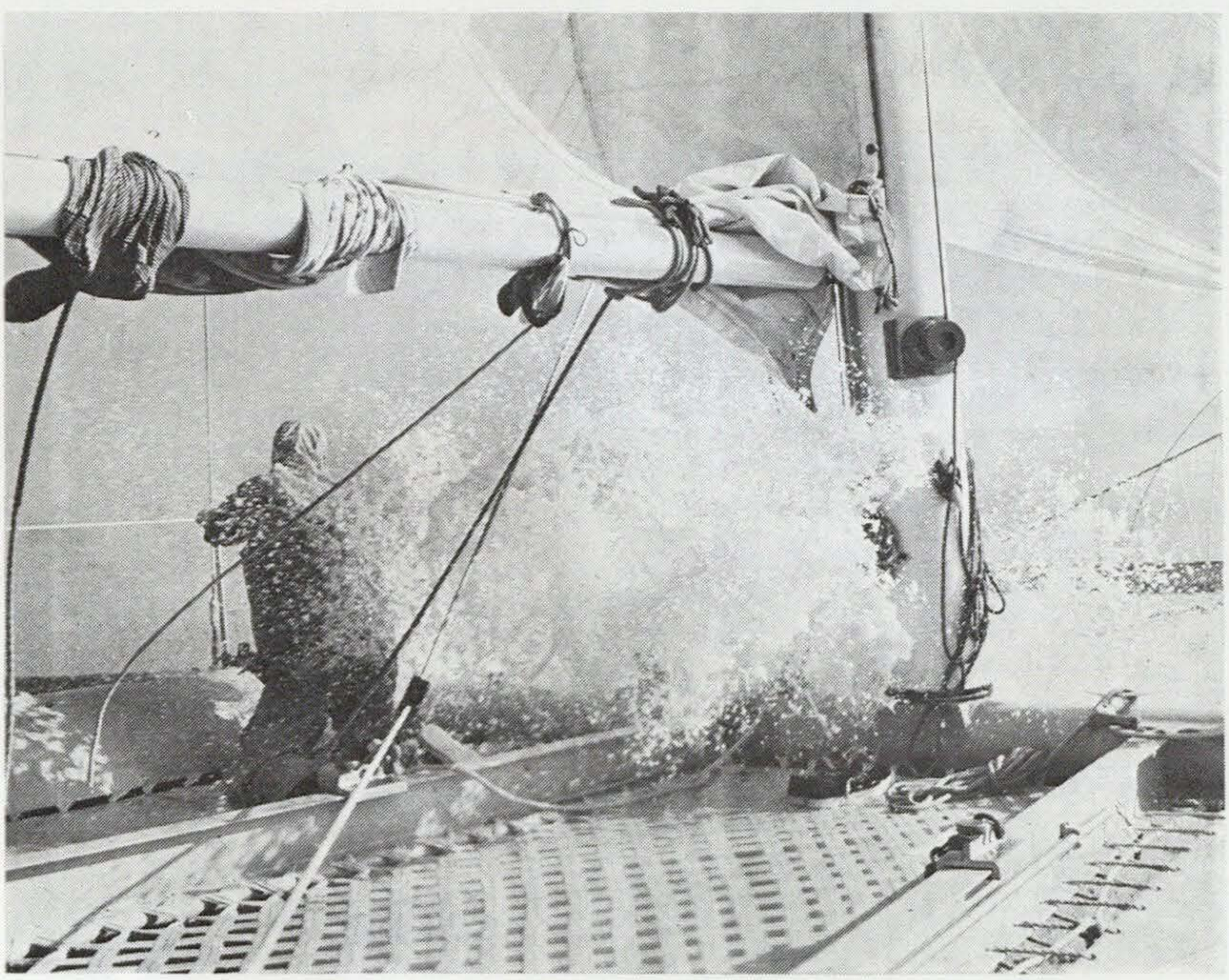
To keep *SEA BIRD* well within her known limits, we dropped the jib and reefed the main the first two nights, but held well to windward, whereas the other Catamarans kept up full main and genoa and fell off away from the high pressure area which hangs over the central Pacific in the summertime. My reason for doing this was that we didn't want to take any chances with structural failures, which happened in the 1964 race, when two of the three catamarans had to return after the first night, one under tow. Also, if it turned out to be a heavy wind race, I wanted to be in the lighter winds and practically dead upwind from Hawaii, so that we could make it relatively easily in case of trouble. Thus, right off the bat, we took two measures that cost us many hours: reefing down the first two nights, and staying in the lighter wind high pressure area. In fact, although one catamaran broke a mast, and the trimaran a backstay, and others were blowing out sails, we had no rigging problems.

For practically the whole race we were a couple of hundred miles ahead of the rest of the fleet, and one to two hundred miles north of *SEASMOKE*. The boat was wet going to windward the first few days, mainly because the hatches leaked under the fire hose type action they were getting, and our foul weather gear was inadequate. Otherwise, the trip was physically delightful. The fine entries and exits gave a very smooth ride; the working of the hulls with respect to each other through the torsion bar action of the cross members seemed to absorb the rough water shocks; and of course there was no wing pounding, since there is no fixed wing.

Hugo Myers' *SEA BIRD* on her way to Hawaii

We were naturally excited and concerned about the great adventure of taking a new development across the ocean. It was the first overnight race for the boat and two of the crew. Nevertheless this crew had plenty of experience to back its judgement.

Bob Baker is in his forties, has been sailing and racing all his life, and is a National Pacific Catamaran Champion. Of course, he was by far our best helmsman. Bob Fincher who is the foreman at Jud Grant's Trimaran Design Centre, where the hulls were built, had sailed first to Honolulu on a schooner (eighteen days) and then on Ed Horstman's 40 ft *TRI-STAR* in the 1966 Multihull Trans-Pac. He produced great meals with limited facilities and is a strong and dedicated all-round sailor. Just into his thirties, he was the youngest member aboard, Bjorn Hallin, just into his fifties, raced meter boats in Denmark before WW II is a master experimental machinist, and has been around the world twice as a machinist on ships. He helped design and then built almost all the metal-work, especially the titanium tangs, bridle, and masthead. He can do anything on a yacht, and was our damage control officer, Dr John Novak is an experimental physicist, has raced in major local races, was President of the Los Angeles section of the Amateur Yacht Research Society, and has taught Navigation courses. He is a co-owner, and he served as assistant navigator and helmsman. Bob Hanel is an old friend and co-owner. The least experienced of the crew, he made up for it by his heart and drive. He served as helmsman, deck hand, and photographer.



SEA BIRD: life on deck

Thus the average age of the crew was around forty, and we represented a very broad range of sailing experience. Just after the committee's decision was relayed to us we held a meeting of our own and voted on whether or not to sail to Hawaii to check out the boat and ourselves. The vote was five to one; I voted against on the grounds that neither the crew nor the boat were sufficiently prepared and that incidentally we were bound to irritate some ORCA members. However, I chose not to try to exercise a veto, because everybody had put in a terrific amount of time and money. The overwhelming majority opinion was that we had built the boat for the Honolulu trip, it would have to be tested sooner or later, and the race was now. Everyone agreed to pitch in and work full bore to get the boat ready. Therefore, one might say that the crew unduly jeopardised my life, rather than the other way around. Or, in a larger sense, since I had promoted the whole venture, I was really responsible. The truth is that we were all big boys—plenty of multihull experience, mature, married, with families well along and provided for, and we all enthusiastically embraced the challenge of testing ourselves and our concepts in the open ocean. Therefore, it was really a joint venture in which the risks were quite well evaluated and prepared for.

Soon we were sailing along in the very light winds of the high pressure area, but with confused and lumpy seas. On rare occasion there would be a squall, but according to Bob Fincher, there were none of the steady trade winds that are normal for the crossing. Then Bob Baker noticed that the steering was significantly different, and upon checking found that the port rudder had sheared off completely! Nevertheless, the boat continued to sail well, only requiring more excursion of the helm. This incident separated the racing, driving enthusiasts from the rest of the crew. Bob Baker, Bob Hanel and Bob Fincher feared that I would become "too conservative" and slow the boat down too much, and so they did not tell me, John, or Bjorn about the missing rudder for a day or so. We had all heard a bang on the hull, but thought we had merely hit a log.

The rudders and boards were somewhat new for an ocean going yacht. Instead of being formed out of laminated wood and fibreglass, a NACA 0012 (12 per cent chord) airfoil section mould was made by John and the core was of polyurethane foam. Then, the rudder tubes were only 1/16th in wall 2 in o.d. stainless steel, reinforced at the keel line with a solid rod. What actually happened was that the foam gave way, allowing the tube to work, and the tens of thousands of cycles caused the tube to first bend, then crack and shear off at the keel. When the rest of us did discover the nature of the accident, you can imagine there was considerable ill will. John took a benzedrine tablet, and Bjorn, our damage control officer, skipped supper and went to his bunk, I was very quiet for some time.

The previous night we had been sailing under spinnaker only by mutual agreement—from my conservatism, and from Bob's concern for the remaining rudder. We continued this way for the rest of the trip—a total of seven or eight hundred miles on one weak rudder post. Once Bjorn knew of the damage, he planned for an emergency sweep rudder, since a spare tiller cross bar had been brought along. Also, we were dead upwind from the Islands, so we were in no serious trouble in any case. However, our speed dropped by 20 per cent or so, just keeping the pace of the rest of the fleet, but losing *SEASMOKE* day by day. In summary, we believe that these events show that we were properly conservative in the first crossing, refusing to race the boat hard, and taking a position that would be in light winds and upwind from the destination in the event of trouble.

At this point it is appropriate to thank all my ORCA and non-ORCA friends for all their warm support and help, Ken Murphy, owner of the famous *AIKANE* that holds the Ensenada and Honolulu multihull records, and Doc John Pursell, owner of *PATTY CAT II,* first-to-finish in the 1966

***SEA BIRD*—Inside a hull**

Honolulu Race, both lent a spinnaker and safety gear. That the sails were unsuited for *SEA BIRD* was of course not their fault; they were infinitely better than nothing! Jay Johnson, owner of *GLASS SLIPPER* and President of ORCA passed along our position each day to his home office, so that our families could be kept informed. During the race, James Arness and Warren Seaman aboard *SEASMOKE* were great sports, communicating morning and night, Buddy Ebsen, famous T.V. actor and owner of first-on-corrected time *POLYNESIAN CONCEPT* gave us a thank-you wave as we passed to his lee near the start, to give him the clear air.

In Honolulu, both the Waikiki and Honolulu Yacht Clubs and the Outrigger Canoe Club extended their welcome to us. The yacht and beach clubs in the island have a special "Aloha" for the seafarers that come across, in honour of all the adventurers and explorers that populated the islands over the centuries. Lance Raventlow, famous auto racer and sportsman, and owner of the lovely 50 ft *MANU IWA* in the race, presented us with a beautiful native wooden bowl "Pioneers Trophy", in honour of Woody Brown and all the others who have introduced and taken new multihull developments across the ocean. So, taking the modest criticism in context of the warm support and great satisfaction of this adventure, we feel more than adequately compensated. After all, we were the unofficial second across the finish line, behind the 58 ft *SEASMOKE.*

SEABIRD now has a fail-safe machined mast base rather than a welded one. New hatches have been fitted so that the crew does not have to take inadvertant showers. The solid titanium rudder shafts are, if anything, too strong. So we have all benefited from our first trials and are in that state of pleasant exhaustion which occurs when a long held dream has actually culminated in an exciting and satisfying adventure.

Letter from: Keith Monroe, Reading, Vermont 05062, U.S.A.

October, 1971.

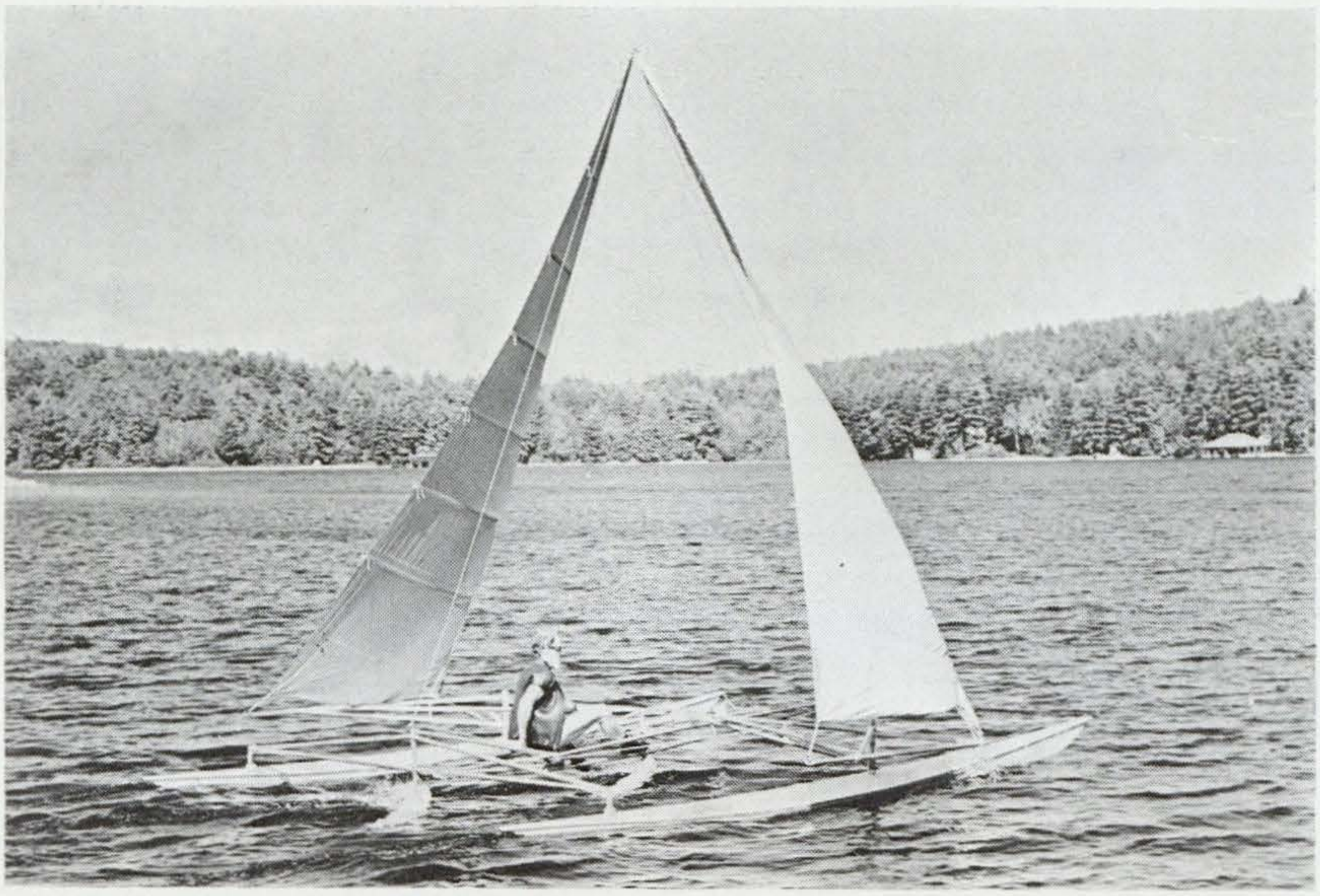
Dear Sirs,

I enclose two photos of a boat I have been building, and of which I informed you in a previous letter. It is built to the principles of the articulated catamaran termed the *Sailplane* in Bernard Smith's book, THE 40 KNOT SAILBOAT, with my modifications.

The pictures were taken on a rather calm day, but since then I have had her out in about 30 mile winds according to the weather bureau. This is the first multihull sailing I have done. I have previously sailed in planing hulls of conventional design, including the *Australian* 16 dinghy, but this is the fastest sailing I have ever experienced. I have had readings of about 13 knots with a hand held indicator, but have sailed even faster and have been so busy I haven't taken readings at peak speeds.

I have found much to change about the boat since I began sailing her. Most urgent of all, the sails need re-cutting. They are much too full, and I have had trouble coming about. I feel that with a flatter cut I can get up into the wind much faster and avoid getting caught in irons. Jibing with such a rig is extremely easy as there are no swinging booms to slap down crew or shrouds. In a good wind the boat makes great speed off her stern quarters and a jibe becomes a real sleighride.

Keith Monroe



Letter from: Keith Monroe, Reading, Vermont 05062, U.S.A.

Dear Mr Morwood,

I am delighted to find you interested in the boat. It is Malcolm McIntyre's conception, but I feel I now have a part in the resurrection of an excellent boat that did not deserve oblivion. I should like very much to write an article on the craft.

However, as often happens with such events, what I thought was the launching of a new boat was only a step toward a really finished and perfected entity. I am already building new hulls. I want more freeboard, and planing shapes. I want to take a passenger. The sails are but too full. There must be improvements in rigging and sails control. I want a net platform to move about on. Etcetera. I am sure you recognise the syndrome.

To answer your first question. I would love to compare performance with a *Tornado*. Imperfect though she is, the boat is, to me, incredibly fast. No doubt I would feel the same re the *Tornado*. But I have very little with which to compare her on the lake where I sail. There is one 30 ft trimaran which I have never seen in operation. Perhaps next season I can get the boat to the sea, where I am sure there will be comparisons galore.

On the sloping sails question. Mr Bruce is probably correct. In light airs, the rig is not that efficient. But in light airs I can hoist another sail on the midhulls stay. In heavy airs, *all other* rigs heel, and would be subject to his rule. However, with this rig, the sails maintain the same attitude in all winds in their relative position to the waterline. In heavy winds this rig can carry all sail, and will not lift the windward hull to increase windage, will not bury the leeward hull to increase drag. I have been in irons, with no way on, in good blows and no ballast but my weight on centreline, and there has been no indication of instability.

To my prejudiced mind, McIntyre's reasoning and marshalling of elements is almost impeccable. A hull sails fastest on its lines. A catamaran-like design, released from customary stresses by articulation to the point where the two hulls can pitch independently of each other, cannot fail to perform better than the conventional cat, boat for boat. I have sailed full speed through power-boat wakes at various angles of attack with almost no reaction in movement of the central girder I sit upon.

I could, of course, set a sail midhulls and add a jib. But this would negate the concept of compensating moments, and result in a capsizable rig. In other words, a conventional catamaran.

The dimensions of the boat are:

Hulls, 19 ft $\frac{1}{2}$ in (which accounts for the scant freeboard, as they were one-man kayak hulls advertised as 19 and $\frac{1}{2}$ ft long!).

Beam, centrelines hull to hull, is 12 ft. The hulls of course approach each other as the skewline operates.

Boom to boom, 18 ft. This is constant, but they skew in relation to the hulls.

Sail area is approximately 140 sq ft.

The rudder and centreboard draw 3 ft at no way on, trail at speed, trail to zero for beaching. They operate in unison on the periphery of a circle. They are mounted, as is the skipper, on a centre longitudinal, also the fore and after stays.

The hulls are joined by tubular aluminium bridges whose uprights rotate in hull sockets. A combination of hinged and rotating joints allow independent pitching and prevent rolling.

The bridges are adjustable to assure the hulls be parallel.

The booms and conjoined masts can be shifted fore and aft to affect trim, or balance. The masts rotate.

On the new rig, these changes. The hulls will be 24 ft long. Flat-bottomed for planing, with long, lifting entry. Skew and rudder controls to be at hand from any point on a netting platform. Sail area in the neighbourhood of 200 sq ft. Fore and after stays to be of a piece, the lower third running along platform centreline and around winch to allow raising and lowering of entire rig at sea. Am thinking of battenless, mitre-cut sails which will reef on the masts.

There seems to be a confusing amount hardware and lines, but in actual practice, working the boat is quite easy. Skewline and rudder are busy in changing tack, but once set up, one can sail with no hands.

CHAPTER XXVI

SUNDANCER

October, 1971

by David Barker

New Zealand

Auckland artist David Barker, who was prominent in local catamaran racing before he went overseas to study art on a bursary, has returned to New Zealand with *SUNDANCER*, the most sophisticated ocean-going catamaran yet seen in this country.

She is 40 ft long, all fibre-glass and was designed and built by David Barker, including the moulds, in 14 months while he was in Sydney. The finish all round is superb and she looks like a high quality production fibreglass job.

The hulls are reinforced by a lattice of rounded PVC foam strips fibreglassed into the inside of the shell. A small cabin bridges the two hulls amidships and there are large section alloy tube cross-arms fore and aft. A net and foam cushion "decking" fills the gaps out to the cross-arms. There is a centreboard in each hull. The rig is a very high aspect main and a ¾-height fore-triangle set on a revolving alloy mast.

The accommodation is yet to be completed and so far consists only of two berths in the cabin and a portable cooker. The hulls are unfurnished and used only for stowage but will have berths fitted later.

Including the trip across the Tasman, *SUNDANCER* has so far sailed about 4,000 miles including a cruise in the Barrier Reef area, and she has been well tested in all kinds of weather.

She is very fast on the wind and reaching, and unlike many multi-hulls, she handles well under main only.

She will be taking part in local racing and the first test was to be in this year's Balokovic Cup although she is not yet fully equipped for racing and has no extras.

OCEANIC 30 ft MARK I

January, 1965

L.O.A.	30 ft	Working rig	423 sq ft
Beam	14 ft	(Main, Mizzen, Yankee boomed staysail)	
Draught	2 ft		
Displacement	3·7 tons (8,300 lbs)	Genoa	260 sq ft
		Spinnaker	800 sq ft

(Also mizzen staysail 140 sq ft, Storm jib 36 sq ft, Sneaker 84 sq ft)

Designer and Builder: Bill O'Brien

The South Coast Catamaran Company Limited,
White's Shipyard, Hazel Road, Southampton, Hants, England

Ed: The following account has been written by Bill O'Brien.

Notes on OCEANIC

1 *OCEANIC* is designed as (and has been proved) a safe, comfortable, deep sea going Family Cruiser.

2 Though safety is of prime importance, the speed of *OCEANIC* under sail compares favourably with cruiser type Mono-Hulls of similar length. When well handled on the wind, she is equal to the latter, and if the wind is free, she can be driven a knot faster, despite being a Motor Sailer carrying two fairly large inboard engines.

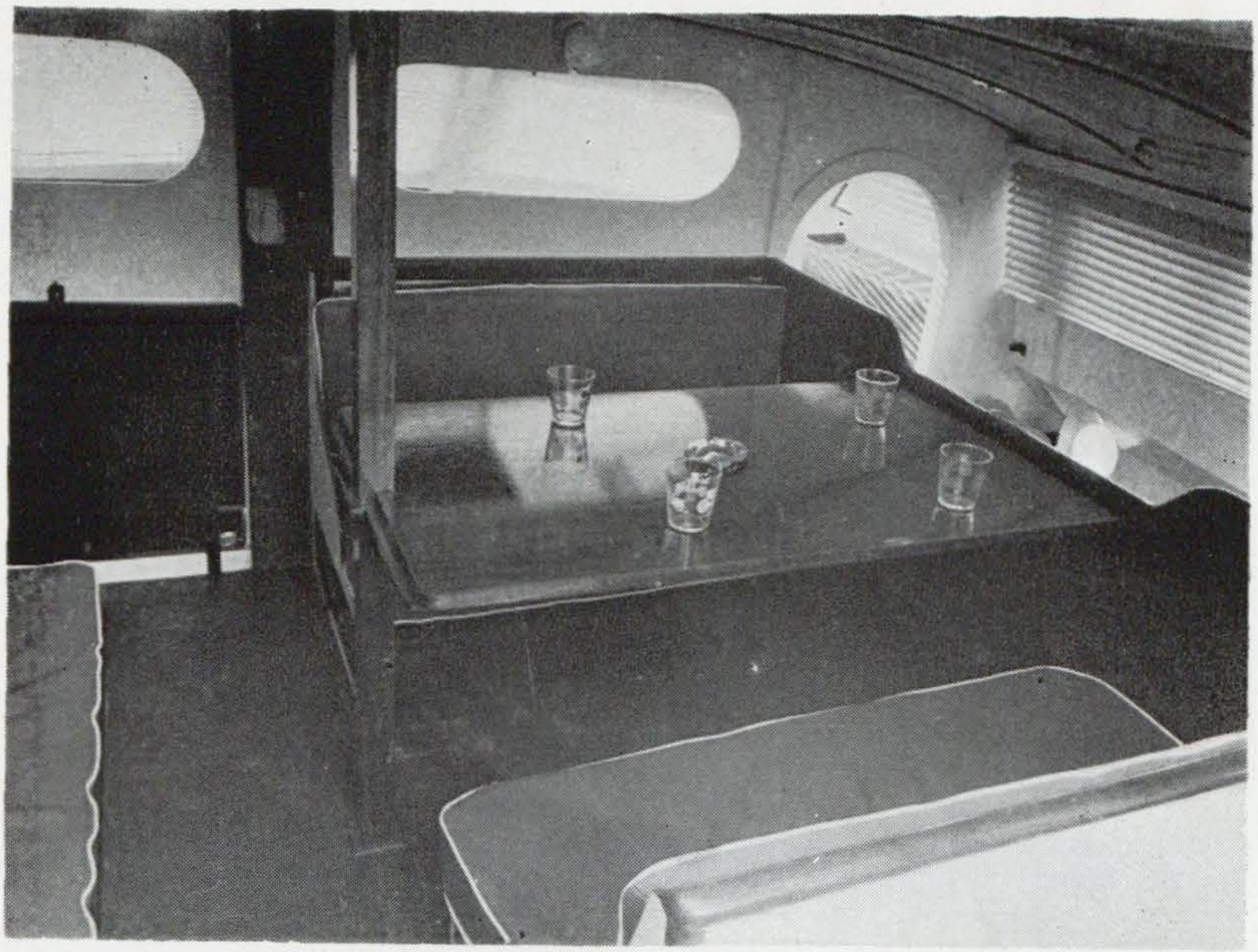
3 To improve windward performance in conjunction with safety, patented fins are fitted on the inside of the hulls to counteract the "tripping effect." Should the craft be thrown sideways in a seaway, the leeward fin is blanketed by the leeward hull, whilst the weather fin still grips solid water between the hulls. To relate the principle to the every day motor car, if we corner too fast the low centre of gravity in relation to grip on tyres will cause a skid, which is preferable to turning over.

4 Though not specifically intended for this purpose, the fins have proved excellent for steerage way under power with one engine. She can be turned hard to port under port engine, with a strong cross wind on the port side. Using two Ford (Anglia) inboard engines, the speed is 8 knots, and consumption 1 gallon per hour per engine.

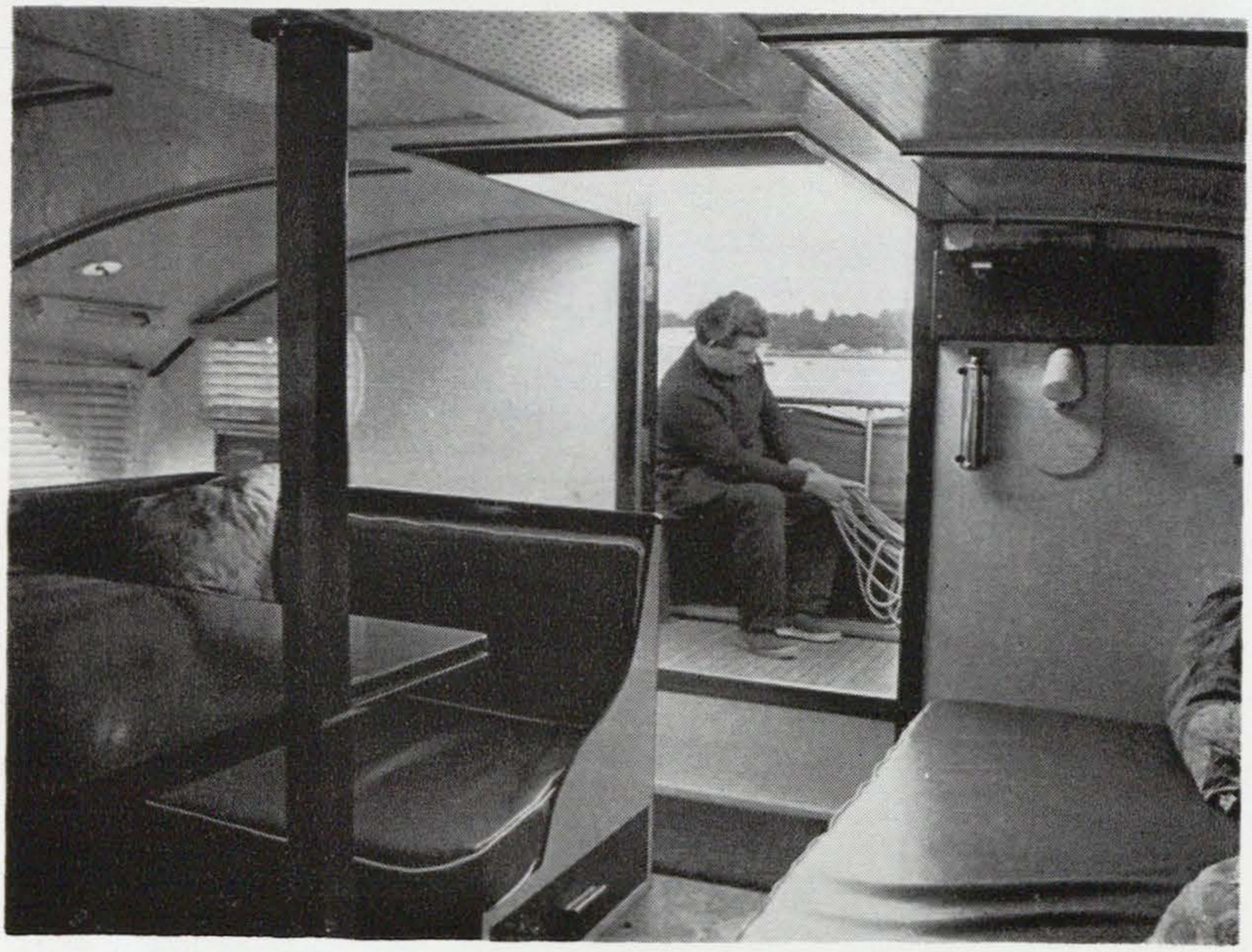
There can be no doubt that the high aspect ratio Bermuda Rig is superior to Ketch or Yawl where speed alone is a requirement, but due to high centre of effort of the Bermuda Rig, the nose tipping couple tends to depress the lee bow on catamarans: on the smaller racing types, this is counteracted by the crew moving right aft and to weather but on cruising catamarans the movement of weight is not so simple, and the only cure in heavy weather is to reef the mainsail.

The Ketch Rig obviates this, because the driving force is spread along the boat, rather than high, furthermore the two spars permit a good spread of canvas in light airs, and the whole rig is easy to deal with single-handed. All halyards and sheets lead to the cockpit, and should it be necessary to reef the mainsail, this can be done through one of the hatches above the forward cabins to avoid going out on deck when big seas are running.

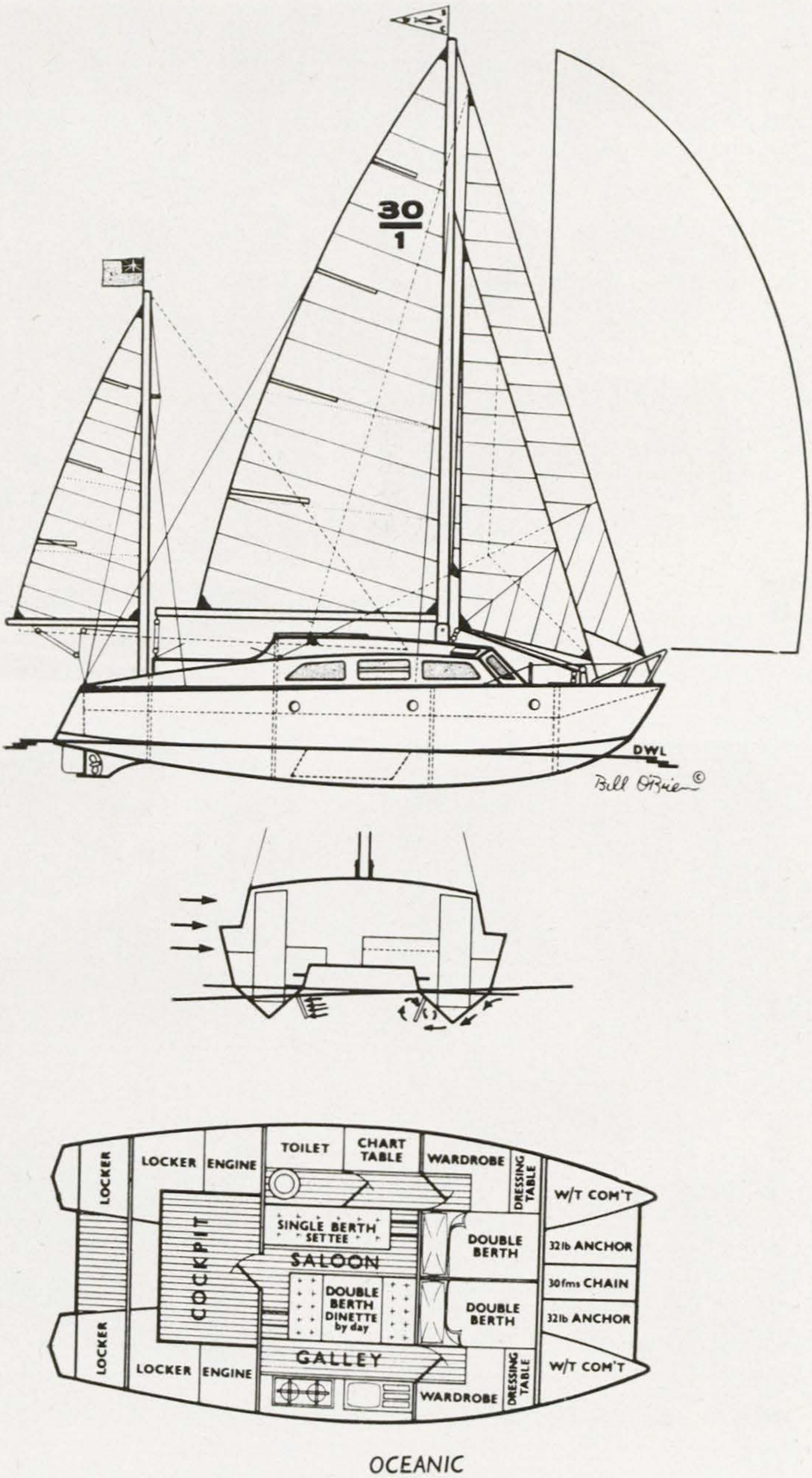
OCEANIC



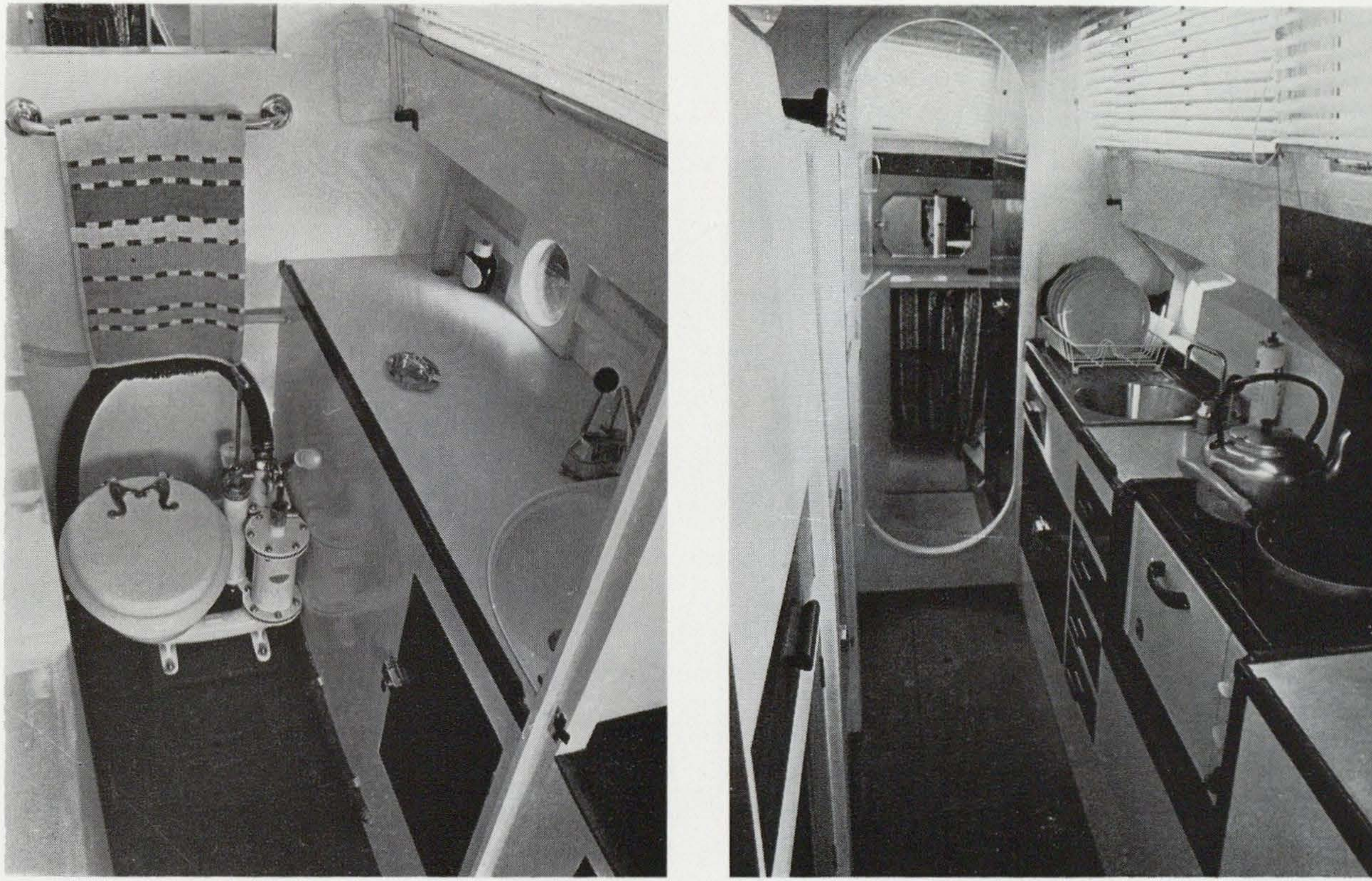
OCEANIC Saloon looking forward



OCEANIC Saloon looking aft


30
1
DWL
Bill O'Brien ©
LOCKER
LOCKER
ENGINE
TOILET
CHART TABLE
WARDROBE
DRESSING TABLE
W/T COM'T
COCKPIT
SINGLE BERTH SETTEE
SALOON
DOUBLE BERTH
32lb ANCHOR
30fms CHAIN
DOUBLE BERTH DINETTE by day
DOUBLE BERTH
32lb ANCHOR
GALLEY
LOCKER
LOCKER
ENGINE
WARDROBE
DRESSING TABLE
W/T COM'T

OCEANIC



OCEANIC's hulls looking forward

OCEANIC 30ft MARK II

October, 1971

By courtesy, Editor, YACHTING MONTHLY

L.O.A.	30 ft 0 in	Beam	14 ft 10 in
Draught	2 ft 0 in	Displacement	4·3 tons
Berths	7	Engines	2 × MD2 Volvo Penta diesels £1,650
Sail Areas, ketch rig:			
Main	187·5 sq ft		
Mizzen	74·375 sq ft	Standard Price £6,145 ex engines	
Staysail	78 sq ft	YM Basic Price Index £8,130·50	
Masthead genoa	290 sq ft		
Spinnaker	800 sq ft		
Yankee	144·5 sq ft		

YACHTING MONTHLY Index figure: To include the following: engine, spars, rigging, deck hardware, cabin and nav. lights, winches, guardrails, pulpits, anchor/cable, bilge pump, fenders, warps, tanks, W.C., mattresses, galley and cooker, echo sounder, compass, log, mainsail, genoa, jib, storm jib, spinnaker, registration.

Bill O'Brien believes that he has the answer when it comes to making cruising catamarans safe. His belief, exemplified in his *Bobcats* and his *Oceanic*, is to undercanvas them, so that, however foolish the owner, unless he buys more sails, his boat will not overturn. Couple this with tubby hulls which positively invite you to load them up well and you've got another very powerful capsize deterrent.

My trial sail was during the 1969 Southampton Boat Show on a private *Oceanic* called *JANIKA* with the owners Dr and Mrs Vandy as crew. We were also lucky enough to have with us an ex-RN officer of charming disposition. Being on a private yacht I had a much better chance of getting a true impression of the boat as *JANIKA* had been sailed for a year and was tested with all the usual gear that the average family collects.

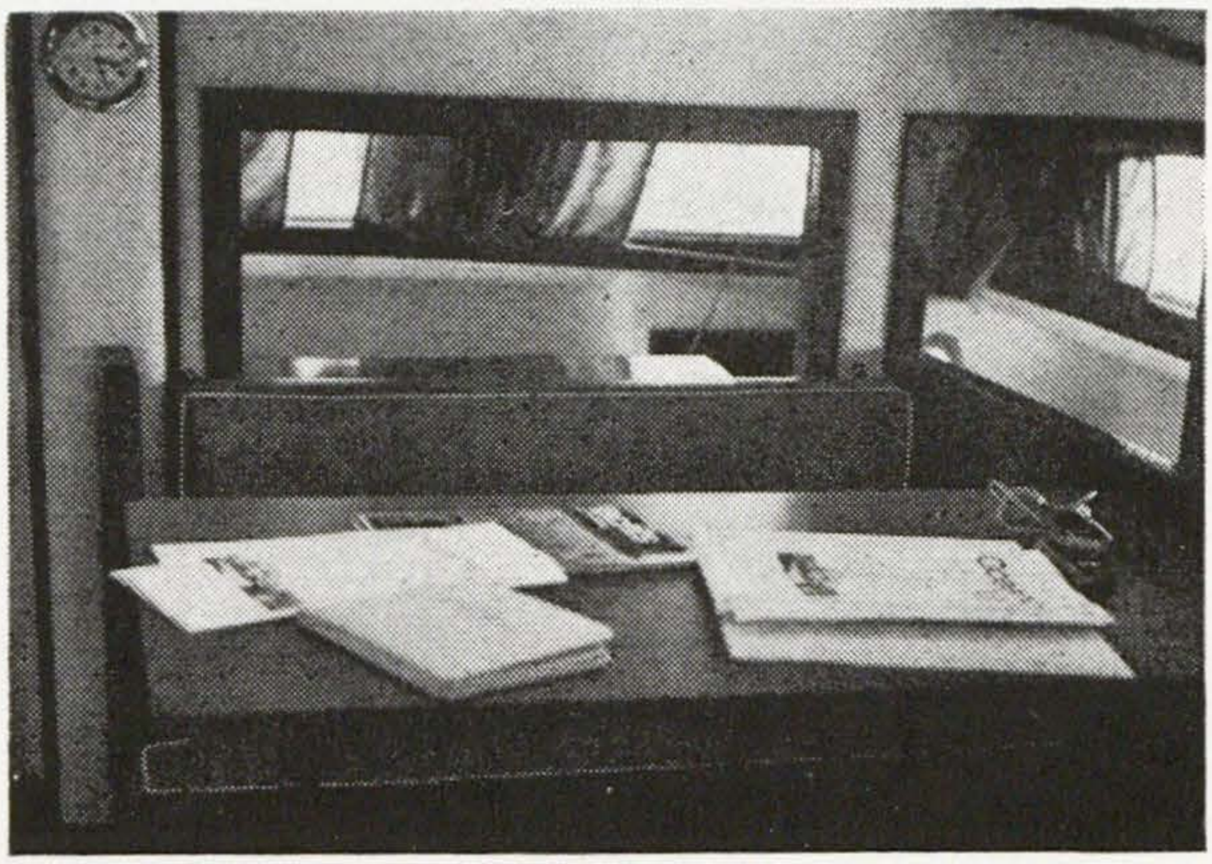
Down below, few concessions to weight saving had been made. The interior would make the average monohull sailor gasp and it made even my eyes open a little wider.

The bunks are on the forward end of the bridge deck, where Rudy Choy says bunks should be, as they are quieter there away from the rush of the water—although I should have thought the odd thump under the bridge deck would be fairly hair-raising. These little staterooms are really palatial with full standing headroom for changing, plenty of light, and cupboards galore. Aft to starboard is the king-sized galley and in the port hull the navigation area and W.C. compartment. Plenty of room everywhere to swing a monohull, this is particularly true on the bridge deck where the dinette is. The dinette is an excellent eating area, and there is even standing headroom under the large doghouse, but it suffers from the usual complaint of dinettes. They are excellent for civilised eating, but imagine being condemned to sitting always at the dining table. Somebody one day will design a dinette which simply rearranged, will give comfortable lounging seats with corners that you can chock yourself into.

On deck, one steps out into a small ballroom which Bill O'Brien calls the cockpit. Under the cockpit seats were the two Penta MD2 engines, one in each hull. *JANIKA* is rigged as a yawl which is ocean cruising rig and the

OCEANIC *Photo: Baker*

sails would be normally used in ideal running and reaching conditions, with the engine being used as the main form of propulsion. I think that it is a rare cruising man these days who does not use whichever form of propulsion that seems most efficient at any given moment and the *Oceanic* is immaculately powered but under-Terylened.

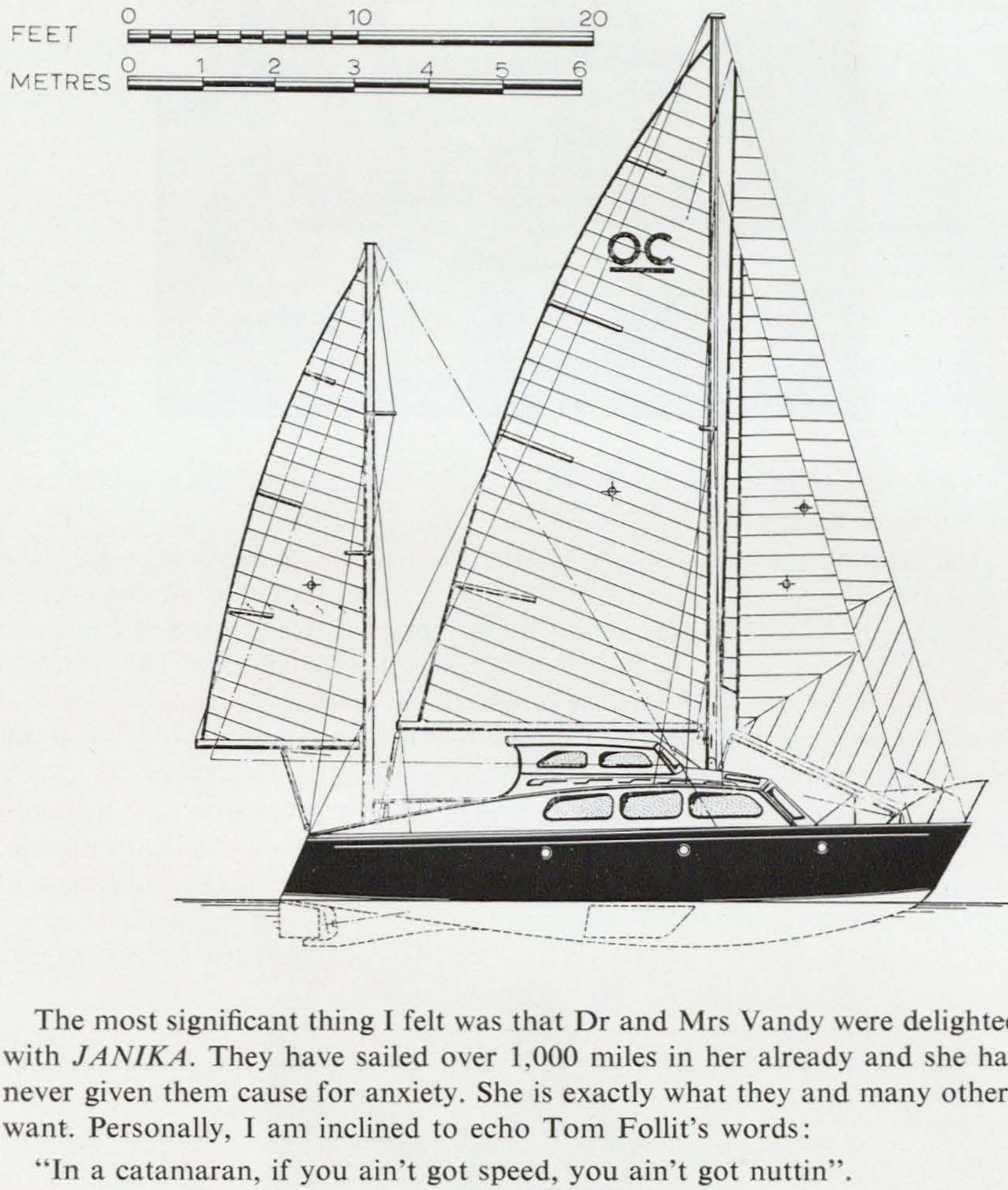


We gave *JANIKA* a thorough work out under sail and power which confirmed these findings.

The steering position is on a plinth; the helmsman peeps over the high coachroof like Mr Chad in front of a huge wheel mounted on the cockpit bulkhead. *JANIKA's* had as an extra the Pinta self-steering which I imagine must make cruising across the Channel on a sunny flat calm day absolute bliss. Imagine deckchairs on the foredeck, a long cool drink, a copy of PLAYBOY and Pinta at the helm for hour after hour never tiring, never off course.

The rig has been designed so that a man and his wife can easily handle it The staysail is boomed and can virtually be left alone to get on with the job. If caught out in a blow one could snug down under mizzen and staysail quite comfortably.

I saw the list of owners which included seven doctors, and six senior officers in both the British and American armed forces. From their ranks, I got the impression they were probably in their forties and fifties rather than the younger age groups, which is understandable when you remember the accent is on safety, comfort and ease of sailing rather than speed and sailing ability. Ocean cruisers and people wanting to live aboard are also on the list of owners.



The most significant thing I felt was that Dr and Mrs Vandy were delighted with *JANIKA*. They have sailed over 1,000 miles in her already and she has never given them cause for anxiety. She is exactly what they and many others want. Personally, I am inclined to echo Tom Follit's words:

"In a catamaran, if you ain't got speed, you ain't got nuttin".

But then, not everybody wants the extra anxiety that the extra sail area necessarily brings with it which would make her faster—I have heard of no *Oceanic* turning over.

CHAPTER XXVII

TEHINI

October, 1971

Built for ocean cruising, she is one of James Wharram's Polynesian catamarans. He explains some of the thinking that lay behind her controversial design.

By courtesy of Editor, YACHTING MONTHLY

TEHINI Sail Data

JUNK RIG

L.O.A.	51 ft
Working Sail Area	1,013 sq ft
For light winds:	
Genoa	530 sq ft
Mizzen staysail	297 sq ft
Maximum sail area	1,645 sq ft
Ratio of sail area to the ton displacement:	
Lightly loaded with working rig	200 sq ft
With genoa and mizzen staysail	330 sq ft
Fully loaded with working rig	140 sq ft
With genoa and mizen staysail	230 sq ft

Calculated stability under working rig with sails sheeted tight:

Lightly loaded (1 ton) up to 35 mph	Force 7-8
With 2 tons	8-9
Fully loaded (3 tons)	8-9

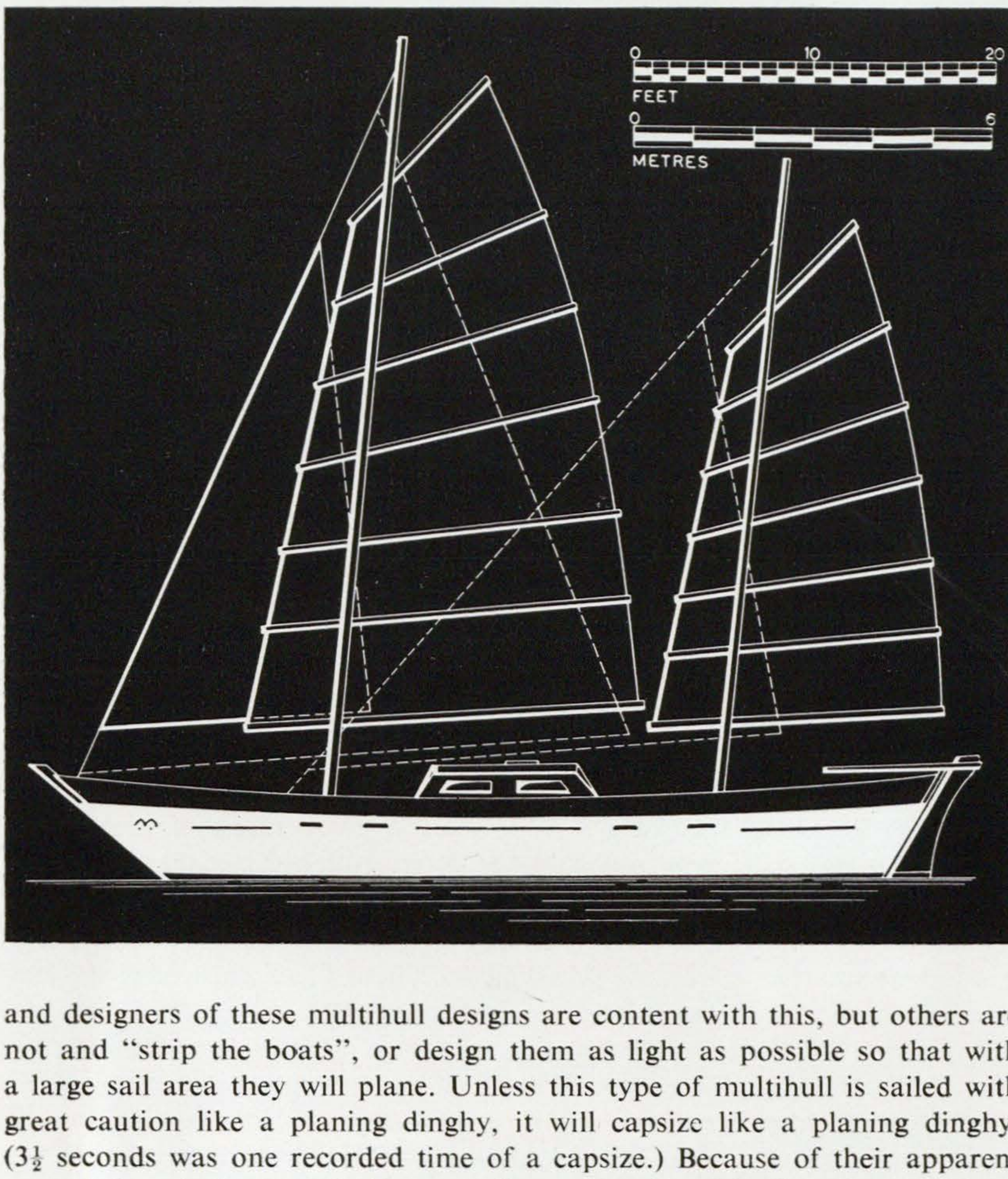
TEHINI is my ship, designed and built to carry the basic staff of "Polynesian Catamarans" swiftly, safely and comfortably anywhere in the world.

In describing her I am describing the ideas behind my other nine stock catamaran designs. Although I have sold over 800 sets of plans, I must be unique as a designer in that I have never designed for a specific customer, but just designed a boat to please myself under a given range of conditions. Telepathy must exist for no sooner is the design roughed out than enquiries pour in.

TEHINI, like the fast American clipper ships is built of softwoods. Early in my design career, I lived in Scandinavia, where I saw softwoods used in furniture, houses and boats. I was overwhelmed with the graceful elegance that one can achieve in softwoods, but my desire to build in wood and plywood was not solely due to my "love affair" with wood. I did examine the possibilities of fibre glass and GRP foam sandwich construction but in cost/strength/lightness ratio, wood was supreme. Not that it always will be, for during the building of *TEHINI* timber costs rose 20 per cent. It will become a luxury material in my lifetime so while I can, I intend to enjoy wood.

Multihulls obtain speeds greater than the $\sqrt{WLL} \times 1{\cdot}25$ in two ways. The "Western way" is by using the planing hull shapes as developed in the early power-boats. The main hull of a trimaran, or the two hulls of a catamaran, have a beam length ratio of 6 : 1 to 8 : 1, with a semi-circular, or arc section below the waterline, and practically straight up and down topsides above the waterline.

Theoretically, it seems an ideal space-giving shape and it has produced some very fast multihulls. Unfortunately, it has also produced heartbreak, capsizes and drownings. Heartbreak, because if you utilise the apparently roomy hulls for accommodation, the weight will prevent the boat rising on the plane, and the boat will have no more speed than a keelboat. Some owners



and designers of these multihull designs are content with this, but others are not and "strip the boats", or design them as light as possible so that with a large sail area they will plane. Unless this type of multihull is sailed with great caution like a planing dinghy, it will capsize like a planing dinghy. ($3\frac{1}{2}$ seconds was one recorded time of a capsize.) Because of their apparent space below decks these designs are often sold as "cruising" designs and have brought obloquy to the whole multihull movement.

The original home of multihulls is in the Pacific where they were used by two seafaring peoples, the Micronesians and the Polynesians. For deep sea sailing against the wind they used "Veed" hulls with a narrow beam/length ratio of, at the widest, about 12 : 1, and, at the finest, about 20 : 1.

The "wave barrier" of a monohulled displacement boat is, to repeat, $\sqrt{WLL} \times 1{\cdot}25$. After that speed it drags too big a hull wave to go any faster. While a planing dinghy, scow, or planing multihull goes, as it were, over the wave barrier, the fine "Veed" hull form of the Pacific goes through the wave barrier by reason of its design shape, in the same way as supersonic aircraft go through the sound barrier.

The advantages of a "Veed' hull form for a fast sea-going catamaran are as follows:

1 It is a "displacement" form, ie weight is not a critical factor in obtaining speeds above the $\sqrt{WLL} \times 1{\cdot}25$, and one can carry "useful" weight, stores, etc for long voyages.

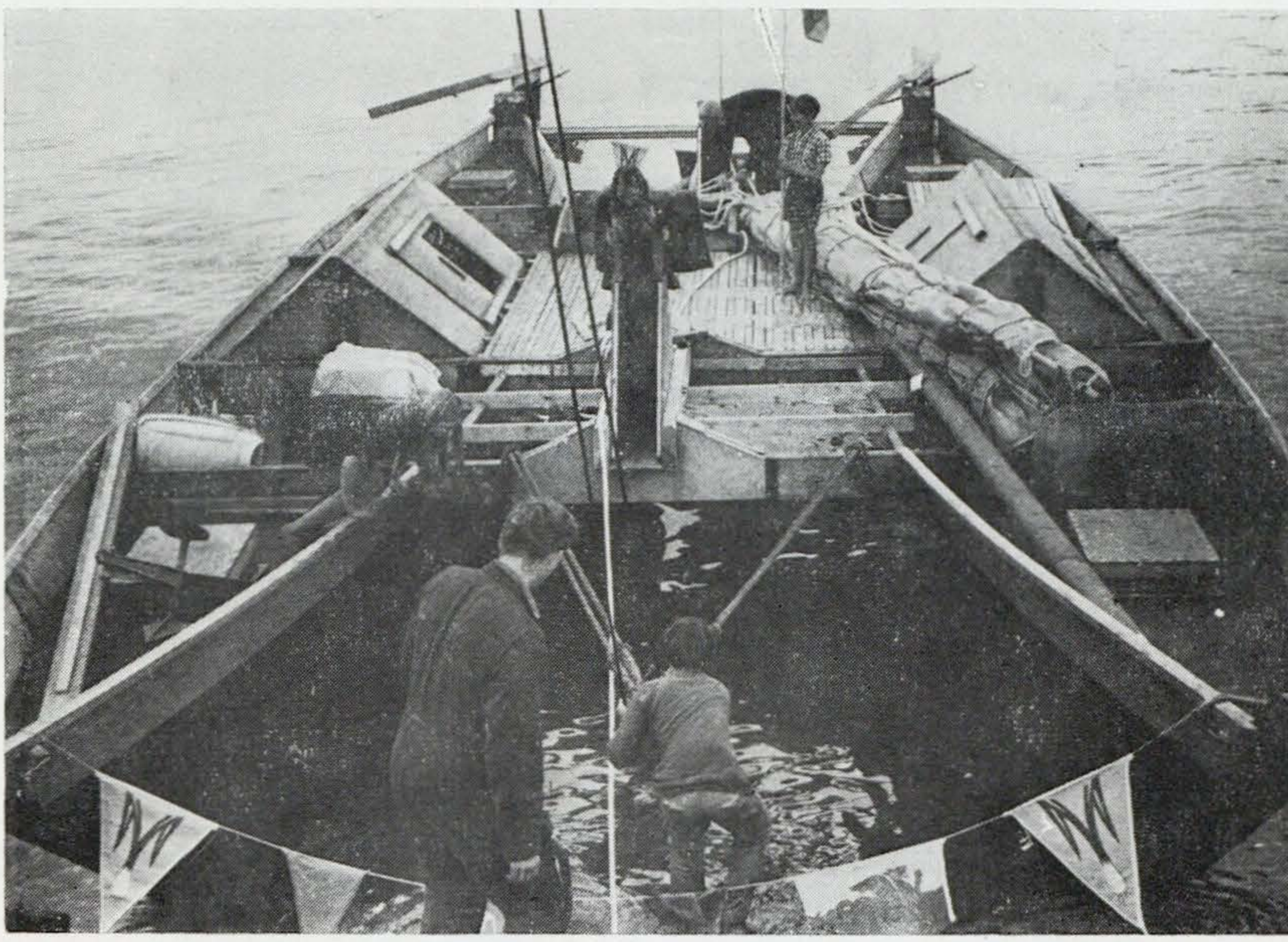
2 This weight placed low down in the ship acts as positive ballast and it is possible to give a catamaran the same stability that traditional sailing ships have always had, (the modern keel yacht is something rather special in sailboat stability history).

3 The weight carried acts as a damper to wild motion and assists tacking.

4 The hull form goes well to windward without (except for utmost racing efficiency), the needs for centreboard or keels.

5 It does not pound.

One disadvantage of the "Veed" hull form is the space it provides. On a given waterline, the waterline beam of the arc bottom planing type will be at least twice as great as the "Veed" hull form, for example, 4 ft on a 28 ft waterline length arc bottom catamaran, only 2 ft on a "Veed" hull of an



TEHINI after launching

equivalent waterline length. If you want the craft to plane, then the space of the arc bottomed type is only an illusion—certainly it is no use for carrying gear. Still, to stand or sit in a roomy hull is better than being in a plywood "slit trench", which the "Veed" hull can resemble. To get good living space in a "Veed" hull, one must use a symmetrical "V" as against an asymmetrical "V", as shown in Fig. 1.

For years there has been a running argument between myself, user of the symmetrical "V" since 1957, and the Hawaiian school of catamaran design who have used the asymmetrical "V". However, after building 92 asymmetrical "V" hulled catamarans, they tried a symmetrical "V" hull form and the owner and the designer of *POLYNESIAN CONCEPT* have agreed in print that it is better than the previous asymmetrical designs. So, it would appear that the asymmetrical "V" versus symmetrical "V" dispute is finished in favour of the symmetrical "V".

An important advantage of the symmetrical "V" hull is shown in Fig. 2. It is a very difficult hull form to capsize due to the flare on the outside of the hull.

The design of the "rocker" on the keel in the profile section is a matter of experience. With too much rocker the boat will tack fast, but make leeway and she is hard to steer. With too little rocker, the boat will steer easily but is the devil to tack. The substantial skeg strengthens the bottom of the rudder and when surfing before a gale holds the boat true on course.

I use wide shallow rudders in line with the base line of the keel. They are adequate for tacking and give no problems in shallow water or when beaching.

TEHINI has a 40 ft waterline and a 52 ft overall length. From a strict space/cargo point of view, this is 12 ft of wasted boat. At sea it is a different matter, for the bow overhangs lean over the sea and lift in a graceful, easy fashion. The extra buoyancy in the flared overhangs prevent the lee bow from nose-diving and cartwheeling the catamaran.

Fig. 3 shows how it acts running down a heavy sea. An owner of one of my 45 ft designs confirmed the theory.

"She seems to slide up on the wave, rather than dive into it."

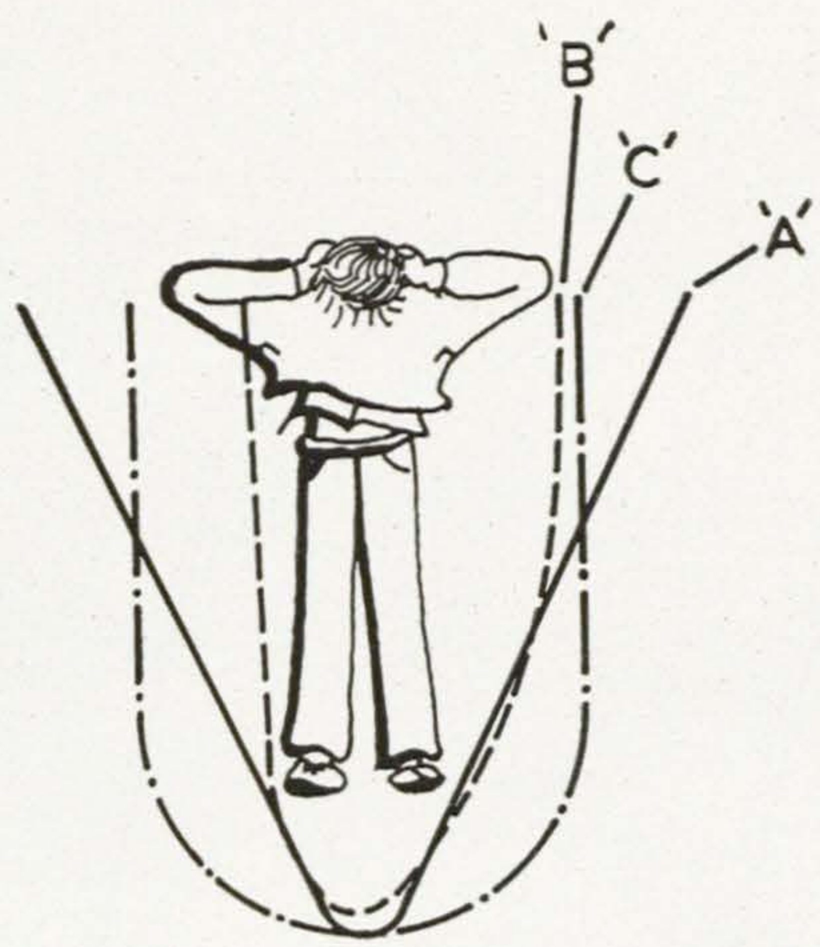


Fig. 1. (a) Symmetrical 'V'. (b) Asymmetrical 'V'. (c) Arc-bottom. Man removing oilies has most space at shoulder height with (a), at floor level with (c) and least space with (b).

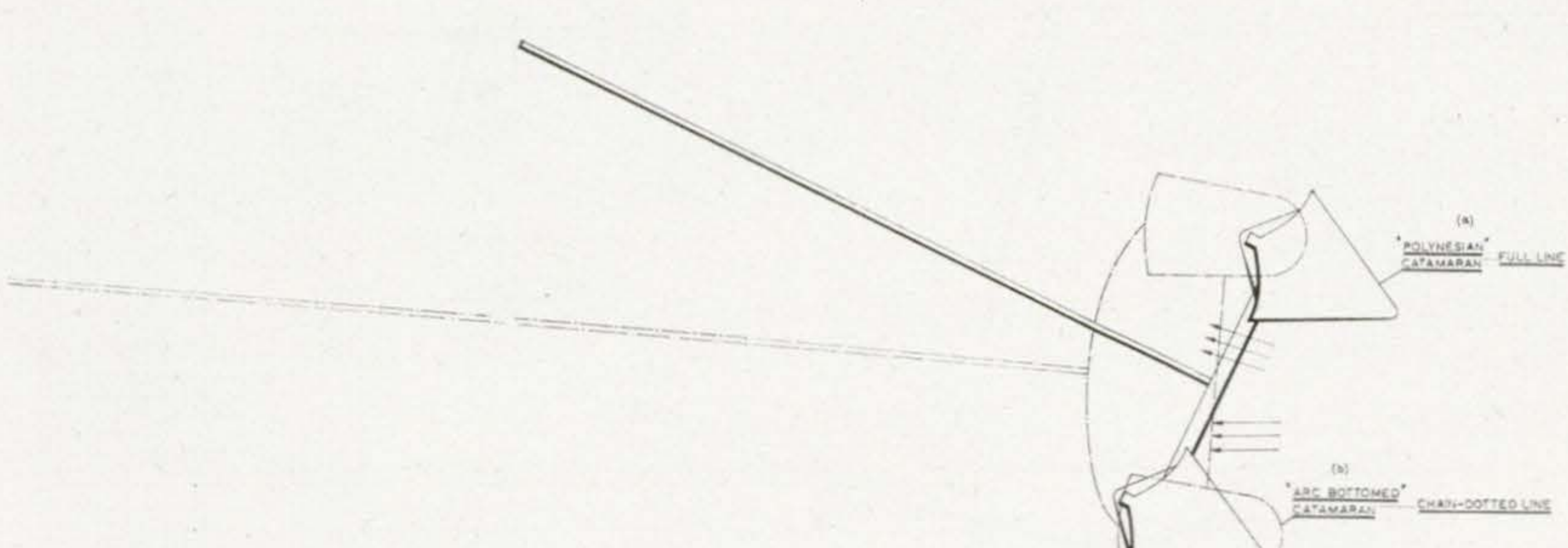


Fig. 2

The freeboard of all my designs is always as low as permissible in relation to the accommodation. High freeboard creates windage (Figs. 2 and 3), hinders tacking and causes leeway. There is no precice formula to define freeboard, only the "rules of thumb" arising out of design experience.

Similarly, there is no precise formula for the sheerlines. Sheerlines are basically a matter of aesthetics. I don't like reverse sheers (no doubt for deep "Jungian arche-type" reasons), or low sterns. In a severe gale there comes the time when the best safety factor is to turn and "run", steering before the storm, running, either free surfing the seas, or with drags out (motor tyres on warps trailing from each stern), slowing the boat down, but still having sufficient speed to steer the stern into the oncoming waves. Whether running free or with drags depends on the weather and sea conditions.

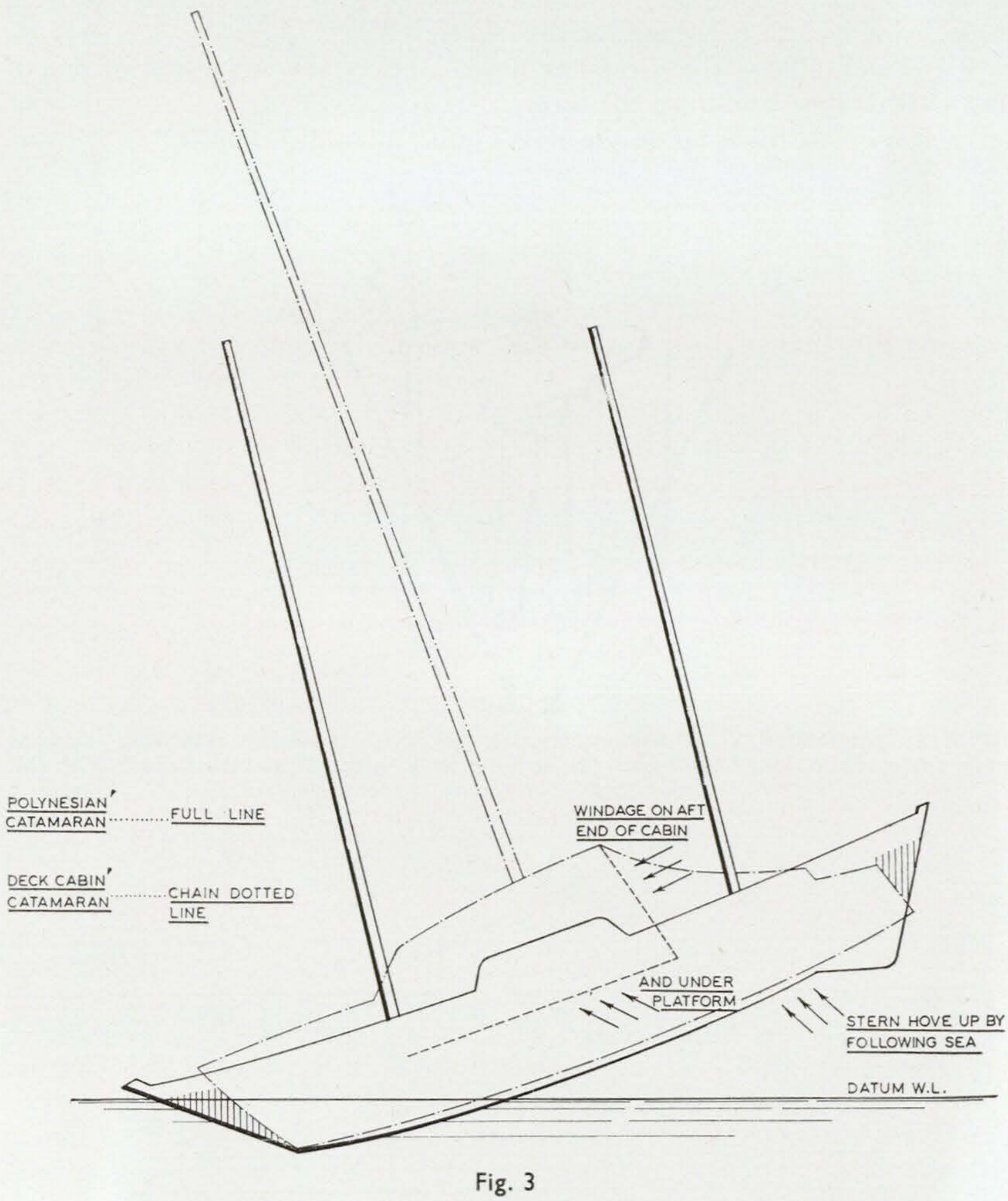


Fig. 3

This desire of mine to have the utmost gale safety (as distinct from light weather performance), is shown clearly in the plan view of *TEHINI*.

There is no deck cabin joining the hulls, only a slatted deck of platform. The cockpit shelters can be closed up, making the hulls flush decked from one end to the other.

The uniting crossbeams are flexibly fastened on top of the decks so that each hull can move independently of the other. The canoe sterns are similar to the bows to ride following seas.

These features, along with the symmetrical "Veed" hulls, have made my catamarans unique in modern multihull design. They arise out of my desire to survive in the worst gales the sea may offer. In "The Great Gale" I hope never to meet, the platform can wash away, the seas smash up between the hulls, and roll over the flush decks. With her stores low down, and low windage, *TEHINI* should ride like a raft, the ancient raft and modern inflatable type being the accepted hope of survival when the conventional ship is overwhelmed.

This preoccupation with what the sea might do, arises from my four Atlantic crossings by catamaran.

The Prout Brothers and Bill O'Brien have shown conclusively that for normal gales around the coast, indeed for 95 per cent of ordinary sailing, the two hulls of a catamaran can be rigidly united by a deck cabin, and be strong and safe in hard weather and that my designing for the "ultimate" is perhaps unnecessary. I accept the criticism, but a catamaran flexibly fastened with no deck cabin has advantages apart from utmost survival. It is easier and cheaper to build and transport, faster due to less windage, and with the lower centre of gravity, one can carry more sail longer. The deck space of a "cabinless" Polynesian catamaran is enormous. In harbour, we can erect a deck tent and use the space.

For 16 years I have lived on catamarans, in the Tropics, Sub-tropics, and "snow-decked" British anchorages. I have come to the conclusion that the interior layout of a boat should be either absolutely luxurious, which includes air conditioning, adequate bathrooms, deep freeze, etc, or close attention given to "basic boat comfort". To attempt to mix the two is bad design, expensive and uncomfortable.

The basic comforts in boat design are:

1 Private, dry comfortable bunks for sleeping

2 Ample space for cooking and washing dishes

3 Ample navigation space

4 The need to creat a sheltering Micro Environment.

I use the mid-section (it being the part of the ship with the least motion), of each hull as the "work" space. In one hull, it is the galley with a workbench 10 ft long. This enables two girls to work efficiently at once. They can turn out a full meal for fifteen people (and have done so). Fifteen people cannot sit around one table, but who cares where you eat as long as you do eat regularly and on time!

The mid-section of the other hull is the chartroom/library/office, with a 5 ft × 3 ft chart table. It is the "quiet room" for reading, writing, and occasionally listening to music.

Fore and aft of the working sections are bunk cabins, rather like large quarter berths; large because they have 3 ft headroom over the bunk cushions, and sleep two comfortably, with ample space under the bunk to store personal possessions.

Moving forward and aft of the main watertight bulkheads are the two bow and two stern compartments. One stern cabin, well away from the rest of the ship, is the toilet compartment, while the other three are used as crew cabins, or on long voyages as storage holds. Eight people can comfortably live on *TEHINI*, and eleven to twelve under normal "yachtsman's" crowded conditions.

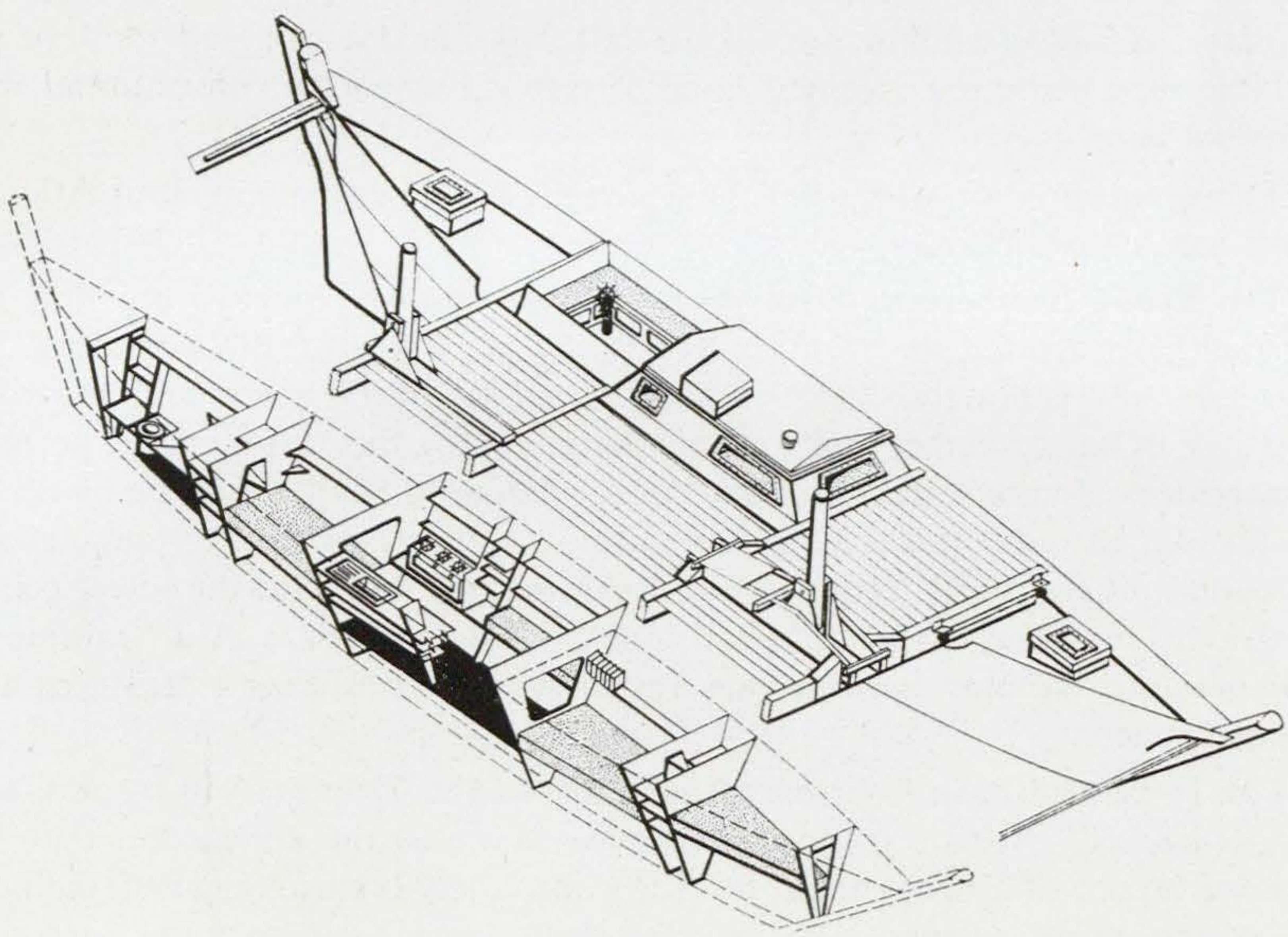


Fig. 4

Item 4 on my list, "The need to create a sheltering Micro Environment", appears to be forgotten in modern interior boat design, particularly by the "trendy non-boatman" designers who figure so well at the Boat Show. The sun, sea, storms, waves are immense and powerful beyond the understanding of any ordinary city dweller. Their vastness can be felt a few miles off the coast as equally as on the deep ocean. One has to provide the sailor's ego with a reassuring retreat in which to relax. The old wooden yachts did this superbly. Going below the visible structure of the ship, deck beams, ribs, carlins, projecting washer head etc, gave immediate reassurance that all was well. Wood is a sympathetic natural material, not only beautiful in its own right, but subsconsciously evoking land, forests, shady glades, a complete contrast to the vastness as seen from the deck. In old yachts port holes were only big enough to light up the interior of the ship, another detail in ego-protection.

Modern yachts, particularly multihulls, have enormous glass-house windows. Not only are they dangerous in a storm, but there is no escape from the "outside". (Modern high flats with large windows have been shown to increase emotional problems.)

The inside of *TEHINI* is lightly polished fir. The shapes of the entry ports into the bunk cabins and clothes lockers are archetype shapes. Window ports are as small as possible, and require a positive glance to see out at the sea. Only low sun angles can shine directly into the cabins, and lit by soft sun, the fir glows golden. Because of the wood grain and the angle the boat is lying to the sun, the permutations of shapes, colours, light and textures, are endless, compared to the very limited range of variables available with synthetic materials and large windows.

Finally, the rig and performance of *TEHINI* to date. Performance is related to rig and it will surprise many people to see the fast hull form of a catamaran married to the apparently slow rig of the Chinese lugsail. The calculated speeds based on data from a smaller design of mine with a similar hull form are as follows.

Hourly averages of 14 knots-17 knots, with bursts of up to 22 knots. To achieve these speeds in practice would require the full elaborate get-up of the Bermudian rig—expensive, tall aluminium spars, a factory output of headsails, spinnakers, etc, winches all over the place at over £30 a time, a total capital outlay of at least £2,000, to say nothing of having to find and feed five burly men to handle the outfit.

TEHINI's staysail, mainsail and mizzensail total 1,000 sq ft and cost £360 (superbly made by Jeckells). The main and mizzen masts, "grown sticks", and standing rigging, cost approximately £76. I can hoist the 500 sq ft mainsail with the assistance of one light-bodied 21 year old girl (easier on the eye than a man and eats less).

Reefing, particularly in a panic is difficult with a Bermudian rig, but my 12 year old son, Hannes, can reef the Chinese lugsail. Let go the main halyard and the mainsail folds down into its nest of ropes. "Nest" of ropes is the operative word, for the Chinese lugsail rig is not a crude rig for amateurs. In its larger sizes, it is a complex balance of rope tensions. If the end of one of the running sheetlets, lazy jacks, parallels, throat halyard, etc is in the wrong place, the sail will not work efficiently.

I chose the rig because I knew I would be sailing perpetually short-handed compared to weekend racing yacht standards. If a deep sea boat can sail well 5 points off the wind, it is efficient enough. I thought the rig would do at least that. Any part of it can be easily repaired, both at sea or in some out of the way part of the world, and it does not impart great strains on the fabric of the hulls.

To our surprise, in winds of 7-8 mph, ie Force 3, tacking to windward (compass checked), *TEHINI* made 5 knots, 45° off the wind, and her speed went up to $6\frac{1}{2}$ knots 55° off the wind (with working rig only). In heavy weather sea trials (Force 5-7) she made 8 knots close hauled.

These figures seem low compared to the advertised claims of multihull designs in the past, but there seems no doubt that *TEHINI* under her Chinese lugsail rig can easily reach her maximum waterline length speed of 8·8 knots, ie $\sqrt{WLL} \times 1{\cdot}25$. Therefore on ocean voyages she should make daily averages of about 200 miles a day. It is not much to "exaggerated figure fed" yachtsmen, but it was Sir Francis Chichester's dream to make 200 miles on approximately the same waterline length of *GIPSY MOTH IV*. He averaged only 131.

Many readers will be disappointed at the lack of mathematical formulae in my description of *TEHINI*. There is not sufficient space in this article for the full mathematics, and it is my belief that the basic of true design is the visualization of the basic concept. Mathematical formulae are but tools, as are the drawing board, squares, curves, paper (and rubber), with which to turn these concepts into a finished boat design.

CHAPTER XXVIII

ALLOUETTE

October, 1971

by C. H. Cunningham

157 Warren Road, Mordialloc 3195, Melbourne, Australia

About 1950 we, that is, Lindsay and I became interested in Catamarans. We had read about the exploits of *MANU-KAI* which, it seems, was the first really good performing cat. We started with the *YVONNE* which finished 20 ft × 7 ft 6 in × 200 sq ft of sail, rightable by its two man crew. After many requests, the *QUICKCAT* followed; then the *X.Y.* 16 ft; the *AUSTRAL* 20 ft; *C.CAT; UNICAT* 12 ft; *MANTA* 16 ft. This took us till about 1959. We then began thinking about a cruising cat which would be self righting. We had read somewhere that Woody Brown the *MANU-KAI* designer was not satisfied with catamarans for offshore work owing to the dire consequences of a knockdown. We were also aware that the lack of heavy ballast was the main reason for the impressive performance of well designed catamarans. A compromise was decided upon—sufficient ballast to right the boat with the hull designed to be unstable when upside down. The boat to be a reasonable proposition for an amateur builder. The *QUICKCAT* hull form was decided upon as we thought that it met that requirement. Lindsay went to work with the slide rule and a beam of only 12 ft 3 in was found to be the ideal to suit the overall length of 35 ft.

The 12 ft 3 in beam seemed a little narrow but figures showed that a wider beam would not be so easily rightable if upside down. A precise scale model was made from balsa wood and much fun was had sailing it on the shore of Port Phillip Bay. This gave us a wide range of conditions. We decided that the model had justified our figures and we would go ahead with the full size boat.

Dimensions were to be 35 ft O.A., 12 ft 3 in beam, 1 ft 10 in draught. Six ft headroom in each hull with 3 ft 3 in headroom in bridgedeck. Sail area 300 sq ft in main and jib. A single centre-pivoting ballasted keel with a hoist and lowering winch. This plate was 7 in thick × 2 ft 3 in × 11 ft hung on a six leg truss under the centre of the bridgedeck, the pivot point being 6 in above the waterline. Draught with keel down was 7 ft 3 in. The swinging plate was to be swung aft when driving hard down wind to off-set any nose-diving tendencies.

The rudders had swing up blades to be consistent with the keel. The area fore and aft between the hulls were netted over to reduce windage when heeled and also to save weight. The skin was $\frac{3}{8}$ in Giant Reswood plywood which comes in 7 ft × 25 ft × $\frac{3}{8}$ from Sydney. All of our designs even the fibreglass ones had these sheets of various required thicknesses incorporated in the design. The outside grain of the ply was vertical in the topside to gain rigidity and across the decks and bottoms for the same reason. The bottoms were double thickness. The hulls were sheathed with fibreglass to above the waterline and glued.

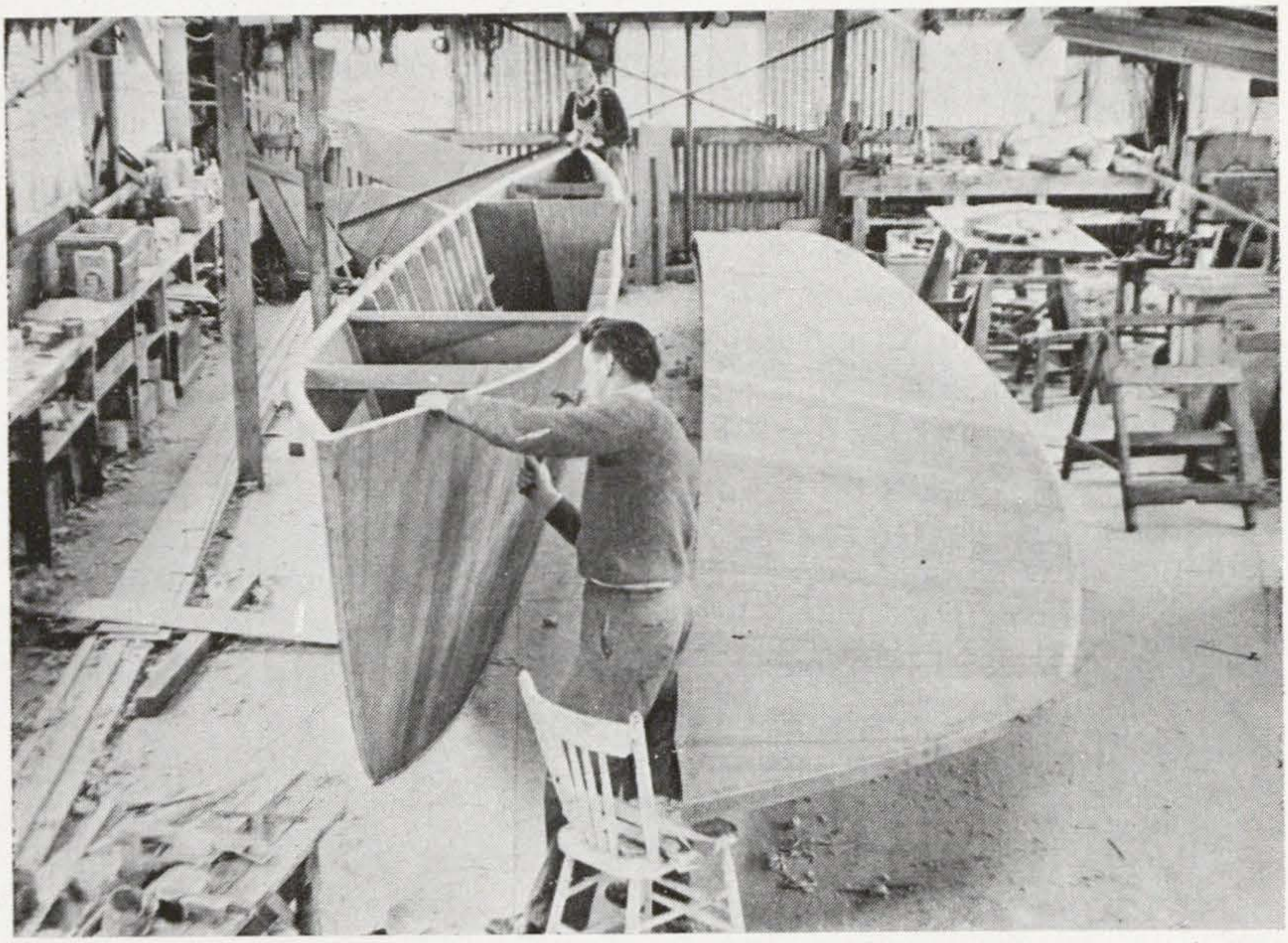
The mast was an edge nailed barrel stave type of construction assembled over formers and sheathed with fibreglass. This mast had to be water tight to assist the self-righting requirement.

A bulkhead at each end of the cabin provided sufficient stability to keep the hulls to form. Two lines of stringers were glued and nailed to the inside of the hull skin and were backed by vertical stiffeners.

ALLOUETTE

The cabin top was framed with $1\frac{1}{2}$ in $\times$ $1\frac{1}{2}$ in laminated, and skinned over with two thicknesses of $\frac{3}{16}$ in plywood. We did try coloured resin as a paint but it peeled off later.

We launched *ALLOUETTE* just in time for the Xmas summer holidays—1961—and sailed her down to Blairgowrie at the southern end of Port Phillip Bay. We had quite a good holiday using *ALLOUETTE* as a day sailer only. With as many as fourteen on board we would set out across the sand banks nudging the keel up on the sand and taking up the slack on the winch. We did enter one race but were left behind by a fleet of *YVONNES*. We did find that in heavy going we could hold them on the wind, but the light weather was disappointing.



We entered in the annual Williamstown–Geelong race of 30 odd miles. We had trouble before the start when the overnight anchor fouled an old mooring, so delaying us half an hour. With a flying downwind start in a hard north westerly "Allie" started to impress: the distant fleet backed towards us. We gained courage and hung up the genoa-cum-spinnaker. Entering Geelong we caught the B class fleet which had been our objective. She would go in fresh conditions anyway. Next morning in an around Geelong harbour race we were again reminded of her poor light weather ability. We sailed back to Melbourne next day in a freshening southerly easily outdistancing a smart eight metre boat.

The accommodation on *ALLOUETTE* was rather spartan. A small enclosed toilet at the fore-end of the port hull inside the cabin, and a gas cylinder with a small twin burner. It was apparent that twin bow waves were mounting up between the hulls causing too much drag against the keel pivot truss. Also the keel itself was obviously too thick. Trouble struck when some split links in the mooring chain failed and *ALLOUETTE* came ashore. The keel was plumb down and she must have been bumping full weight most of the way into the beach which was fortunately sandy. She lay on her starboard side with the lead foot of the keel buried in the sand. Lindsay performed a kind of war dance on finding that all of his structural designing had stood up to such a gruelling test. A slightly damaged topside from a joust with other boats on the way in was all that had happened.

We were not game to try and really capsize *ALLOUETTE*, as any time we approached this condition we gave up in fear of some costly breakage. We did try winching the mast down to a pier but the great strain on the tackle forced us to the conclusion that the righting moment was considerably greater than we had reckoned. We returned *ALLOUETTE* to the yacht yard and began some modifications. A steel envelope only 3 in thick out of $\frac{1}{8}$ in plate with the lead poured into the lower end replaced the wooden keel.

Six feet was added to the bottom of the mast with a 25 per cent sail increase. The result was definitely an improvement.

We could outsail our comparative opposites by 3 per cent in light conditions using a Genoa in under 10 knot winds. She was slightly closer-winded in all conditions and had no trouble outsailing big offshore keelers (some of them well known overseas) in the heavier conditions.

Lindsay sold *ALLOUETTE* when the Little America Cup was coming up as we were keen to join the rat-race. The chaps who bought *ALLOUETTE* were not racing types although they claimed that they were sure of winning in a strong wind. In the winter of 1968 Graham Candy and I were battling to get the L.C.C.C.T. challenge for Australia. Having some time to spare, I talked Lindsay into a re-appraisal of *ALLOUETTE*. A modified model was made with twin lee-boards on the inboard side of the hulls with half the ballast in each one. This was tested against the original model. However we found that we could not improve on the original design to any great extent and still retain the self righting ability.

One of the anchors of *ALLOUETTE's* moorings broke allowing her to swing onto a reef. Being held over this with the keel pounding on the reef for about twenty four hours proved to be a bit much for the swing plate truss and several members were replaced in metal which did provide less wind and water drag. This was about one year ago. Trouble struck again for the third and last time when the moorings let go and *ALLOUETTE* is now no more as she crashed against a large wooden breakwater and disintegrated. The owners had had ten years of happy sailing on the waters of Port Phillip.

Summing up I think *ALLOUETTE* was worth while. I have not garnished this account, putting the facts as I saw them. Another *ALLOUETTE* would be a challenge to some adventurer. I would have preferred double hull thickness and a cabin top. Otherwise, she proved herself quite adequate structurally. I am satisfied that she was far more seaworthy than most of the many multihulls that have gone offshore in the last twenty years. Many of these are built by starry-eyed amateurs with little regard for their own safety or the safety of the unfortunate people who put their trust in them. I have raised great indignation in some quarters when I suggested that none of these types be allowed to take any of these or any other yacht offshore without a proficiency certificate, more particularly when others are involved. Port Phillip is a big rough bay and just outside this is Bass Strait, one of the dirtiest stretches of water in the world. The only time we took *ALLOUETTE* out into the strait it was quite mild and was no test for seakeeping.

The Photos show *ALLOUETTE* as she was several years ago. We made the sail ourselves, having made many successful ones on smaller boats. However, we found that the big sails require different techniques and the battens in these photos do look shocking, however we eventually had the sail setting quite well.

SNOW GOOSE 1971

October, 1971

By courtesy, Editor, YACHTS AND YACHTING

SNOWGOOSE is a name synonymous with fast and extended catamaran cruising. The first boat bearing this name was built by G. Prout and Sons in 1959 for Don Robertson and since that time she has covered many hundreds of miles, won numerous races and come second in the Round Britain Race in 1970. She is still going strong and now twelve years later the new *SNOWGOOSE* class is with us and since January over 12 of these craft have been ordered.

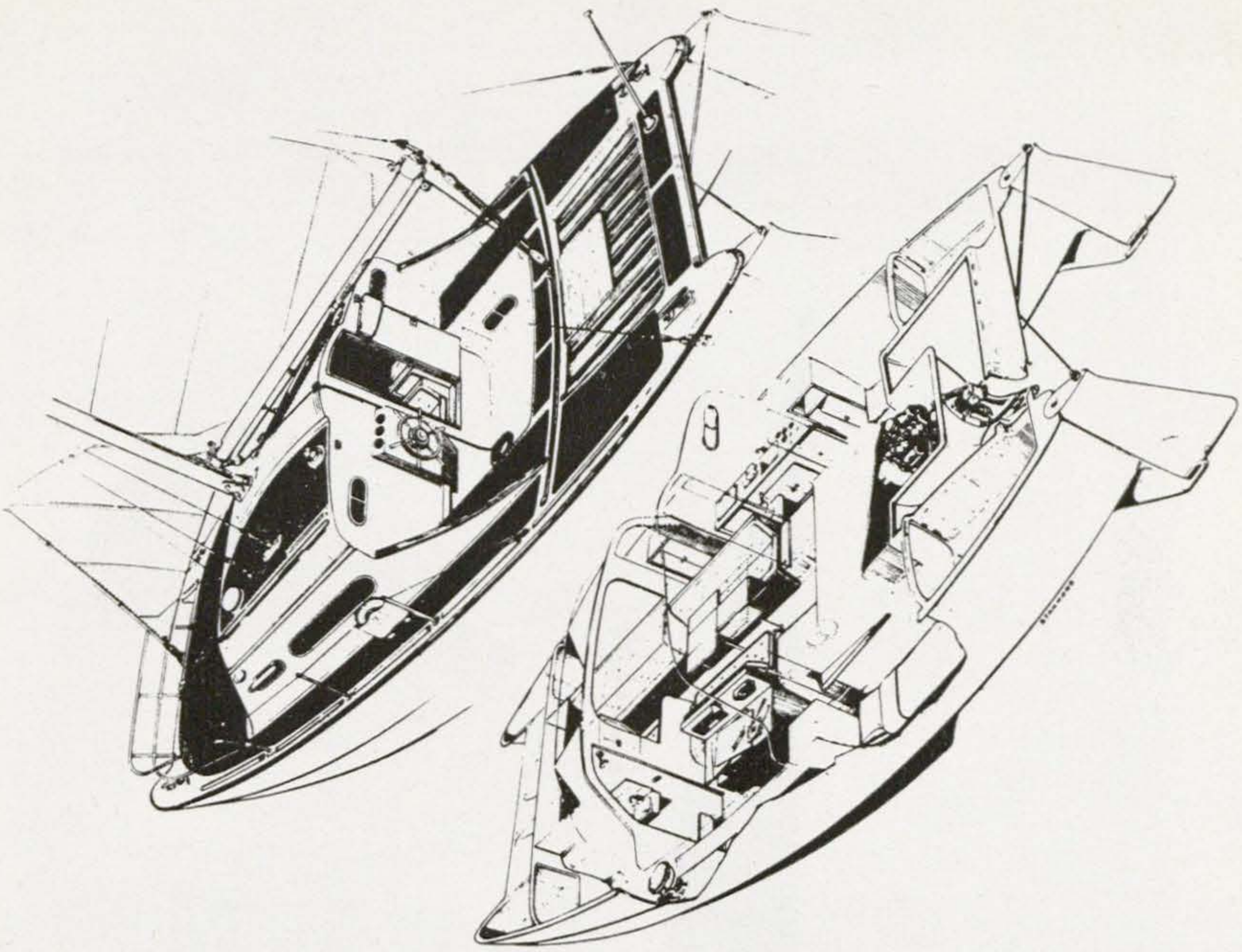
They are marketed by Prouts only this time under the name Prout Marine, The Point, Canvey Island, Essex. A canoe shape centre nacelle, running the whole length of the underbridge deck well clear of the water, strengthens the bridge and is designed virtually to eliminate slamming when ploughing through steep seas. Another factor is that an inboard engine with an outdrive leg can be mounted at the aft end of the nacelle.

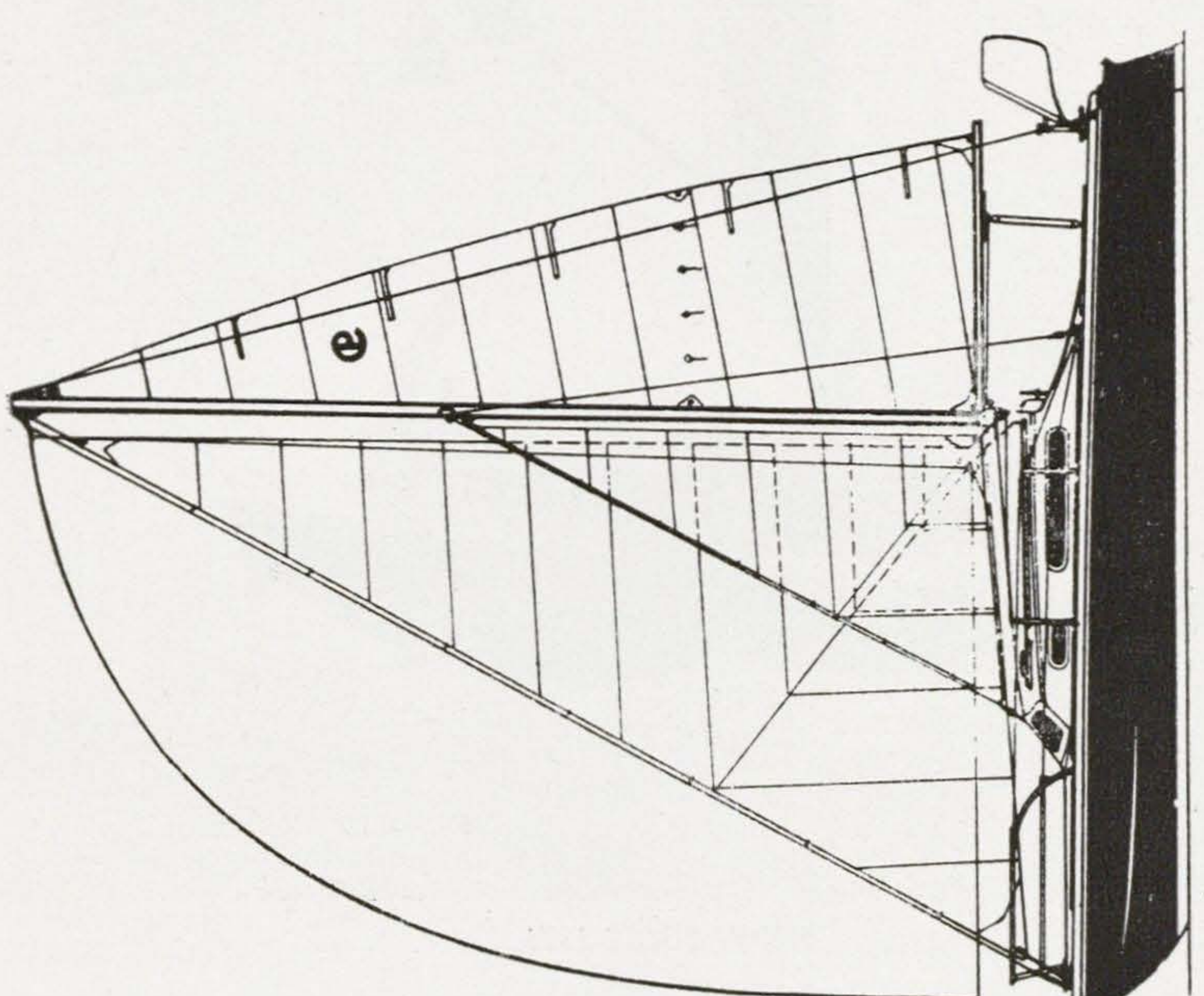
SNOWGOOSE sports twin headsails and a high aspect ratio mainsail. Her cockpit looks as though a dozen bodies could be accommodated with no trouble, but the accommodation is designed for a crew of seven. The aft deck is huge and will take a dinghy up to 11 ft o.a. with no trouble and the foredeck is equally spacious with the fore hatches flush with the deck so that working space is not hampered.

Below decks there are three quarter berths, two berths in the saloon and an owner's double berth forward. The interesting point here is that there is standing headroom in the saloon, made possible by the nacelle.

Chartwork should be easy as there is an almost self-contained navigator's compartment and plenty of chart stowage. The galley is opposite, again with generous standing headroom, and has good working surfaces. In every way she looks comfortable and spacious either for the couple who want to cruise quietly in peace or for those who want to accommodate a large family.

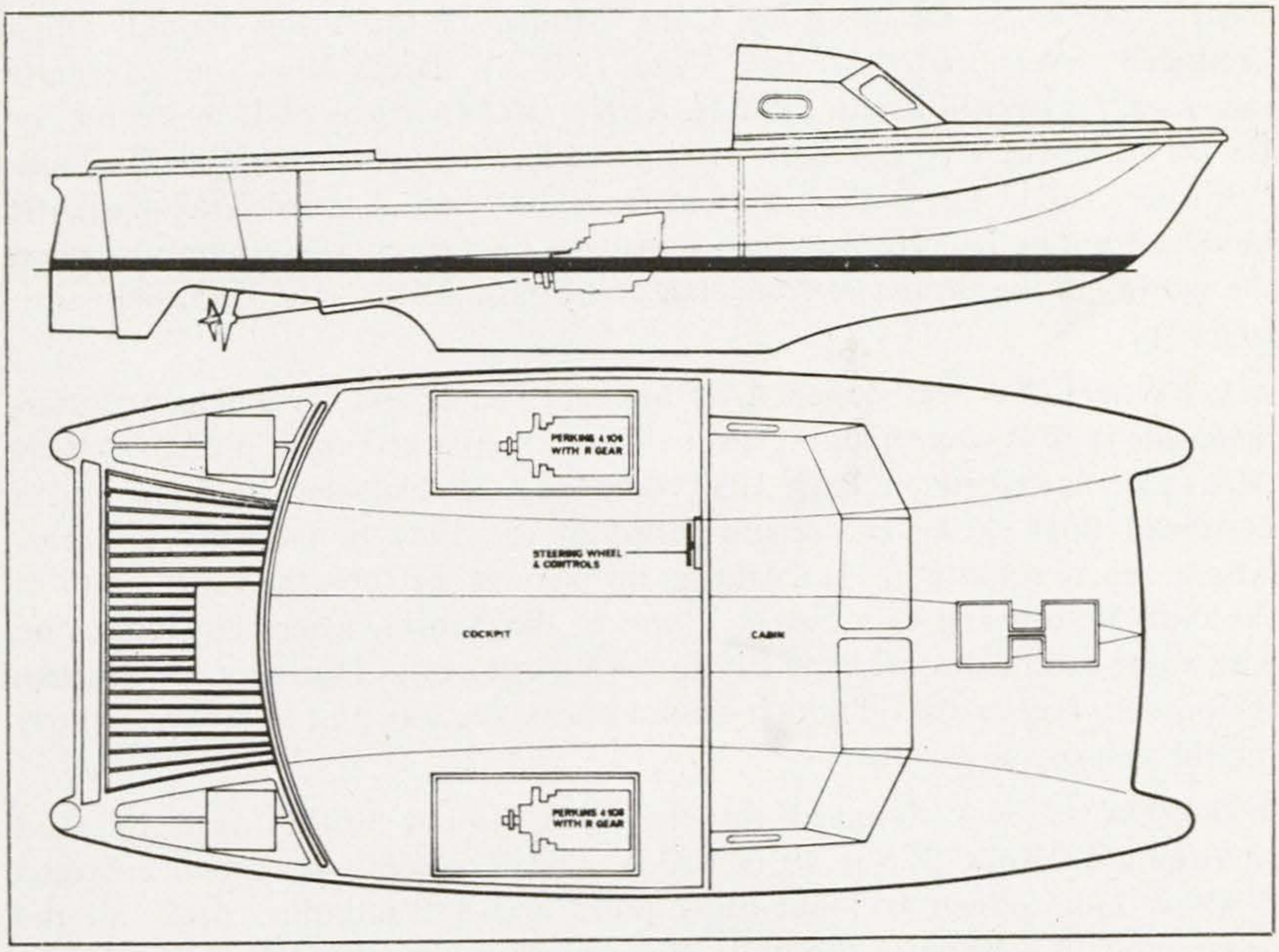
SNOW GOOSE 1971





SNOW GOOSE 1971

Comfortable accommodation for seven does not naturally turn thoughts to the stark reality of an open workboat. But *SNOWGOOSE* is available as a workhorse. With a forward cabin for shelter and two thirds left for working space she should provide an excellent, stable work platform. Two Perkins 4108 diesels with reverse provide the power and are coupled to remote controls in the cockpit. Wheel steering on the workboat is standard.



NOTEWORTHY CATAMARANS

When we had assembled this book, it was realised that several catamarans which had made outstanding voyages or were outstanding in some other way were missing. In our ordinary publications, we can only publish what we have been sent. We know we have missed some excellent cats and apologize to our readers. We hasten to describe briefly four such yachts.

REHU MOANA. Designed by Colin Mudie on the Prout mould which produced *SNOW GOOSE* (see Page 167). A flared bow and overhang increased the overall length to 40 ft. *REHU MOANA* was built by Prouts for Dr David Lewis, who was born in England and brought up in New Zealand. With her, David Lewis took part in the 1964 Single-handed Trans-Atlantic race, coming in 7th. He was then joined by his family and circumnavigated the world via the Straits of Magellan and South Africa—the first catamaran to do so.

MISTY MILLER was designed by Michael Henderson for Michael Butterfield. She is 30 ft overall and is more or less an enlarged version of *GOLDEN MILLER*, described on Page 123, complete with ballasted fin keels and a masthead float. Mike Butterfield sailed in the 1964 Single-handed Trans-Atlantic race, coming in 11th. During his passage, he took the route south of the Gulf Stream and called in at Flores in the Azores, where he stocked up with some excellent local wine before setting out again. During a rough spell, the port fin keel broke off which caused a leak needing pumping three hourly for the rest of the voyage.

MIRRORCAT was designed for the 1966 Round Britain race by Rod Macalpine-Downie. She is 40 ft L.O.A. and is composed of two enlarged C Class hulls joined by light alloy poles and a trampoline deck, all the accommodation being in the hulls. She was thus what the late Arthur Piver would have called a "Speed burner" but she hardly got to the starting line in time and had so much movement between the hulls that she couldn't be driven. Skippered by S. Fearon Wilson and crewed by her designer, she came in 5th after *TORIA* (42 ft), *SNOW GOOSE* (36 ft), *IROQUOIS* (30 ft), and *STARTLED FAWN* (33 ft).

GOLDEN COCKEREL is a C/S/K designed catamaran 43 ft L.O.A. very similar to *ALLEZ-CAT* (see Page 216). She is owned by Bill Howell and was built by Contour Craft in 1967. The hulls are the narrow, deep V, asymmetrical hulls of C/S/K and she is a very fast yacht. Bill Howell had a great deal of deep sea experience in single hulled craft before having *GOLDEN COCKEREL* built and this may have led to a capsize off the Isle of Wight in an early Crystal Trophy race. She has been sailed with more caution since in many races. *GOLDEN COCKEREL's* two most outstanding races have been the 1968 Single-handed Trans-Atlantic race and the Round Britain race of 1970. She came in fifth in both races against very strong opposition. All the yachts which beat her in the 1968 Single-handed race were longer than she but, in the Round Britain race of 1970, the redoubtable *SNOW GOOSE* (36 ft) and *MINNETAREE* (30 ft), an *Iroquois Mk. II* came in before her.

CONCLUSION

This book has, I think, included in its pages nearly everything any one could possibly want to know about cruising catamarans. There is History, Design, Tank tests and very many examples. We have set out to help everyone from designers to buyers, and have, we hope, succeeded in doing so.

From the practical examples and our knowledge of catamarans in use, there would appear to be two kinds of cruising catamaran; firstly, the cat designed and used for Offshore racing and secondly, the cat which is laden with gear and used for modest cruising.

The Offshore Racer

The design objective is to reduce wetted surface to a minimum either by extremely light weight (C/S/K) or having sections of the hull which approximate to semi-circles (Prout, Harris, MacAlpine-Downie etc.). A shallow semi-ellipse four times as wide as it is deep increases the wetted perimeter of a fixed area by 10% and will take heavy loading better than a semi-circle or deep semi-ellipse.

A lightly-built catamaran to these design principles with a lot of sail area will sail at spectacular speeds but will be capsizeable. The same catamaran, especially of the shallow hull section, will make a fast and safe cruising catamaran if the sail area is modest and it is laden with stores.

The Modest Cruiser

The broad hulled catamaran (Bill O'Brien) can take a heavy load and, with modest sail area is still faster than comparable cruising single-hulled yachts. It will not be faster than racing single hulls, however.

The catamarans with deep semi-ellipses (Myers & Ewing) will be very fast if they are very light but, in our opinion, taking loading poorly as compared with shallow semi-ellipses. It is claimed that they have an easier sea motion than broader hulls but if canoe-sterned, they can develop unpleasant pitching unless the weights are properly distributed. The *HINA* design of James Wharram approximates to that of Hugo Myers', *SYMMETRY* and is fast without centreboards. However seaworthy they may be and easy to build, the other Wharram catamarans have never done well in any races, though few to our knowledge have been given a good sail rig—the spritsail rig is poor and the junk rig, atrocious.

Capsizing

The novice and the yachtsman who has not raced a small catamaran over a a whole season has no business aboard an "Offshore racer", if fully canvassed. The O'Brien or Wharram catamarans would be quite suitable, however. Neither should capsize until the wind becomes Force 7 when, it is hoped, the size of the sea will call for a reduction of canvas. These remarks have been made because very highly experienced single-hulled sailors (Bill Howells for example) have capsized the ocean racing catamarans. We know of other examples.

The Supreme Danger

Catamarans have a shallow draft. This is one of their virtues but it can also be a danger because it can lure the unwary mariner into shallow water breaking seas. In the A.Y.R.S. Multihull Safety Study, a capsize was described of a catamaran running under jib only, and trying to get into a harbour up the Estuary of the River Elbe in Germany. A *NUGGET* trimaran capsized running into Salcombe in England in a modest wind. Both of these craft should have stayed in deep water. If you own or intend to buy a catamaran, please take note.

Finale

In spite of the possibility of capsizing a catamaran, we feel that it is safer than a comparable single hull yacht whose deep draft and heavy keel regularly cause loss of life and yachts. Catamarans are, on the whole, faster than single-hulled yachts and sail upright. They have less sail area (cruisers) and are easier to handle. They can have large windows around the bridge-deck cabin and are, as a result more pleasant in harbours.

Catamarans are really no cheaper than single-hulled yachts. However, the Wharram designs can be cheaply built by amateurs and are easier to construct than a single-hull.

Postscript

We wish all our readers happy and safe sailing in the yacht of their choice, whether it be single-hull, catamaran, trimaran or hydrofoil (though the cruising hydrofoil is only just now emerging from the minds of our inventive members into a practical yacht). The modern designs of all of these craft increase the beauty of our lives and give us health and pleasure.

All sailing needs seamanship to be safe. No one type of yacht needs more seamanship than another. They all need seamanship—just seamanship.

AMATEUR YACHT RESEARCH SOCIETY

(Founded 1955)

Woodacres, Hythe, Kent.

List of Publications at 25p or $1·00 each.

Those starred are at present out of print.

1. Catamarans
2. Hydrofoils (Included in No. 74)
†3. Sail Evolution (Reprint)
4. Outriggers
5. Sailing Hull Design
6. Outrigged Craft
7. Catamaran Construction
8. Dinghy Design
9. Sails and Aerofoils
10. American Catamarans
11. The Wishbone Rig
***12. Amateur Research**
***13. Self-Steering (see overleaf)**
14. Wingsails
***15. Catamarans Design**
16. Trimarans and Outriggers
†17. Commercial Sail
***18. Catamaran Developments**
19. Hydrofoil Craft
***20. Modern Boatbuilding**
†21. Ocean Cruising (Reprint)
***22. Catamarans 1958**
***23. Outrigger 1958**
***24. Yacht Wind Tunnels**
***25. Fibreglass**
***26. Sail Rigs**
27. Cruising Catamarans
***28. Catamarans 1959**
***29. Outriggers 1959**
***30. Tunnel and Tank**
***31. Sailing Theory**
***32. Sailboat Testing**
***33. Sails 1960**
34. Ocean Trimarans
35. Catamarans 1960
36. Floats, Foil & Fluid Flows
37. Aerodynamics 1
38. Catamarans 1961
***39. Trimarans 1961**
40. Yacht Research I
41. Yacht Research II
***42. Catamarans 1962**
***43. Trimarans 1962**
44. A.Y.R.S. Yachts
45. Basic Research
46. Catamarans 1963
47. Outriggers 1963
48. Yacht Electrics
49. Keel Yachts
50. Catamarans 1964
51. Foil & Float
52. Trimarans 1964
†53. Solo Cruising Price 40p (8/-)
54. Catamarans 1965
***55. Trimarans 1965**
56. Sailing Figures
57. Round Britain 1966
58. Practical Hydrofoils

† Publications 3, 17, 21 and 53 have been re-printed by offset litho instead of our usual print.

(Continued overleaf)

LIST OF PUBLICATIONS—*continued*

Available at 40p or $1·50 each.

***59. Multihull Design & Catamarans 1966**
***60. Multihull Seamanship & Trimarans 1966**
61. Sailing Analyses
***62. Hydrofoil Victory (Included in Publication 74)**
63. Multihull Capsizing
64. Catamarans 1967
65. Trimarans 1968
66. Foils, Ice Yachts & Sails
67. Catamarans 1969
68. Outriggers 1969

Available at 50p or $2·00 each.

70. Retirement Yachts and Polars
71. Single-handed Trans-Atlantic Races
72. Catamarans 1970
73. Trimarans 1970
76. Sail Trimming, Testing & Theory
77. Trimaran Selection
69. Multihull Safety Study 75p or $2·00

A.Y.R.S. BOOKS

Bound Book on Self-Steering £1·15 or $4·00. 162 pages, 83 illustrations.

Bound Book Single-handed Trans-Atlantic Races £1·15 or $4·00. 108 pages, illustrated.

Bound Book Deepwater Seamanship. 92 pages, illustrated.

74. Bound Book Sailing Hydrofoils £2·15 or $8·00. 285 pages, illustrated.

Subscriptions: £3·00 or $10·00 per annum for which one gets four publications and other privileges starting from October each year.

Discussion Meetings are held in London during the Winter and at least one sailing Meeting takes place. Regular meetings also take place in Los Angeles and other places.

A.Y.R.S. Windsocks:

Dinghy size	5¼ ins.	70p or $2·00
Cruiser size	16 ins.	£1·40 or $4·00

A.Y.R.S. Burgee:	16 ins.	75p or $2·00

A.Y.R.S. Ties:

In black or blue with A.Y.R.S. device £1·05 or $3·00

A.Y.R.S. Polar Curve Graph:

5p or 25 Cents

All prices include Postage by Surface Mail.

Printed in Great Britain by F. J. Parsons, Ltd., London, Folkestone and Hastings.