AYRS

MULTIHULL SAFETY STUDY

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AYRS AFFAIRS

The A.Y.R.S. Organisation

A couple of years ago, members were asked to get their friends to join the A.Y.R.S. Your most loyal support led to an extra 500 members, making the total about 2,000. Due to the inevitable "fall out" from new members, the total has remained much the same since.

I suppose that the appeals by Societies and clubs to get new members can become a "bore" and we don't like to have to do so. But the A.Y.R.S. must soon achieve a paid, full time secretary in order to cope with the work and get the publications out on time. It has already become far too much for a part time "hobby" for Hetty and myself. We can, however, manage the Editorial side and will do so as long as we can.

We need about 4,000 members to function economically with paid help. We hope, therefore, that members will do their best to publicise the work of the A.Y.R.S. and enrol as many new members as they can.

Winter Meetings for 1969-1970

These have not yet been arranged. Members will be notified.

Self Steering

Our book on "Self Steering" is still up to date. No worth while improvement has been devised since it was published. The "Gunning Gear" develops the greatest power possible and the only variations consist of being contentt with vane power alone (without the water "paddle") and having the control strings *outside* the support pipe. A short article on the subject will be published next year, possibly as a loose leaf or separate issue.

A re-circulation Test Tank

I am now in the process of building (with the help of Gerald Holtom and Norman Naish) a re-circulation test tank. The working section of this tank will only be about 10 inches square which will only let us test models with a 1 sq. inch maximum immersed section. This will be adequate for some interesting tests. I have only a few tests which I myself want to do, which concern drag angles. Members will be notified when it is available for testing their own models.

A 3 to 4 foot Yacht Wind Tunnel

When the test tank has been completed, I intend to make a small yacht wind tunnel about the above size. The 8 foot yacht wind tunnel which we have at Woodacres is just too big for our members—the work in making the models is too great. I believe that this small wind tunnel is most correct for our purposes.

The inaccuracies of small tunnels and tanks

In practice, all test tanks and wind tunnels are inaccurate, even those of the most scientific and accurate of workers. Each tunnel or tanks has a "correction factor" which proves this. The laminar flow test tank may, however, be more accurate than the large tank but we still don't know about the small wind tunnel. What is sure on the other hand is that the smooth windflow of the largest wind tunnel makes it quite unrepresentative of the natural wind. A small yacht wind tunnel could easily, therefore be just as good as a large one.

BOOK REVIEW

D. H. Clarke. TRIMARANS (London: Adlard Coles; 1969. 36/-): An Appraisal

by R. du Plessis Johannesburg, South Africa.

This reviewer was picked in preference to grizzled old trimariners, as representative of a wider public of would-be multihull sailors.

Finding out about multihulls must have cost me the price of a day-sailer in boating magazines. And now at long last here in this book I have found much of that widely scattered material brought together in a straightforward, comprehensive and eminently readable primer.

Mr. Clarke's qualifications for this task must be difficult to equal: wide sailing experience in a variety of craft, living afloat for years, together with shipyard experience, certainly enable him to present a well-rounded overall picture.

Here is detailed advice on how to choose the trimaran best suited to your needs—and pocket. The range of designs covered is extensive and profusely illustrated with views and diagrams which give a good idea of what one is getting. The author discusses priorities—cooking facilities, headroom, cabin sole width, etc. and gives his views, obviously from wide experience, on what may be considered adequate accommodation for various numbers (and combinations) of people for day, weekend and extended cruising.

Particularly useful is a list of points to look for, which may not be covered in specifications, but which the author considers to be essential features in a well-found, well-maintained seaworthy craft.

The chapters on loading and sailing a tri are full of practical hints, and the author does not omit disadvantages of this type of craft. And the comparison of the cost (in both cash and time) of buying or building the boat of one's choice is particularly helpful, as are discussions on chartering and on running costs; it might well have been titled (after the book): "I Never Promised You A Rose Garden". Mr. Clarke does really give information—not feed opium to the dreamer living in pink cuckoo land.

As a trimaran consultant not tied to any one designer or firm of builders, the author presents a pretty balanced picture of some of the better-known designs available. And, without shirking the controversial question of trimaran seaworthiness, Mr. Clarke does much to dispel the doubts engendered by talk of "floating coffins".

I am not qualified to judge trimarans as 'safe' or 'unsafe'. From my reading I am aware of some of the accidents that have happened, but I, for one, would rather take the apparently quite small risk of possibly capsizing some day than never get afloat at all.

Something of a Critique by Derek Northall

Johannesburg, South Africa.

After the would-be sailor's impression, here are the views of a real sailor Seven years in the merchant navy, a keen dinghy sailor—and a 'card-carrying' catamariner: a 'gruelling' test for Clarke's trimaran book.—Ed.

The excellent new book, *Trimarans*, by D. H. Clarke, will be found jolly good reading—and good value for money—by anyone who has already more or less made up his mind to acquire a trimaran.

In the first chapter the author tries to give an unbiased comparison between catamarans and trimarans. He does, however, admit to being a 'card-carrying' *tri*mariner. As I am a 'card-carrying' *cata*mariner it is difficult for me to review this book without criticizing certain statements and assumptions—if it is at all fair to have a catamariner review a book on trimarans. Anyway, I will try to keep my criticism as fair and objective as my nature permits.

In the opening paragraph of Chapter I Clarke remarks: "There is no such thing as a bad beer, some are merely better than others". While many of us will agree with these excellent sentiments, can we really apply the same sentiments to trimaran design? We are still in the first generation of trimaran design. Possibly by the second or third generation the law of natural selection will have taken its toll even as it has with beers.

Be that as it may, I am sure that the statement "Tris for Transocean, Cats for Coastal" has been commented on enough by such eminent cat men as Bill O'Brien and the warlike Jim Wharram to leave me little enough to add (in print).

As I have said previously, if you have made up your mind to buy or build a trimaran then you will really get a lot out of this slim 120-page volume and find it most helpful. It is loaded with hints and tips on such topics as selecting the most suitable craft for your particular requirements, correct loading, chartering, building, mortgages, insurance, auxiliary power, sailing in good and bad weather, mooring, launching, and bringing your craft ashore.

I find the author's criticism of designers who make a habit (or a living) out of 'stuffing' berths into every available bit of space most valid. Unfortunately designers are also businessmen and quite a few obviously realize that the buying public buys boats as they would buy a caravan: 20 ft., 2-berth 25 ft. 4-berth, etc.

There is an excellent and highly realistic chapter on chartering; I wonder, though, if spartan Jim Wharram would agree with the figure of £17,500 as the minimum capital outlay for charter craft capable of carrying three couples in separate double cabins? . . .

D. H. Clarke ends with a note of caution to the amateur—and the author is possibly one of the most experienced trimaran men *alive* today! I remember when the first *MIRROR DINGHY* was produced. Uffa Fox was invited to take one for a trial. Even when driven into six-foot breaking waves he found he was unable to capsize it . . .; since then, however, countless others have found it quite a simple procedure. And so it is sound advice that before one can think of becoming a trimariner, a catamariner, or a unimariner, one must first become a *seaman*.

That this book will find a place on the bookshelves of all trimariners, most multihull enthusiasts, and many people interested in sailing, I have no doubt.

FOREWORD

by John Morwood

When one considers that Peter Shreve only started his work on Multihull Accidents two years ago, one is amazed by his success. His tremendous enthusiasm and hard work have assembled in this publication the ideas about multihull safety from many intelligent men who have thought deeply about the subject. He is to be congratulated upon a first class job.

However, this is only the first of his reports. In this issue, we have only a few of the multihull accidents Peter has found. Next year, we hope to have many others.

The A.Y.R.S. is in a position to publish several things which the ordinary yachting journals cannot. "Yachting accidents" is one of these because it is a bit of a morbid subject. The only account I have ever seen published in the ordinary journal was that by Peter Tangvald in *Yachting Monthly*, which we printed ourselves in "Yacht Electrics" (AYRS No. 48). Peter Tangvald assembled his figures and information in a voyage around the world in his yacht *Dorothea* so his study must have at least contributed to the great "Seamanship" he undoubtedly must have. I therefore feel that this issue will contribute to the seamanship of multihull sailors.

The AYRS can publish things which the commercial journals cannot because of our non-commercial and "Amateur" nature. We don't mind saying that a yacht came to grief in some way because our advertising income is of no importance to us. If this material had been published in a commercial magazine, the multihull advertisers would be very cross, fearing that it would affect their sales. Actually, I think that this Accident Study may easily help the multihull movement by increasing people's understanding of this type of craft and thus increase their seamanship. Or, possibly, it might be the first step in the design of a "Self-righting" multihull.

The result of this publication should be controversy and discussion. To start this, I have but three comments to make:

1 I have my doubts if mast-head buoyancy which inflates *after* the mast hits the water would prevent a complete upside-down capsize.

2 Living inside an upside-down multihull might be possible without added oxygen. The air dissolved in water contains a higher oxygen content than atmospheric air and the exhaled carbon dioxide is very soluble. It is just possible therefore that the "air bubble" in a capsized multihull might support life for one or two crew members almost indefinitely. Somewhere, the answer to this matter has already been found, I feel sure. Undoubtedly, one of our members has the answer. Would he kindly write and tell us?

3 Marvin Glenn once again reminds us of the fact that an engine is not part of seamanship. It can be a quick and easy way out of danger. But, if it fails (or hasn't enough power) the danger of the situation will usually have increased. Mr. Glen's account also clearly shows by two incidents how the multihull, by its shallow draft, can be safer than the single hull when cruising in coral waters.

EDITORIAL

by Peter John Shreve P.O. Box 17117, Hillbrow, Johannesburg, South Africa.

The usual practice of giving each contributor's full address has not been followed in this issue in the hope that all correspondence will be sent to the above address and thus provide both editor and research team with the much-needed feed-back. Letters addressed directly to any contributor via this address will, of course, be passed on.

This is a symposium of viewpoints and experiences representative of the material collected in the first year of the AYRS Multihull Safety Study—intended to raise questions more than provide answers. It should not be judged as a completed report but rather as a beginning in earnest, setting the scene for systematic and purposeful discussion. The contents of future publications in this series are expected to become progressively more solid and immediately useful as more material accumulates which permits suggestions and interpretations to be viewed in the light of more adequate empirical data.

The topic of capsizing predominates in this issue because the bulk of the material gathered to date leans in this direction. This study began as an investigation into the problems posed by multihull capsizability before it later widened its scope. And so the contributions move from Jim Brown's and Jim Andrew's relative optimism—balanced by William Mehaffey's note of caution—through Fred Benyon-Tinker's brain prodder on pneumatically self-righting multihulls to Bernard Rhodes' righting experiment under ideal conditions: an actual experiment, not just a proposed method! Lest we cry "Eureka!" too soon, musings on this kind of feat of youthful agility follow—Brookes Heywood is not a professional acrobat, and there must be many more like him. If righting manoeuvres are *not* the sole and whole answer, what about making the best of a flip and learn to survive it if need be? This is the central theme of "Summing Up" in this issue. And, going the whole hog: a craft designed to function either way up—an interesting exercise.

But, as Tony Smith points out, though capsizing constitutes the most newsworthy type of multihull mishap it may not be the most noteworthy from the viewpoint of reasonable preparedness. So there is Mr. Burke's highly technical paper, a reminder of the stresses and strains multihull structures have to withstand—professional designers won't need reminding but then they are not the only ones designing multihulls. And Marvin Glenn's instructive account introduces a breath of real salt spray and sea air, and brings to life a mass of fragments and abstractions. Finally, a searching look in from the outside, by an airman who said to me: "Airplanes are a lot more complex than sailing boats, I'd say, and yet we aren't doing badly safety-wise. If we left as much to luck as so many of you sailing boys seem to do, there wouldn't be a pilot left by now! . . ."

In the supplement will be found the first three accident reports, which may also be had in loose-leaf form so that they can be added to, and arranged in any order for research purposes and discussion. More of their kind are to come, until every significant mishap has been recorded in this fashion. Then both 'prosecution and defence' can argue it out from a common basis of fact—and none of those vague references to "a tri turning up months later and still afloat" or "a succession of serious accidents"!

Quite a few members of the Society, whose 'pets' are monohulls or specialized technical topics, may find little of direct interest in this publication, and we ask their indulgence. There is certainly a lot of scope for a wide variety of technical experts in this project, and we are looking to them hopefully for contributions. The design of inexpensive watertight emergency hatches presents an interesting engineering problem—but what are hatches to a man whose interest is in hydrofoils?! And so this publication has not been put together for this kind of expert, specialist, and experimenter, of whom there must be many in the ranks of the Society, so much as for a wider public including a multitude of 'ordinary' multihull dreamers, builders, and sailors.

Rightly—or wrongly—one assumes that the incurable experimenter will be sufficiently clued-up to keep unnecessary risk to a minimum. And if he does come to grief he is at least in the good company of those who stick their necks out to some purpose, willingly and knowingly. But when the man who just wants to go sailing in the craft of his choice for the joy of sailing suffers *avoidable* injury or worse because he was unprepared to meet some contingency which is sufficiently probable to warrant such preparation: what useless, senseless, unnecessary waste!

If this research project proves of help in reducing that sort of waste, as we hope it may, the Society will have rendered another valuable service to the boating community as a whole.

At the same time another trend is becoming more inevitable all the time. Even though this research team has been focusing its attention on multihulls, the bulk of the information collected applies equally well to single-hulled yachts and their crews. If full use is to be made of the material accumulated in this project, what began as a *MULTIHULL* Safety Study will have to grow up into a broader *YACHT* Safety Study. It is the aim of this group to achieve this transformation in the coming year, and in the foreseeable future to distil the essence of the knowledge brought together in this enterprise into a book: the *AYRS YACHT SAFETY MANUAL*.

ACKNOWLEDGEMENTS AND APOLOGIES

Both the AYRS *MULTIHULL SAFETY STUDY* project and this publication owe much to many people—too many to name them all.

The individual letters we sent out brought in a surprisingly rich harvest; not only did most of those approached by us reply and reply handsomely, but quite a few of them went out of their way to spread the news which led to information and assistance from quite unexpected quarters. Among those who deserve a special place of honour here are Denny Desoutter, Editor of *PRACTICAL BOAT OWNER*, and Martin Cooper, an Editor of *TRIMARAN*. Mr. Desoutter might not care overmuch to be branded one of the principal godfathers of this research project but he has certainly been just that: with his comments, highly practical and to the point, and those 'letters of introduction' he personally wrote to a number of experienced multihull men, he did much to help this enterprise on its feet.

John Morwood is the man to whom we owe more than to any one other man. As Editor and Publisher of the AYRS he bore the brunt of our teething troubles and enthusiasm—engrossed in our 'little pet' we didn't always appreciate that our undertaking was but a fraction of the Society's activities calling for his attention; yet he never ceased to support and aid us all he could. And Mrs. Hetty Tett kept her good humour throughout that barrage of letters, and attended to our requests with enviable efficiency and great patience.

Of the Society's other office bearers, our special thanks go to two of the British Vice Presidents, Mr. R. Gresham Cooke, C.B.E., M.P., and Mr. Beecher Moore, for the kind encouragement they so readily gave this project, and to Fred Benyon-Tinker, Jock Burrough, and Eric Thorne Symmons, of the British Committee, who responded magnificently to our appeal. Both the New Zealand and the U.S. Secretaries, T. L. Lane and W. Dorwin Teague, have earned our gratitude. Though his own interest is in single hulls, Mr. Lane went out of his way to be helpful.

With the progress and growth of this project more and more people have volunteered information and help, and it becomes increasingly more difficult to single out one or the other for special mention. The names that stand out most readily in our memory are those that encouraged and helped us in the early days when we were battling to put this enterprise on its feet. With gratitude we recall, amongst others, Cdr. Erroll Bruce, R.N. (rtd.) who gave us a much-needed whiff of proper perspective, Capt. Terence Shaw, D.S.O., R.N. (rtd.) of the Royal Western Yacht Club, Dr. Brian Whipp, P. M. Patterson, John Neilan, J. H. Buzzard, Jim Andrews, P. R. Chaworth-Musters, Geoffrey Wellens, and Howard Fowler and Dr. George Mandow, Secretary and Rear Commodore respectively of the Ocean Cruising Club, who helped with heartwarming promptness.

In the same spirit, our gratitude goes to the Royal Society for the Prevention of Accidents and the Royal Yachting Association, and especially to the Boating Safety Division of the United States Coast Guard which not only encouraged us in our labour of love but helped materially as well, to Dr. O. G. Edholm of the Division of Human Physiology, National Institute for Medical Research, England, and to the U.S. Information Service.

Editors of boating publications have done much for this project, through their interest and kindness, and in more tangible ways—particularly those of *MOTOR BOAT & YACHTING*, *RUDDER*, *SEA SPRAY*, *TRIMARAN*, and *DIE YACHT*, and Capt. Edward F. Cotter, USCG (rtd.).

And so we wish to thank all those who responded to our letters or wrote to us of their own accord, and the editors who broadcast our appeal for information and assistance and gave us permission to use material from their publications. Also those members of the South African Society of Cardio-Pulmonary Technologists, and our other technical consultants who gave us so freely of their valuable time and professional skills and experience, especially C. W. Benington, H. I. Goldman, Dr. J. S. Harington, Prof. J. W. Mann of the University of the Witwatersrand, Derek Northall, Tony Ovens, Ivor Prinsloo, and Dr. Bernard Van Lingen, as well as *SEAS* (South Africa) which for months confined the topics of their meetings to upturned multihulls.

This is, we feel, also the time for an apology and explanation. This issue is by no means representative of the multihull world—many a voice that ought (and might wish) to be heard here is absent. Our growing card index lists many more names prominent in multihull affairs than appear in this publication. This omission should not be taken to mean that we have simply bypassed or ignored them: we just have not had the time to complete our initial 'Operation Contact'; this project is being carried out on a voluntary part-time basis and there is never enough time to do all that should be done.

It is also the place to apologise for this publication appearing something like a month behind schedule—this is entirely our doing—John Morwood and the Society are quite blameless in this.

Another apology may be owing to those of our contributors whose letters have been printed in a much edited form. In each case several people read both the letters and the edited version to ensure as much as possible that the writers' original meaning was preserved. But with considerable reshuffling of the material in an attempt to distil off the essential points, shifts in manifest attitude may have crept in. If therefore any contributor should feel that because of editing his meaning is not quite what he really said, the editor takes all the blame: any corrections requested will be published in the next issue.

And a final word of thanks to all contributors and to those who burned much midnight oil to put this issue together: Anne Taylor, Derek Northall and Roger Humberstone. Roger acted as associate editor, and redrew neatly most of the diagrams, and Lesley Rootenberg designed the front cover.

THE EDITOR,

on behalf of the AYRS *MULTIHULL*

ACCIDENT SURVEY & SAFETY STUDY GROUP.

SUMMING UP

AYRS Multihull Safety Study Group

Jim Brown suggested that each volume in this series should include our "synopsis of how to make multihulls safer: *some conclusions.*"[1] The upshot of this was a 15,000-word "Survey and Review of Facts and Views" which we decided to shelve in favour of other material that we felt should be included here; in its place we are offering this summing up of some points we think important at this stage.

In the absence of even remotely adequate statistics we have no wish to join actively in the controversy over multihull seaworthiness. By next year we hope to have some more figures; until then we would rather not give any: as they stand, and bare, without a lot more explanatory detail to accompany them. They won't tell much of a story and are apt to mislead.

Take the trimaran which capsized off the Italian coast. Two stayed in the cabin and reached the shore with the boat, two other swam for the shore. One tired and drowned. In the circumstances it might equally well have been a capsizable dinghy, centreboarder, or motor boat[2]. In figures: 1 trimaran capsize with 1 fatality. In contrast, Tom Corkhill's capsize 200 miles offshore where the alternative would very likely have been a ballasted keelboat. Arithmetically: 1 trimaran capsize with no loss of life. Here we have a very real *multihull* accident, it would seem, and the happy end was quite fortuitous—a million to one chance, as Tom says himself. Therefore none of the few figures from our collection for the present.

Just one bit of food for thought. According to *MULTIHULL INTERNATIONAL*, the insurance premium asked for Sandy Munro's *OCEAN HIGHLANDER* in the 1968 Singlehanded Transatlantic Race

> "proves that Underwriters are now prepared to treat Catamarans and Trimarans on the same terms as the Monohull."[3]

Insurance companies are not philanthropic foundations and as a rule have a pretty shrewd idea of the risk.

The need for SEAMANSHIP has rightly been stressed time and again, and for *multihull* seamanship in a *multi*hull—

> "the normal handling of a Cat is not very similar to that of a monohull"[4]

and this point is convincingly illustrated by the capsizes of *ALLEZ CAT*[5] and *EN AVANT*[6]. A number of writers have expressed the opinion that a multihull in the open sea is less tolerant of human error than a ballasted single-hulled craft;

> "while no yacht is foolproof, the ballast keel single-hull is probably more so than a multi."[7]

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(1) Jim Brown, Personal Communication, November 1968.

(2) *The Sailorman*, No. 2, December 1968, pp. 12/13.

(3) *Multihull International*, February 1968, p. 28.

(4) Jim Andrews, 'What It's Like In A Catamaran', *Practical Boat Owner*, August 1969, p. 59.

(5) AYRS Publication No. 63, p. 51.

(6) AYRS Accident Report No. C-003.01a.

(7) *Yachting Monthly*, August 1967, p. 92.

Crew failure rather than craft failure has been pointed to so often as the cause of accidents that we feel we must take a closer look at those crews, and at the "magnetic field" that draws them to multihulls.

Who buys—and especially: who builds—and sails *multi*hulls? Why multihulls? Jim Brown conjectures:

"Multihulls, probably more than other vehicles, attract the aspirant who is self-confident, individualistic. This person is simply unaffected by the magnetic field which says 'buy a Mustang', 'hop on a jet', or 'go Chris Craft'."[8]

Very flattering, and very nice—but no real answer. Are we to take it that it is the inferiority-riddled, gullible who fall for monohull advertisements??? . . . So here we have a man who wants a boat of his own. Very possibly he is "self-confident, individualistic". Fine. But why a *multi*hull? To say he is immune to the single-hull's "magnetic field" is just begging the question. Why is he attracted by the magnetic field of a cat or tri?—that is the question, because he is certainly drawn by *some* magnetic field!

To some multihull adherents the answer is simple: he sees the obvious advantages of multihulls. Maybe so . . . Multihulls do have obvious advantages. What exactly are they *in the eyes of the beholder?* Here is one view:

"It is intriguing to note the tremendous interest in trimarans by the non-sailor dreamer. Here could be one of the fundamental dangers. One Australian building company alone reports in excess of 50 enquiries per week, enquiries mainly from persons of moderate means, admitting that their life ambition has always been to sail the seas, laze under the palm trees looking at the lush brown beauties in the Pacific Islands, admitting having no SAILING experience whatever. Obviously *the trimaran makes it possible to fulfil these dreams due to low building cost and ease of construction* (our italics—ED.). No wonder that in addition to the over 500 tris already on the water, many hundreds (and this is factual) of the triple hulled craft are growing in Australian backyards from a heap of plywood to the means of escape to all those wonderful places, with very little preliminary thought given to the perils of the sea."[9]

Some speak of a "boating explosion"; we prefer the less menacing phraseology of Mr. Desoutter, Editor of *PRACTICAL BOAT OWNER:*

"The bug that everybody seems to be catching these days is the boating bug."[10]

This bug raises some new problems, not just for those innocents afloat that get themselves into trouble but also for the multihull fraternity and the boating world as a whole.

"The Ocean remains one of the few arenas of human endeavour where a man can make a fool of himself without the coppers throwing the book

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(8) Jim Brown, 'Multihull Safety: Safety Is Understanding,' AYRS Publication No. 69.

(9) Peter Rysdyk, 'The Trimaran', *Multihull International*, September 1968, p. 26.

(10) Denny Desoutter, 'Waiting for the tide . . .', (editorial), *Practical Boat Owner*, August 1969, pp. 32-37.

at him . . . All experienced yachtsmen must, if the oceans are to remain free, get to the innocents before they sail—help them, advise them, at all costs dissuade them from attempting ocean passages without at least plenty of coastwise experience on the log. It can be rude out there."[11]

Calls for better seamanship are in themselves not enough. As the "father of motivational research", Dr. Ernst Dichter, has pointed out, throughout history the bad guys have known how to move people whilst the good guys have often contented themselves with ineffectual appeals to 'man's better nature' or 'common sense'.[12] If we want better seamanship on a large scale—and with the boating bug biting left and right (or, portside and starboard), it will have to be on a large scale—we must *motivate* people to acquire it *before* they have to holler "Mayday". To do this we need to have some idea of who they are, how best to reach them. This, too, is *yacht* research, we feel.

". . . what can be done to make sea-going *safer for average little boats with their average family crews.* That is the area in which help is really needed. That is the area where research and development can save lives. It is far more worthy of effort than the building of a boat which is honestly speaking *useless* except for the one purpose of trying to snatch the America's Cup from another equally *useless* boat."[10]

We are therefore looking forward with interest to the findings of a survey, now under way, of multihull aspirants and sailors, what they are looking for, and what draws them in the advertisements and sales literature.

Advertisements very likely sell boats and DIY boat plans but one well publicized mishap may do more braking than six months' advertising will do lubricating. Designers like Rudy Choy seem to be in a position to select the hands into which they put their creations. The man who offers easy-to-follow plans by mail must accept that many of his customers may be novices, and some of them fools. Not necessarily fools in general but certainly in relation to the boats they are keen to launch.

"The amateur builder is the elite of yachtsmen";[13]

he might conceivably be the elite of yacht *owners*, but having built a boat does not automatically confer seaman's status upon him!

"Nobody knows better than I that the main danger of a catamaran is the capsize"[14], Bill Howell writes.

How much of a risk capsizing constitutes we are not prepared to guess at this stage. What we are concerned with here is the aftermath. It would appear that it is not capsizing that kills but inadequately adaptive behaviour *after* a capsize—either action inappropriate in terms of the situation, or lack of effective technical means. Luck like Tom Corkhill's is not something to put one's shirt on. There is no need for absurd provisions against the

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(11) (Editorial) *Modern Boating*, October 1968, p. 3.

(12) Dr. Ernst Dichter, The Strategy of Desire.

(13) The Complete Catalog of *Pi-Craft* Trimarans, received April 1967, p. 22.

(14) Bill Howell '*Golden Cockerel*', AYRS Publication No. 67, pp. 23-27.

improbable but there is certainly a good case for *reasonable* preparations for emergencies that have a certain probability. There is no sure vaccination against *possibilities*, but there is against *probabilities*.

Safety is a matter of personal choice—not necessarily conscious or even rational choice. Some don't *feel* safe on a liner where others are happily unconcerned in a bobbing dinghy. What comprises reasonable preparations must therefore depend on both personality and also, as the Editor of *PRACTICAL BOAT OWNER* has pointed out, on the kind of sailing one goes in for. One estimate puts trimaran losses through capsize in the region of 0.35%.[15] How much expense and bother is a risk of this magnitude—or 'minitude'—worth to a particular sailor?

> "I have always said that while a catamaran may capsize it won't sink, whereas a deepkeeled yacht won't capsize—generally—but will sink like a stone if holed, and on balance I prefer the catamaran's risk"

writes an experience catamaran sailor *after* a capsize experience in which he lost his boat.

> "I am still of the same opinion, *provided* the catamaran has masthead flotation or the equivalent."[16]

But there is also a probability level which the *community as a whole* considers significant! If it regards those 0.35% as too high, then the individual sailor must take steps to keep down his own contribution—especially to avoid headline-making mishaps—or sooner or later he will be forced to from above, and in a more irksome and inconvenient manner. Public opinion goes by impressions, not actuarial tables, and a few mishaps can make a 0.35% risk look like a 35% monster:

> "Although 5,000 people are killed on the roads of South Africa every year, a single shark bite anywhere on the Natal coast is sufficient to empty every hotel within miles, with tourists streaming home along main roads where they face an infinitely greater risk of being killed or maimed than if they were to bathe all day every day for a year in the most heavily shark-infested waters off the coast."[17]

We could have a much higher loss-through-capsize rate than the estimated 0.35%—but as long as it is not accompanied by a series of spectacular fatalities, it will attract less unfavourable attention than a tenth that rate involving an appreciable toll of life. Dinghies capsize all the time and yet there is no loud outcry against dinghy sailing. We accept a succession of dinghy capsizes as part of the game—we rarely even bother anymore to report them in print—where we don't take too kindly to an alarming succession of floating dead bodies or missing ones. But then we do rather insist on dinghy capsize *drill*!

> "Years ago, when I received some well informed practical instruction at the Island Cruising Club, two things were taught before going out in

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(15) D. H. Clarke, Personal Communication, January 1969.

(16) J. H. Buzzard, AYRS Accident Report C-001.01a.

(17) Dr. C. G. Campbell, 'Does a shark problem now exist in South Africa?', in 'Nautilus 3', Documenta Geigy, 1967, p. 2.

the dinghies: 'Going aground drill' and 'Capsizing drill'. When multihill sailors have mastered these techniques with regard to their craft we will have got somewhere."[18]

Is the risk of multihull capsize so small a probability that we can dismiss it as long as our seamanship is good enough? Perhaps it is—but this leaves us at the mercy of that big "IF" of seamanship!

"Many hardy, dyed-in-the-mud monohull enthusiasts raise their eyes in perish-the-thoughtness when you suggest that they would enjoy passage-making in a Cat. At the back of their minds is some ingrained instinct which tells them it would be ridiculous to put to sea in a boat which *could* capsize. Do they think that a Thames spritsail barge is dangerous—or one of those glorious Dutch things? Both types have been inverted from time to time in the past, but *the people who sail them have the knowledge of that possibility in their subconscious* (our italics—ED.), and shorten sail accordingly when things get dusty.")

Until nearly all multihull sailors have that knowledge in their subconscious we consider some *reasonable* preparations for the aftermath advisable.

"There is one matter which should be discussed at great length, I believe," Martin Cooper wrote in *TRIMARAN*.

"That is the question of what should be done on the event of a trimaran capsize . . . It seems to me that designers and trimaran cruising clubs should look into possible ways of using a capsized boat for the safety of the crew."[19]

With this we go along all the way. Quite a few people have done just that, this group included; one of the contributions now afoot is a study of air supply in an inverted hull, by one of our technical consultants, a respiratory physiologist.

But we would go further: multihull sailors should *here and now* at least give some thought to this contingency, without waiting for us or anyone else to come up with answers: think out step by step what they would *do* should they ever turn turtle, and keep their plan of action filed away in that subconscious of theirs.

"Everybody reacts differently to a catastrophe or an accident, and even an individual does not always react the same way . . . Active individuals are more likely to fall victim to the panic of incoordinate movement than to that of paralysis, but there are cases in which both elements are present. . . The only remedy for this is thorough practice on land in which all possible emergency situations are worked through, in the same way a seaman is drilled. Otherwise, in time of accident or disaster when orderly thinking and volition are distorted by shock, the body will take refuge in instinctual types of behaviour such as paralysis . . . panic, flight, . . . Anything we cannot do 'in our sleep', anything which has not become a conditioned reflex, is unlikely to come to mind in a state of shock."[20]

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(18) Dr. F. G. Smith (President, Trimariners' Association, W. Australia), Personal Communication, August 1969.

(19) Martin Cooper, 'Comments', (editorial), *Trimaran*, November 1967, p. 2.

(20) Dr. H. Lindemann, 'Preventing panic in and on the water', in 'Nautilus 3', Documenta Geigy, 1967, p. 4.

So go to it, multihull sailors—"hup, two, three"! . . .

Capsize after-action in one's hands and feet is superior to the same merely in one's head, but the latter is still very much preferable to no plan of any kind

"And if you want to talk about *extreme* situations which are happily *extremely* rare, remember that most catamarans will remain afloat even when filled because they have no ballast and are equipped with buoyancy.

To my family that sounds nicer than being left bobbing around (if you're lucky) in a little dinghy, after a ballasted monohull has sunk."[4]

Thus writes Jim Andrews who has our affection and respect. It does sound nicer, and we will remember—but what is one going to *do* with all that indefatigable buoyancy? Buoyant craft are one thing, live crews another.

Speaking of smaller cats, Robert Harris comments:

"In the hands of a skilled cat sailor capsize is unlikely . . . and if he should capsize it would usually be in an area where there was assistance nearby."[21]

The capsize of *TRI-NITRO* during Cowes Week 1968 is a reminder that the presence of other craft is no guarantee of prompt rescue.'[22]

" . . . the Solent area was well covered with craft of every description. It appears that the gentleman concerned in this accident was not seen at all and being an individual character, no check was made when he did not return."[23]

With buoyancy but delayed rescue, crew survival depends on human endurance under the conditions to which the crew are exposed.

"Survival at sea may seem, on the face of it, to be dependent on the avoidance of drowning, but the case of Mr. Eddom, the mate and sole survivor of the Hull trawler which capsized off the coast of Iceland, emphasizes that drowning is by no means the only hazard. The fate of his two companions in the inflatable raft is evidence of this. It is pretty clear that they died because of cold. . . . Man—or as Desmond Morris prefers it, the naked ape—seems to insist on exposing himself to physical conditions for which he is poorly designed. In particular, the naked ape has quite inadequate protection against cold, and yet he must maintain a central body temperature at or close to 37°C. If this is to be achieved he must, in cold conditions, either maintain a sufficiently high level of heat production or provide himself with the means to reduce heat losses.".[24]

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(4) Jim Andrews, 'What It's Like In A Catamaran', *Practical Boat Owner*, August 1969, p. 59.

(21) Robert B. Harris, NA, 'Catamaran Development', AYRS Publication No. 67, p. 46.

(22) *Yachting World*, October 1968, p. 430.

(23) W. B. Keeble (Warden of the Central Council of Physical Recreation Sailing Centre at Cowes), Personal Communication, November 1968.

(24) Dr. O. G. Edholm, 'Those in peril on the sea', *New Scientist*, 15 February 1968, p. 346.

From the United States Coast Guard we received a copy of a table of survival times in water [25] (abridged here—ED):

Water Temperature °F	Hours Survival Duration
32	less than 1
40	$\frac{1}{2}$- 3
50	1- 6
60	2-24
70	3-40

In case some of Peter Rysdyk's "non-sailor dreamers"[9] console themselves with the notion that they wouldn't be *in* the water but 'safe and sound' atop their upturned craft (if they can hold on to something long enough till rescue arrives—there is the rub of deterioration in manual efficiency as the skin temperature drops!)[26]:

"The wind-chill effect is such that 9°C (48°F) in a strong breeze of 25 m.p.h. is equivalent to —12°C (10°F) in a 2 m.p.h. light air."[27]

It should by now be amply clear that more than buoyancy is needed.

"Man's ability to survive and work in hostile climates, whether hot or cold, depends not only on his physiological mechanisms for temperature regulation but also on his *behavioural* (our italics—ED.) response—in other words, his ingenuity in controlling the microclimate surrounding his body."[28]

Whilst the boat remains upright this microclimate control is adequate to ensure survival (though it doesn't always *feel* that way 'out there'). A capsize changes all that, and a series of new behavioural responses is needed to make things 'livable' once more, or else . . . Looking at crew action in ergonomic terms, the amount of energy stored in the human body is limited. Even without any external activity those kilocalories just trickle away. 'Recharging' is needed if physical efficiency is to be maintained. If that store of energy is used up in a desperate scramble for the 'topside' and, once there, just holding on for dear life, then rescue *very* soon remains the one and only hope. After a couple of hours, fitness has departed. Even if the sea should by then turn mirror-smooth, the crew will no longer be in a position to take advantage of such a break. They have no longer enough energy left to improve their lot. If, on the other hand, this store of energy is used to establish conditions in which the rate of calorie drain is slowed down, with a chance to 'stock-up' again—protection from the cold (or heat), rest, water, food—survival chances are very much better, and an appreciable degree of self-reliance can be maintained.

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(25) Boating Safety Division, U.S. Coast Guard, Personal Communication, September 1968; taken from the *National Search and Rescue Manual* (CG-308).

(26) C. R. Spealman, 'Wet Cold', in Newburg (ed.), The Physiology of Heat Regulation, N.Y.: Hafner, 1968 (reprint of 1949 ed.).

(27) Dr. David Lewis, 'Small Boats at Sea', in Edholm & Bacharach (eds.), Exploration Medicine, Bristol: John Wright, 1965, p. 341.

(28) R. H. Fox, 'Heat', in Edholm & Bacharach, (eds.), The Physiology of Human Survival, London: Academic Press, 1965.

Survival *inside* a capsized multihull is in our opinion a line of investigation worth pursuing, but it is something of a long-term programme, and very likely not universally applicable. What is needed is something that can be adopted by ALL multihull crews NOW, and which does not involve major modifications to existing craft which would nip widespread adoption in the bud (and which, in the last analysis, might not be worth it all).

Our tentative proposals for capsize survival cast the *inflatable life raft* in the starring role. The only major item of equipment required is *a suitable life raft with protective canopy, secured to the boat with a painter of adequate length*, and on offshore cruises equipped with water, emergency rations, and other survival essentials.* It must be ***STOWED IN SUCH A WAY THAT IT CAN BE LAUNCHED, IRRESPECTIVE OF WHICH WAY THE BOAT FLOATS.*** Unless there are good reasons for casting off in the life raft it should be tethered or lashed to the upturned 'mothership'. This is Bill Howell's plan of action:

> "If I had capsized, then I could have unstrapped my safety raft from underneath the safety net. The engine compartment had been crammed full of emergency gear, from food and tools to walkie-talkie emergency radio, and this could be opened from underneath the bridge deck.
>
> Having inflated the life raft, I should have hauled it onto the bridge deck between the hulls, lashed it there and lived in it until the storm subsided. I should have opened my emergency cache of supplies and waited for help, and would not have wasted any effort on attempting to right the capsized catamaran, as I consider this an impossibility, single handed or otherwise. When the emergency food had run out, I should have donned my under-water suit and shnorkel and dived into the catamaran for more food."[14]

It seems to us that if all multihull sailors prepared themselves as effectively —and yet so *simply*.—as Bill Howell, capsize *fatalities* would become collector's items like fifty-carat flawless blue-white diamonds.

The only additional bits of equipment we would recommend for serious consideration are:

(2) *Snaphooks on both ends of personal life lines* to facilitate escape from underneath the capsized craft—this is a *MUST*.

(3) *A few ringbolts in strategic positions* either *on the hulls* (on the bridge-side) *or in the underside of the bridge deck*, preferably with some lines permanently rigged. In small daysailers, or other craft not carrying a life raft, these would be good insurance whereby survival could be prolonged considerably. For one thing they offer points to which crew members can rope themselves, and they could be used for rigging shelter of a sort.

Mr. Cullen's simple line from main hatch to stern looks like an excellent way of seeing the crew safely to the life raft.[29]

If anyone knows of even simpler and cheaper ways to ensure crew survival in case of a capsize we would like to hear of them as soon as possible. Until

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* these may be stored in a two-way accessible locker instead.

(29) W. H. Cullen, 'A capsize survival drill', AYRS Publication No. 69.

then, if anyone should feel that the proposals outlined here are still too much bother—we shall pass his name on to a psychologist of our acquaintance who is doing research on suicide . . .

Unavoidable accidents we have to accept, novices we must teach, fools we must put up with—but we should not accept *unnecessarily* dire *consequences*, no matter what their cause might be.

MULTIHULL SAFETY—SAFETY IS UNDERSTANDING

by Jim Brown Swanton Road, Davenport, California, USA.

Jim Brown is well-known as a trimaran designer and needs no introduction here. In view of his profession his openly pro-trimaran attitude is hardly surprising. It is therefore all the more to his credit that he does not bury his head in that white sand under gently swaying palm trees of which so many a would-be multihull mariner dreams. "Multihulls have *earned* their controversial safety reputation", he himself admits—but it still remains to be seen who has in fact the bigger claim to earning this reputation, multihull craft, or some of the people that have ventured forth in them. As Jim Brown says: multihull safety must come from a *safe attitude*—on the part of the designer, the builder and the crew.

* * *

The purpose of this essay is not to compare the safety of trimarans and catamarans to the safety of unimarans. That subject is so controversial, so charged with emotion, that it has been worn to the same gray middleground as, say, the difference between conservatives and liberals; everyone has his preference, but there isn't a whole lot of difference in the way it works out. The mono-hullist asks, "What do you do with a trimaran that is floating on its top?" and the multi-hullist replies, "What do you do with a unimaran that has sunk to the bottom?" That's about as far as their communication goes.

But boats function—all kinds. Let's face it: a lot of miles have been sailed on log rafts, a lot on "Tupperware" boats, too. Who, when he chooses a trimaran for himself can say that the Tahiti Ketch just doesn't function? The reverse is just as narrow. The same guy who sails his keeler through the reef-strewn Bahamas could do a nice job managing a trimaran in a typhoon. It's a question of skill, and of preference.

I have often heard the question asked, "Why did you choose a trimaran?", and the answer is usually, "It is the safest boat I can get". This answer is not incorrect, but it seems to be misdirected. The real motive for sailing is not safety. But we have been so conditioned with fear of the oceans that the sailor's motives are often clouded with hokum. "Why sail?" can be answered today only with, "For pleasure", and certainly the multihull vessel brings some sailors greater pleasure.

"Multihull Pleasure", though, is another—a larger—subject than "Multihull Safety". One relates to the other only in that it is not pleasant to sail with fear. And fear comes from the *unknown*. Fear does not come from danger, it comes from not knowing. Pleasure does not come from safety, it comes from understanding. So *that*, in my opinion, is the purpose of the Multihull Safety Study. Multihulls are widely misunderstood. Finding out about them, from reading and from sailing is, believe me, a very great pleasure.

Understanding design

The modern multihull is a relatively new art-form. This art involves science to the extent that the artifact must function, but outrigger craft have been around, functioning, for a long, long time. They were the first "safe" seafaring vessels known to mankind. The modern catamaran is basically a double canoe and the trimaran is a double outrigger. Both types put their trust in the ancient peoples, and thus enjoy a special—almost genetic—attraction to the eyes of us contemporary beholders.

I have said that safety is understanding, so I cannot say that the trimaran is safer than the catamaran, if both types are sufficiently understood. But I can say that the catamaran requires greater understanding—greater development—on the part of the designer, the builder, *and the sailor* to be as safe as the trimaran. I don't mean to dispense with the catamaran curtly, because the type has earned its place, particularly in the small day-racers where safety is no grave issue, and in larger (over 50 ft.) cruising types where the bridge-cabin becomes big enough to give nice accommodation without being disproportionate to the hulls. But in the medium cruising sizes (which is my field of interest) the trimaran configuration becomes attractive because of the very presence of the central hull. It offers a boat you can get "down in" without going "way out". Structurally, it is easier to tie two floats on to a main hull than to bridge two hulls together The greatest rigging strains are in the stays which lead fore and aft, and the catamaran requires quite a lash-up between the bows to answer these strains because there is no main bow there in the middle. A catamaran cannot be as wide as a trimaran (because of structural and manoeuvring problems) and so must gain stability within a narrower beam. And this brings up the major reason why cats require greater understanding to be safe. A trimaran tells the sailor very plainly when it is in danger of capsize; the leeward float begins to bury. It is a very obvious signal After the signal, there is still a wide "ragged edge" before real danger. The catamaran is less communicative. The lee hull does not bury; the weather hull starts flying instead, and from there the ragged edge is a thin line. Other design considerations favour the trimaran for safety, which I will mention below, but catamaran enthusiasts deserve great credit for understanding their boats. Their designers and builders are more highly schooled and their crews are real athletes. But anyone who argues that the double-canoe configuration is physically safer than the double-outrigger is missing the issue.

Some basic multihull design features which involve safety are: Hull and Float Form, Construction and Interiors. These are treated in other sections of this essay, but I would like to generalize on them briefly here.

Hull form

The hulls should have narrow form, and be widely spaced. Many multihulls, trimarans in particular, overemphasize the accommodation to the extent that their hulls are so wide and their tunnels so narrow that the water cannot pass between. The fineness of the hulls, however, must be carefully

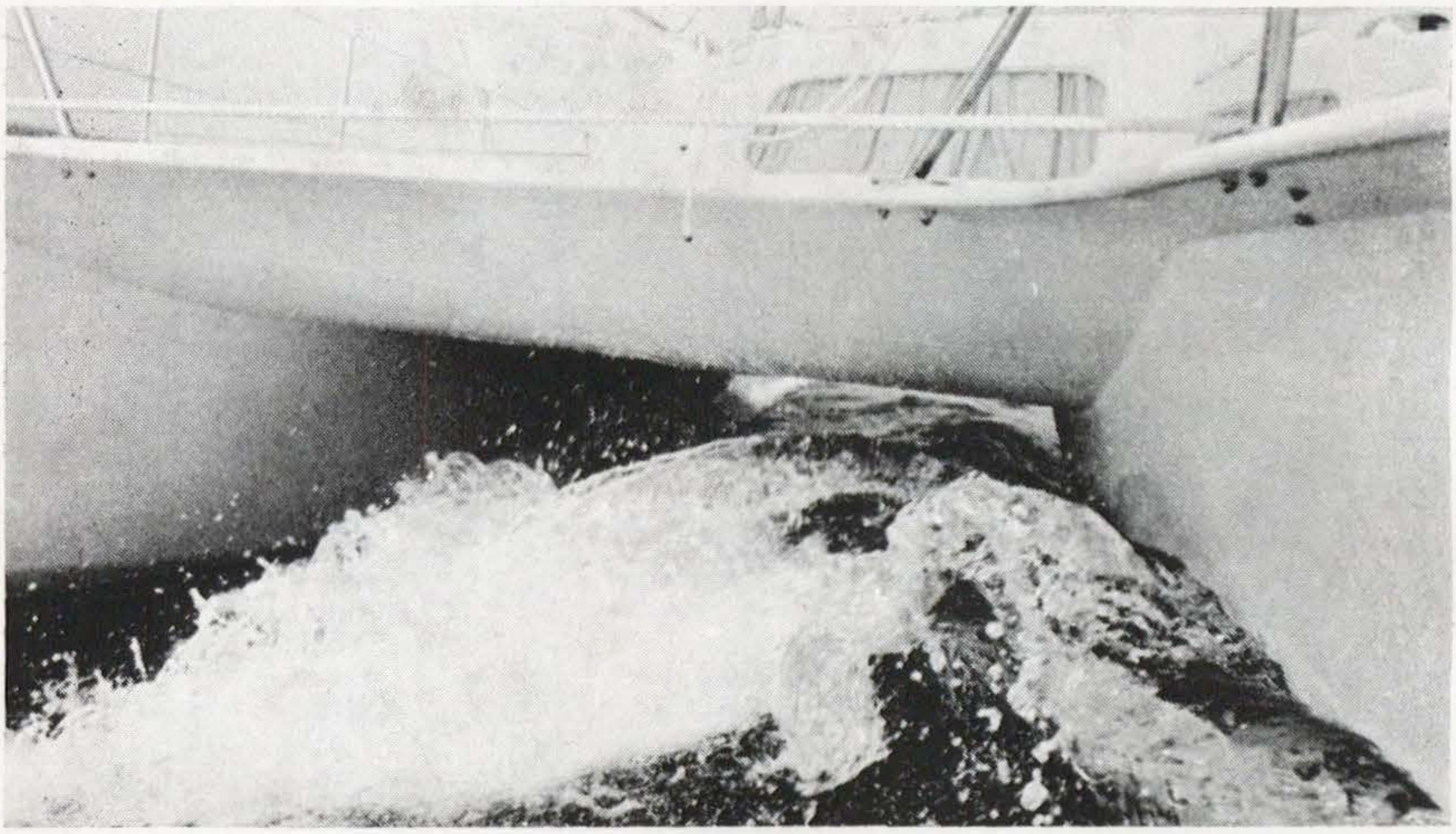


Figure 1 Wide hull spacing in this trimaran gives enough tunnel-space for romping over crests

balanced—compromised—with load carrying ability. Overloaded multihulls result from "racing" designs being used for cruising, or cruising designs being actually racing machines in disguise. We have learned that performance (speed) is important in cruising and that load-carrying is important in racing: thus a compromise design may be the most practical—the safest—for both purposes.

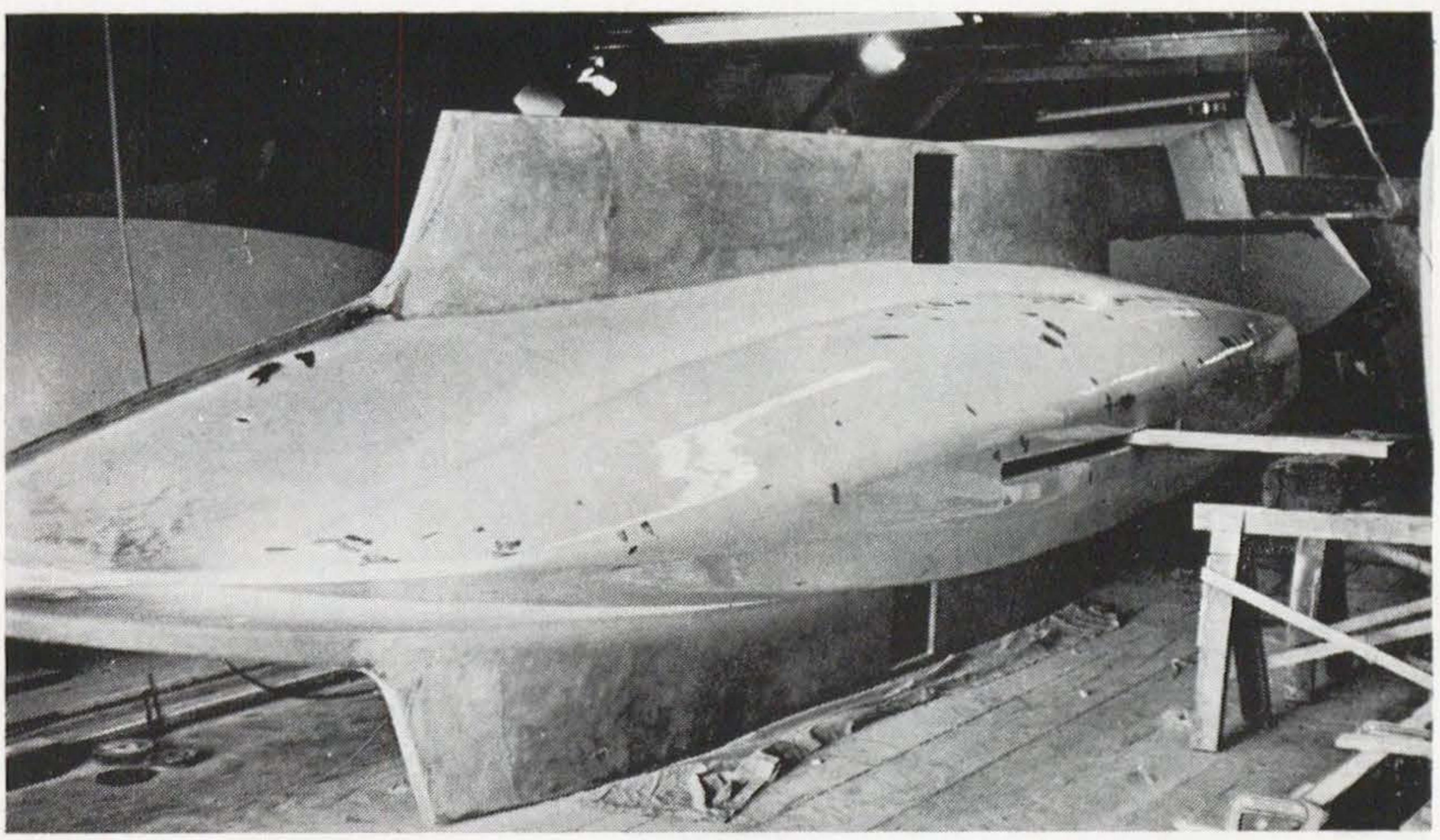


Figure 2 Main hull underbody has 7 : 1 finess ratio and nearly semi-circular midsection for good load carrying with low wetted surface: yet it easily built from economical sheet plywood

Construction

The fabrication of most seagoing multihulls is undertaken by amateurs whose skill is often limited. I tend to favour the less exotic construction methods and materials which favour safety, and economy. A costly moulded hull in a boat with no lifelines is not necessarily safer than one built from economical materials, but well outfitted. Space-age construction is justified in a sailboat only when the builder (and/or the buyer) has the wherewithal to make it safe.

Interiors

Multihull interiors have suffered greatly from the designer's (and/or builder's) temptations to try and do too much with a given size. Should a sailboat be a vehicle or a domicile? My own opinion is that a multihull must not be designed around accommodation. It should be designed as a sailboat, with accommodation fitted in. Many multihull interiors are designed around a "main saloon" which includes facilities for cooking, eating, sleeping navigating, all in one "room". This arrangement gives a spacious impression at the dockside, but leads to ghetto-type living under way. Living in a vehicular ghetto is not just uncomfortable. It can be dangerous. The navigator's light and radio, commotion in the galley, and someone sitting on your bunk, cause fatigue among the crew, and fatigue is danger at sea.

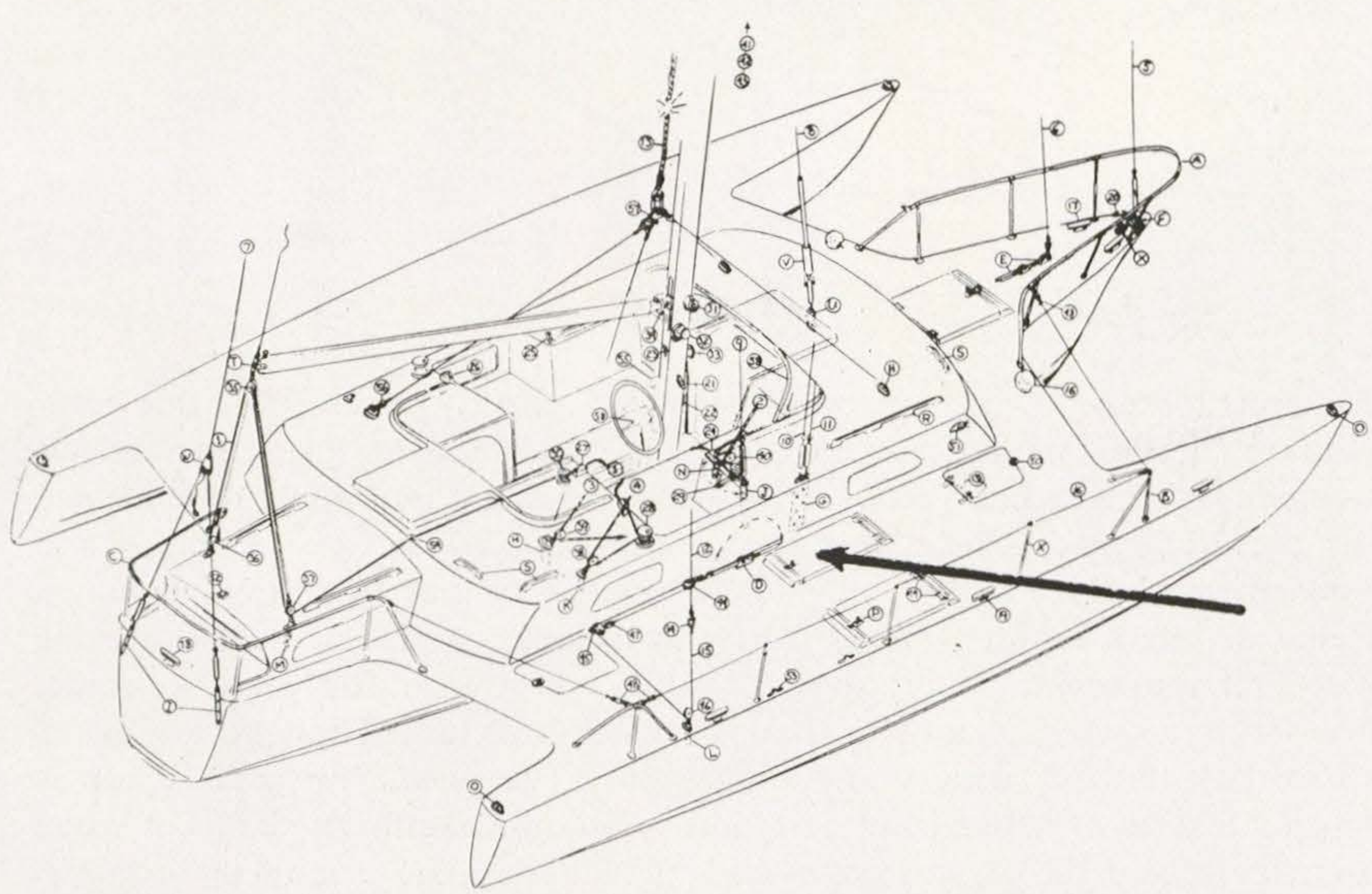


Figure 3 An example of a cruising trimaran designed as a sailboat with accommodations fitted in. Note life-raft compartment in wing; it has hatches on deck and under wing

Two peripheral design considerations have emerged as important aspects of multihull safety: the building plans themselves, and self-steering devices.

Plans

The marketing of building plans for catamarans and trimarans has emerged as an attractive business in the last ten years. Without the aid of "professional" designers or syndicate financing, no other period in yachting history has been marked by such shining achievement. This, in so little time, with so little danger. But there have been some drastic mistakes in basic design, and a troublesome lack of detail. In many cases, the backyard builder has been dealing with plans which have not given him *enough* information to build a creditable boat. The long record of rudder failures, dismastings, and

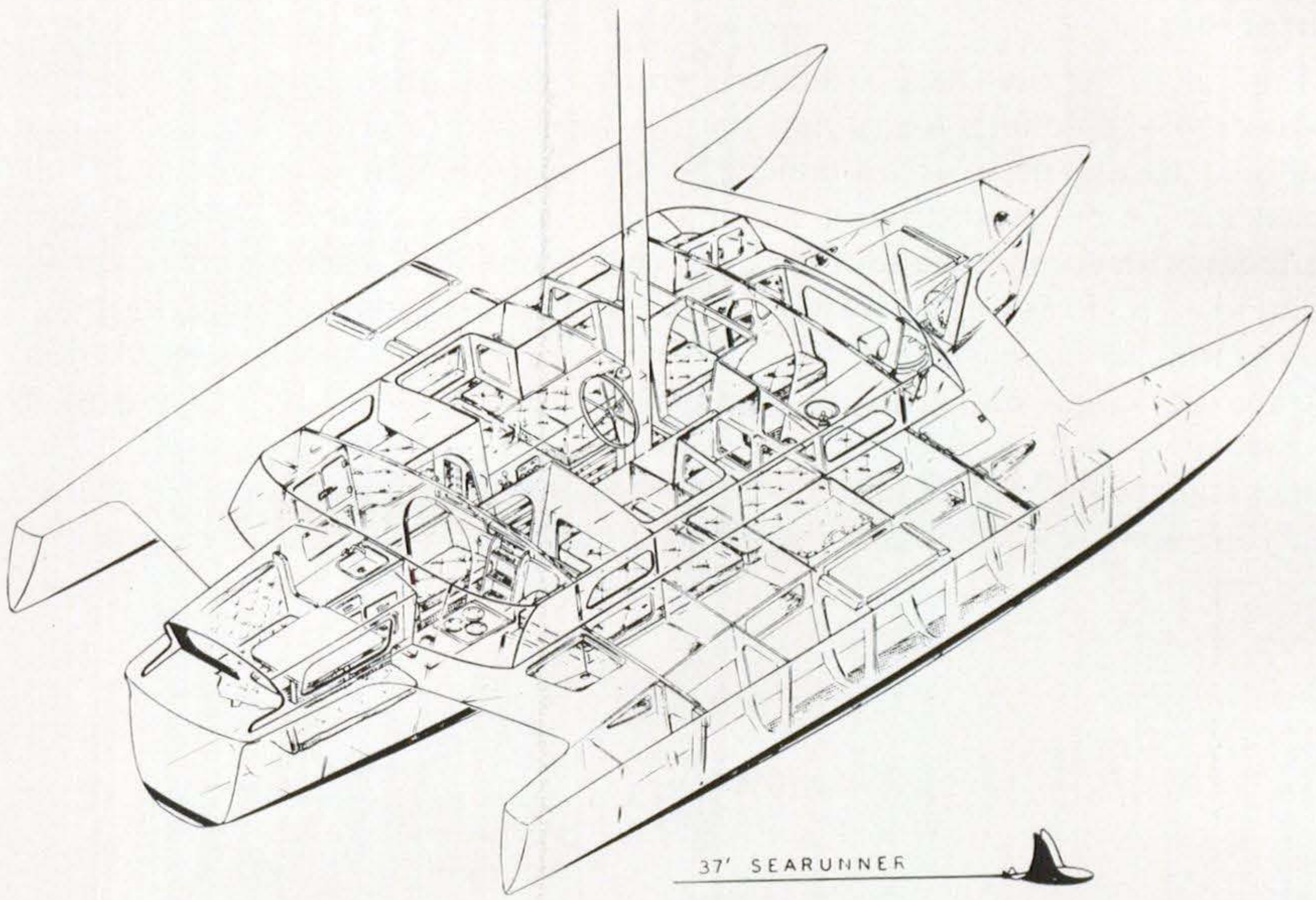


Figure 4

equipment breakdowns, can often be traced directly to design. But competition for this market, and experience, have caused the plans to improve tremendously in recent years. Still, there are many multihulls now headed for the launchpad which have been built from earlier, poorer plans and extensively modified by the individual builders who may be entirely lacking a frame of reference for design. These launchings, I predict, will cause the multihull movement to continue to suffer controversy for years to come. The larger, surer prediction is that those builders, turned sailors, are in for some dark days of danger and disillusion. The disillusion part is not as much a feature of design as of designers' promotional efforts; claims of speed and safety, and the joys of ocean cruising cannot come true in those boats. It's a shame.

Self Steering

On the happier side we have seen the emergence of workable, home-buildable devices to release the sailor from the drudgery of the helm. Make

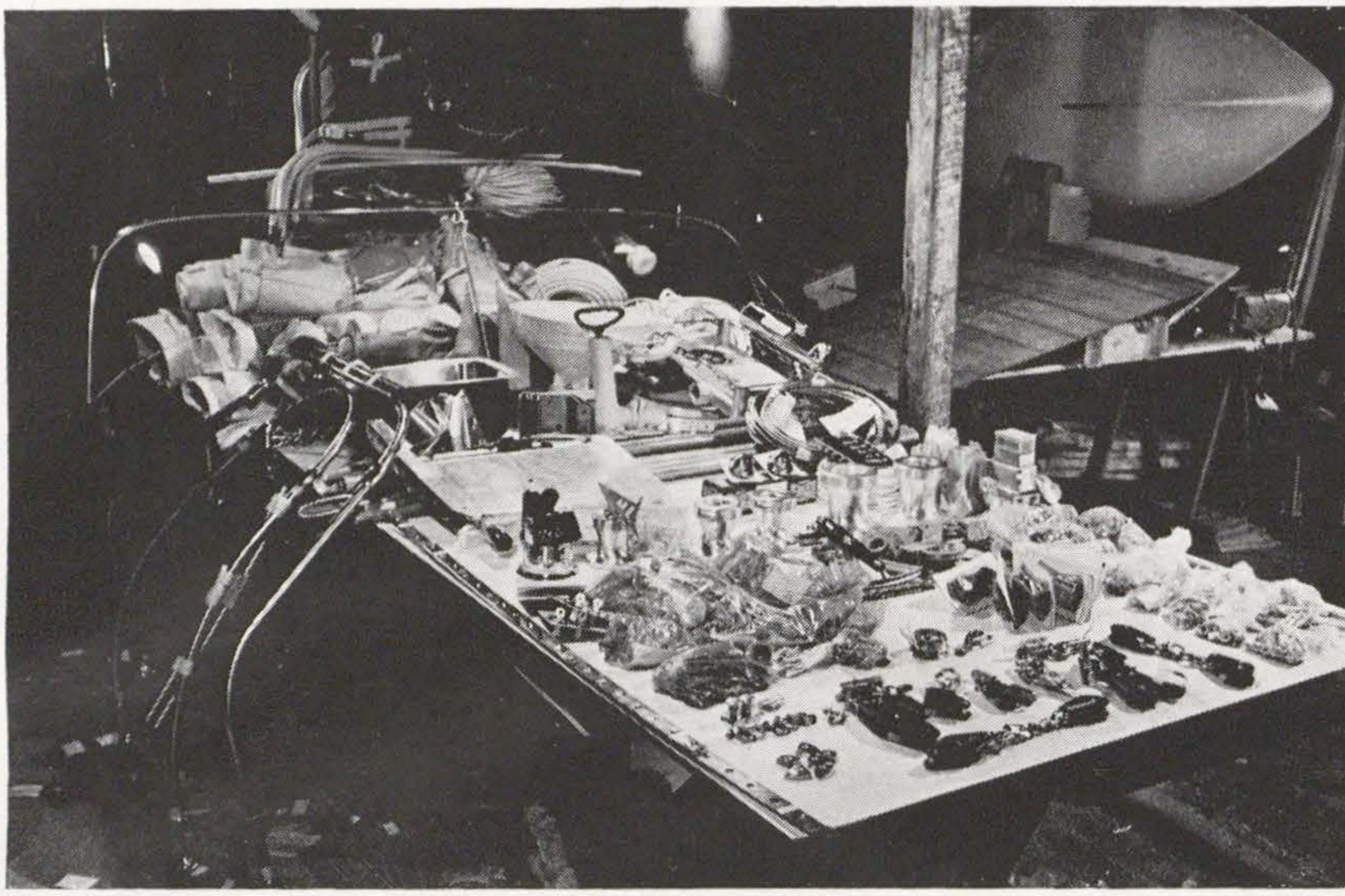


Figure 5 The selection of outfitting materials, particularly, should be detailed in the plans to avoid equipment breakdowns which have plagued multihull history

no mistake: self steering will not steer a cranky boat any better than a poor helmsman; but in those multihulls which enjoy directional stability, self steering brings even greater pleasure to the deep-sea sailor. It can also bring greater safety, but not necessarily. Self steering is not a substitute for a man on watch! But it can be a substitute for one of two men on watch, and it can make watch-keeping very pleasant instead of very tiring.

The real purpose of self steering is to release the helmsman's hand from the helm and his eye from the compass. Now he's got a hand for the boat, and his eyes can watch the sky and the sea. The net result is, like all good things in sailing, pleasure. Because keeping the watches is made more restful with self steering, the result can also be safety.

In discussing design further I shall use my own trimaran designs as illustrations. My "safe" designs do not in any way reflect upon the achievements of other designers and sailors. It is a matter of understanding—and my own designs are obviously the ones I understand best. These are just examples of what *can be done* for safety.

A series of designs which I call "SEARUNNERS" *combine* certain standard features:

(1) the centerboard,

(2) the central cockpit,

(3) the cutter rig.

The different thing about this combination is that, because the cutter's mast is located well aft, near amidships, and because the cockpit is located well forward, the mast just happens to step *in* the cockpit. And the centreboard trunk is beneath the cockpit sole, so the mast steps on the centerboard trunk.

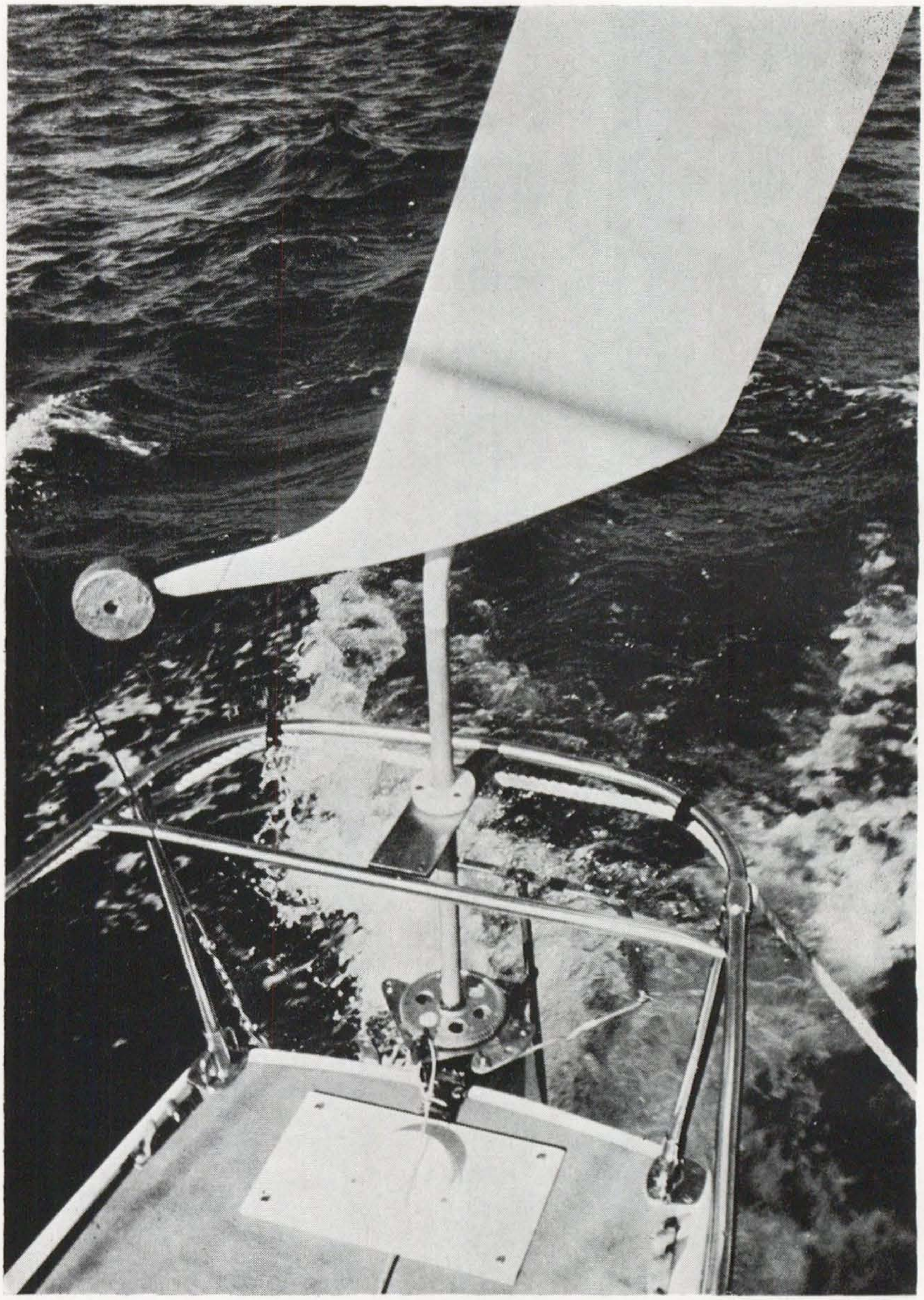


Figure 6 Home-made self-steering device has high vane (to reach up into the wind) which actuates trim-tab on outboard rudder

The central cockpit

Midships cockpits are often seen in cruising yachts, for good reasons. They are safer from waves washing in and the crew falling out. Visibility is best, in all directions: forward, aft, and up. Motion is least: the boat does not gyrate the helmsman, it gyrates *around* the helmsman. Engine, tanks, and heavy stowage are ideally located amidship also—for reasons of motion and control. Space for these is available beneath the central cockpit. Also, the centerboard trunk does not interrupt the accommodation.

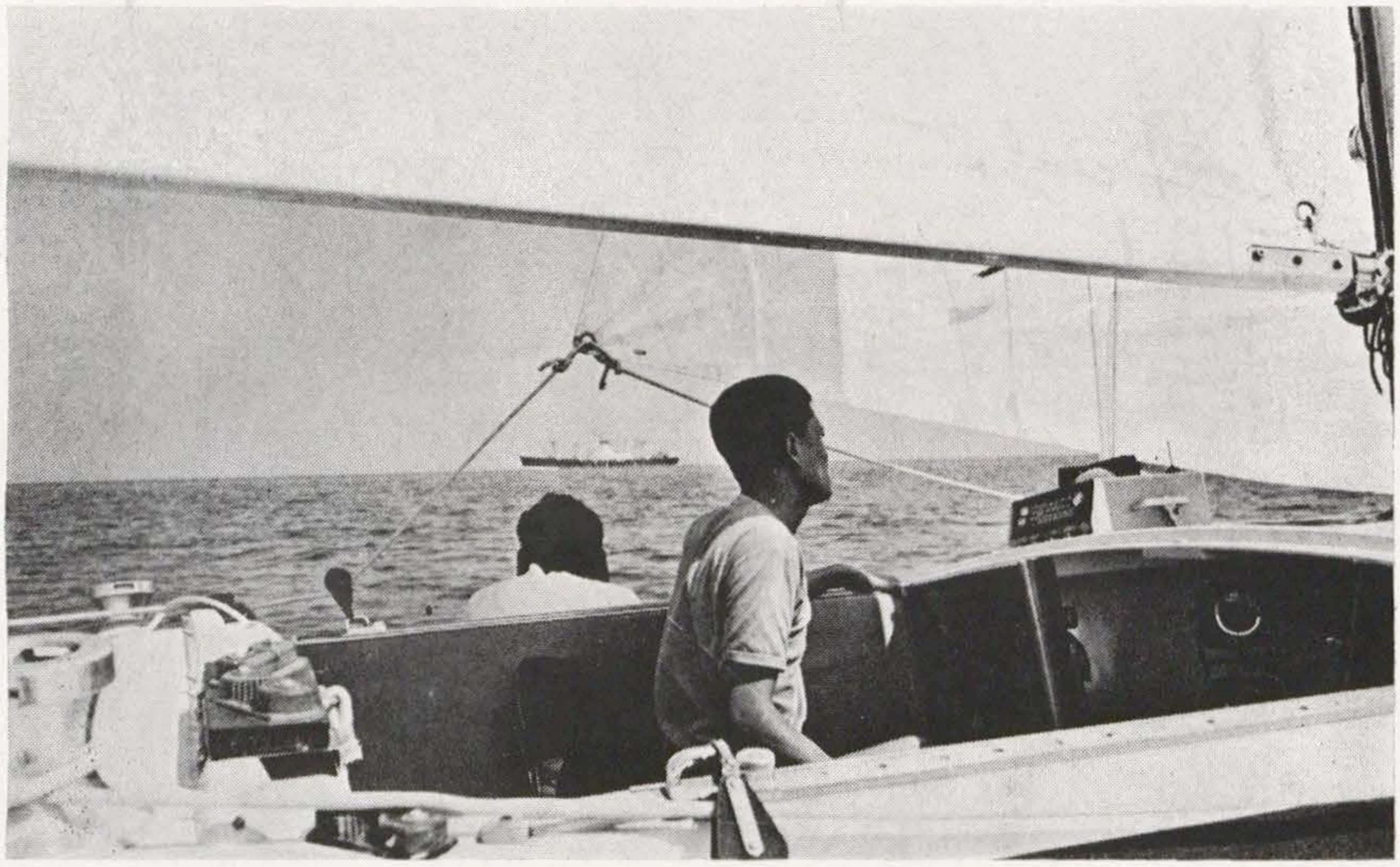


Figure 7 In this cockpit, a single sailor has access to all controls: halyards, sheets roller reefing and helm. Any cockpit should be designed so that the helmsman has good visual contact with all parts of the boat

The cutter rig

A cutter is a sailboat with one mast amidships. The type is well regarded, for it is the strongest of all rigs; very versatile, and very beautiful. In central cockpit trimarans, great things happen with the cutter! The crew, even the *helmsman himself*, can reach the halyards and reef the mainsail without leaving the cockpit!

The center board

A centerboard is a retractable fin-keel which, when retracted, yields a shallow, beachable boat, and when extended, serves *many* purposes. A common misconception is that the board serves only to improve upwind sailing. In trimarans, it also has a profound effect on steering qualities—manoeuvring and downwind control.

More than any other single feature, the centerboard *is the difference* between trimarans that are cranky, and those that are sea-kindly. Safety on the ocean, ease of handling and *comfort* do not depend on cabin space alone. A sailboat that *goes* where it is *headed* is safer, especially if *your* heading just clears the rocks.

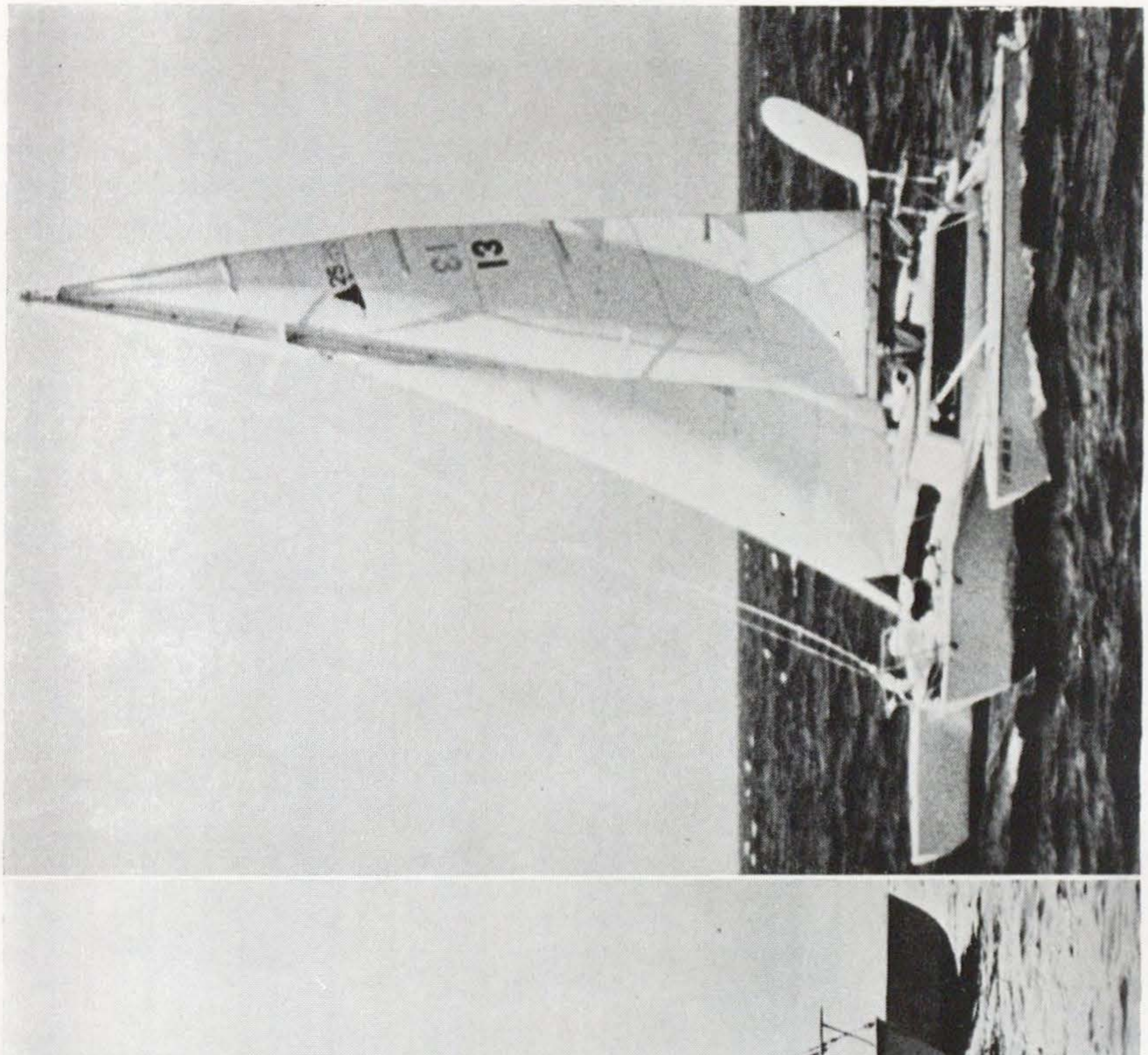


Figure 8 To match sail area to wind force, the cutter can be as versatile as the ketch. As the wind increases, the cutter's large genoa (left) can be dropped, and the small staysail (right) hoisted without *changing* sails on the headstay. Further sail reductions (as the weather worsens) are accomplished by reefing the mainsail from within the cockpit. The ketch's great virtue of reducing area by dropping the main applies to the first reduction only; thereafter the crew is required to change headsails on the bow in bad weather

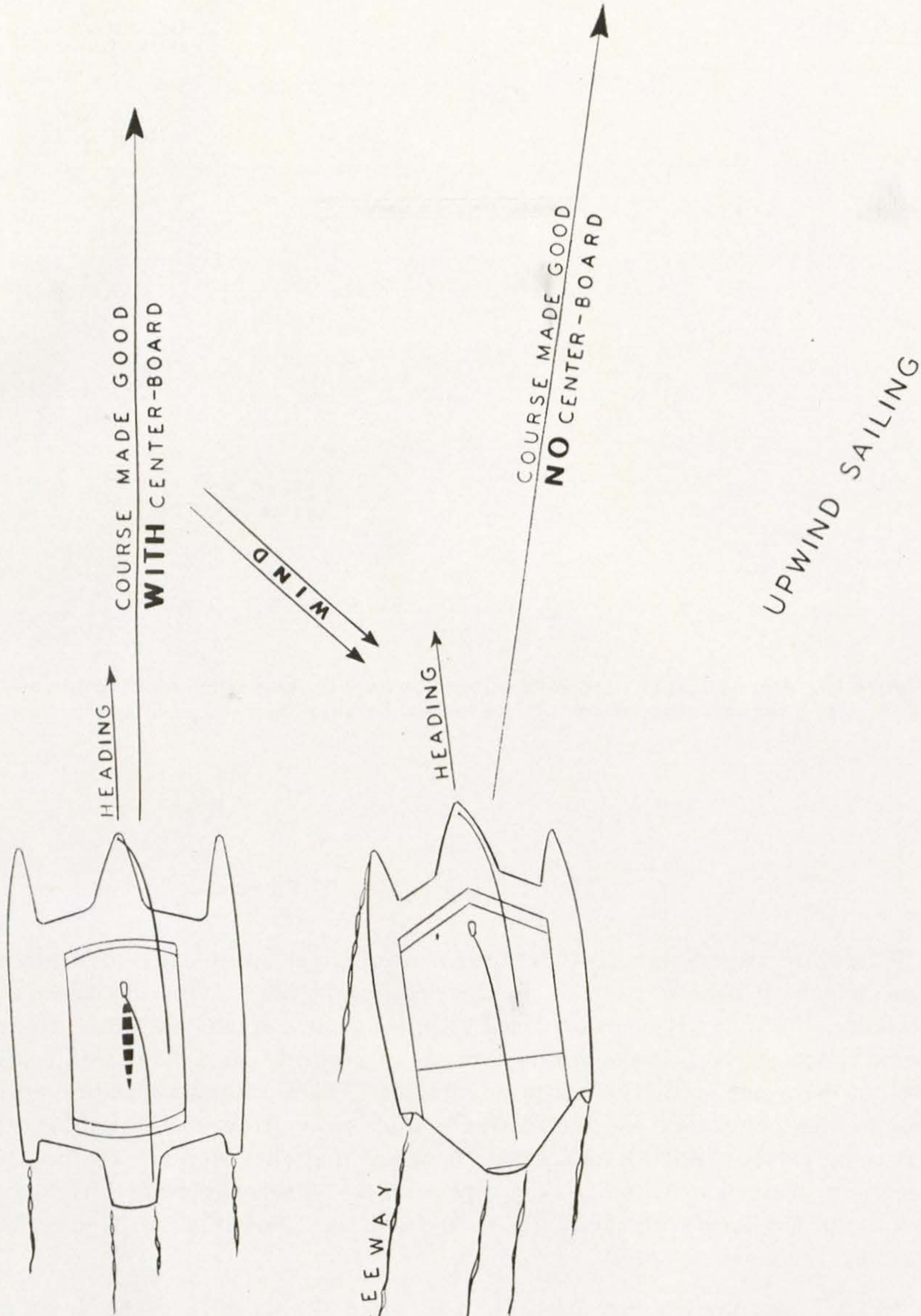


Figure 9 Leeway has the cumulative effect of causing the hulls to move sideways and thus slowly; while at the same time the sails are moving away from the wind, yet needing to point more into the wind. Leeway causes the collapse of both the aero-, and hydrodynamic systems which make a sailboat go. A poor boat to windward requires great understanding to be safe

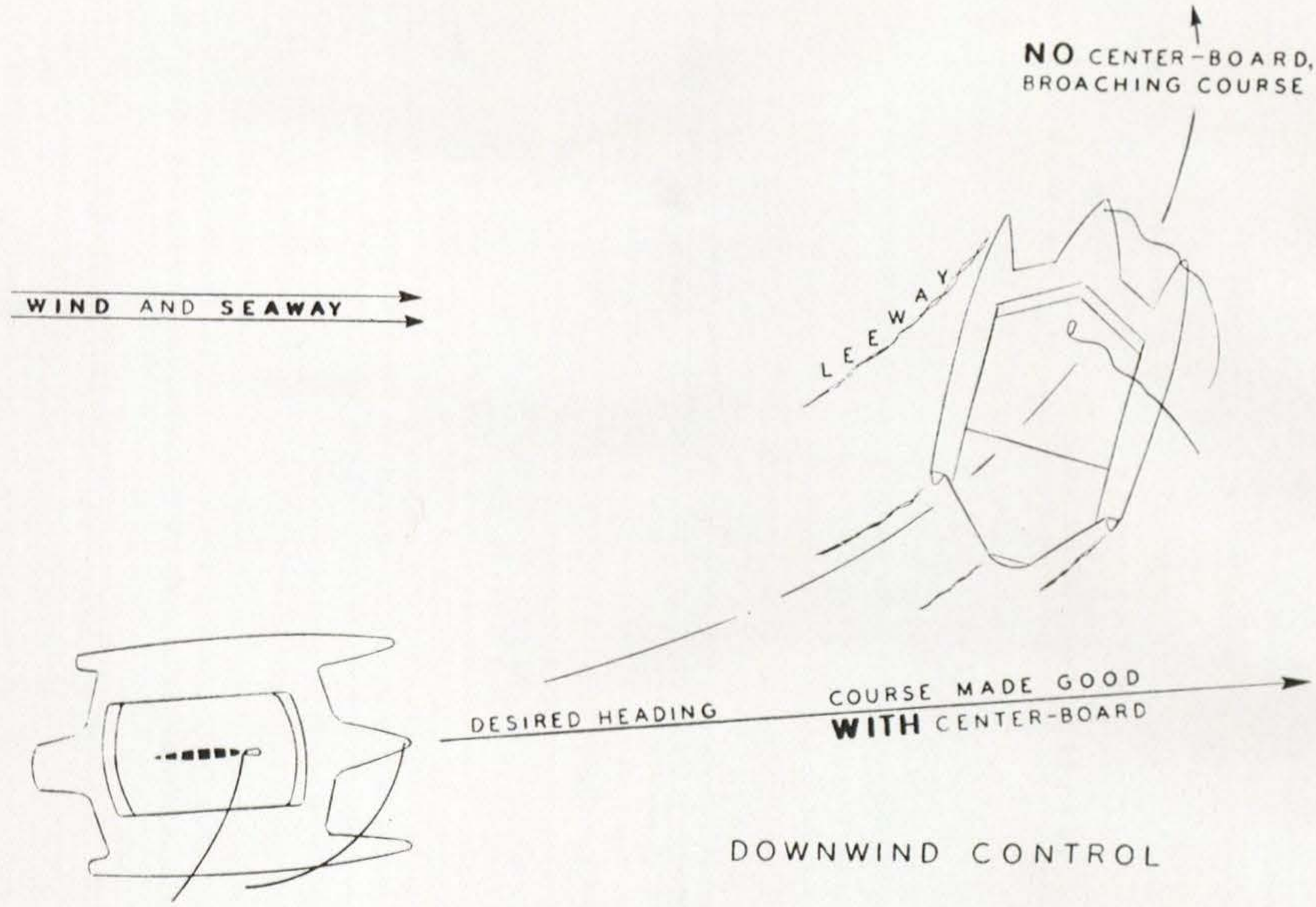
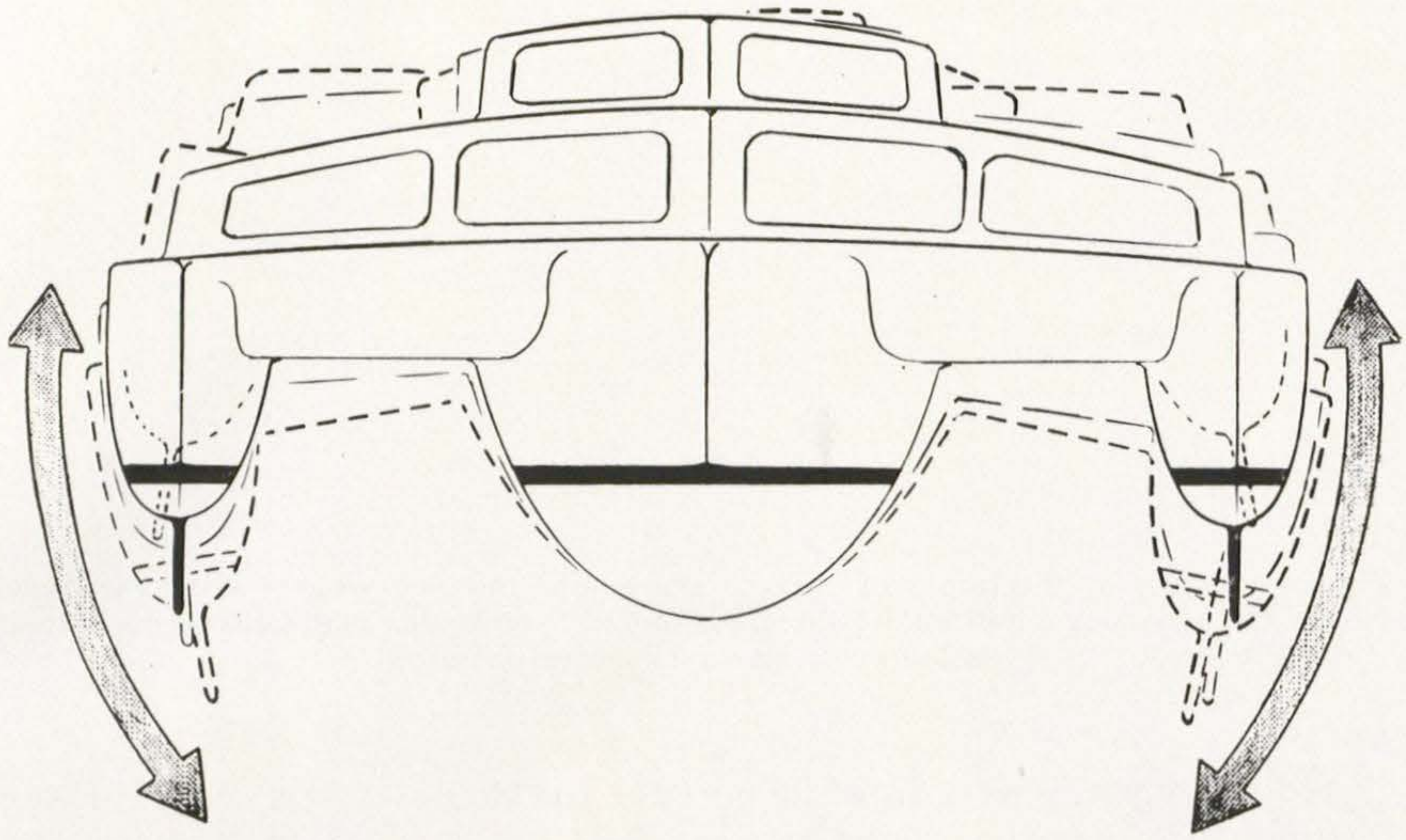


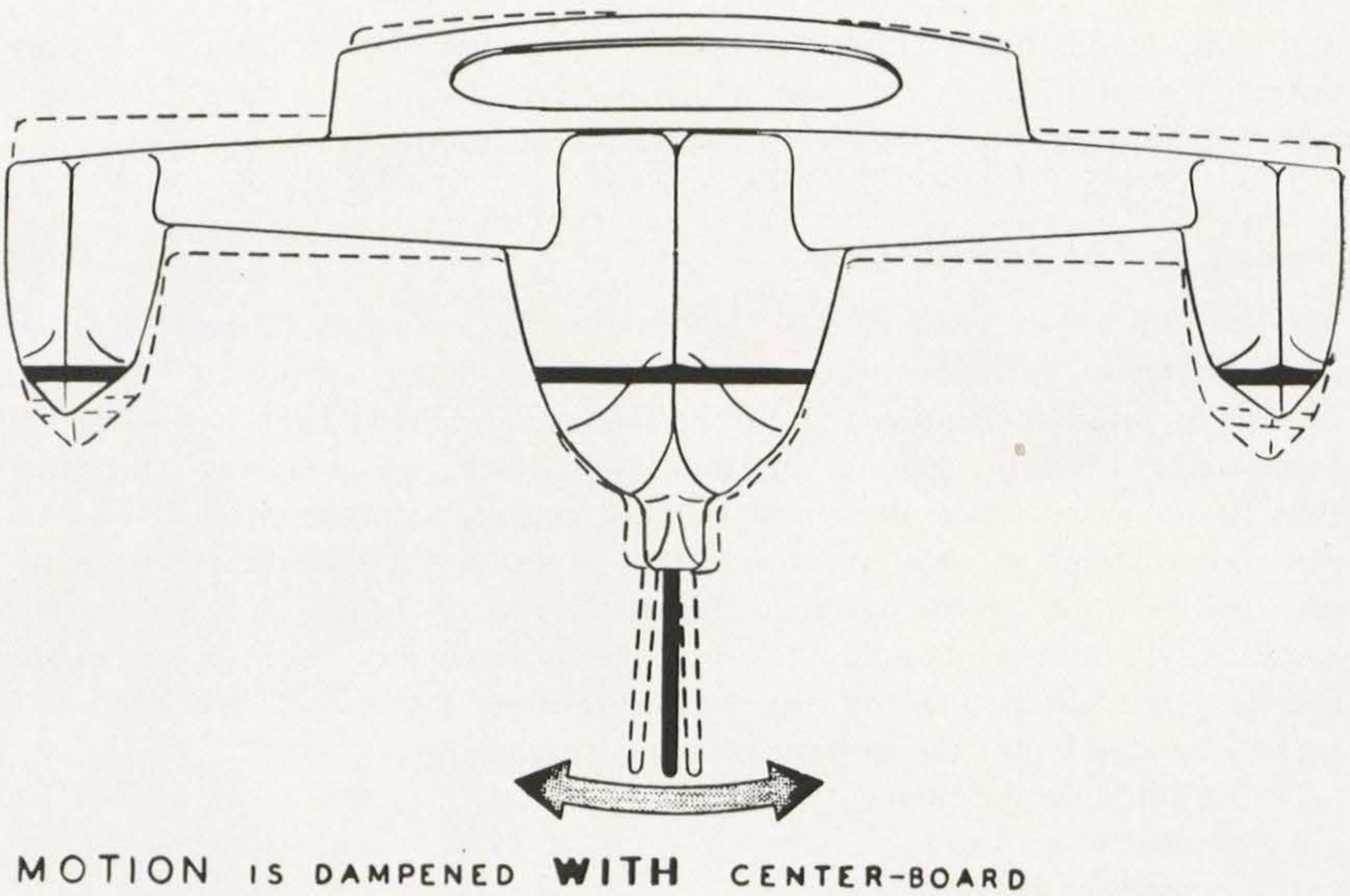
Figure 10 A poor boat to windward will also be hard to steer when running downwind in a seaway, especially at surfing speeds, because "*broaching*" *is leeway*

There are two design considerations which refer specifically to capsizing and which I believe deserve further emphasis here. One is *directional stability;* the other is *float buoyancy* (hull buoyancy in catamarans). In any vehicle, the steering is the primary mode of control. If a boat won't steer well in the rough stuff, you're out of control. The multihull's speed potential allows the helmsman to steer around, and away from the hot-spots, the breaking crests. But to succeed, he needs a boat that *steers.* To me, that means a centerboard and a skeg-type rudder. The skeg rudder is not as good for low-speed manoeuvring in the clutches, but it is really crisp for guiding the boat at speed.

Float buoyancy (or hull buoyancy) is, after all, stability. The floats (or hulls) must be large enough and far enough apart to make the craft stable with the given sailplan. And buoyancy in the bow—far enough forward—can relate directly to the likelihood of capsize in a given design. When a gust strikes the sails and the leeward hull is depressed, it must be depressed *at an attitude* which, as the boat gathers speed, brings it climbing out! If it is diving instead, a capsize is more likely. Or, when sailing downwind at speed in big waves, a short, diving float bow could cause—not a capsize—a boatcrash.



NO CENTER-BOARD CAUSES "SNAP-ROLL" MOTION



MOTION IS DAMPENED **WITH** CENTER-BOARD

Figure 11 Aside from its function in upwind and downwind sailing, the center-board serves to dampen lateral motion. Its effectiveness is dramatic. (One disadvantage of the catamaran is that it practically cannot have a center-board.) To stabilize the motion adds greatly to the comfort in the cabin, and increases performance by steadying the sails so that they can develop full power. Comfort and performance *together* make safety

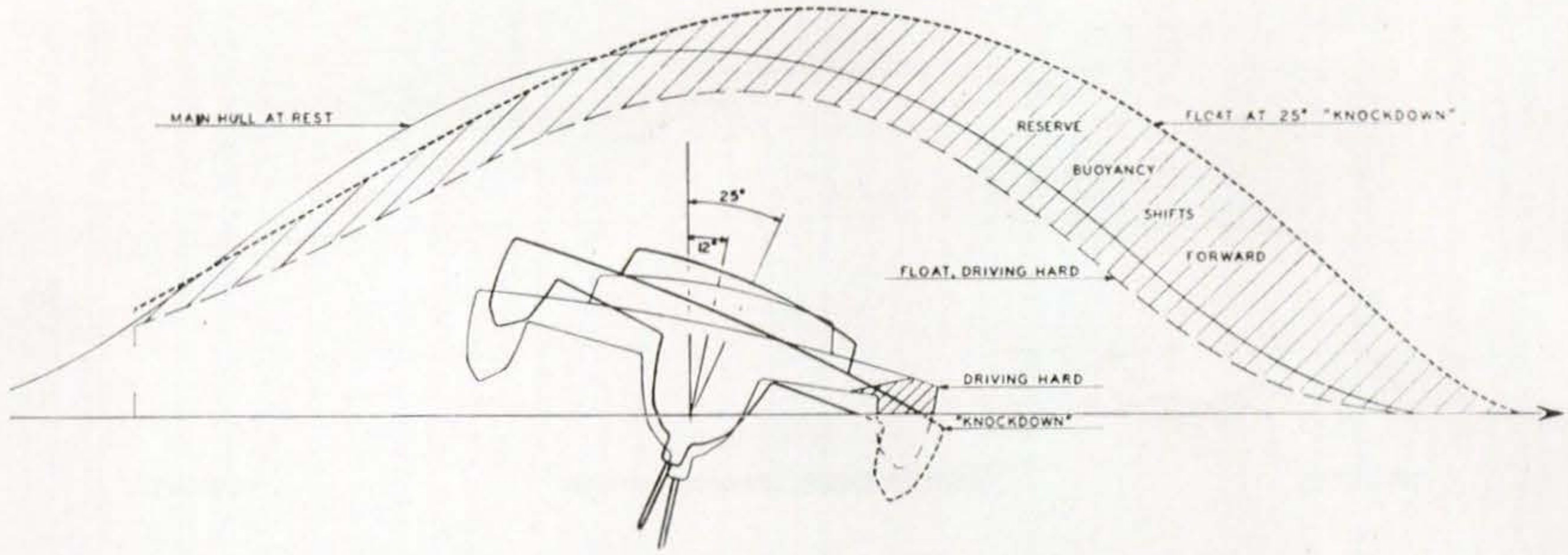


Figure 12 These "displacement curves" are graphs showing where, along the hulls' length, the buoyancy is located; how it is distributed. Note that as the float is depressed, its buoyancy increases sharply forward

Actually, there is very little support for the proposal that certain design features—like centerboards or buoyant float bows—have much to do with making a given multihull "safe" or "unsafe". I suspect, and the *Multihull Safety Study* may find, that the cause of capsize, and of other safety shortcomings that have accrued to multihulls, is to be found more in the tactics and attitudes of their sailors, and less in the design of their boats. A safely designed multihull is simply one which is easier to enjoy, whose handling is easier to understand. The rest of safety is up to the seaman.

Sailing is not seamanship

The multihull "movement" has suffered as much from lubberly displays in the harbour as from lost-at-sea stories. So many neophytes have been moved to build multihulls that lubberliness could have been assumed, and prevented. Instead, because multihulls don't heel, an aura was established that to go to sea in a multihull did not require seamanship. It was the same gimmick as used by an auto firm in propounding that their engines did not require water. One assumed that there was no heat.

Actually, those who build their own boats have the potential to become excellent seamen because of the "understanding factor". They need only to be impressed that the undertaking has three phases:

building the boat,
learning to sail,
and seamanship.

That individuals who have never sailed a boat can sustain the effort of building one, speaks highly of the human potential. Once that job is done, however, the neophyte *must* realize that to turn from builder to sailor is to turn from landsman to seaman; a heavy learning experience!

Learning to sail is, for most people, just like riding a bike. It is very easy for a kid who starts in a dinghy. "Yachting", let's say, is like riding with the big boys. But *seafaring*! That stuff is very grown up.

For most kids, driving a car comes *after* the bike, and yet so many grownups are starting out in crusing multihulls without knowing what it is to sail a dinghy! Many a lanky twelve-year old could step from his bicycle into the driver's seat, and he *could* drive. He would probably get the auto down the street, up the ramp and out onto the freeway. Maybe he'd even make it back again. But that's a very drastic way to learn to sail! The ocean may be safer than the freeway, but that's not what most people think.

An afternoon sail can be rather like a Sunday drive, but that's not what it's like to "hit the road". Real travelling is a way of life that requires massive adjustments, especially at sea. To tighten up the last turnbuckle and at once shove off for Rapa Nui is a trauma similar to that of being born as an adult.

Multihulls, probably more than other vehicles, attract the aspirant who is self-confident, individualistic. This person is simply unaffected by the magnetic field which says "buy a Mustang", "hop on a jet", or "go Chris Craft". There is another polarity which reaches him with "ride a real horse", "fly your own plane", and "build your own boat".

Why? Because it's more dangerous? I doubt that this is the reason, and I doubt that it *is* more dangerous. But it *can* be if one selects an ordinary mount for one's first ride; if one tries to solo without instruction, or if one attempts the ocean without learning the bay.

Seamanship is preparation

It is quite possible for a neophyte to build a seaworthy boat if he is given good plans. There are lots of very seaworthy multihulls around, and some of the best are owner-built. But the thing that makes them good is preparedness. Safety equipment, good solid outfitting, and knowledge in the minds of her sailors is what makes a well designed boat "seaworthy".

Figure 13 "Good solid outfitting" is illustrated by this 40 foot cruiser. Note life lines and pulpits

Multihulls have *earned* their controversial safety reputation, even if the public has been quick to seize and inflate the evidence. *Perhaps the single most fatal mistake made by trimaran enthusiasts in the last ten years was the assumption that, because monohulls sink from shipwreck and trimarans don't sink from capsize, trimarans are their own lifeboats.* It sounds good at first, and it was used as a sales pitch until this assumption caused the loss of several crews. It was exactly the same thinking that caused the high toll in the *TITANIC* disaster. The ship went down, and there were not enough lifeboats. At least three trimarans have been found upside-down at sea, with no crews. There were no life-rafts. Evidence of attempts to survive inside the upturned craft and outside on the under-wings were noticed; but the vessels may as well have sunk. The hypothesis for survival inside the capsized vessel must include provision for air and light, and against such deterrents as battery acid, engine oil, fuels, motion, and exposure to sloshing water. Outside, on the wave-washed platform, exposure is the main problem, even if there is something on the hulls to hang on to. What a real ocean-going boat must have is *another* boat. And the dinghy doesn't count. Since the *TITANIC*, inflatable liferafts have been developed which to a trimaran builder represent only 3 to 5% of the cost of the project. These rafts have water ballast-bags beneath them to make capsize in storms unlikely, and they have tent-like canopies to shelter the survivors from exposure. Complete with rations, such a liferaft makes a welcome retreat—*if it is accessible from the underwing.* It can be tethered to an upturned multihull to ride out heavy conditions. When things calm down, the crew can go back to the striken boat and live for months on its contents while awaiting rescue—and perhaps even salvage of the boat.

Another aspect of the trimaran's controversial reputation has been structural failure. I think the public image started way back in the Forties when Henry Kaiser's big power catamaran came unstuck . . . Since then we have had a shameful list of equipment failures, but *amazingly few* major hull or platform failures. The stories in the yacht club bars have it that "multihulls break up". Multihulls have broken up, but relative to structural problem in monohulls, and considering the pioneering nature of the movement, it can be honestly said that the multihull is a tough boat. I believe that the tabulations of the Multihull Safety Study will show that the exceptions to this rule are few enough to be impressive!

Recently, two French trimarans competed in a race across the Atlantic, but didn't make it because their designers were, I think, really out of touch with trimarans. The boats, quite predictably came apart. Both sailors were rescued. Both had less than one year's sailing experience! But the word really got around that "trimarans break up". Those did. A monohull sank in the same race, but nobody seemed interested. Structural failure comes under design, but belongs here also because a good seaman can sail a rickety boat a long way.

Seamanship is knowledge

There are some interesting differences between multihull seamanship and monohull seamanship. These differences stem from the multihull's light weight, and speed potential. For instance, anchoring can be best accom-

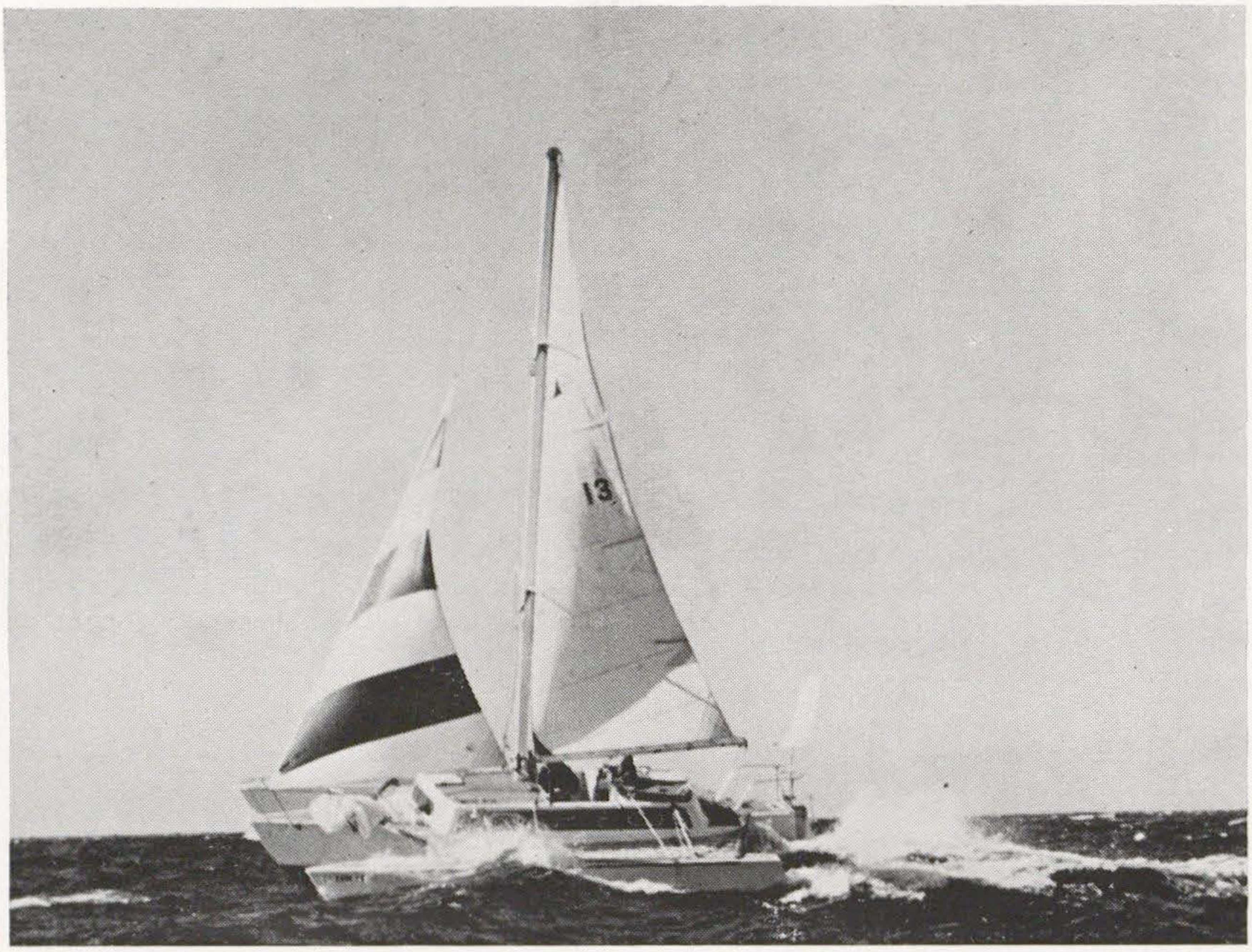


Figure 14 Scalping the ridgetops on a 15-knot reach, this boat is in the process o crossing from the face to the back of a breaking crest; an explosive instant. To lash the boat into such a lather is a tactic used only in racing or while sailing in the company of another boat. It is very necessary for a sailor to "rod" his boat *before* cruising. Without this he cannot really *know* his craft. Then, while cruising, one sails with *reserve* and *confidence*

plished from the stern; or, in heavy weather, by a bridle from the bows. Unbelievable anchorages can be considered because of the multi-hull's light weight. There is the beaching potential to be explored: for maintenance, refuge, and pleasure—this is an aspect of seamanship not present in keelers.

Handling in storms includes such axioms as "don't sail faster than the waves"; don't stop the boat stern-to with a big sea anchor"; "trail your drogue by a bridle from the float sterns"; and, "if seas are boarding from astern, get some sail up and pull away from them" It seems that the boat's speed potential is its salvation at zero-hour. It is a matter of balancing your speed against the speed of the seaway. This lets the vessel give with the punches instead of just lying down and taking them.

In monohulls, the burden of their own inertia plus meagre speed potential makes this brand of seamanship unapproachable. How can you give with the eighteen-knot punch of a growling crest in a boat whose maximum speed is seven? If, at that moment, the boat can quickly get moving at fifteen, the collision is somewhat softer. When the crest has passed, or has spent itself at the transom, the multihulls drops back to seven until another bad one comes along. This brand of seamanship, however, is absolutely and critically dependent on *directional control.*

Figure 15 Surfriding in ocean waves requires a boat with positive directional control. This boat is being controlled by the self-steering device while the sailor contemplates a sail reduction on the bow

Multihull seamanship is a subject for a book, and multihull safety is a subject larger than this essay. But if we consider the broad spectrum of safety—not just the aspects of capsize and structure—and ponder the amazing achievements of the last ten years: the number of safe voyages in rudimentary craft, we will begin to fathom our potential.

To be cognizant of *what has been done* with multihulls is to be excited by *what can be done* with them. Assuming that the word "safe" is applied to seafaring to its real degree, it is unquestionable that the right multihull with the right crew has got to be safe.

But multihull seamen need a new approach to seamanship, and that approach is just emerging. It is a *conservative*, *knowledgeable approach* to the handling of *radically different boats*. Designers are not usually involved with the conduct of crews, but multihull designers can do much to distribute the new knowledge and to establish the conservative approach. Designers' comments, together with the tabulated experiences of hundreds of sailors, will make the Multihull Safety Study a regular bible for trimariners.

What I'm proposing is that the only thing we need now to make multihulls safe is a *safe attitude*. I mean a mental climate for seafaring that lets the sailor meld with his boat and with the ocean in a safe way.

The human desire to voyage is as innate as the human need for song. The motive for each is simply that performance brings the person pleasure. The more practice and the more knowledge the more pleasure. And in the case of seamanship, the more safety.

MULTIHULL HAZARDS: AREA FOR FORETHOUGHT

by A. J. Smith Felixstowe, England

Tony Smith has sailed dinghies since the age of ten. Six years ago the sales literature he read convinced him that it was a trimaran he wanted, so he bought the plans. "I wish I hadn't read the sales literature because trimarans do not sail at 30 knots and you can't 'safely' put to sea in a boat built by an amateur on a restricted budget, built in only a few months". He survived his mishaps, though he wonders how many others who built a boat under the same circumstances have come to grief, or given multihulls a bad name. After crewing in *STARTLED FAUN* in the 1966 "Round Britain Race" he designed a 25-foot trimaran which performed to his satisfaction on a singlehanded 1000 mile non-stop test cruise. "I even took a knock-down and the boat righted herself". He now designs trimarans, specializing in 25-footers with a good turn of speed, manoeuvrability "as good as a dinghy" and good accommodation.

* * *

Discussions of multihull seaworthiness and crew safety tend to be dominated by the topic of capsizing. The most spectacular kind of multihull mishap—or disaster, no doubt: but is it in fact the most common kind? I expect such occurrences as dismastings and rudder damage feature much more prominently in the accident reports collected by the AYRS Multihull Safety Study than capsizes.

The following are, I would say, the hazards of particular concern to the designer and sailor of ocean-going multihulls:

1. Capsizing
2. Loss of rudder
3. Loss of mast
4. Being holed when sailing at speed
5. Wave damage to deck structure
6. Breaking up.

1. Capsizing is a possibility which does worry all multihull yachtsmen—we do as yet not have a multihull designed for ocean work of the Cape Horn kind, though I do believe it possible to construct a multihull that is inherently seaworthy under all conditions; unfortunately speed is the price of safety, and so designers tend to design for speed rather than for ultimate safety. Capsizes are, after all, quite rare, and can be avoided by good seamanship—unless sea conditions are so bad that even the best of seamanship may not be able to avert a capsize, and seas like that are not normally encountered in the *usual* sailing grounds.

When investigating ways of surviving in a capsized multihull we should carefully consider *how* a particular craft capsizes. Some multihulls, mainly catamarans, will capsize and invert quickly, and there is thus the danger that people may be trapped inside or underneath the craft. Others, most trimarans, that is, tend to capsize slowly and will take some time to invert—this may create the problem of a period during which there is nowhere for the crew to hold on to, until inversion has occurred.

Another consideration in this context must be the way she floats when inverted. Most multihulls—unless constructed with extra deck buoyancy—will float with the bridge deck or underside of the cross-arms at sea level. The amount of cabin space left is all important when our thoughts turn to survival *inside* an inverted multihull. An inverted trimaran will continue to float at deck level as long as the float hatches do not leak, leaving about half the normal standing headroom for human occupation. This volume of space would be sufficient to survive in, provided a false floor is rigged above the water so that the crew can ramain dry, and a hole is made in the bottom of the main hull for access and to admit air. Catamarans on the other hand will probably be in danger of filling up if the trapped air leaks out as the boat is rocked by the swell. Obviously, no hole can be made in the hull bottom as that will allow the air to escape. But buoyancy could be built in to make it possible to live inside the hulls of an inverted cat.

Hand holds on the underside of the wings should be provided on all types of multihulls, and I think that the crew should stay with a capsized multihull even though they may have an inflatable life raft with survival rations. When the 'panic' is over it is a good morale booster to be in a position to *do* something—like salvaging food and equipment necessary for remaining a long time at sea. A large multihull is easier to spot than a small life raft, and it is possible, I think, to jury-rig sails even on an upside down multihull.

2. Losing a rudder is something peculiar to a fast multihull. In a squall, or running before a gale, a multihull can reach fantastic speeds which subject the steering gear to high stresses. If a multihull comes into stays it inevitably starts to sail backwards, the rudder is then easily forced flat against the transon and is likely to break. Stops on the transom will prevent the rudder from going flat against it.

3. Losing a mast is another particularly multihull hazard. Sudden gusts are not absorbed by the boat heeling, although trimarans with *thin* floats have overcome this problem to some extent. It is, of course, possible to arrange the rigging in such a way that the mast can break in several places and what is left of it remains supported by the stays so that trysails and storm jib can still be rigged quickly.

Unfortunately most of the mast breakages are due to using a mast with insufficient material below the lowest shrouds which is incapable of taking the high compression loads and just cracks.

4. Multihulls tend to be built lightly and are thus quite vulnerable to holing by floating objects when sailing at speed. For this reason I consider watertight bulkheads essential and a crash bow advisable.

5. Because of their large deck area multihulls are liable to have their superstructure smashed in by breaking waves, with the risk of dangerous swamping. To counter this danger, I would think it advisable to have the floats of trimarans or the buoyancy tanks of catamarans filled with expanded foam plastic.

6. Unfortunately a lot of multihull disasters which normally go under the heading of "Another Multihull Breaking up" are caused by amateur and even professional boat builders who have no idea where the points of high stress are. A common argument from them is that the windward float is likely to fall off when it comes clear of the water. In fact, the stresses act in completely the other direction because the only reason this float comes clear of the water is that the mast shroud connected to it lifts as the wind hits the sails. Even the stress around the cross arm to the leeward float can act in a direction opposite to the obvious one, due to the lateral resistance of the lee float trying to bend the latter under the cross arm.

There is no excuse for anyone to say after his boat has broken up that he didn't know what the stresses were, because multihull building is no longer an experiment and most of the stresses are known. If he doesn't know the stresses then he should not build multihulls.

These, then, are to my mind the most likely multihull failures that should be born in mind by multihull designers and by people planning long ocean voyages in multihulls.

SOME ASPECTS OF STRUCTURAL DESIGN IN MULTIHULL SAILING CRAFT

by I. T. Burke, BSc (Eng)

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The opinions expressed here are his own, and do not necessarily reflect the official views of the U.S. Coast Guard Service.

* * *

Resolution of the conflicting requirements for speed, seaworthiness, accommodation, and beauty, is perhaps the challenge that motivates many naval architects to design sailing yachts. When these same requirements are considered in relation to multihulled sailing yachts the challenge is greater because higher potential speeds tantalizingly beckon, yet seaworthiness, accommodation, and beauty, lie within more restricted parameters by virtue of the morphogenesis of these craft.

The higher speeds attained by multihulled craft relative to monohulls of equivalent waterline length are due to the formers' lower displacement length ratios which are possible because they are unballasted craft. Stabilization of multihulled craft is achieved by dividing displacement between semi-hulls outboard of and parallel to the fore and aft axis of the center of gravity of the vessel. In the case of catamarans displacement is equally divided between two hulls; trimarans, between a main hull and two floats; proas, between a main hull and a single float. The principle is the same in all these types for in each case the division of displacement results in a bigger righting arm and greatly increased initial stability relative to similarly sized monohulls. In fact the condition of high initial stability is so marked that extreme stability conditions have been encountered in larger multihulls.

The writer believes that further development of multihull sailing craft will most likely be the result of more efficient structural design of the hulls and connecting beams rather than a result of hydrodynamic breakthrough. Structural design of multihulls has lagged behind the development of their hull forms in spite of the availability of many new materials. Perhaps this is a hangover from monohull practice where structural design in the main has stultified because of conservative practices and the desire to copy the ways of great masters of yacht construction who have in many cases been endowed with an unwarranted mystique. Good craftsmanship can be acquired by training, since it is not a creative art.

The AYRS has probably done more to develop multihulled sailing craft than any professional body known to the writer. Great credit is due to those members of the Society who have not only gone out and built their designs but who have also willingly shared their experiences and lessons learnt.

It is the intention in this paper to touch on a few areas of structural design in wood which are peculiarly applicable to multihulls, and to consider briefly some aspects of sandwich construction. Wood has been selected because the majority of designs found throughout the pages of the AYRS publications concern wooden-hulled craft.

Although wood is the traditional boat building material, it is neither homogeneous nor isotropic, and its strength properties normal to the grain direction are considerably less than those parallel to the grain. In addition to this, wood readily absorbs moisture which affects its strength, and it deteriorates with age as do glued connections. To overcome the disadvantages of natural wood, veneers with grain directions at right angles are bonded together with synthetic resins, applying heat and pressure, to form a wood product which approaches an isotropic condition and which is highly impervious to atmospheric conditions.

The connection between the semi-hulls of multihulled craft consists of beams loaded so that they are in bending and in torsion. In order to obtain the lightest beam suitable for these loading conditions and so contribute to minimum displacement/length ratio one is forced to consider a box beam in wooden construction. Figure 1 shows the allowable compression ultimate stresses for Sitka spruce beams in bending if stresses are computed from the well known general flexure formula $fy = My/I$.

The Forest Products Laboratory of the United States of America has determined that the modulus of rupture for I-beams and box sections depends upon two ratios; namely t_c/h thickness of the compression flange divided by the centreline depth of the beam) and b'/b (thickness of the web or webs divided by the total width of the beam), and that "form factors" based upon these ratios, when multiplied by the modulus of rupture for a standard rectangular beam specimen gave ultimate stress values which agree closely with test results.

These values for Sitka spruce are plotted in Figure 1, the values being obtained by multiplying the Modulus of Rupture, 9400 lbs/in.^{2} for a standard rectangular beam specimen, by the Forest Products Laboratory form factors for beams of various sections. For other woods the values given in Figure 1 can be adjusted in proportion to the relative values of the modulus of rupture for solid sections.

The most effective section for the transverse connecting beams of multihulls is a box section when considerations of greatest Moment of Inertia relative to specific weight and inherent ability to withstand torsional stresses are taken into account. Torsional stresses are of considerable magnitude in multihull structures. In computing a beam wherein the upper and lower members are bevelled, the section may be considered rectangular, with the height of rectangular beam equal to the centerline depth of the actual beam. Similarly, the thickness of the chords of the equivalent beam may be taken as equal to

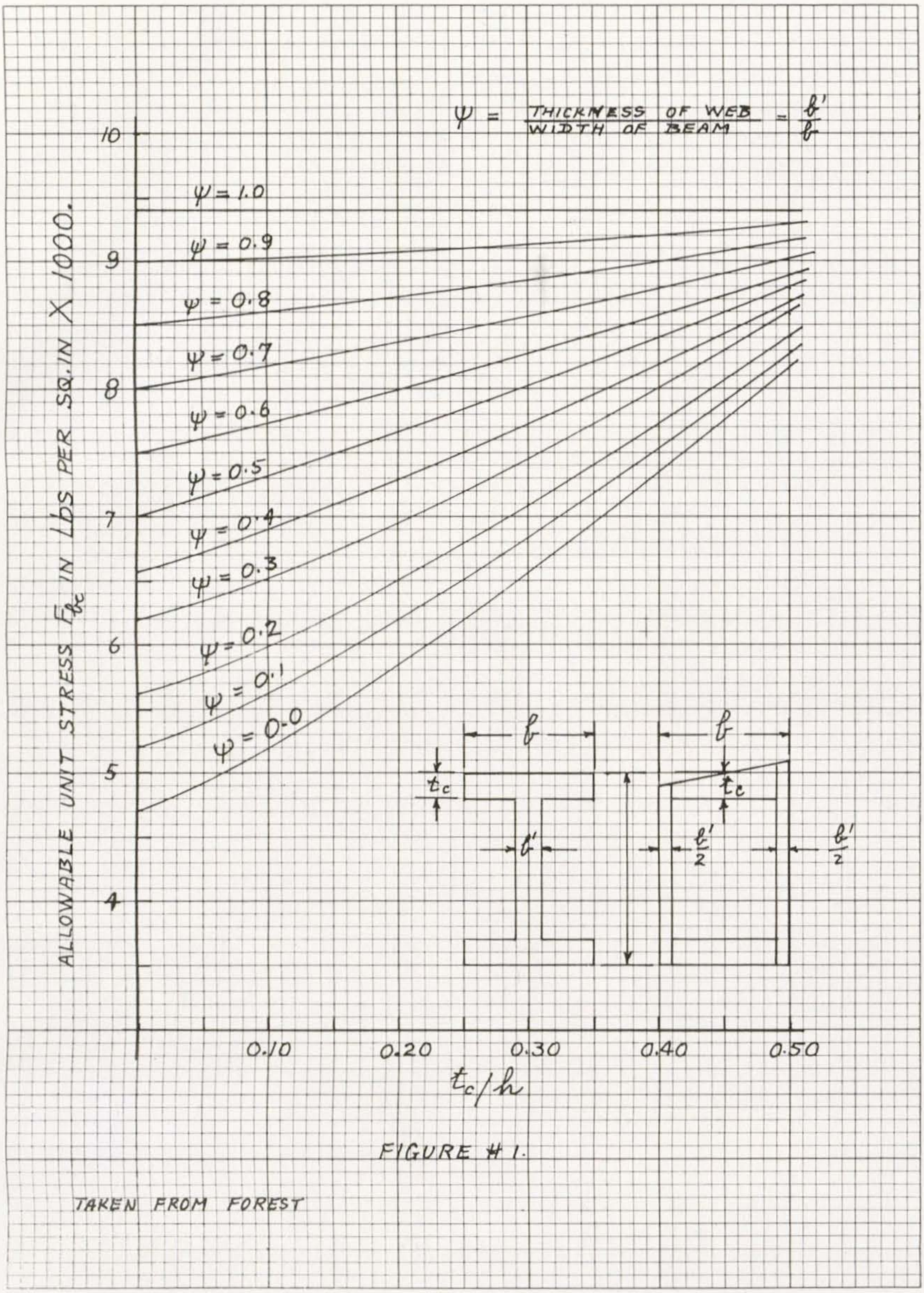

Fig. 1

the centerline depth of the chords of the actual beam. The errors in such a computation are negligible. The bending and compressive stresses given in Fig. 1 are for statically determinate beams, and are conservative for continuous beams, since continuity tends to increase ultimate beam strength. For the tension side the modulus of rupture should not exceed the Modulus of Rupture in compression for a rectangular solid section. For Spruce this value is 9400 lbs./in.^{2} which is slightly less than its ultimate tensile strength.

If beams of rectangular or I-section are made of solid wood the allowable shear stress can be taken as the shearing strength parallel to the grain. Typical values for woods are:

Sitka Spruce	750 lbs./in.^{2}
Pine (Northern White)	840 lbs./in.^{2}
Douglas Fir	810 lbs./in.^{2}
Birch	1300 lbs./in.^{2}
Mahogany	800 lbs./in.^{2}

In the case of a built up box beam, consideration must be given to the strength of the glued joints. The strength of a glued wooden joint depends chiefly upon the angle between the grain of the two pieces being joined. When the grains of both pieces are parallel, casein glue develops the longitudinal shear strength of the wood. When the angle between the two grain directions is around 45° the joint strength is decreased by about 40%, and when it is 90° the joint strength decreases by 50%.

When plywood is used as web material the allowable glue stress between the web and the beam flanges is taken as 1/3 the strength of the flange material parallel to the grain. For spruce this would be 750/3 = 250 lbs./in.^{2}

This greatly reduced shear strength often causes difficulty in the design of box beams using plywood webs because the necessary glue area becomes the critical factor in the design of beams.

Consider a box beam section as shown in Figure 2 upon which an external load of 2160 lbs. is acting. To find the average stress on the glue between the upper flange and the webs along section A-A:—

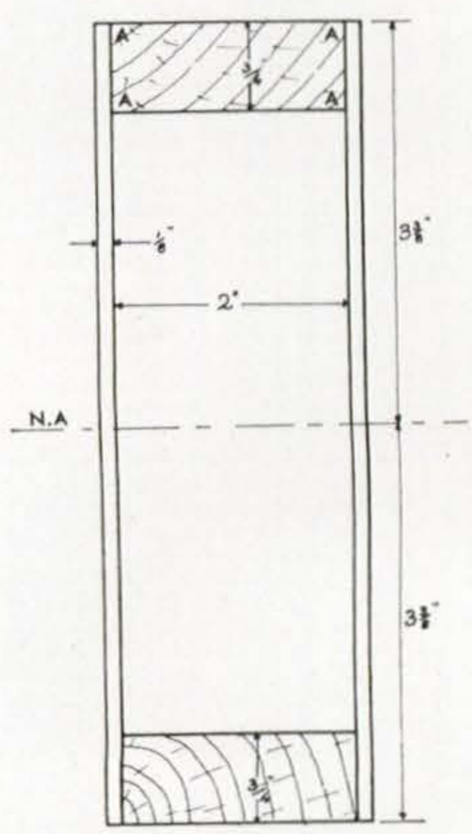

Fig. 2

Using flexual shear equation:

Horizontal shear flow in lbs./in.,

$$q = \frac{v \int y\,d\,A.}{I}$$

$$I_{NA} = 30.4 \text{ in.}^4$$ (which includes ½ web. area as effective);

First movement of flange area about neutral axis,

$$\int y\,d\,A = 2 \times 0.75 \times 3 = 4.5.$$

Hence longitudinal shear load per inch of glue on both sections A-A

$$q = \frac{2160 \times 4.5}{30.4}$$

$$= 320 \text{ lbs./in.}$$

Glue shear area, $A_g = 2(1 \times 0.75)$

$$= 1.5 \text{ in.}^2$$

Hence average glue stress, $f_g = \dfrac{q}{A_g} = \dfrac{320}{1.5}$

$$= 213 \text{ lbs./in.}^2$$

Or, by an approximate method:

$$f_g = \frac{V}{db}$$

$$d = (6.75 - 0.75)$$

$$= 6 \text{ ins.}$$

Shear load per inch of beam, $q = \dfrac{V}{d} = \dfrac{2160}{6}$

$$= 360 \text{ lbs.}$$

Since $\frac{1}{2}$ of web of flange is effective in bending, the shear load on the glue

$$= \frac{2}{2.125} \times 360.$$

$$= 341 \text{ lbs./in.}$$

Glue Area, $A_g = 2(1 \times 0.75)$

$$= 1.5 \text{ in.}^2$$

Hence $f_g = 341/1.5$

$$= 227 \text{ lbs./in.}^2$$

as compared to 213 lbs./in.^{2} by the exact method. The discrepancy is due to the approximate value of d, and also to the fact that the web between the flange and neutral axis has been neglected in computing d.

Figure 3 shows the beam with the same area but the webs have been moved closer together, leaving a flange portion outside each web. This now gives two glue surfaces between each web and the flange instead of one as in Fig. 2.

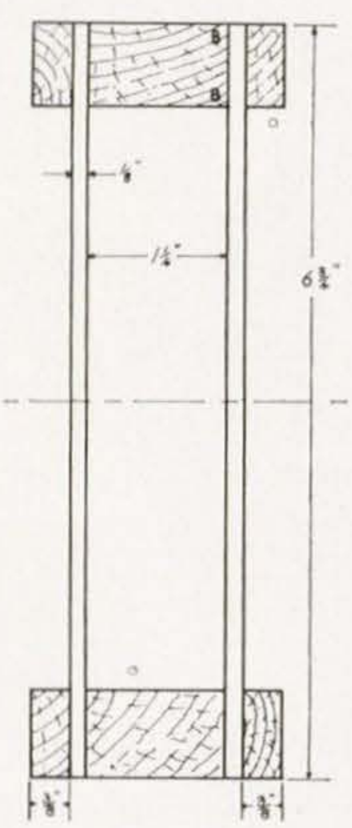

Fig. 3

The horizontal shear load on section B-B,

$$q = \frac{V \int ydA}{I}$$

$$= \frac{2160 \times 0.375 \times 0.75 \times 3}{30.4}$$

$$= 60 \text{ lbs./in.}^2$$

Glue area on B-B $\quad A_g = 0.75 \text{ in.}^2$

Hence

$$f_g = \frac{60}{0.75}$$

$$= 80 \text{ lbs./in.}^2$$

Due to symmetry the shear flow on the flange portion between the webs will be divided between the webs. In other words, one half of the flange area between webs can be considered as loaded from each web, hence

$$\int ydA = 0.625 \times 0.75 \times 3$$

$$= 1.4,$$

and therefore the glue stress on section AA,

$$f_s = \frac{2160 = 1.4}{30.4 \times 0.75 \times 1.0}$$

$$= 133 \text{ lbs./in.}^2$$

Thus the beam in Fig. 3 is better than the one shown in Fig. 2 from a glue strength standpoint.

Now let us consider a wooden box beam as shown in Figure 4 where a bending moment of 45,000 lbs./in² and a shear load of 2800 lbs. is acting upon the section of the beam.

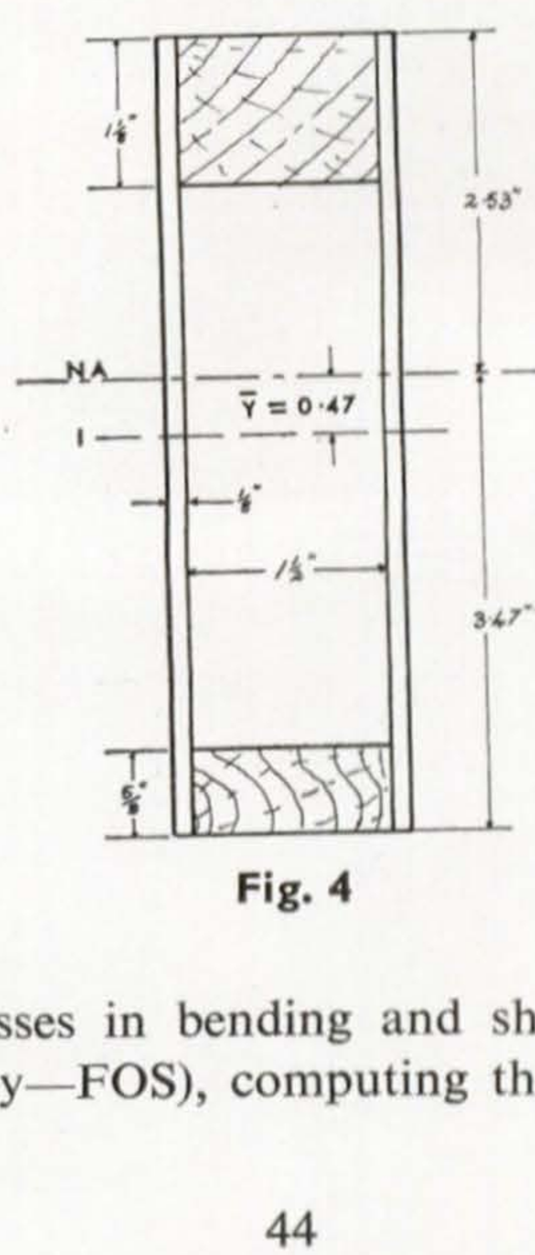

Fig. 4

To determine the stresses in bending and shear and margins of safety (MS) (or Factor of Safety—FOS), computing the Neutral Axis, NA, is the first step.

TABLE No. 1

Portion	Area A	y	Ay	Ay^2	$I_o = \frac{1}{12} bd^3$	$I_{I-I} = I_o + Ay^2$
Upper flange	1.688	2.437	4.11	10.0	0.18	10.18
Lower flange	0.937	−2.687	−2.52	6.77	0.03	6.80
Web	0.750	0	0	0	2.25	2.25
Totals	3.375		1.59			19.23

The properties are first calculated for the reference axis I-I and then transferred to the neutral axis. For plywood webs it is permissible to use only ½ the web area in computing section properties.

$$\bar{y} = \frac{\Sigma Ay}{\Sigma EA}$$

$$= \frac{1.59}{3.375}$$

$$= 0.47 \text{ above I-I to neutral axis.}$$

$$I_{NA} = 19.23 - 3.375 \times 0.47^2$$

$$= 18.48 \text{ in.}^4$$

$$\frac{I}{y\text{ (upper)}} = \frac{18.48}{2.53} = 7.30,$$

$$\text{and } \frac{I}{y\text{ (lower)}} = \frac{18.48}{3.47} = 5.32.$$

And the stresses and margin of safety:

Bending:

Maximum bending stress in upper flange,

$$f_b = M/_{I/y}$$

$$= \frac{45000}{7.30}$$

$$= 6{,}160 \text{ lbs. compression.}$$

$$\frac{t_c}{h} = \frac{1.125}{6} = 0.188,$$

$$\text{and } \frac{b'}{b} = \frac{0.25}{1.74} = 0.143.$$

From the allowable value curves in Fig. 1 the modulus of rupture F_{bc} for these relationships $= 6{,}300$ lbs./in.^{2}

Hence the margin of safety for the upper flange,

$$MS = \frac{6300}{6160} - 1 = 0.02.$$

For the lower flange,

$$f_b = \frac{45000}{5.32}$$

$$= 8{,}450 \text{ lbs./in.}^2 \text{ tension.}$$

The allowable stress can be taken as the modulus of rupture of a solid rectangular beam in pure bending.

From Fig. 1 we obtain $F_{bc} = 9{,}400$ lbs./in.^{2}

Hence the margin of safety of the lower flange,

$$MS = \frac{9400}{8450} - 1 = 0.11.$$

Shear Strength:

The ultimate shear strength of spruce plywood is given by the formula

$$F_s = 960 + \frac{3140}{\sqrt[3]{C}} - 45.5\ D$$

where C = web diaphragm spacing, and D = the distance between flange centroids, 5.12 ins. Take C = 6 in. in this example.

Hence
$$F_s = 960 + \frac{3140}{\sqrt[3]{6}} - 45.5 \times 5.12$$
$$= 2{,}432 \text{ lbs./in.}^2.$$

The maximum web strength occurs at the neutral axis:

$$f_s = \frac{VQ}{I_b}$$

$$\text{where } Q = \int_0^{2.53} ydA$$

$$= 1.125 \times 1.5 \times 1.97 + 0.125 \times 2.53 \times 1.37$$
$$= 3.76$$

$$\text{hence } f_s = \frac{2800 \times 3.76}{18.48 \times 0.25}$$
$$= 2282, \text{ lbs./in.}^2$$

$$\text{and thus, } MS = \frac{2432}{2282} - 1$$
$$= 0.07$$

Glue Strength

The flange members are glued to the two web members. Since the lower flange has the smallest thickness and therefore the smaller glue area it will be more critical than the upper flange. The average horizontal shear stress on the surface between the webs and the lower flange,

$$f_g = \frac{VQ}{I \times A_g}$$
$$= \frac{2800 \times 0.625 \times 1.5 \times 3.158}{18.48 \times 1.25}$$
$$= 360 \text{ lbs./in.}^2$$

where the glue area, $A_g = 2 \times 1 \times 0.625$
$= 1.25$ in.^{2},

and $Q = \int ydA$ for the lower flange about NA.

The allowable stress on the glued surface is based on 1/3 of the allowable shearing stress parallel to the grain of the wood being used. For wood $F_s = 750$ lbs./in.^{2}, so the allowable stress for the glued surface

$$F_g = 750/3 = 250 \text{ lbs./in.}^2,$$

and hence

$$MS = \frac{250}{360} - 1 = -0.30.$$

Thus for the particular loading assumed the critical factor is the glued joint between the web and the lower flange.

To eliminate the negative MS more glue shear surface must be provided. For example a small triangular wood strip could be added as shown in

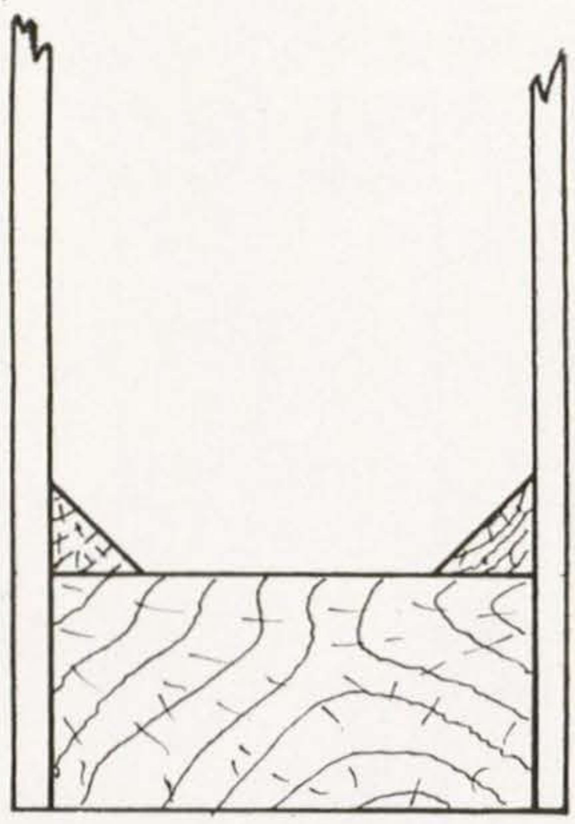

Fig. 5

Another way to do this is shown in Figure 6 where the same amount of material is used as was in the original beam.

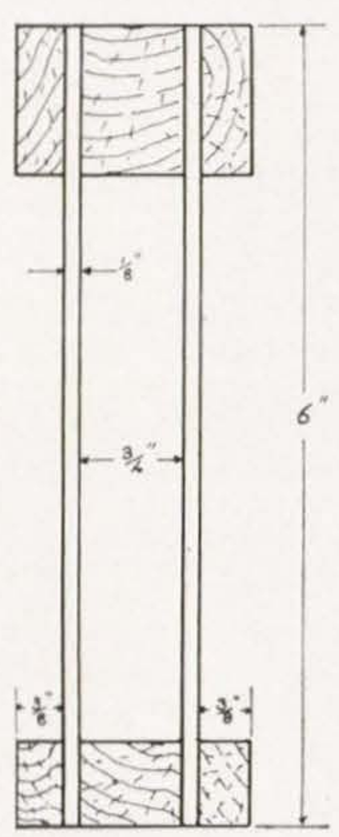

Fig. 6

This is achieved by moving the webs closer together and constructing the flanges from three pieces, thus creating two glued surfaces on each web instead of one as in the previous sample problem.

Since the width of the ear is 3/8 ins. or half the width of the flange between the webs, the shear flow from web to flange will be symmetrical—each glue surface will carry the same shear load. The glue shear stress will be in this case

$$f_g \quad 360/2$$
$$= 180 \text{ lbs./in.}^2,$$

and hence

$$MS = \frac{250}{180} - 1$$
$$= 0.39.$$

It should be noted that glue strength is not always critical in this type of beam for in most cases the ratio of the shear load to bending load is such that the glue shear stress is not made critical.

Now consider the two beam sections of identical total section area.

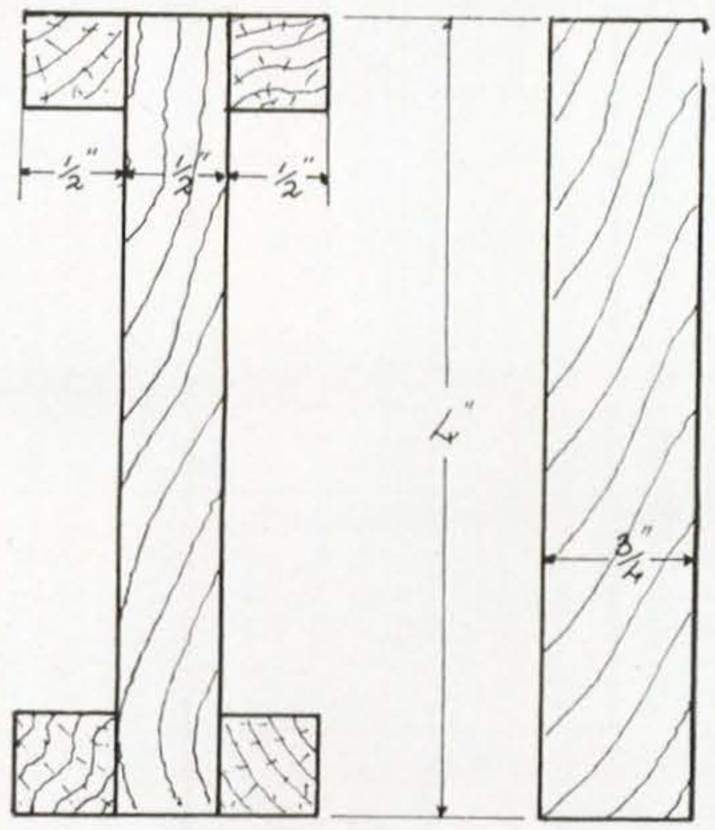

Fig. 7

For comparison, the bending and shear strength for each beam section have been computed.

Beam A:

$$t_c/h = 0.5/4 = 0.125;$$
$$\text{and } b'/b = 5/1.5 = 0.33.$$

From Fig. 1 the allowable bending stress,

$$F_b = 6{,}675 \text{ lbs./in.}^2$$

$$\text{Now } M = \frac{F_b I}{C} = \frac{6675 \times 5.75}{2}$$

$= 19.200$ lbs. in. and is the maximum moment that the section will develop.

The allowable shear stress for spruce,

$$Fs = 750 \text{ lbs./in.}^2$$

$$\text{Then } fs = \frac{VQ}{Ib}$$

$$\text{or } V = \frac{fsIb}{Q}$$

$$= \frac{750 \times 5.75 \times 0.5}{(0.5 \times 1.75) + (2 \times 0.5 \times 1)}$$

$$= 1{,}150 \text{ lbs.}$$

This is based on the strength of the web at the neutral axis or midpoint of the beam. The glue strength of the joint between the web and the flange depends, as stated earlier, on the direction of the grains of both web and flange. If in this case the grains of both are parallel the glue will develop the shear strength of spruce, viz. 750 lbs./in^2. Using this value, the two glued joints on each flange will develop an external shear load,

$$V_g = \frac{f_g I b}{Q} = \frac{750 \times 5.75 \times 0.5 \times 2}{0.5 \times 0.5 \times 1.75 \times 2} = 4{,}500 \text{ lbs.}$$

This value provides a large margin over the shear strength of 1,150 lbs. at the neutral axis and can therefore take care of any normal variation of the glue strength.

Beam B:

$$t_c/h = 2/4 = 0.5;$$

$$\text{and } b'/b = 0.75/0.75 = 1.0.$$

Hence allowable bending stress, $F_b = 9{,}400$ lbs./in.^{2},

and bending strength, $$M = \frac{9400 \times 4}{2} = 18{,}800 \text{ lbs. in.}$$

And the shear strength, $$V = \frac{f_g I b}{Q} = \frac{750 \times 4 \times 0.75}{2 \times 0.75 \times 1} = 1{,}500 \text{ lbs. in.}$$

These values indicate that the bending strength of each beam is practically the same; however the shear strength of beam B is considerably higher.

In general, for beams under 6 ins. in depth, rectangular beams are just as efficient as I-sections. For depths above 6 ins. the box beam appears advantageous, particularly so from the viewpoint of procurement where large sizes of solid rectangular beams are required.

The preceding elementary examination of beam structures is confined to beams of solid or laminated wood structure and box beams. However, the serious designer of multihulls will become involved in sandwich construction if weight-strength considerations are to be optimized.

One might define sandwich construction as a method where panels, usually of uniform thickness, consisting of three laminations of material bonded together are used. In this form of construction the outer two laminations, or facings, usually determine the elastic and strength properties of the structure; the central laminate, or core, serves to separate the facings and to restrain them from becoming elastically unstable. Thus facings are usually made from strong stiff materials and the cores from light ones, having only sufficiently great elastic and strength properties to accomplish their purpose. Therefore in the design of sandwich construction, materials for the facings are chosen that will be consistent with the loads to be opposed, and for the cores, materials that will be the lightest possible for functioning satisfactorily with these facings under the conditions imposed upon them.

There are two broad types of sandwich panels: orthotropic panels, and isotropic ones. Orthotropic panels are those that have different mechanical properties in the direction of three usually perpendicular axes for facings and core materials. It is not proposed to develop the elastic relations of orthotropic panels in this paper, for the mathematics is complex and tedious because there are three moduli of elasticity, three of rigidity, and six Poisson's ratios to be considered. Thus it requires nine independent properties to define completely the elastic properties of an orthotropic material.

However it should be recognized that the mechanical properties of facing and core materials are independent of each other. The critical factor is the bond between core material and facings, and in the practical application of orthotropic panels to the semi-hulls of multihulls it must be recognized that impact damage to the skin will cause separation of facing and core with resulting flooding of the honeycomb core. Another feature of orthotropic panels is that the core materials will creep if a constant shear stress is applied. Fatigue failure of core materials seldom arises.

In summary, it may be said that orthotropic construction will produce the lightest type of hull consistent with adequate strength *provided that careful stress analysis is made* and adequate bonding of core to facings accomplished. The weakness of such construction is the risk of separation of facing from core, should the skin be subjected to impact loads. Difficulty will also be experienced in providing adequate foundations for fittings subject to tension or shear loading conditions.

Isotropic sandwich construction is made up of isotropic materials where the two facings are of one istropic material and the core of a different isotropic material. An end grain balsa wood core panel with isotropic facings is often assumed to be an isotropic panel. But it is not, since it is isotropic only in the plane of the sandwich and orthotropic normal to the plane of the sandwich construction.

Again, as with orthotropic panels, the mathematical analysis is quite complex and so will not be developed in this paper. However, certain fundamental parameters of isotropic sandwich construction will be touched on in the following paragraphs. It will also be assumed that the mechanical properties of the materials used in the facings are great in comparison with those used in the cores.

(a) When an isotropic sandwich panel is stretched or compressed in its plane the strain has the same value in each of the three laminations in regions removed from where the forces are applied.

(b) When a sandwich panel is bent, the strains are proportional to their distance from the neutral plane. In bending, the modulus of elasticity of the core is often neglected. However, the bending stiffness is modified by the thickness of the facings, and by whether they are of equal thickness, unequal thickness, or so thin that their individual stiffness can be neglected.

(c) In general, the effects of transverse shear deformations in the core of sandwich construction have to be taken into account.

(d) When a rectangular sandwich panel is subjected to shear forces applied to its edges, the shear strain has the same value in each of the three laminations.

Failure of isotropic panels may take place in three ways:
1) the tensile facing or the tensile side of the core may fail in tension;
(2) the compressive facings or the compressive sides of the cores may fail in compression; or
(3) the compressive facing may wrinkle, and may break away from the core.

Any one of these three types of failures may precede the others, depending upon the construction of the panel.

In isotropic panel construction adequate foundations for fittings must be provided and through-bolts used to secure the fittings.

The writer is of the opinion that good structural design of multihulls will contribute more to multihull sailing craft progress than efforts in the hydrodynamic field. It is unfortunately true that *more rigorous structural analysis of multihull structures will be required* if these craft are to withstand the higher dynamic loads to which they will be subjected by virtue of the higher speeds they can achieve. The nature of these craft is such that serious re-entrant angles are presented to the sea in their topside structures. *The temptation to place a penthouse on the beams connecting the semi-hulls is admittedly great but in the interests of structural safety this temptation should be resisted.*

Acknowledgements:
Wood—A Manual of its Use in Shipbuilding (U.S. Navy Dept.).
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Most of the material used comes from the writer's personal notebooks compiled from many sources; should there be any source not mentioned in the acknowledgements above, the writer will be the first to give credit wherever it is due.

MULTIHULL SAFETY: LUCK OR COMMON SENSE

by F. Melhop Trimaran *TAURANGI*

(This contribution was not written as it stands by the author but extracted and assembled from a long letter of his, and therefore all credit must go to Mr. Melhop whereas any inaccuracies and 'noise' should be blamed on me.—EDITOR).

TAURANGI is a 35-foot '*Lodestar*' trimaran designed by Piver and built by Mr. Melhop and his partner, Paul Braithwaite, in an Auckland backyard. So far they have cruised half way round the world, covering 25,000 miles in 4 years: from their home port, Auckland to Durban via New Guinea, the Philippines, Hongkong, Vietnam, Cambodia, Thailand, Singapore, Indonesia, the Cocos Islands and the Seychelles, and Madagascar. Their future plans include South America, and the Mediterranean, before eventually returning to New Zealand.

Like many of her sister ships, *TAURANGI* started off with a completely novice crew who had never taken a sailing lesson in their life. So in the first year of our travels we rarely ever went out of the sight of land. This period enabled the crew to pick up some seamanship and learn how to handle their craft, iron out inaccuracy in navigation, and give *TAURANGI's* gear and construction a thorough testing.

Even the experienced monohull man cannot simply change over to a multihull without having to change some of his tactics—if he transfers to a multihull he has to serve something of an apprenticeship once more. Multihulls do not handle like monoholls and in some cases are more difficult to handle, especially in crowded anchorages while under sail.

Any sailing novice who puts to sea in a new craft without a considerable shakedown period may be signing his own death warrant—in a multihull he more than likely does so. The handling of a multihull is not learned in five minutes, and miles from land it can decide whether or not one ever sees it again. General seamanship is a handy measure to take along—unfortunately it cannot be applied straight from books but takes some practice. And an adequate grasp of navigation is one of the ingredients of success in ocean cruising. Finally, even if one has used the best design, materials, and workmanship available, learned to handle and navigate her, *thorough testing* of gear and structure is *a must*. This cannot be done over a short period of time since a variety of conditions may be necessary to bring out any weak points in a craft. Ships designed and built by professionals are put through extensive trials before they are put into commission—so, surely, one's own life is worth taking some trouble over.

Unlike some of hers sisters, *TAURANGI* has not made disaster headlines for the world's newspapers. The worst damage she has suffered to date runs to two torn sails and a broken spreader bolt. Needless to say there have been many times in her career when she did just about end her days but those near mishaps have all been *human* handling or navigational errors.

In those first few months of sailing we did things with our craft—just thinking of them now makes me shiver. But contrary to what we had been led to believe by some, our mast and rudder did not give way when she was hard-pressed. When we got caught in a gale with large breaking seas, *TAURANGI* was left to fend for herself, with a seasick crew groaning below decks. She just rode it out under bare poles while lying beam on to the approaching seas and wind. And although spray was continually washing over the craft she never gave any suggestion of turning bottom side up.

After a year's shakedown period we drydocked her for alterations before setting off on a world cruise. As we had adhered closely to the designer's plans we had very little in the way of alterations to make. She had turned out a little heavier than the design called for though, and we lightened her to the tune of 500 lbs. by discarding the unnecessary interior lining. We had found the ketch rig rather inefficient and replaced it with a masthead sloop which has proved most successful.

For long ocean passages some form of self steering is a big help. On *TAURANGI*, both a wind vane and trim tab mechanism, and sheet to tiller, work well—each method has its own individual merits.

During her 25,000 miles of ocean rambling *TAURANGI* has had to cope with winds approaching 60 knots, and 20 to 30-foot seas, some of which were rather steep and had unpleasantly breaking tops. Conservatively sailed, as she is on ocean passages, her best day's run has been 175 miles. Under unusual circumstances she has been driven to weather under storm jib and deeply reefed main in Force 8 winds, although in such winds we generally find it more pleasant to lash the helm to leeward, sheet in the 60 square foot storm jib, and retire below into the pages of a good novel. Heaving to under mizzen or a sea anchor has absolutely no effect in bringing her bow up into the wind. Under storm jib *TAURANGI* will reach along at 2 knots, making a slight course to windward. If we had insufficient sea room and a hurricane force wind to contend with, we should endeavour to ride it out with a 20 square foot storm jib. Wherever possible, however, the fastest way by far is to run directly downwind under bare poles; we did that at one stage in the Philippines, logging speeds of up to 8 knots for as long as half an hour.

Multihulls do *not* whizz over the ocean at 20 to 30 knots. Where speeds in this range have been recorded by sailing multihulls it was mostly in sheltered waters and always in favourable conditions, and the craft making these impressive speeds were not family cruising boats built and equipped for ocean crossing but racing machines sailed by VERY EXPERIENCED and ALERT crews. I don't think that cruising multihulls have so far proved themselves to be any faster over long ocean passages than good cruising monohulls of similar size; that is over distances of several thousand miles where a craft is given the chance to pit herself against *all* kinds of conditions.

When to reef in a multihull? The novice usually starts to think about reefing when the rigging is down about his ears. A knowledge of seamanship will tell the multihull sailor that the wind is increasing, and common sense should tell him that the time to shorten sail is nigh. After a while, the motion of the craft, and the noise it makes going through the water, will give further warning—increased pressure on the helm, and the speedometer reading, are also telltales. When she is churning along at night, with only a wind vane on watch, the increased wind force will eventually wake you up in your bunk. Fortunately—or unfortunately—the angle of heel which on a monohull determines the number of reefs does not follow for the multihull sailor.

Some wind squalls move incredibly fast; where the average ballasted monohull will survive a knockdown squall by lying flat, a multihull is more liable to suffer damage to gear or structure. Tight on the wind, with the sails sheeted in, *TAURANGI* will luff up as the squall hits, but those sheets must be eased away before she drops back and squares off again. A multihilll accelerates rapidly and this acts as a safety valve for short periods. Naturally, there is a limit to the speed a particular craft can pick up; so the next safety factor lies in a sheet or sail, or some such pierce of gear, which gives out in time. If conditions continue with no easing of the situation the mast may decide to falter. In certain sea conditions the entire craft may capsize but I for one am convinced that multihulls don't just blow over the way some people would like to think. Personally I think that after *bad* management, sea conditions are more likely to be the governing factor than wind pressure.

Multihulls have collected a certain amount of world-wide unfavourable comment.

When judging this type of craft we should bear in mind that a decade of design for the modern multihull is a mere pittance—possibly more work and money goes into one America's Cup racing yacht than has gone into multihulls in the entirety of their short history.

The sea is always the master—something we are liable to forget. One mistake can be enough—after that, one may no longer be round to repeat it. The labels 'multihull' and 'monohull' refer to the number of hulls without telling us anything about the seaworthiness of a craft thus labelled.

There are unseaworthy multihulls and unseaworthy monohulls. Their owners are already doomed before they cast off, not because their craft have one, two, or three hulls, but because they are unseaworthy. If a fraction of the preparation that goes into an aircraft or racing car went into all ocean going yachts then, I am sure, more would stay around to tell the tale.

I would say that most of unfavourable opinion focuses on the mishaps of racing multihulls and prototypes. Yet, after seeing our favourite racing driver crash on the Grand Prix circuit we still hop into the family jalopy and trundle home. And, despite prototype fighter aircraft killing their pilots we still settle aboard airliners for a quick family reunion. So why the *general* condemnation of *all* multihulls as 'floating coffins'??? In any sport where people try for top performance there is a risk which increases as they push harder and farther. Where the background of knowledge is far from complete people may try to 'get there' *too* quickly. Mishaps are the price—but there is enough difference between racing multihulls and cruising ones that one should *not* get the two mixed up.

The most ardent multihull critics are almost invariably people who have never set foot aboard a multihull—and vow they never will. The average monohull owner is inclined to be more than a little conservative in his outlook when it comes to unconventional craft. *We have also a large proportion of multihull sailors who have never owned any kind of boat before and are complete novices to the art of sailing.*

With wide boating circles relatively unfamiliar with multihulls, one can scarcely expect newspapers and magazines to be better-informed on this subject—news is news and, many times, reports are blown up out of all proportion.

Design is the most important feature of any boatbuilding project and multihulls are no exception. Obviously, some designs are better all round than others, especially when it comes to ocean cruising. As with any idea which makes the general public sit up and take notice there is always somebody trying to cash in on the popularity wave—so the choice of a designer is worth some careful consideration. But, within reasonable limits, *any* known multihull designer is preferable to some of the home designers who have little knowledge of what they are about.

Multihulls are thoroughbreds and whatever you may get away with in a conventional type of craft is liable to fail and possibly even cost you your life on a multihull. From what I have seen I would say that the majority of multihull failures is due solely to inability to follow the plans. It is almost *impossible* to find a builder who follows the designer's plans religiously.

Contrary to popular belief, multihulls are NOT cheap boats to build.

The best of materials must be used, and must be used to their greatest advantage. Generally, the higher the performance for which the craft is designed, the better must be the materials and workmanship. Many CHEAP multihulls have been built, with a minimum of work, a combination which is liable to lead to damage, which before long somebody or other will point out as an *inherent* weakness of ALL multihulls. Even so, quite contrary to the beliefs of the average landsman, small boat ocean passages—even in multihulls—are statistically safer than driving home in the family car.

Multihulls, of course, entail occupational hazards which affect *all* small boat sailors—like navigational errors and hazards, sea monsters, hurricanes, and being run down—and which we just have to accept and live with. As for the rest: most of it is simply COMMON SENSE.

EXPERIENCES AND LESSONS

from letters by J. H. Buzzard England
A. C. Atkinson and D. Wilson New Zealand
Tom Corkhill Australia

THE *HAXTED ARGO II* CAPSIZE: LESSONS AND AFTERTHOUGHTS

by J. H. Buzzard London, England

A detailed report (AR/C 001.01a) on this incident accompanies this issue in loose-leaf form. The question of how a single-hulled craft of similar size would have fared under the same conditions is obviously of great interest to Mr. Buzzard, and he would welcome the views of other yachtsmen more experienced in this respect. Although he has had quite extensive and varied experience of sailing catamarans of this class, his only experience of sailing in single-hulled cruisers has been crewing in a 70 square metre and a 30 square metre before the war, and he does not consider himself competent to give any answer to this question. His few remarks in this connection should be regarded as guesses, not an opinion.

This incident illustrates once again the danger of running for shelter in an onshore wind. It is clear that my decision was proved wrong by the event, but it was not taken without careful consideration.

All my reading on small boats running before strong winds in rough seas had emphasized the danger of being pooped, and not of running under, with, I suppose the exception of the famous incident off Cape Horn (the *TZU HANG*, I presume—ED.). We did not begin to have any water coming over the stern, and indeed, the seas were not breaking except for what are generally known as 'white horses'—the two steep waves came very suddenly.

I have on occasion been a little worried at the possibility of *HAXTED ARGO* burying her bows when being sailed hard in a rough sea and a following wind. It is right, to say, however, that on those occasions the boat was carrying a fair amount of canvas and was going considerably faster than the 5 knots (surfing excepted) at which we were travelling immediately before the incident. On those occasions we of course shortened sail.

A self-righting boat, if not flooded, would *presumably* have survived, and been able to carry on? On a non-selfrighting one we would have been worse off than we were in *HAXTED ARGO, I think*. Indeed, whether self-righting or not, a conventional boat would have sunk like a stone, I presume, if the water had got into the cabin, but of course in such a craft one would take care to have the hatches and doors properly secured, and hope that the sea would not break in.

I have always said that while a catamaran may capsize she won't sink, whereas a deephulled yacht won't capsize (generally) but will sink like a stone if holed, and on balance I prefer the catamaran's risk. I am still of the same opinion, *provided* that the catamaran has masthead flotation or its equivalent.

A capsize is far more likely to occur in confined waters, and in particular in places such as the bar of a river, than in the open sea where there is plenty of sea-room. I am, of course, talking about cruising yachts—the *GOLDEN COCKEREL* capzise took place in a race when she seems to have been carrying too much sail, and in addition the sheets had jammed. And I say this because of the ordinary experience of yachtsmen in conventional craft; I do not think that the figures for multihull capsizes can form any guide to this, as the numbers are far too small to have any real statistical significance.

In confined waters it is no use just sitting in a capsized yacht, and wait for conditions to moderate. The wind is almost certain to be onshore as otherwise conditions would not have been bad enough to capsize the craft, and one would want to take instant action, either to prevent the yacht being driven ashore, or to abandon her.

In my view therefore the most important point on which research should be concentrated is the best method of preventing a cruising catamaran from turning upside down—I am naturally confining my attention to catamarans. If the yacht is lying on her side, it is infinitely easier to put out an anchor or sea anchor, to launch the life raft and put into it water, emergency R.T., food, flares, clothing, etc.

Not only is preventing the yacht going upside down the most important factor in saving life, it could also be the most important factor in saving the yacht—provided that some method is available for righting the yacht from the horizontal position. Both experience and experiment, in smooth water at any rate, have shown that a catamaran equipped with a masthead float will float on her side when capsized, high out of the water, and will be blown rapidly downwind, mast first. At first sight one would think that the drag of the mast would tend to bring the mast upwind, with the possibility that the force of the wind, coupled with wave action, if any, might assist in righting the yacht. This, however, does not seem to occur in practice, probably because the force of the wind upon the bottom of the yacht tends to keep it squarely in front of the wind.

The reason given by G. Prout & Son for not fitting masthead floats on their new models is that the shortened mast and moderate sail area make it almost impossible for the yacht to be blown over, and hence there is no danger of capsize. I understand that the builders of the *BOBCATS* give the same reason for not fitting a masthead float to their somewhat short masts. It will be plain from what I have said that in my opinion a masthead float is a necessity for *all* Catamarans. We capsized, although we were carrying a storm jib only, and the size of the mast was quite irrelevant If we had not had a masthead float, two of us, and perhaps all of us, would certainly have been drowned, I think. Another reason given for not fitting a masthead float is to avoid additional windage aloft—this cannot possibly have contributed to this incident.

Of course, when shorter masts are fitted, it is more difficult to arrange for a masthead float which will do its job. It would presumably have to be bigger than the one we had. I think that further research should be done on the alternative method of fitting a device which releases gas into a sort of balloon at the top of the mast when it comes in contact with salt water; such a device has already been described (for the *IROQUOIS*, in *Practical Boat Owner*).

Alternatively, such a device or float might be fitted to each of the spreaders, as was originally proposed for the *IROQUOIS;* the idea had already been incorporated in a Polish catamaran design several years ago. The salt-operated release would, of course, not have worked in the *Ijsselmeer*, but although there can be nasty short seas there, I don't think one would find the sort of conditions to which we succumbed.

I think that, in addition, large seacocks should be fitted in each hull for quick flooding in the event of a capsize, to assist in *righting*. Apart from other considerations, if the mast breaks while the boat is on her side she may turn upside down: *there's not much of a future in trying to stick to the bottom of an upturned boat in a heavy sea*!

Yet another alternative is of course weighted drop keels, but the rub here is that the added weight takes away most of the virtues of a catamaran—Michael Henderson might have something to say about this.

There are thus various possibilities of righting a capsized catamaran with a masthead float. Flooding the lower hull is one I have already suggested. Another is manoeuvring the yacht so that the mast points into the wind, by means of anchors or a sea anchor. Another, to have the shrouds form a continuous 'chain', with a winding gear inside the yacht, so that the head of the mast can be wound down. A combination of methods might be possible, and desirable

The most essential thing in my view is preventing the yacht going upside down. If a gas float is used, it is essential that the inflation is automatic, although it might be desirable to have an alternative release method available if the automatic arrangement fails to work. I imagine that the gas method would probably be the only practical one for a ketch or schooner rigged catamaran.

One small but not unimportant point: I am told that Bill Howell had a very narrow escape from drowning in *GOLDEN COCKEREL*, and only just managed to unclip his safety harness—I understand he had it modified before the Singlehanded Transatlantic Race, with a snaphook on the end of the line which attached to his harness. This ought to be standard for all safety harnesses, I feel, even on single-hulled yachts, but more particularly for all multihulls.

Another small but not unimportant point is that I always carried a very sharp knife in a sheath in the cockpit so that it could be instantly available for cutting the lashings of the life raft, or the main or jib sheet if it jammed.

When we capsized and went over more than 90°, the knife fell out of its sheath and was not available. It should have been secured by some quick-release.

Whilst on the topic of securing things, in rough weather the outboard motor petrol tanks should be secured; ours had been loose in the cockpit and had floated away which nipped in the bud any attempt to start the engine when the yacht came upright again, though water-logged, after the capsize.

Breaking up is a possibility that must always be borne in mind—single-hulled yachts break up from time to time. It would seem possible from published reports, although again the figures are really statistically insignificant, that trimarans are more vulnerable in this respect than catamarans. The possibility of a break-up is another reason for emphasizing the importance of having some system for preventing the yacht going upside down, to facilitate the launching of the liferaft and getting the crew into it with provisions, emergency transmitter, etc.

Regarding Mr. Shreve's suggestions for making an upside down multihull habitable, I have already sufficiently indicated that in my view steps should be taken to avoid this necessity. In a capsize such as ours the boat will be flooded in all probability, and there wouldn't be much air to spare inside if she was upside down. I think, however, that his idea of having strong points underneath the bridge deck, to which safety harnesses or a liferaft could be attached, is very valuable and ought to be standard practice in all multihulls. If possible these points should be strong enough for fixing an anchor or a towing warp. One has to remember that even if one has a sound system of masthead flotation, something might go wrong with it, or the mast might break.

PUSHED-IN WINDOWS AND OTHER EXPERIENCES . . .

From letters by A. C. Atkinson, and D. Wilson New Zealand

ATRIA, designed by J. H. Young of Auckland and built by her owner, D. Wilson of Tauranga, was a 32-foot hardchine trimaran with a 385-ft.^{2} mainsail.

This is the only instance to date where we have received information on the same set of circumstances from two observers which makes it particularly valuable. We are, of course, hoping to get much more of this sort of thing in the days to come.

In December 1967, on the 600-mile delivery trip from Tauranga to Wellington, we were running at night with a following (apparent) wind of up to 20 m.p.h. (true wind up to 30 m.p.h.). Her skipper, who had designed, built, and raced a 50-foot keeler (fastest time in the Auckland-Sydney Race about 1950) which he sailed to the U.S. for sale there, had built and rigged *ATRIA* and sailed her for three years; her crew of four had all had some experience.

ATRIA

It was cloudy and dark but there was starlight. With the main reduced by two rolls we were still surfing down the bigger waves. The watch changed, and she continued running fast.

Suddenly, the two 18 × 36 × 1/8 ins. perspex front windows, in "Claton-rite" rubber mouldings, were pushed in by some 200 to 300 gallons of water. This put some 14 to 18 ins. of water over the cabin floor—the inside cabin light was on at the time (the skipper was on his way forward to get something). My thought on seeing the boat fill up was: "Thank God, she is multihull and can't sink!"

We headed up into the wind, rolled the main down to a minimum, covered the window opening with a spare jib, and headed for the nearest shelter some 15 miles away. The water was bailed out with a bucket, a big toe in each of the self-draining cockpit drains to stop water coming in. Whilst in shelter, we fitted hardboard over the window openings, dried out engine, interior, our gear, and resumed our voyage. The perspex was not broken, and was refitted later.

This tri had never buried her bow before. Once when reaching/running, a crew member was washed off the bow of the lee float when it went under a wave crest; with his safety line made fast, he was hauled back on board again with no real trouble.

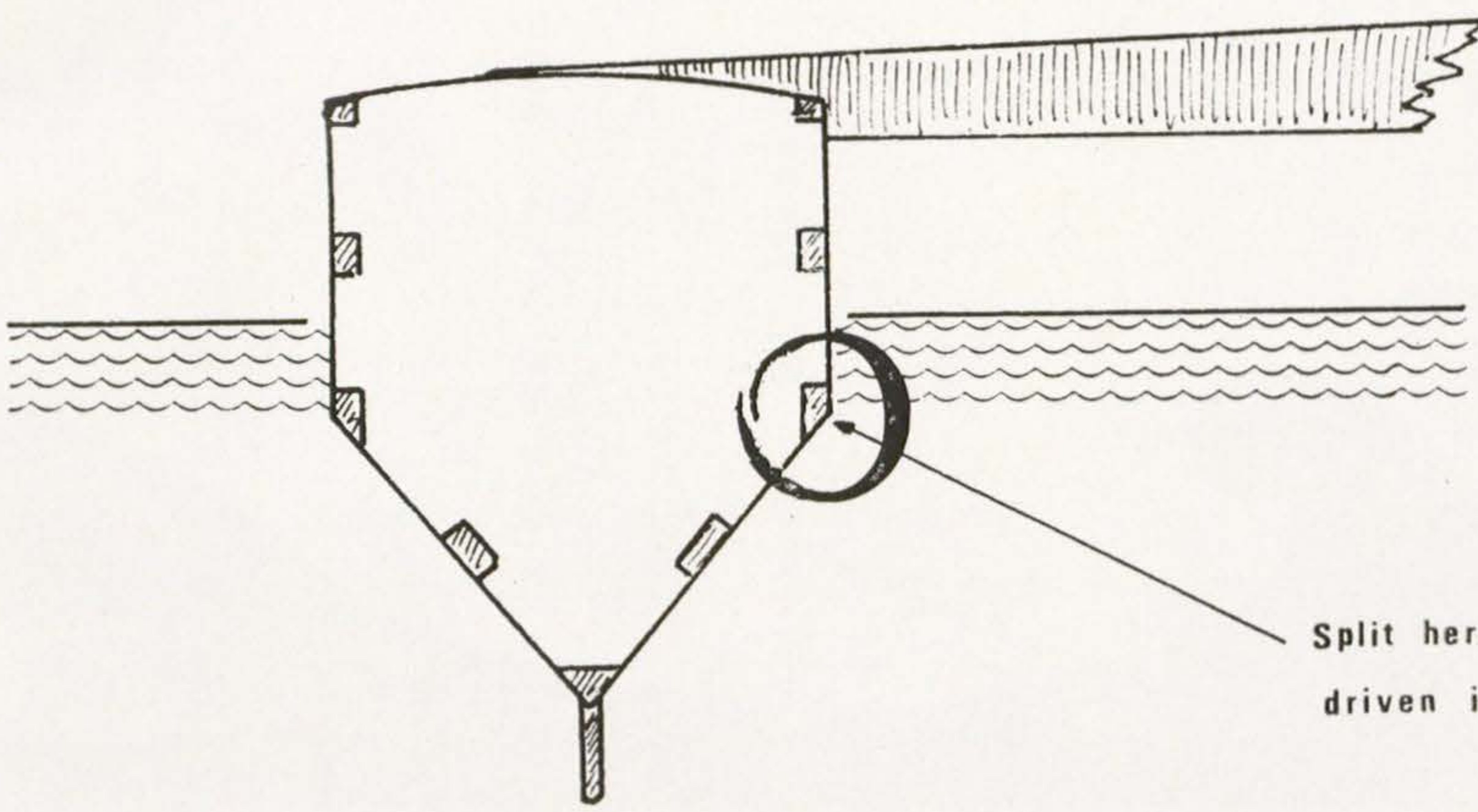
The lesson to be learned from this experience may be summed up thus: don't run fast at night when you can't see what the waves are doing. Or if you do, be sure the cabin is strong enough to turn the water if it comes on board green or the ship runs under a wave. Half-inch ply shutters fitted over the perspex windows would *perhaps* have prevented this occurrence.

To this D. Wilson adds: she ran under because (a) we had too much weight forward, (b) we had too much sail on, and (c) the seas were quite big and exceptionally steep. We were quite worried on leaving Tauranga with almost full fuel tanks (twice 30 gals., I think) and only half full water tanks. On top of that, three of the crew were down below forward. With the wind dead aft and travelling at 12 to 16 knots we did not appreciate just how strong the wind was in the dark. It increased very rapidly over the last half hour (my estimate would be nearer 30 m.p.h.). And Piver had said about the seas off the east coast of New Zealand: "The worst I have ever encountered".

On the same trip (continued Mr. Atkinson) head winds up to 40 m.p.h. (from New Zealand Met. Office records) caused considerable seas, and we were unable to make any headway to get a lee under a high coastal range because of white squalls blowing off the shore. All crew members found it difficult to keep forward way on the ship when luffing in very strong gusts, and often found that stern way instead of headway was being made. After we had been caught twice with no forward way so that we were blown side-ways, we lowered all sail and lay ahull and slept for four hours until the wind went down at dawn. Setting sail again, as we put up the small jib, it tore. We hoisted the larger one but found the running backstay stranded some six feet from the end fitting (it was stainless steel, with no apparent fault). So we again lowered the jib and continued under main alone until it tore from leach to luff. At this stage we radioed for assistance which came in the form of a fishing launch before we had finished sending the message—he had seen us lose our main sail.

The wind was strong enough to force the lee float under, so much so that we stuffed a towel in the lee float ventilator to stop it filling. And yet, with the very heavy gusts blowing the tri sideways, and considerable seas, there was no apparent feeling that she was unstable and likely to capsize. This *may* have been due to up to 1,000 lbs. of water in the windward float; it must have added very greatly to her stability—beyond that I cannot go.

When inspected for damage the float was found to have a split in the 3/16-in. ply along and just below the chine stringer for some 5 feet—between bulkheads. The plywood bottom had been driven inward by the pounding as the float came down and the sea came up, with the water trapped between float, deck and main hull.



In addition to his comment that the water in the windward float *may* have had an anti-capsize effect, he comments: "Too much sail. Spit Fire jib and storm trysail would have been a help here."

Mr. Wilson again:

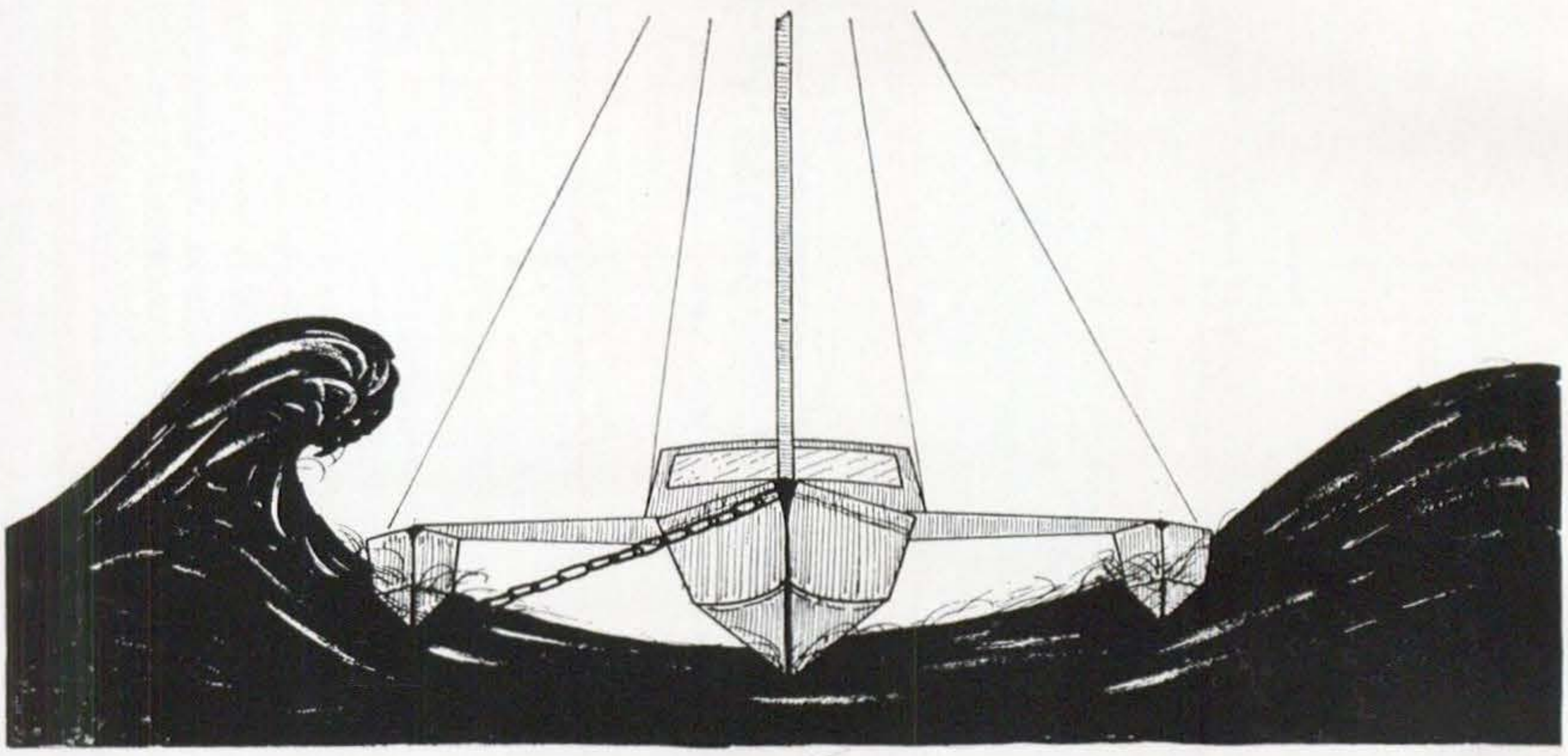
The reasons we couldn't make to windward were that the storm jib had lost half of its efficiency when it got torn, the main when reefed right down to the first radial batten was also pretty inefficient, and (I seem to recall) the tide turned after we got up to that light.

On the previous trip back from Wellington we slogged our way out round East Cape when a trawler out there with us reported on the radio that with 50 m.p.h. winds on his gauge he was going back behind the Cape for shelter. The wind we got this time off Turakarai Heads was, I feel, well in excess of 50 m.p.h. With good storm sails and a crew that wasn't tired out I am quite confident we could eventually have made Eastbourne.

Because of that long radial batten we couldn't reef the main any further and the storm jib was too big. If all the sails were allowed to fill she quickly picked up speed to a point where the pounding was too much to bear. So we had to luff up continually and naturally in that strength of wind lost steerage way.

ATRIA became a total loss in the April 10, 1968 freak storm; 23 boats were moored on the eastern side of Wellington harbour—only 3 remained afloat after the storm. Four sank at their moorings, the rest were driven ashore—some on sandy beaches were o.k., several went on to rocks and broke up. *ATRIA* and a 24 ft. *Nugget*-class tri were the only multihulls broken up (number of multihulls moored not given. ED.). The 8,000-ton overnight ferry *WAHINE* struck a reef and rolled over in the harbour entrance.

The wind was gusting up to 60 m.p.h. Spray lifted off the water in sheets; the waves were some 4 feet—tops blown off when gusts hit. The wind then swung, and *ATRIA* lay at about 80° to the waves. Three successive waves rolled up and while the floats were taking most of the weight, the crests rolled flat onto the float deck. The first pushed in the starboard (three) windows. The second filled the main hull, and the third rolled right through the cabin and pushed *out* the port windows.



ATRIA dragged her moorings, was driven ashore and ground to pieces against a concrete sea wall, but did not break apart.

Mr. Atkinson concludes his account of *ATRIA's* last hours: "A multihull when unable to be pushed sideways by a breaking crest must have a cabin and windows strong enough to withstand green water coming on board—again half-inch ply shutters, or smaller and stronger windows, would have prevented this swamping".

Since the loss of *ATRIA* he has been crewing on a Piver 35-foor *Lodestar* which was blown into shallow water (sand bank) when she dragged her moorings in the April 10 storm. Lying side on to the storm she was turned over by wind force alone. Four other tris in the same harbour Paramata 10 miles north of Wellington, were o.k. and came to no harm.

Tom Corkill

Catamaran *NINETAILS CAT* Letter July 1969

Tom Corkill had already sailed his 25 ft. trimaran *CLIPPER I* for $2\frac{1}{2}$ years continuously over some 15,000 miles, mostly alone, when he was capsized with no sail up by wave action in the Atlantic, 200 miles off the South African coast. He is at present in Australia, fitting out his new boat—a $34\frac{1}{2}$-foot cat—for his next voyage, again to Africa and then on from where the left off the last time.

Of himself and his ordeal he says: "I am an adventurer mostly and have often placed myself in danger for the hell of it; *CLIPPER* was a small boat taken the hard way to Africa and should not have been in those waters anyway. 'Kicks' are better this way than with the drugs many of my generation use; you have to *do* something, for your constitution, and making yourself scared is one of the best."

At the time of my capsize I was drifting in a storm—not a bad one; I would not put the waves over 20 feet. *CLIPPER* was a very beamy boat, 17 ft. on the waterline, and low-slung—less than 5 feet from bottom of hull to cabin top—and she had come through a lot worse weather before this mishap.

After the capsize she floated with her box section wing awash. I was always in the water between the hulls and swept off time and again as waves crashed on the boat and went between the hulls. Movement was so great that several attempts to get in under the boat for the air which I knew would be trapped there failed.

I expect that even inside movement would be too much in such conditions to survive in any comfort. I would say, if you are thinking of staying inside a capsized craft, forget it—unles she is a big one: have you ever built a water tank without baffles? try it!

Staying with the boat was in fact only possible by tying a rope around my waist and the other end to the rudder; without that I would soon have drifted away. I was so cold within 30 minutes that I was unable to do anything constructive, and within a few hours I could no longer feel my legs and this was not from lack of movement—it was just cold, yet warmer in the water than out of it because of the cold stinging spray, and so I kept immersed. Land was 200 miles away against wind, almost nobody knew I had left, and those that did would not search for at least two months since I was only two days out of Cape Town. I know what I am worth and I am conditioned to a hard life at sea. Although not physically strong, I have had to endure hardships before and my mental attitude is such that I am not afraid of dying. I am not the panicking type in a situation of this kind, and have found on many occasions that I have resources of hidden strength. But in those hours on *CLIPPER* they were being taxed greatly. At times I almost decided to drown—except that I wanted to see the sun once more.

The ship that finally rescued me—a chance in a million—saw the air-sea rescue orange on the underside of the hull, and the rudder sticking up, otherwise they would have missed me. When I left *CLIPPER* she had not changed in the way she floated, and nothing other than the mast broke away, still dangling by wires, though. Underwater she may have had a fractured cabin from the breaking wave; windows were broken, I know, as I was wet before the boat had capsized completely.

To sum up: *hanging on to a capsized boat is impossible in rough conditions.* Sitting on the wing is o.k.—for a few minutes, till you are swept off (as I was every few minutes. At times I was sitting there, water was up to my neck).

I would not bother to try to turn a capsized craft up, unless there were more than three crew, and most of all provision for this in the design—a waste of time, to my mind. Surviving *exposure* is what should be concentrated on! I feel that if one capsizes far from land, with no chance of rescue within 24 hours, I for one would rather set off in a rubber dinghy. If land is near, or one is drifting towards it, or there is the possibility of a search, staying with the boat would be the better bet.

MULTIHULL CRUISING

by Marvin Glenn Trimaran *REBEL*

The Glens are in the midst of a voyage on their 35-foot *Lodestar* class trimaran which they built in San Francisco and sailed to Australia and later New Zealand via the South Pacific.

REBEL, who is No. 13 in its class, has the aft crossarm forward of the cockpit, and the following modifications to the original design:

(a) a pivoting centerboard in the *aft* cabin, about 3½ feet deep when lowered;
(b) extra fibreglass mat reinforcement strengthens the non-pivoting, transom-hung rudder (there is no skeg to support it below the transom);
(c) main cabin width has been increased from 12 to 14 feet, and cabin height by 4 ins.;
(d) the ketch rig with plank mast shown in the plans was changed to masthead sloop rig with alloy mast—no spreaders—supported by ¼-in. 1 × 19 stainless steel wire attached to chain plates 50% thicker than specified by the plans;
(e) a wind vane mounted on the stern, operating a servo rudder on the trailing edge of the main rudder.

At present she is powered by an 18 h.p. Evinrude outboard motor through a well in the aft cabin. A watertight bulkhead between aft cabin and cockpit keeps spilled gasoline and water from running into the main cabin. Cooking and lighting are both by kerosene. A 12-volt lighting system was tried but discarded when it failed to work satisfactorily in the tropics—we have no charging plant aboard.

Positive flotation has been added in the form of polyurethane foamed in situ in the float bilges, about 12 ins. deep. And the roof is of foam sandwich construction: 3/8 in. ply on top, then 1 in. of foam, with 1/8 in. ply beneath.

Although my wife and I have sailed *REBEL* over 14,000 miles in the 3½ years since the boat was launched, we have never experienced a true storm at sea. We have been in Force 7 conditions—perhaps Force 8 at times—several times however which have exposed some of the craft's weaknesses. The mishaps which occurred were minor, but they could have led to more serious trouble had conditions been worse.

One weak spot is the wing fairing forward of the forward crossarm. On *REBEL* this fairing is only 1/8 in. ply, and has been damaged several times—always while beating into a steep, choppy sea. Once, in December 1967, while beating into a 30-knot "Southerly Buster" off the NSW coast of Australia, the fairing was smashed badly enough to get about 10 gals. of water into the central hull via the wing locker (which opens into the main hull) before the damage was discovered. By stuffing life preservers into the locker to block off the damaged area and slowing the boat down from 8 to 5 knots to reduce the force of the waves against the fairing, the volume of water coming in was reduced to a negligible amount.

Another weak spot lies in the front windows which are quite large—¼-in. perspex bolted to the cabin sides and front. We discovered this weakness in September 1967 when we were approaching Viti Levu, Fiji. It was dark, and there were dangerous reefs about 15 miles away on both sides. We were heading for a poorly-marked pass between the reefs, averaging 6 knots, with a fresh 20 to 30-knot wind on the beam, and occasionally surfing to 10, with just a 75-sq.ft. storm jib set. The sea was very confused, most waves coming from abaft the beam but some from just ahead of it. The waves were high enough so that I couldn't see over them while standing on the cabin roof but it was their steepness and conflicting direction of movement that made them difficult to cope with. Shortly after midnight I took down the jib—at the speed we were going we would reach the pass before daybreak—and left the boat lying ahull while I went below for some sleep. Most of the waves hit us on the stern, but some came from abeam, and occasionally we would be momentarily surfing on a stern wave when a second wave would break against the side. When this happened, the top of the wave cascaded over the deck and slammed against the cabin front and sides. Sometime during the night the front window on the windward side of the cabin was split—we didn't discover it until after daybreak. The pieces all stayed in place, but enough water trickled in through the crack to soak the books which were stowed on the crossarm beneath the windows. If we had run off before the waves instead of lying abeam of them, I'm sure the window would not have broken, but there were dangerous reefs to leeward. We repaired the split with masking tape on both sides, and it didn't leak any more until we replaced it in Suva. The obvious way to prevent broken windows is to keep them small, and put plywood shutters over them in bad weather. Keeping the boat light also helps, by making it easier for it to lift to the waves, thereby keeping the water on deck to a minimum. *REBEL* is very heavily loaded—her chine, which was an inch clear of the water when she was launched, is normally about 3 ins. under the surface when she is loaded for an ocean passage.

Unlike most *Lodestars*, *REBEL's* rudder has never been broken. It was cracked once on a coral reef but that is another story. The rudder is strongly reinforced with fiberglass, but I think the main reason for its good record is that it has rarely been heavily strained. On ocean passages the sails are adjusted and the centerboard in the aft cabin is lowered until there is little or no pressure on the rudder. With practice I have learned to achieve this balance on all points of sailing and in most wind strengths. The pressure on the rudder is so light that the relatively small 5-sq.ft. wind vane is able to steer 90% of the time. Waves do tend to cause some yawing in a following or quartering sea, but the centerboard gently dampens this turning action, and so the rudder still doesn't have to work very hard. The steering cables have broken several times—always while steering manually with the centerboard up and the boat not well balanced—but we've had no more cable breakages since we replaced the original cotton-with-wire-core ones with 3/8 in. diameter terylene.

REBEL has suffered some damage to her rigging, but it has been of the sort that can happen to any yacht. The most serious breakage was the main boom. It is aluminium but has a bronze roller reefing gooseneck. The 1/8 in. thick gasket between them was easily bridged by salt water, resulting in electrolytic corrosion. I first discovered this two days out from San Diego en route for the Marquesa Islands. The four 3/16 in. stainless steel machine screws fastening the gooseneck to the boom stripped out of the weakened aluminium. I could think of no good way to repair the boom at sea, so we sailed the final 3,000 miles of the passage with headsails alone. With the 360 sq.ft. genoa our speed was still reasonably high, even in light winds, and we covered the remaining distance in 20 days, including 3 days of drifting through the doldrums. In the Marquesas I repaired the boom by drilling and tapping for ¼ in. diameter bolts, and this repair lasted until midway between New Caledonia and Australia, when the boom fractured 3 ins. from the gooseneck as I was raising the sail. Again we completed the passage under jib alone. At Brisbane I made a 12 ins. long hardwood plug to separate the gooseneck from the boom, and have had no further trouble with corrosion in this area.

At least not until February 11, 1969, during a passage from Auckland to Kawau Island in what the New Zealand Weather Bureau described as "strong gale force easterly winds". Conditions were severe enough to cause an ocean racing keelboat, the Australian 37-foot yawl *ANDROMEDA*, to be abandoned as it was shipping water at an uncontrollable rate; this happened near the Three Kings Island, 180 miles NW of Kawau, where conditions might have been worse than those we experienced in the Hauraki Gulf. The seas, which came from about 20 degrees ahead of the beam for the first 11 miles, and were right on the beam for the final 12, were 6 to 7 feet-high and unusually short but reasonably regular. The beam wind was blowing 25 knots and gusting to 35—by my own estimate. With the club jib and full main *REBEL* sailed the 23 miles in 3 hours 10 mins. There was some weather helm, even with the main eased until it almost luffed but with the centerboard lowered the boat was easily steered with a steady pressure on the wheel. As we came into the lee of Kawau Island I decided to reef the main before beating into Bon Accord Harbour. But I had rolled the boom only half a turn when the pin on which the furling gear pivots broke away from the bronze gooseneck casting, allowing the boom to swing free of the mast. I lowered the sail and we motorsailed into harbour with the jib and the 18 h.p. Evinrude. This makes the third time the boom has broken at the gooseneck. The gooseneck and roller furling assembly is a standard commercially-produced item advertised by the manufacturers as being suitable for a mainsail area up to 250 sq. ft.—*REBEL's* main is almost exactly 250 sq. ft. The lesson here is that all components of a multihull's rig must be considerably stronger than would be needed on a monohull rig of the same size.

The genoa is a roller furling one, and this has created more trouble than it has saved. Because it is unsupported by the forestay, it puts an enormous strain on the haliard and the tack downhaul pennant. The original 5/32 in. s.s. wire haliard broke numerous times before I replaced it with 3/16 in.

diameter s.s. wire. This hasn't broken, but the $3\frac{1}{2}$ in. diameter Tufnol haliard sheave was split and the heavy stainless steel shackles holding it badly bent when an unexpectedly heavy squall struck us near Auckland, New Zealand.

Our most serious mishaps have occurred while in harbour. In April 1966 at Anaho Bay in the Marquesas we had an unhappy experience with our first coral reef. Arthur Piver had told us that sailing in coral water was easy. "Just watch the colour of the water," he said. "Stay in blue or green water. Stay clear of brown patches. They signify coral heads less than three feet down". He said something about good light, too, but I must not have been listening closely enough. We entered the bay about noon and were scooting into a smaller cove with a fresh breeze behind us. The sky was overcast, and the breeze was kicking up quite a chop. My wife, Ann, was on the bow trying to judge the colour of the water. It all looked a sort of dark shiny green to me. Suddenly when we were still 100 yards from the beach, she pointed and said, "There's brown water ahead!" "Where?" I asked. "It's under us now," she announced, and I spun the wheel. As *REBEL* came around I could see it too. We were in a pocket, with reef on three sides and the wind blowing from the fourth. Our way carried us into deeper water again, but we lost way and went into irons before I could get the sails sheeted to beat our way out. There wasn't room to fall off and gather way, so I dropped the anchor immediately. It went down more than four fathoms, (the length of our chain) before it touched the bottom. I let out another four fathoms of the nylon warp and cleated it down. As *REBEL* sagged back, her stern swung over the reef which the boathook showed to be only inches below the rudder. As quickly as possible I unplugged the motor well and installed the 5 h.p. Seagull. As soon as it was running I went forward to haul in the anchor while Ann took the helm. The outboard was barely powerful enough to push us against the stiff breeze, but I helped by hauling on the warp. As we went over the anchor I snubbed it to let the motor break it out. Instead of breaking loose, the anchor hung, and swung *REBEL's* bows in a tight circle until she was facing the beach. *Then* the contrary thing broke free of the coral it had been hooked on. There was no room to turn around again. Ann cut the throttle, but with no reverse, she couldn't back out. As *REBEL* went over the reef head first, I dropped into the waistdeep water to try and stop her, but couldn't hold her against the wind. She continued a few more feet, then ground to a halt. The tide was falling rapidly, and it soon became obvious that we wouldn't get her off until the following high tide. The water was less than ankle deep at low tide as we scrubbed the bottom and tried to pretend we'd beached on purpose. I launched the dinghy and carried two anchors out into deep water. When high water returned we winched off with no difficulty, and no damage to the boat except scratches on the bottom (the keel is protected by 8 layers of fiberglass). At the time I blamed our tiny engine with its lack of reverse gear, but I have since figured out how I could have stayed off the reef—apart from not approaching it in the first place. Instead of depending on the engine to get us out of our tight spot, I should have immediately launched the dinghy and set out our second anchor as far as possible from the reef.

We could have pulled out to this anchor without bothering about the motor.

However, I learn slowly, and had another brush with coral before I finally learned how valuable anchors can be in manoeuvring an underpowered craft. This happened in August 1966 at Bora Bora. We had drifted in through the pass with a dying breeze just at dusk, and didn't have time to find a secure anchorage before dark, so we anchored in $10\frac{1}{2}$ fathoms near another yacht "just for the night". Since there was no wind and we planned to move first thing in the morning, I set only one anchor. We normally use two, to restrict the swinging circle and to lift the nylon warp off the bottom. Around midnight we were awakened by a squall with torrential rain and a strong wind. It was impossible to see more than a few feet, but the bowsprit of the other yacht swinging past our stern told us all we needed to know. We were dragging fairly rapidly towards shore. I should have set the other anchor, though the dinghy would have been hard to manage in the strong wind, but instead I again relied on the engine—and again it failed me, through no fault of its own. I discovered later that it was nearly out of petrol. The roller furling genoa was still up, so we unrolled it and tried to sail clear of the other yacht and the shore, which was fringed by an inner reef. The anchor, a 20-lb. Danforth, came up easily, a chunk of coral jammed in the flukes, and we sailed out. We couldn't go far, though, because there were more coral patches in the area, and we could see absolutely nothing in the blinding rain. We made a couple of short tacks, then dropped the anchor again. This time I paid out plenty of scope, and felt the anchor bite hard as *REBEL* surged back against it. My satisfaction was shortlived. As the rain let up slightly Ann spotted a reef less than 15 feet behind us. The wind, which had a fetch of several miles across the lagoon, was building up a sizable chop which was breaking on the reef. I tried to haul in the anchor, but it was bar taut; though I heaved with all my strength I couldn't budge it. The wind was just too strong; another yachtsman measured it at 25 knots, gusting to 35, a short time later. Well, we'd sailed out once; we could do it again. But we couldn't. As I unrolled the genoa it flogged a couple of times, then the haliard broke and the sail came down around our ears. We cleared away the mess and set the club jib on the spinnaker haliard, then got the mainsail up. I managed to get in a few feet of warp each time we tacked, but on about the third tack I got the warp tangled up and lost most of what I'd gained. We must have disturbed the anchor, however, because it started to drag again, and before I could get the mess on the foredeck straightened out, we struck the reef. The rudder hit first, and we pivoted on it until the boat was lying beam on to the waves, which by now were big enough to break right over the deck. We were lucky that the trimaran has such a shallow draft. Instead of being smashed against the edge of the reef, which was about two feet below the surface, *REBEL* was picked up by the waves and bounced over the reef until she was several feet back from the edge. Ann waded ashore to get help while I tried to remove the rudder which was being wrenched badly as *REBEL* washed back and forth with each wave. I removed the pivot pin, but before I could pull the tiller out of the slot in the transom, *REBEL* was moved sideways by another wave, and the tiller snapped off. At least the rudder itself wasn't broken. Next I led the anchor warp back to the sheet winch and started trying to force *REBEL's* head back around into the seas. It was backbreaking work, but slowly the bow swung around, a few degrees each time a wave partially lifted us. Then we started creeping back towards the edge of the reef.

Meanwhile Ann had reached shore and awakened the manager of a nearby hotel—who told her that if her boat was on the reef, then she "might as well forget about it", but he finally led her to a Tahitian who in turn went to find the skipper of a large inter-island ferry, a powerful 65-footer. Two others waded out to tell me that the *MANUIA* was coming to tow us off. By this time *REBEL* was almost free of the reef, but the anchor was almost straight down. Evidently it was hung on the edge of the reef. The Tahitians offered to row the anchor further out, but when they tried to climb into the dinghy, it capsized and both oars were lost. Then the anchor slipped once more, and *REBEL* was washed back onto the reef again, this time on her other side. I felt completely powerless now. Without the oars I couldn't reset the anchor. Without the rudder I couldn't sail, and the motor wouldn't start and wasn't powerful enough anyway.

Then, miraculously, the ferry appeared. She hove to about 100 yards out while one of the Tahitians swam a line out; then, without even seeming to strain, she yanked *REBEL* off the reef and towed her round to a more protected spot in a neighbouring bay.

I expected to find all three hulls smashed and taking water—after all, the boat had been grinding on the coral reef for three hours or more—but a thorough underwater inspection revealed only gouges and cracks in the fiberglass on the keel, and one of the float fins cracked. Also, the rudder had been cracked just below the lower gudgeon, and the tiller broken. I felt lucky indeed to have gotten off so lightly.

When we looked up the hotel manager the following day, he said, "Well, I hope you fools learned your lesson." I don't know just what lesson he had in mind, but I did learn something from the mishap. First, never depend on the weather remaining constant all night. Second, don't shirk anchoring procedures just because it's a temporary stop. If I had set both anchors in the first place, we probably would never have gotten into trouble. Third, some sort of winch for the anchor warp is almost essential if you are short-handed. A haliard winch near the base of the mast would be better than a sheet winch

REBEL will go to windward in Force 6 to 7—the worst conditions I've experienced so far—with the 130 sq. ft. club jib, no mainsail, and the helm lashed to hold her head up. She points about 50 to 60 degrees from the wind, and makes about 10 degrees of leeway. Her speed will be 4 to 6 knots, and she takes no more than occasional spray aboard. We sailed from Samoa to Tonga—350 miles against a Force 5 to 6 trade wind—like this in 4 days. She will point higher and go much faster—8 to 9 knots—in the same conditions with the main, reefed down to 180 to 200 sq. ft., and club jib, but she makes heavy weather of it, driving her bows into the tops of the steeper seas, and constantly drenching the helmsman. Also, it has always been while driving into head seas that we have cracked the wing fairing panels.

On a broad reach, with full main up in anything rougher than Force 5, *REBEL* gets quite heavy on the helm, even with the centerboard down. If we expect such conditions to continue we always take the main down; then the wind vane can steer. If there is any strong tendency to round up, I set two jibs, poling out the windward one.

In October 1967 we ran before a very fresh tradewind from Fiji to New Caledonia. Small craft warnings—rough seas, strong winds—had been out for several days. On the day we left conditions were described by the Suva weather bureau as "moderate to rough seas, and fresh winds" but by noon of that day the radio announced that conditions had worsened to "strong winds and rough to very rough seas". The direction of wind and primary seas was from SE, with some seas coming from a more southerly direction. On our desired course, WSW, *REBEL* lurched violently as she took the seas on the beam, so we bore off towards the New Hebrides on a more westerly course. The few degrees change in course eased the motion considerably, and only a few waves broke against the side. The apparent wind was about 15 to 20° abaft the beam. With the club jib vanged out to the windward float bow, and the storm jib to leeward, *REBEL* steered a somewhat erratic course, at times coming around until the wind was abeam. I then tried an experiment which improved her steering considerably. I set both jibs flying with their tacks fastened to an eyebolt about 4 feet forward of the mast, and sheeted them to the floats. With them set this way, the centerboard down, and the vane doing the steering, *REBEL* held a steady course, even when surfing. Her average speed was 6 to 8 knots at first, but this gradually dropped to 5 over the next few days as conditions moderated. Three and a half days after our departure from Kandavu, Fiji, we spotted Aneityum Island in the New Hebrides, 500 miles out but 80 miles north of our desired course. Larger sails might have increased our speed, especially towards the end—the two jibs total only about 200 sq. ft. However, for self-steering, especially in rough seas, the boat must not approach the speed of the wind, since it is only the wind pressure on sails and vane that keeps her on course.

Many multihull sailors frown on the practice of letting a multihull steer herself, maintaining that a sudden squall might catch her with too much sail up and cause a capsize. I think that this is extremely unlikely in our case because I keep the boat grossly undercanvassed most of the time. Also, as the wind freshens, *REBEL* develops an increasingly strong weather helm on all points of sailing except dead downwind, and unless this is compensated for by trimming sails and centerboard, she will override the wind vane and round up until one or more of the sails luffs, which, of course, will awaken me immediately. Even if she didn't spill the wind, a heavily loaded tri such as *REBEL* is more likely to break rigging than to capsize due to excessive wind.

I'm not so sure about big waves. *REBEL* has been caught on the beam by some fairly steep breaking waves, without serious consequences—she seemed to skid sideways with a terrific lurch, but without damage—but then the largest waves I've seen are nowhwere near as large as some of those pictured in Adlard Cole's *Heavy Weather Sailing*.

Havannah Pass, the eastern entrance to New Caledonia's lagoon, provided us with the biggest I've ever seen. Apparently they were caused by a strong ebbing current opposing the onshore wind and seas in the relatively shallow

—3 fathoms—water. The waves looked at least half as high as the mast—I now doubt if they were actually over 12 to 15 feet—and were hollow with the top of the wave cascading down its front We surfed right through the pass on the same wave, a thrilling and terrifying adventure. If *REBEL* hadn't surfed ahead of the wave, I believe she would have been pooped, or broached—and possibly even capsized.

In managing our trimaran during ocean passages, our governing philosophy is "Take it easy". I have learned that it is difficult to average much over 8 knots in an overloaded *Lodestar*, but easy to average 6—so we normally settle for 6. This is easier on the boat, and also—more important—easier on the crew. This lesson was brought home to us during the passage from Tonga to Fiji in July 1967. We had the first steady following wind since leaving the United States—believe it or not!—and decided to try for a record run. Our best 24-hour run to date had been 196 miles—under jib only with a beam wind, between the U.S. and the Marquesas. We were aiming at 200 miles per day. As we left Nukualofa, Tonga, we ran before a moderate SE trade wind. I left the main up which I rarely do with a following wind, and poled the genoa out on the opposite side. For 8 hours we made great progress, frequently registering over 12 knots on the Sumlog speedometer as we surfed on the five-foot wave crests. During those 8 hours we logged just over 70 miles, but after the first two hours I became less thrilled and more apprehensive as I tried to catch each wave exactly stern on. This was made more difficult by a secondary set of seas coming from the South and catching us on the quarter. Great concentration was needed to steer the boat. If it started to turn as her stern rose—this seemed to happen when a quartering sea arrived at the same time as a following one—full helm was required immediately to prevent the boat rounding up and jibing one or the other of the sails. This never actually happened, but I felt that only my quick action prevented it. Self-steering was out of the question; and I wouldn't even allow my wife to steer, though she probably can steer as well as I can.

This reckless run came to a halt after eight hours, when the steering cable (wire at that time) broke. I jumped into the aft cabin to steer with the rudder tiller, but couldn't see the compass or the waves, or feel the wind. The clouds raced back and forth across the cabin hatchway a few times, then I pushed instead of pulling and gybed. It had to happen sooner or later. *REBEL* lay patiently beam to the seas while we got the sails down. The only damage apart from the broken cable was the centerboard, which was broken off flush with the bottom of the hull. This probably happened much earlier, and would account for much of the steering difficulty

Since it was getting dark, and I was very tired, I made no attempt to repair the steering cable that night. We set the storm jib across between the float bows and let the wind vane (which works independently of the steering wheel) steer, while we turned in for a night's sleep. When I checked the log next morning, I found that *REBEL* had covered 60 miles in the past 12 hours while we slept—an average of 5 knots. The course was rather erratic without the steadying effect of the centerboard, but the point of this story is that it is easy to average a decent speed, but quite an effort to increase this speed appreciably. I don't think that it is worth the extra effort. We still go all out for speed occasionally—and sometimes break gear as a result—but never since have we pushed the boat hard during a long ocean passage. Even so, the average speed for the 14,000 miles *REBEL* has logged to date has been 5.2 knots. Our best week's run has been 1,068 miles (6.4 knots average), but then only one of our passages has lasted longer than a week. This may sound slow to one who has heard claims of 20 to 30 knots for cruising multihulls, but it is still faster than most 35-foot keelboats average on ocean passages—and I would emphasize that this was accomplished by an inexperienced husband-and-wife crew with the boat steering itself 90% of the time and rarely pushed hard.

FROM AN EXPERIMETER

by M. B. Rands, MSc, F.N.Z.I.C Auckland, New Zealand

Mr. Rands has been sailing and progressively developing his trimaran *SUSANNAH* since 1961. Her main hull has a flat-run round bilge and her present floats are double chine approximating round bilge as closely as possible—the first set were of 60° triangular section. Other modifications include increasing LOA from 18 to 29 feet and overall beam from 14 to 18 feet, and experimenting with sloop rig with 3 different mast styles, with bilge keels on the main hull, and with 2 sizes of leeboard.

His comments are based mainly on his experience with this prototype though he has also sailed on a Piver *Lodestar*, a 26-foot New Zealand catamaran, and another cat operating off the beach at Honolulu, and frequently crewed on shoal-draft centreboard mullet boats and a 45-foot yawl.

Overseas cruising trimarans have visited Auckland in appreciable numbers and the number of local trimarans with accommodation has increased from 2 in 1961 to something approaching the 100 mark in 1967.

Few, if any, of these trimarans would have self-righting characteristics. If a conventional trimaran should turn upside down the resulting stability could be similar to that of the normal position and the chances of self-righting, even with a ballast keel, would be remote.

On no account then must inversion be permitted and the most practicable way of preventing this would be provision of a mast of adequate buoyancy and strength to ensure that in the first instance the overturned craft would lie on her side only. The factors governing self-righting will then include the relationship between float buoyancy and weight of the whole craft, and the relative positions of the centres of gravity of the exposed section and of buoyancy of the immersed one.

Fig. 1 shows a capsized trimaran in which the buoyancy of a float is sufficient to support the main hull and other float. With buoyant mast and masthead float the craft will not invert but will not right herself either because CG falls between $CB_{\text{masthead float}}$ and $CB_{\text{immersed float}}$. In this case the situation is not helped by the transversely extended cabin which moves CG further towards the masthead.

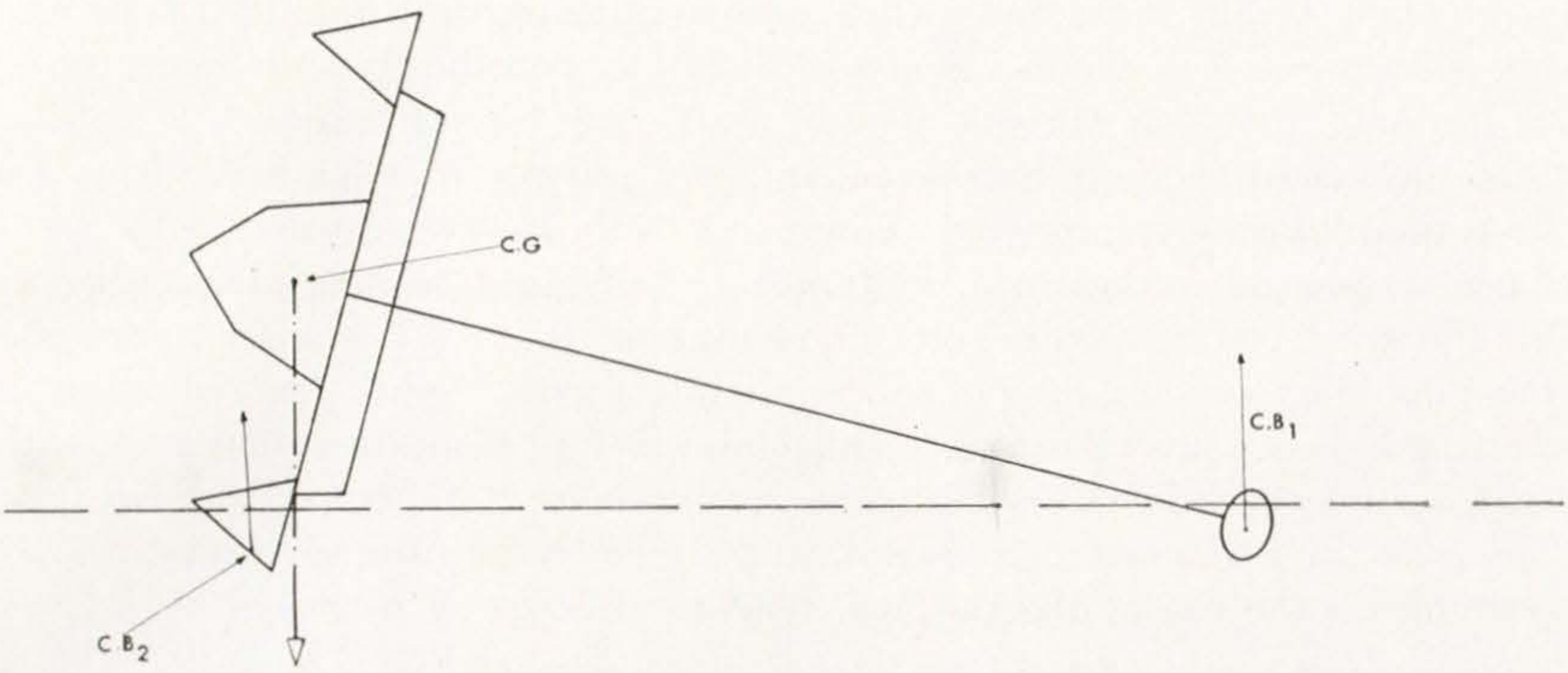


Fig. 1

Figure 2 shows a float submerged as its buoyancy is not sufficient to support the main hull and other float. The mast is thus more nearly parallel to the water surface, and, if with appropriate design, the CG of the main hull system is kept as low as possible, this could be on the opposite side of $CB_{\text{immersed float}}$ from the buoyancy of the masthead float, and the craft will be self-righting if $M_{cg} > M_{cb}$.

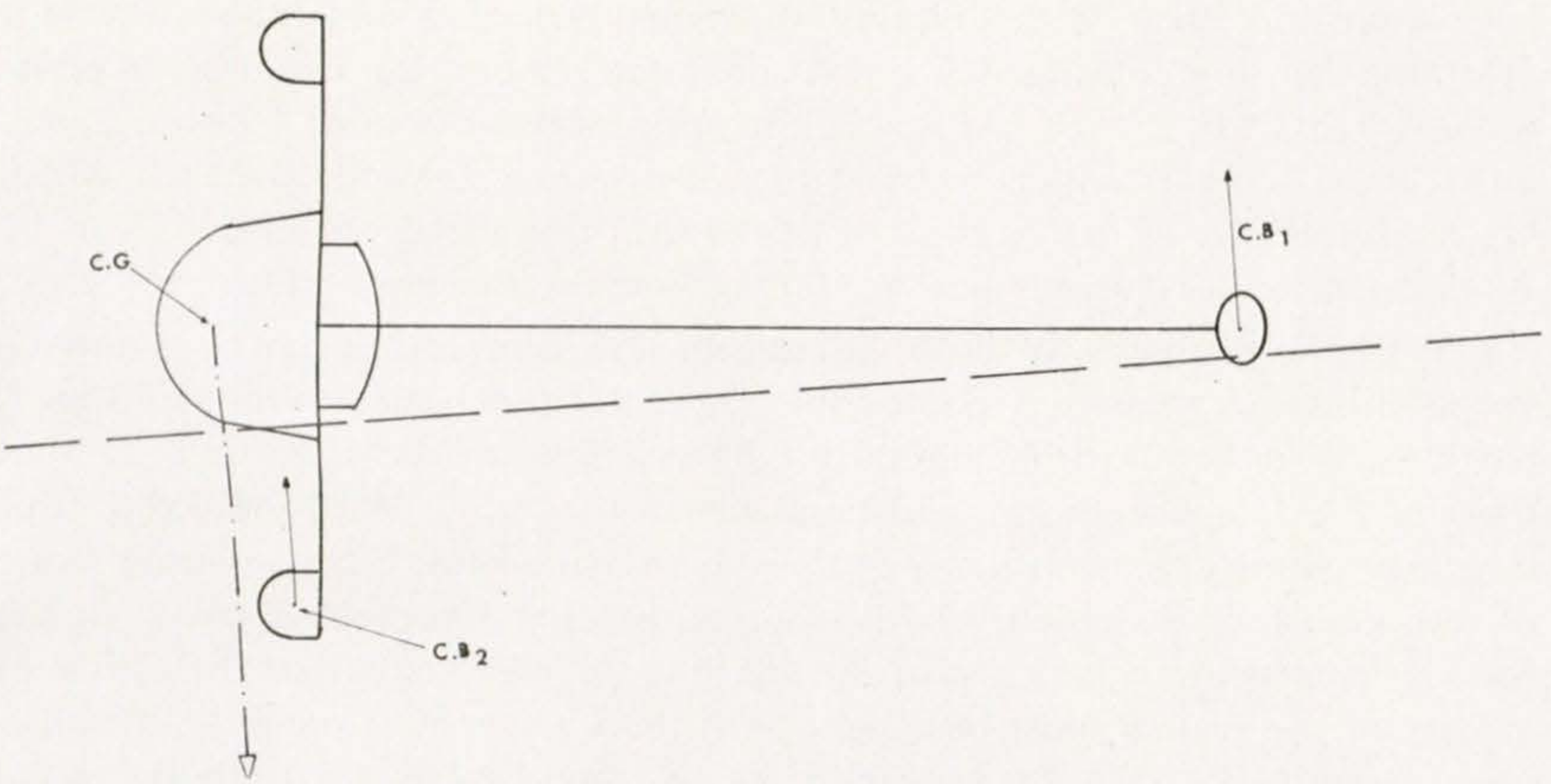


Fig. 2

In my own experience, increasing overall beam benefits both performance and stability, provided suitable hull forms are used. When *SUSANNAH* was 26 feet LOA, with 22 feet LWL, I found a beam of 18 feet vastly superior to a 14-foot one. A beam equal to overall length might well be quite practicable. A large beam has a number of advantages: It keeps interaction of hull wave systems to a minimum, and provides a smoother and more level ride. Mast and rigging windage, and wear on sails, can be considerably reduced by eliminating cross-trees, diamond shrouds, and such like which becomes possible with adequate angles for the standing rigging. Great flexibility is gained in sheeting sails, as well as sufficient deck space, even on quite small craft, for carrying a dinghy.

The late Arthur Piver had a tremendous influence on trimaran design, and his conception of V-section plywood hulls has become fixed in many mind as the only hull form for this type of craft. He himself realised, of course, that such cross sections had disadvantages, and round bilge hull forms are now becoming more popular. Compared with V-shapes, round bilge hulls have several advantages for multihulls. Minimum wetted surface, better load bearing characteristics, and more internal space for a given beam, and the possibility of designing them as planing forms. With the reduction in draft, and hence less resistance to turning, this hull form, in conjunction with centre- or leeboards, offers better manoeuvrability. With the boards raised this is an important factor of stability: imagine trying to upset a light raft by pushing on the mast—the raft will tend to slide away sideways.

In my experience with *SUSANNAH*, hard on the wind with full sail, it is difficult to immerse the lee float much above the second chine, whereas the previous 60° V-floats immersed rapidly to a point where they offered considerable uncontrolled lateral resistance which was markedly inefficient from the viewpoint of pointing ability. In comparison, the present high-aspect modern Dutch-style leeboards contribute a very noticeable lift in their own right—and they can be adjusted to suit conditions. A major factor in keel boats capsizes is the relative immobility of the keel; this underwater immobility should be absent in multihulls.

I would say that, with suitably shortened sail and controlled leeboard position, the only contingency which could cause a capsize would be an enormous wave with a crest whose height approaches the craft's beam, and a hurricane force gust which would not give her time to slide down the wave. Or, as in the case of the Australian trimaran, being lifted out of the water by air pressure under the side decks (Hedley Nicol's trial flip—ED.).

One of the problems of both catamaran and trimaran design is arranging accommodation that does not unduly detract from basic stability. This is particularly difficult with catamarans unless they are large enough so that most of the accommodation can be places in the hulls With the erection of large, spreading cabins on many of the smaller trimarans, because of the shape of the main hull, so much weight is added at deck level and above it in the form of crossbeams and most of the sleeping arrangements that the centre of gravity of the system must be nearer deck than water level; such an arrangement cannot possibly be self-righting. A round-bilge centre hull, on the other hand, of modest beam—a minimum of say 6 feet—can quite comfortably take bunks along each side, very close to the water line. If all stores are firmly packed under these bunks—so that nothing can be dislodged even in the event of total capsize, this weight is in effect internal ballast which, under cruising conditions, could be quite sufficient to provide the self-righting requirements of Fig. 2.

The design of joining members between hull and float often seems to go for streamlined appearance rather than low weight and great strength. This trend may well have resulted in poor structural design, and contributed appreciably to the breakup of a number of trimarans. Some deck structures, too, have a lot of weight in their box sections. Boats do not aspire to the characterists of aeroplanes, and many of the sleek-looking deck structures of some modern trimarans, while allegedly in the interest of reduced windage, are just so much nonsense in comparison with strut arrangements which have the advantages of low weight, high strength, and great rigidity.

In *SUSANNAH* two pairs of simple Oregon struts—6 × 2 ins., with rounded corners—on each side terminate in manganese bronze universal joints which are in turn bolted to the main hull and floats through appropriate anchoring plates in the hulls. The strut pairs, spaced about 12 ins. apart vertically on the inboard end, gave a feeling of insecurity with the amount of spring felt in a choppy sea, and so a third strut was added, between the points of attachment on the floats and the cabin top, running vertically above the two existing ones (the craft has a central cockpit). A horizontal light plywood deck was placed between centre struts to prevent rack, and this arrangement has proved most satisfactory for several years. Whatever movement occurs in the outriggers is confined to the bolts in the universal joints, thus avoiding alignment stresses in struts and hulls. The vertical distance between the extreme inboard attachment points is about 36 ins., and with a strut length of some 6 feet, this gives a triangular brace of extreme strength. In addition, the upper struts act as very useful deck rails, and the sheet winches mounted on the aft pair are very conveniently placed near the cockpit.

With the cabin top inboard of the main hull, and the side decks reduced to a size commensurate with adequate but not excessive horizontal bracing, the effect of heavy sea and wind is minimal.

Another undesirable feature of many a cruising multihull is the excessive freeboard of both main hull and floats, resulting in too much windage and rough water obstruction. This springs probably from a desire for headroom in the main hull (and level decks in the case of trimarans), and the idea that insufficient clearance of the connecting decks will result in unpleasant pounding in rough seas. The latter may well be true with deep narrow hulls but if the hulls tend to round bilge forms the height of connecting members can be reduced. The lowest struts of *SUSANNAH* would not be more than 12 ins. above the water line at the inboard end, and it is very rare for solid water to hit these.

POINTS

VIEWPOINTS. COMMENTS and SUGGESTIONS
from letters by D. Wilson, New Zealand
I. T. Burke, USA
W. R. MacKenzie, New Zealand
T. L. Lane, New Zealand
John Goodwin, South Africa
John Glennie, Hawaii
Jim Brown, USA
P. R. Chaworth-Musters, England
Jock Burrough, England
P. M. Patterson, England
William J. Allday, USA
Richard L. Andrews, USA
M. Decat, France
F. Benyon-Tinker, England
Lock Crowther, Australia

TEN POINTS FOR RUMINATION

by D. Wilson Tauranga, New Zealand

The statement that multihulls are "very much cheaper so one can have a bigger boat" (AYRS Publication No. 63, p. 75) only echoes what most multihull enthusiasts have stated many times. I believe it is this conviction and our persistent, determined efforts to justify it in practice that have been our downfall. I have not lost faith in the conception of multihulls, far from it, but until it is accepted that a *safe* multihull is going to cost as much or more than a monohull of the same size we will get nowhere.

Here are ten suggestions. One could probably think up plenty more but they would be of lesser importance. I am quite confident that if full attention were given to these ten, and, of course, if the standard of seamanship amongst the multihullers was raised, we would have only something like a tenth the number of disasters.

1. Hulls must be moulded and enormously strong—not flat sheets of plywood glued and nailed together on battens.
2. Connecting members must be stronger, and the stresses and strains must be spread through as much of the hulls as possible—integration with strongback, bulkheads, etc.
3. Superstructure must be kept compact and be much stronger than in the past.
4. Hulls must be designed with more buoyancy so that they can go to sea with a full complement of crew, gear and equipment.
5. Spars and riggings must be made far stronger.
6. More emphasis should be placed on good deck gear—winches, etc.
7. Fuller sail lockers.
8. Everything possible should be done to facilitate shortening sail. This is more important than on a keeler. It should be possible for *one* man, tired and sick, to reduce sail with ease under any conditions. Consequently roller reefing gear is a must and should be of the highest order of efficiency and reliability.
9. Engines are a safety factor as well as a convenience.
10. A transmitter with self-contained power supply capable of sending out a continuous distress signal should be carried on all boats leaving the coast.

by I. T. Burke New Orleans, Louisiana, USA
November 1968 Letter

"I believe that the multihull vessel is really less suited to amateur construction than is a monohull because of more complex hydrodynamic and structural considerations which cannot be ignored."

(A very good reason for starting with the plans of a reputable designer and sticking to them closely if all that's wanted is a seaworthy boat. Experimenters are, of course, 'in a different boat'. ED.).

GIVE HER PLENTY OF WEIGHT—AND SOLID STRENGH . . .

by W. R. McKenzie Taupo, New Zealand

With the exception of James Wharram, the plea is generally for lightness. Mr. McKenzie prefers weight. He has designed and built a 33-foot trimaran with a beam of 20 feet and an all-up weight of about 3½ tons which he has sailed for the last six years in conditions up to 60 m.p.h. winds—"without any trouble so far". He has been sailing for 30 years in a large variety of boats and feels that a tri is a "fairly safe boat if properly designed, built, and sailed, but will never be quite as safe as a good ballasted keelboat".

I think it is desirable to have plenty of weight. An ultra-light boat, even with extreme beam, will still be thrown and blown out of the water where a heavier one with less overall beam will still retain her grip. I have found also that a heavy boat goes to windward better than a light one.

My floats have about 2½ tons of buoyancy—I think it is very desirable that float size should be such that the main hull always has a good grip on the water, and have found that 2½ tons of float buoyancy plus an overall beam of 20 feet allows me to carry full sail (650 ft.^{2}) up to 20 m.p.h. winds. I have never reefed to less than 300 ft.^{2}, even in a 60 m.p.h. wind. To sum up as concerns design:

(a) sufficient weight,

(b) sufficient beam,

(c) float buoyancy of about 2/3 of the all-up weight.

I also think the space between the main hull and the floats should be left mainly *open*, apart from walk ways and safety nets.

As concerns construction, I feel stresses are often under-estimated—and the strength of light plywood structures over-estimated. My own boat has two solid Oregon Pine beams, 8 ins. deep, 4 ins. wide, and 20 ft long. These fit into steel brackets bolted to solid timber bulkheads in the floats and main hull. This structural arrangement gives, I feel, some flexibility with plenty of ultimate strength.

by T. L. Lane Auckland, New Zealand
September 1968 Letter

Mr. Lane is the New Zealand secretary of the A.Y.R.S., and though his own interest is in single-hulls he has gone out of his way to be helpful to the Multihull Safety Study team.

"Most small craft failures, both multi and mono hulls, seem to start with mechanical troubles (engineering and boat-building). Quite often these faults can be located by testing, and corrected before leaving on a voyage. Usually lack of funds is the main cause of inferior work, and people will take risks to achieve their ambition."

by John Goodwin Hout Bay, C.P., South Africa
September 1968 Letter

John Goodwin, well-known for his singlehanded Atlantic crossing in *SPEEDWELL* and as *STORMVOGEL's* skipper for some 18,000 miles, as an 'Aerohydrohull' experimenter (AYRS Publications No. 62, p. 62, and No. 66A, p. 65), has been interested in multihull design, construction, and performance for the last 10 years. He has made 3 multihull trips from Cape Town to Durban round the Cape of Good Hope which requires no comment.

Many people I know would consider it a waste of time to carry out a MULTIHULL SAFETY STUDY, pointing out that if you take one multihull and one monohull and place them upside down in the water next to each other, the monohull will right herself and be able to sail on, after a fashion, whereas the multihull will remain upside down for good!

If however one is prepared to accept this slight(!) disadvantage, and you then place your monohull and multihull next to each other with a *beam* wind blowing, the multihull will leave the monohull standing. There are also other factors, such as comfort (multis are superior here) and cost (multis are somewhat cheaper).

. . . I consider that the large wing deck between the hulls is a great danger and my own designs have webbed decks.

by John Glennie N.Z. Yacht *HIGHLIGHT*
January 1969 Letter

John Glennis, a boatbuilder by trade, and his brother have just made a passage in their trimaran from New Zealand to Hawaii. They are at present in Hilo "where we've been flat out working—we spent 2 months practically renewing the bows of the floats and general damage that we did en route from New Zealand".

We hoped to have a fast trip from New Zealand to Tahiti, so when we planned to go south down past the Chatham Islands to 46° latitude in the Roaring Forties we had a special, heavy 600-ft.^{2} $4\frac{1}{2}$-oz. spinnaker made up for running. We eventually used it in a SW storm down off the Chathams for $1\frac{1}{2}$ days in which it was blowing too hard for us to go on deck to take it down (we steered inside). But apart from that we had winds from NE to NW and battled against headwinds and giant seas all the way. We had three days with the wind aft during the entire trip. We all but capsized a thousand miles south of Rapa and had some other near escapes. Generally we pick our weather and nurse the yacht but the Pacific has been bad this year.

Until our recent trip from New Zealand I thought I knew a fair bit about tris and would go along with many of the harbour and fine weather navigators' theories.

. . . In preference I would rather have a trimaran and would love to play with a new design (with a designer) to improve on what I think has great potential. But unfortunately that's not being realistic. So my next yacht will probably be a 50-foot flush deck in wood with attractive lines and good finish inside; it will be mainly for resale—but we may make a quick trip around the world for 3 years.

Unfortunately trimarans can't be loaded down, which is inevitable with a cruising yacht. And they fetch low resale. However, if I was living in New Zealand and wanted to cruise to Tahiti and the Cooks each winter, I wouldn't go past a trimaran.

by Jim Brown Davenport, California, USA
September 1968 Letter

I believe that the concept that the "unsinkable multihull is its own lifeboat" has led to the loss of several crews in the known trimaran tragedies. If we could talk to those crews, we would know more about capsizes. In the event of a capsize (or fire, explosion, collision) what the crew needs is *another boat*. If they can retreat to the life boat, they're back in business. (In the 37 ft. *SEARUNNER* there is a space in the wing for an (*AVON*) life raft which has a hatch both on deck and in the underwing. A similar space in the port wing can be useful for other emergency equipment).

Tethered to the striken multihull, in a craft with *canopy* to protect from exposure, they can wait until the weather improves and then avail themselves of the stores and equipment on board (the 'mothership'). Chance of survival is very good.

But clinging to the waveswept under-wing, exposed to the wind and cold, doesn't give them much hope.

I consider survival inside an upturned multihull also unlikely. There are the adversities of darkness, air supply, battery acid, engine oil, stove and engine fuel, plus the cauldron of water and debris churning round with the crew. The first thing is to *get out;* maybe come back for supplies later.

by P. R. Chaworth-Musters Poole, Dorset, England
July 1968 Letter

Firstly, I feel that everything should be done in the basic design to gain stability and reduce the changes of capsize, which will always be a risky and unseamanlike manoeuvre. However accidents do happen and racing multihulls offshore in strong winds is bound to be not only exhilarating but slightly dangerous.

Having said that it seems to me that:

1. The boat should be designed to float upside down, which is easily achieved with polyurethane foam or watertight bulkheads.
2. The liferaft, with flares and emergency radio, should be accessible from both sides
3. Whether it is worthwhile having a hatch into the mainhull so that the boat can also be used as a life raft, I am not sure.

   Depending on design, the crew would be standing in near waist-high water. The lights would be out, but torches should be all right if waterproof and getatable. It would be impossible to cook but tinned food could be found. It would be necessary to keep a lookout through the hatch and this would be unpleasant for any length of time while the storm lasted.

4. It would be an advantage to have 'SOS' and the name of the boat painted on the bottom, or at least a can of contrasting paint stored in the liferaft. If the liferaft was provided with a specially long painter, it could be attached to the overturned boat to make it easier to spot.

by Jock Burroughs

London, England
June 1968 Letter

Jock Burrough is no doubt well known in AYRS circles—even to faraway members like myself who have never had the pleasure of meeting him, through his levelheaded writings—and in the yachting world (Trimaran *TAO*). He does not seem a man to 'just sit' for long, and is at present working on a very simple downwind selfsteering gear which will "take over forcibly when the vane gear is least effective, i.e., when surfing". Reading Adlard Coles' '*Heavy Weather Sailing*,' he tried to imagine a multihull under the various conditions described: "Generally I think we would come off very well as long as we have sufficient crew to keep her moving in the right direction and have no rigging breakage, or alternatively, plenty of sea room and an adequate downwind selfsteering gear."

In AYRS Publication No. 63 ("Suggestions for the *SHTAR* Capsizing-Safety Arrangements", p. 42) he advocated tentatively: ". . . Escape if trapped inside a hull . . '", while S/Ldr. D. H. Clarke wrote in *YACHTSMAN* of May 1968 ("Flip Side", p. 23); ". . . It would seem that it is perfectly safe to stay in the cabin of an inverted tri . . ." "Well, that makes it easy," a colleague commented, semi-humorously, "if we should capsize, we just holler 'Clarke or Burrough?', and then it's up to you! . . ."

This lighthearted little quip sums up very neatly the *need for having a good idea of what to expect in such a situation—and how to act*! ED.

The notion of equipping a multihull for upside-down 'habitability' is a logical step in discussing the multihull offshore capsize. Too many have been living in a fool's paradise—"almost impossible to capsize". Even the multihull leap which should not happen with proper seamanship—I agree it should not. Unfortunately experience shows that it does.

In our fighter aircraft safety harnesses, parachutes, a dinghy in the seat of the parachute, with a hard CO_2 bottle that hurt after a few hours sitting on it, ejector seats, etc.: these were expensive nuisances which had to be lugged around and checked, and all for something that might never happen. But without them morale would not have been so high. It is nice to know that if the worst happens there is a way out.

Or, better perhaps, if in the middle of the ocean, a way *in*, a means of survival remaining capsized. Time would, of course, be an enemy as food and water supplies would probably be inadequate for the unexpected extension to the time at sea. So a radio transmitter of the emergency dingy type should be included in the survival gear.

Sealing off the normal hatches would seem to be a necessity in making the vessel habitable when inverted, since trapped air gives buoyancy, and some of this would be lost if the hulls are ventilated as they must be for breathing.

In the long run, masthead buoyancy might seem to be the simplest solution —but conditions which have caused the capsize are hardly likely to spare the mast for long.

by P. M. Patterson Catamaran *ICONOCLAST*

From May and June 1968 Letters

A cat or a tri can easily be capsized if the mast and rigging are strong enough. Design comes into it—some flip quickly, others go much more slowly, often giving time for releasing the sheets or luffing up. I believe that with the increased use of self-steering we will hear of more capsizes off-shore. You are so comfortable down below, that despite the fact of the wind piping up, things do not seem too bad—until either the mast folds (which happened to me a thousand miles west of Ireland) or she flips.

Righting a multihull without a crane is a Herculean task. In mid-ocean a Batman task. It might not be impossible. But it is certainly a lot more difficult than some correspondents seem to think.

As to survival in upside down multihulls, I have thought about this quite often—indeed, when it is getting a bit hairy, and you are in a multihill a thousand miles from the nearest land, you have to be exceptionally devoid of imagination not to. As I have never yet sailed with a life-raft aboard—my sailing is invariably done on a shoestring—it is a problem I would like to solve, at least in theory.

From pictures of the *GOLDEN COCKEREL* capsize it would appear probable that a cruising catamaran will float with its hulls out of the water and some waves occasionally washing over the bridge deck. The hulls will float high while the air is trapped in the hulls—but how to arrange a suitable air change without losing buoyancy bothers me. The bridge-deck offers only the most tenuous of grips—I feel one should get into the hulls out of the wind to survive (having sailed in Arctic Canada, I have learnt a little about 'wind chill factor'). But built-in buoyancy is not really practicable at deck level; as there is more likelihood of hull damage, it is more practicable, and more easily fitted into the accommodation, to have buoyancy low down fore and aft. This would of course be of little use when inverted. Perhaps the suggestion of rigging a shelter on the inverted wing is the most sensible for a cat. If a life-raft is used it should be tied to the inverted multihull as this might increase the chance of being found.

The floats of a *Nimble* type trimaran—if undamaged, and it would appear that in all probability they would not be damaged in the event of a capsize—have sufficient buoyancy to float the whole craft upside down, with the water rising to about level with the underside of the wing.

I have had a 30 ft. *Nimble* I built blow over on dry land, in a gale reaching hurricane force in the gusts (recorded locally at well over 90 m.p.h.) and channelled by buildings so the boat got the full force. The boat vibrated in the wind—probably due to the considerable windage of the mast. The back chock worked loose and fell away, the boat rocked back and then presumably took off—it landed a boat's length down the beach. Even so the cabin top was not fully flattened, the side windows were o.k., the front ones smashed, and all hulls undamaged. We floated her off and sank one hull to haul her back upright. It was incredibly difficult to sink a hull: we bored holes to let the air out, laid on 6 cwt. of ballast, then bounced on the float for a long while before we could get the float even three-quarters down. The inverted boat floated with the water more or less level with the cross arms; the wing section, which was awash, was most difficult to walk on or hold on to. Access was not difficult as she tended to float bows down a little, so one could have dived through the normal doorway. I was of the opinion that with holes bored in the main hull for an air change, the main hull could have been made to give adequate protection and accommodation for survival, bunched-up but out of the wind and the worst of the water. Would the seacocks as fitted for the head and sea water pump perhaps be sufficient for an air change?

It would be important to jettison ruthlessly all heavy gear such as outboard, anchors, fuel—no matter how expensive. Obviously, water would be a major problem unless it was normally kept in sealed plastic containers. Canned food can be eaten cold. Damp sleeping bags are uncomfortable to get into, but providing they are above the water, your body does warm them up sufficiently for a reasonable sleep.

The preparatory measures suggested in your letter:

(1) a quick release, or easily released, link between safety belt or harness and personal life line;

(2) a couple of strategically placed, through-bolted fittings for rigging lines for the crew to hold on to if the craft has turned 'bottoms up';

(3) life raft stowage for accessibility in either position;

are sound. And, that there is time and sufficient trapped air to think things out, don clothing (or better still, a wet suit) for protection outside, and prepare to go outside with the necessary rope and gear—if a life jacket is worn, a weight must be carried so that one can dive if necessary for egress—this knowledge is something that should be passed on to all multihull sailors.

by William J. Allday

Hamden, Connecticut, USA
October 1968 Letter

To right a capsized trimaran it should be possible to arrange for one float to be detachable. In this way, the drilling of holes (AYRS Publication No. 63, p. 54. ED.) will be unnecessary, and with the anchor and other movable weights on the floatless side the mast should rise to the surface. It should not be too difficult then to right the boat and reattach the float. Methods of attaching wings to gliders should be a fruitful field of study for ideas on attaching and detaching floats.

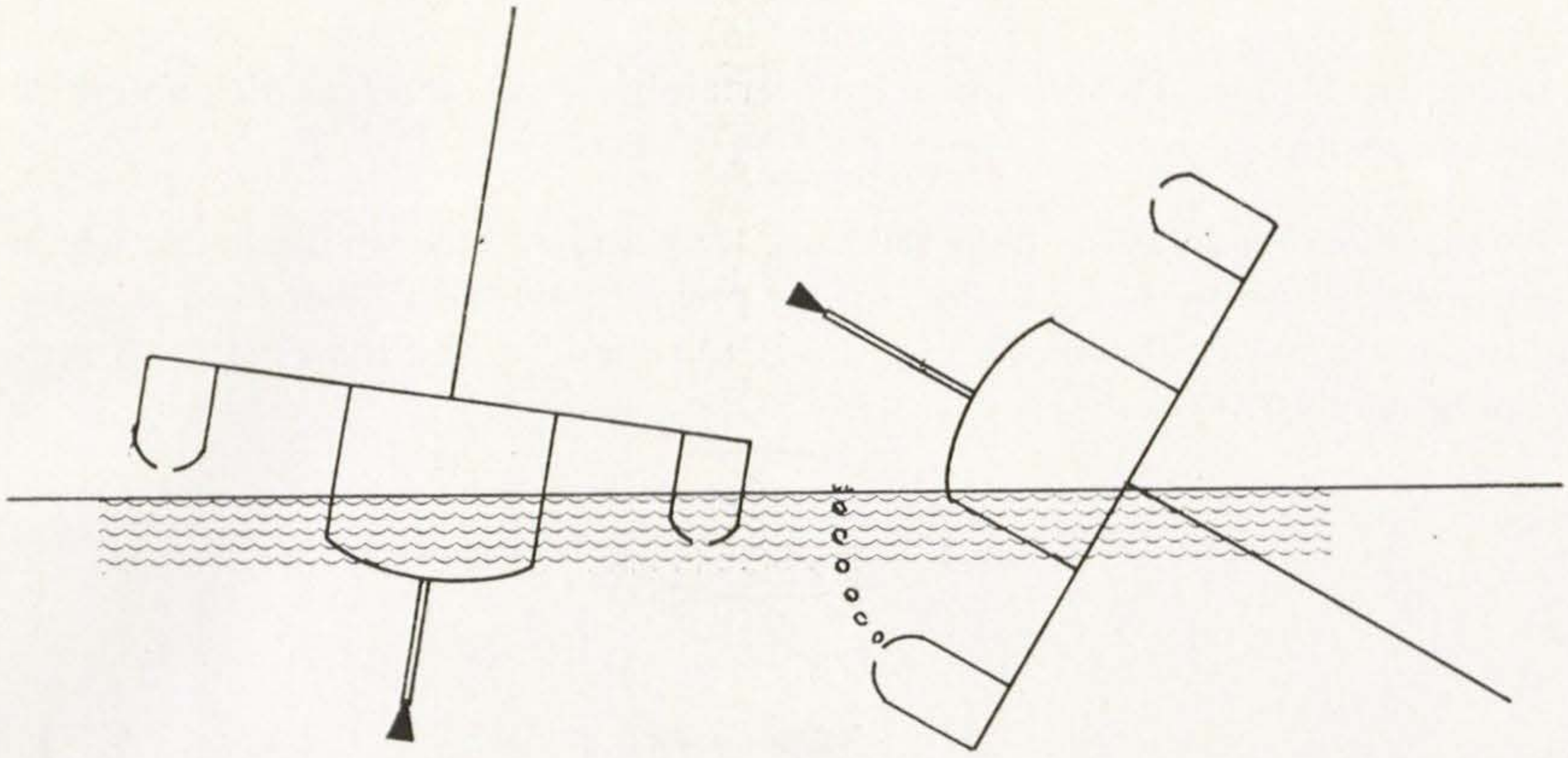
(This approach has been adopted by João Mendonça in his *LUNGA*—*S.A. Yachting*, November 1967, pp. 14 and 15, and AYRS Publication No. 65, pp. 46-50; and in the design of *ARACHNE* by Philip Bolger—*Yachting World*, September 1967, pp. 416 and 418.—ED.).

by Richard L. Andrews

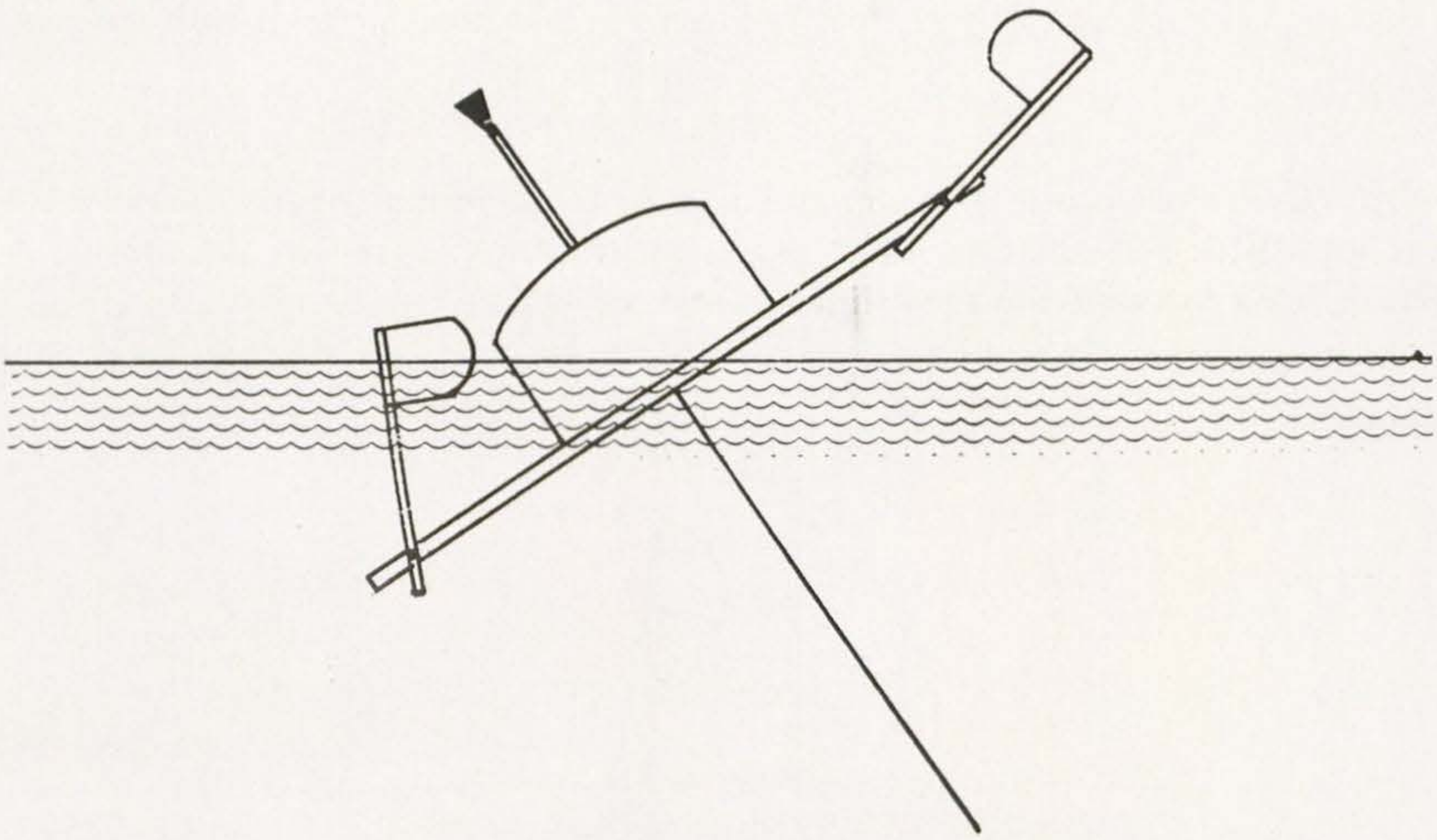
Ossining, New York, USA
November 1968 Letter

To make a trimaran selfrighting with a weighted board or fin, I can imagine two systems to remove the positive buoyancy of the floats.

1. Floats with openings by keels, so when the craft overturns, the lee float empties of air. Openings could be like suction bailers.



2. Floats on hinged stubs arms to basic crossbeams so that the bulb weight on the fin can right the craft while the float swings back next to the main hull.



A SIMPLE INFLATABLE MASTHEAD BUOYANCY DEVICE

by M. Decat 106 Quai Bleriot, Parie 16e, France

(The author's name was 'deduced' from the AYRS membership list; his letter, written in June 1968, arrived somewhat circuitously—minus name. ED.).

M. Decat's cost estimate for the device is £12-15, plus another 5-6 for the gas bottle—at 1968 prices. Whether inflatable buoyancy devices are something that can be successfully tackled by amateurs in general remains to be seen—South African members of the Multihull Safety Study group feel they'd rather leave this job to Fred Benyon-Tinker. This is a matter of personal preference, M. Decat's solution seems certainly simple and feasible enough to warrant inclusion here.

A plastic-coated canvas bag, 180 cms. long and 35 cms. in diameter, which will withstand some $1\frac{1}{2}$ kgm./cm.^{2} of air pressure, with an inner-tube airvalve at the bottom—as shown in Fig. 1—is attached to the mast with 10 self-tapping screws.

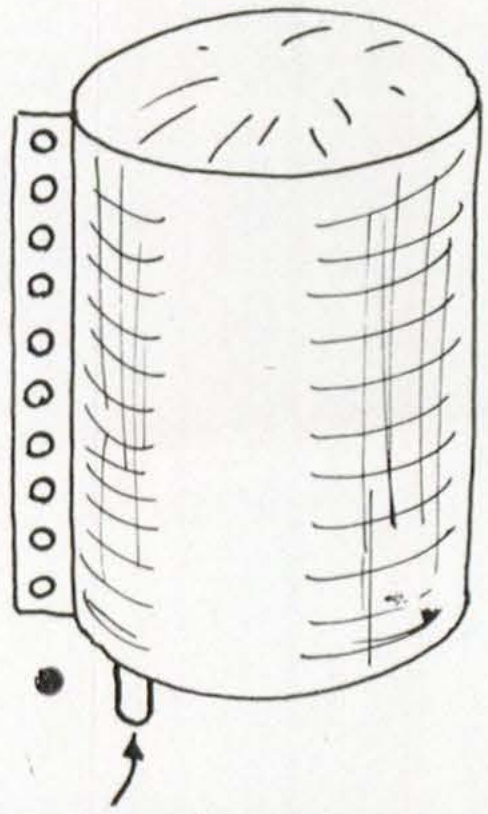


Fig. 1

A 160-litre gas bottle of compressed air or CO_2, with a trigger release valve (as used with self-inflating dinghies), is secured at the foot of the mast. A nylon tube through the mast links bottle and bag.

Deflated the bag is rolled up, secured by half a dozen rubber bands. The arrangement is shown in Fig. 2.

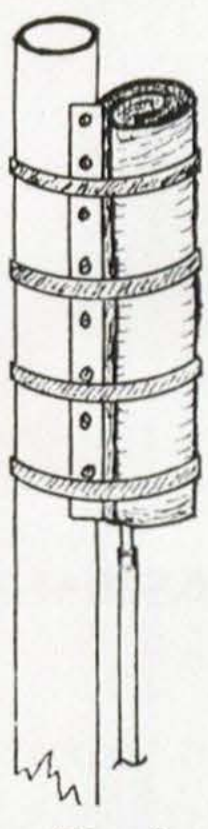


Fig. 2

In a capsize there is a delay of some 30 to 45 seconds between 90 and 180°, due to the air trapped by the sail. In this period of grace a member of the crew pulls the rip cord and the bag inflates, with the rubber bands snapping one by one.

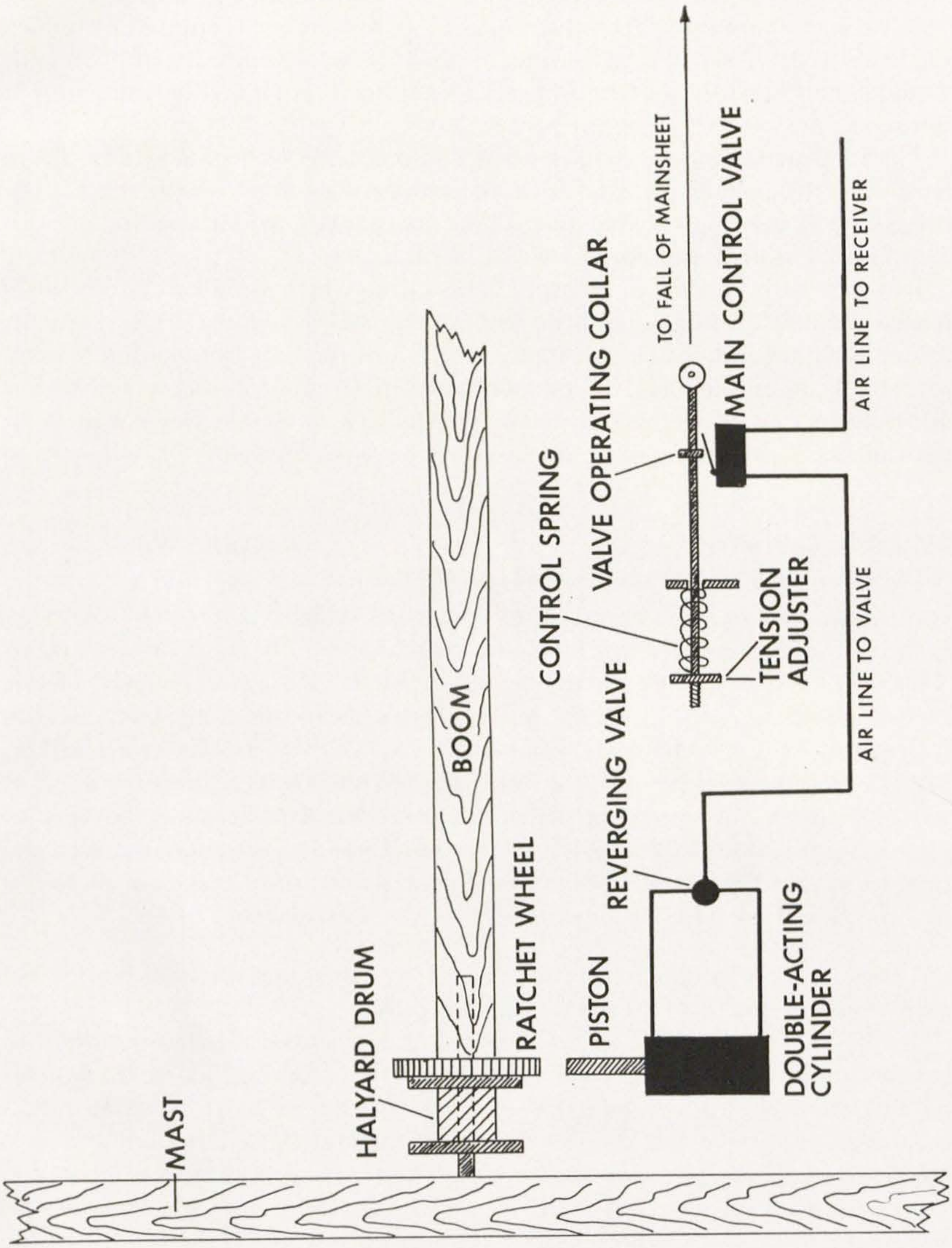
I have tried this device several times in port—it worked perfectly.

ONE WAY OF REEFING AUTOMATICALLY . . .

by Fred Benyon-Tinker England

One of the safety devices which have become increasingly used on multihulls is the sheet release gear. There can be no doubt that this can provide an extremely valuable sailing safety valve. It can be argued, however, that it has its own danger elements. The sudden removal of the main driving force from a boat can be a considerable hazard under quite a variety of conditions and situations.

It is evident that when such a device is brought into operation it is simply because too much sail is being carried under the prevailing conditions. It



therefore seems to follow that the preferable method would be to evolve a self-reefing gear. The schematic sketch shows a possible way of doing this. As will be seen, the suggested system is basically a fairly conventional roller reefing gear, with the rotation of the boom operated by a pneumatic ram, suitably positioned and mounted. Its operation would be controlled by a valve, which in turn would be operated by a spring-loaded plunger. If the fall of the mainsheet were taken to this plunger, then any load on it in excess of that predetermined by a simple adjustment to the spring system would open the valve. This would then feed air to the double-acting ram through a suitable mechanically operated reversing valve. Thus, as long as the sheet load exceeded the chosen triggering point, the ram would continue to roll the sail down and stop only when the reduction in sail area was enough to reduce the load on the sheet to a 'safe' value. Any further increase in wind strength would simply start the system up again and bring about a further reduction in sail area.

The load signalling the danger point could equally well be taken from the tension in the shrouds or even from the compression load on the mast. On the whole it seems probable that these alternatives would require a more complicated system and could well be less reliable.

It would be necessary to incorporate a device which would simultaneously release the halyard by the required amount but this would not seem to present insuperable difficulties. For instance, the fall of the halyard could be wound round a drum on the mast, of appropriate diameter and rotating in a direction opposite to that of the boom when reefing. Then, as the boom rolled up the sail, the halyard would be released by the same amount.

by Lock Crowther New South Wales, Australia

From February and July 1969 Letters, and in AYRS Publication No. 63, p. 47

It is hard not to be impressed by the care with which Lock Crowther examined and presented the evidence available on the fate of *BANDERSNATCH*. At least one person wasn't, though. In Peter Joubert's letter (*Modern Boating*, February 1969, p. 18) there appears this somewhat cavalier statement—or is it a rhetorical question?: "Mr. Crowther claims *BANDERSNATCH* capsized because of a collision. What absolute proof has he of this? It seems far more likely that the boat failed structurally because of poor design." Maybe, the writer of that letter had the advantage of a special revelation over Crowther? Whatever the elusive truth in this case, there can be little doubt that Lock Crowther learns from experience. ED.

Three major changes have occurred in my thinking on multihull safety as a result of the *BANDERSNATCH* tragedy:

1. To my mind, one does not survive on a capsized flooded multihull in storm conditions for more than a few hours. *I would not go to sea without an acceptable life raft on any type of craft.* Although a tri does not sink, a crew cannot survive for long on an upturned boat in cold waters and gale conditions; a life raft with shelter cover and emergency rations costs 400 dollars, fairly expensive but good insurance on one's life. Should a capsize occur, the first aspect is *crew* safety, the second salvage of the boat. In the

event of a collision or major structural failure it is obvious that the boat may not be worth salvaging and may not be habitable despite built-in upside down habitability—hence the life raft.

2. There are possible methods of righting an undamaged upside down multihull which require little in the way of equipment, just preparation and planning. It would be impossible to attempt any righting in rough conditions, so crew survival in *fit* condition is necessary until calm weather. Exposure soon saps strength and initiative. Shelter, either in a liferaft or preferably in a hull is essential. An upside down multi will float very high on wingdeck and crossarm buoyancy, and temporary accommodation clear of the water on canvas slings etc. is easily arranged. Ventilation through toilet or sink outlets should suffice—a family survived some hours in the *WANDERER* which capsized, the only ventilation being through the toilet; the wingdecks were foam-filled (Jan van der Vusse's 35 ft. *TANGARA*, in February 1968 in Barnes Bay, near Hobart. ED.). Despite this, one would have to be stupid not to take a life raft as there is always the possibility of fire or damage beyond habitability.

3. The major danger in a well-designed multihull is collision. Whales are not that rare. In the 1967/68 Sydney-Hobart Race *ZILVERGEEST* struck a whale but was not damaged (regarding *BANDERSNATCH*, I feel a lightly constructed monohull of similar conditions would have been holed and sunk. However, a heavily constructed steel or aluminium alloy monohull would have survived*). This year a 45 ft. plywood keeler sailing from New Zealand to Sydney for the Hobart Race, was sunk by a whale. The crew spent five days in a life raft. In the race, *ONDINE II* was surrounded by a pack of whales on the way to Hobart and ran her generator to scare them off. *NORLA* struck a whale off Eden but was undamaged. Apart from whales there is plenty of flotsam around, large enough to make a mess of a light multihull travelling at 10 knots plus.

And one other thought, this time regarding "man overboard". Flashing-light 'Dan Buoys' should have the light mounted on top of the pole, not down on the float as at present. We made 19 knots for a while in the New York—Bermuda Race, and had a man fallen overboard it would have been quite a distance before she could be turned back—probably 15 mins. if the spinnaker were up, i.e. about 4 miles.

* Mr. Crowther gave this opinion in answer to our question.—ED.

A CAPSIZE SURVIVAL DRILL

by Walton H. Cullen, P.C. Maryborough, Queensland, Australia

Mr. Cullen himself an ex-keelboat man, has been helping to fit out a tri going overseas in the manner suggested here.

Trimarans equipped with survival gear usually carry the same kind as keel boats which is of little use in a capsize situation. Crews seem to rely on the unsinkability of a trimaran but panic keeps them from staying inside the upturned craft: *what is needed most in any survival situation is a workable survival plan that will eliminate panic.*

Here then is a *capsize survival drill* worked out through actual experiments which would ensure the survival of every crew member who adheres to it.

The equipment required is very simple: two eye bolts, one at the main hatch and the other at the stern in a position where it will be above the water when the boat is inverted, with a line fastened to both. And, of course, a suitable inflatable life raft.

In the event of a capsize one man is sent out to launch the life raft, fastening it to the stern eye bolt—the boat acting as a sea anchor. This done he raps on the hull to let those inside know that everything is ready, whereupon they follow him to the life raft, one at a time, along the line leading from main hatch to raft. When conditions improve they can return to the upturned craft to replenish provisions and start transmitting distress signals. On the basis of some experiments I have carried out, I would suggest that the radio carried be an ex-British-Navy dinghy SOS or similar transmitter—the average marine R.T. set carried on yachts is of little use in situations like this.

MULTIHULL CAPSIZES

by W. R. Mehaffey, PE, NA, SSCD, AYRS Oak Park, Illinois, USA

The author, a naval architect, is President of the Society of Small Craft Designers, and has been an American Vice President of the AYRS for years. His well balanced contribution bears the stamp of the highly competent professional.

The public and press seem surprised at the recent epidemic of catamaran and trimaran capsizes. This is indeed amazing. These types have been with us for centuries and represent the maximum limit of stability of form. All competent naval architects understand the characteristics of these types within the limits of classical naval architecture. The multihull has been tried at various times by both naval architects and promoters and also by enthusiastic amateurs. Its speed potential is without question and it is now accepted as a day sailer whose stability is controlled by live ballast, as in a wide variety of centerboard monohull day sailers.

As a sea-going cruising yacht where live ballast is of little use, the multihull is still an experimental type. Its speed potential over extended distances is unquestioned. Properly designed by a competent naval architect, the structure will stand the stresses encountered at sea and the amazing abuse during hauling.

The high initial stability is very undesirable as it causes loss of the much sought and seldom achieved description 'seakindly'. Only under the bias of a sail plan will the motion be satisfactory. In periods of short chop and no wind the motion is objectionable.

In spite of claims by promoters, but never by naval architects, the usable cabin and stowage space is small considering both size and beam. A monohull of similar size would contain more usable space.

To a new boat owner the small heel is very attractive but this small heel during moderate winds represents a major portion of the usable positive slope region of the stability curve and margin for error is very low. A famous designer of clippers once said when asked if a clipper was safe: "For every ship there is its own private Nemesis". For the multihull, the sudden gust of steep waveform such as a line squall represents the nemesis with which it cannot cope unaided. The suddenly applied heeling moment of several times the maximum righting moment carries the heel angle rapidly beyond the peak of the stability curve and the rate of change of righting moment with heel angle is negative beyond this peak, so a capsize is inevitable.

Automatic sheet releases and similar devices are of little use in such gusts because the momentum created by the gust will carry the multihull over even though the sheet is released.

At this point I would like to comment on masthead floats. The additional windage well aloft helps to cause a capsize. In addition, if a capsize occurs at sea, a 180° capsize results in a stable platform with hulls filled with trapped air so she floats high. The exposed shape is well suited to taking punishment from breaking waves. If a masthead float is used, much of the trapped air will be lost and the crew will find the portion of the hull above water a mighty poor platform to keep them dry, and help to survival. The author survived a capsize for $34\frac{1}{2}$ hours during storm conditions—with a 180° capsize.

It is absolutely essential that strong nylon lines be permanently attached to pad eyes at both ends of the bottom of the bridge deck so you won't be washed off by waves. Additional pad eyes should be provided on the hull bottom amidships. A locker with a cargo hatch cover, which can be opened from the bottom of the bridge deck, should be provided with emergency rations, water, flares, and a portable radio transmitter. The dog-down for this hatch must not require tools to open.

A small tarpaulin with strong sewed-in grommets and lines attached to fit hull bottom pad eyes is essential to provide protection from the sun. Of course, blankets, dry clothing, first-aid kit, tools, binoculars, etc. will help to survive. All items in an emergency locker must be lashed to avoid damage during a capsize. Since it would be difficult to load this locker from under the deck, a top port will be needed for loading, but it must have a well secured airtight cover at sea.

I have discussed the gust problem because this is the condition that has caused trouble for large cats and trimarans; it should not be inferred that catamarans cannot stand strong steady winds. With proper adjustment of sail area they behave extremely well under these conditions. The ketch rig is particularly desirable because of flexibility of sail choice while maintaining balance. Under these conditions the limited—range stability curve is not a serious limitation. Small gusts are taken care of by an idler block tied to a heavy shock cord. This automatically lets out the mainsheet in a gust and takes it up when the gust is over. Although this is adequate for normal gusts that occur in the wind structure it is worthless for a line squall, or for a tornado.

Some multihull promoters have stressed the point that a cat or trimaran is well suited for an inexperienced sailor. I completely disagree. The multihull cruiser requires that the skipper shall be very experienced and eternally alert to wind and sea conditions. A man with several years' sailing of capsizable centerboard boats will have less trouble than a monohull keelboat skipper.

The big problem in a multihull boat for long-distance cruising is that the best skipper eventually reaches a state of exhaustion where he is no longer alert. It is during these periods that capsizes are most apt to happen. It is for this reason that I have recently discouraged several groups of youngsters from buying a cat or trimaran for world cruising, although I would have enjoyed designing the multihull boats.

In the last few years promoters of multihull boats have sailed them over many oceans on the theory that if you sail them enough, people will agree that they are completely seaworthy under all conditions and the wide publicity will convince the public that naval architects and race committee members are idiots. Some have had a guardian angel—others have been lost at sea. The situation is somewhat like the glorious age of the clipper ship. They could be capsized but professional skippers were remarkably good at avoiding this mishap, although many were lost. *No amount of lucky passages will ever change the fact that a multihull can capsize nor that a ballasted monohull can fill with water and sink.*

The monohull is however more tolerant of the bad seamanship of a tired or exhausted crew. The author has just learned of the apparent loss of Arthur Piver, a trimaran pioneer, on a solo passage from San Francisco to San Diego to qualify for the Singlehanded Transatlantic Race. He was a gallant sailor with great enthusiasm and confidence in the multihull. He also had outstanding talent for writing books about his many voyages in trimarans.

In closing, we should consider the multihull in the same light as a centerboard monohull, in that it can be capsized; with alert active crews the probability of a capsize is not great except in extreme gust conditions.

There are many thousands of capsizable centerboard boats used throughout the world with few fatal accidents. They are, however, mainly used for inshore work and only rarely as offshore racers.

The multihull ocean racers or cruiser must be considered in the experimental phase until we can learn to minimize the danger of a gust capsize.

TOWARDS STAYING UPRIGHT—BUT IF SHE DID GO OVER NOW . . .

by Jim Andrews, AYRS Craigavad, Northern Ireland

This contribution arrived just in time to beat the deadline (not the original one but the deadline after the deadline). The Andrews' had been away cruising in their *TWINTAIL* and have only just got back—in the midst of the 'Irish Troubles' (should this perhaps be counted as a new multihull hazard???).

Referring to his (earlier) contribution "IF SHE DID GO OVER NOW . . . " he writes: ". . . it seems to me to be bolting the stable door after the horse had fled—to worry too much about what to do when badly designed craft are allowed to continue going over, when—I at least am quite certain—catamarans anyway could have the horrors of inversion virtually 'designed out' of them."

Towards staying upright

Up to the time of writing it seems that most cruising multihulls have been designed for one of two purposes: speed and thrills which you can live with if skilled and lucky, or comfort and accommodation where performance is not of importance. A number of well-known designs fall between these two stools, but compromise is, I am now convinced, NOT the answer for a true safety-with-performance craft.

Surely the time is ripe for a concerted effort by designers to produce multihulls which are *utterly unlikely* to capsize, and which will, by themselves and without gadgets or assistance, recover from a heel angle of at least 100°

To my mind this can be done (un-crankily)—some rough models I've made certainly suggest it—not by destroying performance with weights and things, but merely by giving the vessel *the right shape* to start with.

Most capsizes have happened as a result of sail- (and sometimes sea-) pressures depressing the lee bow. Surely the ends should be *balanced* and far more reserve buoyancy provided to bows immediately above the load waterline than is usual today? I feel, too, that many designs are encouraged to dig their bows in because their rudders are hung on 'trailing transoms' instead of in a heel-forward attitude—thus creating a disastrous tail lift when the helm is applied to correct the broaching effect of already partly depressed bows.

With long shallow hulls, any pitch effect is bound to shift centres of lateral resistance by a very considerable amount; therefore everything should be done to minimise sail-pressure induced fore-and-aft trim. To this end it looks as if large-area/low-aspect-ratio rigs might be more practical than the more close-winded tall things. In practice anyhow, most multis have to be driven hard to make really good windward progress—and one can drive a lot harder with big sails low down than with high thin ones which spend much effort trying to blow one over.

Should the worst occur, say in a freak sea, the boat (I can only apply this to catamarans) should be designed with all weights including engine *retainably* low down, and with possibly exaggerated maximum beam high up (possibly as carried-out topsides or cabin tops above the sheerline), and with really strongly stayed masthead flotation.

A further thought would be hollow, *water-filled* low-aspect-ratio long keels, which would weigh little immersed, but be most effective ballast when exposed to fresh air.

If she did go over now . . .

With my Prout *Ranger* 27 a capsize seems relatively unlikely in the sort of coastal sailing we do. Nevertheless she *is* fitted with a masthead float (even though it has been said that the extra weight and windage aloft of such a device could be a factor in bringing about a capsize).

Still, the mast *could* get broken . . . So let us suppose that we managed to invert *TWINTAIL*. In coastal waters we would then reach for the flares and emergency transmitter and go and sit on top until somebody arrived, I suppose. Some form of handhold and/or ringbolts for the clips of personal life lines would be desirable if it were rough. *TWINTAIL* would not be too bad in that respect even as she stands. If it were cold, I am sure it would not be at all impossible to rig some sort of a tent, using a sail and a boat hook or ensign staff; one would not have to go far for the latter.

But if we were well offshore, and wanted to stay 'below', then I think we would have to play it more or less by ear, depending on how much water she had taken. In *TWINTAIL* there would be quite a lot unless the cabin doors had been shut in time. Windows, too. She would still float, of course, because of her built-in buoyancy. But it would be damp, and what air there was would sooner or later be 'breathed out' and become lethal. I think we should attempt to get out 'on deck' as soon as possible, and preferably camp out in the life raft. The important thing there is that it must be possible to get at one's life raft when the boat is upside down—either through a bridge-deck locker which opens top and bottom, or some other way. The raft could then be lashed down between the sheltering hulls—again, assuming that there was something to lash it to. Or, if conditions were too nasty, it could be launched and made fast to the craft so that it would stream comfortably in the slick to leeward, the parent vessel acting as an expensive but, I would think, rather good sea anchor. One could go swimming for such stores as were needed whenever the weather brightened up. Drinking water might be hard to get at but there is a lot of juice in tinned food—a point against dried packets.

Of course, if a boat were *designed* to be habitable when upside down, I don't see why there should be many problems.

The above remarks are pretty well my stock answer to sceptics who insist that sooner or later *all* multihulls are bound to capsize, and then what, etc. Certainly there is no harm to have some plan pre-developed and shared with one's crew, but in my own view this is looking at the problem of multihull safety from completely the wrong end.

The *really* important thing now is to try and get everyone capable of designing a sea-going multihull to work towards producing a practical *shape* of boat that will, without any gadgetry recover from any kind of knockdown at once and without assistance even from those on board, and secondly a final shape which in itself does every thing to prevent inversion from even beginning to occur. *Then* we'll have got somewhere!

THINKING TOWARDS SELF-RIGHTING MULTIHULLS

by Fred Benyon-Tinker, AYRS Brixham, England

By comparison with the conventional ballasted monohull, multihulls in general suffer from the simple fact that they do not possess the power of *automatic* recovery in the event of a knockdown or complete inversion. It is true, though, that this very advantage of the ballasted vessel is frequently accompanied by the equally great drawback of foundering if more than a limited amount of water gets below, an argument often put forward in extenuation of the multihull's shortcomings of not being self-righting. Whilst a non-sink characteristic is undoubtedly of great importance in any boat and especially so in a long-range cruising boat, my own view is that the multihull cannot be considered as safe in this latter role until it incorporates the power of righting itself *unaided by the crew*

Over recent months many ideas have been put forward in attempts to resolve this present *inherent* defect in the genus multihull. They range from stressing the need for a high level of competent seamanship to a whole host of suggestions involving sinking one float, detaching bits of the boat or hauling the masthead to the surface by means of the inflatable dinghy. It seems to me that this kind of reasoning is simply evading the issue. If a cruising multihull is overturned it is almost certain that the conditions will be such that the crew are rather unlikely to retain the necessary physical ability to meet the strenous demands of the moment. Any recovery procedures which are essentially based on the crew's ability to carry put prodigious exertions under possibly prolongued gale conditions in open water are highly likely to be impossible to execute—because of sickness, injury, or fatigue. It is this line of reasoning which has prompted the suggestions put forward here in an attempt to meet the need for completely automatic righting entirely independent of the crew: *self*-righting.

Before presenting these suggestions in detail, it is necessary to consider the nature of the problem and to establish certain definitions. Multihulls can be divided into two classes:

(1) those which have sufficient buoyancy in a float to support the weight of the whole boat,

and

(2) those in which the float displacement is less than that of the entire boat.

In the former case the action of righting from an inverted position will require the boat to be revolved about a float which is on the surface, and this will inevitably need a great deal of power. There is also a considerable windage problem under some conditions. In the latter case one float will have to be moved through the water, revolving around another float or hull which is the one on the surface. In this case it is self-evident that the power requirements will be a great deal less, as will be the windage problem.

Generally, it can be said that the catamaran type comes within the first category whilst the trimaran type will come within the second. This is, of course, not wholly true since there are many trimarans in which float buoyancy is such that from a righting aspect they must be classed with the catamaran group. Similarly, a catamaran with low buoyancy floats, as suggested by Julian Allen amongst others, would in this respect fall into the trimaran category. The above definitions will be adopted, however, for the purposes of this article.

There is one other point on which comment seems to be desirable. It is commonly assumed that a boat will be overturned as a result of wind action, and whilst this is frequently so, vessels can equally well be capsized by wave action, possibly under relatively light wind conditions (as was Tom Corkill's *CLIPPER I.* EDITOR).

Taking the case of the trimaran first (Category 2), it is now suggested that a suitably-housed inflatable buoyancy chamber is fitted at the masthead which is ejected and inflated from an air storage cylinder. The operation of this device would be controlled by a valve actuated by a dampened pendulum system. It is not desirable that this system should be brought into operation before the masthead is well down in the water; the precise angle will be determined mainly by beam and mast height. The reason for delaying the inflation point is simply that if masthead buoyancy were to be inflated at the moment when the mast hits the water there would be considerable risk of its being torn off, or of damage to the mast itself as it might travel at a fair speed. With the masthead well down in the water, however, the drag would quickly reduce speed of movement to a safe value.

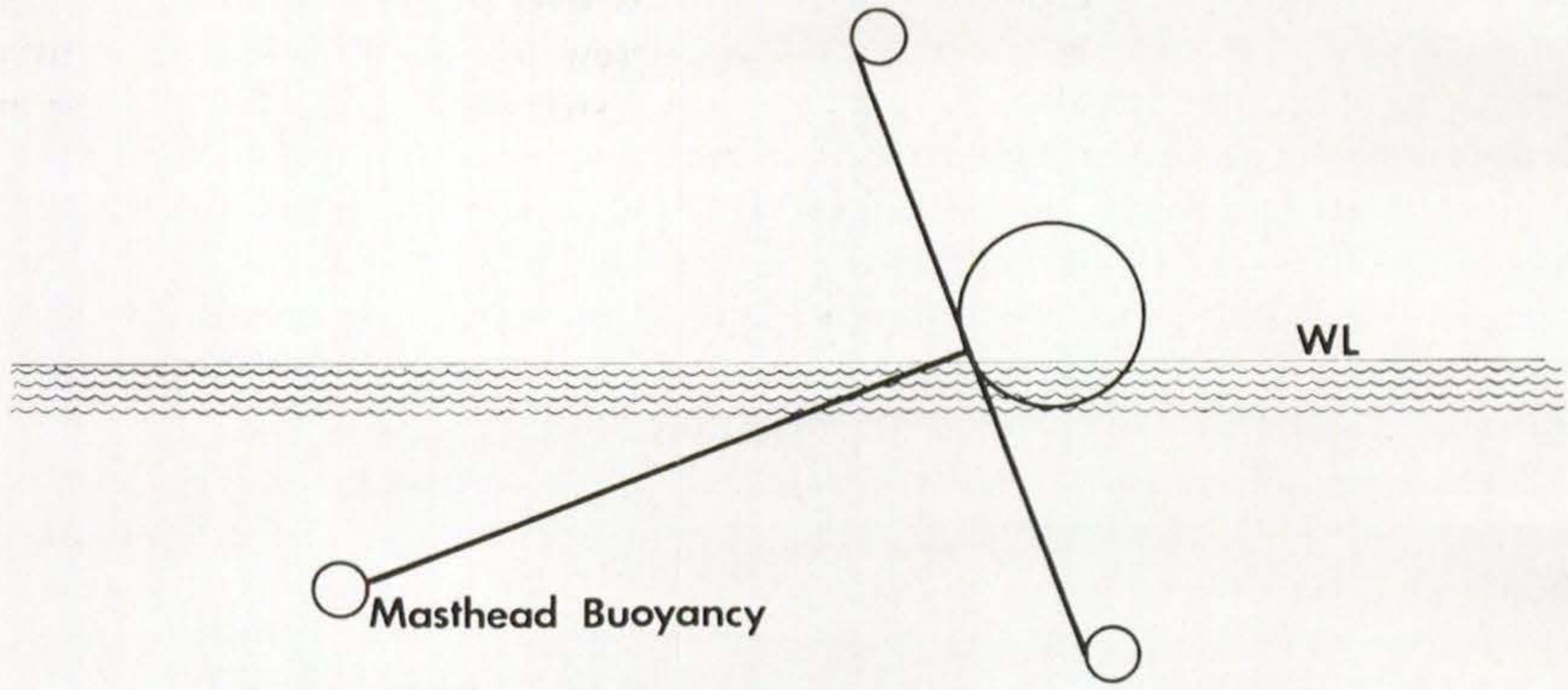


Fig. 1

Fig. 1 shows the position when masthead buoyancy starts to operate. Under most conditions this arrangement would be adequate to prevent complete inversion and to restore the boat to a position of masthead afloat, as shown in Fig. 2.

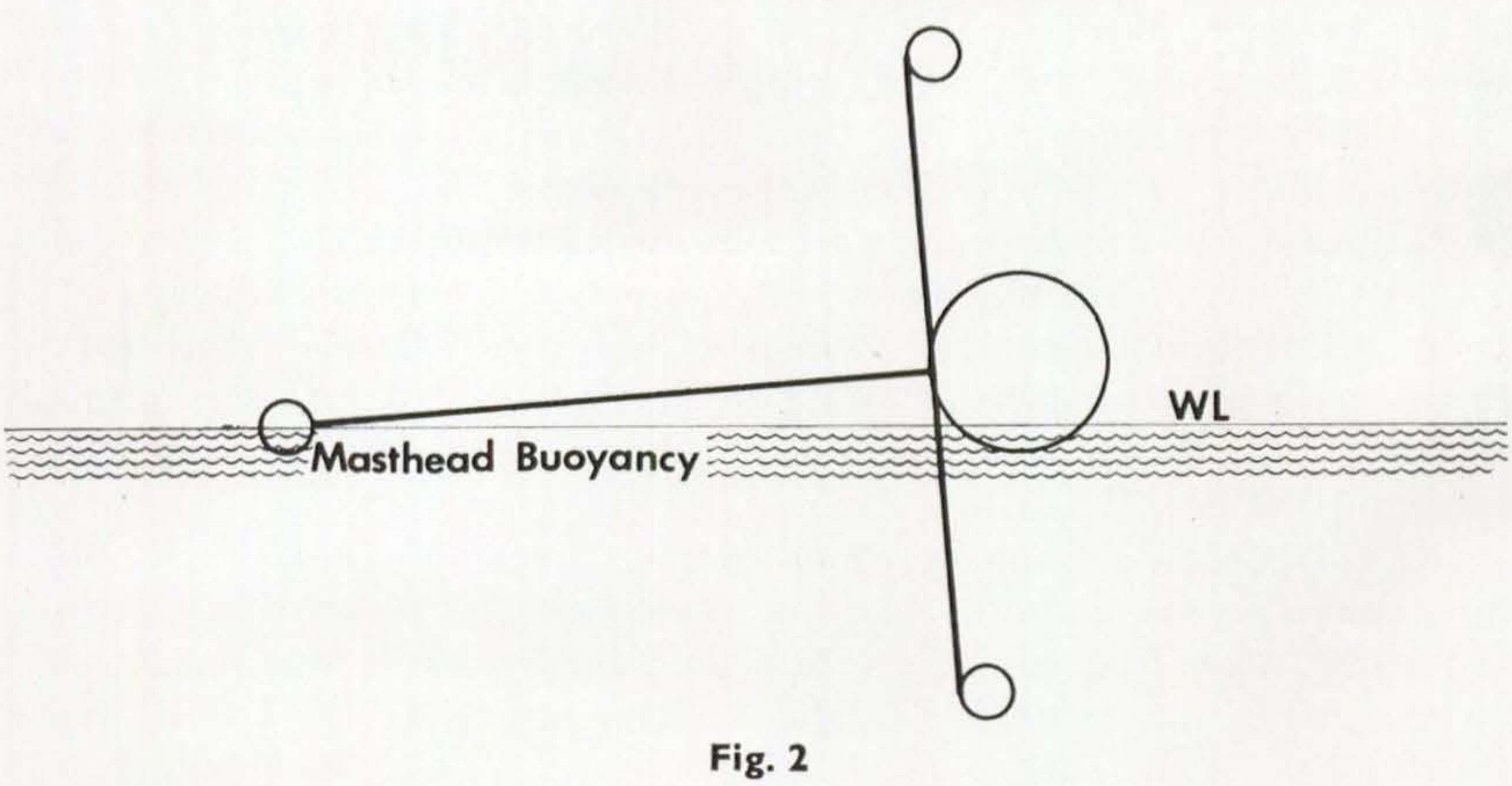


Fig. 2

What further action would be required to bring about complete recovery depends a great deal on the design of the boat. If, for instance, the disposition of the combined centres of buoyancy of the immersed float and of the connecting wing structure were sufficiently offset in relation to the centre of gravity of the main hull acting through its own centre of buoyancy then a righting couple would exist which should bring about a complete recovery, as in Fig. 3.

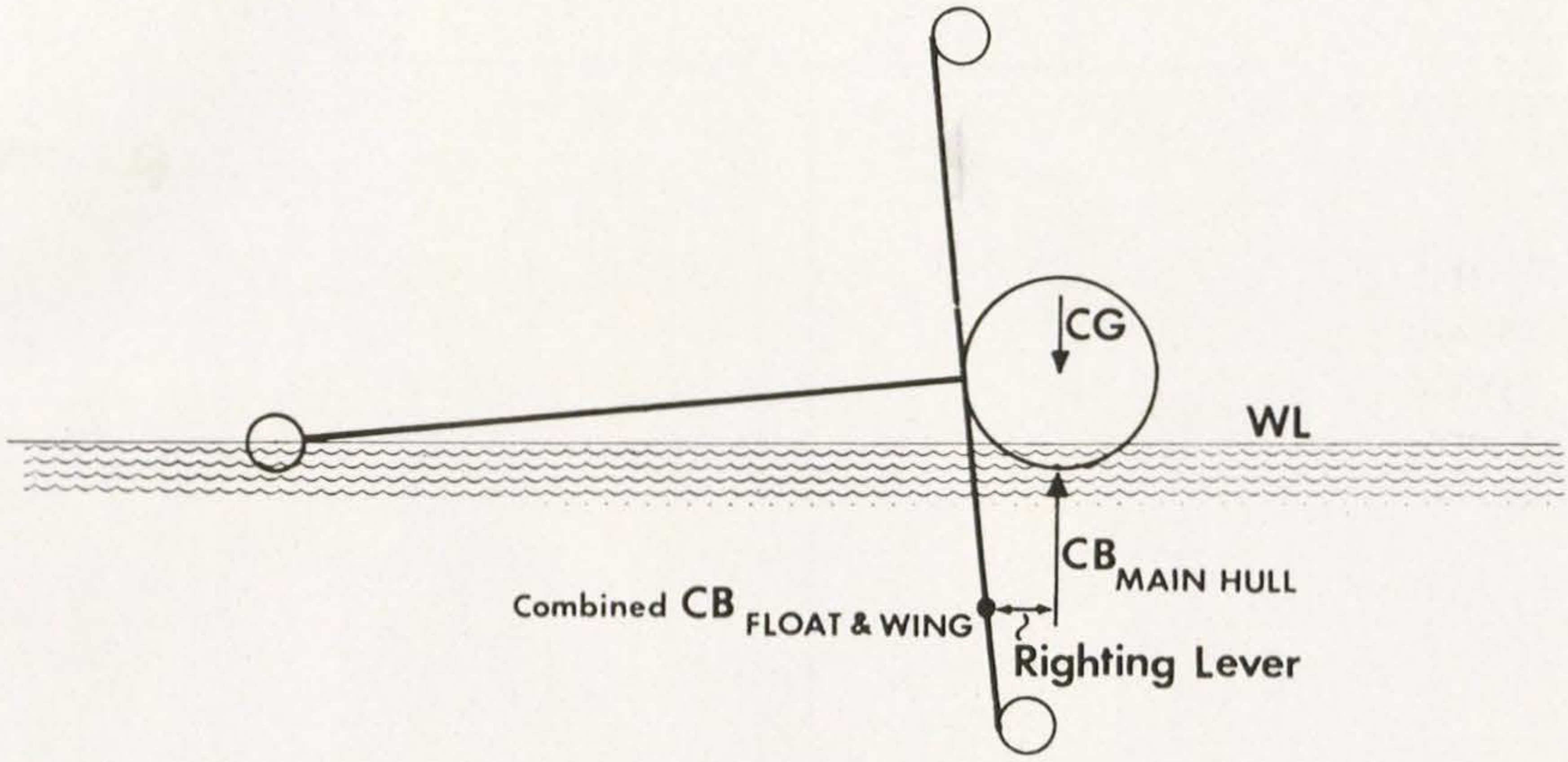


Fig. 3

It is, however, probable that this positive righting moment would be fairly marginal and possible wind pressures might well be sufficient to nullify it The second stage of the recovery sequence calls for the incorporation in each float, or at a suitable point in the wing, of a further inflatable buoyancy chamber, supplied from the same storage chamber of compressed air but controlled so that it will not come into operation until the masthead-afloat attitude had been attained. This delayed-action operation of the secondary stage is important, and its position and buoyancy would need to be worked out carefully to ensure that it would not have an effect opposite to the one desired.

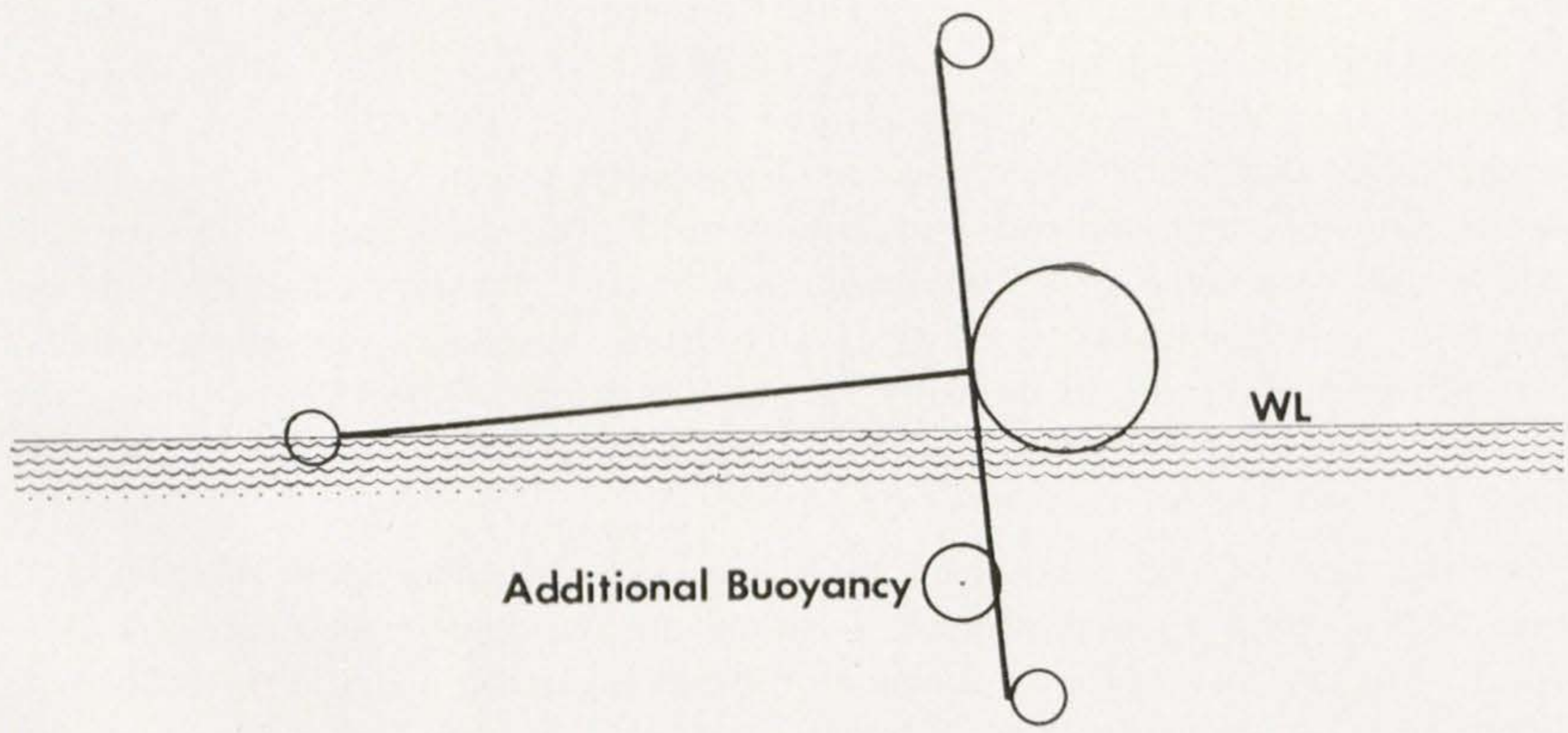
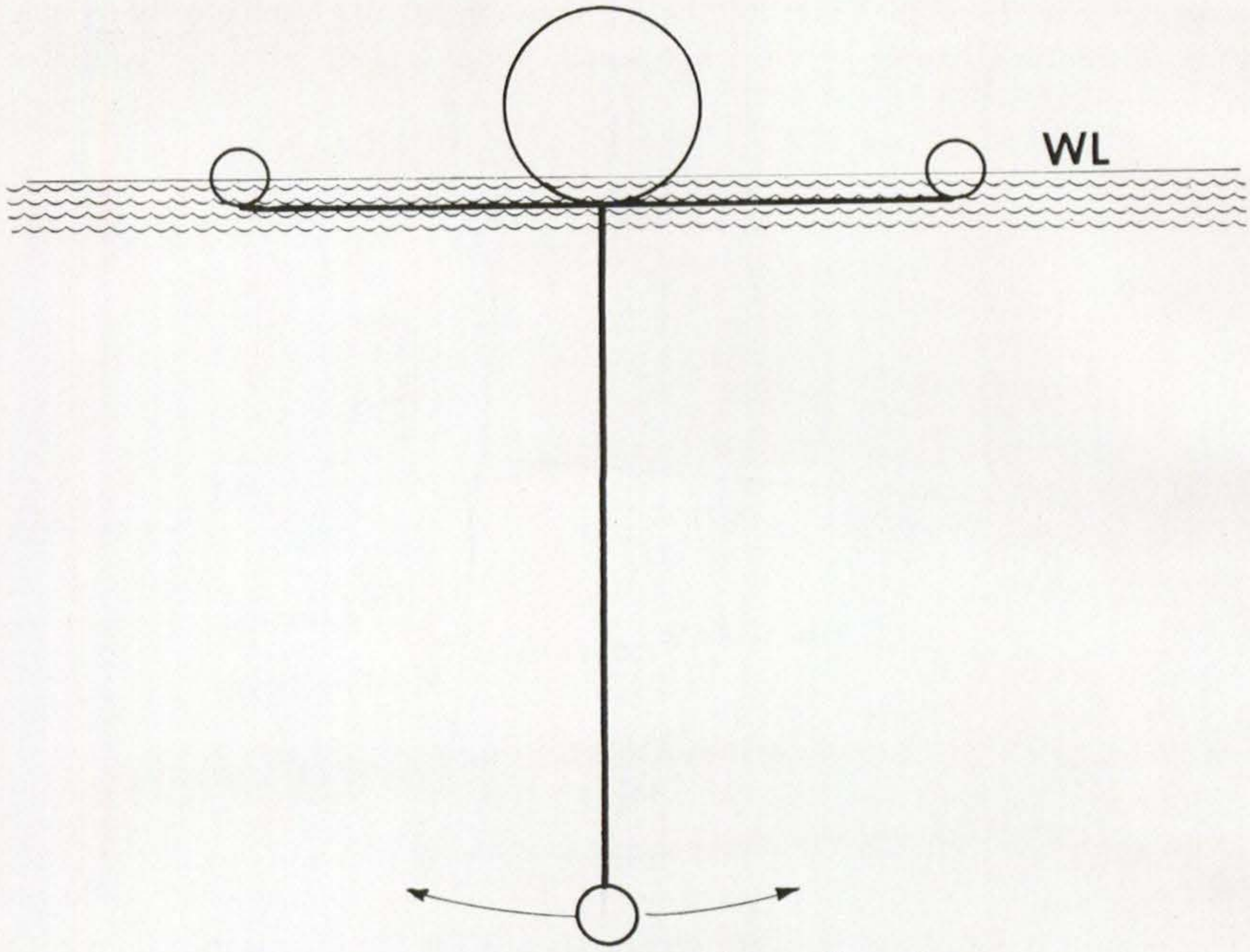


Fig. 4

In the event of a complete inversion one would have a position in which the boat was completely upside down and with the masthead buoyancy inflated as shown in Fig. 5.



Movement in either direction produces Righting Couple

Fig. 5

The normal movement of the sea would be adequate to bring about enough sideways displacement of the masthead to bring it to the surface. To achieve this, it is evident that the system must provide enough power to overcome the buoyancy of whichever float has to be submerged. This would be a matter of checking the moments of the two systems involved, and also of ensuring that the mast and its supporting rigging were of adequate strength. It is conceivable that with some designs, especially those having considerable beam, the normal masthead buoyancy would not be enough to do the job and would thus need to be inconveniently large. In such cases it would be possible to incorporate additional masthead buoyancy as an auxiliary, brought into play only in the fully inverted position. The 180° attitude calls for the same float buoyancy control as stated previously so that it does not become operative prematurely.

In the case of the catamaran type (Category 1), provision of masthead buoyancy similar to that already outlined and operating in a like manner, would go far towards preventing complete inversion after a knockdown. From then on, however, the problem becomes very different. Fig. 6 shows the attitude attained in the masthead afloat position.

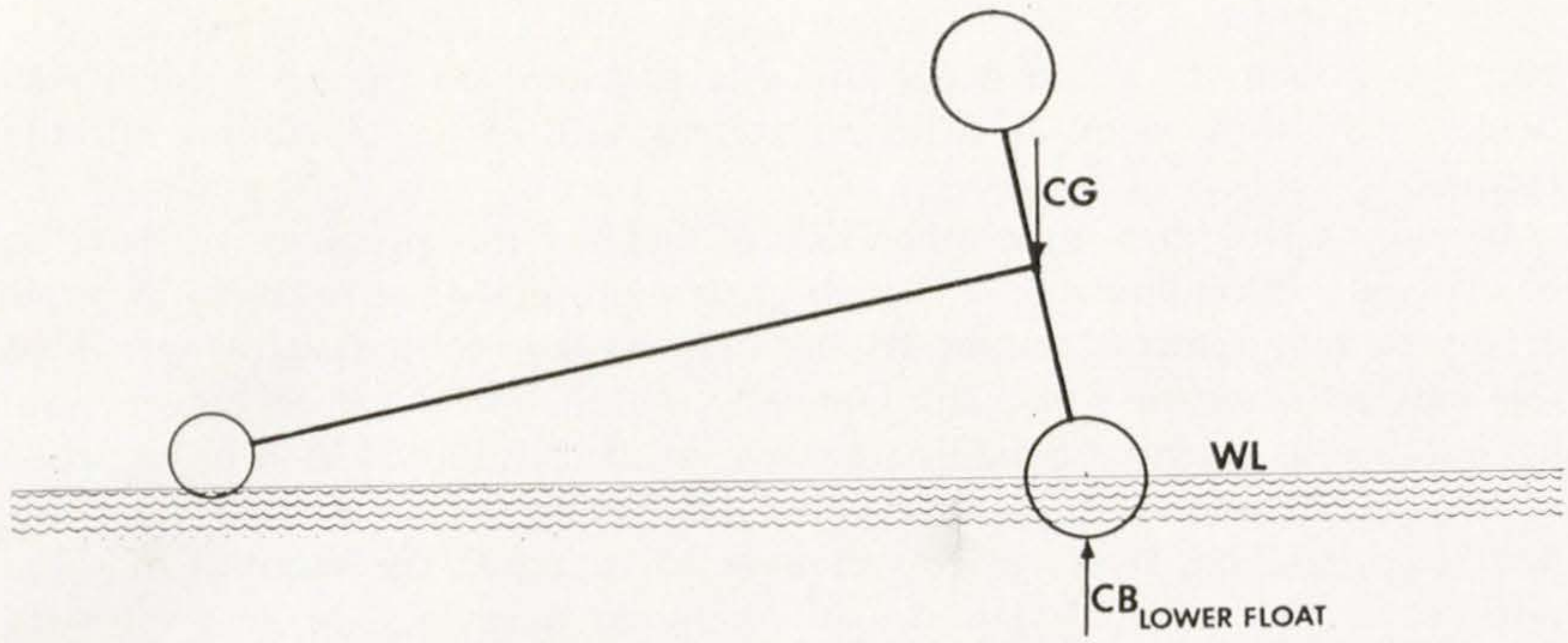


Fig. 6

It is evident that the angle will be considerably greater than is the case with the trimaran type. The disposition of the centre of buoyancy of the float on the surface relative to the centre of gravity of the boat is such that there is no righting couple. The only thing preventing complete inversion is the masthead float. The problem now becomes one of altering the attitude so that the centre of gravity will fall sufficiently outside the centre of buoyancy of the float in order to provide the necessary righting lever. There is no point at all in adding buoyancy to the float as in the case of the trimaran type since this will simply increase the difficulty.

One possible method might be to arrange for the length of the shrouds to be capable of alteration. If the mast were to be mounted on a ball and socket type of support, its attitude relative to its original vertical alignment would change as the lower shroud is shortened and the upper one correspondingly lengthened As the masthead, supported by its buoyancy chamber, would remain on the surface, the angle between hull and water would change. If this change were of sufficient magnitude, the centre of gravity would come to fall outside the float's centre of buoyancy, producing a positive righting lever as shown in Fig. 7.

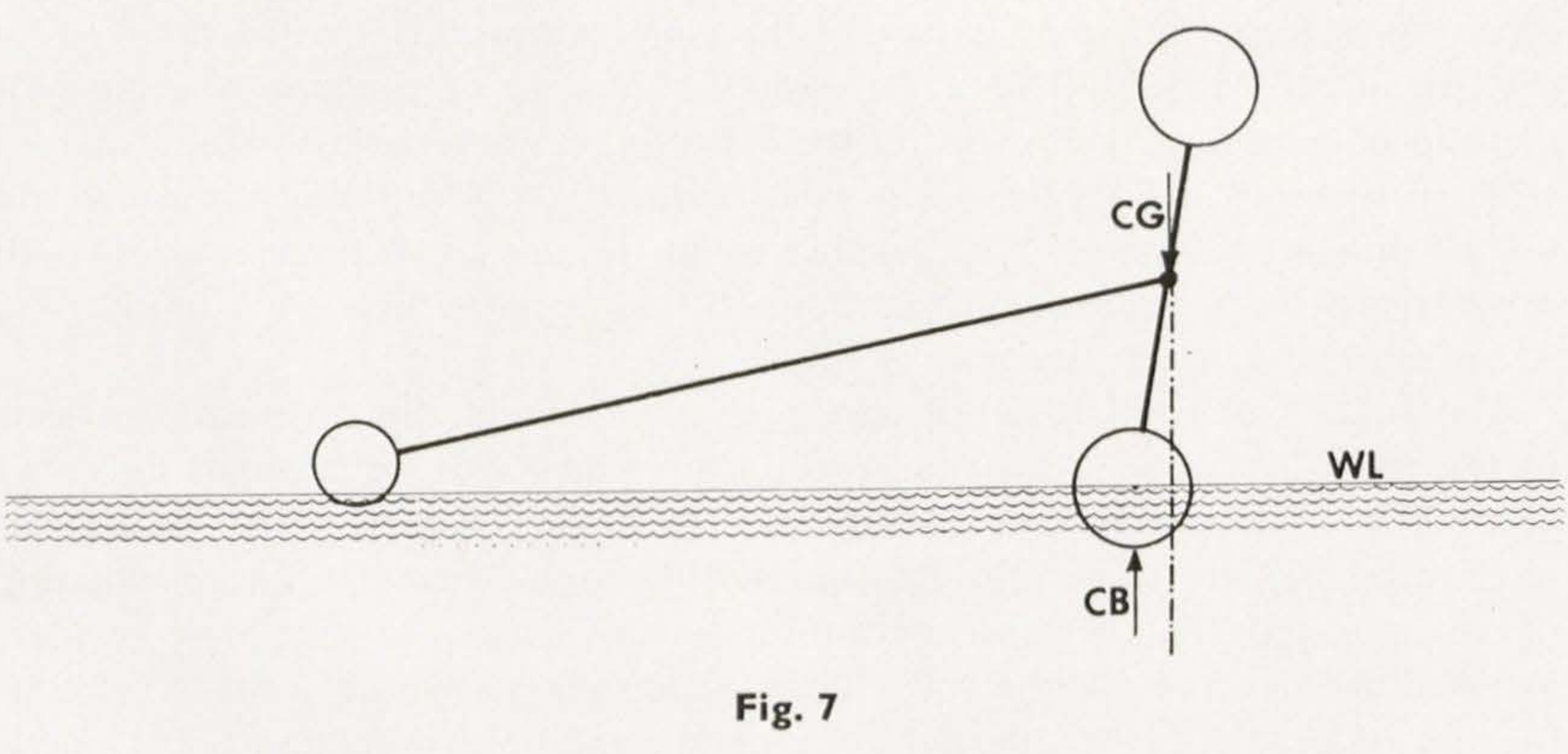


Fig. 7

There are several means whereby this system might be put into practice—for instance, by taking the lower ends of the shrouds through suitable rollers and connecting them to pneumatic rams which would need to have sufficient range of extension to alter shroud length sufficiently. Whether this is a practical possibility would depend to a large extent on the design of a particular craft, with beam, mast height, weight, and so on, all coming into the picture.

It may well be that some other way of tackling this problem will have to be evolved. Flooding a float, which greatly simplifies the problem in terms of power requirements, might be the only workable alternative—provided this can be made to work automatically and independently of crew action, for only if this essential condition can be satisfied can a solution be regarded as fully acceptable. I for one see no fundamental reason against this float-flooding approach, but a price will have to be paid: the sacrifice of some portion of the accommodation. It would be necessary to seal off such volumes in the floats as a particular design makes necessary. Accepting this, it would not be very difficult to arrange for a valve system that will open suitable ports to admit enough water to sink a float. An attitude as shown in Fig. 8 would then result.

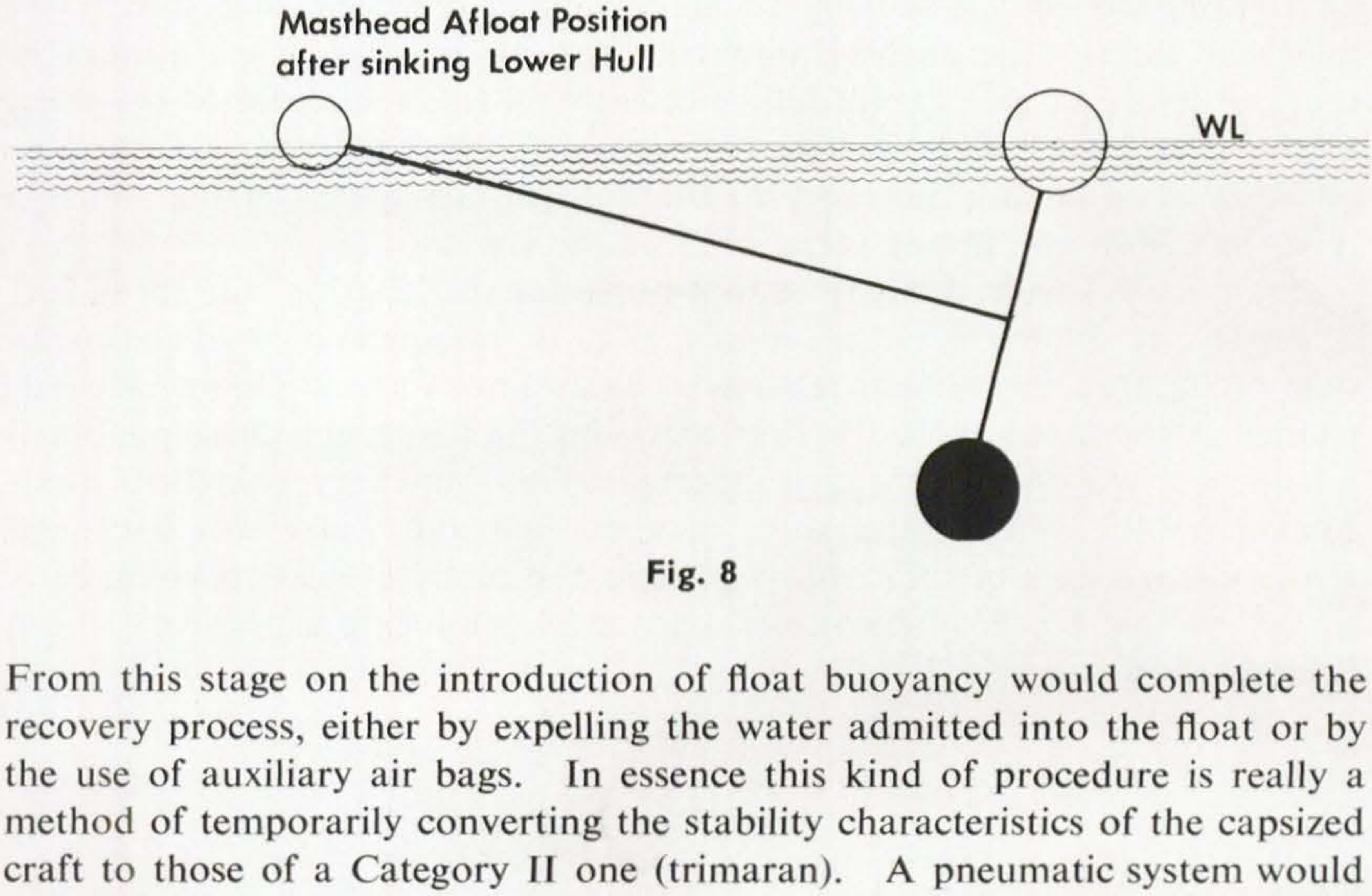


Fig. 8

From this stage on the introduction of float buoyancy would complete the recovery process, either by expelling the water admitted into the float or by the use of auxiliary air bags. In essence this kind of procedure is really a method of temporarily converting the stability characteristics of the capsized craft to those of a Category II one (trimaran). A pneumatic system would not be difficult to evolve, but, depending on the design of boat, it could well present problems regarding the amount of air needed and thus of the size of air storage cylinder needed.

The suggestions put forward here aim at replacing the physical exertions of the crew by some form of stored power which can be brought into play automatically under certain conditions. Any such system must have complete reliability, freedom from malfunction through corrosion, and be capable of being tested for correct functioning at any time. It must not rely on external fuel sources, like petrol. These requirements would seem to rule out the use of electricity or internal combustion engine power, and leave pneumatic arrangements as the only practical alternative. A wide range of components is readily available and so tailoring a suitable system does not call for specially made components which are expensive and not easily replaced.

In design and installation a considerable degree of flexibility is possible. One major advantage of any such system is that it can readily be recharged by the crew by means of suitable pumps operated manually. The same pump may be used, through appropriate valves, to retract all the inflatable buoyancy into its housings, ready for the next emergency. And the same setup can be used at any time for testing. A typical installation is illustrated schematically in Fig. 9.

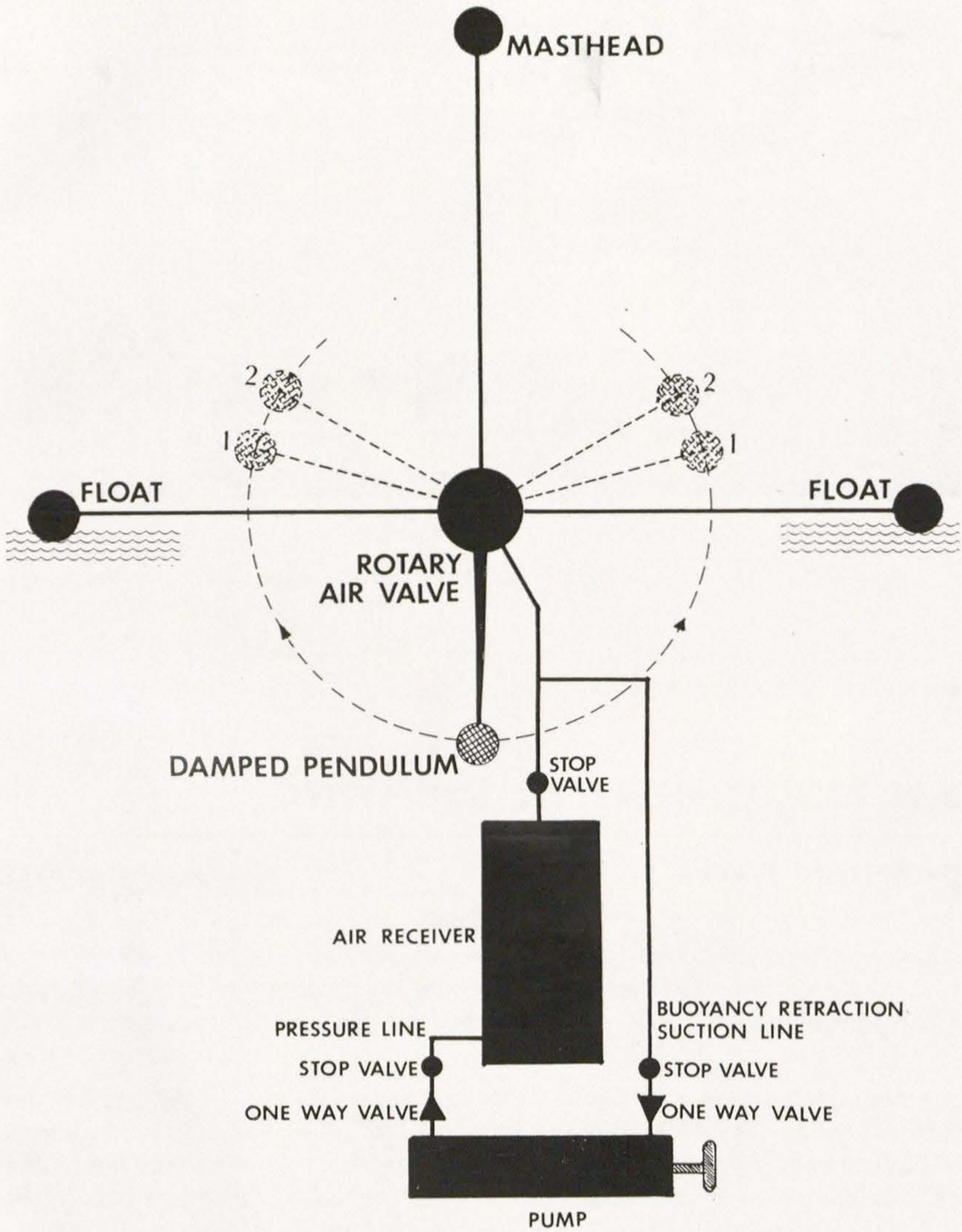


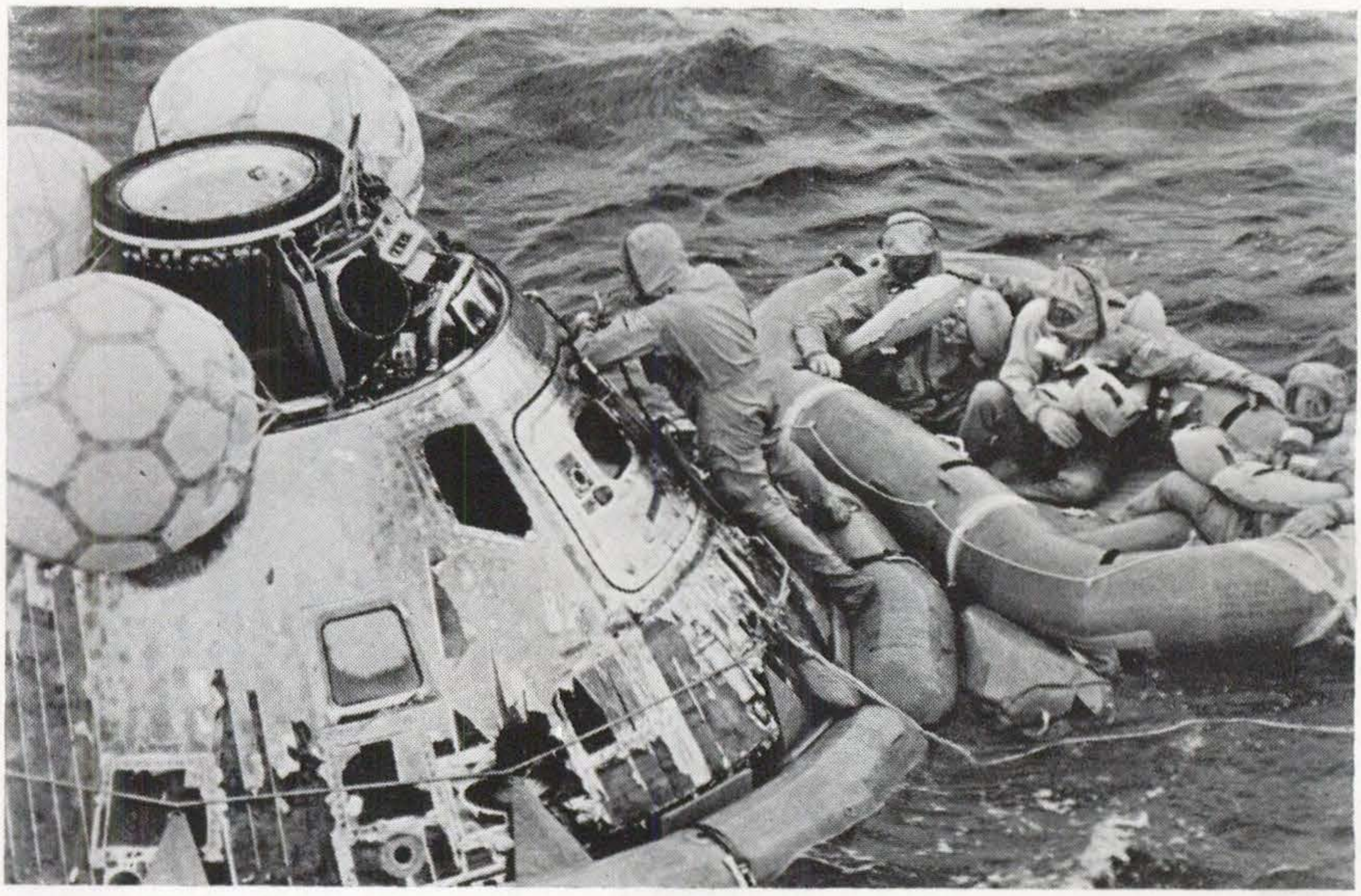
Fig. 9

Positions of pendulum for masthead inflation

1 Positions of pendulum for masthead inflation

2 Positions of pendulum for float buoyancy—operates only on return swing

It is hoped that the suggestions put forward here will *stimulate the thoughts of others* along lines that will in the end equip multihulls with the power of *recovery without aid from their crews.*



Others too have righting problems . . .

Photo from IPS (69-3066) *by courtesy of the U.S. Information Service*

(Mr. Benyon-Tinker's paper was about to be embellished by us with a somewhat whimsical cartoon in this space when this shot arrived.

AN EXPERIMENT IN RIGHTING

by Bernard Rhodes Trimaran *KLIS*, AYRS

KLIS is a 22-foot trimaran, designed, built, and owned by Bernard Rhodes, which was fully described in AYRS Publication No. 60, pp. 83-89. "*KLIS* is my dream-ship come true, and her design was made possible by close study of all information on trimarans published by the AYRS" (op. cit.).

Snugly installed at the Yacht Club de Tahiti, I began to plan my cruise further ahead. Some day I intend to tackle the Cape of Good Hope where a strong current runs sometimes against gale force winds, producing quite exceptional seas. I have been mulling over the various disasters that might befall the single-handed trimariner when AYRS Publication No. 63, "Multi-hull Capsizing", arrived in the post, and I decided that now was the time to capsize *KLIS* deliberately and test an idea I had for righting her single-handed. Now, in the calm, deep, *warm* water of the lagoon, with plenty of help and all shore facilities close at hand.

First of all my belongings were stored ashore and she was ballasted with sailbags full of stones to compensate. The water bottles were filled and placed in the floats where they are usually stowed; sails, fenders, inflatable dinghy, etc., too, were left in the floats as usual.

Then the special gear was prepared: the large 13-foot spinnaker pole (serving also as a spare main boom or jury mast) which was to be stepped in the angle between the main hull and the underside of the wing. Chocks were fitted in this angle to hold it in place. The pole was to be used as a derrick, with weights on the end—two 5-gallon water cans plus myself—and a 4-part tackle to the chainplate on the other side. 'Shrouds' led fore and aft from the end to points roughly in line with the heel completed its rigging. Then drain holes were drilled in each float and plugged with corks so that the 'lee' float could be flooded by letting the air escape.

It took seven of us to turn her over and then we had quite a struggle. She had positive stability to 90°; at this angle she was well down by the stern, I noted, due to her floats being well forward.

Once she was upside down I swam down into the cabin and found it habitable, with ventilation through the daggerboard trunks—though God knows what it would be like in a 'real' situation, with all my belongings swishing about in a soggy mass!

I then set about rigging the spinnaker pole, diving to retrieve the tackle through the aft hatch, denying myself the use of a face mask to simulate the 'real thing'; it is necessary to open one's eyes underwater which I dislike doing, and then I still cannot see clearly. After this I uncorked the 'lee' float drain hole, and tried to get the hatch cover off to fetch the water bottles. At first it would not come off, not until enough water had leaked into the float to equalize the pressure. This points to the need for hatches that are not positively watertight. Fig. 1 shows mine which work very well, even with heavy water on deck.

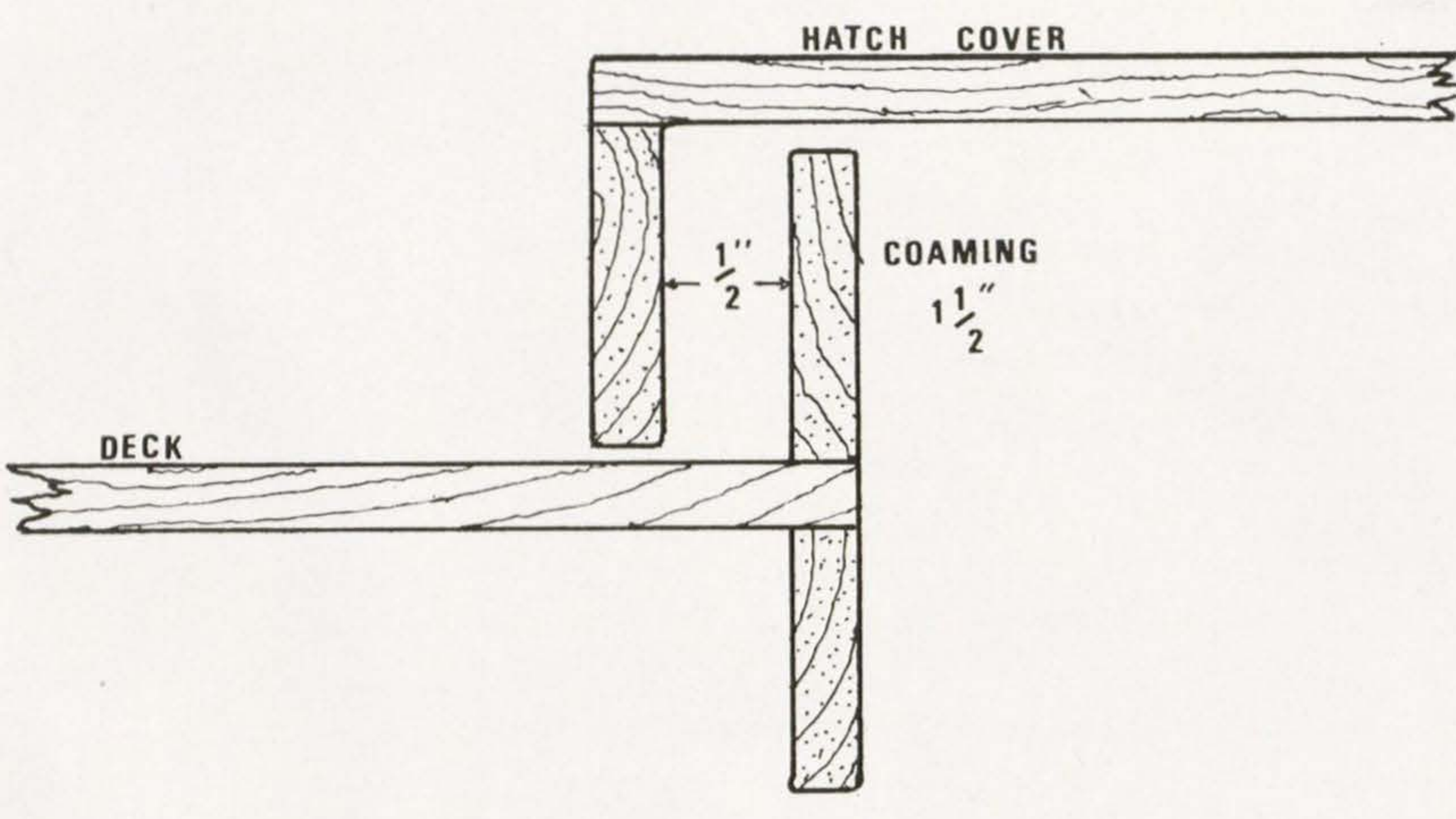


Fig. I

The alternative would be ventilators that can be opened from the outside I then had to dive up inside the float, with soggy sails clamming round my head, and search for the jerry cans—most unpleasant without a face mask, and certainly not for the claustrophobic! I attached them with a 2-part tackle to the end of the spinnaker pole which was then rigged out as shown in Fig. 2, and righting operations could begin.

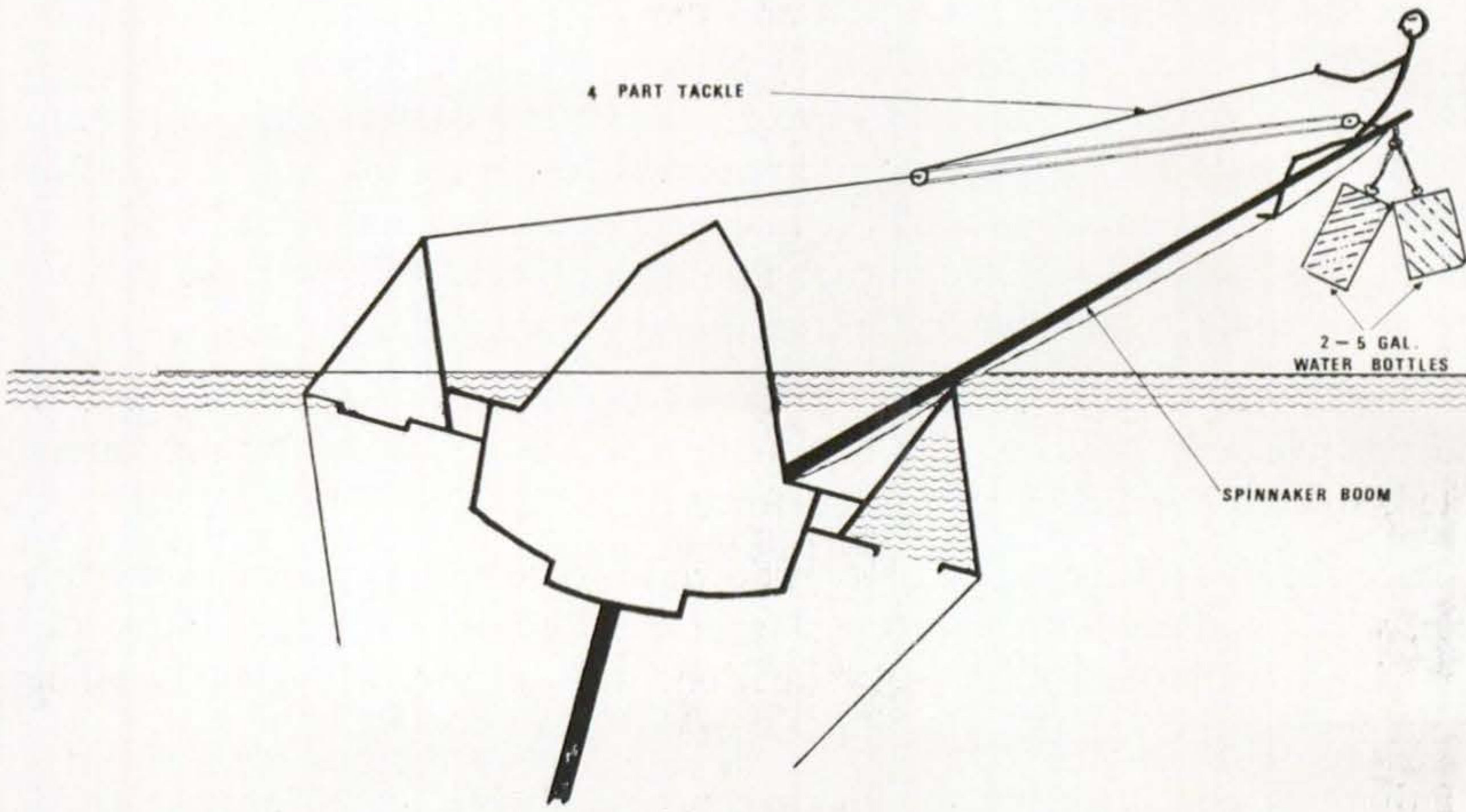
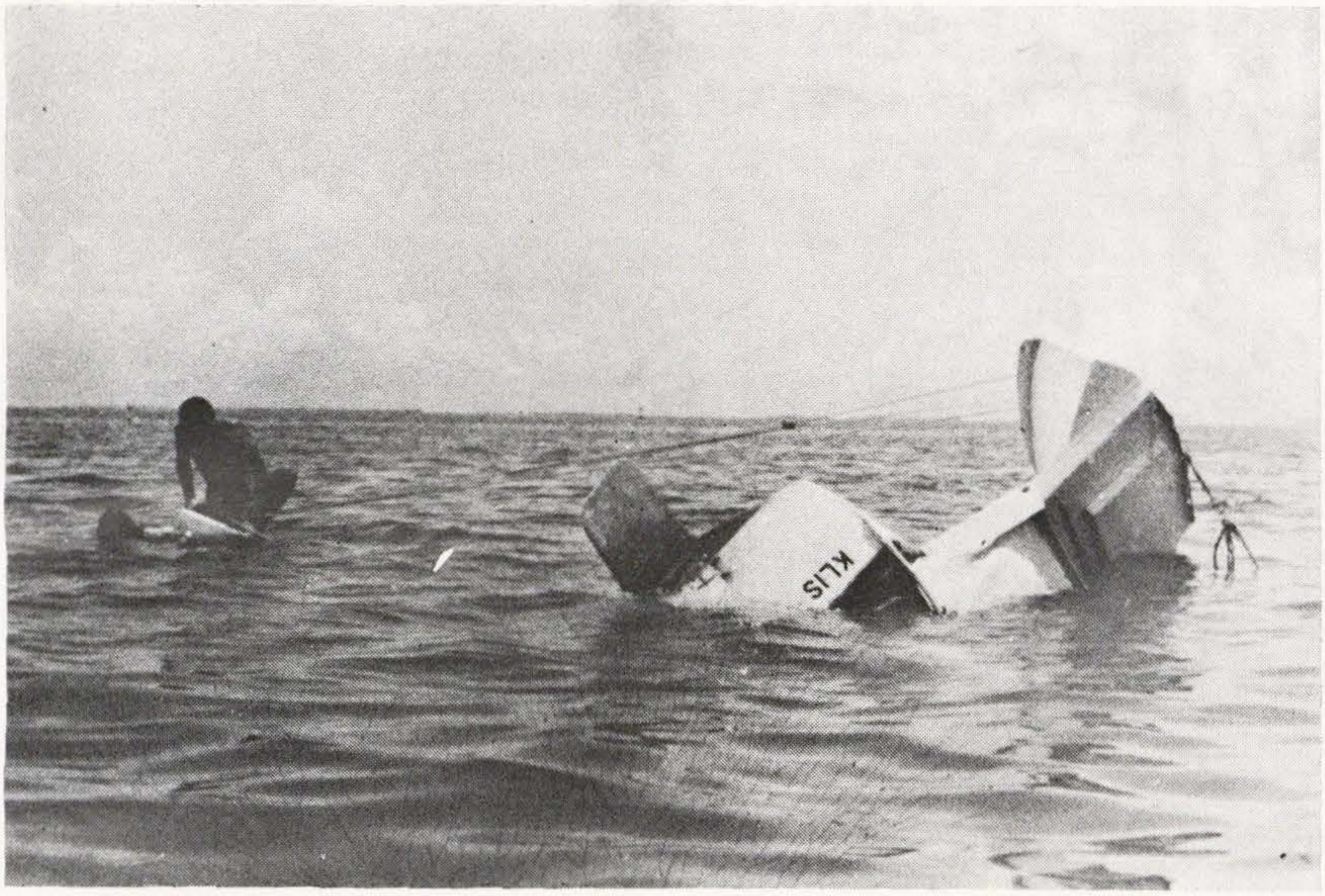


Fig. 2 Method of righting KLIS

I swarmed out to the end of the pole and sat on it with my feet on the 'shrouds' to steady myself, then hauled the jerry cans up to me and made fast. I was pleased to note that the windward float immediately lifted clear of the water. Then I began hauling on the tackle supporting the derrick but now a big snag arose: the tackle twisted round on itself and was soon useless.

Righting operations begun, the snarled-up tackle can be seen

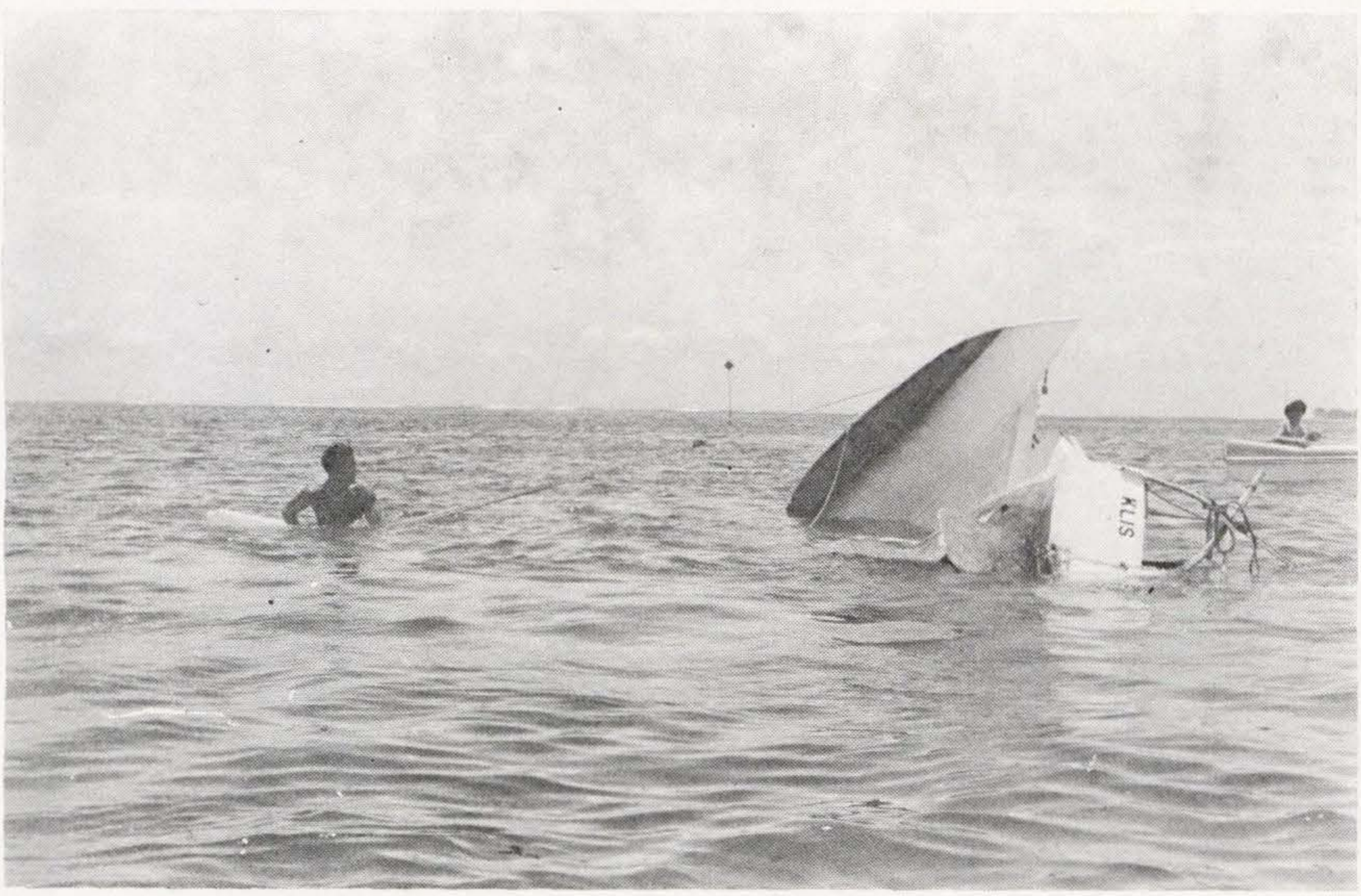
I had to rig a second line to take the weight while I sorted things out; meanwhile the windward float flopped back into the water.



Trying again

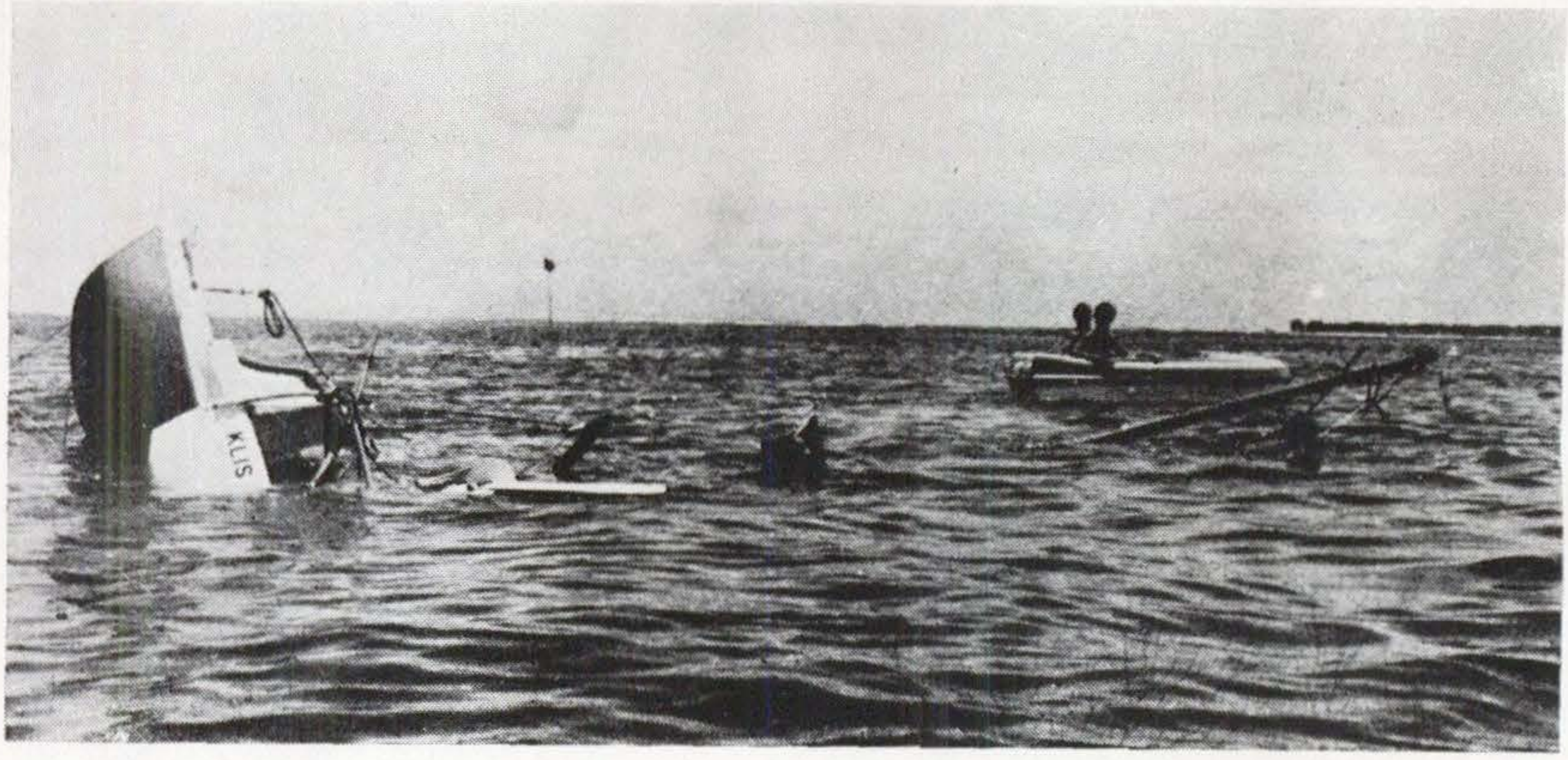
Proceeding thus, the righting to 90° was done in four stages. The windward float was by then half full of water due to the airlock having been repeatedly broken.

From about 135° to 90° she began to come quite easily.



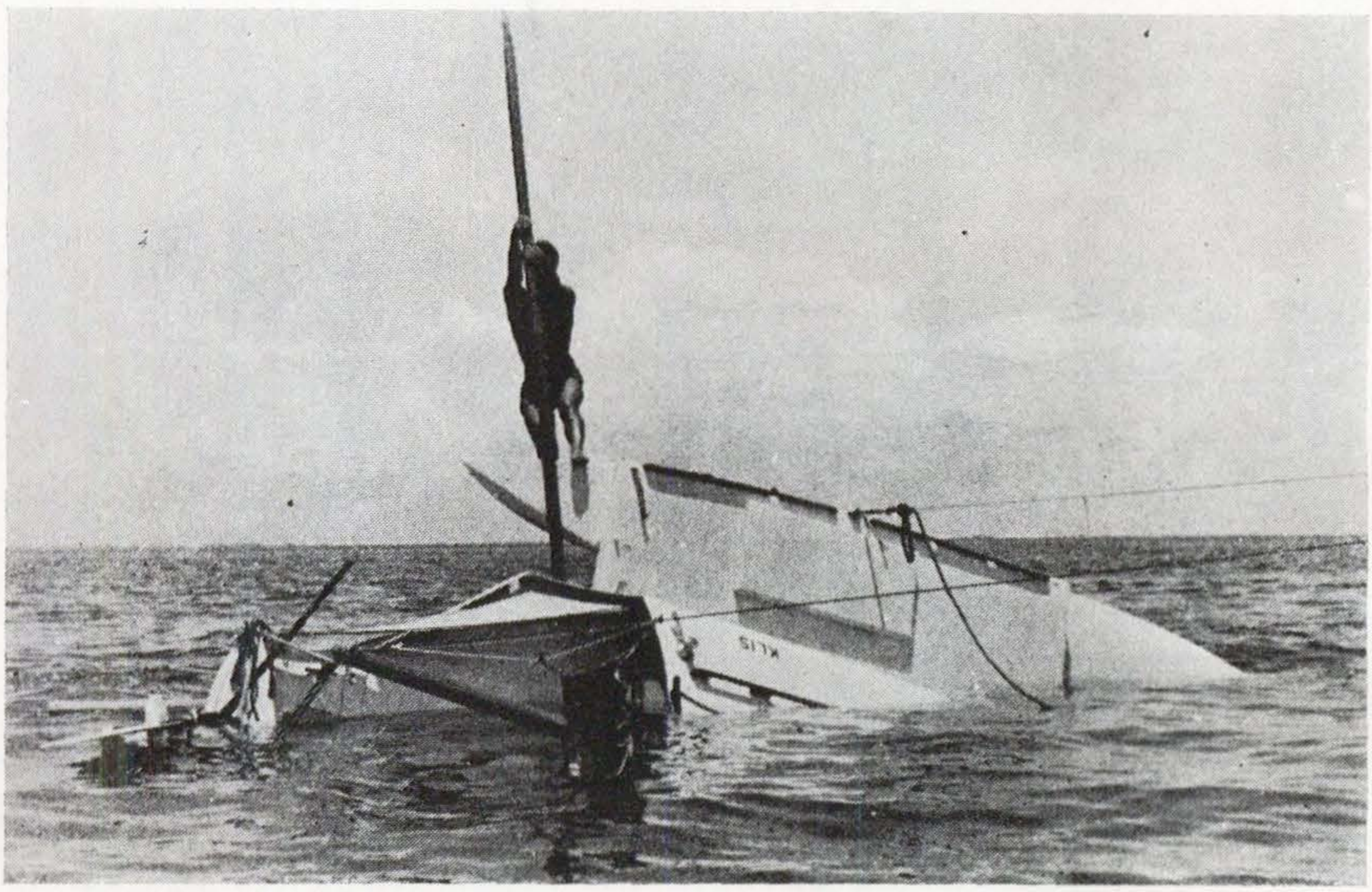
Coming easily

Then the weight came off the derrick and it floated clear, just as the masthead showed above the water. Here another surprise awaited me; she did not flip gaily upright as I had expected but lay in a state of neutral stability at about 80°.



She rested in neutral stability at about 80°

She was finally righted by taking the second spinnaker pole and using it as a lever, wedged between the float aft-deck and the cockpit side-deck.



The second spinnaker pole was used to bring her up

She settled with the lee float about 2 feet under water, and down by the bows. I emptied the two water cans, and with some difficulty forced them through the hatch, and under the deck of the lee float. Then bailing was commenced through the main hatchway.

Victory! Bailing was possible from here on

Soon it was possible to bail the lee float too, and at this stage I thankfully called in my friends to help.

It had taken $1\frac{3}{4}$ hours of gymnastics and I was tired. Subsequently we found the windward float, too, half full of water; it was this water running forward that had caused her to go down by the bows.

Conclusions

1. The object of the experiment was achieved. The experience gained points the way to a piece of special equipment which would make righting much easier, and, I believe, possible even in a moderate seaway. This consists of a reel type winch, such as is used on boat trailers, mounted on a short plank which has a rope beckett on its other end to attach it to the spinnaker pole. The 'shrouds' are attached to the plank, and the wire from the winch leads to the opposite chainplate. The operator sits on the plank, with his feet on the shrouds, and turns the winch handle. The boat is thus brought up in one operation, without flooding the windward float.

2. No use was made of the mast. If conditions are bad enough to capsize *KLIS* they might well dismast her, too. The weight of the mast actually hindered the later stages of righting—as soon as it left the water its weight produced a heeling moment. However, if the mast did remain 'in situ'

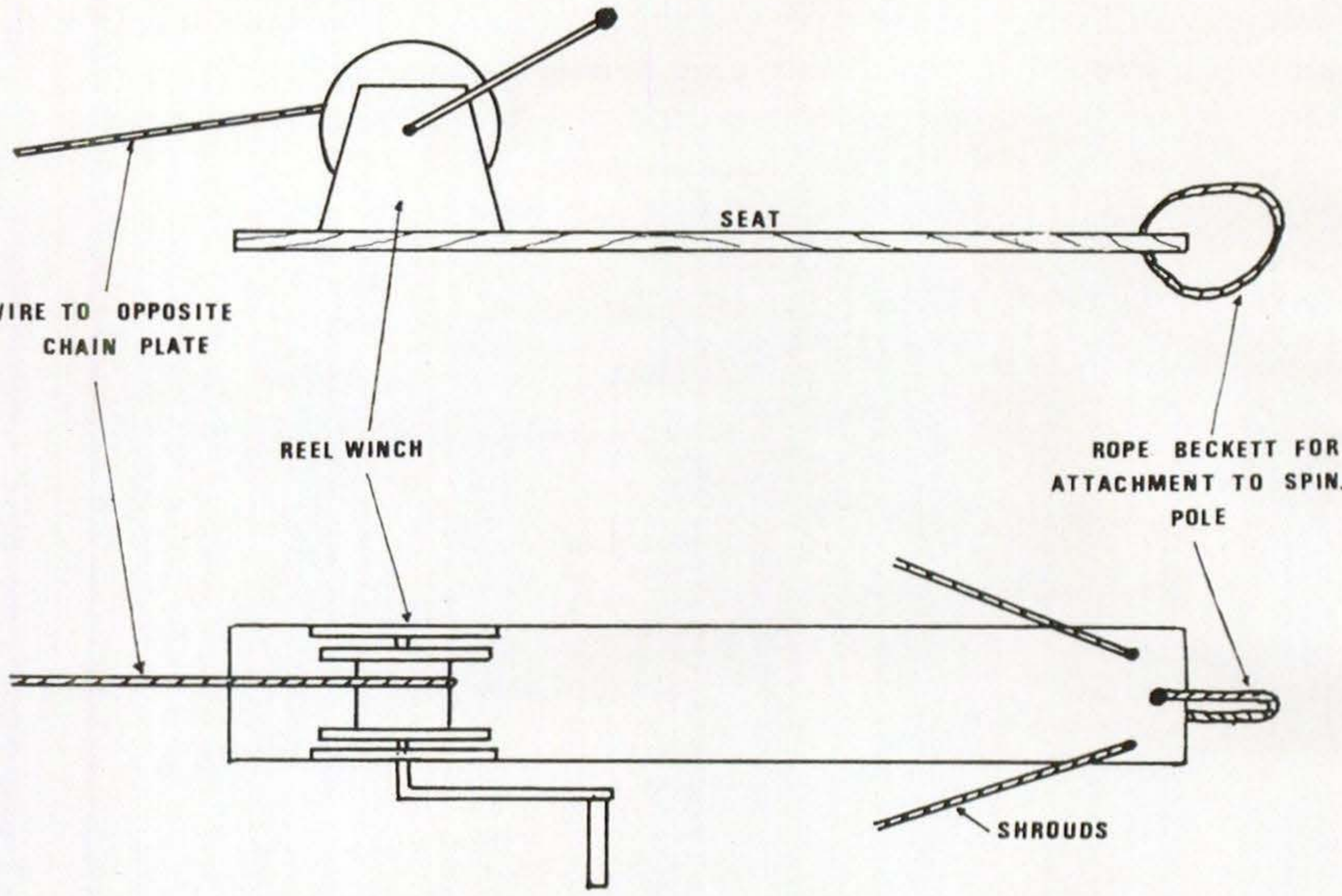


Fig. 3
Method of righting *KLIS*

then an alternative approach in the later stages would be to inflate the dinghy (CO_2 emergency inflation bottles would prove a great blessing here), take the tail of a halyard and haul on it from the dinghy. A swell running could help here, the technique envisaged being to 'take a bite' as the dinghy descended in a trough. Then, when the masthead had been reached, work down the shrouds until a rope can be passed through the lee scuppers.

3. Obviously, the method used would not work for a tri whose floats are filled with foam buoyancy. But foam in the bow of the main hull is a good idea, giving collision protection and extra buoyancy if waterlogged. Foam should then be added in the stern to compensate.

4. A standard feature on future designs should be an Emergency Locker, situated within reach of the helmsman and accessible from the underside. This should contain:

special winch as described above,

spare warp,

flares,

emergency rations,

a face mask.

This would make righting operations much easier, and would at the same time be the equivalent of carrying a life raft since a multihull cannot sink.

Of course, righting a capsized multihull would be much easier with a crew than single-handed.

REFLECTIONS ON RIGHTING MANOEUVRES, and: HOW TO LIVE WITH A FLIP?

by Dr. Brookes Heywood, AYRS Rondebosch, C.P., South Africa

In trying to right a flipped tri or cat with mast intact by partly sinking one hull and adding buoyancy at the masthead, the problem is going to be poor mechanical moment produced by the inflated balloon, dinghy, or what-have-you, situated almost vertically below the pivoting point.

Fig. I

A more laterally-directed pull would have far more chance of success. When I tried to right my *Nimble* without a crane, we failed despite a manual downhaul by block and tackle secured to the mooring block, and another manual uphaul from a neighbouring tunny boat. A float (rubber dinghy) boomed out from abeam on two spinnaker poles, might work—or on one spinnaker pole and a lashed-up job consisting of whisker pole, boathook, and whatever spars are to hand.

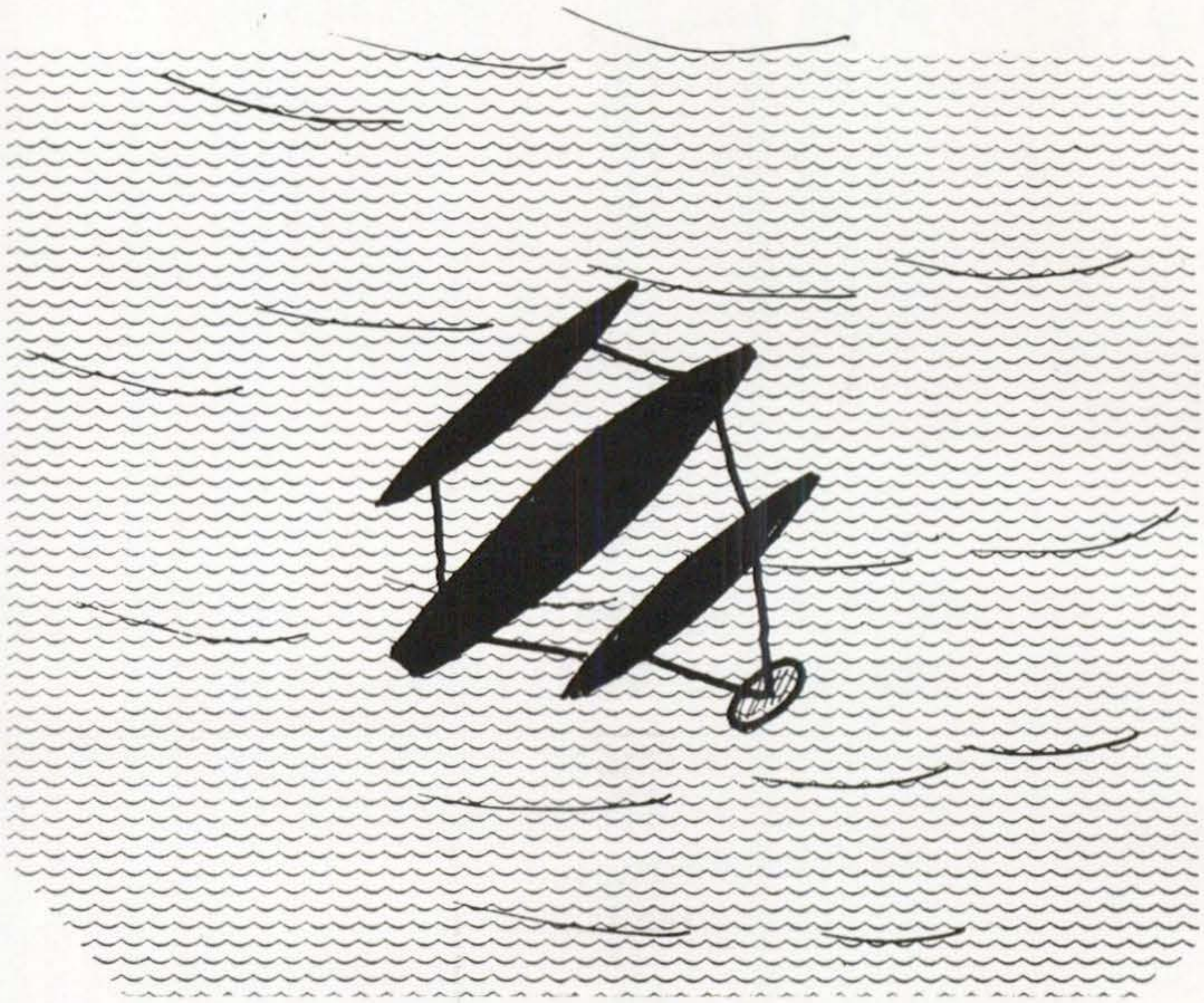


Fig. 2

The mainsheet block and tackle are then hauled down to the masthead by means of the main and genoa haliards to act as a better purchase giving a more lateral pull.

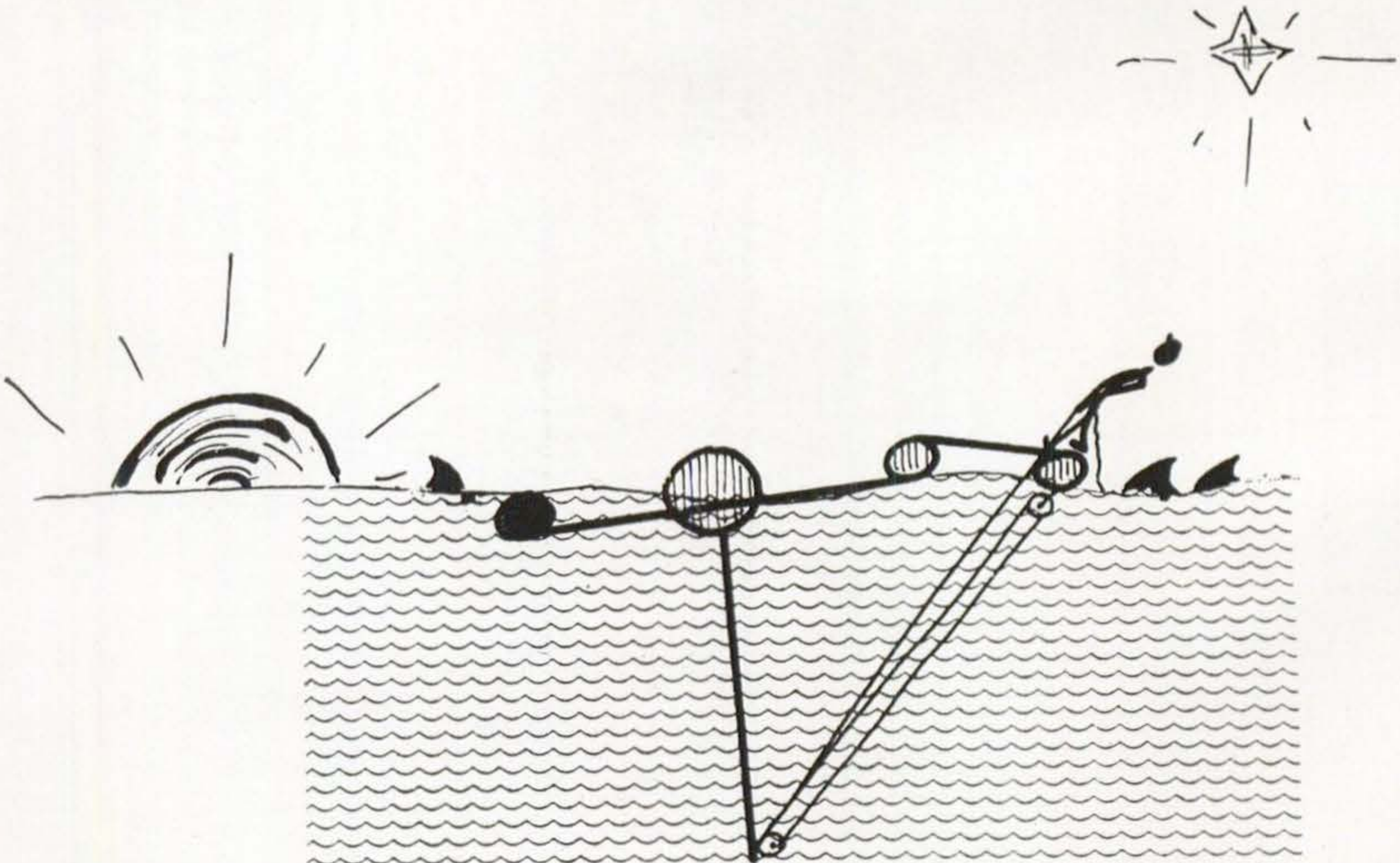


Fig. 3

Of course, the float to be sunk must by now be bereft of all buoyancy, as must be the cross-arms or wing connecting it to the main hull. Hollow GRP floats on metal cross-arms might be best for this kind of exercise . . . Air must be allowed to escape via holes or inserted tubes. Another snag will be the length of rope needed for a continuous tackle through the blocks. With a 40-foot mast and double blocks at each end of the mainsheet some 200 feet of rope—in one piece—will be needed. Well, there is the nylon anchor warp (If one can get at it—and if the mainsheet blocks are wide enough to take it).

So now the little man in the diagram starts hauling. Let us assume that he manages to lift the nearest float out of the water—an engineer will be able to calculate the pull on a 4 × purchase required to lift something like 400 lbs; the float hatches are open for quick exit of any water. But he can get no farther than a nearly self-righting position until he has cast off his booms.

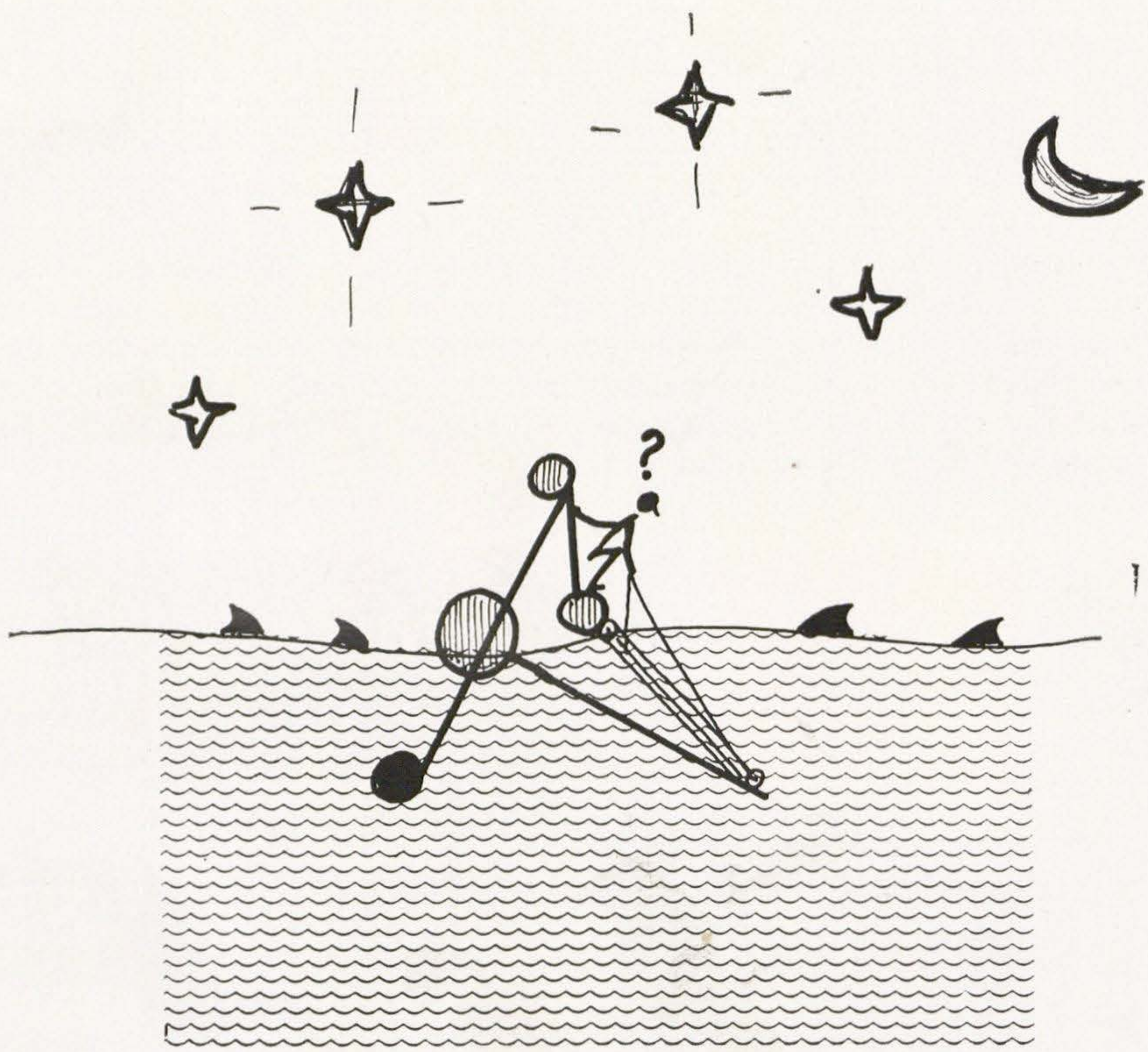


Fig. 4

They are now under tension, not compression as they were earlier . . . When they are released, the float will rush out towards the masthead as the latter sinks back a little. Our mannikin thus takes an involuntary dip, and is pleased that wind and sea have abated so that he can climb on again and haul the masthead back to the surface.

But still the tri is unlikely to right itself unless it has some sort of keel or ballast. So the poor exhausted boy has to re-rig his sideways sheerlegs (made up from spinnaker poles) from the main hull, pointing 'keelwards' and projecting beyond the point at which the float will land as it plops back. And he has to improvise a *heavy* raft from floorboards, lifejackets, and such like, weighted down with jerry cans of drinking water (this is not the time to throw out his freshwater supplies!), from which he can then rig his block and tackle to right the boat.

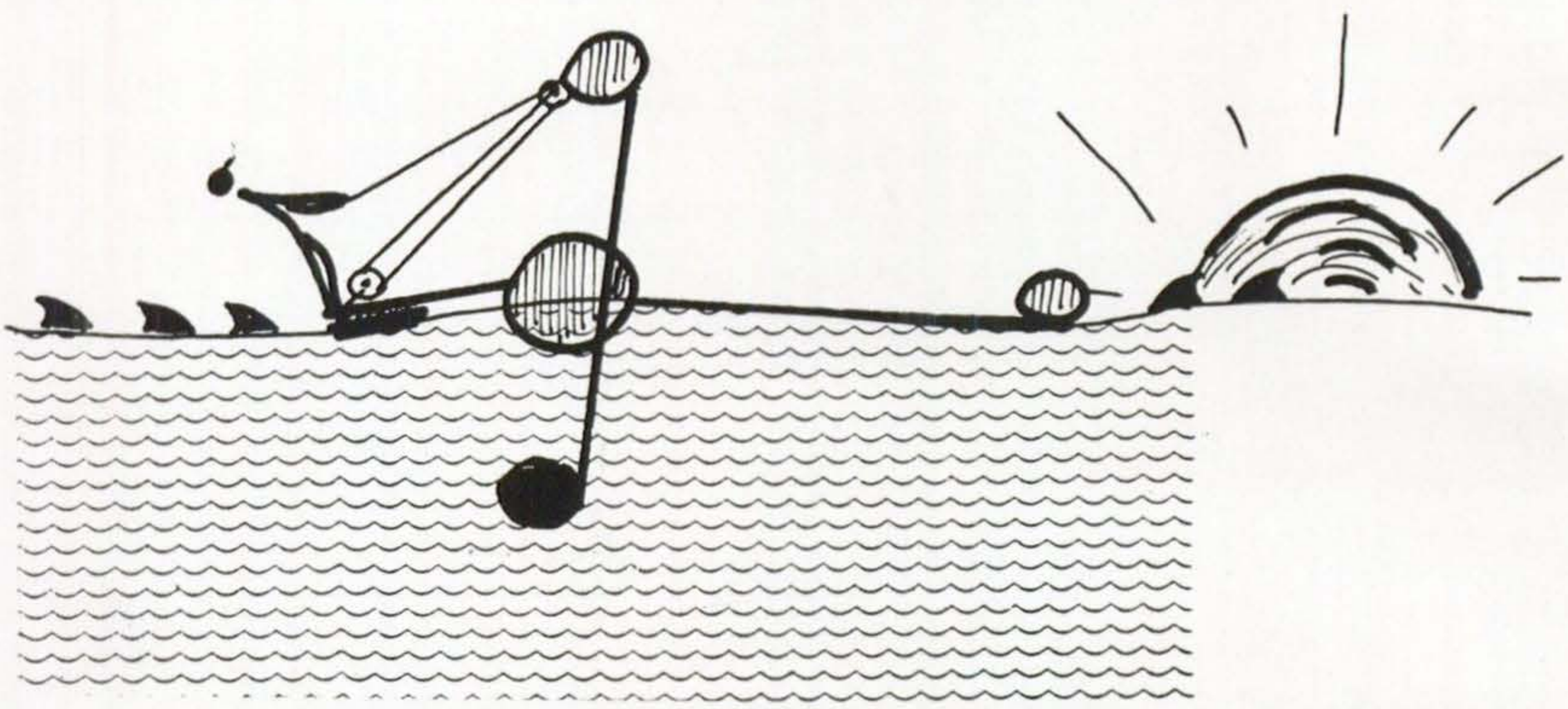


Fig. 5

But even now he is still likely to fail because the turning moment of the mast is probably greater than that of the high-and-dry sponson, considering their lengths of leverage. So now he may have to let go his shrouds on the above-water side, attend to the mast step so that it can angle without slipping sideways, and haul at the chainplates on the sunken side with his block and tackle—if he can dive to secure it there.

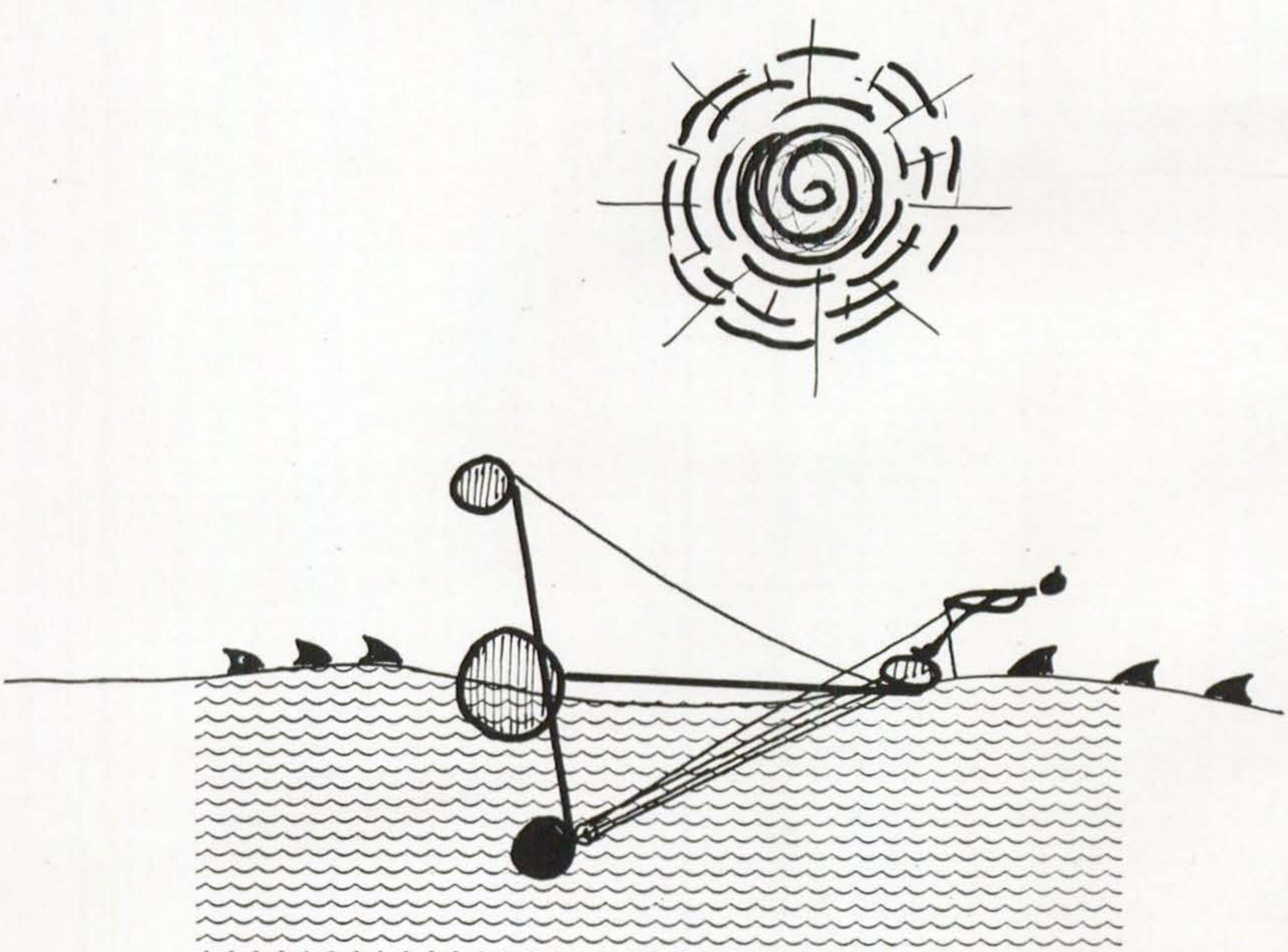


Fig. 6

Now he is upright but dismasted, unless he has found some way of paying out the upper-side shrouds gradually on an improvised lanyard arrangement until the lower sponson and the masthead float are close enough together for the tri to be righted by his clambering along the mast to the airborne sponson and getting his weight there.

All a terrible lot of work. Possible for me, seated with pencil and paper in front of me—but for a frail exhausted mortal in big trouble??? . . . I very much doubt that I would be able to remember it all in the hour of need. And I rather suspect that all these grand schemes are a bit too fanciful, and that Father Neptune would cut them down to size.

And so one is finally back to living on an upside down craft until rescue arrives. Righting a capsized multihull at sea is probably more of a fireside theoretical exercise than a practical possibility. I am convinced that *ultimate* safety must depend on being able to live in the upturned craft.

If we can't right her, we will have to take her as she floats: upside down. I would still rather try to live on a flipped multihull than on a sunk keelboat. At least some parts could be made dry.

When someone in Tom Corkill's predicament flips he should be able to stay *inside* his upturned craft where he would be quite safe. What would he need?:

1. *Air.*

The boat is completely sealed, except for the skin fittings for drain, heads, and seawater. Well, he could disconnect the seawater pump, or the sink drain, and breathe through these openings if the cabin gets too foul. Using hoses, water pipes, or what-have-you, the air could be piped to wherever the crew was 'holed up'. My own "Ball-head" head can be permanently opened to a 2-inch vent by flipping a lever. This opening to the atmosphere in the main hull will not sink a trimaran since she is supported by air trapped in the sponsons. A catamaran would need thick foam insulation/flotation in coach-roof and all decks to survive this without filling very full as air escapes.

2. *A Dry 'Corner' for Sleeping and Living.*

A lilo floating and splashing about in the middle of the cabin is not good enough. Some arrangement must be made whereby pipe berths, hammocks, or even lift-sections of planking from the cabin sole, can be suspended from the chines so that they come a foot or two above the water. Mattresses can eventually be dried and put on them.

3. *Water and Provisions.*

If stored under the sole, these will now be drier than ever before. *But* the sole boards should not be loose (as mine are), allowing everything to fall into the water. The sole must be secured in place by simple clips, Barrel bolts, or something like that *when the boat is built.* It is too late when you have already flipped. Water will be safer in multiple jerry cans than in large tanks, liable to dribble from their filler caps.

4. *Exit.*

When the weather improves, an opening will have to be made in the main hull, for easier exit and re-entry—diving is likely to be hazardous for the inexperienced (like me), with guardrails and such like to negotiate. A hand drill and a keyhole saw—with spare blades!—must be kept where they can be got at, sealed in an airtight container. The hole must obviously be cut in a place between the old waterline and the new one—if this is practicable.

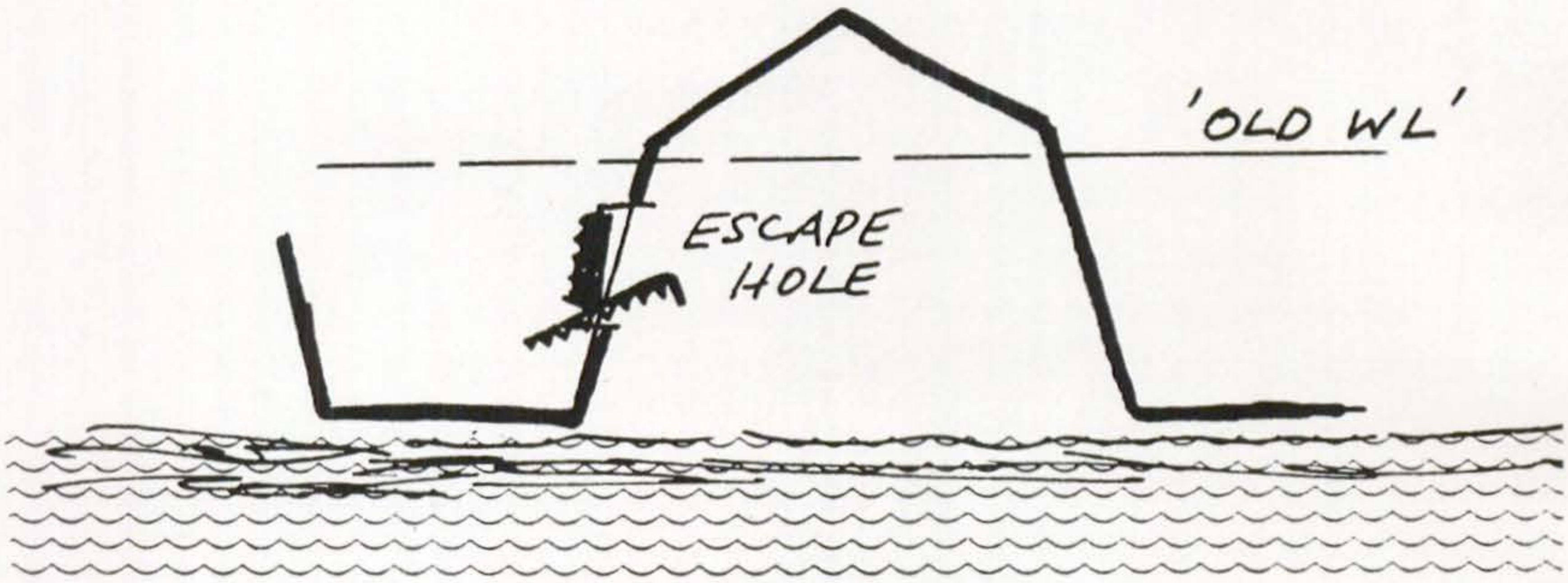


Fig. 7

My *Nimble* floated with bridge decks 1 to 2 inches above the water, so there would have been plenty of space. If there is plenty of foam insulation in the coachroof, the flipped boat will float higher, with less water inside on the coachroof.

The piece cut out can be roughly made into a hatch that is at least weather proof. Or, *better:* build the boat with an emergency hatch that can be unscrewed and knocked out from within.

5. *Galley.*

The stove will never even get wet if it has been bolted down all the time. Later, it can be righted and mounted elsewhere.

By now, in this increasing luxury, some four days after the storm, one will even be thinking of beer . . .

6. *Rescue Aids.*

The undersides should perhaps be painted orange, though this would be hard to live down in one's Club, and it would have a very limited aesthetic appeal. A brightly coloured spinnaker buoyed out on empty plastic jerry cans, floating on the water, would make the stricken craft more conspicuous—and in times of need only.

A transmitter, if carried, should be bolted down midway between sole and coachroof so it will stay dry. An aerial can be jury-rigged later, using a spinnaker pole or what-have-you. If no transmitter is carried—and even if there is one aboard—a small lifeboat unit that sends out an SOS should be packed in a *watertight* container under the cabin sole, in the same place as a *duplicate* set of flares.

When winds are favourable the idea of sailing the 'raft' upside down may well work. My *Nimble* had no directional stability when we towed her upside down, but I daresay a less decked-in tri or a cat having no bridge-

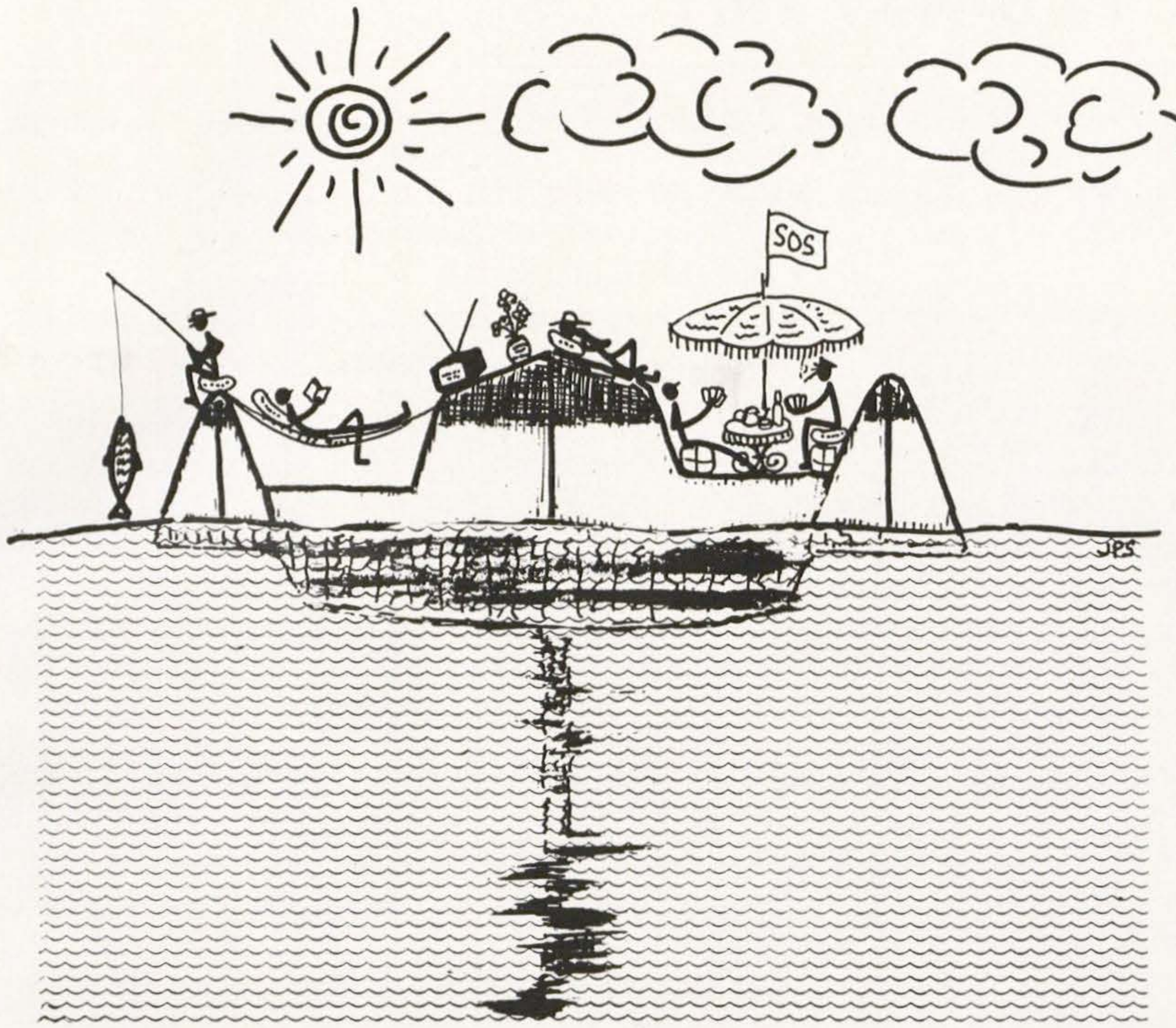


Fig. 8

deck cabin would probably have some. Steer with an oar—and by now our inverted hero will be regretting that he did not see to it that he had an old little compass and a plastic sextant stowed watertight under the cabin sole, with his flares and other emergency items. His charts can be dried out on the upturned hulls if handled carefully while wet. Even Thor Heyerdahl would by now be envious.

But to get this far one must reach the safety of either the inside or the wing in the first place—it would be awkward to be trapped under the deck of the upturned craft, unable to free oneself in time to reach air. So the line on one's safety harness should be fairly long. Long enough to reach the edge of the boat, plus some 3 feet, from wherever it is clipped on. (The single-handler's lifeline cannot be long like this as he dare never go overboard, even on a line. This would be a greater hazard to him than the flip). Under these circumstances one's life jacket, too, might prove a liability, even make it impossible to clear the guardrails at the edge of the deck by pinning one upwards against the deck.

In jotting down my first thoughts on the subject this last-mentioned point came as something of an afterthought. Should I flip one day offshore there may not be the time and opportunity to have afterthoughts. It is *fore-thought* that is needed.

A TWO-WAY TRI?

by Frank Schikkinger, AYRS Cowies Hill, Natal, South Africa

The viewpoint that it is capsize *prevention* that is needed, rather than dwell on what to do after a capsize, seems to be still quite widely held. Experience of what the Indian Ocean and the Southern Sea off the Agulhas Bank can deliver soon brings home the sobering realization that there is no such thing as a yacht that cannot be capsized—and this includes any and all types of yachts.

Unlike a ballasted monohull, multihulls have *two* stable positions, and where the monohull *must* return to its normal upright position after a knockdown or capsize a multihull may 'settle down' in either one or the other position: right way up *or* upside down. And so we must *either* render the second position unstable *or* accept it and design accordingly. I would say that the first approach is suitable for smaller multihulls, whilst the second seems the more practical in the case of larger craft.

Over the years there have been various proposals for righting an overturned trimaran but even those outlined in the most recent AYRS Publication on the subject (No. 63) do not appear to offer much in the case of the bigger multihulls. I for one feel that the righting methods suggested would not really be practical with medium-sized or larger craft, say over 30 feet LOA. But no one as yet has said: "All right, we accept that even a big trimaran *can* be capsized under certain conditions, almost unheard of though that may be. So let us now design a shape that is manoeuvrable and can be *lived in* upside down—not just survived upon—and this even under storm conditions. Jock Burroughs has come near to suggesting this in his letters especially the one on p. 54 (AYRS, Publication No. 63), and Peter Shreve (*Trimaran*, Nov. 1968) seems to be thinking along these lines.

If such a craft can be designed without appreciable loss of performance the right way up, then the one big disadvantage multihulls have in comparison with ballasted monohulls will have been countered, leaving them still with the very important advantage of unsinkability. The remaining disadvantages listed on p. 74 (AYRS Publication No. 63) are comparatively trivial, and even the second-biggest, that of excessive beam, could possibly be dealt with.

Suppose we accept it for the purposes of this discussion that a larger multihull cannot be righted without help hundreds of miles out at sea, especially not in rough weather which may persist for days. What features would then help the crew to reach such assistance? Here are some suggestions.

1. *Rotatable Floats.*

If the floats are rotatable through something like 160° to 180° their buoyancy and underwater shape can then be restored when the trimaran is upside down, and they can be made to provide both shelter and storage space. For structural strength it may be preferable to have three or four cross-arms

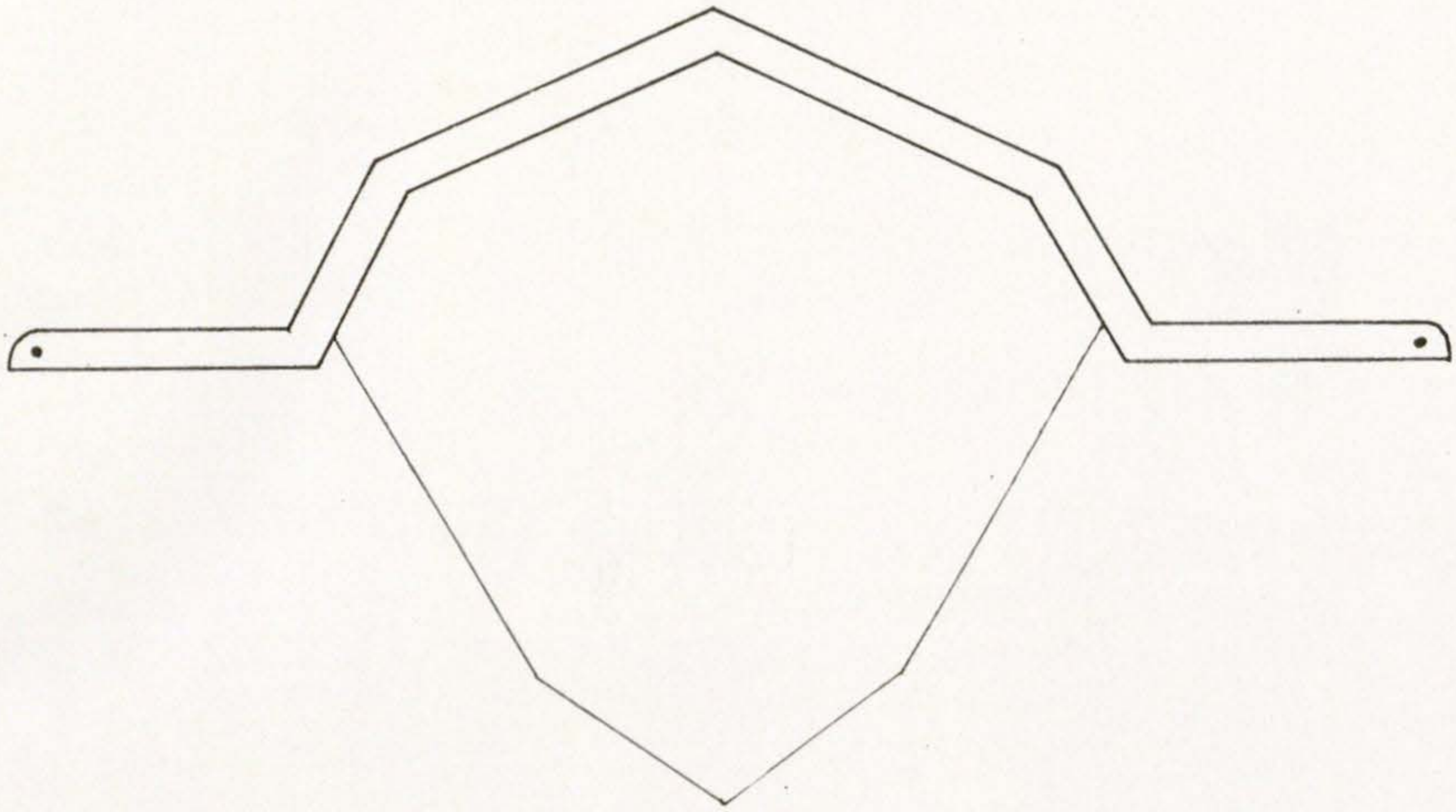


Fig. 1

instead of the usual two. The methods of rotating them should be one that works under difficult conditions and requires only one or two people. The turning and locking mechanisms must not be complicated—preferably without any loose bits that can fall overboard. Anything to do with the sea must be kept as simple as possible or the sea will corrode it, loosen it, or injure the person working with it. In the situation that calls for the use of such an arrangement the crew will almost invariably have to work amongst tumbling waves and howling winds which may continue for days on end.

Maybe some sort of windlass arrangement in the cross-arms would work. If possibly only bare hands or very simple tools should be needed: pliers and spanners have a habit of disappearing when most wanted.

Rotatable floats may have advantages under normal conditions as well. In harbour a float could be turned up for repair or cleaning without the need for careening or slipping—and the floats do seem more susceptible to general wear and tear than the main hull. Furthermore, shock rubber could be placed between float and cross-arms, reducing strains on the latter in rough water. This system thus need not be an emergency arrangement only.

But in an emergency its operation should need only a minimum of preparation. The stanchions should be easily removable and transferable. No rigging to the floats—shrouds and chainplates must be attached to the cross-arms only.

2. *Reverse Sheer.*

Give the main hull a considerable degree of reverse sheer, and have the foredeck arched or veed so as to provide a better underwater shape when upside down.

Design the cabin with a similar object in mind. Here I would suggest a shape rather like a broad-beamed pram dinghy carried on deck, single chine and constructed over frame and stringers so that it will do its job when it becomes the bottom of the boat. Under normal conditions this shape gives headroom where it is most needed: down the centre of the saloon. And it cuts windage, and may deflect the wind up into the mainsail.

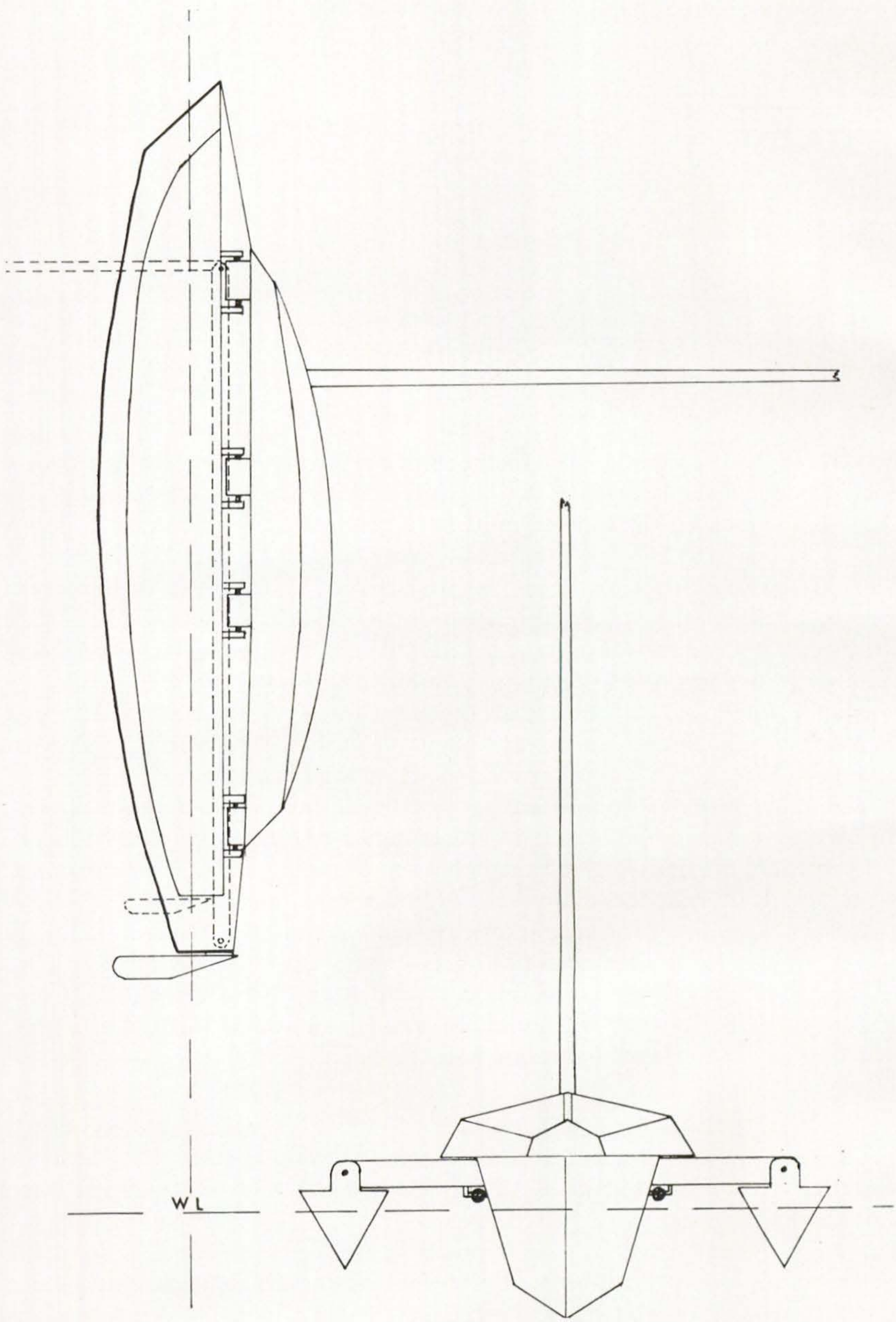


Fig. 2

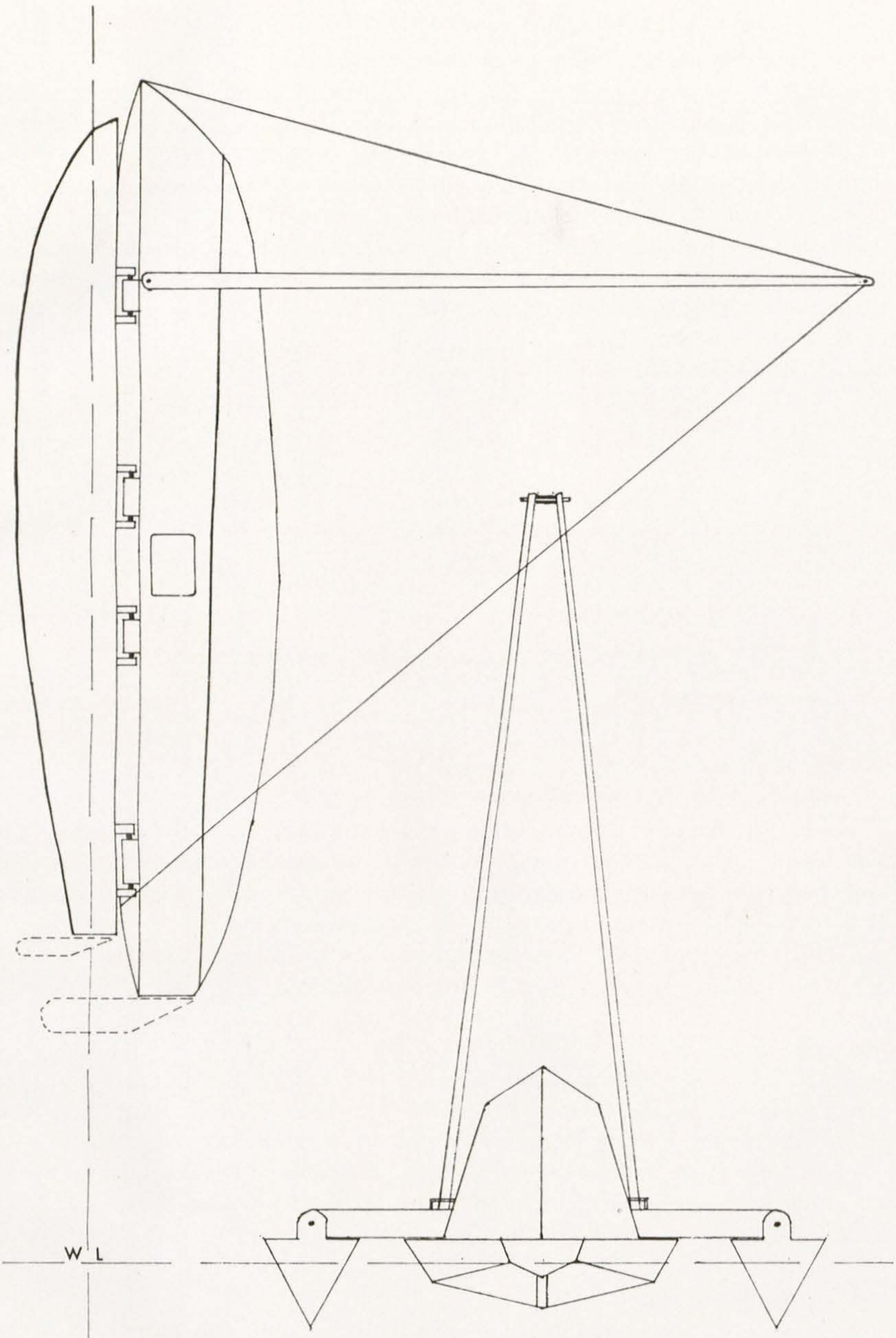


Fig. 3

I would prefer the cockpit placed right aft, kept small, and perhaps provided with a sliding cover, and I certainly do not favour a permanent pilot house.

3. *Small Portholes. Watertight hatches.*

Instead of the huge windows sported by most trimarans—and quite possibly one of the reasons why they "don't look like yachts"—have flush-mounted, thick Perspex portholes. *Small* ones, and preferably fixed. Keep the number to the absolute minimum: it is surprising how much light comes through, especially when the interior finish is light and glossy.

Restrict the number of hatches. A foredeck hatch I regard as essential: someone may get trapped there—for instance, if a fire should break out in the saloon. This hatch should be either as flush as possible with the deck, or be given a faired shape.

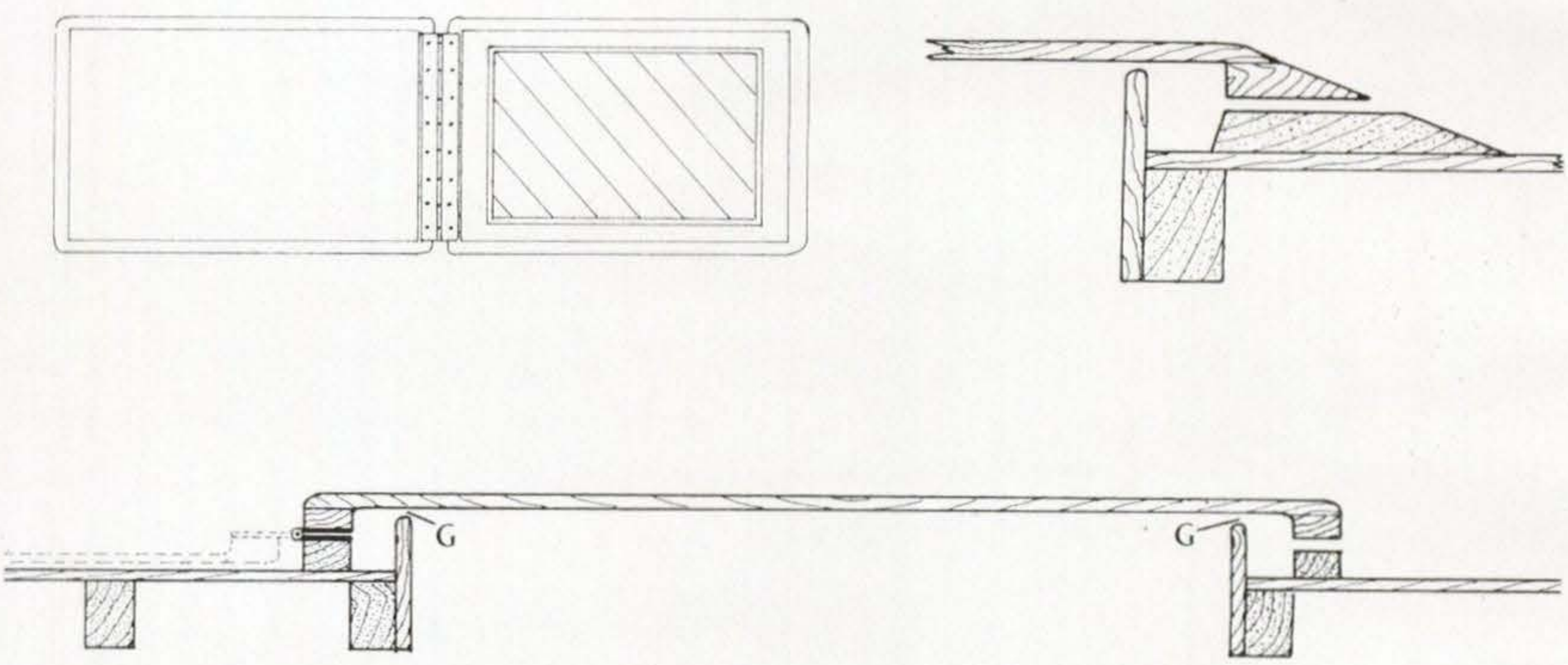


Fig. 4

It must be able to be dogged for watertightness, whether the craft is the right way up or upside down. Figure 4 shows my own float hatches which are hinged and have proved satisfactory—with a compressible gasket placed at G a hatch of this type could be made quite waterproof.

Circular hatches would be easier to make and maintain watertight; on the debit side, their construction calls for considerable skill, and it is slightly more difficult to orientate oneself when passing through a circular hatch in the dark.

Apart from the foredeck hatch the only other access to the main hull that is really needed would be one in the aft 'transom' of the cabin; this, too, must be capable of being made watertight when required.

Ventilators must be removable to avoid drag, and provision must be made for either screwing them tight or plugging up the ventilator openings in the deck.

4. *Emergency Hatches.*

These may be positioned in the side of the main hull, and should be of the completely watertight type. Judging by photographs of capsized trimarans, this part is still above the water when the vessel is floating upside down; rotation of the floats should raise it even higher. These emergency hatches might take some time to open, and thus some other, quicker exit may be called for—if there is a centre cockpit with an outboard well then the latter could be made large enough for a man to pass through.

Whilst on the subject of swimming about a trimaran: I have had to go overboard in near gale conditions to clear wreckage lodged between float and main hull after a dismasting, and found that it is not as difficult to swim under and around a bare trimaran in roughish water as one would think. There is none of the being dashed to and fro and against the hull as there is with a keel boat: you and your tri move together, up and down, hither and thither, with swimmer and craft tending to remain where they are relative to one another.

5. *Rudder and Rigging.*

Steering ability may be restored either by reversing the rudder if its mountings allow this or by providing an auxiliary emergency rudder

If mast and rigging remain intact, these can either be left until the weather moderates (or, deliberately, as a steadying influence on the boat) or dismounted. In the latter case one would be better off with attachments that can be loosened easily and quickly. Wirecutters may be to hand at the time or they may not be, and they may damage components needed to reach port.

For an emergency jury mast I would suggest suitable spars, hinged to the fore crossarm, and lying along either side of the main hull. When the time comes, these two spars are connected and raised to form a bipod mast. It could be made to serve equally well in the event of a dismasting. The principle could be elaborated in a variety of ways—e.g., a mizzen mast as well But the simpler the better.

And so to the inside. A crew that is very likely exhausted and may be injured as well will need food and adequate facilities for rest.

After installing watertight hatches, and further insuring the integrity of the cabin top by reducing the size of windows, it would be rather silly to stick it out kneedeep in water. If the bilge pump is mounted on a bulkhead halfway up, it can be used either way up. The hose ends should be loose so that intake and outlet can be placed according to need.

6. *Resting Facilities.*

The cabin ceiling over the wing bunks may be made sufficiently comfortable to lie upon. In my own *Lodestar* there are pipe cots as well, over the settees at a level just below the cross-arms. Such cots would serve equally well in the inverted position.

7. *Galley Arrangements.* Stores.

As far as the galley is concerned, if the stove were mounted in gimballs allowing 360° rotation, it would remain useable and no inflammatory fuel would be spilled.

Crockery, cutlery, and stores should be kept in drawers or lockers—not in bins with lids. A whimsical touch here would be reversible drawers . . .

8. *Freshwater Storage.*

Fresh water should not be stored in fixed tanks in the bilges. There is little if any advantage in having these in a trimaran where compact storage is not only unnecessary but also something of an invitation to dangerous overloading. Fresh water should be kept in plastic containers. I have found the 2-gallon size the best: they are not too heavy for the cook to handle (and the cook may be a she!) yet hold a reasonable amount and are easy to store. To name but some of the safety aspects of this arrangement:

(a) They can be distributed to trim the boat, no matter which way up she is floating.

(b) If scattered in a variety of places it is but the work of a moment to grab a few if one has to abandon ship in a hurry; if not completely filled they won't sink if tossed overboard where they may be retrieved later.

(c) If numbered consecutively, and used in their numerical order, one can tell at a glance what one's water reserves are, and how fresh it is.

(d) Empty containers can be used for buoyancy anywhere—in the main hull or floats, to support someone in the water. And they can be used to float a towline to another vessel, thereby reducing the risk of collision.

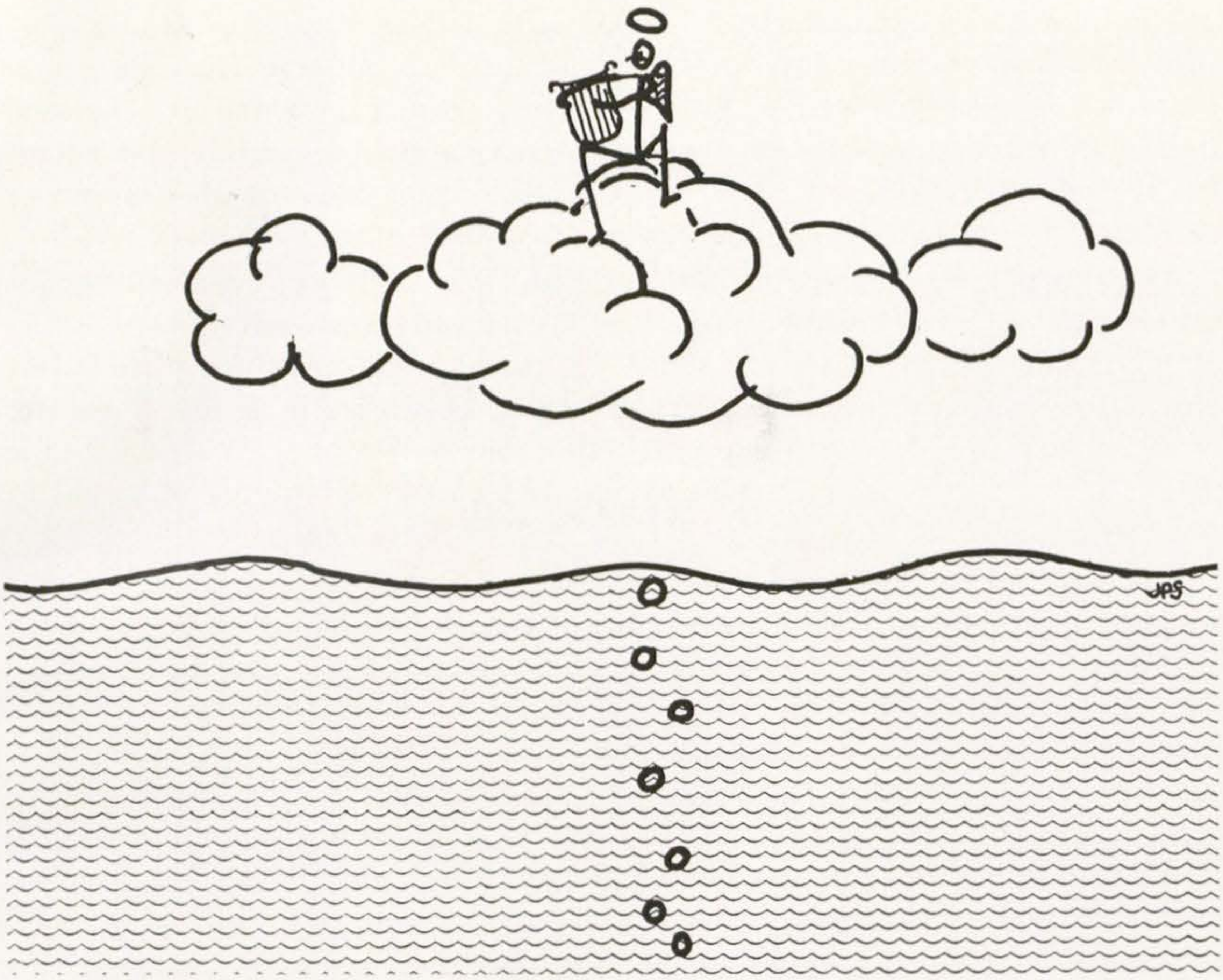
9. *Lighting. Electrical Equipment.*

Even during daylight the interior of an inverted hull is likely to be rather dark. If lights were mounted low so as to illuminate the cabin floor under normal conditions they would serve as emergency lights after a capsize. The same lights could be used routinely to light up the throughway without disturbing sleepers by switching on the main cabin lights. Of course, accumulator batteries must be mounted in gimbals to ensure their continued functioning when the craft has turned over, and to keep battery acid where it belongs.

Other electrical apparatus, such as torches or radio, can be clipped or bolted in a midway position so that they remain 'high and dry' in either position.

There are no doubt many other suggestions—I have confined myself to the ones that would not penalize performance too much, e.g. by adding a lot of additional weight, and to those that would serve a double purpose. This last-mentioned feature is highly desirable since their emergency roles would be rarely if ever required.

But I do feel that serious thought should be given to the subject of 'inverted living'. One only has to recall Miles Smeeton's "Once Is Engouh" to be forcefully reminded of what can happen 'out there', and how *self-reliant* a multihull and her crew will have to be even under cruising conditions.



WHY 'HARP' ON ACCIDENTS

by Peter Shreve, AYRS Johannesburg, South Africa

"Stressing capsizes, etc., does nothing but harm the public's attitudes towards multihulls—just as does the flaunting of visible masthead flotation. Why not have more stable boats in the first place?" (Arthur Piver in AYRS Publication No. 63, p. 44).

"We consider it valuable to analyse multihull capsizes in the hopes that they will become even rarer than they are now." (ibid., p. 61).

As was to be expected, hypotheses and suggested solutions have been far more common in our incoming mail than full, detailed factual reports. Facts of the kind we are after tend to come as illustrations of viewpoints rather than 'neat'.

Opinions are for the purposes of this project a valuable and most welcome *addition*, but no substitute for factual data. Our resources don't run to experimental testing and we therefore have to base all our conclusions and theorizing on *reported* observations of varying validity and reliability. The conditions under which most of those observations are made are anything but ideal. A man battling for survival in an Atlantic gale can scarcely be expected to be a meticulous, detached observer. His observations are almost certain to be haphazard, and vary in degree of 'certainty', and to this must be added the mental processes that reshape his memories of the event.

The information collected this way comes to us from a number of observers who differ widely in ability (and opportunity) to observe accurately and put down succinctly what they have observed. But if the volume of material thus obtained is large enough, these differences will to a considerable extent be 'ironed out'. Since it would appear that there are not all that many accidents, we must try and squeeze all we can out of each of them.

And this is how we come to 'bite the hand that feeds us'. A letter arrives setting out, say the considered opinion that automatic sheet release will just about eliminate capsizing. The writer has used such a device for two seasons and it has made all the difference—he had two capsize experiences before. So we thank him with genuine gratitude—and immediately accost him for details of his two capsizes! And to add insult to injury we ask if we could possibly get separate reports from other eye witnesses as well!

It is not that we doubt his word, or his conclusions. We don't doubt that what he has given us is 'the truth'—but it is not 'Truth' we are looking for but *facts*, 'primary' facts. What he has handed us is a fact too, but a 'secondary', higher processed one. He has come to the conclusion that automatic sheet release is the answer, and the primary fact because he has not had another capsize since he installed the device two seasons ago.

Secondary fact of this kind is very valuable indeed—"fifty million Frenchmen can't be wrong", or whatever the saying is. The greater the number of people who *independently* form an opinion which then reaches us as a secondary fact, the higher the probability that they are right. But we can never be quite sure how *representative* our collected sample is, which makes weighing up the significance of such an opinion fact a little hazardous. An opinion poll of multihull seaworthiness would yield widely differing results, depending on who goes into the sample!

And therefore we warmly welcome everything that comes our way—attitudes, opinions, viewpoints, conclusions, dogma . . . , but the basis of this study must be an accumulation of primary facts. If 80% of the capsizes in our collection occur diagonally (the figure is quite fictitious) *we* can with a good conscience publish our conclusion that diagonal capsize is the dominant mode as far as our sample goes (how far we could then extrapolate would depend on our sampling). But if someone, no matter how well qualified and eminent, tells us that diagonal capsize is the dominant mode, all we can report in all honesty is that *he* said so. And if 50 people are of the opinion, we can still say no more than that *they* are of that *opinion*, and in essence we have got no further than the learned men who quoted Aristotle.

That's why we 'bite the hand that feeds us'. We need as much detail as a reporter can recall—we'd rather hear in detail what he had for breakfast that day than have him leave out that bit about the galley stove not being bolted down and *nearly* starting a fire as she went over. The man who cured his boat of capsizing may have a wealth of detail on conditions inside an upturned craft, no longer of any concern to him now that he has solved that one, which might link up with items in other reports and bring something of importance to light.

And we would like to have wherever possible several versions of the same incident from different observers. The impressions of the cook in the galley may be quite different from those of the helmsman in the cockpit, and in this way small but possibly quite valuable points may come to light. *Independent* reports preferably, as far as possible. In trying to get some estimate of the total multihull population we have turned to several people—their guesses are so much of the same magnitude range that we are wondering who might be the *common* source of information! . . .

Again, it is not a question of doubting anybody's word, but simply one of following a method of data collection that has already proved its value time and again. Experimental work has demonstrated beyond doubt how much the testimony of several *eye* witnesses can differ, even on major points, and how such differences tend to be ironed out if there is a comparing of notes among the participants, and in this levelling process important detail may be lost and observations modified.

Purely 'private' impressions can be as valuable as publicly verified ones. Accuracy does matter, but in a study of this kind, wealth of data matters even more—half a dozen half-accurate impressions may well be more valuable in the long run than one truly accurate observation; where the former may add up to something (like a flock of birds all flying in the same direction), the latter, though in itself highly reliable, stands in isolation, and there may be no way of assessing the degree of its accuracy: one swallow does not make a summer.

Having presented our case for the 'Harping' what about our preoccupation with accidents? If it's wealth of detail we are after, isn't there much more to be had from those countless miles of straight sailing than from a few dozen accidents. Well, it's much easier to prospect for 'sin'; to establish a saint takes a brace of ecclesiastical experts a lot of time—and so we'd rather stick to sinners.

Accidents show us the limits through 'testing to destruction'; the only way to determine the ultimate strength of a rope is to break it. One way of conceptulizing a boat, somewhat prosaically, is as an artificial mini-environment, an instance of man's adaptation to a particular (and inimical) enviroment. Every accident is an instance of failure in the life-support-capsule + operator system: a failure of man or machine. And analysing such failures is the *quickest* way of finding out about the properties of such a system. We could use a given rope in many situations and learn slowly, by trial and error how much it can take—or measure its strength right away by breaking it, after which we can predict what it can be used for. The sea is no tidy laboratory, and boats and their crews are not pieces of rope—and we aren't the mad scientist of horror fiction. So we can't *make* accidents; we don't even have the resources to test destructively boats or gear.

The next best thing then is to study them systematically and learn everything we can from each. An accident is a misfortune in itself; an accident from which nothing is learned is a waste. And so we harp on accidents.

GUIDE TO ACCIDENT REPORTING

by R. M. Humberstone, AYRS Johannesburg, South Africa

Roger Humberstone is associate editor of "*Multihull Safety Study* 1969" (AYRS Publication No. 69), and is as the research team's computer programmer closely concerned with the processing of accident data.

* * *

We use a standard report form* which ensures adequate coverage of all essential aspects, and greatly facilitates data analysis and statistical treatment.

But there is the Gordian-knot problem of distribution, and filling in forms does have a damping effect on most of us. And so we decided to cut that knot by filling in the forms ourselves from the information received.

Reports may well include aspects not provided for in our rubrics, and we shall modify and widen our present system accordingly as we go along. We shall be glad to get such windfalls. At the same time we need to reap a full harvest of 'staple diet' data. Therefore this *guide* to accident reporting.

> As used here, the term 'ACCIDENT' should be taken to refer to any occurrence that causes the performance of either CRAFT or CREW to be IMPAIRED materially.

And in this context 'report' includes *any* communication telling us of an accident or giving details of it. We are, of course, particularly keen on full reports that tell the whole story, but fragments and even vague rumours can be quite invaluable to us. A fragment may be the missing piece in the jigsaw puzzle, and a tipoff can put us on the trail to information.

If a report is set out systematically it will greatly facilitate processing. But presentation is a luxury: what matters is that ALL *POSSIBLE* information pertaining to an accident or potential accident has been included, no matter how fragmentary or uncertain it may be.

With this in mind, the following items (listed in order of priority) should as far as possible be included in all reports; they are essential for identification of the incident and statistical purposes:

1. *DATE.*
2. *AREA.*
3. *TYPE OF CRAFT* (cat, proa, or tri).
4. *SIZE* (LOA).
5. *DESIGN CLASS* (e.g. x-designed, y-class).
6. *NAME OF CRAFT.*
7. *SKIPPER'S NAME.*
8. *TYPE OF ACCIDENT.*

* Based on 'Boating Accident Report" (CG-3865) (Rev 12-67) by courtesy of the Boating Safety Division, United States Coast Guard.

9. *CONSEQUENCES* for (a) *CREW*,
   (b) *CRAFT*.
10. *SOURCES OF INFORMATION*.
    (Name and address of reporter, and how information was obtained—e.g. as a crew member, from a news report, etc. If the source is published material, the full reference should be given, e.g. "Pacific Islands Monthly, Jan. '69, p. 28).

Cataloguing all known accidents is an essential part of this study; without the data listed above this cannot be done satisfactorily, as even a cursory glance at the accident tabulation in the next issue will show. Even if, say the date or area cannot be pinpointed, any remark that narrows down the range of possibilities is better than nothing.

In addition to the basic items already listed, as many of the following details as possible should be included in any full report:

(A) CREW DATA.

11. *ADDRESSES* (*and NAMES*) of anyone who may be able to furnish additional information: skipper, owner, crew members, other on board at the time of the incident, anyone else.
12. *PERSONS ON BOARD: number;* ages; sex; status on board; family relationships.
13. *EXPERIENCE* of skipper and crew: previous general boating experience; multihull sailing experience; experience with the craft concerned.

(B) BOAT DATA.

14. *DESCRIPTION OF CRAFT:*
    (a) Dimensions other than LOA; displacement; *material; rig and sail area.*
    (b) *Builder;* year built.
    (c) Significant design and structural features if the craft is not a standard design. Significant modifications if it is.
    (d) State of maintenance; *loading;* handling characteristics and brief summary of boat's previous history.
    (e) Equipment: life raft, radio, safety harnesses, personal buoyancy, etc. (in general to convey an idea of how well equipped, and in particular in so far as it may have a bearing on the accident or its consequences).

(C) CONDITIONS.

15. *WEATHER:* (e.g. clear, cloudy, fog, rain, snow, hazy).
16. *WATER:* (e.g. calm, choppy, rough, very rough); wave height, shape, and direction (uniform or confused); current conditions; state of tide.
17. *WIND: estimated strength* (on Beaufort Scale or in knots); type: whether steady or gusting; direction. Data supporting estimates.
18. *TIME and VISIBILITY:* day or night; (Greenwich) time. Light conditions; visibility—(e.g. good, fair, poor)

(D) OPERATION.

19. *GENERAL* (e.g. coastal cruising, round-the-buoy racing, passage racing, ocean voyaging).
20. *AT TIME OF ACCIDENT:* under way or in port; course and estimated speed; sail up, and type of sailing (e.g. running, reaching, beating—details).

(E) SEQUENCE OF EVENTS.

21. *PREDISPOSING FACTORS:* summary of events and conditions that preceded the actual accident—sea and wind, craft, or crew—and which have in the opinion of the report writer a bearing upon the accident.
22. *THE ACCIDENT.*
    Crew Disposition: whereabouts, activity, and condition of each crew member at the time. *What happened*, and *what was done*—the impressions, reactions and actions of each crew member during and immediately after the event.
23. *THE AFTERMATH: IMMEDIATE.*
    Extent of damage to both crew and craft. Description and assessment of the situation. Decisions (giving reasons as far as possible) and actions. *In the case of a capsize* we are particularly keen on *observations* that may shed light on such questions as survival *inside* the hulls, egress, conditions up top—in short, how best to survive a capsize experience.
24. *THE AFTERMATH: FINAL.*
    Subsequent measures and events. If rescued: when, how, and by whom. Fate of crew: number of fatalities and causes; number of crew members injured, and degree of incapacitation (over or under 72 hours). Fate of craft—final assessment of damage; repairs necessary and estimated cost (*in case of collision with another craft*), details of damage to other craft and her crew should be given as well).

(F) COMMENTS AND OPINIONS.

25. *CAUSES AND PREVENTION.*
    (a) What, in the writer's opinion, caused this accident? Was it a case of CREW failure or CRAFT failure?
    (b) Can the consequences for the CREW be regarded as 'just one of those things', or could certain *reasonable* preparations have reduced the toll?
    (c) Suggestion for preventing or avoiding similar accidents in future, and for coping more efficiently with their consequences when they do occur.

The foregoing scheme should not be regarded as a rigid prescription but should be freely adapted to fit the accident reported and the information available. It lists the points we shall be looking for and should be used as a check list to avoid *unnecessary* omission of valuable or essential points.

One final explanation. We are studying MULTIHULL accidents which we define for this purpose as *accidents involving craft having more than one hull.* It has been repeatedly pointed out that an accident involving a multihull is not necessarily a 'multihull accident'—it could have happened to any craft irrespective of the number of hulls. This is certainly a valid argument, and our definition must not be misinterpreted to mean that we regard them all as 'multihull accidents' in the second sense. It is just that we would rather bag the lot, and only then separate the sheep from the goats—the other way round is apt to be a shortcut to "lying with statistics".

A MULTIHULL SAFETY AGENCY?

by P. D. Jackson Johannesburg, South Africa

Peter Jackson, himself a pilot and navigator, is an aerial photographer with a map making team. It is in his capacity as a photographic expert that the Multihull Safety Study team first came in contact with him. He showed a lively interest in this project and attended many of our discussions. This is how he has come to get interested in sailing as he learned about multihulls. In turn we heard much about the ways in which aircraft safety is ensured. "I envy you sailing boys your freedom and easiness", he said once, "but I think you're a bit too easygoing—it's asking for trouble . . .". "What do you suggest? Something like the Civil Aeronautics Board, with graded licences and permits and certificates, till there's nowhere left to sail but the bathtub???" "No—just a bit more system—some kind of voluntary safety body or bureau run by the multihull fraternity themselves." "Well, then, write your ideas down, and I'll include them in the first Multihull Safety Study issue if they are any good".

* * *

What drives a man to build his own boat? To my mind a desire and the determination to create something with his own hands, something he can look at and touch, and say: "I built this myself". It proves that he can build a boat, but it doesn't mean that he is now a seaman. Unless he has learned the practical rudiments of handling a craft of this type he may be a danger not only to himself but also to others who sail with him.

With the ever increasing popularity of sailing there has been a growing influx of landlubbers who buy or build a boat for weekend relaxation, summer cruising, racing, and even ocean voyaging. The appreciably lower cost of construction puts a fairsized multihull craft within the reach of many a complete novice.

A fierce controversy seems to be raging over the respective safety merits of multihulls and monohulls, and from what I have heard and read it is still an open question which type is the safer. What did strike me most forcibly was the almost complete absence of any reference work which could be considered to be a 'Handbook for the Multihuller'. On the other hand a large amount of information is readily available to the budding monohull owner.

With some ten years in aviation, I have been brought up in a world where safety is put before all other considerations. An aircraft is a complicated piece of machinery in which failure of any one part can have disastrous results. Each time a plane is taken aloft those on board entrust their lives to those who built and service their machine—and to the competence of those flying it. That flying is nevertheless relatively safe is due entirely to the stringent regulations governing aircraft and the high requirements its crew is expected to meet.

You who sail the oceans of the world are lucky in that you are still free. Free from legislation governing your every movement. In this modern society in which we have to obey so many laws, rules, and regulations, this freedom is something worth fighting for, yet you yourselves are putting it in jeopardy through needless omission in following your chosen sport or pastime.

To me it seems utterly unbelievable that someone with no sea-faring experience is allowed to put to sea in an uninspected home-built craft with fare-paying passengers when on his own admission he has never been to sea before, never built a tray before, let alone a boat, never had any practical sailing experience, and learnt his navigation from books?

These days you can buy a set of plans to build your own aeroplane—as you can buy a set of boat plans—but you wouldn't dream of flying it until you had a pilot's licence. Yet anyone can build a multihull (a point stressed in some of the sales literature: that *anyone* can build one), launch it, climb aboard, and without any practical sailing experience at all, set out on a voyage across an ocean. He can even take others with him, farepaying passengers, and risk their lives through his inexperience. No one can stop him, and what is more, no one will really try.

Accidents are bound to increase in frequency as more and more novices take to the water. This will lead to as much red tape and governmental interference as already exists in other fields unless those interested in multihull craft get together and exercise some form of control themselves.

What I am venturing to suggest is not an enforcement body but a 'prodding' one that can recommend to multihull enthusiasts steps they ought to take to ensure satisfactory construction of their vessels, and supply information on handling those craft under various conditions based on information collected from multihull designers, builders, and sailors all over the world. This body could also provide a list of recommended safety features to be built into their boats—this way they would be *prepared* for emergencies at sea.

The lack of any reference book on multihulls means that builders have no really comprehensive source of information to which they can refer in order to ensure adequate quality and build into their craft a minimum of safety features which would increase the chances of crew survival in case of accidents. By having a comprehensive, up-to-date reference work multihull builders can avoid the mistakes of others and gain increased confidence in the seaworthiness of their handiwork. I shall be interested to see the information the present Multihull Safety Study project is going to bring together.

One item I already suggested to its editor is a check list for inspecting specified items of equipment at regular intervals. How often don't we read of ropes parting in a sudden gust of wind! How often is this due to the simple fact that changing a frayed rope proved too much trouble—or maybe it didn't seem all that serious—and so it was left for another day? Regular maintenance as suggested by such a checklist—in aviation such checklists are not just *suggested* but insisted on—would go a long way in cutting down accidents of this nature which could have serious, even fatal consequences. If these recommendations are not carried out then only one person could be to blame—the culprit himself (not the designer or the craft nor multihulls as a class!).

But is information alone enough? Perhaps this body could ultimately give something of a seal of approval to craft which meet the minimum standards laid down. In fact, something like Lloyd's 100A—a *non-compulsory* mark of quality which inspires confidence.

When an accident involving a multihull occurs, this body could speak with authority on behalf of the multihull community. A simple statement on an accident it had investigated to the effect that the craft concerned did not have this seal of approval as it did not meet the minimum requirements laid down, would encourage more multihull owners to meet these requirements in the interests of their own safety.

A Multihull Safety Agency that will provide information on multihulls, from construction and safety features to actual handling, and guide the novice from lubberliness to competence. For example, it could perhaps persuade the planetarium to conduct a course in astronavigation for the would-be ocean-going yachtsman. Multihull men themselves have repeatedly pointed out that multihulls require different handling from monohulls. This body could arrange for training courses in multihull seamanship the way the RYA does through approved sailing schools for yachting novices in general. And should legislation from above ever threaten, this body could advise and speak with a single voice on behalf of all multihull owners.

To me as a layman with a growing interest in sailing, the formation of a Multihull Safety Agency seems the logical outcome of the work done by the Multihull Safety Study. *Now* is the time for interested parties to get together.

AMATEUR YACHT RESEARCH SOCIETY
Hythe, Kent, England
MULTIHULL ACCIDENT SURVEY AND SAFETY STUDY

ACCIDENT REPORT No. C001.01a

Craft:	HAXTED ARGO II
Type:	Catamaran 31 ft, GRP Prout-built
Date:	1968, July 10
Position:	North Sea Germany: mouth of Elbe River
Category:	Capsize in exceptionally steep seas.

SUMMARY:
Professionally built and well equipped 31-foot sloop-rigged GRP catamaran with experienced and alert crew of four on extended summer cruise from England to the Baltic capsized in high steep seas in the mouth of the River Elbe whilst running for shelter under storm jib with Force 9 onshore winds. Masthead float prevented complete inversion; she filled but remained afloat and righted herself. Crew taken off without any injuries of consequence, craft drifted off and broke up later—possibly because of damage sustained in collisions with the rescue vessel.

HAXTED ARGO II was a 31-foot sloop-rigged GRP catamaran, fitted, at her owner's special request, with a torpedo-shaped masthead float by the builders, G. Prout & Sons. She carried a very full inventory, including a 40 h.p. Evinrude auxiliary and a 4 h.p. Crescent as standby, Sestrel-Moore main and handbearing compasses, Homer HERON R.D.F and a NOVA PAL as standby, safety harnesses for all crew members, a 9-foot Avon rubber dinghy with emergency CO_2 inflation and an R.D.F. 4-man life raft (tied to a cord grid stretched between the two sterns underneath the self-steering device)—and a very sharp knife was always kept in a sheath in the cockpit to be available instantly for cutting the lashings of the life raft, or if the main or jib sheets jammed.

Having had a very good night's rest and an easy downwind passage, with a smooth sea for most of the way, her crew* were in no way fatigued at the time of the capsize. They had had considerable experience of sailing the yacht over several successive seasons, including a crossing from Dieppe to Ramsgate during the early September gales the previous year, when they had found that she could be sailed safely with the mainsail well reefed down and the storm jib set in a rough Channel sea with a beam wind gusting up to at least force 8. The Prout Brothers' dictum about keeping the bows light

* J. H. Buzzard (56), his son (20), A. M. Morgan (20), and B. M. Simpson (20). (*Die Yacht*).

and keeping weight towards the stern had been followed—"the water tanks which are placed fairly far aft were full, which meant 150 lbs. in each hull in the best place, and the Evinrude engine alone weighed, I suppose, about 130 lbs., apart from the other gear carried aft". The cruise had obviously been planned with considerable care. Her skipper carried all the conceivably necessary charts and listened to, and took note of, the weather reports. It was a standing order that any crew member outside the cabin at night or in rough seas had to wear a safety harness fastened to the vessel.

So here we have a well-found craft sailed by an experienced and careful skipper and crew. They left Lowestoft on the evening of July 5, bound for the Baltic via the Kiel Canal which they intended to reach either by the outside route, if the wind was favourable, or alternatively via the Dutch waterways, putting to sea again at Delfzijl—"if the worst came to the worst we were prepared to take the mast down and go as far as Wilhelmshaven via the Ems-Jade Canal". "One notable feature of the voyage . . . was the unreliability of the weather forecasts".

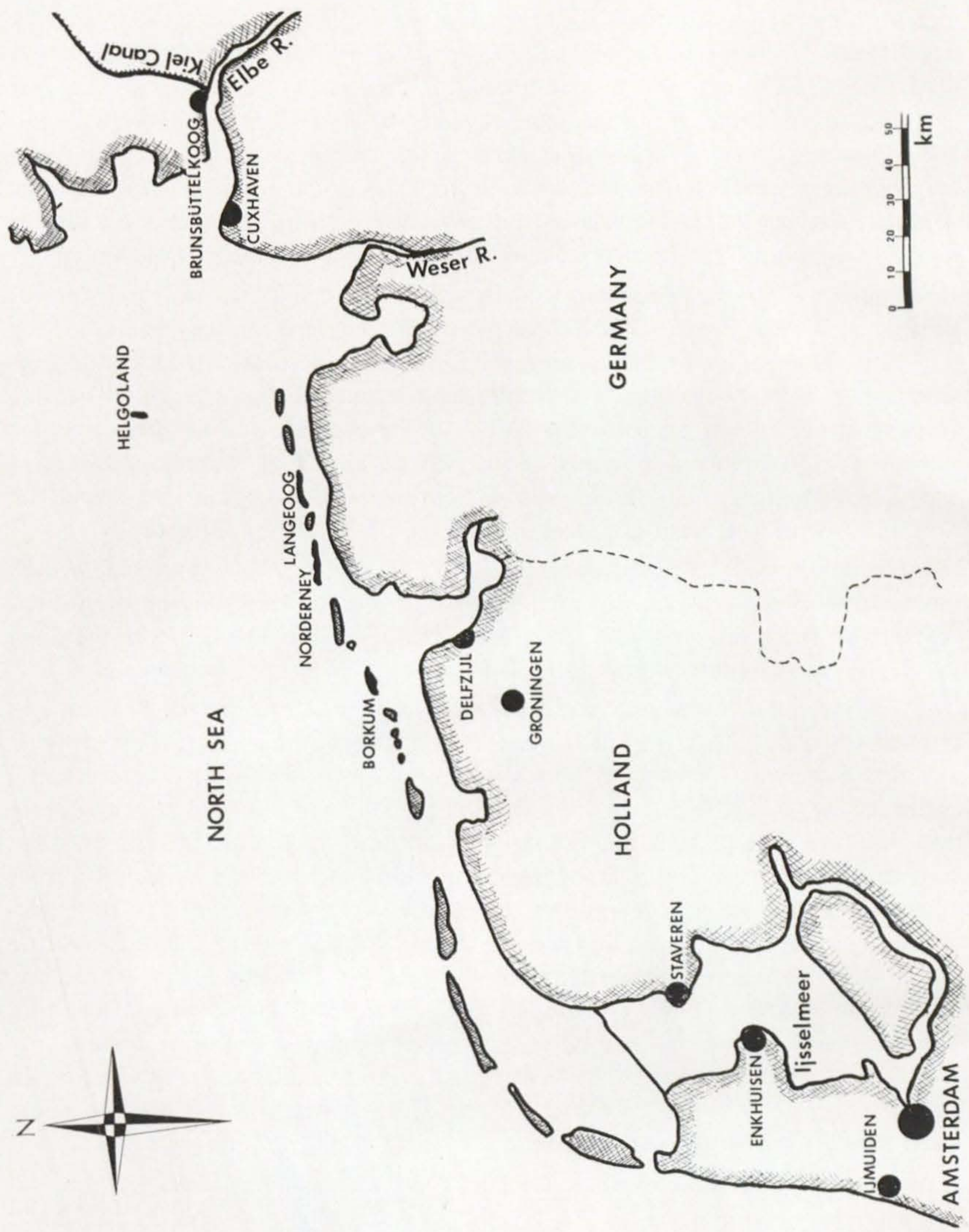
Here is her skipper's account of *HAXTED ARGO II's* last voyage which we decided to present almost in full instead of merely summarizing the salient features of the accident itself. Mr. Buzzard, of course, speaks from memory as all logs and papers were lost with his ship.

"We had a north-easterly wind for the passage of the North Sea, and in consequence put into Ijmuiden on the late afternoon of Saturday, July 6. We had a forecast of easterly winds which made us decide to take the canal route as far as Delfzijl. In fact on Sunday the wind turned southwesterly and we were able to sail through Amsterdam and up to Enkhuizen. On the morning of Monday, July 8, owing to the lack of wind we motored across to Staveren, but after entering the canals the wind, again contrary to expectation, came from the west and we sailed most of the way to the locks a little short of Groningen, spending the night just beyond the locks. Tuesday, July 9, we passed through Groningen and arrived at Delfzijl in the afternoon. We stopped to make a telephone call home and get a special forecast by telephone which promised us continued anticyclonic fine weather with moderate easterly winds. We therefore decided to take the outside route even though the wind was adverse.

We left Delfzijl that evening and had to motor out against the tide via Borkum as we preferred not to try the passage to Norderney in the dark. We spent that night and the next day beating up the North Sea against easterly winds with a falling glass and deteriorating weather. We had in mind the possibility of running to Heligoland but a forecast—the 1758 hours from England, I think—prophesied north-easterly winds force 6, and we decided to go for shelter behind the island of Langeoog where we found a comfortable sandy anchorage. The forecast was right because it did blow hard from the north-east during the night.

In the morning we had a forecast of continued north-east winds gradually backing to south-west and decreasing. The wind in fact changed to south-west as soon as we had heard the forecast and we sailed out between the islands, well reefed down and carrying a storm jib, to see what it was like outside before deciding how much canvas we could carry. In fact we were

*



able to set full main and genoa, at first on the starboard gybe with the genoa boomed out to starboard. When we altered course a little in order to run parallel with and inside of the shipping lane, we came out on the other gybe, and except for a short time when we downed the genoa for a thunderstorm, continued in this way until we were approaching the Elbe One light vessel.

I am not certain whether it was the 1355 forecast or a later one (from some other source) which talked of the wind gradually veering later to the north-west, and possibly growing to between Force 6 and 8. I had in mind always the desirability of not entering the Elbe before the first of the flood, and also the possibility of running to the Jade or the Weser if necessary. I had naturally studied the North Sea Pilot with considerable care, as well as notes in the Cruising Association's bulletins. Again, without a log it is difficult to be exact, but I think that it was when we were about south-east of the Elbe I light vessel, and starting to round the buoys which guard the Schaarhorn shallows, that the wind began to veer and blow harder. The wind increased further and eventually we reefed well down and set the storm jib. The sea, however, was still remarkably smooth.

The 1758 forecast quite unexpectedly prophesied north-easterly winds of Force 7 to 9.

This was really the moment of decision. I calculated, with the aid of large-scale charts and the tidal information upon them, that if we stood on into the Elbe we would be running over the last of the ebb and at no point have more than a one knot tide against us. This calculation was correct as was confirmed later by the Elbe River pilot on board the ship which picked us up. I therefore decided that to go on over the last of the ebb would not involve a risk of dangerous seas. In this I was clearly wrong. I had intended that if we got to the mouth of the Elbe before the start of the flood tide we would stand off and wait for the flood, but the 1758 forecast made this undesirable.

The alternative was to turn back, once the wind veered sufficiently, and run down the Jade, but this involved the risk of being caught out in a north-easterly Force 9 which might have come from some more easterly direction. Heligoland would only have been possible once the wind had gone to the East. At the time the decision was taken, the sea was still fairly smooth and I do not think that the wind could have been blowing more than Force 6. We continued running into the Elbe with a moderate sea running, and it was not far short of the Elbe Two light vessel when the wind increased and the seas got a little steeper. The wind was on our port quarter, so that it must have been a little north of west by this time.

Although the ship was handling easily under heavily reefed mainsail and storm jib, we took down the mainsail and carried on under storm jib alone. Under this rig she was making about 5 knots, except of course when going in front of a wave.

At the actual time of the capsize we had, perhaps fortunately, made up a good bit to port towards the Elbe II light vessel in order to be well placed in case the wind did veer suddenly. Although we were not anticipating any disaster it so happened that at the time of the incident all four members of the crew were in the cockpit and in accordance with normal procedure clipped on by their safety harnesses. The cabin doors, or one of them, were either open or not securely fastened, I think, because I was about to return to the cabin in order to refresh my memory as to the approaches to Cuxhaven, In any event we were not contemplating the possibility of a capsize as we had taken down the mainsail.

When we were about half-way between the Elbe II light vessel and the buoys on our starboard side guarding the Schaarhorn sands a high and steep wave passed underneath us. We went fast down the front of it but the bows rose on the other wide. A second similar wave came along and I think that as we were going down the front of it we all realized that the bows were not going to rise."* In fact the bows went under the water, the three members of the crew who were not at the tiller were flung forward, hitting their heads with very minor injuries against the cabin top, or the cabin doors. The helmsman hung on to the tiller, and therefore remained in his place for the moment. His impression is that water filled the cockpit, coming from the bows over the cabin top.

The ship then capsized to leeward, that is to say to starboard. Two members of the crew felt themselves trapped under water and indeed assumed that they were about to drown. However they soon saw the sea get lighter and emerged upon the surface.

What I think happened was that when the ship capsized the masthead was driven under the water for a moment or two, so that the ship started to turn upside down. The masthead float then asserted itself with the result that the ship was floating on her side. She, had, however, filled with water. While she was in this position, one of the crew succeeded in cutting loose and inflating the emergency life raft. I lit up an orange smoke bomb which was in fact unnecessary, as we later learned that our capsize had been seen by the pilot on board the *DRAKA*, a Dutch cargo vessel of some 650 tons, which was nearby on our starboard side. The time was about 2030 hours, and it was, of course, still light.

At this moment I had the feeling that the ship was going to right herself, and sure enough, almost immediately she did. I think that we were particularly lucky that this happened, and that the fact that she had filled with water probably played a large part in enabling her to right herself.

The question then arose whether we should take to the life raft or stay on the ship. Although she was supposed to have sufficient floatation to enable her to float under all conditions, it certainly seemed to us that she was sinking by the bows, although it may be we were wrong—we were in fact wrong—and that she was merely achieving her equilibrium. I decided, however, that we must stay on the ship until the last possible moment because I feared that the rubber life raft would be driven rapidly by the strong wind upon the Schaarhorn sands. We unshipped the life raft and kept it at hand, and prepared to try and get the water out of the cockpit. We did think of starting the engine but the petrol tanks, which had been loose in the cockpit, had floated away.

* "These notes were dictated soon after the event. On reading this over, and discussing the incident with those more experienced in single-hulled yachts—although I have had quite extensive and varied experience of sailing catamarans of this class in the last few seasons, my only experience of sailing in single-hulled cruisers was crewing in a 70 square meter and a 30 square meter before the war—I think that from a wish not to appear to exaggerate I have not done justice to the conditions. I had never experienced waves anything like the two which I have described. *The second must have been around* 30 *feet high, and so steep that it felt like going down a water chute* It seems unlikely that a conventional yacht would have avoided a capsize."

"The pilot of the *DRAKA* put the wind force at 8 to 9 at the time of the capsize, and some estimated that the wind rose to Force 10+ or even 12 that evening. The following morning an Elbe River pilot told me that in 16 years' experience on the river he had never known a storm blow up so quickly. We heard that no ships put out of the Elbe that night."

"Downing the storm jib and trailing warps might have saved the yacht, but I very much doubt it. In any event the two steep seas came very suddenly."

We then saw that we were drifting rapidly towards the *DRAKA*. We heard later that on seeing the capsize the pilot had stopped the engines with the result that she could not manoeuvre into the wind. She was therefore lying beam to the wind and rolling very heavily. (she was in ballast!). This was a rather unsettling sight, and in fact we motioned her to stand off but, perhaps fortunately in the result, she did not. As we found out afterwards, the *DRAKA* had a crew of only nine, including the captain, and three were in the wheelhouse attempting to control the ship. This only left six free to try and pick us up: I cannot praise too highly their successful efforts in this regard—they obviously saved our lives.

As we got close to the *DRAKA*, members of her crew threw towards us their two circular life buoys secured to ropes, and also put down a rope ladder over the side of the ship. One member of our crew was taken off by one of the life buoys before the two ships touched. A second was taken off in the same way, but at one moment he slipped between the yacht and the ship, and I was afraid that he might be crushed between them, but in fact he was not. I should perhaps explain that the ship was rolling so heavily that at one moment my son, the third member of my crew, could touch the rail of the *DRAKA* and very nearly got hold of it to enable him to hoist himself over, but decided not to in case he could not continue to hang on when the ship rolled over. He got up the rope ladder successfully, and I followed him after an awkward moment when I was momentarily caught perhaps by my safety harness in the rigging of the yacht.

The crew of the *DRAKA* made some attempt to take the yacht in tow but soon abandoned it owing to the high seas running. We heard afterwards that the Elbe II light vessel carried two motor life boats, but as far as we were aware, neither of them was launched*(see footnote) although a Mayday call was sent out by the *DRAKA* as soon as the incident occurred, and it seemed that four other ships were standing by. The rescue would of course have been very much easier by life boat, though it may be that it was decided that the seas were too high to justify a launching. By this time, according to the *DRAKA's* captain, the *DRAKA* was only about 200 yards off the sands. Apart from other difficulties, one or two oil barrels carried on her deck had broken loose and two members of the rescue crew of the yacht narrowly escaped serious injury from one of them.

No one could have been kinder to us than the captain of the *DRAKA* and his crew. As soon as they could spare a man they plied us with drink and later food, and gave us some of their spare clothing etc. The *DRAKA* was bound for the Kiel Canal but the captain offered to put into Cuxhaven. As, however, we had sustained no injuries of any consequence I did not accept, and we were in due course put ashore somewhere round midnight at Brunsbüttelkoog." The rescued yachtsmen found the *DRAKA's* agent, the German police, the agent of the United Baltic Corporation (whom they had already asked to act as their agent), and the British consul general and his staff at Hamburg, very considerate and helpful.

* ". . . Attempts by the Cuxhaven rescue vessel *ARVED EMMINGHAUS* to salvage the wreck were in vain. It drifted away in the direction of Schaarhorn." (*Die Yacht*).

"The only further information which I have had about the yacht consists of a press photograph and a letter from the salvage authorities at Busum to the effect that on the 14th July a broken mast and boom with furled mainsail was salvaged as flotsam, and on July 15th the stern half of the *HAXTED ARGO II* was found. From the photograph, there is a fairly clean break just in front of the entrance to the cabin from the cockpit—the yacht may have been on the sands, broken up, and later floated off. If the legend under the photograph is to be relied upon, both mast and stern half must have been found somewhere in the mouth of the Eider.

The paragraph in *Die Yacht* seems to indicate that some information is available that the yacht broke up soon after the capsize. The only information as to this that I have is that one or two members of the *DRAKA's* crew throught that the yacht had gone under the *DRAKA*, and the captain at any rate expected that his propeller might have hit the yacht. The yacht was of GRP construction and we thought that a tear might have been made in the fabric by a collision with the *DRAKA* or her propeller, and that either subsequent wave action, or being driven upon the Schaarhorn Sands would have completed the process of breaking her in half. The stern half then might have been floated off and with the change of wind and ebb tide been carried to where it was found in the mouth of the Eider.

In view of the likelihood that the yacht was damaged by the *DRAKA* I do not think that any conclusions can be drawn from the fact that at some time she broke in half. If you make a tear in GRP the tear can easily be extended, I understand? I suppose that we were on board the yacht for not more than 20 minutes after the capsize, but she certainly showed no signs of breaking up during that period. I cannot say whether or not the cabin windows were broken."

Commenting on this experience, Mr. Buzzard—who has since acquired another catamaran, built on the same mould as *SNOWGOOSE*—comments:

"If the *DRAKA* had not come to our rescue so quickly, we should, I think, have easily been able to drop an anchor and waited, with the rubber dinghy ready to get in. The anchor might well have dragged in those conditions, and perhaps the boat might have become untenable if the anchor had not dragged, but this might well have given us time for the motor life boat to reach us if it had been launched. We had at hand, and could easily have put into the life raft, the emergency R.T. and water can, and a bag of emergency rations, flares, and such like.

I have always said that while a catamaran may capsize it won't sink, whereas a deepkeeled yacht won't capsize—generally—but will sink like a stone if holed, and on balance I prefer the catamaran's risk. I am still of the same opinion, *provided* that catamaran has masthead flotation or the equivalent."

(1) Report and letter received from Mr. J. H. Buzzard, *HAXTED ARGO II's* owner and skipper.
(2) A short news paragraph in *Die Yacht* of 8 August 1968, p. 4.

AR/T 002.00a.
July 1969

AMATEUR YACHT RESEARCH SOCIETY

Hythe, Kent, England

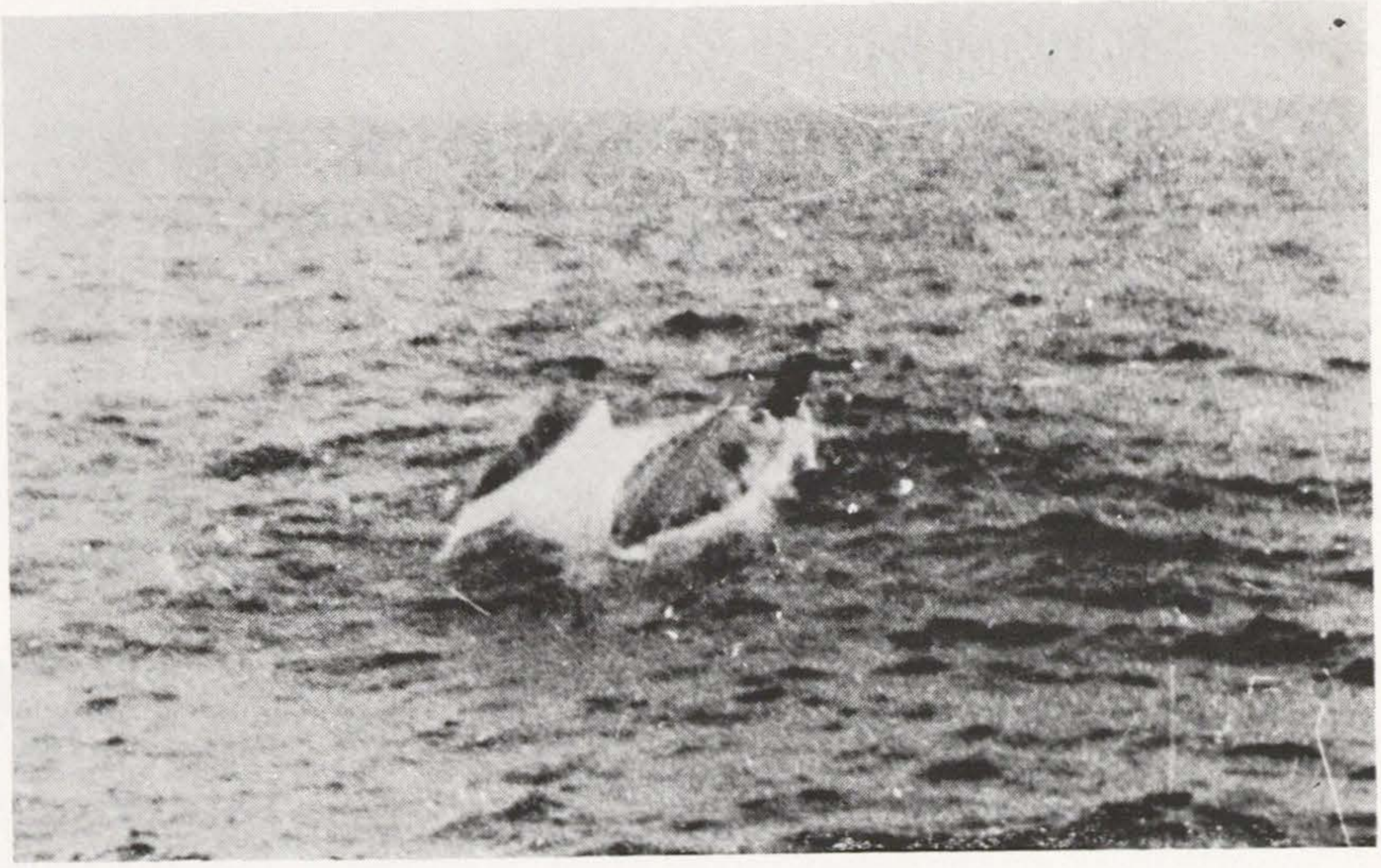
MULTIHULL ACCIDENT SURVEY AND SAFETY STUDY

ACCIDENT REPORT T.002.01a.

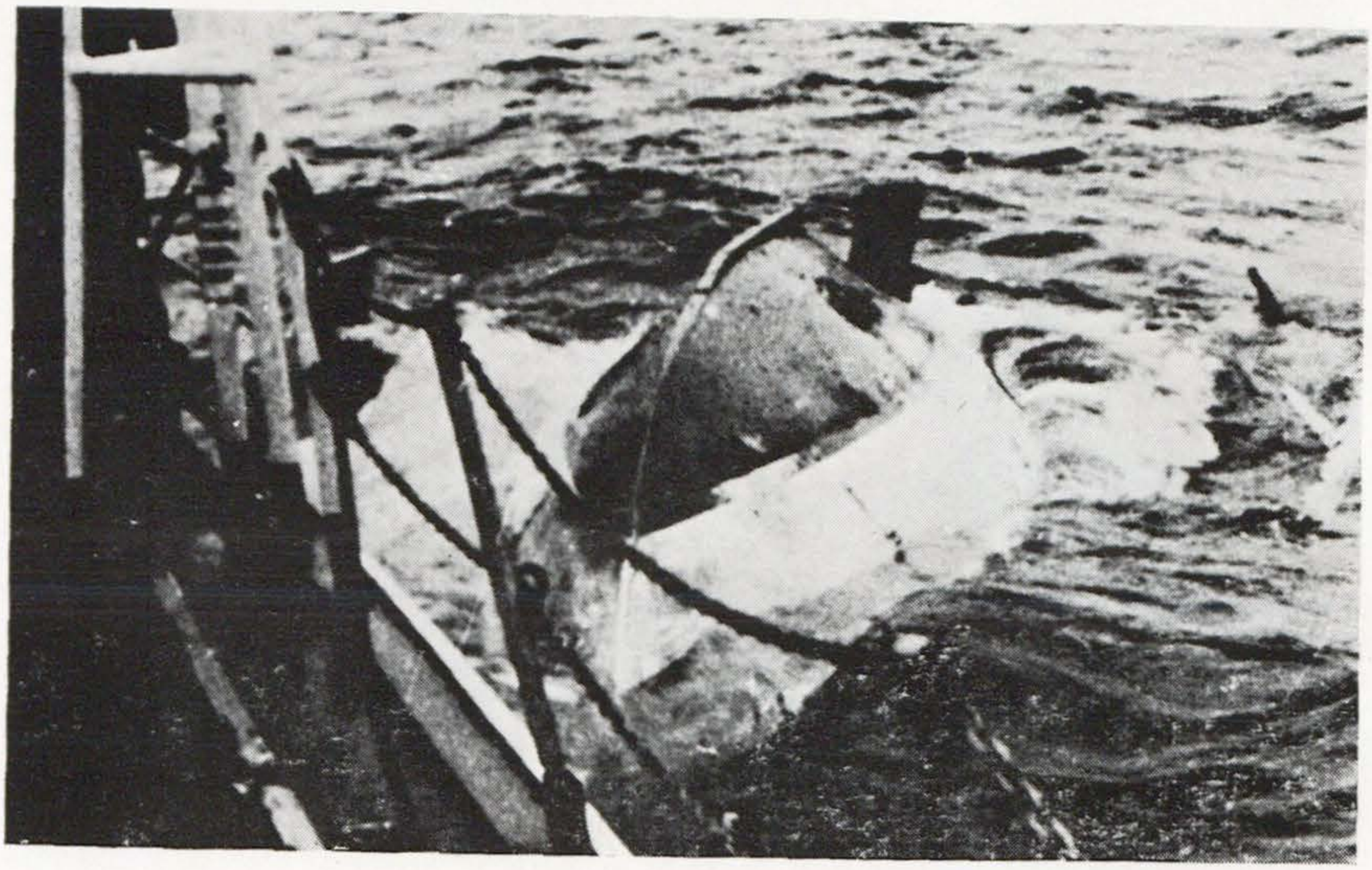
Craft:	*? PATHFINDER*
Type:	Trimaran in the 25-30 foot range.
Date:	probably 1968, May
Position:	Pacific Japan: off East coast
Category:	Not known. Abandoned wreck.

SUMMARY:

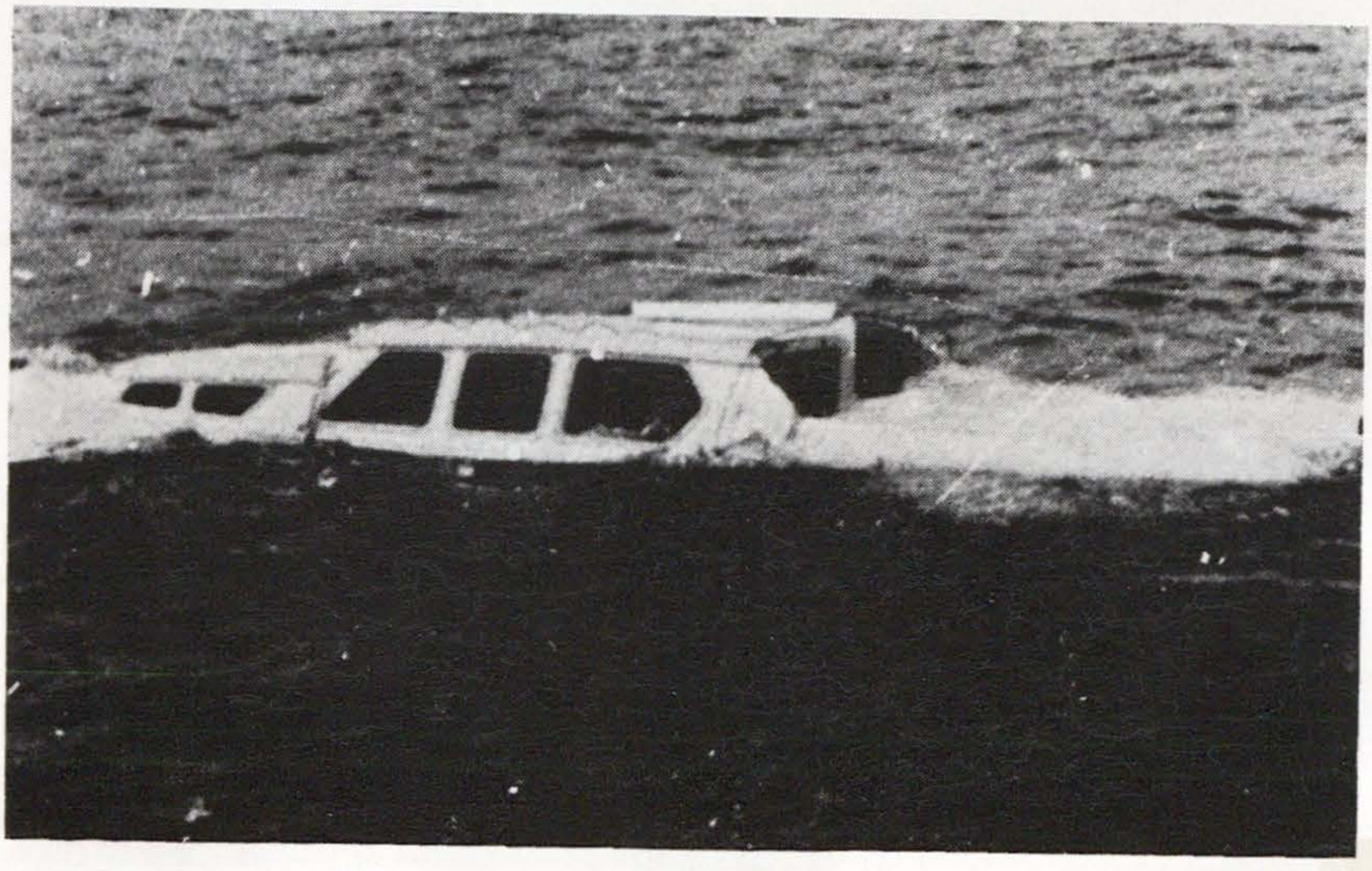
Abandoned, nameless wreck of trimaran in the 25 to 30-foot range, capsized, dismasted, starboard float missing: presumed to be *PATHFINDER* (4 crew).



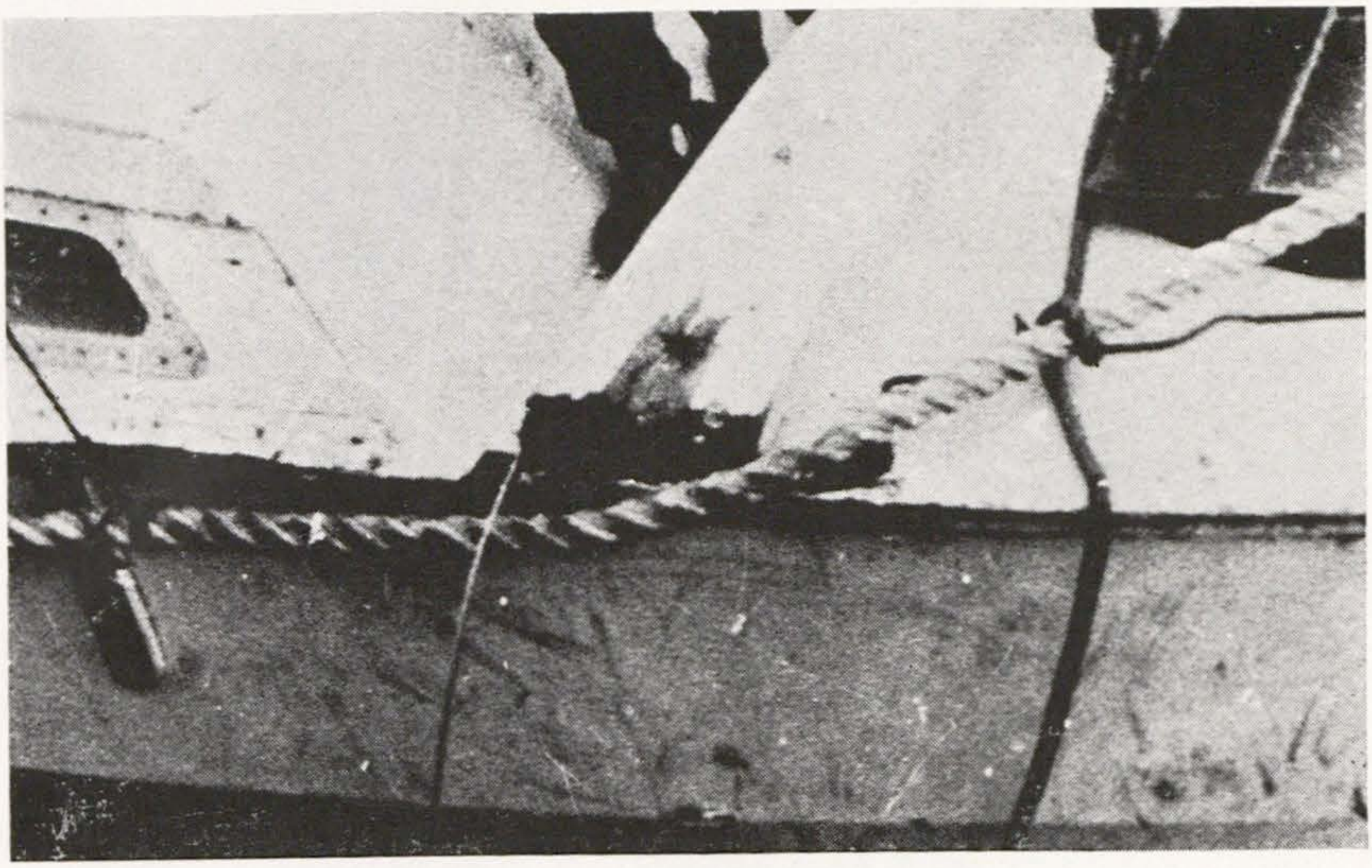
Capsized craft when sighted



Capsized craft alongside examining vessel

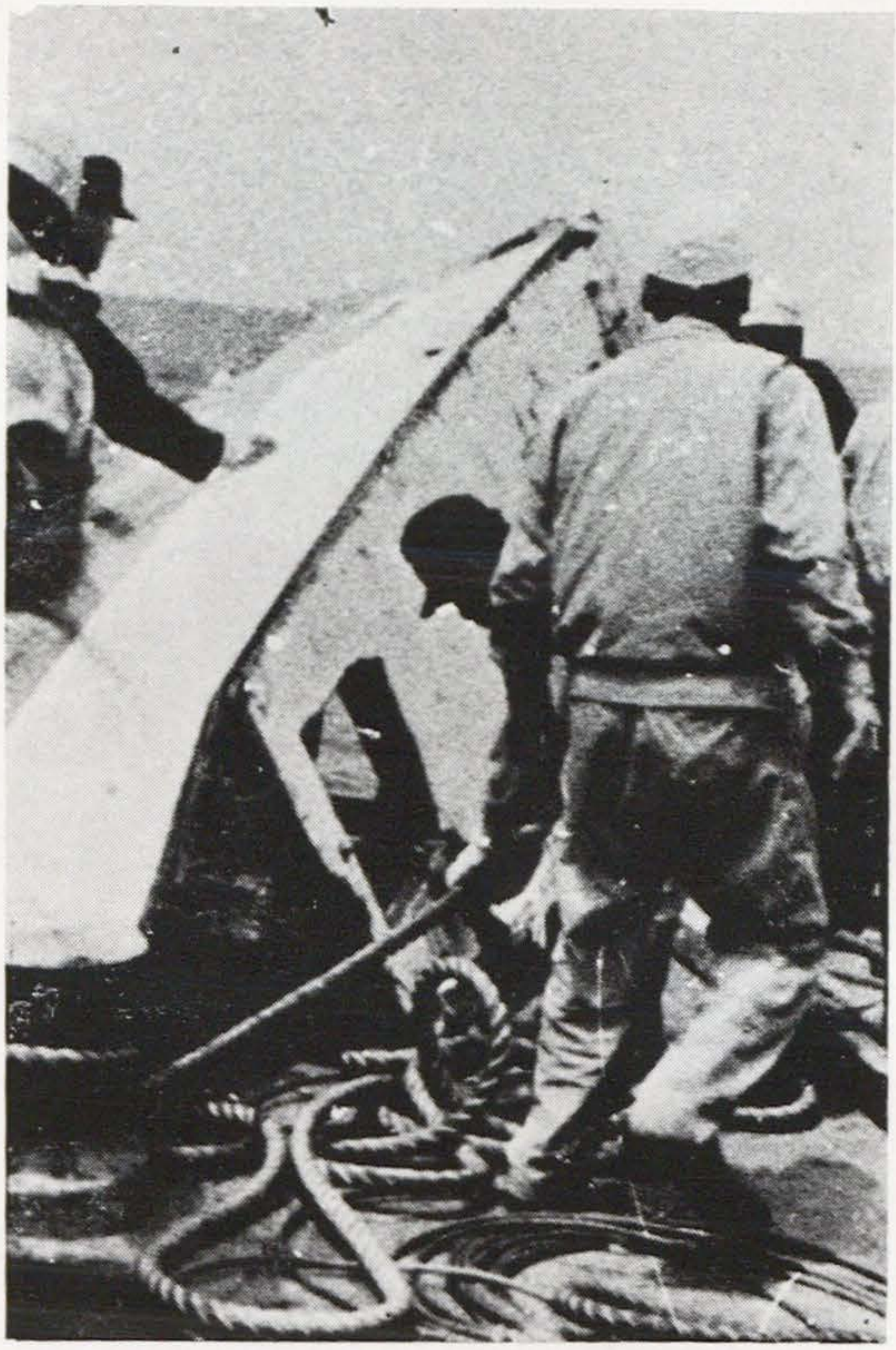


Derelict righted but still waterlogged



Broken cross-arm

Wreck pumped out



One of the floats on deck

Items found aboard

On May 26, 1968, a nameless trimaran—abandoned, dismasted, and capsized, with the starboard float missing—was found by a Japanese whaler, some 200 miles East of Sendai (East Coast of Japan). To our knowledge there has been no trace of survivors. The wreck was subsequently examined by the Japanese Maritime Safety Agency.

It appears that the wreck is *presumed* to be that of the trimaran *PATHFINDER* for the following reasons:

(a) From articles recovered after pumping out.

(b) *PATHFINDER* which had previously sailed from Auckland, New Zealand and was apparently home-built, left Enoshima on May 10, bound for Vancouver with a crew of 4, despite Maritime Safety Agency warnings in view of inadequate safety equipment—apparently she carried no radio transmitter, and the only emergency buoyancy provided for her crew consisted of 4 life jackets. Very bad weather occurred around May 13-14, and about this time *PATHFINDER* might well have been in the area where the wreck was found.

On the very scanty information received the theoretical possibility of damage from an unreported collision cannot be ruled out.

Letter from Dr. Brian Whipp, July 1968.

AR/C 003.00A
July 1969

AMATEUR YACHT RESEARCH SOCIETY
Hythe, Kent, England
MULTIHULL ACCIDENT SURVEY AND SAFETY STUDY

ACCIDENT REPORT No. C 003.00a

Craft:	*EN AVANT*
Type:	Catamaran 36 foot, *Snowgoose* type.
Date:	probably 1968 or 69.
Position:	Pacific New Zealand: mouth of Tamaki River
Category:	Capsize due to unfamiliarity with this type of craft.

SUMMARY:
Whilst being raced under main, staysail and Yankee by an experienced keel-boat man, the 36-foot catamaran lifted a hull after tacking and subsequently capsized slowly—appropriate action having been delayed too long. Complete inversion was prevented by the mast hitting bottom. One crew member injured in a fall. The craft was towed ashore with a broken mast, and repaired.

The craft was sailing very fast under main, staysail, and Yankee (quite small but set high) and lifted a hull after tacking whilst being raced by an experienced *keelboat* yachtsman. He pulled her off harder and she came up more; too late he realized that he was not sailing a keeler. She went up to 80° where she hung for something like 2 minutes, then went over slowly. Her mast hit the bottom and prevented complete inversion.

One crew member had fallen into a back stay and was in a bad way with a badly gashed head. Thus salvage attempts were left for some time whilst the injured man was sent off to hospital. The photograph, taken about ¾ hour after the capsize, shows her with starboard hull swamped.

An attempt to tow her upright from the port bollard of a powerful launch failed. Eventually she was towed ashore, with a broken mast, where she was pumped out. She is now back in commission, "none the worse, with all new gear inside at considerable expense to the insurance company."

The accident was reported by her owner who witnessed it from another boat close by.

OWNER'S COMMENTS:

EN AVANT, a 36-foot *Snowgoose* class catamaran was launched in December 1962, and had been sailed extensively for 6 seasons round the Wauraki Gulf and the East coast of New Zealand's North Island. The owner's wife did not care for the sailing angles of keelers, and "in this respect this catamaran proved to be definitely the answer".

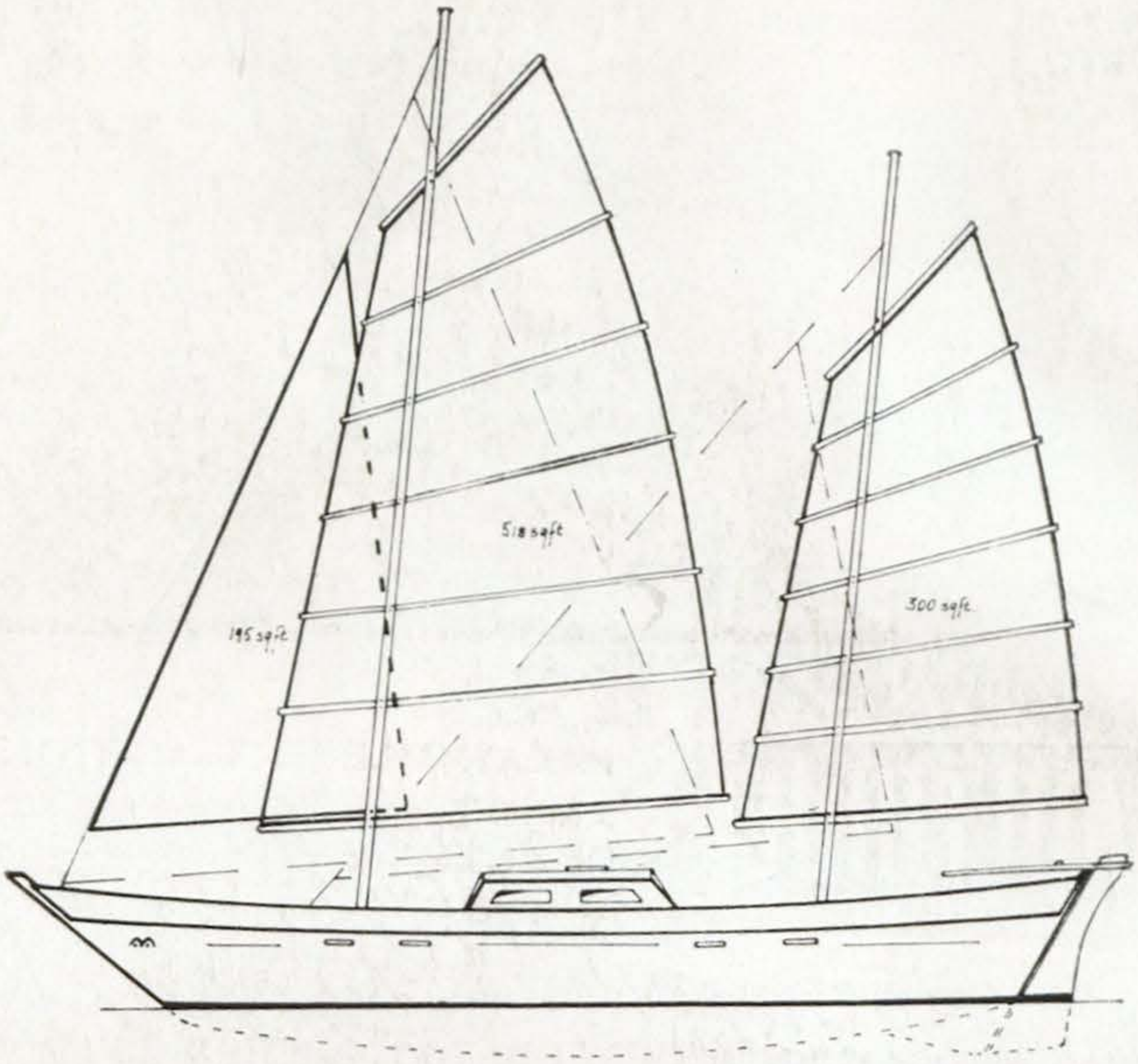
She proved herself very fast in passage as well as in buoy racing, and many point to point passages reached at average speeds of 16 to 18 knots—clocking 24 knots while flat running with a 1,500 square foot spinnaker. "I have driven her hard on many occasions, and felt safe as long as the speed was high. The only frights I have had have been when others have had the helm". On two occasions the hull suddenly lifted while racing hard on the wind, and dropped back down after reaching an angle of about 45° and hovering for some moments.

Mr. Williams, Commodore of the Panmure Yacht Club, Auckland, who has had considerable ocean racing experience (25,000 miles) is "still confident that properly sailed she is still a good proposition for Gulf sailing and under most conditions, . . . but would prefer to face storms at sea in a well-found keeler, especially when racing".

And here, without further comment, is Mr. William's concluding remark: "Should you know of anyone interested, *EN AVANT* is for sale—cheap."

Letter from her owner, Mark M. Williams, February 1969.

TEHINI



JAMES WHARRAM

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