SAIL RIGS

A.Y.R.S. PUBLICATION No. 26

The "BACK" Rig

CONTENTS

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EDITORIAL

August, 1959

The Printers Strike. This publication is more than a month late due to the strike of English printers. Indeed, most of the publications for this year have been late owing to the previous " Go-slow." It is hoped that we can now once again get our publications out on time.

The Wind Tunnel and Test Tank. These progress, if slowly. We have got a 12 foot 6 inch diameter ex-aeroplane propellor free and instruction for putting it up will follow. This comes from Messrs. ROTOL. There will be no trouble about a diesel engine. It will be put up so that, if the 15 foot high wind tunnel is a success, we can then make the 27 foot high one of publication No. 24. The ground is now cleared for the test tank at *Woodacres* and digging could commence anytime. No start has yet been made but the preliminaries are all being dealt with.

Mrs. Evans reports progress with the research fund which is slowly mounting.

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SAIL RIGS

In our previous publications on sails and aerofoils (Nos. 9, 14 and 17), there was some difficulty in getting material to cover the ground at all well. For this publication, on the other hand, we have really got many ideas and sail rigs which have been tried out in actual sailing boats. As a result, the publication is lively and more vitally interesting. Many of the rigs show a promise of increased efficiency but the only one which seems to be better than the sloop rig is the " Mast aft-'Back' rig " which gets rid of twist and has all the canvas in a single sail.

SOME RIG EXPERIMENTS

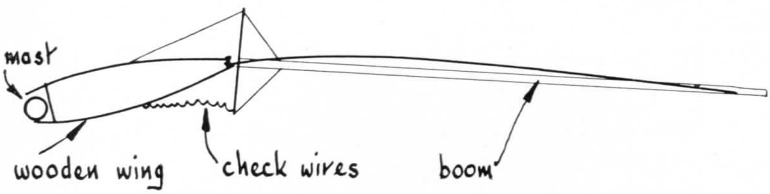
by Donald Robertson

Like many other people I thought that some of the vast knowledge which has now been obtained on the flow of air over wings and other surfaces could be used to advantage in improving the performance of a sailing boat. I therefore made one or two models to try some wing sails but very soon came back to the conclusion that it was essential to control the boat oneself in order to obtain any useful information.

The outcome was a 15 ft. boat called *Fun* which has been described in Publication 23, *Outriggers*, 1958. The wing sail consisted of a 20 ft. tapered symmetrical section wing mounted on a 16 ft. hollow mast about which it could revolve, the mast forming the leading edge.

A soft canvas sail with a bolt rope could be hauled up the hollow groove in the trailing edge of the wing section. The proportions were : fabric covered wooden wing area 30 sq. ft., canvas sail 60 sq. ft., making a total mainsail area of 90 sq. ft. The foresail was conventional, 30 sq. ft. in area.

The boom was attached to the bottom of the wing, but lateral movement was checked and the angle could be controlled to prevent a movement of more than about 20° either side of the centre line of the wing section (see Fig. 1). There was also a method of preventing

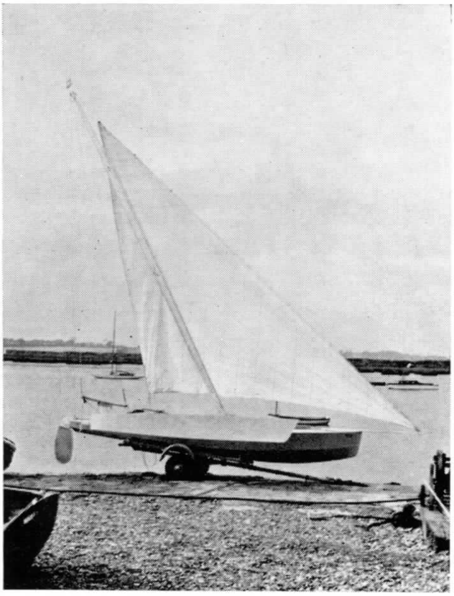


the boom lifting similar in effect to a kicking strap. The main sail which was loose footed could be hauled out to any degree of tautness by a wire running over a cam shaped lever. The idea was to provide an efficient leading edge and a sail with a variable camber without twist at the top.

To erect the wingsail, the wing was held at the lower end and then more or less " flown " into the vertical position. It was then lowered on to the top of the mast about which it could revolve. This operation needless to say required a steady gentle wind. It also had to be lowered overnight as it would oscillate violently from side to side unless checked.

Under sail the performance of the boat was not too bad but it had one fundamental snag. The wing portion of the sail was very rigid fore and aft, but the soft sail always had a large amount of flow about halfway up the mast. With a conventional rig this flow can be reduced by hauling down hard on the main sheet and bowing the mast slightly but in this case it was not possible. It might have been possible to recut the sail to overcome this but a woven cloth held along one side and pulled out at one point does not give a true arc, but tends to go baggy under pressure from the wind. In addition the weight of the wing plus the sail is bound to be more than a conventional rig and in a sailing boat the area of sail determines the power, whereas any additional weight in the mast reduces the ability to carry sail !

After sailing the boat and carrying out some experiments on the hull with a conventional rig, it was decided to try a lateen type of rig. A single large triangular sail mounted on a wire running from a bowsprit to a raked mast was tried. The object was to obtain some upward lift from the sail when reaching. It is clear that a single sail on a vertical mast gives a downward thrust to the bows as well as a capsizing moment. If, however, a sail was mounted horizontally like the wing of an aircraft it would give lift. Somewhere between the vertical and horizontal position of the leading edge should therefore give lift and forward thrust, and if the sheet of the sail could be held well to the leeward side of the boat the capsizing force would be reduced.



Fun's jib rig

The boat was only sailed twice with this sail. The first trial in a light wind showed that the boat was well balanced on the helm and went about normally. It was difficult to tell how close winded she was but there did not appear to be any change from the previous conventional rig. She was not close winded, but as previously mentioned, the air resistance of a trimaran is considerable and this was increased by the need to have a special cross beam on which to sheet the sail. In a strong wind the boat appeared to be faster on a reach but only a very limited test could be made as the mast started bending and would obviously have broken if the boat was pressed. The end loading of the mast with a relatively large sail (120 sq. ft.) on a long wire is very considerable and although this could have been overcome it happened to be the end of the sailing season and no further tests were made. I felt that the results were promising.

I next built a catamaran called *Snap* which will be described in a later publication. She had a conventional sloop rig of 170 sq. ft. with which she sailed a full season. During the winter I decided to re-rig her with twin masts, one on each hull. The masts were mounted well forward on the decks and raked aft at 10°, each carried a fully battened mainsail of 85 sq. ft. which was controlled from a separate horse. Each horse had a travelling slide fitted with a jam cleat from the main sheet and the lateral movement of the traveller could be controlled by the helmsman with a separate rope. The rig was carefully made and looked strong and businesslike.

The object of this rig was to improve the performance of the boat close hauled and to avoid the work entailed in handling a large foresail when tacking in a tidal river. The sails were cut rather flat as the previous mainsail had also been flat and the boat had always sailed best in a strong wind.

The fore and aft position of the centre of area of the new rig was the same as before but it was found that the boat carried more weather helm and the masts were accordingly re raked to 8° and this had the desired effect. In a light wind the boat felt under-canvassed and was slow, although the sail area was the same as before. This may have been due to the flat cut of the sails but the weight of the two masts two booms etc. was also an additional adverse factor. However in a strong wind she went to windward very well indeed, very close and fast through the water. Tacking was easy and quick. On a reach the performance was disappointing not, as one might expect, due to interference between the two sails but due to the bow being pushed deeply into the water, this was a serious snag which had not been anticipated. The boat on its fastest point of sailing was slower than before.

When running each sail was boomed outwards, i.e. on opposite tacks, thus confusing the racing rules ! The boat ran well before the wind, but if possible down wind sailing is to be avoided with a catamaran as it pays to start a very broad reach and bear away. This manoeuvre is not practicable with the twin rig. Interference between the sails did not appear to me to be a major adverse factor as it is always possible with a catamaran to avoid a wind dead on the beam. This is due to the fact that the speed of the boat is so much faster

Snap with twin mainsails

with the relative wind ahead of the beam and on bearing away the boat's speed drops suddenly causing the relative wind to become a following wind.

Another reason for trying the twin rig was that the height above the water of the centre of pressure is lower than the equivalent area sloop rig using the same aspect ratio, and it was thought that there would be more forward thrust before the weather hull lifted. As far as one could judge this appeared to be true but on more than one occasion when a hull did lift in a puff it came up suddenly without warning and the boat very nearly capsized. In my opinion it is essential to have warning of a capsize in a catamaran by having a sail plan which lifts a hull gradually and spills the wind in good time. For cruising or sea going boats it is obviously most important.

From the foregoing it will be clear that the twin rig was not as successful as I had hoped and so I reverted to the original sloop rig but ordered a fully battened mainsail of larger area (142 sq. ft.) instead of the soft sail of 102 sq. ft. It was also decided to try a foresail mounted on a pivoting boom as used by some canoe experts. With the foresail rigged like this it required no handling when tacking, remains relatively flat even when broad reaching and, when running, can be goose-winged out very quickly without any fumbling with spinnaker poles or guy ropes.

This rig was most successful particularly reaching and running. Close hauled in a strong wind it was also most efficient, but in a light wind the boat would not sail very close. From more recent experience I put this down to a mainsail which was cut very flat and to a fault in the hull design, namely lack of centreboard area.

In an attempt to improve the windward performance a wooden luff was made for the foresail to reduce the sag in the luff. This was effective in keeping the luff straight but did not seem to make any difference to the ability to get to windward. The revolving wooden luff was found to be most convenient for stowing the sail, as it can be both difficult and dangerous in a catamaran to go forward at sea in order to stow a wire mounted foresail.

Before laying the boat up at the end of the second season I decided to have another try at a lateen rig. This was a single triangular sail of the same area as the original sloop rig (170 sq. ft.) It was mounted on a streamlined revolving spar which raked aft at 30° and the clew was held by a wishbone boom. The raked spar was held in position by two struts attached at their lower ends to the shroud plates and bolted together at the top. About 12 in. from the top there was a short cross beam against which the raked spar could press and roll from side to side.

The first sail with this rig was disappointing as the support struts started bending near the mast and the wishbone boom was obviously too weak. Also the boat carried too much weather helm.

These struts and the boom were strengthened and the mast rake was altered to 28° before the second sail. There was a lot of wind and as it was late October and time was limited, only two further tests were made. The boat sailed reasonably well, it went about normally, but

Snap's bipod lateen

if by carelessness one got into stays it was difficult to get sailing again as it drifted sideways and aft and seemed to take up a stable condition. She seemed to sail as close to the wind as with a sloop rig and was as fast off the wind as normal but not faster. During a run the sail was not good as it spilled the wind badly and there was a lack of driving power. During another sail the mast was strained and no further tests were made.

In my opinion the lateen rig has possibilities for special boats as it can undoubtedly be made to give lift which is probably the best way of reducing water resistance and obtaining higher speed. For instance in a competition for speed only it might be highly successful. However for a race round a triangular course where a good compromise under the various conditions is called for, a sloop rig is very hard to beat.

On my next boat, another catamaran *Freedom*, I tried to make some use of these experiments. I decided on a sloop rig but with a revolving mast mounted relatively far back (in the centre of the boat) in order to be able to increase the foresail area and obtain lift in the bow. As before, the foresail was mounted on a pivoting boom with a wooden luff. The main sail area was also increased to the maximum possible on a 25 ft. mast. The final areas were foresail 75 sq. ft., mainsail 170 sq. ft., a lot of sail for an 18 ft. 6 in. boat.

As the reader will appreciate, having made all these experiments I have come back to a more or less conventional sloop rig as being the most efficient all round compromise. For any given area of sail the sloop rig is very strong in relation to its weight, and it seems to me that the best field for development is a method whereby a very large sail area can be reefed quickly and simply, and after reefing still

Freedom's foresail

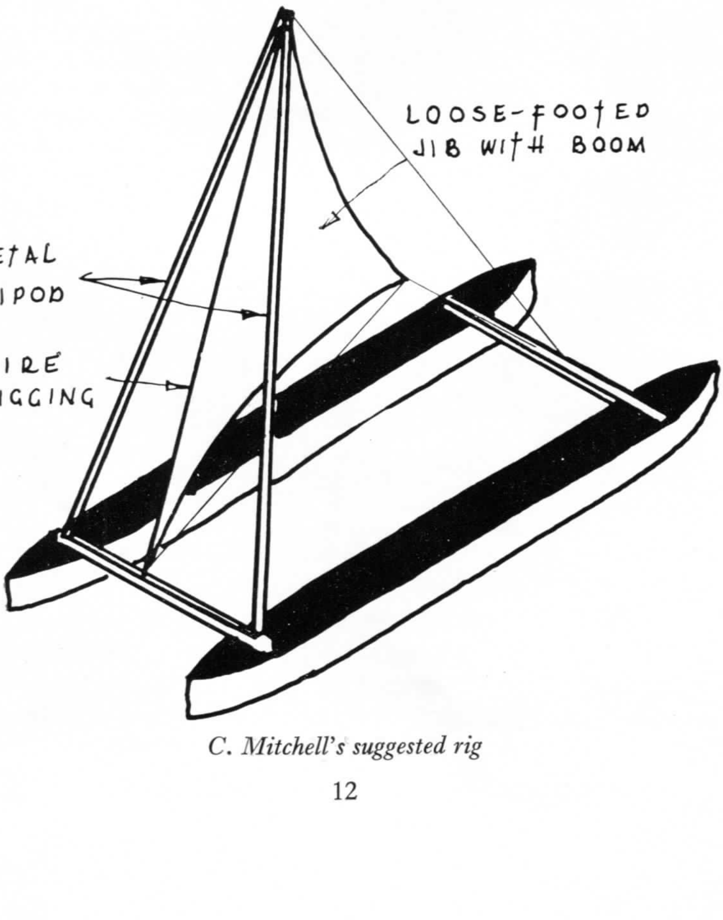
remain efficient. At the same time the reefing must not cause any change in the balance of the boat. Obviously this can be done in the case of a cruiser by changing sails but for inshore racing round buoys some improved method of roller reefing might be satisfactory. Roller reefing is however not too happy with fully battened sails and these are almost a necessity in order to get a large roach area and to eliminate flogging when tacking.

A CATAMARAN UNA RIG

devised by C. Mitchell

The lateen rig in all its conceivable variations will always hold a place of esteem in the minds of yachtsmen. Several different types of it are described in this publication and accounts of its use in one form or another are constantly being sent to me.

When putting about with the classical lateen, the sail is gathered up by one of the crew walking forward on the lee side, passed in front



C. Mitchell's suggested rig

of the yard and allowed to fall back on the new lee side. In strong winds, the craft is gybed and the sail got on the other side by that means. Lateens on Lake Geneva and in the Western Mediterranean and elsewhere are content to have the mast on the lee side of the sail and put about like a balanced lugsail to which generic type the lateen sail can be said to belong.

Any eddies created on the lee side of any sail are a source of inefficiency and eddies from a mast on the lee side of a lateen sail must spoil the airflow to some extent. The vast majority of modern applications use a bi-pod mast with the " legs " at some distance from the sail and hope by doing this to avoid spoiling the airflow over the sail. In practice, however, none of these lateen-like sails have proved to be superior to a normal sloop and, until they are accurately tested in the wind tunnel, we will not be in a position to know why.

This version by C. Mitchell seems to me to be an excellent one. It is suggested for use on a catamaran with a resultant wide base for the bi-pod mast and hence little upset to the windflow over the sail. The light alloy pole masts would be cheap and nicely placed to tension up the forestay. The boomed sail would sit well and give lift to the bows when on a beam reach—probably very necessary owing to the forwardly placed weight of the masts. It would be well worth trying. However, a traditional lateen rig should also be tried to see if it would be faster than a sloop and the more usual version of a lateen sail set on a short, bi-pod mast, fully battened and boomed is also worth studying.

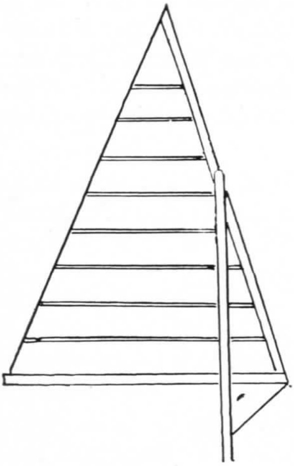
THE LATEEN RIG

The traditional lateen rig is undoubtedly very efficient and could easily be faster than the Bermudian sloop if properly made. The rules for its construction are as follows :

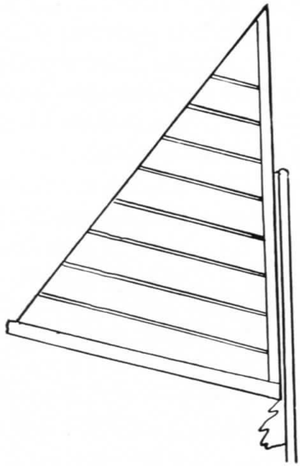
1. The vertical height should be twice the distance along the boom. This gives an aspect ratio of 4 : 1, using the formula $\frac{\text{Luff}^2}{\text{Area}}$.
Owing to the partial sea reflection, this might be equivalent to a full aspect ratio of 6:1 in free air.

2. The peak of the sail should be placed vertically over a point 40% of the foot from the fore end. This gives a vertical aerodynamic axis to the sail.

3. A boom with a kicking strap to hold the boom down should be used.



Traditional lateen



Putting about

4. The sail should be fully battened.

5. The yard should be put on the lee side of the mast on each tack. This can be accomplished by pulling back the tack of the sail so that it comes aft of the mast and it will then go to leeward as the wind comes on the other side of the sail.

In my opinion, lateen sails with a low aspect ratio or greatly "swept back" or with bi-pod masts must be less efficient than the traditional lateen sail.

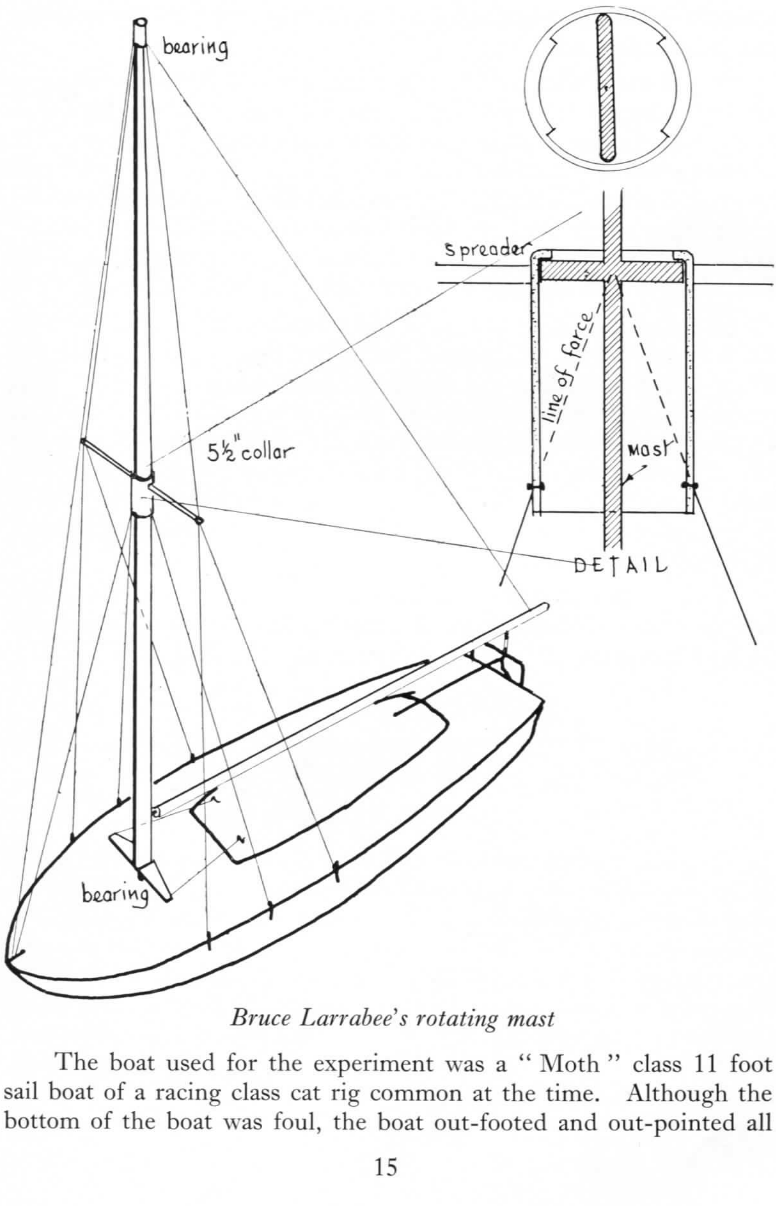
THE FLAT MAST TRIAL

by Bruce M. Larrabee

256½ Second Street, Lakewood, N.J.

Ever since reading Professor Edward Warner's thesis on the aerodynamics of sails, a lasting impression was retained about the effect of air turbulence caused by the mast of a sail boat. The conclusion drawn from the test was that the negative unit pressures on the lee side of a jib were 1.75 times that found on the lee side of a sail close hauled behind a mast. While no attempt was made to correlate the difference of pressure under increased velocities, it is reasonable to assume the ratio would increase with higher velocities of wind.

An experiment was conducted by constructing a flat mast 1 1/8 in. x 5½ in. in section which was fastened by 9 stays with a collar and bearings, top and bottom. This permitted the rotation of the mast about its axis. The flat part was set at 45 degrees to the keel line for close hauled sailing and parallel to the keel line for sailing before the wind.



Bruce Larrabee's rotating mast

The boat used for the experiment was a " Moth " class 11 foot sail boat of a racing class cat rig common at the time. Although the bottom of the boat was foul, the boat out-footed and out-pointed all other boats in the race and was first around the barrel to windward after the start. So much for performance.

The position of rotation was controlled independently of the boom. Structurally there were problems. When the air freshened, the mast would tend to buckle and eventually broke by the buckling stresses encountered.

The 9 stays were attached in a manner which set up moments tending to buckle the mast. If the stays attached to the collar are so placed that the line of force goes through the center of the ring of the collar the bending moment caused by the tension on the collar will be greatly reduced. Originally, the wires were fastened to the rim of the collar where the spreaders were attached and the stays which went to the top were attached to a flat washer on top of a ball bearing. This also set up a bending moment tending to buckle the mast.

A cylindrical fitting as a collar will afford a point of attachment for the wire stay which will permit the line of the wire to be from the center of the ring where the ring bearing attaches to the mast. This cylinder will of course cause some turbulence in the immediate area. The top bearing could support a cone shaped fitting also to bring the line of force to the center of the bearing on the top of the mast and lastly a set of spreaders half way between the collar and each end of the mast would further resist buckling and not give too much turbulence effect to the air below.

The Zephyr aluminium masts have been a step forward in the reduction of turbulence from the angles. The relative diameter is reduced and some of these masts rotate with the boom.

THE SURPRISE

by George W. Barker

In 1951, when I was Commodore of The Waveney and Oulton Broad Yacht Club, one summer Sunday I was sailing my half-decked sloop *Lutra* on Oulton Broad in company with some Waveney one designs, Oulton Broad *Gulls* and dinghies when the queerest contraption I had seen for a long time, attached to a national dinghy hull, appeared at the west end of the Broad and ran down to the lock buoy. She was running with her bow well up and a glance at her lifting sail disclosed the reason. With a tall thin mast stepped aft and raked aft, she had a single triangle sail tacked to what looked like an outrigger forward of her stem, with the head attached to a halliard at the masthead. The helmsman was sitting abaft the mast in what appeared to me to be a somewhat cramped position. Off the wind she was going very fast but her unusual apperance caused considerable merriment among those of us with orthodox ideas. We thought she would be useless except for running before the wind and had visions of the occupant lowering everything at the end of the run down in order to row back.

I recognised the helmsman as my friend W. E. Back of Mancroft Towers, Oulton Broad, as he rounded up with *Reynard* and came on my lee a boat's length away. I smiled to myself about this because there was no boat on the Broads that could outpoint *Lutra* on the wind ; what hope had this strange object? Still I liked Ted Back's cheek, but I wished he had come up to windward to give himself a chance. I gave *Lutra* a good " full and by " and waited for *Reynard* to fall away further to leeward and drop astern. *No such thing happened.* Instead, I was amazed to find the two boats getting closer together. I had to luff *Lutra* into a pinched position to keep clear with the result that she lost way and *Reynard* slipped across her bows and well out to windward of her course. It took some little time to believe that, in fact, this new contraption had beaten my boat at her own game. I yelled my congratulations and asked for confirmation with another trial.

This time *Reynard* came on the wind dead astern getting all *Lutra's* dirty wind and water with the result that she had no hope of overtaking to windward. However, by bearing away and using the dinghy's faster "get-a-way" (*Lutra* has about 15 cwts. of lead to move) *Reynard* went through *Lutra's* lee some way off and luffed up, repeating her previous performance.

I am a little conservative about boats and rig. Nothing would have induced me to be other than scornful of this innovation except performance quite out of the ordinary such as I have described.

THE " BACK " RIG

The previous article by George Barker refers to a " Mast-Aft " rig developed by W. E. Back, Mancroft Towers, Oulton Broad, Suffolk.

In this rig, all the canvas is in one sail which is an enlargement of the balanced foresail which has been in use for many years. The sail is attached below to a boom which is on an axle pointing at the peak halliard block and is hoisted flying, there being no forestay or lift to the aft end of the boom as used by Donald Robertson.

The " Back " rig

The cover photograph shows that the sail is completely untwisted, the luff and leech making a triangle. The above photograph shows that the wind will strike the lower surface of the boom along its length and thus do away with some at least of the boom eddy.

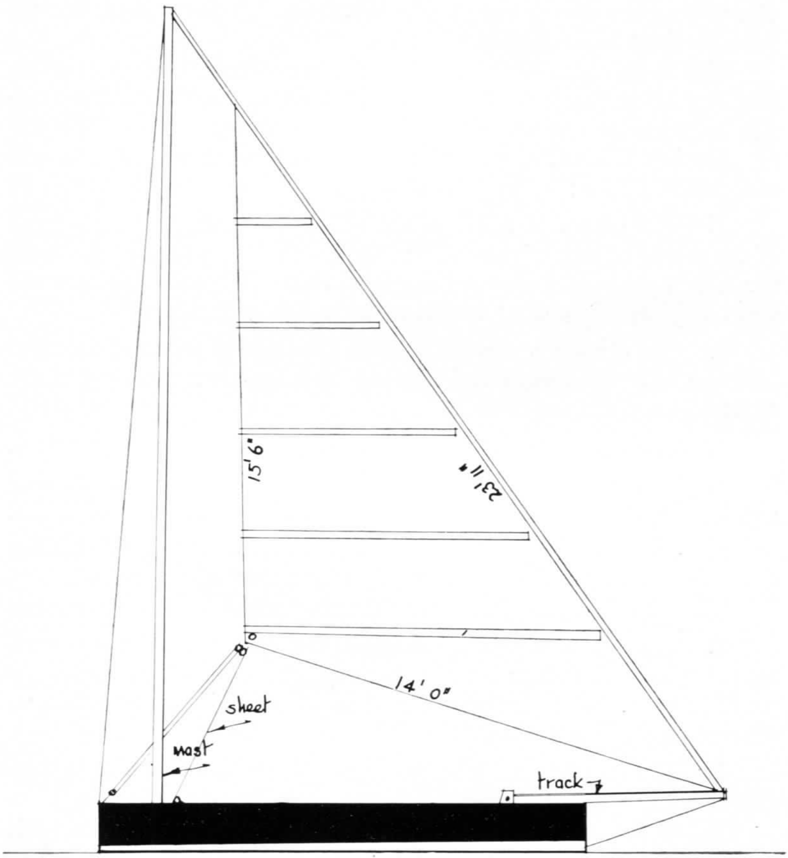
Efficiency. This sail should be an efficient way of setting canvas, the main virtue being the absence of twist and the accumulation of all the area in one sail. The pivot for the boom must be about 25% of the chord from the fore end to cause the sail to fly out on all courses if the sheet is let fly. As far as handling goes, no rig could be easier. Mr. Back has a patent on this sail which depends on the pivoting of the boom.

A MAST AFT RIG

by Bruce M. Larrabee

During 1958, a " Mast-aft " experimental sail was designed and constructed which uses a single flying jib on a *Jet* 14 racing hull. Since the mast is 18 inches from the transom, the boat has been named *Bassakwards*.

The sail area of 104 square feet is the same as that used for the rest of the *Jet* class and in order to use the conventional trunk and centreboard, it was necessary to add a bowsprit and track with a slide to adjust for balance. Since this job did not come out of the book, it was more a case of trial and error to iron out the bugs.



Bruce Larrabee's mast aft rig

On the day of launching in May at Island Heights, the adventure spirit imbued by the Vodka and Champagne punch led my cousin Flint Larrabee to try the rig out in a brisk wind. Within 5 minutes of departure, the wooden mast (shortened *Lightning*) collapsed in 3 pieces and ended that day's trial run. The angle of the single back stays was too small, the slenderness ratio too great and the fibre stress too low.

A new mast was made of 3 in. by 1/16 in. wall 6061 ST 6 Tempered aluminium tubing, using 2 stock 12 foot lengths, joined by a thick piece of 3 in. aluminium pipe collar. The back stays were attached to the collar as were three spreaders, the forward one being 18 in. as a jumper. The spreaders aft of the mast were 65° apart but there was serious bending of the mast at the sleeve in strong winds but the boat capsized before the mast broke.

Full length battens were used which were stiff at the after section and limber at the leading edge to give the camber a section more like an aeroplane wing.

During the trials, several facts were learned which were not recognised before :

1. The centre of effort of the sail has a noticeable lead ahead of the centre of area of the sail and the boat sailed with lee helm until the tack was brought aft over one foot. Then the sail caught on the forward jumper spreader and almost capsized the boat.

2. The sail rig is very sensitive to the angle of attack of the wind into the sail. Performance improved by a constant working of the sheet to keep the angle low.

3. The boat outpointed *E Sloops* which were sailing in the area.

4. The heeling moment, because of the higher mast (28 lbs.) and higher centre of effort, made the boat more difficult to stabilise.

5. The resulting forces of the sail have a lift effect which pitches the boat upwards and needs correction by a shift of live ballast.

The experience has led to the following scheduled improvements:

1. The use of 4 pipe spreaders at 90° having the forward ones spread widely to reduce interference with the leech of the sail and a possible guide block between the ends of the forward spreaders to prevent the sail catching.

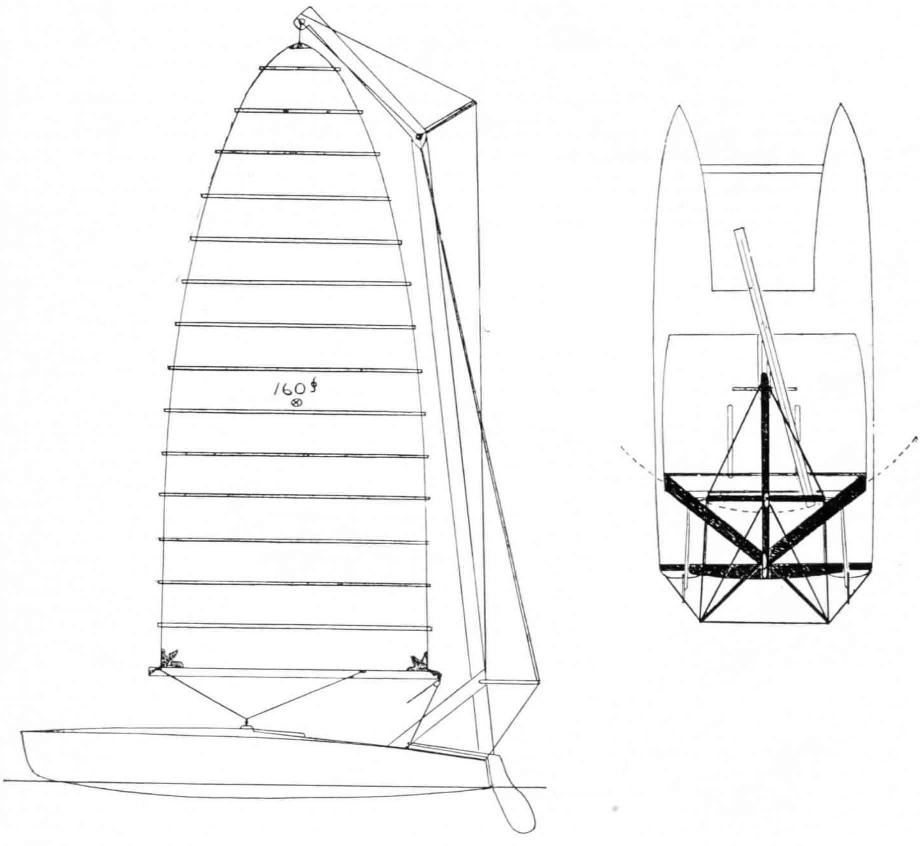
2. The possible addition of hydrofoil stabilisers or *Styrafoam* floats to improve the stability.

When the bugs are ironed out, the ultimate test will be trials with some conventional *Jet* class boats to obtain some direct comparison of performance.

A SEMI-ELLIPTICAL SAIL

The " Back Rig " is a good rig and is, in my opinion, a better rig than the normal sloop. However, it is worth while drawing it up in the form shown with the sail as a semi-ellipse of 4:1 aspect ratio. Unfortunately, this needs a mast with an angle in it with the resultant difficulties in getting it to stand up to the strains involved but these are not insuperable and the result might be worth it.

The rig shown in the drawing is aerodynamically almost perfect. There would be no twist and no mast interference. The ideal aspect ratio, the better semi-elliptical plan form and the full battening would allow it to produce a larger sail force at a better thrust to side force ratio than any sail at present in existence. The mast would, as in



Mast aft rig

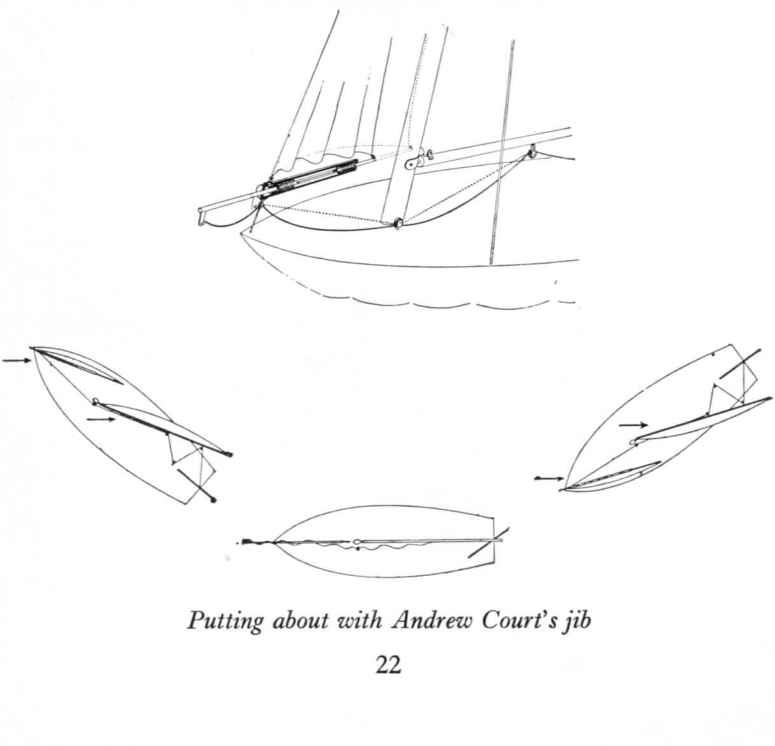
the "Back" sail *increase* the sail force, though at a slight loss of thrust to side force ratio.

As compared to the previously described " Perfect sail " as shown in publication No. 9 *Sails and Aerofoils*, which was a squaresail, this sail is a fore and aft sail and thus would be easier to handle. Because the sail is " balanced " the pull on the sheet would be very small. It would be well worth trying this sail on any boat.

AUTOMATIC OVERLAPPING JIBS

Overlapping jibs or Genoas are very useful sails but, if of any size, they need winches to get them sheeted correctly when hard on the wind. As opposed to a non-overlapping jib, no club can be fitted at the foot to make putting about easy for the cruiser. Any device which will help in handling an overlapping jib, therefore, should be regarded as most useful and developed to its utmost.

In this publication, we are lucky enough to have two completely different ways in which overlapping jibs can be automatically handled, or at least made easier to handle. The first was devised by Andrew T. Court, 1517 Iroquois, Detroit 14, Michigan, U.S.A. and the second by Julian Allen, 3 Kenystyle, Penally, Tenby, Pembs.



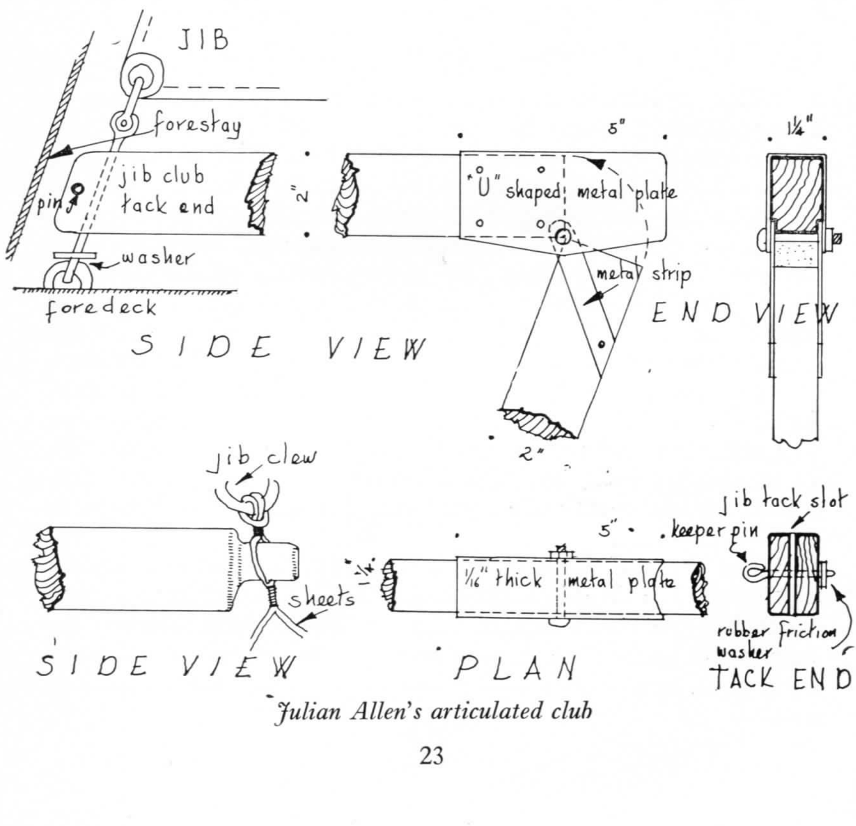
Putting about with Andrew Court's jib

Andrew Court. The drawing shows the main features. The mainsheet acts as a " kicking strap " to hold the boom down but passes through a block at the deck and runs to the fore end of the jib club, pulling it aft when there is tension on the mainsheet. The club runs in a collar which is swivelled at the stem and to whose aft end is attached the jib sheet. When putting about, a spring slides the club forwards in its collar so that it can clear the mast and, when the mainsail fills, it is pulled aft again. The only difficulty seen with this arrangement is that the tension in the spring of the fore haul of the club would have to be variable for different strengths of wind.

AN OVERLAPPING JIB CLUB

by JULIAN ALLEN

With this system, the club for the jib is given a " Knuckle-joint " just forward of the mast so that when the knuckle is bent at right angles to the rest of the club, it can swing across. On each tack, the club is straightened out to keep the foot of the loose footed jib taut.



Julian Allen's articulated club

This articulated club was originally designed for a mast aft rig by Julian Allen and the helmsman sat in front of the mast. On putting about, the boom was given a pull up at the knuckle and the flogging sheet kept the joint at a right angle till it had passed the mast. It was then given a sharp push down at the knuckle and the foot of the sail became taut and its tension kept the boom out due to an " over centre " mechanism such as is found on a baby's pram.

The details of construction are shown in the drawings but several variations are possible such as fixing the fore end of the club some distance aft of the tack of the sail which increases the flow in the sail when the sheet is eased. A line could also be fixed to the boom near the knuckle and passing through a block some distance up the mast to break the joint from aft. A horse could also be used.

In all, this is a most valuable mechanism and it is hoped that its use will be extended.

BATTENED FORESAIL EXPERIMENT, JANUARY 1959

by RICHARD A. SCHROEDERS

120 Wottlin Drive, San Antonio, Texas

This experiment was conducted to explore the possibilities of using full length battens in a foresail. Since this sail was to be used on the writer's *Aloha* Catamaran, described in A.Y.R.S. 23, *Outriggers*, 1958, it had to be self tending as *Aloha* is a single hander. The sail has to be non-overlapping, and had to have a boom of some sort.

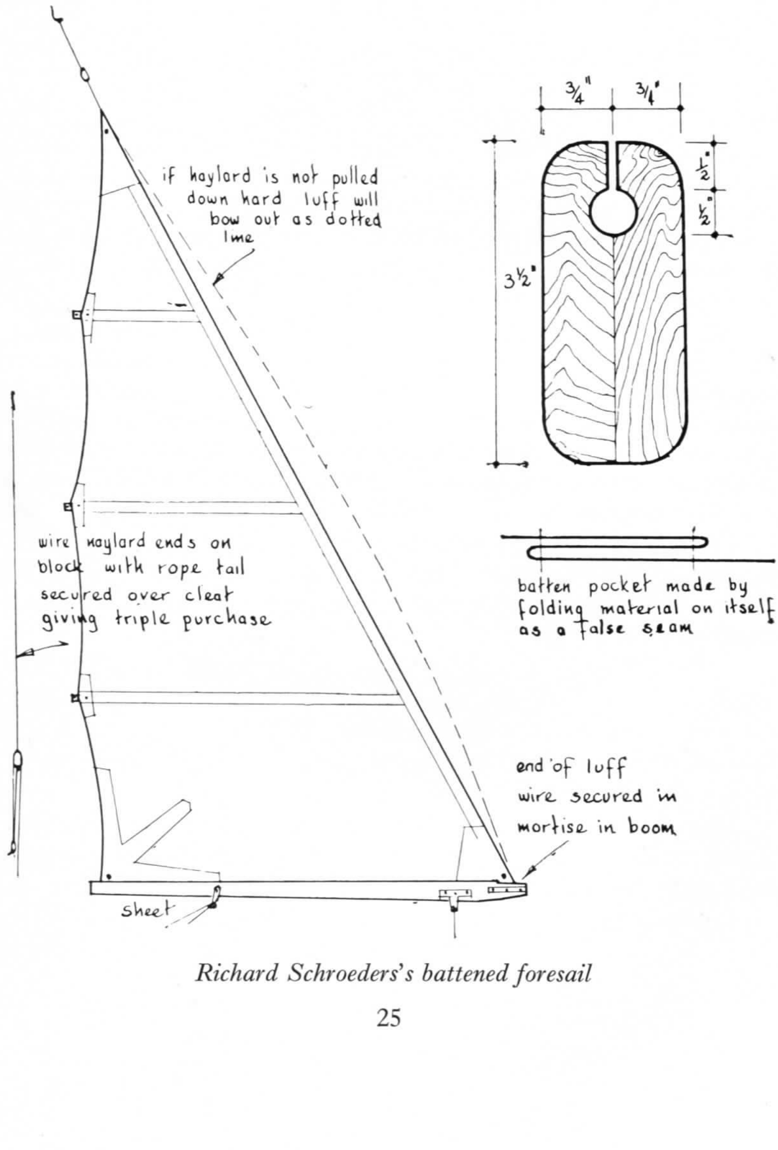
It was decided to use the boom configuration, where the boom is attached to the boat about 1/6th of the overall length back from the front. This configuration is not new at all, numerous uses have been made of it, in everything from log canoes, sand baggers, to ice boats. Quite a number of these were sailing machines of their time.

In making the sail, full use of the book *Make Your Own Sails*, by Bowker and Budd, was made. The writer does not recommend *any* amateur to even think about making his own sail without this most excellent book, but with the book and the proper materials, almost any one could make a *good* sail, if he followed the directions without variations.

The cloths of the sail were laid vertical, the round of the foot and luff was laid out as in a normal sail. The batten pockets were made by folding the cloths as in a false seam. The leech between the battens was scalloped, to keep it tight and straight, this caused much extra work, as the leech tabling had to be cut and resewn between battens.

The battens were secured in the pocket at their forward ends, by drilling holes in the batten and sewing to the luff wire, this caused the considerable thrust of the batten to be directed to the luff wire, tension on the batten was adjustable by means of a lanyard on the aft end of the batten pocket.

The sail was to take all the strain taken by luff wire, and fore stay in an ordinary fore sail set up. An additional fore stay was led to one side, but was only a safety, and not under much tension.



Richard Schroeders's battened foresail

Since this sail was to be artificially supported, the cloth used was unbleached muslin 160 threads per square inch, this made the cost of material very low. The sail was water proofed with a dry wax water proofing agent, then ironed smooth. Total cost of sail was under $5.00, boom and hardware $3.00. Time taken to construct 25 hours.

Results

The sail turned out much better than was hoped. If it had any faults it was that it was too flat, if this is possible. It had no twist, the boom could not rise when off wind, the draft of the sail was about 5 in. in 6 feet, the luff wire stayed exactly straight under all wind velocities, the sail did not flog or even shake when coming head to wind.

Since it did not overlap it could be hauled in almost amidship without backwinding the main, this of course was not the best point for windward work. The best way of trimming being to trim the main for that particular wind velocity, and then trim the fore sail out as far as possible with out luffing, then cleat everything, and sail by the foresail as in a conventional rig.

By using full length battens it is possible to use cheap material, that would be unsuitable for conventional sails, this is good for the experimenter, who might have to throw a failure away after only one trial. The porosity and water absorption being cured in this unbleached muslin, by water proofing with a dry wax agent, and then ironing for smoothness, the ironing presses the nap of the cloth down into the waxy substance and leaves a very smooth surface.

The self tending action turned out well, since part of the sail is forward of the attachment point, it balances part of the area. The sheet is led to give a double purchase and at the same time to act as a traveler.

The sail made a definite improvement in *Aloha*, which was previously " cat " rigged, wind gusts could be parried by luffing the main and letting the fore sail drive. The 187 sq. ft. in main and fore sail could be carried in a higher wind, than the 156 sq. ft. in the main only as previously rigged.

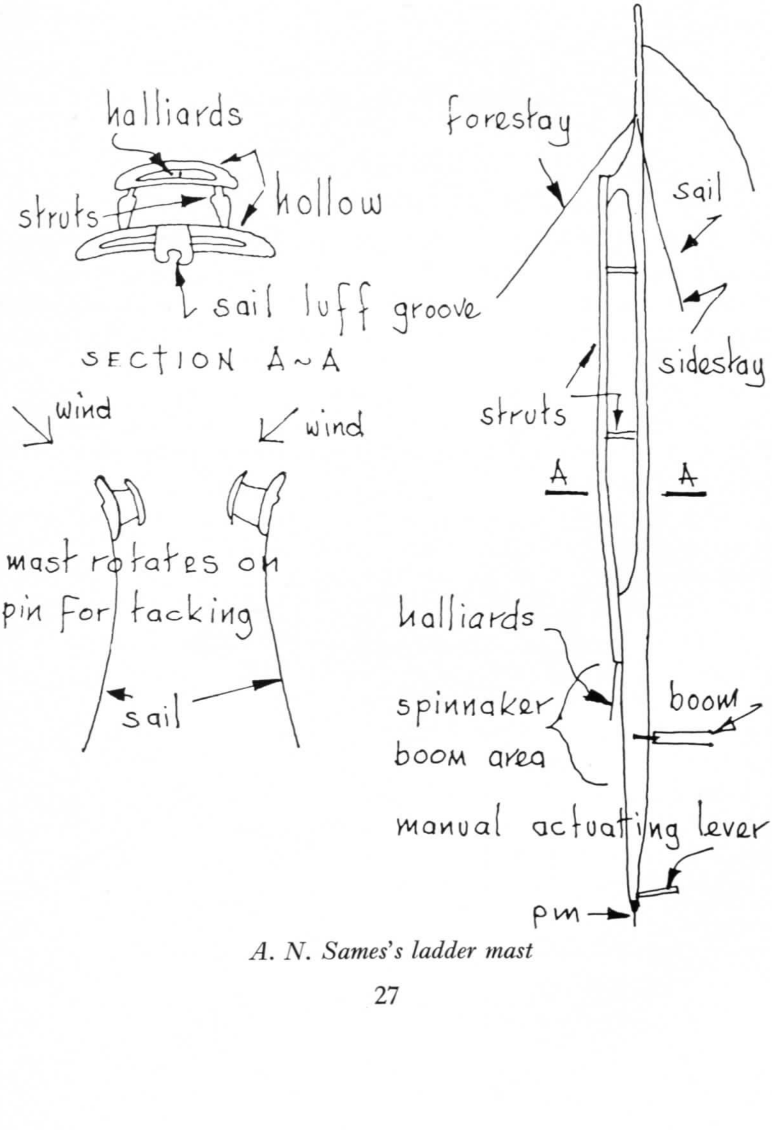
My final observation is I think all sails should be fully battened. Also there is some question in my mind about the value of overlapping sails, except to cheat some rule.

A DOUBLE MAST

by A. N. Sames

Auckland, New Zealand

The Handley Page " slat " at the leading edge of an aeroplane wing is a small proportion of the main chord of the wing. It delays the " stalling point " very considerably, however, and this allows very much greater lift to be obtained. The jib of a boat is alleged to act in a similar manner but, if it does, there is a great waste of sail area in doing so as compared with a " slat."



A. N. Sames's ladder mast

It would be a great economy of sail area if a slat the size of those used on aeroplanes could be devised for sails and two examples of trials have been sent in. A cat rigged yacht sails with its mainsail stalled on all courses except close hauled and the forces would be greater if it could be " unstalled " by a smaller device than a jib.

Both of the methods used by members to " unstall " the mainsail use a mast made up of two streamlined boards separated by " rungs " from each other, giving a ladder formation.

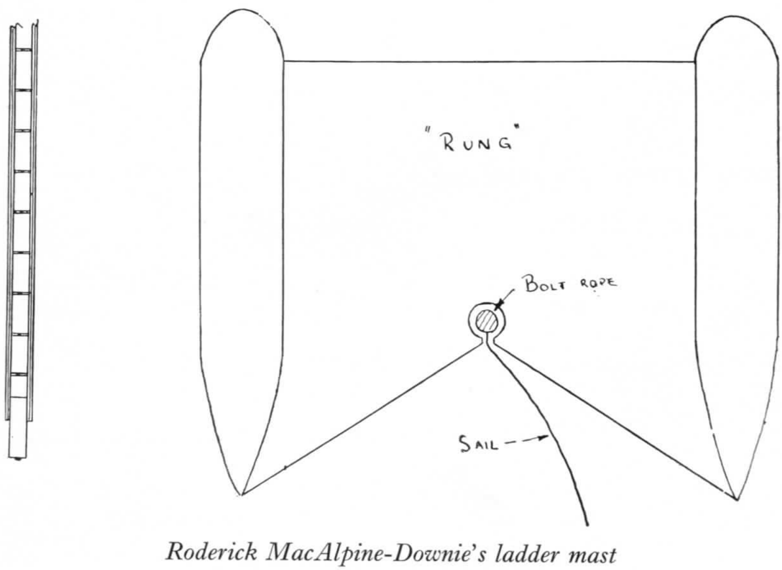
A. N. Sames uses a normal mast in the lower part but between the gooseneck and the attachment point of the stays, the mast is of this ladder formation whose profile and section are shown in the diagrams.

When sailing, the free piece of the mast acts as a slat and should increase the force of the sail. On putting about, the mast is revolved through about 120° to bring the slat again on the lee side of the sail.

A DOUBLE MAST

devised by RODERICK MACALPINE-DOWNIE

In this method of using a double mast, it is again made of two boards connected to each other in a " ladder formation " but the " rungs " are small bits of plywood between the side boards which are of symmetrical section, and each has a hole in it for the bolt rope of the sail.



Roderick MacAlpine-Downie's ladder mast

This mast is a " fore and aft " mast as opposed to A. N. Sames's which could be called a " square rigged mast." That is, one side of each side board is always forwards and other, always aft.

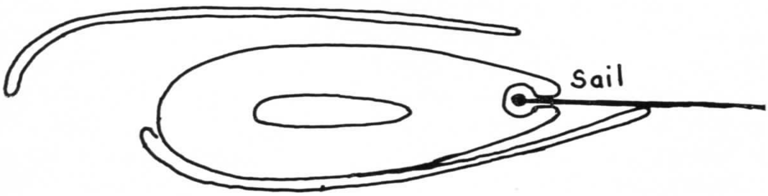
When sailing, the board of the mast which is to lee acts as a " slat " while that to weather acts merely as a parisite. On putting about, the mast is turned in much the same way as the elongated mast used in the *Shearwater III* and other boats.

In practice, the one snag found by Roderick Macalpine-Downie was the difficulty of hoisting sail. The halliard did not lead the bolt rope of the sail in the holes in the " rungs " and, in practice, he found the only way of getting the sail up on his catamaran was to climb the " rungs " of the " ladder." This, he found was a most rewarding experience and a fine exercise. It has recently been lamented that, since the conversion of yachts to the Bermudian rig, no longer does one see vast numbers of yachtsmen up their masts as used to be the case with gaff rigged boats. Perhaps this state of things will be rectified if this mast should become fashionable, and once more a fleet of yachts at moorings will be ornamented by a high proportion of their owners or crews finding some excuse to be aloft.

Efficiency. It was not believed that this double mast as used was of much value. It appeared that the loss of the sail area of the jib was not compensated by any extra efficiency of the slat at the leading edge. Again, the device needs to be tested in a wind tunnel.

SLATTED MASTS

Twin Handley Page-type slats could be fixed to revolving masts of the *Shearwater III* pattern, one on either side so that the one to



Sail slats

lee automatically went forward when the angle of attack became large enough and thus give larger forces. Alternatively, a single slat could be slid up a groove on the fore side of a mast to act likewise.

Both these ideas look attractive at first sight but the area of slat possible would be far smaller relative to the sail chord than an aeroplane wing slat and they could easily be useless. Only a trial would tell us if this is so.

KITE-RIG

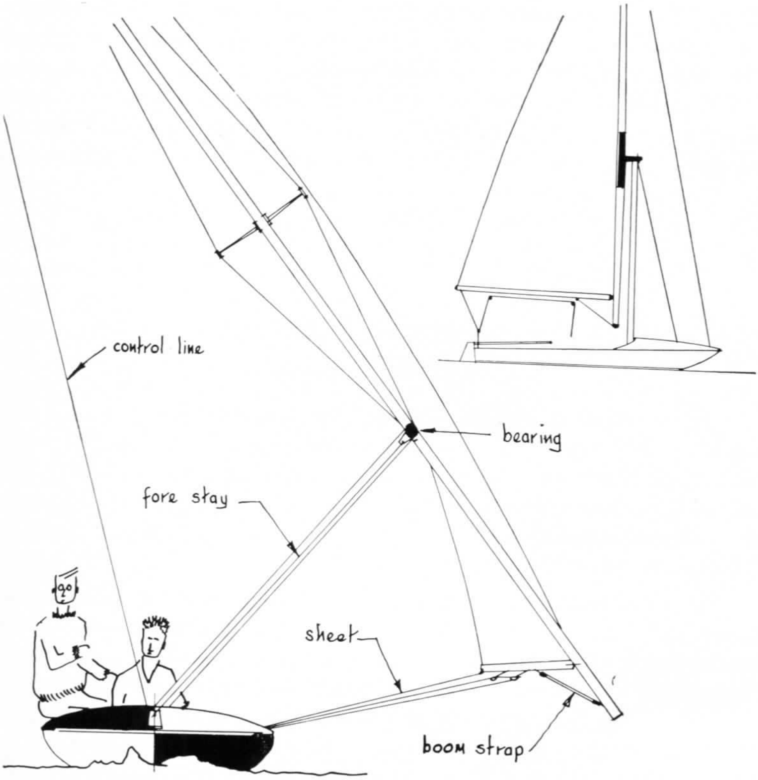
by WALTER BLOEMHARD

A kite to be of any use on a sailing boat must be set to leeward and slope to windward. In that way the sail can exert a righting moment on the boat, which is what you expect of it in the first place. As the wind increases there will be only a small variation in the balance of righting and heeling moments, which is compensated for by control, while the thrust builds up very rapidly. In addition, the boat will experience some lift from the sail, which in the end may be considerable. Very high speeds can therefore be expected from a properly used kite ; that is, if the hull allows itself to be driven at the intended speeds. It has already been proven on many occasions that a sail sloping to windward can be made to stand correctly.

It will be clear that a kite enables one to separate the generation of thrust from the stability problem. One is therefore free to choose the most suitable hull form for speed, with little regard to stability. It will only be necessary to incorporate sufficient stiffness to make a practical boat under light conditions.

In the normal case high speeds are impossible because of the increasing heel angle and the rise in wave drag as the boat attempts to ride on less than a single wave-length. The big promise of the kite—as I see it—will be its use on cruisers, which though fairly heavy, even without ballast could conceivably be brought to the point of planing. Speeds attainable would be in the order of $2\sqrt{L}$. It would not be very difficult to incorporate automatic control.

The sail itself could also be made as an airfoil, which would have a number of advantages and also disadvantages. There are many hidden points in the arrangement as shown, many possibilities and I recommend the kite rig for serious study by members. Note that the mast is not under heavy compression or bending ; it is loaded only in tension and can therefore be light and unsupported. The use of a boom strap, luff pocket, and full length battens requires no explanation. The yard will be controlled by a single guy, passing in front



Walter Bloemhard's kite rig

of everything. The whole unit is supported and aligned by this guy, the sheet and a needle bearing at the mast top. The footblock of the sheet runs on a track for adjustment of the lead angle. A spherical bearing could also be used at the mast top, and would serve to relieve overloads at this point, but control would then also be so much more difficult. The whole control arrangement could of course be made more sophisticated and would have to be on bigger vessels. As shown the mast will be supported by a single stay. The step would consist of 2 pivots, allowing the mast freedom to swing from port to starboard, and to turn on its own axis. I designed a small scow, to be rigged with such a kite and actually started building the boat. However, conditions did not seem to be very favourable at the time and there was little progress, until the hands of God finally ended it all by throwing a heavy, waterlogged branch on the fragile structure from 40 ft.

high. The Supreme Architect either must have gotten thoroughly disgusted with the whole affair, or else He may have wanted to remind me that I should be in church, because it was 10 o'clock Sunday morning and I was still in Morpheus' arms. Of course, the only thing I could do was to utter a devout " Amen " and feel sort of relieved. I hope to take it up again, some time later. If any one of the members meanwhile would like to try the rig out for himself, I would be most happy to advise.

A " SAIL " GLIDER, 1923

by O. W. NEUMARK

In publication No. 17, Arthur Piver proposed the use of sails for aircraft wings. Such an aircraft was built by Reinnhold Platz, Technical Director and Chief Engineer of Fokker Aircraft from 1913-1932. A report was published in " Zeitschrift fuer Flugtechnik and Motorluftschiff-fahrt " of the 26.1.1924 and republished in " Sailplane and Glider " of March 1953.

The purpose of the experiment was to develop a very simple and cheap sailplane capable of slope soaring. After some models, a full scale piloted glider was test flown in February 1923. Prior to free-flight tests, the aircraft was flown in captive flight some six feet above the ground in the slope lift of some sand dunes.

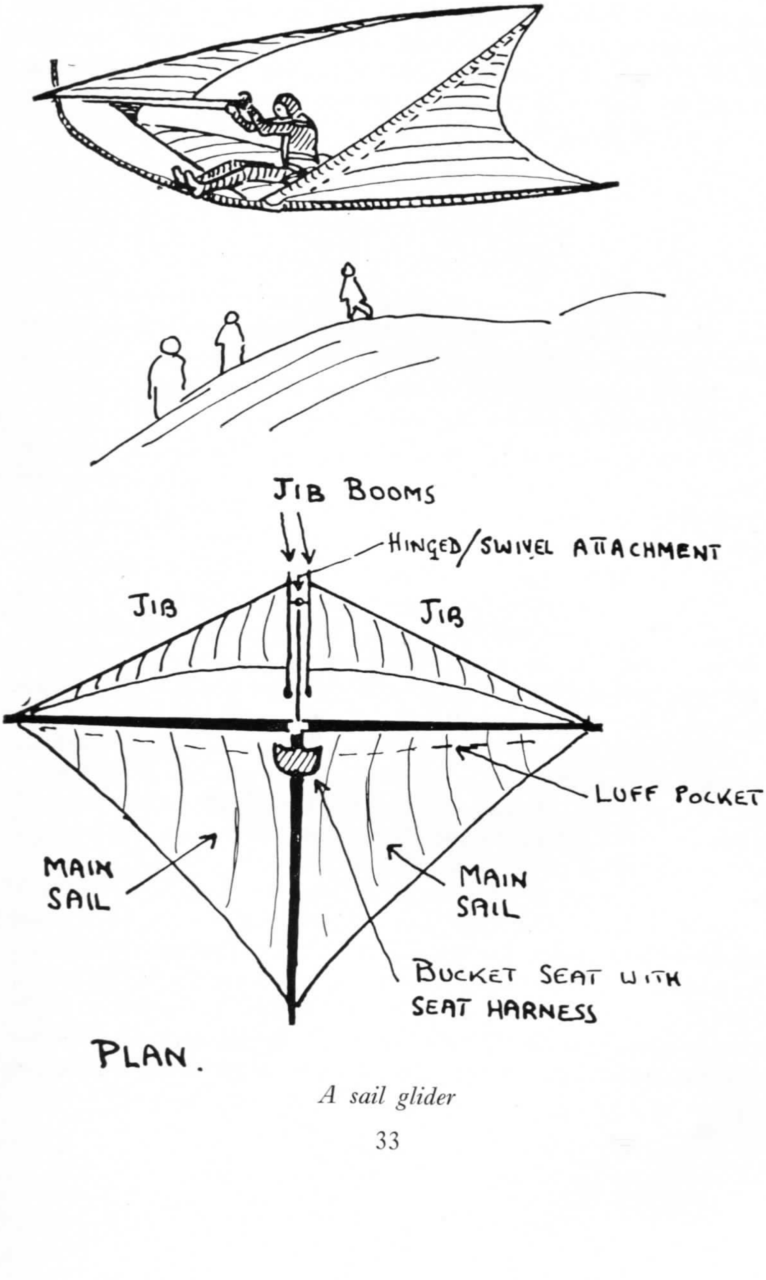
The glider consisted of a Bermuda rig sail and its mirror image laid out in the horizontal plane but given some dihedral for the sake of lateral stability. The structure consisted of a curved steel tube which continued as a solid wooden mast forming the fuselage or the common boom for the two main sails. At the junction of the steel tube and the fuselage mast, two other solid wooden masts (acting as wing spars) were fitted into two cups welded to the tube. The pilot sat on the junction of the three masts and the tube.

The front end of the curved tube served as the point of attachment for the two jib sails which appear to have had individual booms, the ends of which were held by the pilot.

Elevator control was obtained by moving both jib booms up or down in unison, while differential movement gave aileron control. A rudder for yaw control was not found necessary.

Only few figures are available : wing area 172 sq. ft., span 21.6 ft., max. wing chord 10.8 ft., weight empty 88 lbs., wing loading between 1.2 and 1.8 lbs./sq. ft. (it was flown by one pilot weighing 220 lbs.).

It is evident that a similar glider could be built using very much lighter materials and that its *lift/drag* ratio would be superior to any other form of kite. The L/D ratio could be further improved by using pocket luff sails which might be partially inflatable.



A sail glider

Such a device could be used as a kite rig for driving a mastless hull. It would be desirable to experiment with a motor powered hull for the sake of ease of initial launching but good centre or side boards must be provided for the subsequent sailing trials. It would save endless time, disappointment and expense if the kite were piloted by a sailplane pilot experienced in "kiting" off a winch launch.

After piloted flight in moderate winds, remote control from the hull for pilotless kite flight in light winds might be developed but this will be more difficult and expensive than piloted flight. The present writer would be glad to test fly such a kite rig.

FLYING ON SAILS

by MAJ.-GEN. H. J. PARHAM

The following experiment which I have recently made will, I hope, provide food for thought and also encouragement for those who think that there is still quite a lot to be learnt about soft sails . . . even though they have been in use for so many centuries.

The reasoning behind the experiment was this :

(a) On all points of sailing in which a sail is acting as an aerofoil as distinct from a parachute, it *must* pay to have the sail's effort exerted as near fore and aft as possible, which means, in effect, as near a right angle to the apparent wind as possible.

(b) This involves using a sail with a good Lift to Drag ratio.

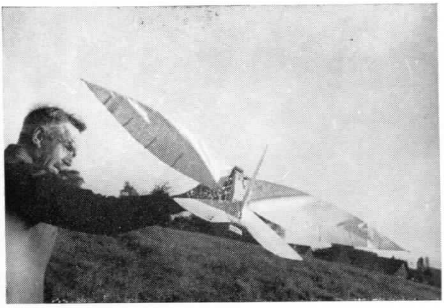
(c) The closer to windward one wants to sail, the more important does L/D become. (On a broad reach, because a boat can then stand a lot of "drag" in the L/D, it may pay to have a poor L/D ratio *if this goes with a very high lift*). But close hauled, it is D which is the devil.

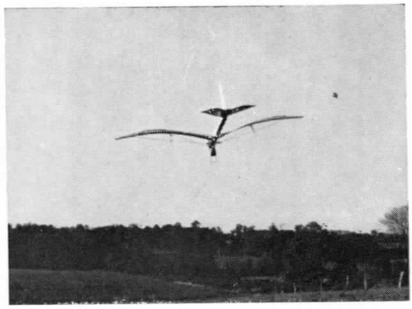
Since at the moment a wind tunnel is not available to the amateur, a possible method of seeing what a soft sail can really do in the way of producing a good L/D ratio is to use a free flight model glider. I do not know if "Flying on sails" has been done before, but I myself have not heard of it. The results are most interesting.

Eiffel, in about 1910, tested a number of thin, rigid, aerofoils of curves corresponding closely to our sails and the results are still available. They show that the lift and the L/D can be quite good. The question has always been "are our sails being really made to work, or are they dodging the work by not being held at the correct angle or at the correct camber ?" One has only to look at any Bermudian or Gaff mainsail in action to see that it is highly probable that they are *not*.

For the test, a model of 50 inches span was made. The chord at the root (i.e., boom) was 10 inches and a large gap of some 3 inches was deliberately left between the " booms " to avoid giving an exaggerated good aspect ratio. Incidentally, the two sails or wings are loosefooted.

The wings of this " sail plane " differ from standard Bermudian rigs in one very important aspect. They have a *curved* mast (or main spar), the curve of which approximates to that taken up by the leech when under load. In this way, one achieves a more or less constant angle of attack along the span i.e., very little twist. I have sailed with such a rig for the past 10 years and have learned a lot about it by now. The sails are of Terylene, the spar of birch.





General Parham's sail glider (*Note : No twist*)

The total weight is 16 ozs. which is quite heavy for a 50 inch span model. There is lots of lift and the *angle of attack at the wing roots only has to be some 7° to enable the whole sail to fill.*

The model glides nicely at a carefully measured angle of 1 in 5. Its best flight so far is of 50 yards down a uniform slope of 1 in 5 in dead calm air late on a summer evening.

Now, here is the interesting point. An exactly similar wing was made but with a straight spar (mast) and fitted to one side of the model. Every time, when launched, the model cartwheeled to that side. No extra incidence at the root and no amount of opposite rudder would stop this. There was just not the lift that side, because the sail could not be held up to its work, due to " twist."

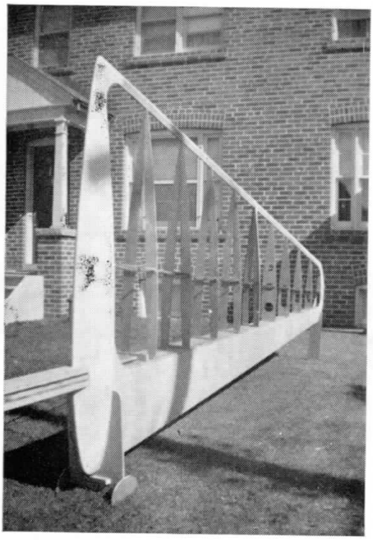
I hold no particular brief for my rig. All I want to rub home is that there is a lot of power being wasted. It reinforces my long held theory that research should be switched away from hulls onto sails. I also believe that, though, high-lift devices (i.e., the jib and its slot effect) are obviously good things to have on a broad reach, a simple untwisted monoplane rig is the best thing to windward and is so efficient that even reaching, it can hold its own with a slotted but twisted " normal " sail.

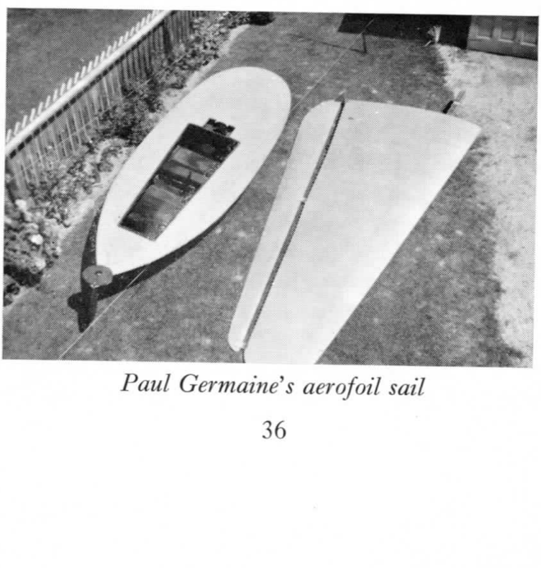
AN AERO SAIL (WINGSAIL)

by Paul S. Germaine

Purpose : To reduce losses due to mast interference, sail twist, sail flutter etc. and to provide more versatile handling.

Design : A symmetrical section of the author's design was used with the spar at 25% of the chord, on the centre of pressure. The root chord was 6 feet with a thickness to chord ratio of 12%. The tip chord was 2 feet with T/C ratio of 9%. The span was 14 feet between these sections, giving a sail area of 60 square feet.





Paul Germaine's aerofoil sail

The *Moth* class hull had a bearing-mounted box to receive the square spar base. A drum on the box with a rope control running around the cockpit provided 360° rotational control. Later, a trailing edge " servo " flap, 25% of the wing area, was added with a control rod which normally kept the flap parallel with the centreline of the hull, thus increasing the camber as the wing was moved away from the centreline, port or starboard.

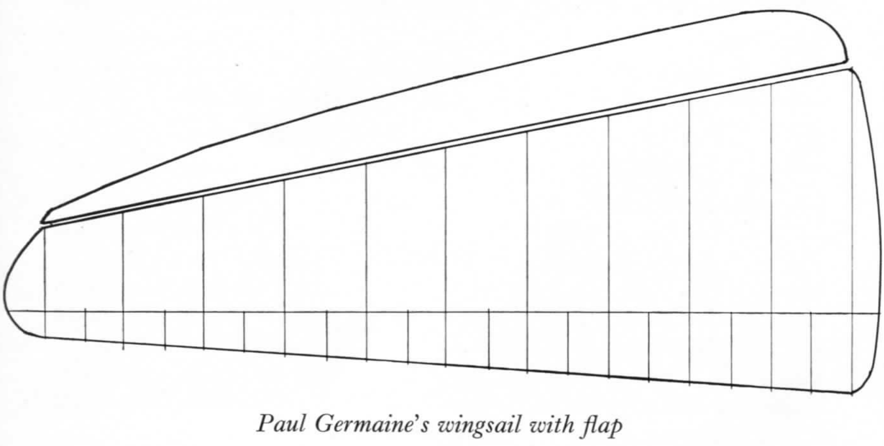
Construction : Completed in 1944, the wing had a plywood leading edge and a fabric covered trailing edge. It weighed about 45 lbs. and was stepped by rolling the hull on its side and inserting the spar into the box and then righting the boat. No locking was necessary.

Performance : The boat sailed very close to the wind ; so much so that slight changes in wind direction caused the sail to change tack. The boat could be stopped in its own length from 5 knots, could be sailed backwards or inch slowly along for docking etc. It was not tried in a strong wind due to hull instability.

Disadvantages : The wing oscillated when moored as described by P. V. MacKinnon in A.Y.R.S. No. 9. A mass balance is definitely required. The weight above deck required a stable hull.

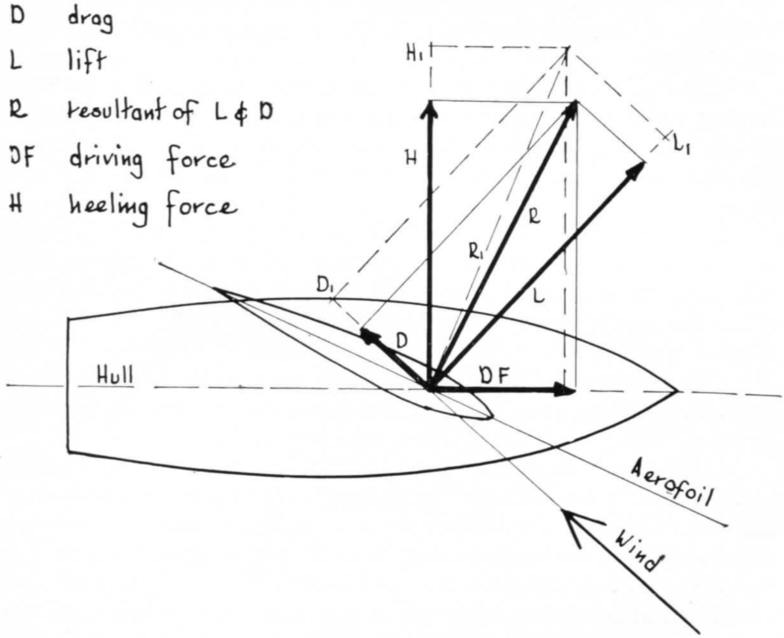
Conclusion : The system as described by Fin Utne in A.Y.R.S. No. 14, using a controllable " stabiliser " aft of the wing with a mass balance forward and mounted on a twin hulled catamaran should prove very successful. The wing should be free to rotate for mooring.

Comment : Many seem concerned with needing highly cambered asymmetrical aerofoils to obtain high performance but this is unnecessary except for " running " as lift coefficients of over 1.5 for some



Paul Germaine's wingsail with flap

symmetrical aerofoils compare with 1.6 for the best asymmetricals. It is the lift to drag ratio which is important and here the symmetrical is up with the best (23:1 for NACA 0012).



In the above diagram, if “ L ” increases slightly to “ L‘ ” but “ D ” increases at a higher ratio to “ D‘,” the “ R‘ ” slopes less forward, resulting in “ H ” increasing but “ DF ” will decrease. In other words, it is the Lift/Drag ratio, not total lift alone which is important.

Editor : While the above argument is, of course, correct, in the actual calculations of aerofoils one finds that, with asymmetrical aerofoils and those with flaps, slats and high lift devices, in general the greater the lift force, the greater is the thrust force (“ DF ” in the diagram). However, the side force (“ H ” in the diagram) increases disproportionately. The excess side force can be absorbed in light winds by the lateral resistance of the hull and, to me, this proves that a thin twistless sail will be best in light winds. In strong winds, the excess side force cannot be absorbed and Paul Germaine’s argument holds. A symmetrical aerofoil is then best.

THE TRANSPARENT SAIL

by ARTHUR PIVER
Mill Valley, Calif.

Question : Are Mylar sails truly practical ?

Answer : Not really, but they are a lot of fun.

The above exchange about sums up the case for the transparent sail, although at present I feel I will always use a transparent jib.

Although we have heard reports of these sails coming apart, we have never had any trouble with ours in this respect.

In order to let the reader decide for himself, we will list disadvantages and advantages for these sails.

Disadvantages : Noisy. If you are peace-loving, the sound of this sail when being handled and while luffing will be annoying. It is almost overpowering when the material is handled indoors under normally quiet conditions.

Deterioration. The DuPont Company, maker of the Mylar material we have used, does not recommend it for outdoor use, as it deteriorates in the weather. There is a weather-resistant type, but it is made only in heavier weight of 5 mils. We use 2 mil. for our small boat sails, and would probably use 1 mil. if we made a spinnaker.

Wrinkles and crinkles. Here is the chief difficulty with this material, as the originally beautifully transparent appearance soon is marred, with marked reduction in visibility.

Advantages : Increased visibility is particularly important with faster boats, due to rapid closing speeds when encountering other craft. Even when well wrinkled, close-up objects can be seen.

Economical. It cost about $5 for material to make a 30 ft. jib, although we have not included the cost of the adhesive used. The DuPont people gave us such a generous sample of their 4695 Mylar Cement that we have made four Mylar sails so far and have most of it remaining.

Noise. Because of the noise this sail makes when luffing, it is possible to sail aurally, as it is not necessary to watch the jib luff when keeping close-hauled.

Deterioration. Such a sail will apparently last a full season, and because of the low initial cost, can be replaced each year.

Speed of fabrication. Such a small sail can be made with only several hours work. It is a pleasure to be able to see the guide lines on the floor through this material.

Visibility. If the sail is handled as little as possible, the original transparency should be more lasting. For instance, if the sail can be taken off the boat and hung up indoors it should be in better condition than if it were stuffed in the sail bag.

Fabrication. We use seams 2 in. wide. The sail is laid out, with one side of the seams being taped with ½ in. 1-mil. polyester tape. After all the seams are so taped, including the corner reinforcements, the sail is turned over. A thin coating of the Mylar cement is then painted with a brush between the two layers of film at the seams.

A regular adjustable-heat flatiron, set in the " cool " position is applied to the seams, being allowed to set in one place until the adhesive boils, which takes a few seconds. This seam is then held down by a weight, and allowed to cure for about 48 hours.

After curing, the seams on the exposed side are taped.

The sail is finished by taping two layers of the ½ in., 1-mil. polyester tape around the edges on both sides. Two-mil. tape is available, which should save some time, although we have not yet gotten around to trying it.

The corner reinforcements are made with one thickness of .750 Mylar.

Regular grommets are used, although if they are the type with teeth, these teeth should be turned under with pliers before setting.

Caution : According to our experience, when the iron is set at the temperature recommended by the manufacturer for the 4694 Mylar cement, the Mylar film is destroyed.

Practice on some scrap pieces—the iron should be hot enough so the Mylar just starts to pucker, and the adhesive should boil within several seconds.

SAIL TESTING

by Christopher Mattingly

The problem of proper testing of sails has recently been highlighted by the development of model and full size hull testing techniques to a point where accurate sail data is required to complete investigations.

The ultimate aim in any dynamic investigation is to trace and evaluate the movements of energy within the system and if possible to rationalise them into a mathematical form from which behaviour in other situations can be predicted. To this end a study of full size sail rigs under conditions close to those experienced over water and in apparatus capable of measuring directly the forces and energy dissipation involved in sailing, is now required.

In order to make an accurate determination of the power developed by a rig, its speed and the resistance against which it works must be known. The latter particularly is hard to measure in a boat and impossible to measure accurately.

The classical method of power measurement is the balanced brake and its application to the field of sail investigation is quite simple. Brakes capable of great power absorption without alteration of their characteristics are now available and could easily be fitted to a trolley, akin to the sand yacht, with the rig mounted on it. Measuring the torque applied to the brake would be easy and could be automatically recorded, as could apparent wind speed, mean angle of attack, and ground speed.

The primary investigation would be that of sail efficiency in similar conditions against differing resistances and this basic programme could be expanded to cover efficiency investigations of various conditions of aspect ratio and jib overlap. Later programmes could extend to the investigation of hull effect on the rig by mounting a complete boat on the trolley, allowing for the angle of yaw by offsetting the wheel slightly and the effect of angle of heel by setting the mast over. Determination of scale effect would be a little more difficult, but a contribution could be made.

Design of the trolley should be kept as simple as possible both to keep the cost down and to increase its usefulness, complex apparatus often being the cause of experimental failure. A three wheel carriage with no springing, the two wheels being in front and steerable, the brake being mounted on the single wheel at the back. Recording would be electrical and brought to a central recording box where the readings would be combined onto a single strip of paper or cheap photosensitive material, if such exists. Crew could be kept to helmsman alone to avoid variations in windage due to crew movement but ballast to maintain stability would be needed. This ballast together with the weight of the trolley, would provide an inertia to iron out small thrust variations but would not have to be so great as to occupy much of an experimental run with gain of speed. Sailing gear could be exactly as used in any boat so that a rig could be tested in its entirety, with no concessions to the experiment.

A more expensive version could mount two brakes, the lee one being used so as to take advantage of the increased pressure on that side to increase the retarding capacity of the brake.

The most suitable location for the experiments would be an airfield runway close to the sea, where the wind has not suffered distortions due to trees and buildings before it reaches the test path. A seaside promenade might prove useful if the authorities agreed but both of these suffer from an inherent lack of directional flexibility. So far as I know there is no horizontal stretch of hard pavement with an area comparable with a medium sized reservoir close to the sea, but maybe someone else knows of such a place.

The last and most attractive use to the ordinary " man in the boat " would probably be to settle bets about who is the better helmsman given all things equal. With this setup he would be the one to obtain the best efficiency.

LETTERS

Dear Sir,

Sailing and aviation are (or ought to be) closely linked. It is one of the never ending fascinations of the aviation world that, no sooner does it seem settled in a definite " pattern " than it jumps ahead with some entirely new idea.

The most exciting, probably, of all its developments is about to burst upon us, i.e., V.T.O.L. (vertical take off and landing). We now look like getting that missing bit of speed range from 0 to around 100 m.p.h.

Now, one solution being tried out is the so called " flat riser " aeroplane, the slipstream from whose tractor airscrews is directed onto a very high lift wing which deflects it through some 80° downwards. The aircraft rises vertically, gains forward speed, retracts its slats and flaps and cruises as a normal aeroplane.

The point of interest to us is that deflections of airflow of as much as 80° are possible—with a high drag admittedly but we can handle quite a lot of drag on a boat or catamaran. The problem of utilizing this knowledge on *sails* is not easy (but the " bait " is there!) and, if it could be solved, it gives promise of extremely high thrusts *on a broad reach.* (The idea is no good, of course, for windward work).

The kind of configuration being used for these " flat risers " is thus :

High lift wing section

A leading edge slat may be added too, in some designs. The centre of pressure moves far aft but this should not worry us too much.

The points I want to make are that :

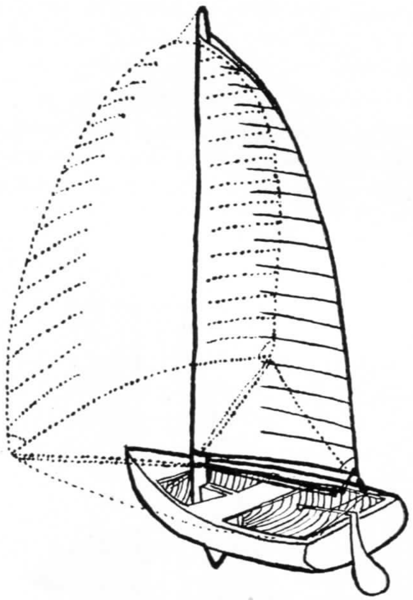
1. It is possible to get these vast deflections of airflow and as a result very high lift.

2. Perhaps one could go some of the way even with soft sails if one began thinking of bending the air *aft* of the main sail rather than *ahead* of it.

MAJ.-GEN. H. J. PARHAM.

Dear Sir,

The accompanying drawing shows a rig I would like to try on a dinghy. It is simply a stayless mast mounted at a slight rake with a heavily battened sail folded around it but not attached to it in any way except by the peak halliard. The two sides of the sail would then lie in contact with each other as in H. G. Hasler's "Lapwing Rig" (A.Y.R.S. 21, *Ocean Cruising*). The clews would be attached to twin booms, also lying in contact with each other.



Rig suggestion by Douglas Newton

When on a reach or run, the booms would be separated and then the whole sail would fly forward as an efficient spinnaker.

Since I am in no position to construct the rig (a college student) I am hoping that someone might try it out and report on it. I believe it combines a good aerofoil shape with handling ease. The only real problem is building the stayless mast.

DOUGLAS NEWTON.

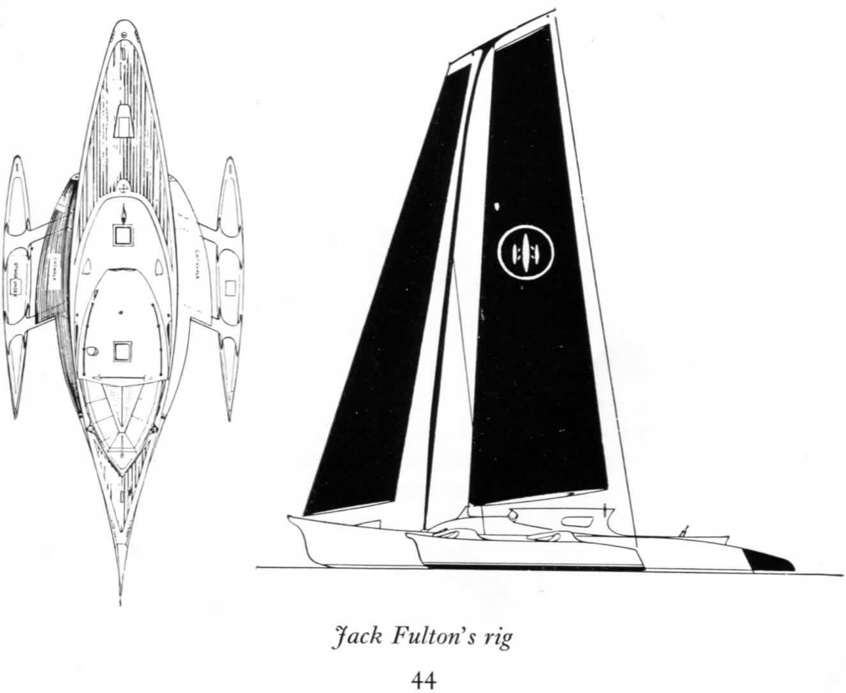
Gen. Deliv., Stanford, Calif.

Dear Sir,

I read with great interest your article in the December issue of *Motor Boating* and was prompted by your remarks about sails to write you a letter, in spite of the fact that my partner, Dean Kennedy, and I have been spending every bit of our spare time for the past year constructing the 40 foot cruising trimaran *Kolu Naia*. As a consequence we have not been able to communicate to others what we have been doing. Final detail specifications and performance figures for this craft will not be available until after April when we expect to launch, however I am enclosing a simplified plan and a sail plan which might prove interesting to your members if you wish to publish any of the information in this letter.

Our performance estimates for the *Kolu Naia* (three porpoise) are based upon figures obtained from a four foot scale model and we feel that it would be improper for us to release our own predictions before the full scale model has been proven.

The writer has been struck by the fact that most published pictures of catamarans and trimarans show that they use conventional marconi sail plans in almost every case, whereas our findings indicate that



Jack Fulton's rig

this arrangement is not at all suited to a high speed hull. Our first test with a marconi rig with overlapping jib resulted in the leeward hull being completely submerged. A very high aspect ratio marconi sail gave us the same speed but was very hard to control and we noted considerable loss of power due to mast turbulence, peak luffing and the straight boom, though it gave us considerable less heel and leeway. We were forced to conclude that a special sail must be developed especially for the high speed hull. The sail plan enclosed is the result of our research and performed to the best of our expectations. Note that we run the luff of the mainsail up a track wire spaced about four feet from the streamlined " Bow " mast to give a relatively clean entry into the wind. The head board " gaff " on the main and jib are both controlled to maintain a proper air foil along as much of the sail as possible. The boom for the mainsail and the jib are curved to hold an air foil shape in light airs, and " flop " from side to side when changing tacks. The boom is held between an outboard vang and the sheet. Results with the model indicate that this sail plan will be easy to handle, will convert more of the wind into forward thrust with only slight heeling and leeway, and will head very closely into the wind. Using this sail the model easily equalled the speed of the normal wind at 2 or 3 knots and travelled at 6 knots without excessive heeling in a wind of 10 knots. This is the sail plan that will be used on the *Kolu Naia* when she is launched and we expect both the hull and the sail to result in outstanding performance figures.

General specifications for the *Kolu Naia* are : LOA 40 ft. 0 in., Beam 19 ft. 2 in., Beam of main hull 8 ft. 0 in., Headroom 6 ft. 6 in., Mast 46 ft. 0 in., Draft 8 in. (12 in. when loaded for cruising with 3000), Sail arez 500 sq. ft. main and jib).

JACK A. FULTON.

844, Tourmaline Street, San Diego 9, California.

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