OUTRIGGERS

A.Y.R.S. PUBLICATION

No. 4

The Baker Craft which has done 30 m.p.h.

CONTENTS

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THE AMATEUR YACHT RESEARCH SOCIETY

(Founded June, 1955)

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EDITORIAL

Readers are cordially invited to the first meeting of the A.Y.R.S. on Saturday, 10th December next at 123, Cheriton Road, Folkestone. The A.Y.R.S. Catamaran will be on show with Sandy Watson's Micronesian canoe, a simple squaresail and my hydrofoil stabilisers. Several models of hydrofoil and other mechanisms will also be available. It is to be hoped that members will send us their models for display, even if they cannot come themselves.

All are welcome from 2 p.m. onwards. Trains leave Charing Cross at 12.55, 1.15, 3.15 and 4.15 p.m., the journey taking about 1½ hours. The above address is only 100 yards from Folkestone Central Station.

Tea will be at 4 p.m.

A short formal meeting will take place at 5.30 p.m. followed by a very short talk on Catamarans and Hydrofoils followed by cocktails and general informal discussion.

The meeting will end when it does. A pleasant hotel nearby charges 17/6 for bed and breakfast, 6/6 for dinner. The last trains for London leave at 6.30, 8.20 and 11.02 p.m.

R.S.V.P. to the Editor. Trains will be met by a grey Bedford "Dormobile" whose number is TKR 842.

. . . .

The A.Y.R.S. must have more members if it is to survive. It would be appreciated if the enclosed leaflet would be given to a friend or left in your yacht club.

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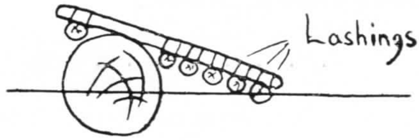
OUTRIGGERS

It is a curious thing but the outrigger principle is almost entirely confined to islands. It gives stability to dugout canoes and narrow, plank built boats in Madagascar in the west; in Ceylon, Indonesia, the Philippines and Papua in the centre and in the whole range of Pacific Islands as far east as Easter Island where the large and grotesque statues are found.

The outrigged craft and double-hulled canoes are usually called "Catamarans" from the Indian words "Cattu-maram" which can be translated as "Ropes, logs," indicating a structure of logs tied together. This term is most properly used to mean a group of three, five or more logs shaped to fit each other and having a smooth outside boat-shaped surface. The buoyancy is got from the floatation of the logs themselves and not from the fact that the water is kept outside a concave structure by caulking. Such a water craft is transitional between a raft and a boat and represents an entirely different culture from that of the outrigged canoe. But the term "Catamaran" has achieved an entry into our speech to mean outrigger craft, and attempts to oust it have so far been unsuccessful.

The Melanesian Canoe.

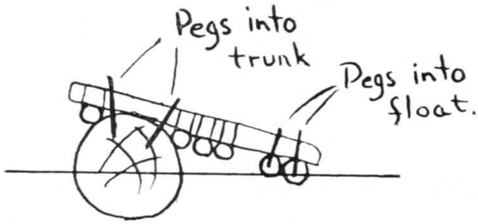
The most primitive type of craft which I have been able to find which used the outrigger principle is noted by Hornell in Papua, the very large island to the north of Australia. In two places, widely separated, Hornell describes the natives as using a raft under which one or two large logs or tree trunks are placed to increase its buoyancy but they are not attached to it in any way, as shown in Fig. 1. This unique custom can, however, be easily explained by the fact that the wetted surface of such a log-supported raft is less than that of a normal raft which gives the same lift and is thus much easier to paddle.



Papua (Fly Estuary)

Fig. I.

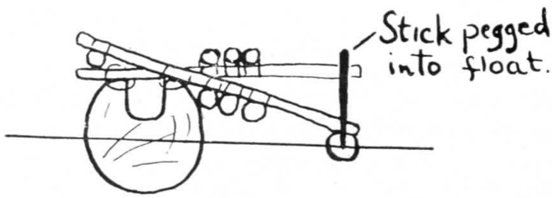
The next step in the development of the outrigger canoe came about when the raft was pegged into the large log (Fig. 2). Hornell again cites two instances of a large log with an outrigger pegged to it also from Papua. However, he thinks that this type of craft was a degenerate version of a more advanced canoe rather than a more primitive type still persisting. But, throughout Papua, the islands off its coast and in Indonesia many canoes have been described which have floats made from two or even more logs. For this reason, it is my opinion that the primitive type of craft is likely to have been composed of a large solid log with a raft simply pegged onto its top.



Hypothetical.

Fig. 2.

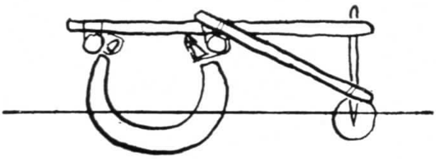
It will be noted that two large logs placed under a raft could give rise to a double-hulled outrigger canoe. It is, indeed, possible that side by side with the development which is about to be described there was a parallel development of a double canoe but it is also likely that the main emphasis was on the development of the single outrigger craft.



Papua.

Fig. 3.

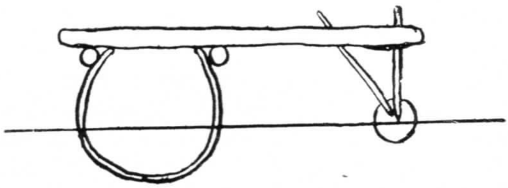
The craft shown in Fig. 2 would be very awkward to sit on because of its slope. The next stage in development was therefore the addition of another horizontal raft to the top of the existing canoe. As shown in Fig. 3, this would require the pegs into the float being left longer to tie the outboard end of the extra raft to, to keep it up. One would think that this would be followed by the degeneration of the first sloping raft but this has not always occurred. Often, there are sloping platforms on these craft on the opposite side to the float in the line in



Micronesian.

Fig. 4.

which the primitive raft would have been placed. In many cases, also, the fairly heavy sloping pole from the gunwale to the float persists, though its absence from the majority of these craft shows that it is not necessary. Fig. 4 shows this pole.



Melanesian.

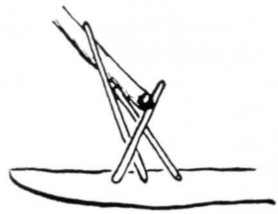
Fig. 5.

The final state of the Melanesian canoe is shown in Fig. 5. All that remains of the original sloping raft is now a slanting stick, pegged into the float at its lower end and tied to the thwartships pole to give sideways strength to the float. The short pegs which were probably originally used to attach the cross poles to the float instead of the primitive lashings, have become long enough to bring the cross poles horizontal and allow the greater height of the hull when it began to be fully dug out. Two wash strake poles usually remain to tie the cross poles firmly and to be tied, in their turn, to the hull.

The stick connectives from the cross beams to the float are very important from a development point of view. As already stated, these sticks were originally pegs driven into the float to which the cross beams were tied. They would naturally be put at an angle so that they overlapped above the bar they were holding in place. It is my belief that their original purpose was to avoid the chafe over coral beaches which would have cut through direct lashing with cord very quickly. When the sticks became longer, they still were put crossing *above* the cross poles and the more primitive Melanesian canoes all show this feature. In the most highly advanced canoes, however, such as those of Fiji and many other places, the mechanically more sound principle of crossing the sticks *beneath* the cross pole arose. Figs. 6 and 7 show these attachments.

Primitive Melanesian connective.

Fig. 6



Later Melanesian Connective.

Fig: 7.

It is more than likely that during the long period of time during which the outrigger was developing, the solid log of the earlier craft was becoming more and more hollowed out. In this process, one must not necessarily think in the terms of the naval architect. Primitive man always tends to accept his lot with a good grace and would pull his heavy log craft up a beach with the help of his neighbours without much thought of making it lighter. But these craft were mainly used for fishing and a fisherman needs some place to keep his gear and the fish he catches. The Melanesian fisherman solved this matter by making holes in the top of the main trunk of his outrigged tree. Soon, there was a series of holes all down the middle of the trunk, each one about 8″ to 10″ in diameter, that being the size most convenient to his stone (or sharpened shell) hand tool. Eventually, the wood between the holes was removed to produce a long narrow slit down the middle of the trunk which was widened and deepened to make a dugout hull. The main purpose of this hollowing was, I believe, for internal accommodation. It could not be entirely for lightness because the ends of the log are often left untouched and the slit does not extend to within

4 or 5 feet of the bow and stern. Nor was the idea that of achieving stability as was the case with dugout canoe of the rest of the world, including our own ancestors, because the outrigger apparatus made stability in the main hull unnecessary.

The evidence for the sequence of the hollowing out of the hull in the manner described is obtained from the method used for hollowing out a log for a canoe up till recently. Where fire was not used, the process was to bore a series of holes down the middle of the trunk by twisting their stone or shell hand tool around and then cut the wood between the holes away. Just as a chicken in the egg goes through all the evolutionary stages from a gilled creature like a fish through a lizard-like thing in its development to a new born chick, cultural habits of a primitive type tend to persist in a primitive society where habits change slowly.

Thus was developed the Melanesian canoe. The final craft is typically a tree truck about 20 feet long with rounded external sections and pointed at each end to form a bow and stern which are often exactly alike because the craft can sail in either direction. The inside is hollowed out, usually, but not always, to the ends. The top opening is extremely narrow so that the crew cannot sit in the hull or even put both legs into it side by side. If they put their legs in the hull, one must be before the other. The thickness of the planking is often as little as ½ inch, its thickness being judged by tapping with a knuckle during the hollowing out. The cross beams are typically four in number and they stretch out horizontally, being surmounted by numerous poles placed fore and aft to form a raft. The outer ends of the cross beams are above the single float, to which each is attached by three sticks at least, although there are many variations in these. The three sticks are disposed as in Fig. 7 in the most highly developed craft. They are firmly pegged into the float and securely lashed to the cross pole.

The Place of origin of the Melanesian Canoe.

It seems likely that only a few thousands of years ago the Melanesians lived in what is now Indonesia and the islands where they now live were then uninhabited or, in the case of Papua, were populated by a Pygmy people. It is certain, however, that the outrigger principle developed in Indonesia and it is quite likely that the true Melanesian canoe developed fully somewhere in those islands, though doubtless many stages of development could be found at any one time among them some two thousand years ago. About that time, however, the Melanesians were pushed out from Indonesia by the early Polynesians and they went down south and east by the coast of Papua and along the outlying islands. They spread to Fiji and Tonga and the other islands of the Melanesian chain and on far into the Pacific ocean to the Marquesas. The statues on Easter Island are very likely to have been made by them though the population, when it was discovered by Europeans, was Polynesian. But the Polynesians had the jolly habit of killing off the Melanesian peoples on islands which they wished to inhabit so that is not of very great significance. In all these islands, canoes of obvious Melanesian origin are to be found and the people are of a much darker complexion which indicates that there was an admixture of the Oceanic Negroid Melanesian blood in the Polynesian stock.

The Polynesian People.

Despite the theories on which the Kon-Tiki exploit was founded, it is generally agreed that the Polynesians originated in Burma or Indo-China and belong to the same stock as the Malays. The languages are similar amongst other things.

Possibly about three thousand years ago, the early Polynesians invaded Indonesia from the north and lived there for any unknown period of time. The Dyaks of Borneo may be their descendants among other peoples. But they were not allowed to stay unmolested for very long in their new territory. The Malays followed them and the Polynesians once more began to migrate.

By this time, the Melanesians had become a very fierce people and they were living in all the islands to the southeast of Indonesia, so the Polynesians had to take the northern route through the chain of islands now known as Micronesia, which were then probably uninhabited.

The Polynesians started to voyage through Micronesia at a time which their traditions place at 80 generations or about 2,000 years ago. They passed through the Palau group, the Caroline islands, the Marshalls, Gilberts and Ellice islands down to the Samoan archipelago, then probably sparsely peopled with Melanesians. In Samoa, the Polynesians settled and multiplied, later to spread to New Zealand in the west and Easter island in the east. They came across the Melanesians in most of the southern islands but always conquered and absorbed them, imposing their language and customs in all cases though Melanesian words and customs still exist in many places.

Hawaii is especially interesting for us because it was settled by people of pure Polynesian stock somewhere about 500 A.D. though the date has not been finally settled. They probably came from the Marshall or Gilbert Islands directly, taking the original type of Polynesian canoe with them. Apart from some friendly and unfriendly voyages to Tahiti, there was little outside contact and the Hawaiian canoe did not become influenced either from Melanesian or other Polynesian sources.

The Polynesian Canoe.

The simplicity of the true Polynesian canoe is deceiving in so far as it might lead people to think that it was an early type of craft. As compared with the Melanesian canoe, it consists only of a dugout hull with washstrakes, as a rule. Two outrigger cross beams are lashed directly to a single float at their outer ends, which are generally to port and to the washstrakes over the hull. The ends of the hull are usually decked in. Such a simple craft could not have been the ancestor of the Melanesian canoe.

In my opinion, the early Polynesians came to Indonesia with the knowledge of the art of dugout canoe making already developed. They would naturally come into contact with the outrigger culture in its most primitive form at first because this culture was being developed, one supposes, in the centre of the Melanesian area of the time and that was to the south and east, possibly Java or the Moluccas.

Observing the outrigger principle in the primitive raft of the

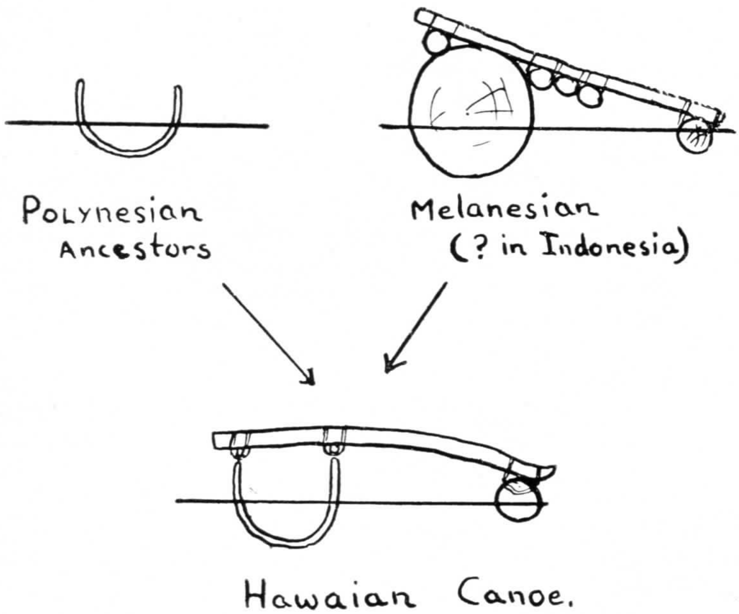


Fig. 8

Melanesians, partially supported by a large log, they ruthlessly adopted the essentials of two cross bars and the float and thus achieved their outrigger craft in one conception. This development is shown in Fig. 8. It was not necessary for them to build platforms on their canoes because they were, from the first, proper dugouts and therefore could accommodate the crew and goods inside them. The outrigger was simply used to stabilise an already perfect craft. The float was tied on in the early types, though usually the cross beams were tied to a small peg driven into it or through a hole put through it.

The Polynesians thus achieved their canoe by one single adaptation from a Melanesian source and this was the Hawaiian canoe when the European arrived there, the only change from the primitive idea being the very necessary one of having the cross beams curved to let the dugout canoe float with its gunwales level. It may be assumed that all the early Polynesian voyages were undertaken by peoples using this type of canoe.

Later, Polynesian canoes again became influenced by the more advanced Melanesian canoe where the two cultures once more came into contact. For instance, the Melanesian stick attachment was adopted for the fore cross bar in Tahiti, Samoa and Tonga. The after bar remained directly attached to the float, however, and was made pliant to allow the float to work in the waves. In these cases, the after bar was pegged directly into the float. The Marquesans used the Melanesian canoe almost without modification. The Oceanic lateen sail might also have come from the Melanesians.

The Polynesian Double Canoe.

The Polynesians made extensive use of double canoes in their migrations and their wars. These double canoes were of two types. Either, they were composed of two single outrigger craft linked together by their cross beams so that the bow of one was placed beside the stern of the other, one going forwards and the other backwards. Or, as in the war canoes, two huge matching tree trunks were hollowed out and put with the bows together and the sterns likewise. Occasionally, Redwood trees would drift over to Hawaii from America and often one of these would be kept for years till a mate was found for it. But for fishing and casual use, which would be similar in its nature to what the European or American understands by "Yachting," only the single outrigger canoe was employed.

The Indonesian Canoe.

The Malay or Indonesian was in a superior state of culture when he arrived in Indonesia than was the Polynesian who preceded him.

He had iron tools which allowed him to be more efficient, if not a more skilful worker in wood than his Polynesian relations. But what is most important in understanding the use he made of the outrigger principle is the fact that he arrived with a plank-built boat of considerable size such as the Orembai of Ternate which was often 40 feet long (shown in section in Fig. 9). The resemblance to the Viking

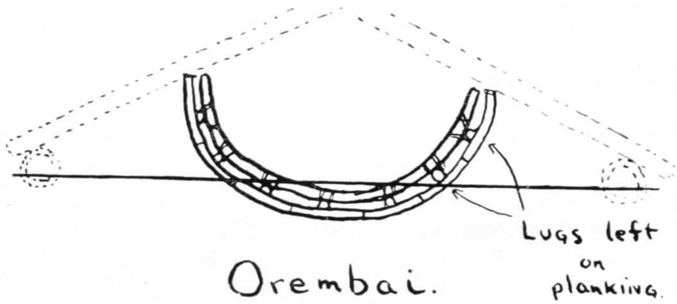


Fig. 9.

boats in the lugs on the planking which are lashed to the frames may be noticed. Such a craft, as we know, does not need outriggers to give it stability but boatbuilders from the beginning of time have, I suppose, turned out an occasional boat which was tender and tended to roll in a swell. So, perhaps from seeing some of the canoes which had been left behind by the polynesians, they fixed outriggers to their boats. But a single outrigger is not much good to a large boat, expecially if the float is made of bamboo as is the Indonesia custom, because it can easily be lifted up and thus does not act effectively as a counterpoise. For this reason, the Indonesians developed the double outrigger on their larger boats.

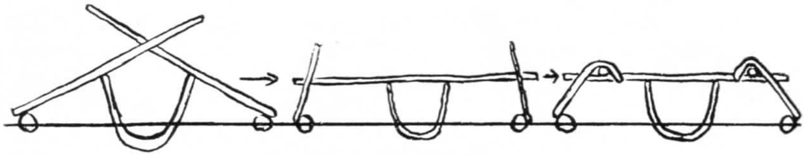
The Indonesian Dugout Canoe.

The reason for the adoption of the double outrigger on the dugout canoe is, by contrast to the case of the larger boats, slightly obscure but it may have merely been due to a slavish copying of the feature, a trait which is not completely foreign to us at the present day.

The evolution of the double outrigger of the Indonesians is very easy to trace, indicating only a recent origin, as we would expect from other sources. In the drawing of Fig. 9, a probable first stage for the trial of double outriggers is shown in dotted outline. The cross beams are straight and therefore slope up on the off side, above those going to the other float.

The second stage takes four forms :—

1. The Halmaheran attachment. Here the cross beams are connected to the float by short elbow pieces, Fig. 10.



Development of Halmaheran Canoe

Fig. 10.

2. In the Sulu islands, the floats are simply tied to the ends of the cross beams but there is a curved pole above the canoe hull to which the cross beams are tied. This top pole seems quite unnecessary and is very often missing, as one would expect, Fig. 11.

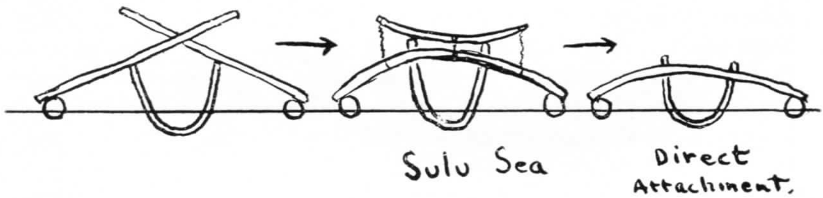


Fig. 11.

3. Fig. 12 shows the system used by the Indo-Javanese craft of the ninth century A.D. in the sculpture at Boro Budur.

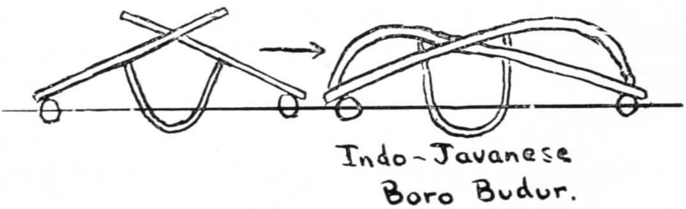


Fig. 12.

4. The Moluccan attachment consists of two cross beams, one put through holes in the hull and the other placed above it, on the gunwales. At the ends of these poles, a bent wand is tied and the float is tied to

the turn of the bend, Fig. 13. This last is one of the few Indonesian outriggers where there has been some attempt to raise the cross beams to some height above the water.

Fig. 13.

From my personal experience in sailing with the A.Y.R.S. catamaran fitted with floats nailed directly to the ends of the cross beams it would seem that some raising of the beams is necessary because they used to drag in the waves from time to time.

Both Ceylon and Madagascar owe their outrigger canoes to an Indonesian source and both mostly use a single outrigger at the present time which proves that, firstly, the Indonesians made an error in using floats on either side of their dugout canoes and, secondly, the Indonesian double outrigger was not the product of natural development but the result of the adaptation of an already well established principle belonging to an alien culture to their well developed dugout canoes and plank-built boats.

In the first A.Y.R.S. publication, I said that I had not discovered any native canoe which used lift from the lee float. Since then, however, it has been noticed that the floats of a double outrigger canoe in Madagascar, though still buoyant, have a shape like water skis and it would therefore appear likely that, in this case, dynamic lift from the lee float is, or can be used.

It was as a result of this observation that the A.Y.R.S. Catamaran was fitted with planing floats which have, on the whole, proved to be very satisfactory.

CATAMARANS . . . THEORETICAL CONSIDERATIONS

Most people think of Catamaran in terms of speed and there is no doubt that these craft are faster than most sailing boats of the same waterline length.

Now speed depends on the driving power or sail area and also on the length and displacement of the boat concerned. The sail area which any boat can carry depends on its weight and the distance between the centre of gravity and the centre of buoyancy when it is heeled to the greatest amount which can allow the sails to work effectively. One of the reasons why Catamarans can go faster than other boats is simply that with them, the centre of buoyancy can be made to shift much farther to leeward on heeling than in any single hulled craft. For instance, the centre of buoyancy in Roland Prout's double hulled craft shifts some 10 feet from side to side, which is a movement comparable to that found in a Thames barge.

Catamarans also have the advantage of being much lighter than other craft for the same length and beam. Even the double-hulled type, which is the heaviest of them, can have only a light bridge between the two hulls in which the crew can sit.

Ideally, the best disposition of Catamarans for speed occurs when all the weight is as far out to weather as possible and all the buoyancy is as far to lee as possible. This is a general statement and is made more with the Micronesian type of craft in mind rather than the double-hulled kind.

The Double-Hulled Catamaran.

In this type of craft as developed by Roland Prout, the hulls themselves weigh only 90 lbs. each but the whole thing weighs about 350 lbs. excluding the crew so the rest of the weight is in the cockpit, mast and sails. When one of the hulls has just been lifted out of the water, therefore, all this cockpit weight is only exerting half the righting moment it would have if it were put in the weather hull. It would be still more beneficial for speed if this weight could be removed altogether to reduce the resistance. This is hardly possible, of course, with our present knowledge and still maintain hulls which are rigid in position relative to each other. However, if the hulls can be arranged to work freely in relation to each other using the linkage developed by N. Herreshoff nearly 100 years ago (details of which I do not know) or some other system, considerable weight could be saved and extra speed obtained.

The Micronesian Canoe.

This type of canoe has the buoyancy always to leeward which is, from the theoretical point of view, perfect. The bridge to the float can be very light as compared with that necessary for the double hulled canoe and because the whole structure itself has such little displacement, the crew can exert a relatively greater effect on the stability and hence the power. Also, if more weight is needed than the crew can produce, it can easily be achieved by taking in water ballast by a mechanism which will be described later. In the model canoe races, which used to be as great a feature of Micronesian life on their islands as football is to us, the little craft were sailed in strong winds with a coconut pegged onto the top of the float for ballast.

It is felt that, for the above reasons, this type of canoe is likely to give the greatest speeds because it fulfils all the theoretical requirements. There are, however, some practical difficulties of sailing, such as the sail and rudders which have still to be solved but we are working on them and will have them fully developed next year. Our present devices, however, already seem to be satisfactory.

The Indonesia Canoe.

This type of canoe must have less stability and greater weight than the Micronesian canoe because, at any one time, one of the floats is not being used. However, it has the advantage that the bow and stern are always the same so the boat can be designed slightly more efficiently to the water flow and a normal Bermudian rig can be used.

From our experiments with the A.Y.R.S. Catamaran, it would appear that a planing lee float can be effectively used without any dire consequences and if such a float should be absolutely efficient, the theoretical conditions of lift coming from the lee side and the weight being on the weather side would be fulfilled even better than in the Micronesian canoe.

Hydrofoils.

To achieve the theoretically desirable feature of lift from the lee side and weight to weather, the hydrofoil holds forth a very great promise. Firstly, it can be combined with a float to give stability in light winds, or even be arranged to be retractable in at least three simple ways. Secondly, it can give a lift of about 15 times its resistance to the waterflow which is far, far better than any float or hull can do. Thirdly, like a planing float, it produces the lift to leeward. Fourthly it is easily possible that in great wind speeds, the whole hull may rise from the water and all the weight to be taken by the hydrofoils running beneath the surface.

THE A.Y.R.S. CATAMARAN

In the first publication, there was a drawing of the A.Y.R.S. Catamaran, and it was made by Prout's exactly as shown, using one of their plywood hulls such as they used on Ken Pearse's Endeavour and their own Shearwater.

On the first sailing trials, it was apparent that I had not given enough support to the float because the working of the waves caused the plywood itself to tear. These floats were then temporarily discarded and two planing floats were made by the Dover Yacht Company and fixed to the end of a light alloy step ladder by a single bolt so that they could pitch freely. The ladder was so arranged that it could be slid across the hull from side to side in the manner suggested by L. Francis Herreshoff.

The Catamaran was then taken down to Weston near Southampton for the speed trials and placed in the able hands of Ivan Morris for their duration. The first fault found was that the floats tended to dig their bows under, which was probably due to having too bluff an entry and not enough V. Ivan then put bolts from the ladder ends to the floats to fix them firmly. This stops the floats from pitching in the waves. Ivan now notices that when travelling at great speeds, the floats can suddenly submerge but will rise again quickly when the sheet is eased for a moment and the speed will hardly be affected. Extra lateral resistance was necessary and a leeboard was made of a well seasoned piece of pine but this snapped off "like a carrot" at hig speed. Roland Prout had the same difficulty with Shearwater and his present centreboard is 2″ thick at its greatest.

On one occasion, one of the original floats was tried out on one side against one of the planing floats on the other. Paced by one of Bill O'Brien's Darings, it was found that the planing float was faster but the trial was not quite fair as the original float was designed to go in the water on the *weather* side and, on this trial, it was being used on the *lee* side. Ivan is now altering the original floats for use on the lee side. Planing floats with a greater V and a finer entrance will be made this winter for trial next spring.

Speeds. There is no doubt that the A.Y.R.S. Catamaran is very fast, certainly much faster than the Daring or any of the other planing dinghys. Unfortunately the winds have not been completely suitable for the speeds trials and no great speeds have been obtained even by the Prout's Shearwater so no exact speeds can, as yet, be given but Ivan is sure that in one strong gust, she was doing some 15 knots. Compared to Prout's Shearwater, there seems to be very little between them for speed, though it would appear that she is slightly slower as yet.

Commander Fawcett is at present fitting hydrofoils to the A.Y.R.S. Catamaran which can either be used as stabilisers or could, if conditions were right, actually raise her from the water.

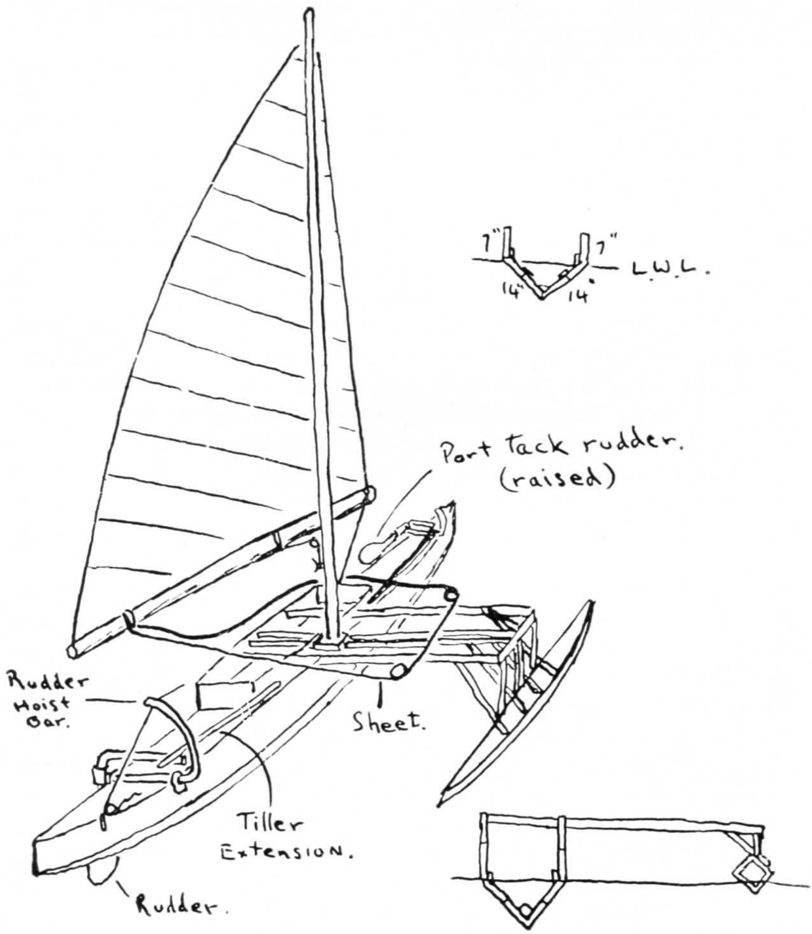
It has been noted in all our trials that it seems to make little or no difference to the steering which float is in the water. Control always stays positive and easy and she is as quick in stays as any other boat of her length.

A SINGLE OUTRIGGER CANOE

This spring and summer, Sandy Watson and I have made a single outrigger canoe. The hull was of a V section with a right angle below and an absolutely straight lee side. Length 20 feet, beam 20 inches. Above the V, the sides were built up vertically with one 7-inch plank and there was an extra 7-inch plank in the middle 10 feet around the "cockpit."

We had no plans of any kind but the main canoe hull was completed in 8 days of casual work owing to the main simplicity of the design.

A single float 9 feet long was then made from 4 planks 7 inches wide, screwed and glued into a square section but tapering to an edge



fore and aft in the manner used for the A.Y.R.S. Catamaran. This was set on edge and, by means of four cross beams and connectives, was made to slide into slots above the cockpit of the main hull.

A mast and sail were added of Micronesian pattern. The total cost of the deal wood used was about £8.

Because Sir William Acland (see A.Y.R.S. No. 1) had difficulty in steering with paddles, we thought we would try lifting rudders.

Unfortunately, we have not had enough time to complete full trials but we first of all found that the centre of effort of the sail had to be surprisingly far backward, so much so, in fact, that she was not too badly balanced when a Bermudian mainsail was set on the mast which was, of course, amidships. We now use a triangular lugsail as shown in the drawing as a result of a suggestion of Owen Dumpleton. This will let us move the sail backwards and forwards till we find the best balance.

The lifting rudders work quite well but the upright bar must be held from moving by two control lines instead of the one which we thought would be enough.

Changing tack does not seem to be a dreadful thing. The sail being a fore and aft, is always under positive control and can be whipped around to leeward extremely quickly by the sheet. We are still a little slow on the rudder, however, and the tiller extension is just a little hard to get used to.

On the whole, the craft can be said to give a very good promise of being a successful mechanism and, if lightly made from plywood, its speeds would undoubtedly be comparable to those of a Micronesian canoe or even better. The Micronesian canoe has been timed at speeds in the region of 20 kts.

CATAMARAN IDEAS

Float Springing, Double Hulls.

To allow the two hulls of a double-hulled catamaran to work in the waves independently of each other, it might be of value to put semi-elliptical springs between the outside corners of the cross structure and the main hulls as shown in Fig. 1. Some systems of metal guides

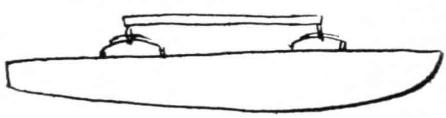


Fig. 1.

would be necessary to keep the hulls in alignment with the top because of the sideways flexibility of the springs. These are not shown.

J. C. Hines of Inverness suggests that the after spring could easily be replaced by a simple hinge joint, Fig. 2. This would cause the

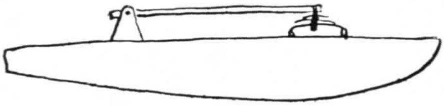


Fig. 2.

weather bow to dip lower than the weather stern, on heeling and, as a result, the lee bow would not tend to bury itself so much. With the Prout hulls which do not bury the lee bow at speed, the hinge joint could well be used instead of the *forward* spring.

Float Springing, Indonesian Catamaran.

For large Indonesian type Catamarans, to prevent the floats banging on the waves and to provide self righting in the case of a capsize, the mechanism of Fig. 3 is suggested. Each float is separately pivoted at the gunwale and the inboard end is connected to a semi-elliptical spring by a large, long, threaded screw. Both floats would always be in contact with the water and the heeling force of the sails

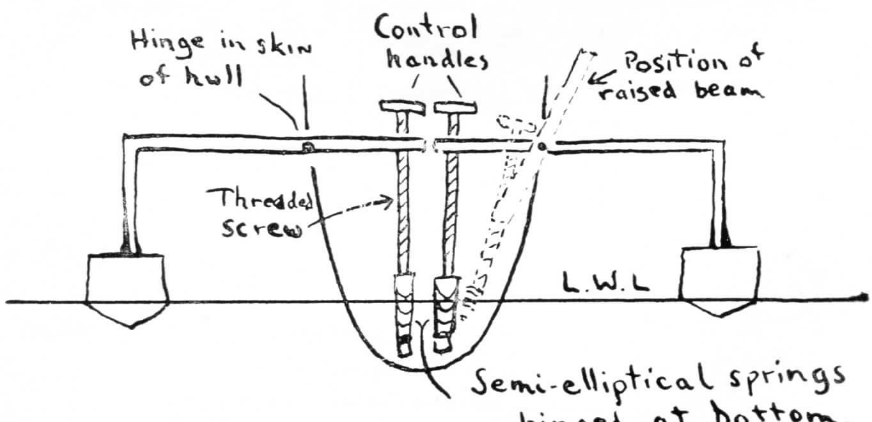


Fig. 3.

would be taken by the springs so that some heeling would occur, though it could be abolished by adjusting the screws. Should a complete capsize occur, both floats, if need be, could be raised almost vertically so that the craft would lie on its side. On lowering the appropriate float, the craft would be brought right way up.

Water Ballast for Micronesian Canoes.

Fig. 4 shows a method which could be used for taking in and discharging water ballast from the float of a Micronesian canoe. If the plunger is down below the bottom of the float, it acts as a suction bailer. When flush with the bottom, both bottom and top openings are closed. On being raised a little higher the bottom can be opened with the top still closed. Air could then be blown into the float through the side tube shown to clear it of water in that way. If raised right up, water ballast could be taken in, either when right way up or completely capsized. It will be seen that this mechanism could right a large canoe if completely capsized.

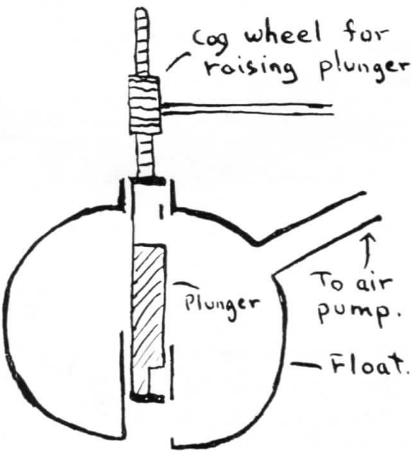


Fig. 4

Submerged Buoyancy.

A fish has a greater intrinsic and actual speed than a surface craft because it does not make waves on the surface of the water. A fully submerged streamlined shape would therefore have less resistance even than a Catamaran. Fig. 5 shows a tentative suggestion for such a craft. The weight is counteracted by the small, streamlined submerged shape while stability is obtained from three planing floats or floats and hydrofoils. Both the wetted area of surface and weight of such a craft would be less than that of a Catamaran and there would be practically no wave-making resistance.

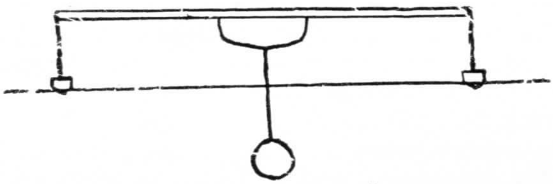


Fig. 5.

A RIVER TRADING CRAFT DESIGN

by C. A. Satterthwaite.

This little wherry design is the result of the suggestion in A.Y.R.S. booklet No. 2 "Hydrofoils" that a craft to carry about 10 tons of cargo might find employment on a navigable river or the Norfolk Broads.

The lines show a round bilged edition of the Thames barge with a raking transome and a cutaway forefoot. The bow sections are U shaped to keep down wave-making resistance and wetted surface. Possibly the hard chine type of barge will have more lateral resistance but it also has more forward resistance and a high performance in gentle breezes is particularly valuable in a trading vessel which must try to maintain a schedule. As a result, the lateral resistance is almost entirely got from the leeboards but, if these are of a good hydrofoil section as shown in the drawing, and they are set to the best angle of attack, they will be extremely efficient.

This craft is meant for smooth water so the lines are fine which with her shallow draught should make her a fast boat in light winds. She should be very similar to a Thames barge in her character, stiff and stable and rarely heeling to more than 15°.

The simple, single Bermudian type of sail shown should be satisfactory and easily handled. The sail is sent aloft permanently and is handled by means of the brails indicated running from leach to luff and thence down to a winch on the port side of the mast box. Thus, the sail is controlled by sheet and brails, as is that of the Thames barge, stowing aloft out of the way. Reefing can be effected by partly brailing the sail or by unlacing a bonnet from the foot. There is no reason, however, why reef points could not be fitted, as in the Montague whaler and reefing be done in the orthodox manner. The sail itself should be in "Terylene" or similar rot-proof synthetic canvas for durability.

No boom is shown, and off the wind the sail could be held out by a special spar acting as a boom, the same spar doing duty as a cargo boom or to swing out the barge's boat. It would be stepped just abaft the mast box. Alternatively, a "wishbone" type of boom could be used arranged to pivot high on the mast and sloping down to the clew, the sail being set by an outhaul. When lowering the mast, the outhaul would first be cast off and the sail brailed up, then the boom would be topped up and the mast would be ready for lowering. However, a boom is a curse and if one were not used, the handling would be so much easier.

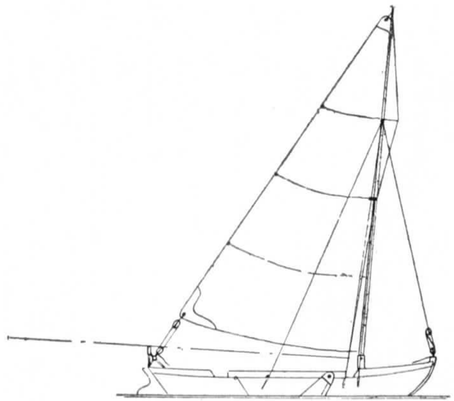
The mast should be a hollow Sitka spruce spar. It is shown as being arranged to lower in the drawings, being controlled from the windlass forward through the tackle on the forestay. A permanent crutch for the mast straddles the taffrail and incorporates a mainsheet horse.

The rigging shown is a minimum—one set of spreaders with jumper struts to brace the topmast. Runner backstays would help, set up by levers put just forward of the leeboard winches so that nobody is very likely to kick them up.

Accommodation is quite palatial for a working boat and consists of a double cabin, or cuddy, beneath the poop and a single berth in the large forecastle. The cuddy would be the living and sleeping quarters. A double berth is shown in dotted outline which could be stowed and used as a table or sideboard during the day time. Locker, shelf and tank space would be forward of it beneath the main deck. There is room for a settee, table, hanging space and pantry. This cuddy is well lit with a skylight and ports on either side. The forecastle would be the ship's kitchen and workshop and be fitted with one or more bunks. Locker space and a W.C. would be there. A stove is shown both fore and aft and would be an essential for winter use. The after chimney would project through the poop deck adjacent to the helmsman to give him that little glow of warmth which means such a lot on a bitter winter's day. Altogether, very comfortable accommodation could be arranged for a man, his wife and even two children in this boat.

She is a large vessel for her hold capacity but she should stow a cargo of 10 to 15 tons. At 25 tons gross displacement, her draft

PROPOSAL FOR RIVER TRADING CRAFT.



MAIN DIMENSIONS.

LENGTH OVERALL - 46 FEET.
LENGTH WATERLINE - 38 FEET.
MEAN DRAFT - 3 FEET.
MAX.' BEAM - 12 FEET.
DISPLACEMENT - APP. 15 TONS. (AT MEAN DRAFT).
HOLD CAPACITY - APP. 1000 CUBIC FEET.
SAIL AREA - APP. 750 SQ. FEET.

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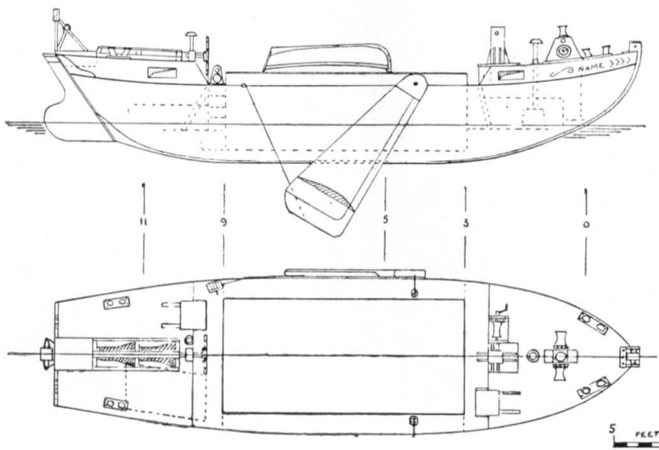
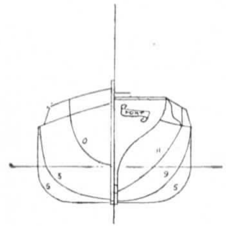




C.A. SATTERTHWAITE,
"BARNCROFT", HARTLEY, KENT.

would be 4 feet and with leeboards right down, 9 feet. Her minimum draught unladen would be about 2 feet. The cargo hold has deep coamings and would have at least two beams fitted right across to hold the vessel's shape. These would be removable when stowing or unloading.

Gear on decks is simple and heavy as befits a working boat. Anchors would be C.Q.R. pattern, stowing on the foredeck. A hefty windlass is an essential and mooring bollards, fairleads, etc. would be in proportion. The wheel steering would be in normal barge fashion with a right and left hand screw box. The leeboard and brail winches would also be of the usual barge pattern.

Construction would be of perfectly orthodox barge type, long-leaf Pitch Pine planking on English Oak laminated timbers with an English Elm backbone. Decks of resin-bonded plywood, the main deck being clad with pine to take excessive wear when handling cargo. Leeboards and rudder to be compressed laminated resin-bonded wood "Jabloc" or "Pennali." These are strong and heavy materials with a smooth hard finish.

I think this idea is rather attractive but I hesitate to say whether such a vessel would pay because regular cargoes might be difficult to get. Anyhow in summer time on the Broads she would make a fine floating cafe and general stores. It could travel about the waterways supplying people's wants. I wonder if one could get a licence for the sale of beer on board and what would be the hours?

THE PERFECT SAIL

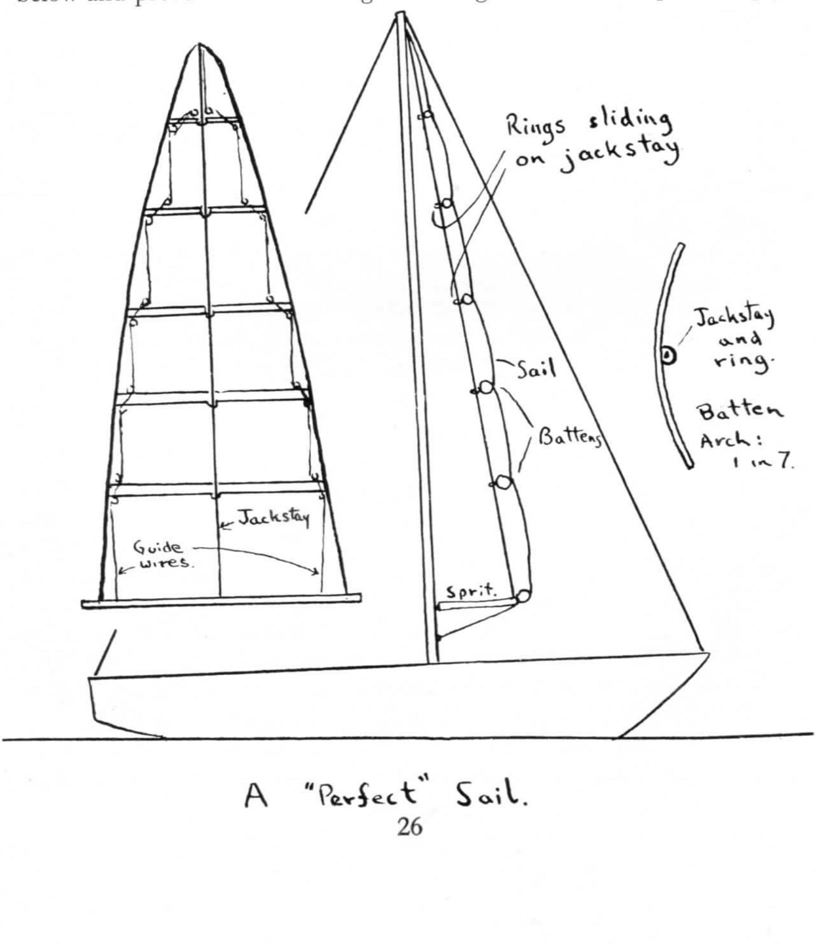
In the last booklet, we saw how almost perfect rigs and sails can be produced by the natural process of evolution and in the article on Captain Illingworth's development of the fore triangle we saw how one piece of that process took place.

Major General Parham's approach is quite different, however. His approach is the one of modern science where a device is studied in every possible way to find out its inefficiencies and, where one is found, a way is devised for its removal. The operative studies on which the sail of the last article is based are two. Firstly, Manfred Curry proved that the twist in a sail was a great waste of power. Secondly, Warner and Ober showed that the eddies in the wind behind a mast caused a loss of 18% of its driving force. These eddies cause the loss by interfering with the smooth flow of air on the leeside of the sail. The eddies on the weather side are of little importance. Therefore, Major-General Parham produced a sail which does not have these faults.

In this article, a "perfect" sail will be described which is a very easy thing to do because the scientists of the aircraft world can tell us exactly what we need. Thick aerofoil sections, which might possibly be of value are not considered here. Their satisfactory erection on sailing boats is still to be achieved.

The "perfect" sail is half an ellipse with a Span^2/Sail area ratio of approximately 4 : 1. When this ratio is multiplied by 3/2 because of the sea favourably interfering with the boom eddy, an aspect ratio of 6 : 1 is obtained which is as good as can be of use to us. The flow of the sail should be an arch with a rise of 1/7th of the chord or luff-leach length. Te be used efficiently, the luff of the sail should be slightly aback and it therefore needs to be very fully battened.

The diagrams show this sail erected as a squaresail. Probably not enough battens have been drawn. The sail is very simply set by hoisting the main halliard. First one batten and then another is lifted up till the sail is fully set. The battens slide up the Jackstay—topping lift which runs from the mast head to the centre of the boom and the guide wires at the sides of the sail seat each batten on the one below and prevent them skewing. Reefing is carried out quite simply



A "Perfect" Sail.

by slacking away on the halliard till the required number of battens are sitting on the boom. This is obviously derived from the method of using the Chinese battened lugsail.

Advantages.

1. At present, we are troubled to get the luff of our jibs straight. Ideally the luff should not only be straight but convex. In this sail it *is* convex.
2. Ideal aspect ratio.
3. Ideal amount of flow.
4. Instantaneous furling.
5. Simple reefing.
6. Sail area not reduced by heeling up to 10°.
7. Better mast staying.

Disadvantages.

1. Weight of battens.
2. Difficulty of putting about.
3. Difficulty of taking sail from boat.

Considerable thought has been applied to this sail to see if it could be used as any kind of fore and aft sail without much success. If the battens are not used, however, a very simple triangular lugsail with many advantages can be got by having two sails, set one on either side of the mast.

CONGRATULATIONS to Col. C. E. Bowden on the success of his wing sail which he has been trying out this summer with Dr. Lamont. Also for the success which he has had with his radio controlled sailing yachts.

Congratulations also to the Baker Company of the U.S.A. for getting 30 m.p.h. with their new hydrofoil craft with its deep V ladder foils.

The ultimate survival of the A.Y.R.S. is not quite assured at the moment. If, however, these publications continue, the following subjects will be used :—

The Yacht Navigators.
Sailing Aerodynamics.
Olympic Racing.
Yacht Electrics.
Catamarans in the U.S.A. and Australia.
Dinghy Cruising.
World Cruising.
Racing Yacht Tuning.
Sails and Aerofoils.
Hull Evolution.
Yachting Accidents.
Winds and Waves.
Hull and Sail Tests.
Racing Tactics.
Members' Letters.
Sailing Vessels.
Amateur Boat Building.

A.Y.R.S. PUBLICATIONS

No. 1. CATAMARANS.

Contents

1. The Objectives of the Amateur Yacht Research Society.
2. The A.Y.R.S. Two-hour Yacht Designing Method.
3. The Double-Hulled Catamaran.
4. The Polynesian Canoe.
5. The Indonesian Canoe.
6. The Micronesian Canoe.
7. The Balance Board Sailing Craft.

No. 2. HYDROFOILS.

Contents

1. General Information.
2. The Traditional Hydrofoils.
3. Asymmetrical Keels.
4. Hydrofoil Stabilisers.
5. The All-Hydrofoil Sailing Craft.
6. Miscellaneous Uses for Hydrofoils.
7. More about Catamarans.
8. Future Research.

No. 3. SAIL EVOLUTION.

Contents

1. The Evolution of Sails.
2. Captain Illingworth's Development of the Fore Triangle.
3. A Wing Sail Design by Major-General H. J. Parham.
4. Self Steering for Every Yacht by Peter Johnson.

No. 4. OUTRIGGERS.

No. 5. HULL DESIGN. To come out in February, 1956.

A Study of Hull Design by C. A. Satterthwaite, B.Sc., M.S.N.R.

This study will be presented for and to the amateur yacht designer so that he will be able to appreciate the factors which make a fast and well behaved yacht. Even though the reader may never design a yacht himself, however, it is hoped that he will get an insight into the work of other designers from this booklet.

F. J. PARSONS LTD., London, Folkestone and Hastings.