The sailplane on a close reach. It will be noted that she sails without any angle of heel.

Sailplane reaching. Although the wind is moderate she is moving at a fast clip

The Sailplane—A New Type of Sailboat

By MALCOLM and T. A. McINTYRE

Photographs by C. M. Brooks

[The following article describes a new type of craft designed entirely for speed, which was tried out in rather crude form this Summer, and embodies an interesting principle. What she has done is described by her designers and builders, who have unlimited faith in the idea. What they have done with this first craft shows that the theory is at least worthy of consideration.—ED.]

IN the year one, the first yachtsman must have discovered that his log dugout carried her sail better if his wife happened to be aboard. We sailormen follow the leader like a flock of sheep, so ever since then, wherever there were boats, ballast in some form has always been used to make them carry their sails. As a result, even after hundreds of years of development, modern racing yachts sail mighty little faster, as we measure speed these days, than the first yachtsman's dugout.

In spite of the affection every sailor has for the heavy, ballasted, type of boat that lays over in a breeze (an affection we ourselves share), we now believe that for high speeds they are fundamentally wrong in principle and design, and that it is impossible to ever develop the type into really fast boats as compared with speed by other means of locomotion. The following are some of the thousand and one reasons for this opinion:

The displacement in the accepted type of boat is about five times that required to float the crew, rig and sails. To get this great displacement the beam is usually about one-third and the draught one-quarter the water-line length. Obviously, it is impossible to drive this heavy, wide, deep hull at high speeds. The submerged portion of the hull is lop-sided. The wind pressure on the sails buries the hull almost as much as it tends to capsize and drive it, and thus the hull buries, pounds and gripes in a breeze. The effective sail area and lateral resistance is reduced about 30 per cent at about a 45-degree angle of heel. Weights aloft and the water pressure on lee side of keel both increase the angle of heel. In a word, the heavy, wide and deep hulls cannot possibly be driven at high speeds, even if the sails did not lose a great proportion of their driving power by the inclination of the mast.

Now, all sail boats, past and present, are extremely slow, comparatively. The usual 25-foot W. L. racing boat cannot be driven over 8 knots unless towed by a husky towboat. The fastest time in the races for the America's Cup only figures out at about 10 or 11 knots over a triangular course.

A great deal of time, brains and money have been spent in trying to perfect and develop the heavy-ballasted, heeling type of racing boat, but are they so much better now than they were in the beginning? A little faster, perhaps, but certainly much more flimsy if built to save weight. We believe that these boats have been developed about to the limit, and that something new in principle and radical in design will have to be gotten up to get really high speed under sail on the water.

The ideal theoretical fast sailboat should be one that will stand upright and carry her sail in any breeze, have no ballast in any form and only enough displacement to comfortably float the crew, sails and rig. At first glance a catamaran or double-hulled boat would seem to answer these requirements. But we designed, built, sailed, capsized and nose-dived three different types of catamarans during a number of years, trying to make them work, even after they had been abandoned, years before, by our forefathers. They were fast reaching under certain conditions, but it was only the weight of the windward boat and the platform acting as ballast that tended to keep them from capsizing. When driven hard they would lift, catapult the crew overboard and quit for the day, with the top of the mast headed for China. It took an acre lot to tack them or to jibe in. They were all poor in a sea, even the double jointed, knock-kneed varieties. The wind resistance of the two hulls and platform amounted to a good deal. The skin surface of the double hull was about twice that of a single hull of the same displacement, so they couldn't get out of their own way in moderate weather. After a good deal of wasted time and effort we agreed, with the previous generations of catamaran sailors, that it was impossible to develop a practical sailing catamaran.

The natives of the South Sea Islands have developed their outrigger canoes into fairly fast boats. They put the ballast in the form of a log and some nimble natives on a long outrigger to windward. The amount of ballast is thus less than would be required on the keel of the accepted boat. It seemed that this ignorant, heathen edition of the outrigger canoe catamaran offered more possibilities of development than our educated, civilized, double-hulled varieties. So we decided to build one this last Winter.

On locating, on the drawing, the keel or fin to provide lateral resistance of this boat it only required simple mathematics to demonstrate on paper that if the fins or keels were put on the ends of outriggers, on both sides of the boat, and if these fins were set at an inward angle inclining towards the hull, that it would be impossible for the wind pressure on the sails to upset or even heel over the boat.

Figure 1 is a bow view diagram of this principle showing the narrow shoal draught hull supporting the mast and the two horizontal outriggers with the planes at their ends set at an angle of 45 degrees towards the hull. Assume the overturning resultant of the wind pressure on the sails is 1,000 pounds at the center of effort, C. E., and say this point is 15 feet above the line of lateral resistance, C. L. R., then the overturning moment caused by the wind is 1,000 pounds $\times$ 15 feet = 15,000 feet-pounds.

Ignoring the slight lateral resistance of the hull, the 1,000 pounds wind pressure tending to shove the boat to leeward through the water necessarily is counteracted by 1,000 pounds water pressure on the lee sides of the two inclined planes. To make the figures simple, say this pressure is equally divided between the two planes, each getting 500 pounds. If the planes are inclined at a 45-degree angle, as shown, then the lee plane will shove up vertically with 500 pounds pressure, and the windward plane will pull down vertically with 500 pounds pressure. So, if the center of lateral resistance of each plane is 15 feet out from the center line of the mast the righting moment, due to the water pressure on the lee sides of the two planes, is (500 pounds $\times$ 15 feet) plus (500 pounds $\times$ 15 feet) = 1,000 pounds $\times$ 15 feet = 15,000 feet pounds. As this equals the overturning moment, due to the wind pressure, the boat is absolutely stable against overturning or even heeling over in any wind pressure, and will carry her mast vertically until it blows out of her. If the planes were flatter their distance apart could be reduced.

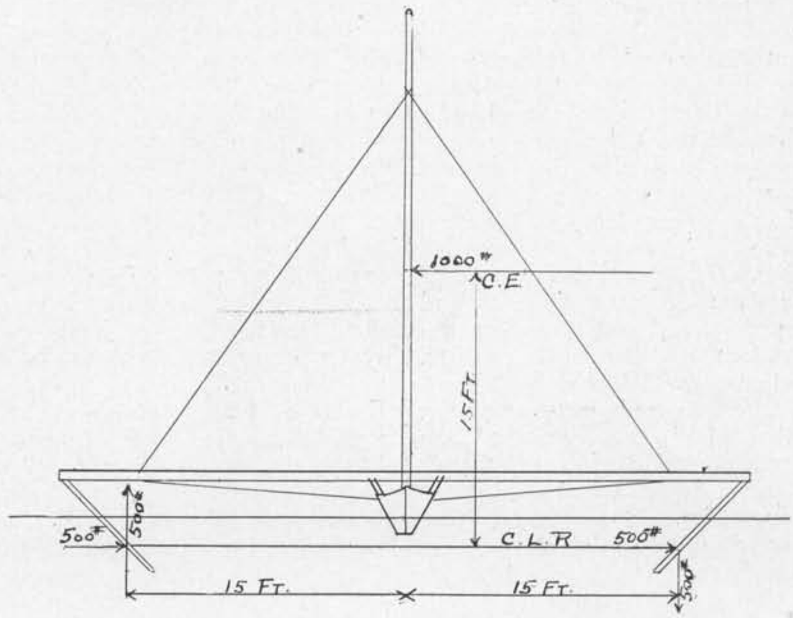

Fig. 1. Plan of Sailplane, showing the theory on which the designers worked

This complete, automatic stability is obtained entirely by the water pressure on the lee sides of the planes, and not by their buoyancy or the forward movement of the boat through the water. The stabilizing effect is independent of the dimensions of the planes, so they have only to be large enough to give proper lateral resistance, the same as the keel or centerboard on the usual boat.

Here was the ideal, theoretical fast sailboat that could carry sail in any blow without heeling over at all, we thought. All ballast could be left ashore, and there was just enough displacement to float the crew and rig—all worked out on paper.

Figures can't lie, but liars can figure. Is that what you are saying, Mr. Reader? We don't blame you for these sentiments, as we could hardly believe it ourselves at first, and were quite unable to make a couple of celebrated naval architects accept it. They assured us that the first puff of wind would turn us over. But by nailing two cigar box covers to a cross stick, and a knitting needle for a mast, arranged as per Figure 1, and testing it out in the bathtub, we convinced ourselves that the principle was correct.

Looking for jokers to develop when the principle was applied to sailing, we built a 60-inch model, which worked perfectly and had absolutely no tendency to lay over and was very fast in a breeze. This model was so successful that we started the design and construction of a real boat with a good deal of confidence, in spite of our calamity-howling naval architect friends.

The photographs herewith show this boat, which we call a sailplane to distinguish it from the present types, reaching in a good breeze, and one may note that there is no tendency to lay over. Even the photographs show that she is traveling some.

The hull we used was 34 feet O. A., 4 feet beam on deck, 2 feet beam on water line, 10 inches draught, V section and double ended. The planes are 1½ inches thick, each submerged portion being 5 feet long and 3 feet 6 inches deep, giving a draught of 2 feet 6 inches. The sails are an old jib and leg-of-mutton, 410 square feet area, all that remained from the last of our catamaran family. The cockpit is 8 feet long and 4 feet wide inside the coaming. The total weight, including rig, is 1,500 pounds. We had lots of fun and some hard work building the sailplane, but that is another story.

Let's forget about theory and mathematics now, and try some real sailplaning. The trip was in Newark Bay. We wanted to be sure that she would not turn over, so set the planes at a flatter angle than 45 degrees, and the harder it blew the more she laid down, or rather *up*, to windward. This was a remarkable sensation, and has probably never happened before in all the hundreds of years of sailing. The next day we steepened the angle of the planes and got perfect automatic stability, independent of the wind velocity. We had a good breeze both days, and she traveled fast—all boats do that when they are alone. She steered perfectly and was better in stays than we hoped for; although slow, she was sure. This slow tacking is caused by the long, straight-keeled hull, and not by the planes, which move on a tangent of the turning circle.

On the third trip we left Newark Bay, bound for Oyster Bay, with a good S. E. breeze. We struck the tide rip beyond the Kill Von Kull, and were so agreeably surprised at the way she behaved in a sea that we ignored the spray going down our necks. Started sheets and shot under the bows and sterns of the tramps anchored off the Statue of Liberty, and ran over to Governor's Island in short order. We went up the East River against the last of the ebb tide, blanketed sometimes by the tall buildings. We got slack water at the 59th street bridge, and went jumping through Hell Gate at low water, picking up and passing buoys nearly as fast as a Sound steamer. Hit the high spots only going across Flushing Bay, as we struck some hard puffs here. Some of the fast steam and motor ferry yachts returning from their daily run to the city passed us, but we passed everything else that day—all kinds and manner of boats.

Stepping Stones was abeam at 5 P. M.; Sand's Point at 5:25, and Matinicock at 5:50, or just 50 minutes for that 10 miles. This averaged 12 miles per hour, although she surely did 16 at times in the puffs. We would sight, way ahead, sailboats wallowing along, some with double reefs, but it didn't take long to put them far astern. We arrived at Oyster Bay at 7:10, wet, but satisfied, for it was a mighty good run for the third trip of a brand new type of boat.

What is it that is said about pride going before a fall? Well, we nearly fell plumb overboard next day when the racing boats of our sail area, or even smaller, went by us in a light breeze. We couldn't understand it at first, but the answer is perfectly simple. Our long, skinny hull had the same wetted surface as the ordinary short, chunky hull of about five times our displacement. As wetted surface is the whole thing at slow speeds, our amateur-built hull didn't have a chance with the racing boats' polished underbodies.

The sailplane was built to demonstrate that a boat could really carry sail without ballast and to sail faster and faster the harder it blew, instead of burying up and stopping at about 8 knots, the way the usual sailboat does. This she did. Nothing went by us in a good breeze, and we sailed by all kinds and sizes, even up to 100-foot schooners. The slow speed in light weather was a great disappointment, and we kicked each other around the block for the assinine mistake in the design of the hull.

During the summer's sailing she developed no weakness in hull, outriggers or planes, although the mast was too light. We never tied in a reef, and were always howling for more wind, so next year we are going to increase the sail area from 410 to 600 square feet, which will make her livelier and even faster than now in a breeze. The angle of the planes will have to be a little flatter to take care of the higher center of effort of the sail.

At present we are sailing a model which has, proportionally, only 50 per cent of the wetted surface of the sailplane described above. By giving the planes themselves enough buoyancy to float the rig and outriggers and by placing a small, buoyant plane at a flat angle forward to take the forward drive, the hull is entirely eliminated. Therefore, this new design tacks quickly, is much faster in all weather and is particularly good in a sea, due to the three-point suspension. By making the angles of the planes slightly flatter the beam has been greatly reduced.

The cockpit on a full-sized boat of this type would be a light, double-ended skiff, hung between the outriggers, 'thwartships. When wishing to go ashore this skiff, or, cockpit, would serve as a tender.

For some years we have felt that racing and day sailing have hardly been holding their own with the younger generation, who desire only speed, due to fast motor boats, aeroplanes, automobiles, etc. On account of the much higher speeds that can be obtained the sailplane will make racing and day sailing more interesting and exciting, and in place of the much-discussed and complicated racing measurement the only restriction would be sail area for the different classes, as in an iceboat.

Although motor boats have only been in use for a few years their speeds have jumped to around 70 miles per hour, aeroplanes to 180 miles per hour, automobiles to 130 miles per hour, while the racing yachts have always been slow, and will continue to be slow unless something radical is done about it. Certainly this sailplane is radical, and from the experience with the real boat and action of the revised model there is no doubt in our minds that they will make well over 20 miles per hour.

[The authors of this novel "Sailplane," who have patented the invention recently, expect to exhibit a model of it in a tank of water at the forthcoming Motor Boat Show, where it will undoubtedly attract the attention of all sailing yachtsmen. Let's hear what some of you "sharps" think about it.—ED.]

For Limitation of the Marconi Rig

At a recent meeting of the Yacht Racing Association of Long Island Sound, at which delegates from practically every club in the Association were present, the question came up of the advisability of limiting the height of the mast in the Marconi rig and of certain other restrictions in regard to it that might prove of benefit to the sport. It was the sense of the meeting that some limitations must be placed on the rig. Our whole measurement rule is made up of limitations in order to prevent extreme and freak designs and to produce a wholesome boat, and it seems, therefore, reasonable that steps should be taken to prevent going to the extreme lengths in the development of the Marconi rig that were seen this Summer. A committee was appointed to take up this matter of limitations, and to get co-operation from the Yacht Racing Union of Massachusetts Bay and some of the other associations.

A number of suggestions were made as to the form of limitation, but the one that at present seems most advisable is one limiting the length of the mast to 1.7 times the square root of the sail area plus the constant 5. This is considered better than limiting the height to

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