Hiking in the laboratory

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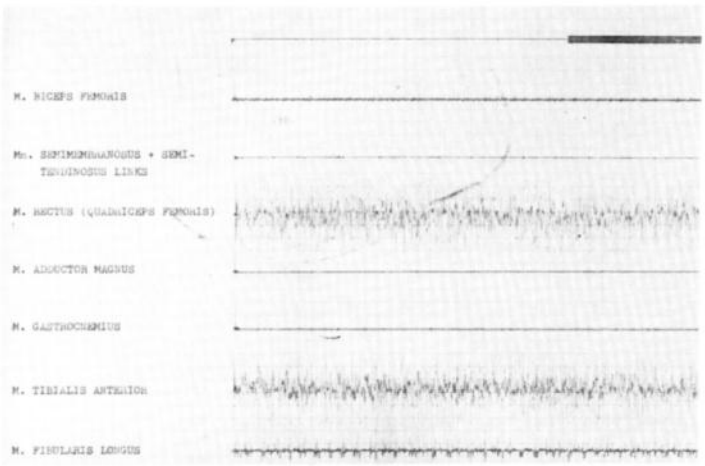
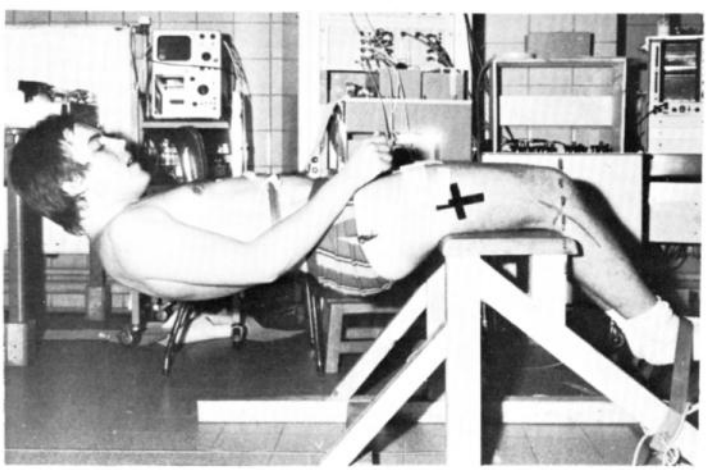
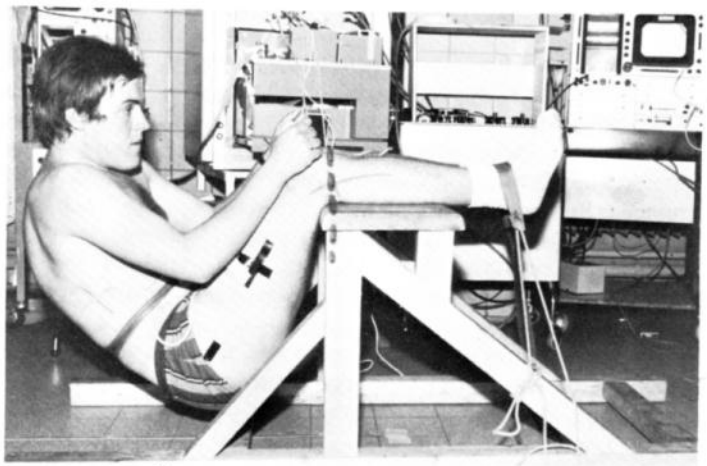
We recently made a study of hiking in the laboratory.
The electromyography is the science in wich the electrical activity of muscles is studied.
A muscle that contracts, produces an electrical activity.
By means of very small needles, inserted in the muscles, the electrical activity produced during a muscular contraction, is recorded and amplified.
The electrical activity can be read on a oscilloscope, or by graphic means. In fact there is no great difference in method with an electrocardiogram (photo 1).



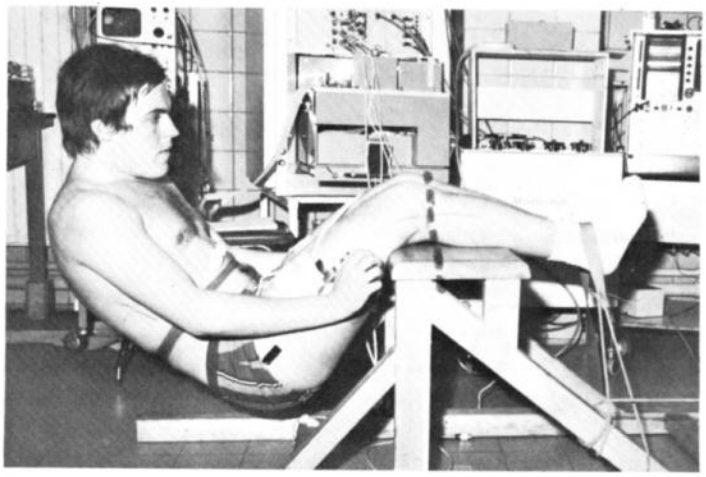
The purpose of the experience was to study different ways of hiking.
We tried to find the most effective and economic way of hiking.
Six sailors (two of them were Finn-sailors), were examined. We could not find more volunteers, because each of them had to get 34 needles into various muscles.
After one week all the local yachtclubs were warned that cruel maniacs were torturing the four sailors and soon we did not see them any longer.
It is difficult to classify the different ways of hiking, because everyone has his own method and habits. Moreover the width of the deck and the lenght of the sailor's legs, of course, play an important part.
To simplify the study, we asked the sailors to hike in three different ways (photos 2,3,4), viz. with the knees at the inside of the deck (as in boats with small decks), at the outside, (as in Solings) or in the middle of the sidedeck, (as most Finn-sailors do).



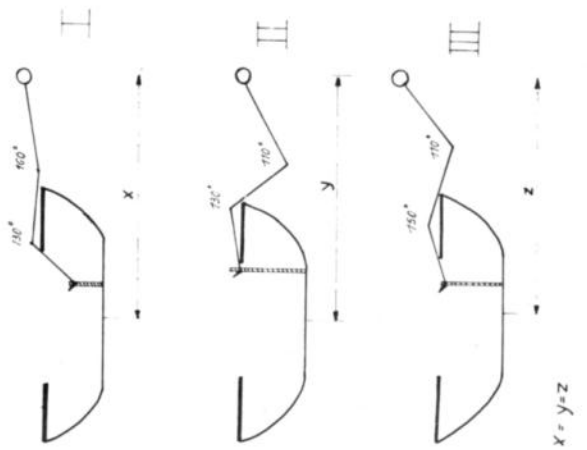
Our first object was to perceive which muscles were contracting in hiking. I do not want to sum up the long list of eighteen muscles involved in the process, but it is interesting to note, that the abdominal muscles, fact only come at the fourth place.
In fact, the most important muscles in hiking are the thighmuscles, followed by the muscles that arise at the forepart of the leg. After



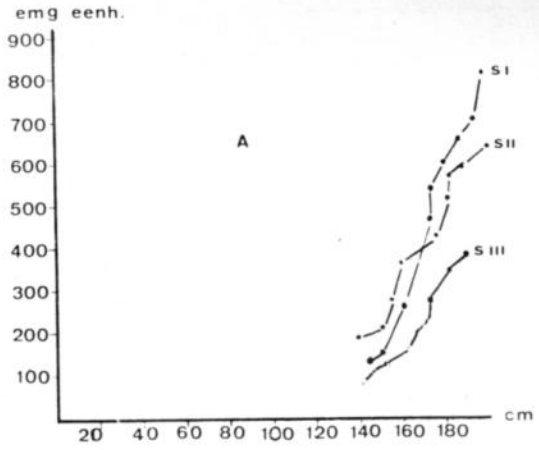
those comes the psoas-muscle, which is a muscle that arises from the spine.
Various authors, (amongst them Philippe Soria) have proposed hiking methods, to avoid the contraction of the psoas-muscle, which can cause severe pain in the back.



In fact we found that no method could avoid the contraction of this muscle.
For that reason we believe that the schemes for powertraining should attach the greatest importance to thighmuscularity (squatting, leg-pressing etc.).
We think that abdominal muscles are much less important.
Another part of the study was to find the most economic way of hiking.
The sailors were examined in the three previous described positions, with the same position of the centre of gravity, thus with the same leverage effect on the boat. (photo 5.)
The hiking efficacy was the same in the three positions, but the muscular strain was not the same.



The next graphic (photo 6) shows, that position III (with the knees in the middle of the deck) is much more economic that the other positions.
The amount of electrical activity, or to simplify: the muscular effort, is put on the vertical scale; the distance from the centre of the boat to the centre of gravity of the sailor, or the effectiveness of hiking, is put on the horizontal scale.
We therefore have a relation between muscular effort and hiking efficacy.
It is obvious that position III is the most economic way of hiking, as the effort is the smallest for the same efficacy.
We also tried to find which joint-angles were most efficient.
Every joint has an angle on the place where the muscular strength is the greatest.
This relates to both the optimal mechanical relations of muscle and joint, and the ideal muscle-length.
We found that when a sailor has bent his knees at 60 degrees of flexion (or at 120 degrees of extension, wich is the same) and the hip at 110 dregees of flexion, he produces the least effort, as his muscles have most power.



In conclusion we should advise a hiking position with the knees exactly in the middle of the side deck, and bent at 60 degrees and a 110 degrees of flexion in the hips.

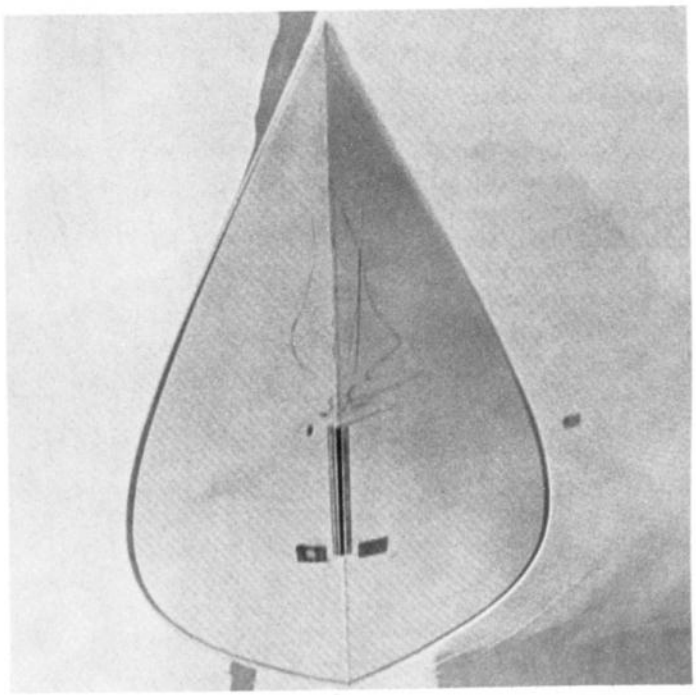
Looking Up At Your Boat.

Photos by Chris Caswell
Commentary by Bruce Kirby

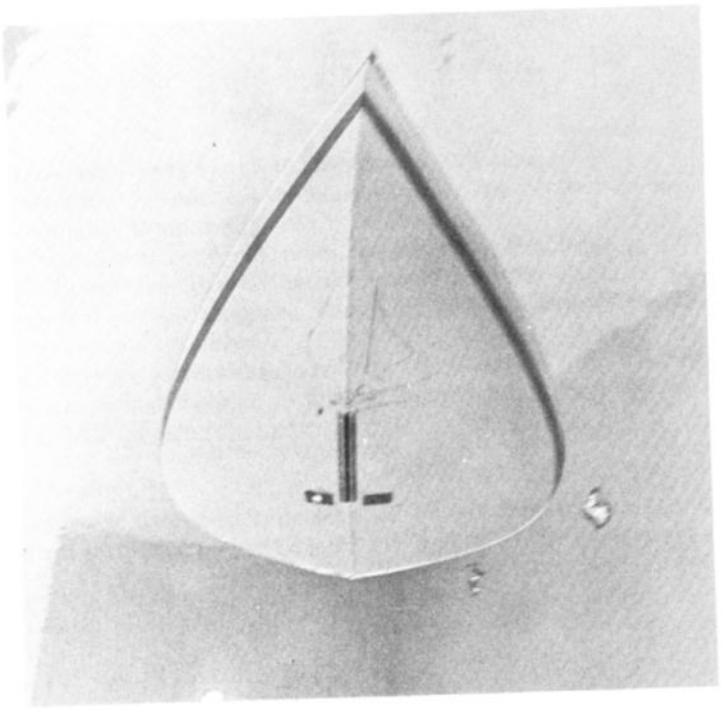
The Finn, Olympic single-handed dinghy, was chosen for our underwater shape experiment as it is typical of many modern planing hulls — fine forward and flat aft.

Credit Yacht Racing and these two people

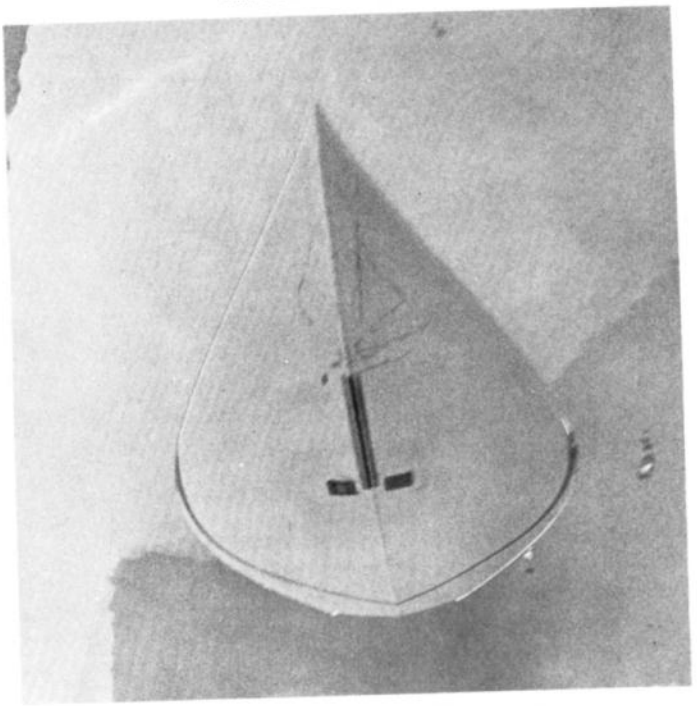
When our West Coast staffer Chris Caswell sent in his material for this feature his notes began: "OK, slosh, here are your, glub, pictures from untersea, as we used to say in the U-boats.
Then he remembered that the whole project had been his idea and he dried up a bit. With full cooperation from Lee Bender, manager of the Long Beach Olympic pool, Caswell launched a Finn, found himself an experienced Finn helmsman to ballast boat according to "the plan" and took to the water himself with his trusty Nikonos. He noticed that his magnificent handlebar moustache caused his face mask to leak profusely, that "you have to be a hell of a long way down to photograph a Finn full length," and also that one can get quite tired puddling around in a pool several feet below the surface.
The object of Chris's exercise was to show how the waterline shape of a boat changes according to how the boat sits in the water. Although a boat makes somewhat different shapes when moving, these pictures indicate clearly such phenomena as why a boat develops helm as it heels, or why a heeled or bow down attitude increases light weather speed. There's a lot to belearned from the shark's eye view.



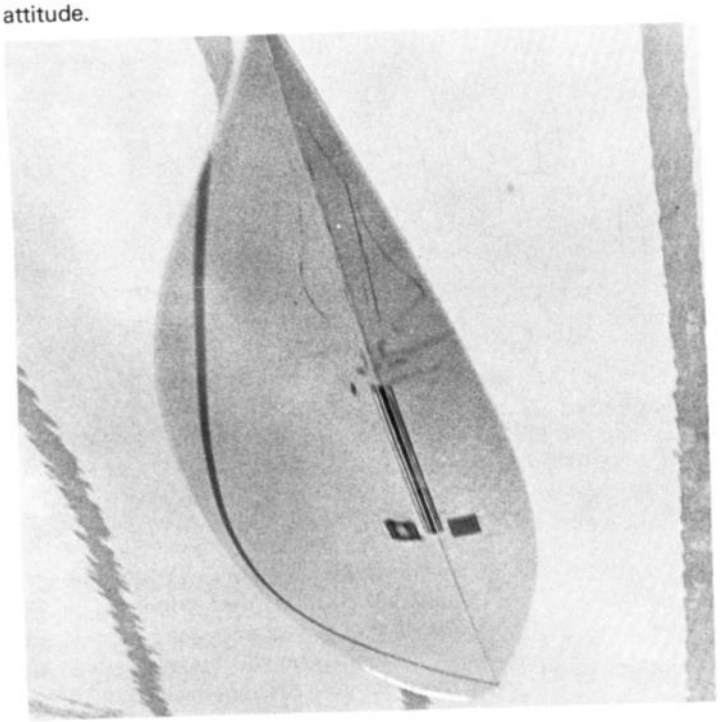
1.
Photo No.1 shows the Finn the way the designer drew it — level both fore and aft and athwartships. And this is the way it should be sailed most of the time. The two squiare patches are the self bailers, one one either side of the after end of the centerboard box. The scuff marks forward of the box were made while launching the boat in the pool, and Yacht Racing magazine certainly hopes its West Coast Editor managed to sand the bottom clean and smooth for the owner.



2.
Picture 2 shows how the Finn looks with crew weight well forward of the center of buoyancy, as it might be in very light conditions, either upwind or down. With the photo taken from the same angle as No. 1 it is obvious that wetted surface has been reduced as the bow is buried and the wide, flat stern sections are lifted out of the water. This is a good attitude for the hull in light airs and sometimes is combined with healing either to windward or leeward to further reduce wetted area and help the sail set.



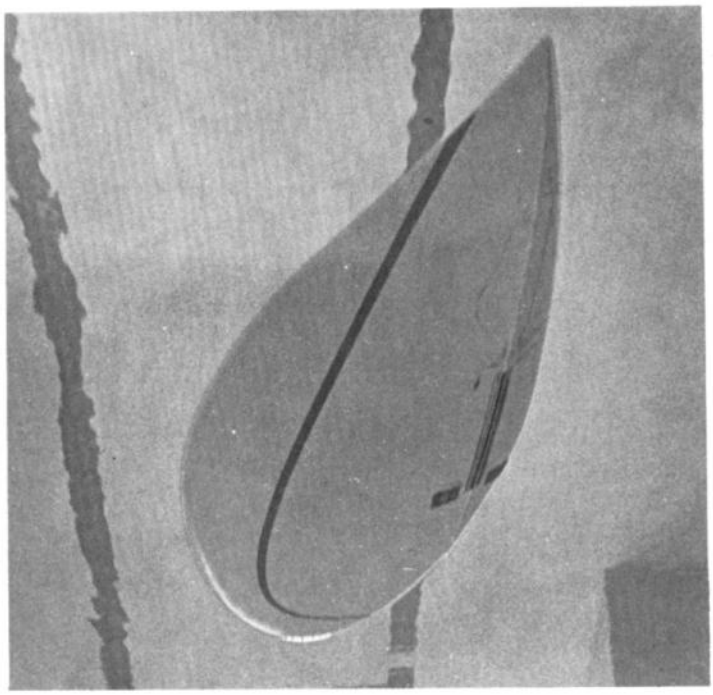
3.
In photo No. 3 the stern is down and the wide stern being emersed (and the narrow bow lifted) increases the wetted surface. Note the sharp edge at the transom, indicating the transom is three or four inches down in the water, which would cause considerable drag in anything but planing conditions. The boat should be like this only when true planing is possible. For surfing — or using waves to get the boat up on a plane — the bow should be down initially to get the boat moving "downhill" as the wave comes up under the stern. Then if a true plane is achieved, weight can be moved aft so the boat rides in this attitude.

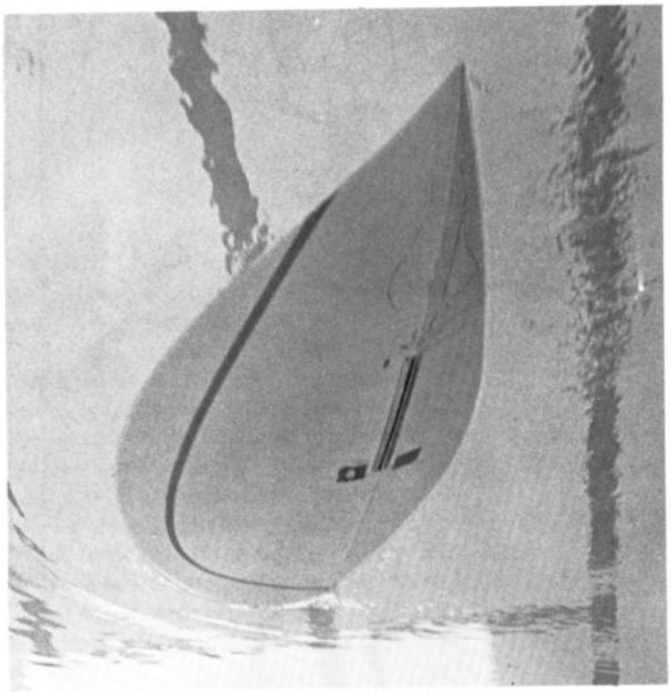


4.
In picture No. 4 the boat is level fore and aft but is heeled 10 degree to starboard. And in No. 5 it is heeled the same way, but to a 20-degree angle. It can be seen how heeling reduces wetted surface, but also distorts the shape of the boat in the water. This distortion causes excessive weather helm by giving the boat a shape which is nearly straight along the weather side (the right hand side in these shots) and very curved along the lee side. This "immersed banana" naturally wants to turn into the wind, and this is the chief reason why any normal small boat develops weather helm progressively as it heels. However, when the wind is light, so that the boat is moving very slowly, heeling is an effective way to reduce wetted area and achieve higher speeds.

Heeling the boat in "drifting" conditions can also help the sails to take some shape, rather than hanging limp, thus making the boat a bit more efficient.

But when the wind gets up to about four knots, so that sails are filling of their own accord, and there is a bow wave and wake, the boat should be brought to an even keel so the sailplan will be working at its most efficient angle to the wind, and excessive wather helm which causes increased rubber drag, will not develop.





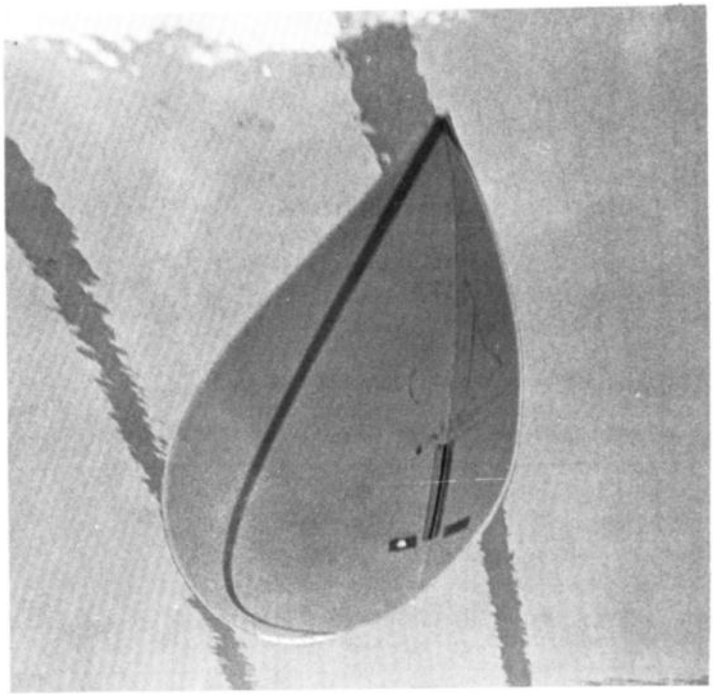
6.

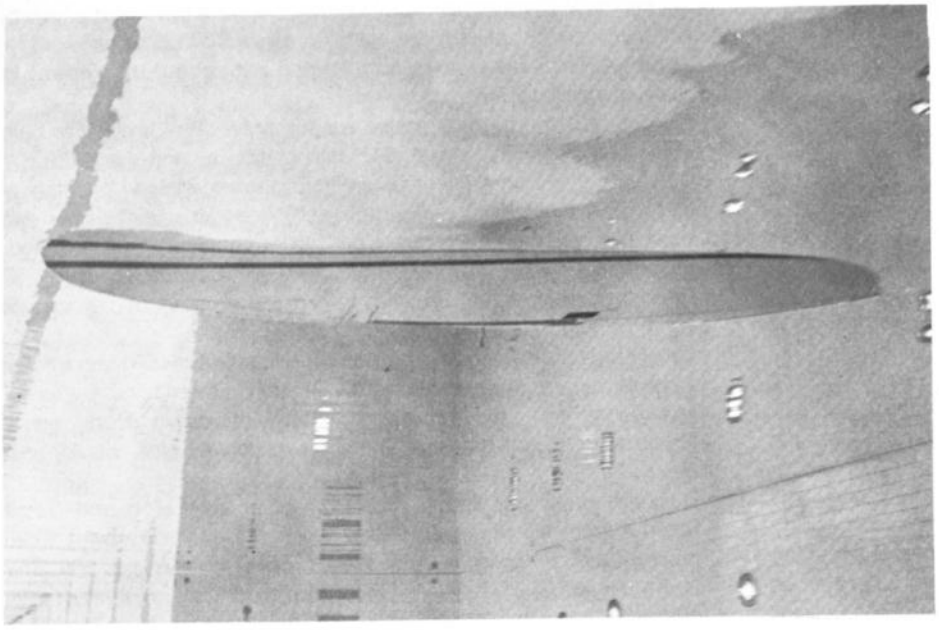
In Photo No. 6 the boat is down by the stern and is heeling about 10 degrees. This is an attitude frequently seen under strong planing conditions, where the boat has been allowed to heel a bit, weight is aft and speed may be great.

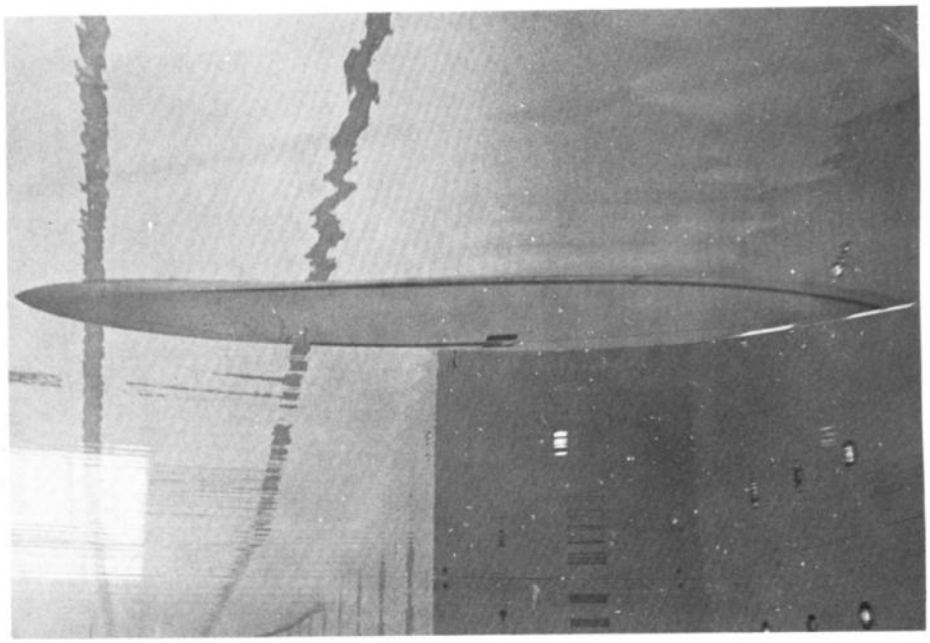
Helmsman (and crew if there is one) should be struggling to keep the boat flat under all-out planing conditions, but a few degrees of heel does not slow most planing boats down. Again, if too much heeling is allowed the distorted underwater shape wil cause excessive weather helm, which in turn results in too much rudder being used, and this slows the boat down

7.

Photo No. 7 shows the boat down in the bow and heeled at the same time. This is the best way to reduce wetted surface for drifting matches, as it combines the heeling and bow down attitudes. Under such conditions the boat should be heeled to leeward when going upwind or reaching. But on a run many boats will sail faster when heeled to windward. Heeling to windward on a run works for more than one reason: 1. it reduces wetted surface, 2. it raises the boom and gets more of the sail area up in the air, 3. the sailplan is working to develop helm in one direction (weather helm) while the hull shape (immersed banana) is developing helm the other way. The results is that helm balances and virtually no rudder action is necessary, so speed is greater.







10.
The last three pictures, 8, 9 and 10, show the boat from the side in three basic attitudes - top, bow down, center, stern down, bottom sitting level. Here again it is easy to see that in the bow down pose there is least boat in contact with the water, and the stern down position produces the greatest wetted area.
In anything but a drifting match, sail it like the man designed it — on its feet and on the level.