Notes on Waterplanes.

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Every boy worth his salt builds castles in the air. But sometimes his wings (opportunities) have not enough area to carry the load. And sometimes his engine (force of character) is a bit short of power. So grey hairs come, and the castles fade. The castle I built was to fly, and lo! it materialised after five-and-thirty years, in spite of the grey hairs.

It is, however, not yet four years since I decided to concentrate on waterplanes. At that date waterplanes were unheard of, and water flying was ridiculed, and judged impossible, just as a year or two before the idea of any machine really flying was laughed out of court.

Waterplanes! What are they? Why are they called that? Is it not a name invented by the "Daily Mail"? Very likely it is, but it is a good English name all the same, and, after all, what ought they to be called? Hydro-aeroplanes, or Aerohydroplanes? Surely too cumbersome altogether. Then Waterflyers has been suggested but not adopted. I thought at one time that Water-birds might be a good name, but one of Canon Rawnsley's friends said that in that case he would call them "Waterfoul," spelled thus instead of with a "w"—and that we should not like! Others who are not quite of my way of thinking have kindly suggested several names (such as Vile Buzzards, Stinking Kites, Death Toys, etc.).

In some ways "Clouds" might not be a bad name. Observe, most of the characteristics of an efficient waterplane are to be found in clouds. For instance, both always rise from water; fly easily through the air at very varied speeds, and descend either on land or water indifferently. But poet Rawnsley says if I call them Clouds he and his friends will call them Fogs! And that would not do; so we are back again at Waterplanes, until some more appropriate or popular appellation has been invented or suggested.

Why was the problem of rising from water not solved until long after that of rising and flying from land? I think because it presented more difficulties though fewer dangers, and most men prefer dangers to difficulties. (A good illustration of this maxim is the instance of "Tommy," who greatly prefers fighting to starving and marching.)

Some Difficulties.

Let us see what these difficulties were, and how far, or how many of them have been met, and to what extent. It seems easy enough to mount a flying machine on a boat, or a canoe, and so it was and is. Yet such a combination has only very recently been persuaded to fly, and then only by those who had availed themselves of all the information and experience obtainable from machines that had been flying off water for a couple of years or more. In fact, the difficulties of using a boat or canoe are much greater than if one of the systems of floats be adopted. This is so because among other reasons the friction of the water at high speed is much greater on a body shaped like a boat or canoe than it is on a body shaped like a float or hydroplane.

But to come back to our initial difficulties. If a boat or

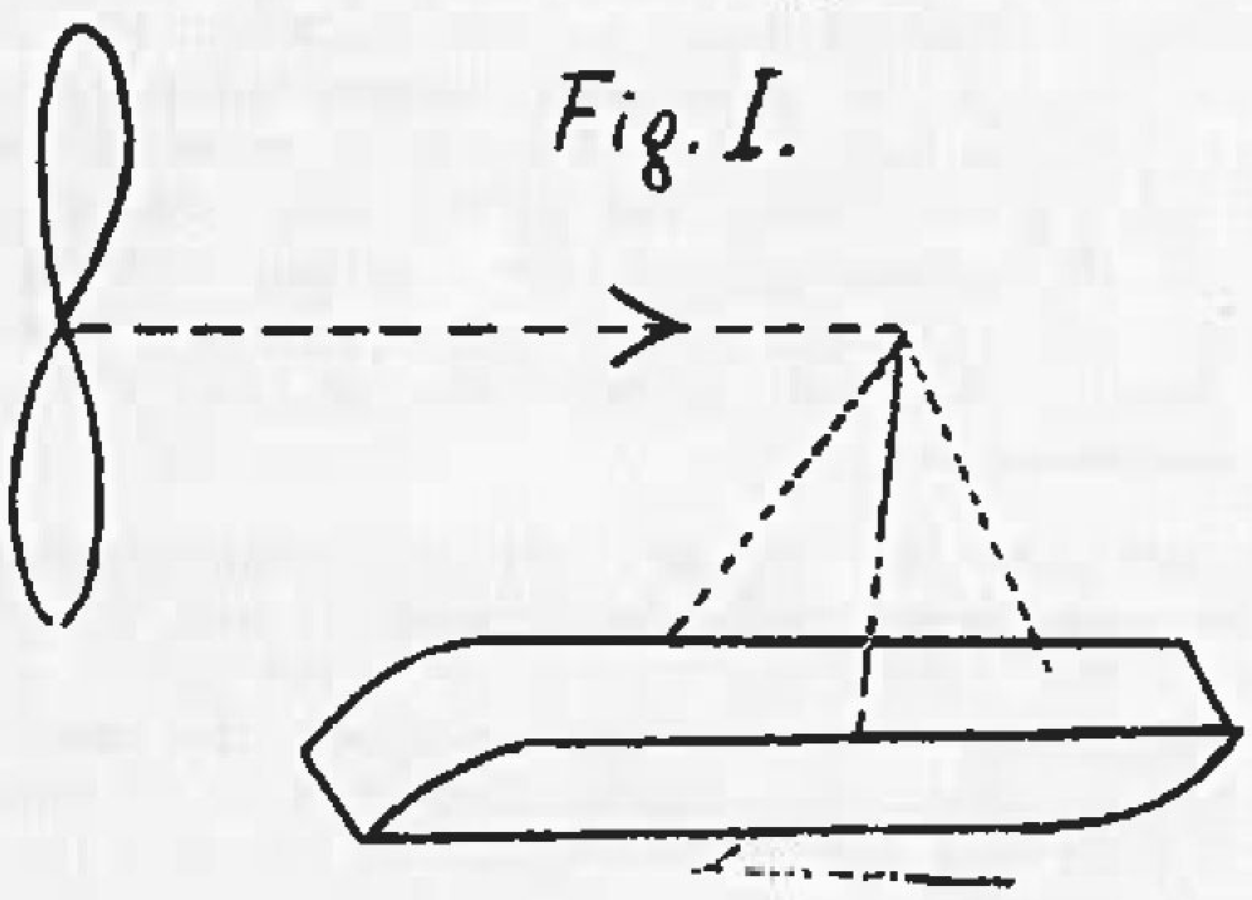


Fig. I.

canoe produces, as it, in fact, did produce, too much friction at high speed and too little stability, what was the objection to using an ordinary racing hydroplane? Many people tried this, but so far as I know, no one succeeded. The racing hydroplane is designed to be propelled from behind and below by a screw revolving in the water; the waterplane, on the contrary, is to be propelled or drawn along by a screw revolving in the air. Now if you look for a moment at Fig. 1 you will see that the aerial propeller is pushing from left to right, and the water friction from right to left at opposite ends of what is practically a lever, thus producing a turning moment which rapidly drives the bow of the hydroplane under and into the water instead of out of the water and into the air.

It was suggested that the axis of thrust should be lowered, as in Fig. II, in such a way as to lessen this motion, and

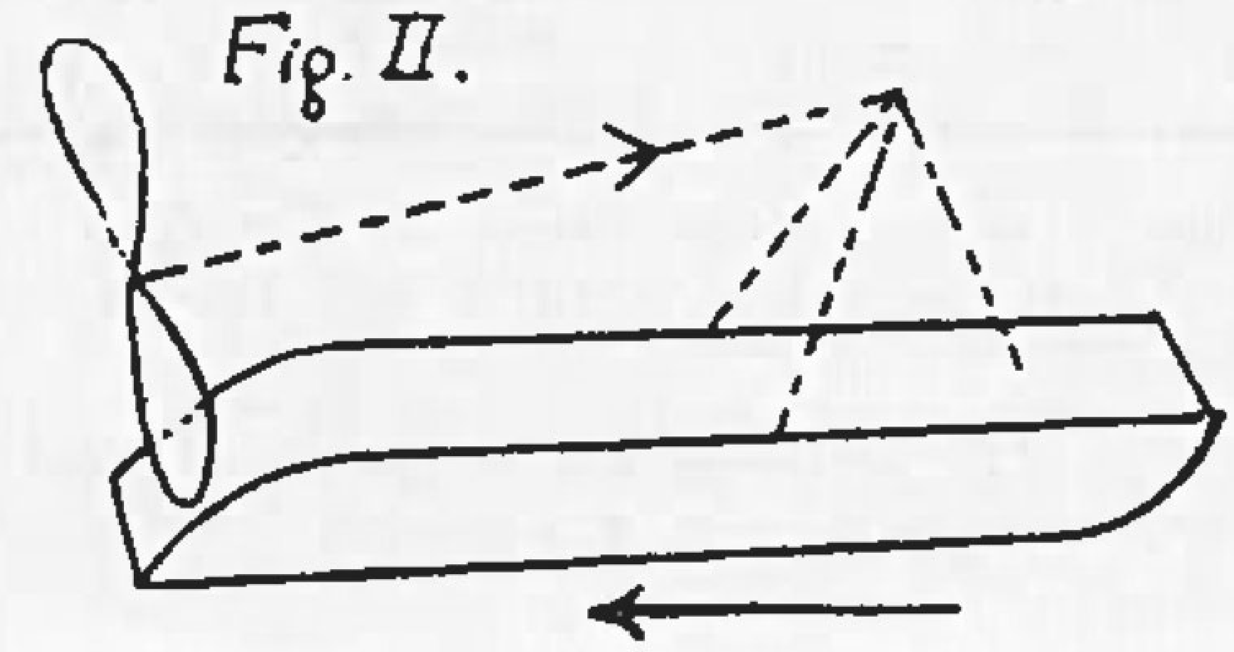


Fig. II.

it is very likely that anyone desiring to propel a racing hydroplane with an air propeller might successfully adopt such a system. But in the case of a waterplane, just consider what happens: The angle of incidence of the wings in the air and, consequently, the centre of pressure, is completely out of the flying position, and even if it were possible for such a combination to leave the water and take the air, it would certainly be impossible to remain long in the lighter element.

How, then, is this difficulty in fact overcome? By making the float or floats with inclined-plane bottoms, so that as the speed is increased through the water the pressure of the water on the inclined plane tends to raise the nose of the float, and thus counteract the tendency of the propeller to thrust the nose down. In this way no doubt a considerable amount of engine power is wasted, and that is why it was found at first, and still is found in the case of most waterplanes, to be a more difficult business to get up the necessary flying speed on water than on land. The minimum flying speed for most machines is in the neighbourhood of 35 miles per hour, and many machines cannot be flown at less than 45 or 50 miles per hour. As this speed is in excess of any racing hydroplanes, even when unencumbered by large and more or less clumsy machines mounted on them, it will be obvious that some contrivance more efficient than a racing hydroplane is a necessity.

The Search for Stability.

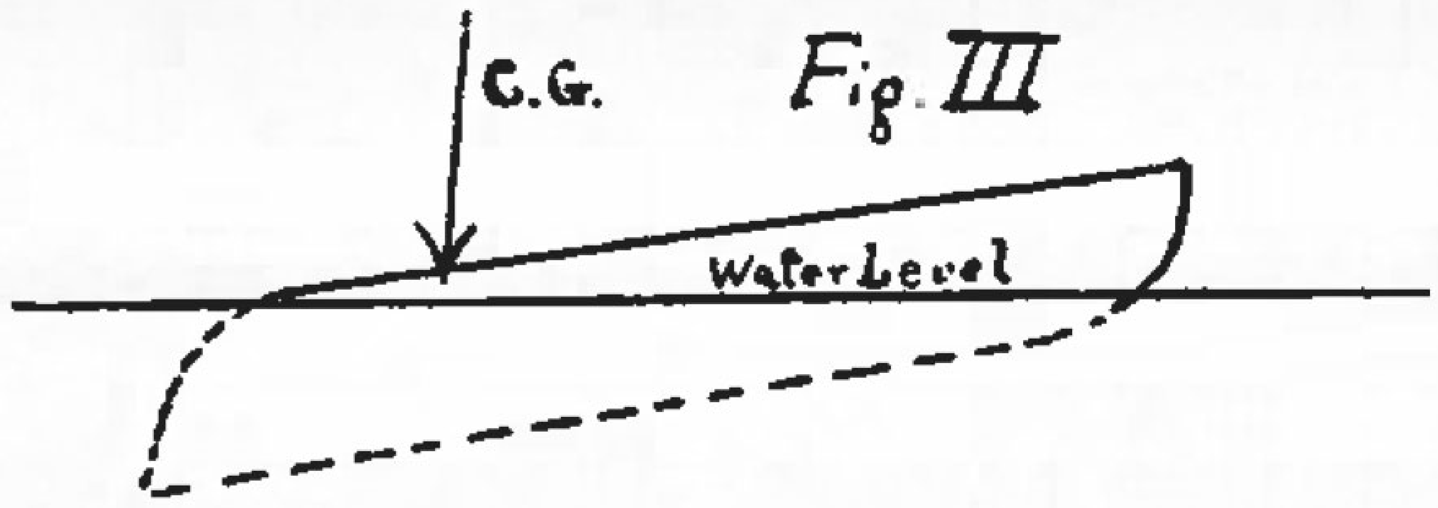
Now let us see how this contrivance has been arrived at. It was necessary to obtain at least a certain amount of stability on the water; because, although it is true that the early experimenters were quite accustomed to spending almost as much of their time in the water as on their machines, and seemed to thrive more like amphibians than men, yet these frequent immersions proved highly inconvenient to their experimental structures, and often resulted in twisted frameworks, in splintered propellers, and even in damaged engines.

Stability can be obtained on land by four wheels, or by three wheels set in the shape of a triangle, either two in front and one behind, or vice versa, or even by two wheels in front with a skid behind, but not so far as I know, with less than three points of support. Arguing from this, the earliest experimenter with waterplanes, M. Henri Fabre, tried for a long time with three floats, because he felt so sure that stability on water could not be obtained with a less number. And there are still many people who think that M. Henri Fabre will ultimately prove to be right, and that some arrangement of three floats will be the final solution of the, as yet, only half-solved problem of waterplane stability.

Another very important point which arose from the early experiments was the importance of having the underside of the float an inclined plane, and not any modification of the underside of a canoe or boat. The object of this was in order that the floats might rise out of the water and not rest in the water like a boat, for unless the floats be constructed to rise well out of the water before any great speed is obtained, it is almost impossible to overcome the enormous surface friction which increases, as is well known, much more rapidly than the speed, in the case of a body moving through water. But in spite of the valuable results obtained by M. Fabre, he, like many early experimenters, achieved but moderate success, and it was reserved for the American, Mr. Glenn Curtiss, to show that with a single float constructed on certain lines so as to lessen resistance, it was not only possible to rise from the water, but also to alight on it with a reasonable amount of safety; for, if the truth must be told, while the Fabre system had shown itself able to leave the water, it had not been equally successful in alighting without damage.

Among the important results derived from Mr. Glenn Curtiss' experiments may be mentioned in addition to the possibility of using a single float, the importance of retaining the Fabre float bottom together with parallel sides, and mounting the float under the aeroplane in such a way that the greater part of the buoyancy was forrard the centre of gravity, and only just sufficient buoyancy left at the stern of the float to prevent the risk of a tail dive (see Fig. III). By

Fig. III



this means a considerable speed could be attained in the water before the excess of forrard buoyancy was overcome by the pressure of the propeller, and when once speed has been got up the inclined plane comes into action and the risk of a nose dive is greatly lessened.

Single Float Stability.

But you will ask how was it that Curtiss obtained the necessary stability with only one float? Well, as to the fore and aft stability, the problem was solved by making the float some 14ft. long, but seeing that it was only about 2ft. wide there was obviously very litte lateral stability, that is until speed had been got up on the water, so that the wings themselves assisted to maintain it. To help in achieving this, and to lessen the risk of accidents, Curtiss attached a curved spring-board to the underside of the end of each of his lower wings This contrivance worked fairly well when the machine got going, but there were great difficulties when it was stationary, or moving quite slowly, and not a few upsets in consequence.

More Troubles.

Now at this stage of development the drawbacks of the waterplane were very obvious and may be summarised as follows:—First, in the matter of lateral stability there was much to be desired, because the unlucky pilot had either to adopt the Curtiss system, in which case if he came to rest on the water he was pretty sure to upset; or the Fabre system, in which case he was able to get off, but the difficulty was to alight safely on the water without smashing up. The question of longitudinal stability which had presented difficulties, had been more or less surmounted by this time. There were obviously two or three alternative ways of trying to meet the reasonable requirements—we will not say of the pilot, who ought not to mind the water, but let us say of his lady passenger, who, however good a swimmer she might be, had perhaps no special desire to immerse her frock, and risk the loss of her pet ornaments.

Among the possible alternatives were the following:—First, to add auxiliary floats of small size, but of sufficiency buoyancy, which would not come into action unless, or until, they were needed. This plan has been adopted by many experimenters and constructors in all sorts of different arrangements. Secondly, to see what could be done with two floats, instead of either one, or three. And, thirdly, greatly to widen the float, say from 2ft. to 6ft. or 7ft., and trust to get lateral stability in that way. Each of these methods has its advantages and also its drawbacks. For instance, if small auxiliary floats be added as balancers under the extremities of the lower wings, though they will frequently save an upset when the machine is stationary or travelling at a slow speed, there is also the risk that just as the machine is rising or alighting it may meet with a slight gust and dip one of its balancers into water which it is passing at a rate of say 40 miles an hour. The impact of the small auxiliary float or balancer on the water at this speed will not only break the balancer, but probably wrench off a wing, and upset the whole machine.

The Two-Float System.

In the case of the two floats, the difficulty of lateral stability is more successfully overcome, but even here there are drawbacks. The friction in the water is greatly increased, and consequently if either of the two floats leaves the water, or takes the water, sooner than the other, the machine is spun round in a dangerous and undignified style; and it is to be noticed that this may happen without any fault on the part of the pilot; because, however level he may keep his machine, the existence of even a small wave under one of the floats and not under the other may result in disaster.

Then there is the third method of widening the float. This avoids some of the difficulties and dangers of the two first methods, but it does not attain as good a degree of lateral stability as might be desired, and it also subjects the float to undue strain from the blows of the water on such a large surface.

It is noticeable that in spite of the drawbacks of the second method most of the successful waterplanes are now made with two parallel floats, often aided by a small auxiliary tail float. These machines prove quite reasonably stable, nor do they seem to subject their pilots and passengers to any undue risk. Also, incidentally, it is felt by many people that two feet are more natural than one, although I don't think this last is a very strong argument; and it always seems to me that the advocates of the two parallel floats are in this dilemma: If they place them far enough apart to secure lateral stability, the risks in rising, and especially in alighting are quite considerable; while if they place them near enough together to minimise these risks, they lose much of their lateral stability.

Perhaps it may be found possible to widen the single float considerably, at the same time introducing some method of breaking up its large flat surface, so as to lessen the force of the impact of the water, and in this way achieve a combination of the advantages of the one-float and the two-float systems. At any rate, I throw out this suggestion for what it is worth. We shall see in a year or two, perhaps sooner.