Mrs. Kuosma holds "Bleak", number nine in the author's series of designs

A fascinating account of model flying boat design by KAUKO KUOSMA from Finland, introducing two plans to A.P.S.

A WATERY STORY

DURING THE WINTER of 1958 the author became possessed by the idea of designing and building free-flight flying boats. These day-dreams were partially inspired by a lovely summer cottage in the eastern lake district of Finland, the locality having near ideal conditions for this kind of sport flying.

Murky stories were heard about the problems of getting the models to take off from water, and the extra power needed. A small size of airframe was decided upon and to be sure of success, two different types were drawn, one with personal ideas of how a flying boat should appear, the other model being more like current designs.

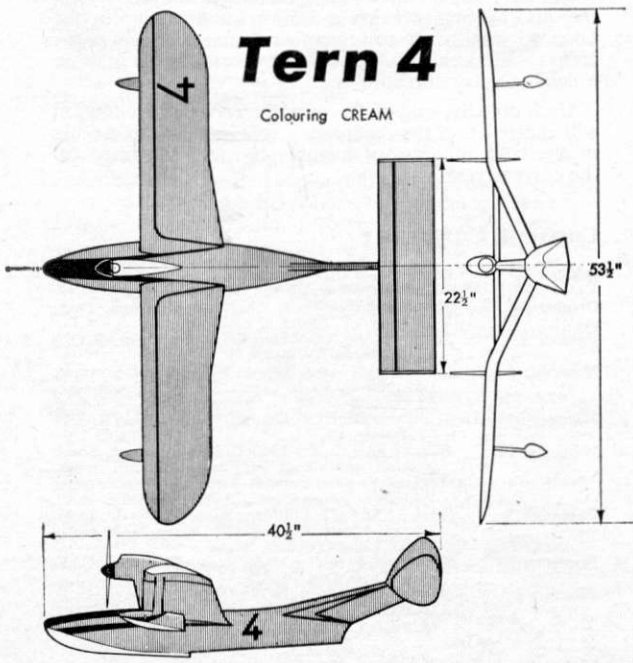
The result of the own-design was an airframe with gull-wings—this in order to have sufficient water clearance, with tip floats and twin rudders. The step was located *behind* the c.g. position, the idea being to support the hull in near level attitude much like the case of tricycle landing gear on landplanes.

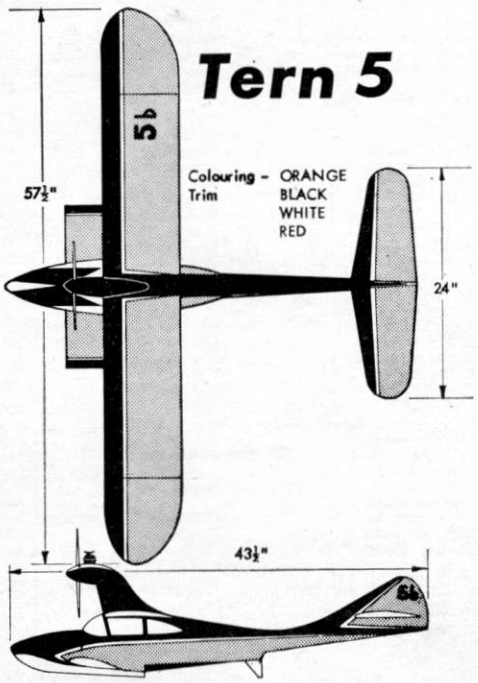
All these untried ideas and the fact that it would also be a first power model seemed to point towards a brilliant fiasco. The plane was dubbed *Tern*, had a wingspan of 53½ ins. and proved too heavy to be trimmed by hand-launching. After some short runs to verify course holding ability, the tank was filled amid tense excitement, enlarged by instability of a modest rowing boat, went off furiously ploughing through the water, getting on the step and after last long jumps, shot skywards. *Tern* settled in a steady turning climb and everything went well. Minutes later, it was realised that the tank was over-size and the model diminishing rapidly from view. Binoculars were used to follow the continuing climb. Such was the calm that the model came down close to the launch point! One could clearly hear the whistle of wind as *Tern* passed the boat in the silent air of the summer evening.

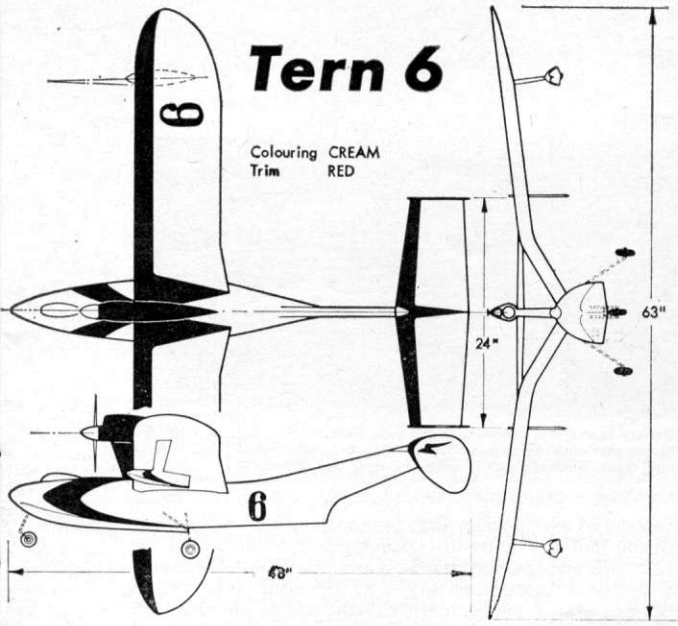
The author's exultation did not have any noticeable limits at the time he picked the plane from the water, where it had been rolling lazily on the waves produced by the hasty splashing with oars.

Curiously enough, no similarly happy results were obtained with the other model, not even after repeated modifications and it was finally dropped as not being able to unstick. Of course, it could be hand launched when forcefully heaved and it flew alright. This model had hull sponsons and a long narrow water-hull form. The plane ended its career as a test bed for raked butterfly tailplanes.

The next model was an enlargement of the successful *Tern*-4 type having a span of 63 ins. and weighing 58 ounces. This new *Tern*-6 proved to be an extremely stable design with an appreciably shorter water run for take-offs and able to unstick from a disturbed surface. It could be fitted with wheels and was actually glide trimmed this way.



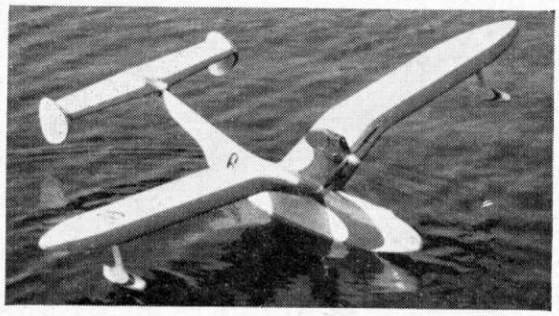




The model had a steady and consistent flight pattern with wide turns and reduced risk of loss in thermals because of the heavy weight. It allowed a 30cc tank for very long flights over the lake in calm evening air.

Tern 6 now has four summers of intensive flying behind it. The consistency brings a loss of interest in the type since it no longer offers any real challenge. It also introduced a complacency which rapidly disappeared when trying to get airborne a big twin-float cabin type sportster *Tern*-8. This model flew and looked beautiful, but stubbornly refused to rise off water, though clearly riding on steps. A sudden gust could turn the model upside down, no doubt because the high wing position. Wing incidence was too shallow, this being evident when observing the climb—it somehow lacked the urge of earlier models. The wing section, thinner than usual and not sheeted on the leading edge, could have been the reason of not obtaining enough lift. Two big floats and their struts caused much drag and this, combined with the big size (span 63 inches) probably absorbed the marginal power of 2.5cc. Though this type will be further investigated, it is already evident that for water performance, the flying boat design is to be preferred.

During the summer of 1960 a new 71 in. flying boat, the *X*-9 was flown in order to try an entirely different layout. It had a raked butterfly tail sitting on a low fin, the tip floats were moved close to the fuselage in order to avoid the somewhat flimsier design at the wing tips, but to be of equal effectiveness, they had to be bigger, adding to the total drag. Wing tip wash-out proved very efficient —the model refused to stall and could easily be trimmed to fly in a typical "flaps down" attitude. However, the slow airspeed needed much offset of the tailplane to introduce a turn. The solution was a left-right flight pattern. The motor torque gave a left turn under power, the tail set at right holding the nose high, as generally a left turn in this phase of flight is hazardous if not controlled by cross-setting of tailplane. Before this combination was found, the model made one particularly hair-rising flight, stubbornly continuing on a dead straight path both power-on and gliding, ending somewhere in a forest one could barely distinguish from the boat. After two days searching in the uninhabited wilderness, the model was found nestling intact on the top of a 60 ft. Birch tree. Rescue was by nailing cross-ties on this tree and the next. In this process, hanging halfway between soil and high heaven the author certainly lost all trace of ancestral abilities in tree-climbing. . . .!

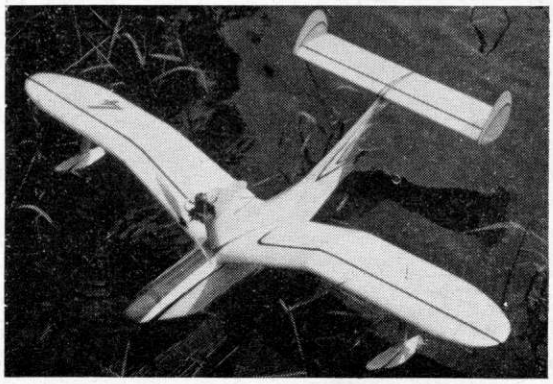


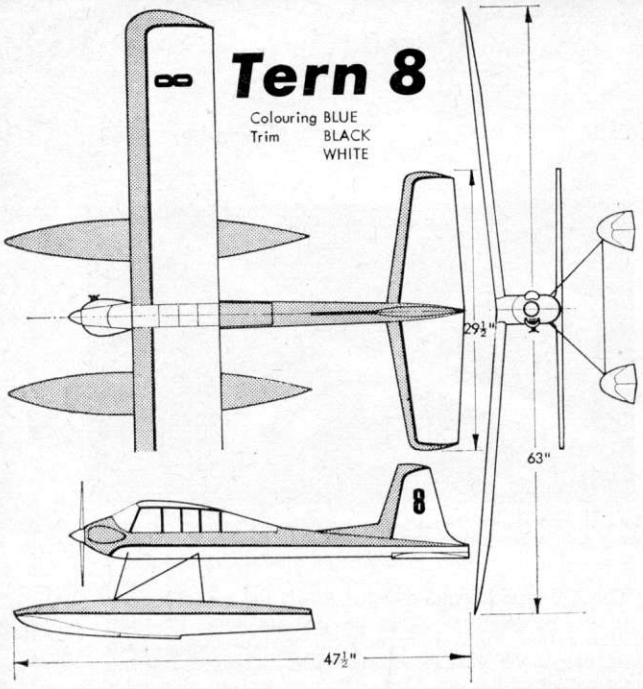
"Tern 4" (below) and "Tern-6" above and left, are twin fin gull-wing models with a remarkable stability, especially number 6, now four seasons old

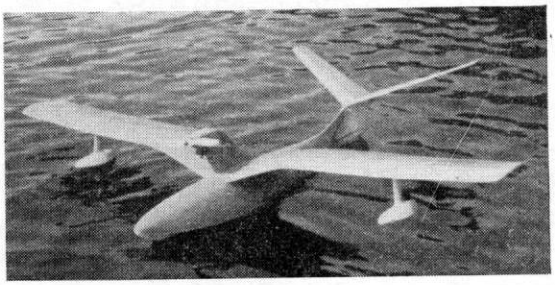
The *X*-9 experiment led to the *Bleak*, the model having a 67 in. wingspan of more rake in the tail, the wing section rather thick, purposely chosen for comparison with that of the *X*-9. Power-on speed increased, but the glide remained flat and slow. The new section allowed a much stronger structure, particularly in the root and joint regions. *Bleak*, like all other models, had a three-piece wing, the centre part built integral with the fuselage; the outer panels were fastened with hardwood dowels. This was very handy for transporting and should the model suffer any severe impact on landing, the dowels sheared neatly at joints, leaving the wing panels intact. Tailplanes were secured with rubber-bands, allowing for trimming changes.

To combine the features of the *Tern* and *Bleak* types a new model, the *Gull* was built in summer 1962. The gull-wing, with tip floats were joined to a *Bleak* fuselage and raked butterfly tail. Whole length of the hull was made "wet" in order to try any improvement in water run. Span is 63 in. with weight only 39 ounces. Results obtained lead to the conclusion, that here is the most effective layout. Power-on speed is more than adequate with a fast climb, the glide again nice and slow. There does not seem to be any need to design a long water line in the hull, a shorter after-step portion having all the necessary steering control.

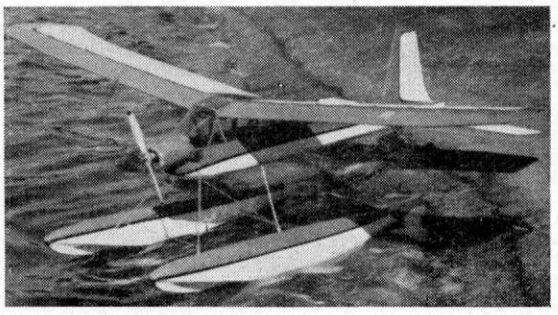
It is this model which is introduced to AEROMODELLER PLANS SERVICE. A reliable hull form had now been determined with some details not entirely in accordance with ideas commonly approved. All the books tell one to design the hull and step position after the two-wheel undercarriage principle. The splendid water performances of *Tern*-6 proved that a step location *behind* the c.g. position is possible. A stout hull-form, rather broad, gives good heeling stability and most probably is easier for planing, a narrower hull sinking, of course, much deeper.

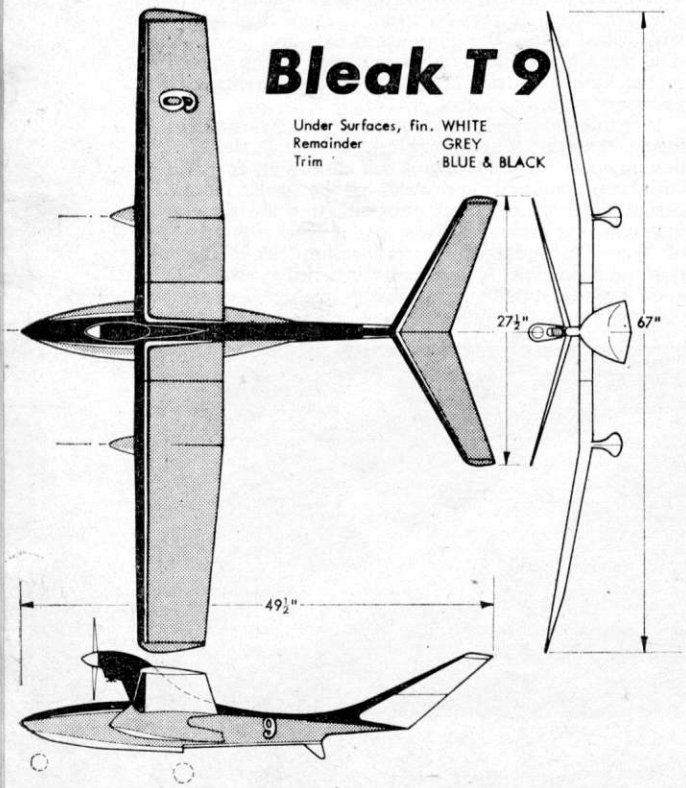






Variety in shape is shown with the twin float number 8 at left, the flat centre section of flying boat "Bleak" and the gull-wing of "Gull" above and right. Butterfly tail is both practical and attractive



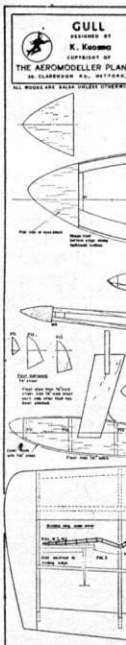


Instead of a long water line, the shorter after step portion of the hull can be built with a concave water line at the rear, this giving a very strong corrective action, combined with proper mounting angles of tip floats—the model obtains a sort of automatic steering and heeling control. Clearly, these are stronger in effect during water run than the flying surfaces—so the flight trim does not change the water run, but the moment it leaves the surface, flying trim takes over.

A very important point to remember, when designing this type of model is to give the hull bottom in the short straight section just before step location a more positive angle compared to the wing incidence, otherwise take-offs would not be possible. When glide trim is obtained, motor thrust is used to control power-on flight. If the take-off is difficult, then add upthrust. Now this may produce a stall in motor flight. To correct, add ballast in small increments to the nose and retrim for glide with tailplane angle. On the contrary, if the model tends to turn too steeply without gaining height, do not correct with the tailplane, as this would only stall the glide, but first add upthrust.

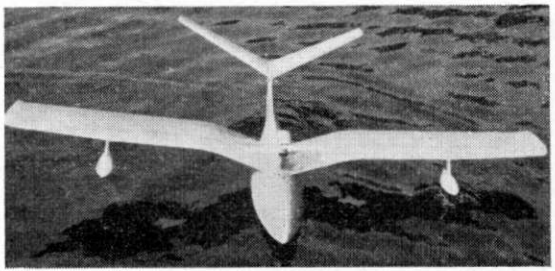
All turning under power is controlled by off-setting the motor thrust to the right.

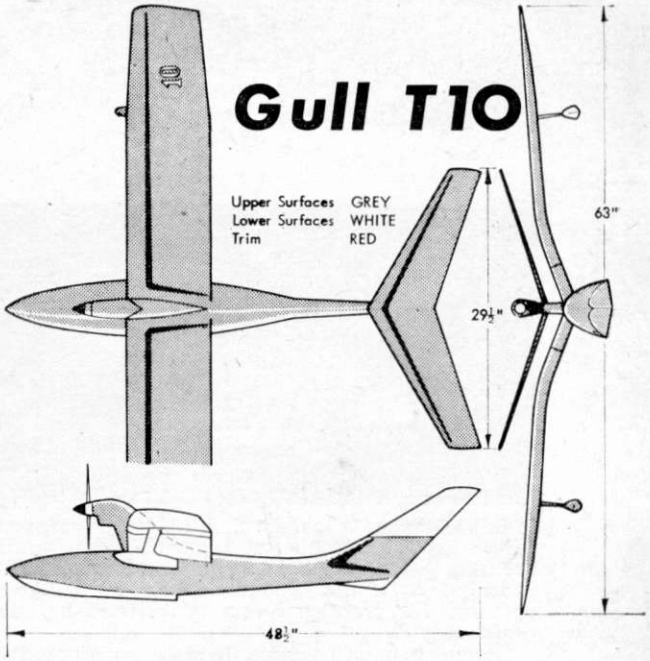
Initial climbing angle is usually very steep, then diminishes rapidly, until the model attains its normal flying attitude. This may be a result from the rearward step location, helping to keep the tail high. This attitude lessens the effective wing incidence, also the drag. So apparently the model reaches a higher speed in water than when flying! The result is a sharp upward nose pitch on take-off. Once airborne, the tail corrects the angle, the overspeed declining to a short, steep climb. As this offers a quick safe altitude for the most critical short initial flights, it is a good practice to begin flight tests by take-offs from water.



Latest model in the series is a biplane of "antique" lines and simple design, known as *Seal*. To fool some onlookers, the *Seal* has a pilot and observer sitting in their open cockpits, the pilot looking steadily ahead, the observer on his side peers at the things down below. Of course, both Jack and Jim, properly moustached, each wear a red scarf.

Having generous flying surfaces, the size of the model is rather small with a wingspan of 49½ ins., the simple shape reducing the weight to 35 ounces. Compact in size, it is a very rugged model. It once *did* fly to pieces, when after clumsy positioning on water, *Seal* dipped its lower





wing, changed direction of the take-off run and charged the boat. In the next second, the model shot through two of the cabin windows, the impact smashing the rest of the glass too!

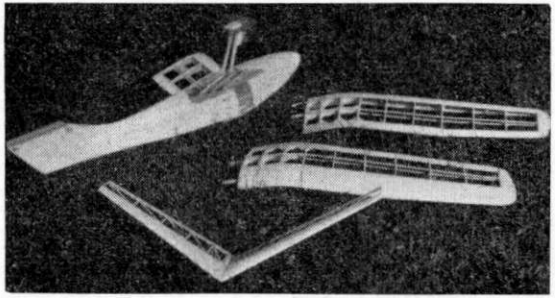
The construction of all these flying boats is all balsa, except the hardwood engine bearers, two main struts of pylons and wing-fastening dowels, ply being used for those wing ribs where the dowels seat. The hull is all planked with 1/16 in. balsa sheet, flying surfaces being covered with thin brown wrapping paper. This paper was used a lot in Finland during the war years, later rejected because of weight. However, it is extremely tough and elastic, and after the final varnish it is completely waterproof.

Full building instructions are included with each of the A.P.S. plans for *Gull* and *Seal*, but since they are different in their layout of thrustlines and drag centres, some trimming problems may arise and these will be of interest.

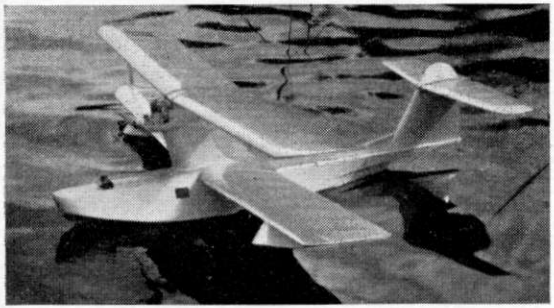
Glide trim is best obtained by ballasting rather than by altering tailplane incidences the usual way. The wing and tailplane settings on the plans are necessary for water take-offs, so in order to obtain a stall-free glide, add more ballast to the nose. Bore a hole in the solid nose piece and fill with solder. Do not be afraid of moving the c.g. forward of the location noted on plans, as that shown is the ultimate possible rearward position.

To control the glide angle, move to a high bank-side spot to launch. The short glide resulting from a launch standing in a boat is not sufficient.

Directional instability in water, wing tipping and heavy bouncing before final take-off are caused by wrong



Tenth in the series and incorporating the wealth of experience from previous designs "Gull" meets the demands of many aeromodellers who want a goodlooking, steady flying boat. Structural photograph above shows how it breaks down for transport. Full-size plans with building instructions and R/C conversion for rudder control are available from AEROMODELLER PLANS SERVICE price 10s. post free for this 63 in. span model (see 3-view above)

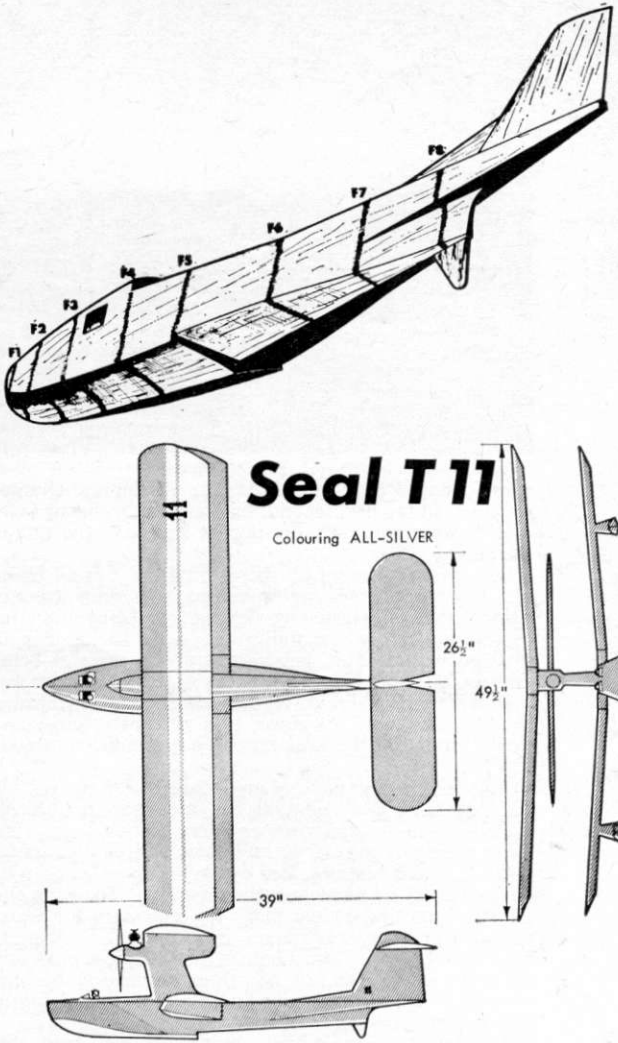


thrustline settings. Add more upthrust. These flying boat designs have drag centres well below the engine thrustline, thus giving the models a natural tendency to dive under power, if not compensated for by 3 degrees upthrust. The propeller torque is corrected by right thrust.

Contrary to normal practice, the model is positioned on water the nose pointing *downwind*. Lower the model down on to the water surface and let go. *Do not push*, as this most certainly would cause wing tipping. Some practicing may be necessary before the modeller is able to quickly set the model on the waves with the engine running. The secret here is to hold with left hand on the pylon while starting the engine, then grab with the right hand somewhere in order to move the left hand to the stern post *under* the tailplane. If one grabs the fuselage between wing and fin, *You* are locked in . . .

Each flying session is started with a short flight to ensure proper power-on trim. The damp air and water may cause the shims under flying surfaces to swell or compress, thus causing trim change.

For an unusual approach to sport flying in the vicinity of a suitable lake, nothing can beat this free flight flying boat hobby. As yet this kind of sport is not yet sufficiently appreciated, not even in the author's country, Finland, where there are innumerable lakes offering ideal conditions. There are no flying space problems and the endless thrill of watching flying boat take off from water is incomparable—what better way to enjoy *your* next holiday!



Biplane approach offers unique stability and is very simple to make. Like all its predecessors, the prototype was powered by an Alag 2.5 c.c. diesel. Full size plans, complete with building instructions are available from AEROMODELLER PLANS SERVICE price 10s. post free