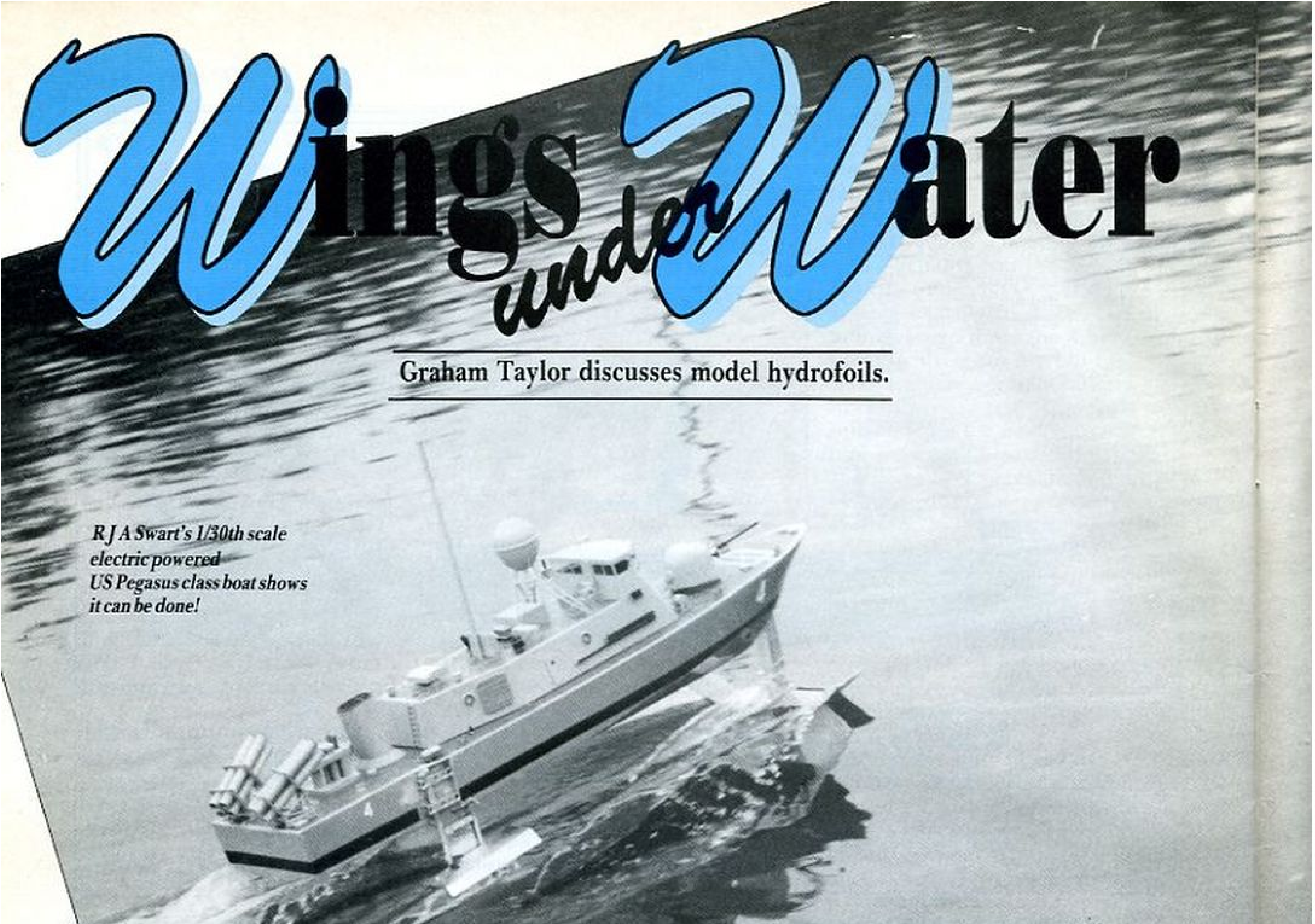
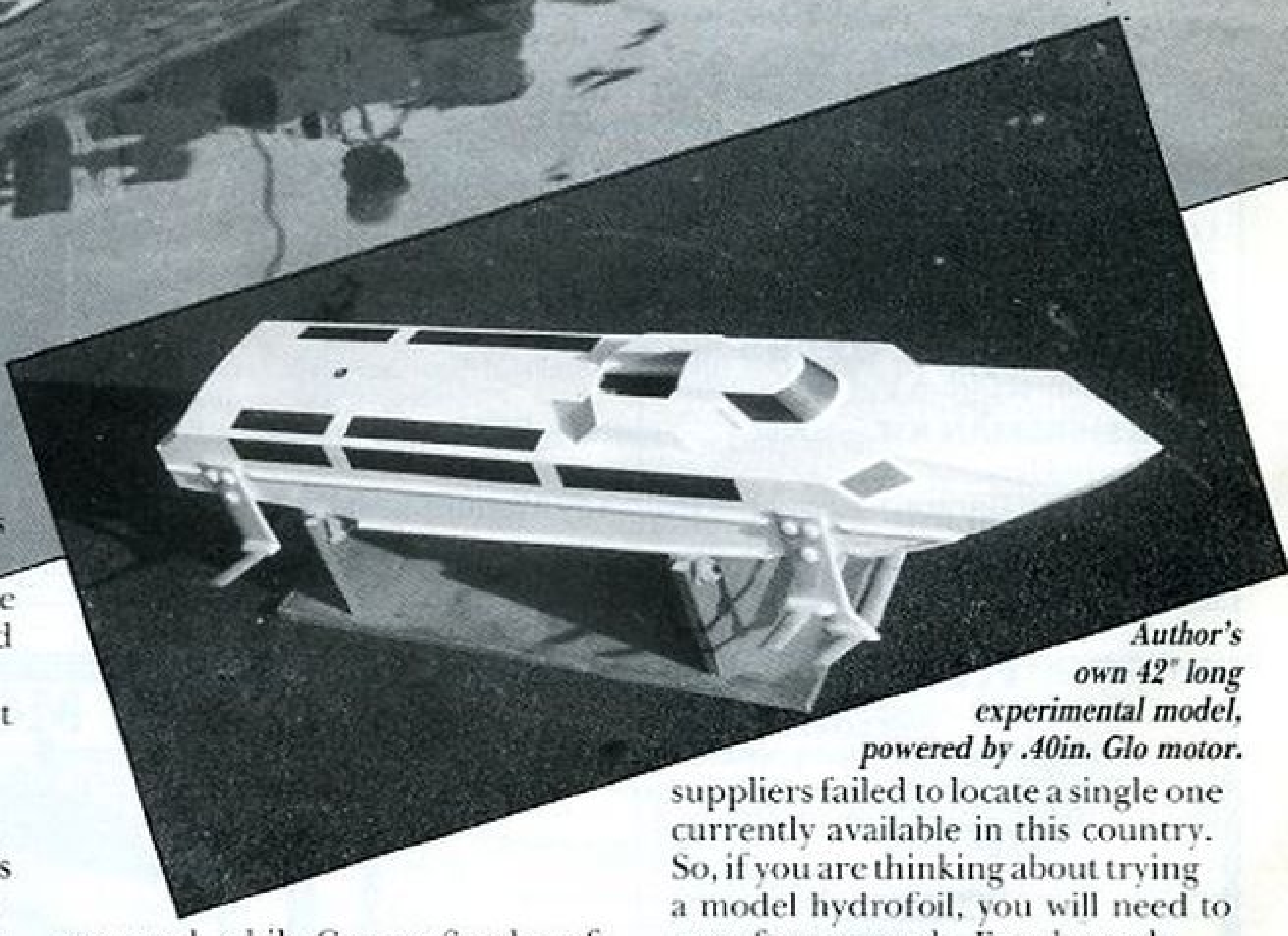
Wings under Water

Graham Taylor discusses model hydrofoils.



R J A Swart's 1/30th scale electric powered US Pegasus class boat shows it can be done!



Author's own 42" long experimental model, powered by .40in. Glo motor.

It would seem that Al Ross's recent article on the Pegasus class hydrofoil (see March edition) has stirred up more than a little interest in the subject. Strangely, it is not often that anything is written about the hydrofoil. Over the next few months, Marine Modelling will be shedding a little more light on this intriguing subject. Interest in this novel craft comes and goes, but with the increasing popularity and improved technology of fast electric boats, now may be the time for another revival.

Mr R. Swart of Holland sent us a lovely picture of his Pegasus class "Aquila" model, which is electrically powered, while George Snyder of the USA wrote to us about his model, with details from the Sanko kit of the Supramar/Hitachi PT50 that he bought in San Francisco.

Hydrofoil kits appear on the market occasionally, but my fairly extensive survey of model shops and suppliers failed to locate a single one currently available in this country. So, if you are thinking about trying a model hydrofoil, you will need to start from scratch. For the scale modellers there are literally hundreds of hydrofoil craft in operation around the world, some of which lend themselves to modelling better than others and a browse through an old Jane's "Surface Skimmers" in the public

RHS 160 Condor, Channel Isles based.

Kometa class hydrofoil, in service in Greece, 1987.

library will reveal a host of good subjects.

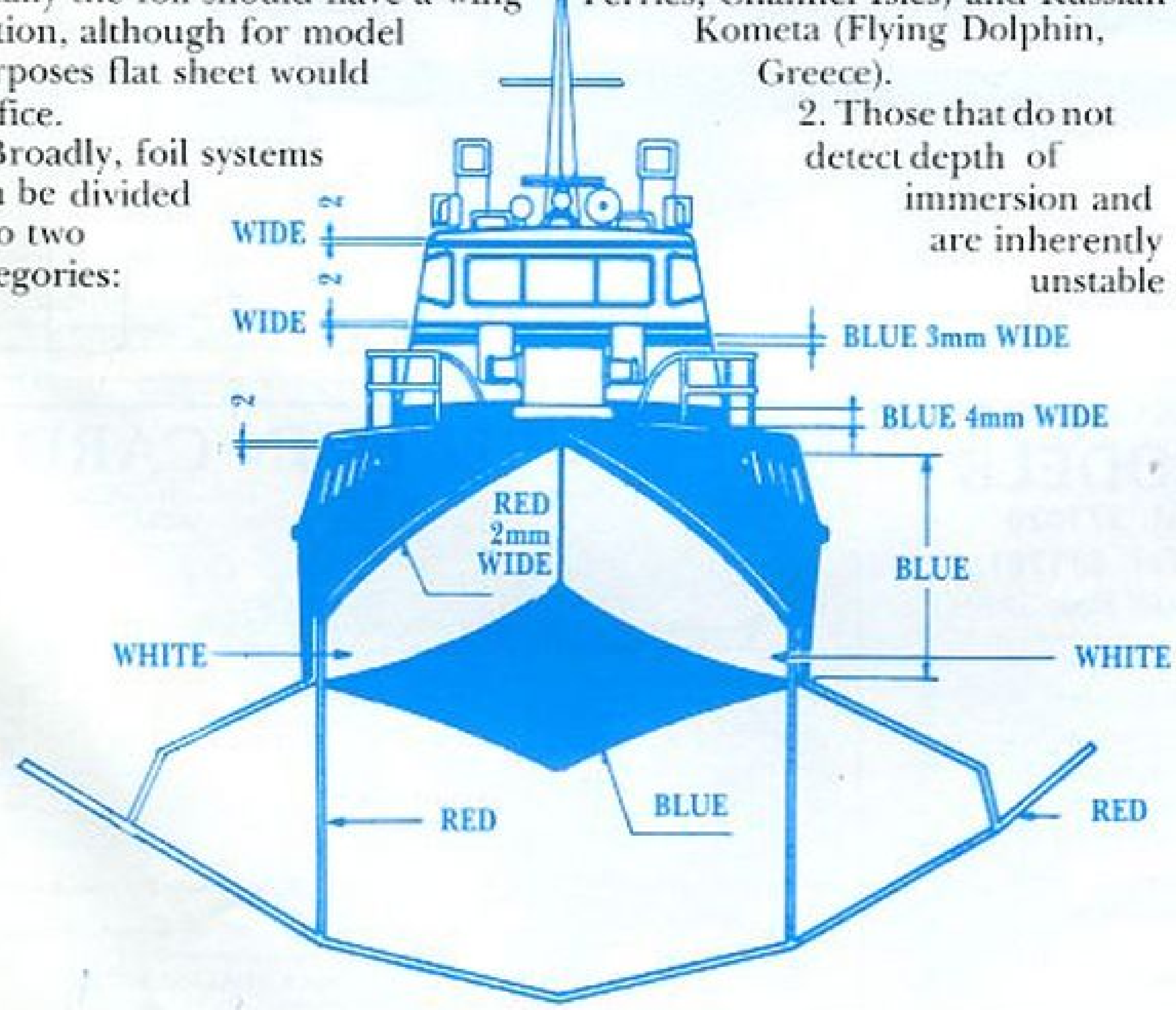
There are three things that need special consideration in a hydrofoil model; the foil system, weight distribution and propulsion system.

The foils themselves function exactly like wings that fly underwater, giving sufficient lift to support the hull clear of the surface. Ideally the foil should have a wing section, although for model purposes flat sheet would suffice.

Broadly, foil systems can be divided into two categories:

1. Those systems that are inherently self stabilising, through mechanical detection and response to the depth of foil immersion. These include the "Ladder", "Surface Piercing" and "Alexeyev" (Free Surface Effect) systems. Examples are, Rodriquez Cantiere RHS 70 (Red Funnel, Southampton — Isle of Wight), RHS 160 (Condor Ferries, Channel Isles) and Russian Kometa (Flying Dolphin, Greece).

2. Those that do not detect depth of immersion and are inherently unstable — the "fully submerged" system, eg. Boeing Jetfoil and Pegasus.



Full size craft are designed to function within an "operational envelope" which is dependant upon the purpose of the craft so the foil system is chosen accordingly. For example, medium speed ferries on island waterways where wave motion is minimal have surface piercing systems, whereas craft that are designed to maximise speed in high sea states will have a fully submerged system.

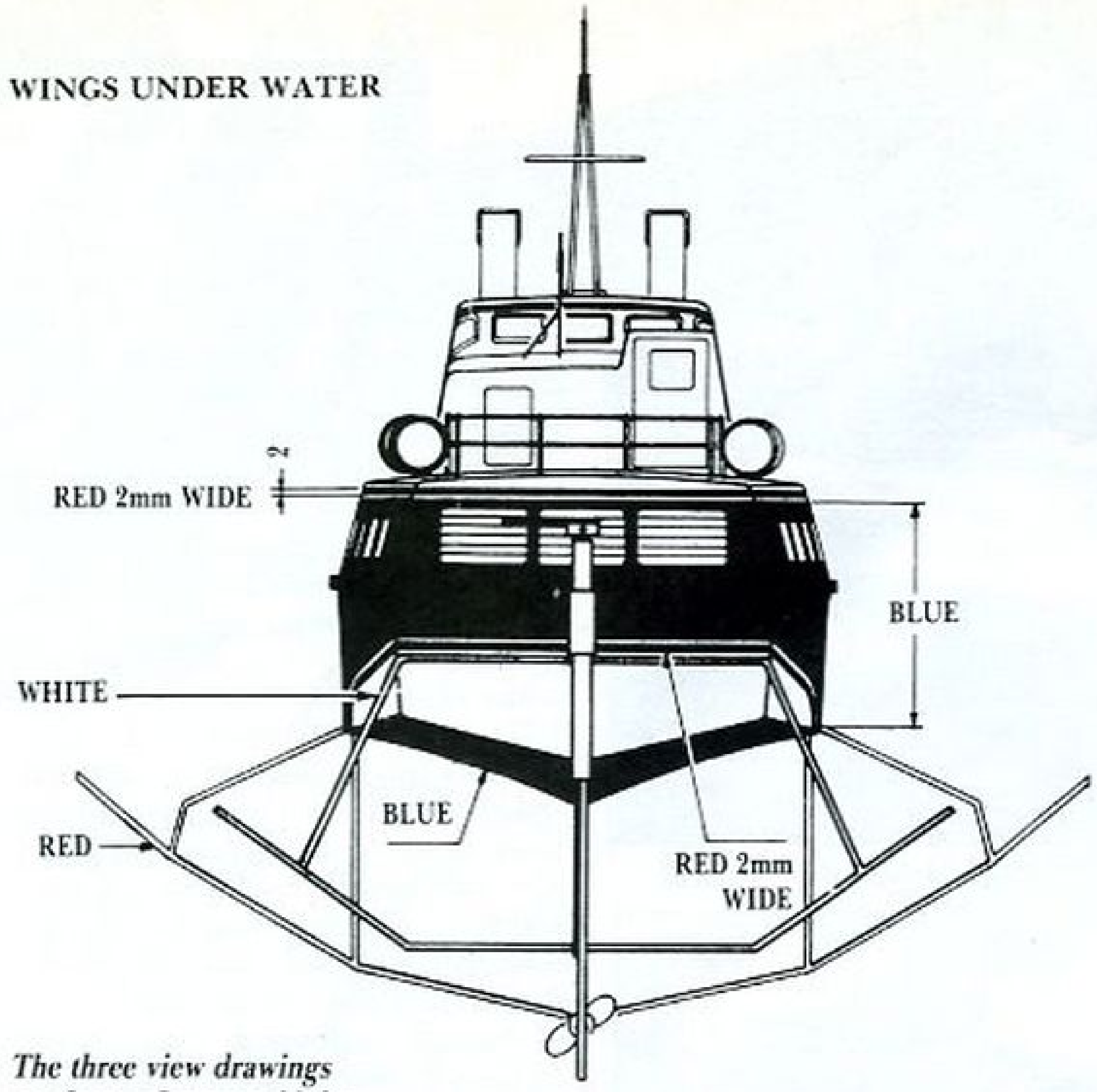
Craft with foils in category 1 will make viable model subjects as their foil-borne self stabilising qualities simplify model control. Craft with foils in category 2 however, do not lend themselves to easy modelling because their lack of inherent foil-borne stability would make the model impossible to control without duplicating the "fly by wire" on-board computer, gyroscopes and electronic beam wave sensors that the full size craft rely on.

The stability of systems in category 1 is derived from the additional foil area that is immersed as the craft banks or pitches, which then provides a righting force. Also, as speed is increased more lift is generated. This in turn lifts more of the craft and foil system out of the water, further reducing drag. The photo of the Condor RHS 160 shows clearly the tips of the main foil above the surface that would become immersed to give a stabilising force when banking or turning.

Some craft use a combination of surface piercing and submerged foils. Also, if you are not too much of a purist, you can always fit surface piercing foils in place of a fully submerged system, as Mr Swart has done to his Aquila model, for "stand-off scale" effect.

The relative sizes of the bow and stern foils that support the craft's weight are important. Like an aeroplane, the "wings under water" will only fly successfully if the weight distribution is correct. The options are: conventional aeroplane layout, tandem or canard. Each have different stability and control implications. Selection would be dependant upon the propulsion method since this tends to determine the position of the main weights and centre of gravity.

Three types of propulsion method are used in full size craft; inclined propeller shaft, Z drive and



The three view drawings are from a Japanese kit by Sanko (not available in the UK), of a Supramar/Hitachi PT50. Reader George Snyder has built this and run it successfully.

water jet. Unless the modeller is prepared to construct their own Z drive or water jet unit they are restricted to the inclined shaft method, which has its limitations. These are:

— To give shallow propshaft angle the engine/motor must be positioned well forward in the hull.

— Propeller efficiency decreases as shaft angle is increased.

— Limited flying height/wave clearance.

— High risk of air entry/propeller cavitation.

By far the greatest limitation is the motor position, since this will determine the position of the main items of weight particularly in an IC boat.

What I'm saying in a roundabout way is that the modeller is generally restricted to Aeroplane/tandem foil configuration models. Fortunately there are plenty of full size craft of this type, like the ones I've mentioned above, to act as a guide.

The successful design of a model hydrofoil is every bit as much an art as it is a science, and nothing beats trial and error, so why not have a go? Watch out for my next article in which I shall be describing how I solved some of the problems on my experimental model.