The First To Fly - Part 2

How We Learned To Skim In Steps
Development of the Stepped Hydroplane

By Dave Gerr © 2014 by Dave Gerr

> Now, about the design dope; where does a fellow begin when he starts out to design a hydroplane?
>
> Naval Architect, E. Weston Farmer

In the previous article, we examined the development of something we all take for granted these days—planing. Newfangled gas engines provided the spark, which—quite literally—permitted planing (flying too, it was no accident that the Wright brothers' success was at this time). Steam engines—even sophisticated double-action, multiple-expansion, compound machines—had simply been too heavy for the power they produced. Their sheer mass couldn't generate the zip required for high-speed excitement.

Now, with gasoline machines, all that was left was to find the proper form of lightweight hull to mate with these newfangled featherweight powerplants and we'd be set. From 1905 on, things were really cooking: model tests, experiments, false starts, races and more races, and inexorably rapid progress. Indeed, the conventional planing runabout, as we saw last article, was being mass produced just a few short years later—by 1909.

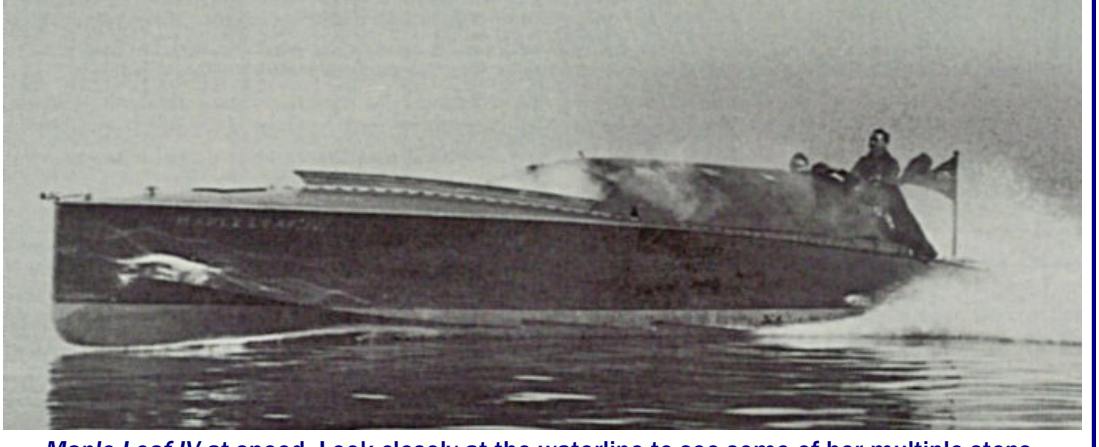
Stepping Off

So far, however, we've only covered half the story. In fact—besides the right Reverend Ramus, who we discussed last article—there was yet another inventor that would influence planing boat development—William Henry Fauber. Fauber took out no less than nine patents on an all-new approach to planing, the principle ones being in 1908 and 1909. Fauber reasoned that, since a boat skimmed (planed or generated lift) by striking the onrushing water at a slight angle, adding more of these angles would generate more lift. His angles were in the form of multiple jogs or steps in the bottom of the hull. What's more, while the boat was supposedly skimming along on these numerous steps, only their very tips would be touching the waves. The remainder of the hull underbody would be in contact with air and foam alone. Since everybody knows that air (and foam) are less dense than water, resistance should decrease dramatically.

What's particularly nice about all this, is that—broadly speaking—Fauber was right. In fact, just a year later (1910), a multi-step hydro competed in the British International Trophy. (Powerboat racing was hot, hot, hot back then—it was *all* new.) According to the September, 1910 *Rudder* magazine:

> "*Dixie III* [the U.S. defender] got the honors but *Pioneer,* a Fauber hydroplane, showed by far the greatest speed possibilities."

The only reason *Pioneer* didn't win every race by



Maple Leaf IV at speed. Look closely at the waterline to see some of her multiple steps.

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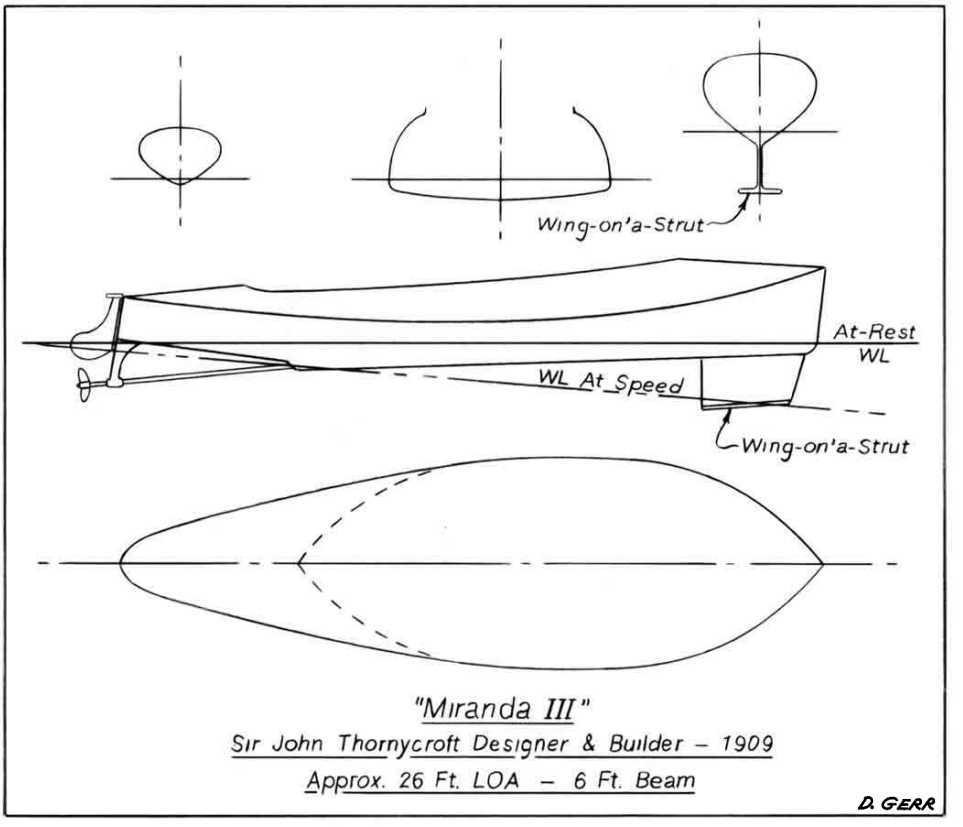
a huge margin was repeated gear failure.

Maple Leaf IV

In 1912, S.E. Saunders (the designer and builder of *Ursula*, see last article) knocked together a little 40-footer. A multi-step hydroplane named *Maple Leaf IV*. She was also based very closely on Fauber's multi-step patents, and she did 55 knots with a single 800-hp engine—a 157-percent increase in speed over *Ursula* in just 4 years, and that with nearly the same power! Indeed, by coincidence, both *Maple Leaf* and *Ursula* weighed in at exactly the same 5.25 tons.

Maple Leaf IV succeeded where *Pioneer* fell short; she took back and successfully defended the British International Trophy (the Harmsworth Trophy) twice! She was also the first boat in history to exceed 50 knots. If you have any doubts about *Maple Leaf*'s effectiveness, ask yourself how many 40-footers you know that can sustain an *honest* 55 knots (63 mph) today? I doubt you can think of many. I'd be surprised indeed if you can think of any this size that can make this sort of speed with a mere 800 horsepower.



A Thorny Boat

Meanwhile, back in 1877, a fellow named John I. Thornycroft (Sir John Thornycroft, to be precise) was experimenting with the new-fangled Ramus effect, using models he towed along at the end of a fishing rod. He had some limited success, but—as we've seen—the power wasn't there and he appeared to abandon this skimming madness, going on to build the "sensible" ultra-narrow torpedo boats of the day. (By the way, Thornycroft—later Vosper Thornycroft—was to become one of the greatest builders of planing boats—pleasure, commercial, and military—for the next 75 years. Sadly, last time I was in Portsmouth, England, the plant was shut down.)

As we all know, however, once a crazy idea gets into some inventor's head, it just doesn't get out again. (Maybe someone should start and organization: Inventors Anonymous? The Gadgeteers Recovery Society?) Anyway, Thornycroft was no exception, and—as engine power increased—he returned to the skimming thing in a big way. In the space of a few short years, around 1906 and '07, he built his own model-testing tank and ran experiments on well over a dozen different models. Of course, back then, nobody knew for sure what a planing boat should look like. The models had every imaginable shape. Some were no more than neatly rounded bricks or shingles, others were like canoes with wings on the bow, and still others were similar to modern planing hulls.

Miranda III Does The Bounce

Thornycroft came to the conclusion that a single step amidships would be just as efficient as Fauber's multitude. After satisfying himself about his results, he built himself *Miranda III*. She was a single-stepped hydro with—I don't know what else to call it—a "wing" mounted on a strut, projecting down from her bow into the water. The purpose of this wing-on'a-strut was to lift the bow so the boat would ride at an up-angle on it and on her after planing steps. (On "single"-stepped hydros, The transom itself acts as a second step or planing surface.)

Miranda III actually made fairly good speed in smooth water, Her problem was the confounded wing-on'a-strut thing. (It's easy to be scoff about

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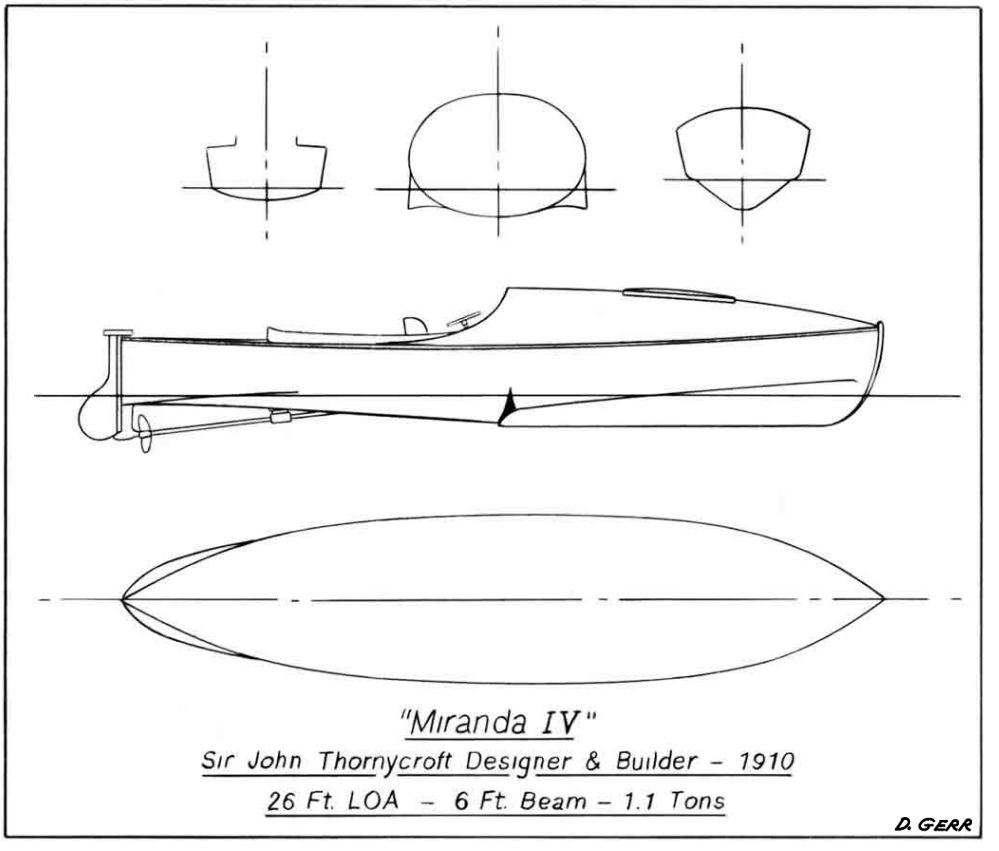
it now but, in those pioneering days, who knew what would work?) In any case, the slightest wave action caused poor *Miranda III* to bounce up and down spectacularly and virtually out of control. What would any inventor do? Yep, back to the drawing board.



Miranda IV Does It Right

Thornycroft's next effort hit the mark dead on. His *Miranda IV* was a true modern single-stepped hydroplane (remembering that the transom actually acted as a second step or planing surface, but isn't counted in the conventional naming system.) She had hard chines, and was 26 feet LOA by 6 foot beam. Powered by a single 120-hp engine, she clocked in at 35 knots—a speed-length ratio of 7. Sir John's new boat is speced as weighing 22 cwt., in racing trim. What is a "cwt."? Good question; nothing like the old English measurement system?! A cwt. is a hundredweight, which in England is equal to 112 pounds (it's probably best not to ask why). At any rate, *Miranda IV* was 2,460 pounds, or at 20.5 pounds per horsepower she was doing 35 knots. This is good going even by modern standards.

Miranda Meets Parliament

In 1910 this sort of speed (on so small or so short a vessel) was unheard of. Indeed, *Miranda IV*'s made quite a sensation on a run down the Thames past the Houses of Parliament. It was tea time—what else—on the verandahs overlooking the river. As *Miranda IV* shot by, eating stopped and all heads swiveled to take in the approaching missile. Sir John eased her off and pulled along side the shore to hobnob with a few friends (handy to be a knight at times like this). Then, he headed her out, goosing the throttle

Model of *Miranda IV*

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and leaving little behind but foam.

. . . and Takes a Photographer for a Ride

Some weeks later, a passing photographer asked for a ride on *Miranda IV.* Thornycroft, was always willing to give demonstrations. He offered the fellow a seat (really "a stand," I suppose) in the foredeck hatch, and *Miranda*'s engineer recalled the trip:

A 55-foot CMB on patrol

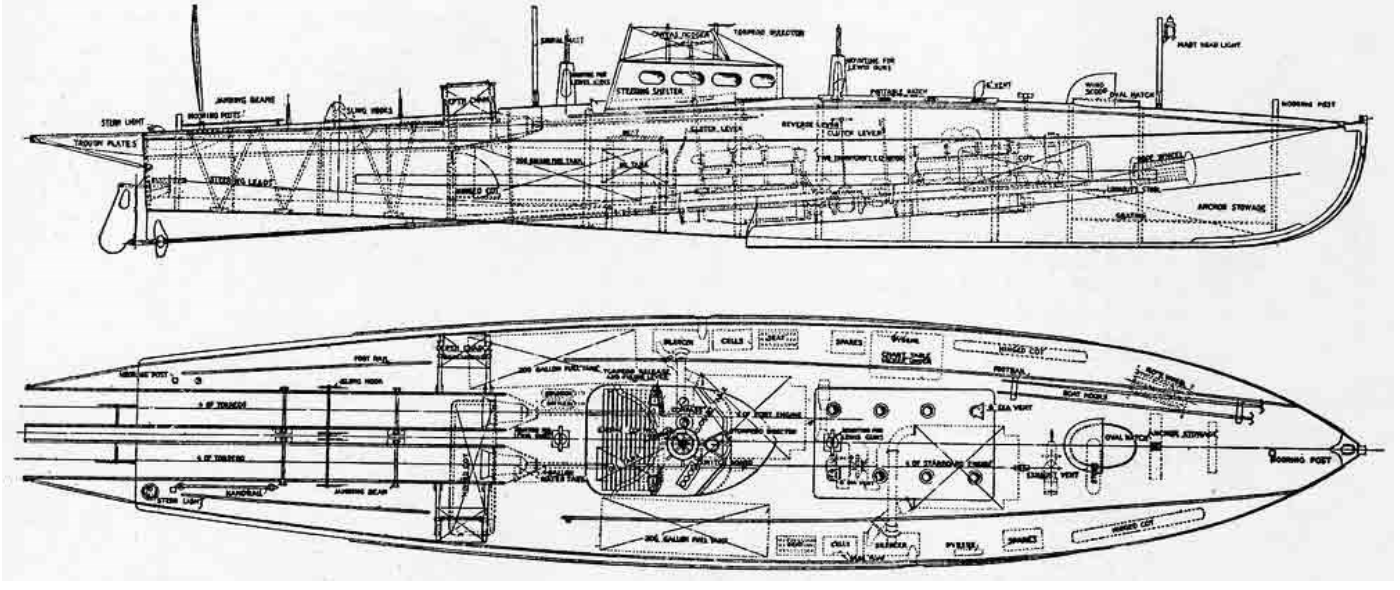
> "We found it quite bumpy enough aft, for it was really rough, but forward it was very much worse apparently. The first bump shot our friend up through the hatchway till his knees were visible above the coaming, and at the second he disappeared with a crash, camera and all into the bilge. From a spectator's point of view it was really very funny, though I doubt if the victim thought it so."

To be fair, Thornycroft and crew hadn't considered the extreme motion at the bow. They weren't playing a nasty trick; everything was so new they simply hadn't thought it through.

Getting the Water Out

Thornycroft's experimenting wasn't limited to the major breakthroughs, however. His engineer went on to relate:

> "The bump that had taken the photographer into the bilge had apparently landed him against a plug placed up forward which had become dislodged, letting in a stream of water, . . . Our passenger by this time was somewhat scared, for which I did not blame him, and I really think he imagined himself at the mercy of two lunatics, when we proceeded to cheerfully pull out another plug about 2 in. in diameter in the stern "to let the water out," as



55-Foot Coastal Motor Boat (CMB)

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Model of a 55-foot CMB
National Maritime Museum Greenwich London, www.rmg.co.uk

> we explained to him. As a matter of fact, it did run out very nicely, because the plug in question was just aft of the step where, of course, there was a good deal of suction, so that the boat emptied herself at once. "And you might make note of the careful way we design these things," said Mr. Thornycroft. "The hole forward is about an inch diameter and this one much bigger, so the water will always run out faster than it comes in." The explanation I am afraid, only partially satisfied the photographer."

Yes, Thornycroft seems to have invented the suction bailer. Before planing speeds, if you opened a hole anywhere in the bottom of *any* boat, water always came in, it never ran out. No wonder the poor photographer thought *Miranda IV*'s crew was mad.

The Best Planing Boats?

Stepped hydroplanes, it turned out, were and still are more efficient pound-for-pound than conventional planing hulls. Given two hulls of similar overall proportions and weight, the stepped boat will be significantly faster. A 9,000-pound stepped hull, for example, would do about 34 knots with a 250-hp powerplant, while a 9,000-pound conventional planing hull would reach a bare 25 knots, with the same 250 hp—a 36 percent difference! It was because of this that the British Admiralty chose stepped hulls for their Costal Motor Boats (CMBs), during World War I.

Steps to War

CMBs were built principally in two sizes 40 feet and 55 feet. Largely forgotten today, they proved themselves in the English Channel, and the North Sea (not areas noted for calm). All the CMBs were designed and most (if not all) were built by non other than Sir John Thornycroft. They were almost perfect enlargements of the original 26-foot *Miranda IV,* with—naturally—a few tweakings and refinements, plus the adjustments necessary to carry armament. The 55 footer was 11 foot beam, displaced 14 tons, and did 46 knots with 1,200 horsepower. At the end of the War to End All Wars, some of the British CMBs were sold to Russia, where they were fitted with extra machine guns, and were used in river patrols during the end of the Russian Revolution.

A peculiar thing about the CMBs: Most of them weren't fitted with mufflers. The reason? The noise was supposed to mislead the enemy into thinking they were under attack by *airplanes!*? Well, the CMBs served well; maybe it worked? We do know—from examining German ship's logs—that during several night attacks the German seamen mistook CMBs for submarines, even after getting the boats dead in their searchlights.

Where are the Stepped Hydros?

Of course, you might well ask: "If stepped hydros are so good, why aren't we surrounded with them?" The answer's a bit complex. At the start of the Second World War, most of the world's navies considered stepped hulls for their patrol

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40-foot CMB on display at the Imperial War Museum
Imperial War Museum, www.iwm.org.uk/visits/iwm-duxford

boats (even the U.S.). Good as their speed is in proper trim, however, it turns out that stepped hydros are equally bad if they're out of trim. (This had been an on-and-off problem with the WWI CMBs.) When a small boat's carrying a couple of torpedoes weighing two tons apiece, it's an understatement to say that trim tends to change after firing. Performance and handling suffers as a result.

40-foot CMB running gear

Now, back in the nineteen-teens, light powerful engines were hard to come by. As a result, the out-of trim difficulties were put up with to get more speed with the limited power available. In the late 1930s, though, bigger engines were in production, so most navies decided to avoid the out-of trim problems, sticking with conventional non-stepped planing hulls. Italy was the major exception. They had several models of double-stepped hydros (two steps amidships plus a third, not counted—the transom). Their 61-foot by 15-foot 4-inch MAS 500 series proved quite able, doing 43 knots, on 28 tons displacement, with 2,300 hp. This was with crew, two torpedoes and six depth charges.

Considering that the MAS 500s were almost 160 percent heavier than the CMBs had been, they were going great guns. What's more—as had the CMBs—the MAS 500s proved relatively good sea boats. Our own U.S., 77-foot, WWII Elco PT boats weighed 46 tons at full load, and were powered with three 1,200-hp Packard engines. Considering they did 41 knots all up and had their problems with seakeeping, I'm not entirely convinced that giving up on stepped hulls for patrol-boat service was the right move.

Nevertheless, with non stepped hulls chosen for the navies, most folks got the impression there was something wrong with steps, or at least that standard non-stepped planing hulls were somehow superior. Finally—adding to the stepped hull's public-relations problems—is that they're harder to engineer properly and more expensive to build.

Stepped Speed Today?

A yacht has none of the out-of-trim difficulties that military craft have, at least, as long as

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Model of *H.M. Pope III*, by Dave Gerr

Fountain 48 Cruiser

you're not carrying torpedoes. If you want to go *really* fast, a moderately narrow (by todays standards) single-stepped hydro would be hard to beat indeed. The photo shows a model of a 42-foot stepped hydro of my design, the *H.M. Pope III.* The *Pope*'ll do an honest 60 mph with twin 800-hp diesels, and she'll be able to keep going fast in weather that'd have most everyone else slowing down. Forty-two feet overall, 10-foot 2-inch beam, and displacing 8.7 tons, She's one boat that can honestly *cruise* at 35 to 40 knots!

Of course, production builders, such as Fountain, build both high-speed cruisers with stepped hulls as well as extreme-speed, offshore race boats.

Fountain Raceboat