

ONE SMALL STEP



Waterbird flying by its base at Hill of Oaks, Windermere. FRANK HERBERT

The stepped float has been key to the success of water-borne aeroplanes — but who first devised, and flew properly with, such a design? New research tells the story

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What is the purpose of the step on a seaplane?

The step — a notch or discontinuity in the lower surface of a float or hull — divides the planing area into two parts. As the seaplane increases speed over the water on its take-off run, the forward surface of the float rises and the craft ‘rides’ on that part of the float behind the step. This has the effect of reducing the surface area in contact with the water as speed increases, allowing the aeroplane to rotate and lift off. From the second decade of the 20th century, most seaplanes have incorporated a step and, in some cases, more than one.

The question is, who invented the step and first flew successfully with a stepped float? Here, the definition of a ‘successful flight’ is one where the aircraft concerned took off, flew and landed safely and without mishap.



In the history of flying from water, some facts are incontrovertible. French engineer Henri Fabre achieved the first successful flight in a powered seaplane on 28 March 1910, taking off and successfully landing on the Étang de Berre in the south of France. This, his third design of hydravion (seaplane), is sometimes referred to as ‘le Canard’ (the Duck) and was the culmination of four years of design and testing. Unconventional in many respects, it was a pusher design, with the wing at the rear and with two control surfaces ahead of the pilot, who sat at the mid-point of the beam that constituted its fuselage. There were three floats in a tricycle arrangement, one at the nose and



LEFT: Henri Fabre with his hydravion, probably on the occasion of its first flight which occurred during March 1910.

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two mounted under-wing at 40 per cent span. These floats, with a curved upper surface but a flat planing surface — effectively an aerofoil cross-section — were designed to produce lift either in water or in the air. Photographs show they were mounted with

a considerable (around 10°) ‘nose-up’.

Fabre recalls, in an account he gave to a French aeronautical magazine in 1923, how the surface of the lake that day was “like a mirror”, ideal for the test flight. He abandoned his first take-off run, ➤



LEFT: Fabre's hydravion ‘le Canard’ under tow. GETTY

RIGHT:
A glorious shot of Henri Fabre in flight over the Étang de Berre, probably in 1910. His altitude seems to agree with press reports of the time: "about two metres".

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as one of the rear floats rose from the water before the other, which risked instability. On his second run, both rear floats left the water simultaneously, the aeroplane skimmed the surface on its front float before leaving the water completely, and stabilised to fly for some 500m at a height of some 2m. Then, reducing power, he touched down on the lake, first on the front float which, as Fabre recalled, "left a thin trace like that of a diamond on glass."

Unconventional it may have been, but his hydravion was undeniably successful. He would make a number of flights in 'le Canard' before it was damaged beyond repair (*Flight* magazine of 22 April 1911 says "completely wrecked") in a crash at Monaco just over a year later, piloted not by Fabre himself but by Jean Bécue. Fabre claims in his *Les 3*

Hydravions d'Henri Fabre that he was the first person to fly a full-size aircraft "with nothing behind its motor". Much later, this would lead fellow French pioneer Gabriel Voisin (1880-1973) to assert,

“Fabre proved it was practicable to fly from water”

perhaps slightly fancifully, that 'le Canard' was thus the father of the supersonic Concorde and Tupolev Tu-144, both of which "feature the same peculiarity [of design]."

Fabre had proved his point: it was practicable to fly from water and this, he argued, made it safer

than flying from dry land, especially in the case of a crash. He had an exhibition stand at the Deuxième Exposition Internationale Aéronautique (Salon de l'Aviation) at the Grand Palais in Paris from 15 October to 2 November 1910. There he displayed his hydravion, billed as "le Premier Aéroplane Marin" (the first waterborne aeroplane). His stand was visited on 26 October by Glenn Curtiss, of whom more later, as well as Oscar Gnosspelius and Edward Wakefield (ditto), each no doubt examining closely the hydravion and making careful note of its features.

Fabre produced no more seaplanes of his own design, but went on to design and build floats for other early pioneers including Gabriel Voisin and Glenn Curtiss. He converted Caudron G.IVs and Sopwiths into seaplanes at his Marseille workshop during World War One and lived to 101, remaining active into old age and even experiencing a supersonic flight in Concorde. Air France, of course. The Musée de l'Air et de l'Espace at Le Bourget has conserved Fabre's hydravion since 1920, but one wonders how much of it, still proudly on display in the 'Pioneers of the Air' hall, is original.

Meanwhile, elsewhere in Europe and across the Atlantic, other aviators were following in Fabre's footsteps and designing seaplanes with varying degrees of success. Crucial to any such craft was the design of float. Fabre's flat-bottomed 'aerofoil' design had been proved to work, but it was not the way forward. A more significant design feature was needed. This would come in the form of the stepped float. But who would be the aviator who designed, built and demonstrated such a float?

At this point, a number of pioneers come into the picture. The first is the American Glenn Curtiss. Curtiss was born in 1878, just four years before Henri Fabre. In July 1902, he established his own business, the G. H. Curtiss Manufacturing Company, and soon after built a plant at Hammondsport, New York. Hammondsport is on the southern tip of Keuka Lake, one of the Finger Lakes in central New York state, and is some 20 miles long. Its width varies between half a mile and two miles, making it an ideal location for the testing of seaplanes. Curtiss was undoubtedly one of the great

RIGHT:
The Curtiss 'Flying Fish' — also known as Flying Boat No 2 — on its take-off run (or taxiing) on Keuka Lake during 1912. This aircraft was originally built without a step in the hull, a step later being incorporated.

LIBRARY OF CONGRESS



Glenn Curtiss
sits for a portrait
circa 1909.
LIBRARY OF CONGRESS



pioneers. He began selling motorcycles in 1901 and would go on to design and produce landplanes, floatplanes and flying boats, constructing several manufacturing plants within New York state. World War One saw considerable expansion, with the North Elmwood plant at Buffalo built in 1917 touted as the world's largest aircraft factory at that time.

Hammondsport remains, though, the spiritual home of Glenn Curtiss and his creations, and his legacy is very much kept alive by the Glenn H. Curtiss Museum on the lake there. It goes without saying that its experts are the established authority on the subject of Curtiss, the man and his designs.

It has long been believed — and stated in several authoritative volumes — that it was Curtiss who designed, developed and tested the first step on a seaplane's float or hull.

This 'fact' is reflected in several accepted works on the history of aviation and, in particular, those on seaplanes.



For instance, *American Flying Boats and Amphibious Aircraft* by E. R. Johnson (McFarland & Company, 2009) says, "Unwilling to give up, Curtiss built another flying boat at Hammondsport, New York, during the summer of 1912... The solution he finally hit upon was to incorporate a traverse [sic] 'step' between the fore and afterbodies of the hull... Much the same as the Wright Brothers' quest for heavier-than-air, powered flight, Glenn Curtiss shifted the paradigm as to waterborne flight, and every flying boat, amphibian and seaplane that has flown since, is an heir to his efforts."

In *Hero of the Air: Glenn Curtiss and the Birth of Naval* ➤

THE DRAMATIS PERSONAE

Capt Edward William Wakefield

Wakefield was born in 1862 at Kendal. He read natural sciences at Cambridge and joined the family bank, becoming a partner upon the death of his father. While there was no family tradition of military service, he served during the Boer War and again during World War One. Although he had constructed cardboard model aeroplanes at school, the first time he saw a 'real flying machine' was at the Blackpool Aviation Week in October 1909, when he was 47. It was there he witnessed aeroplane accidents, only to be told they were unavoidable. As a result, he formed the view that flying from water would be safer, this at a time when nobody in the world had succeeded in so doing. On land he owned at Windermere, he built a hangar and carried out experiments for two years with floats of various shapes and sizes. As his pilot he engaged Herbert Stanley Adams, whom he had met at Brooklands where Waterbird was first tested as a landplane.



Maj Oscar Theodor Gnosspelius

Born at Liverpool in 1878, Gnosspelius began training as a civil engineer in London in 1895 and served his time at a boat-builder's yard to the south of Windermere. Having worked abroad and accumulated wealth, he returned to Windermere in 1909 and attended the Blackpool Aviation Week in October of that year. His motivation to develop hydro-aeroplanes was to use available water rather than expensive land for operations. He began collaboration with Wakefield during 1910, and in 1911 learned to fly straight and level at Brooklands. Whilst he opposed Wakefield's second application for a patent, *The Aeroplane* of 25 January 1912 described him as, "designer and engineer to [Wakefield's] the Lakes Flying Company".



AVM Sir Oliver Schwann (later Swann)

The son of a London merchant, he joined the Royal Navy at 17. Having become assistant inspecting captain of airships, Cdr Schwann conducted experiments at Barrow-in-Furness in an Avro Type D to which floats were lashed. Initially using his own money, a syndicate was later formed. David Hobbs wrote in *The Royal Navy's Air Service in the Great War*, "Despite having no formal training and no pilot's certificate, he was [on 18 November 1911] the first British aviator to take off from water but his lack of experience let him down and the subsequent crash cannot be considered the first water landing even though both pilot and aircraft survived to fly again". He did, though, gain an aviator's certificate in 1912. His work included remarkable patents for anti-icing by leading exhaust gases into hollow spaces inside wings, and for catapulting an aeroplane from the deck of a ship.



RIGHT:
Herbert Stanley Adams, Edward Wakefield's pilot for Waterbird. Wakefield himself did not possess a pilot's licence.

FAR RIGHT:
The front cover of *The Aeroplane* for 25 January 1912 shows Waterbird making its second flight on 25 November 1911, photographer Frank Herbert not having been present for the first.

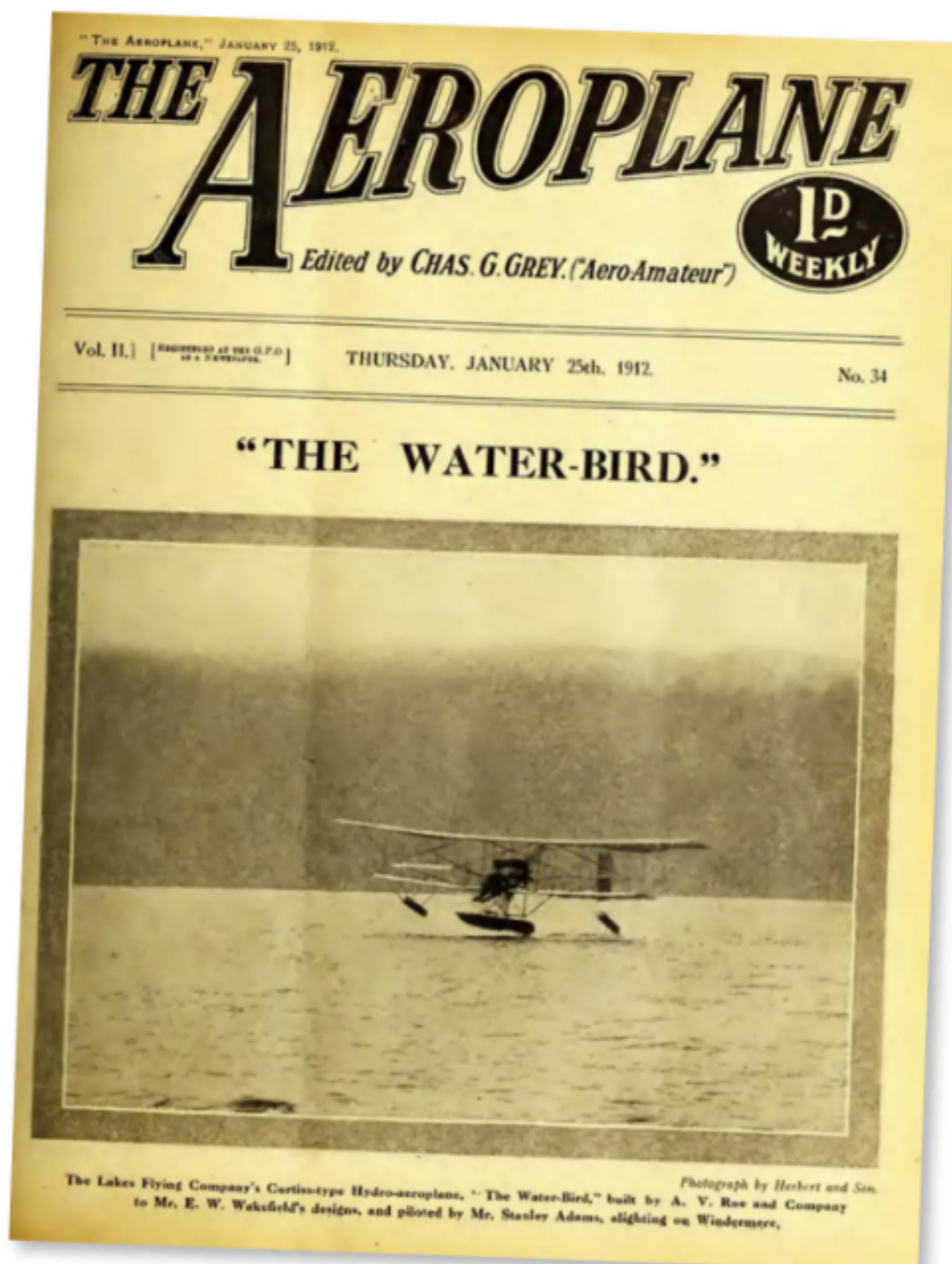


Aviation (Naval Institute Press, 2010), William F. Trimble writes, "Through the remainder of the spring and early summer of 1912 at Hammondsport Curtiss was determined to solve the problems that had been so evident with his abortive flying boat design... At last, in what is sometimes referred to by historians as a 'Eureka moment', Curtiss visualized a separation or 'jog' in the bottom of the hull that would disrupt the flow sufficiently to break the hull loose... Curtiss instructed his shop foreman Henry Kleckler to cut out blocks of wood that he fixed transversely to the hull to create what later became known as a 'step'."

And Glenn Curtiss: *Pioneer of Flight* by C. R. Roseberry (Doubleday and Co, 1972) contends, "Thus it came about, with some poetic justice, that Keuka Lake saw the world's first flying boat arise from her bosom in the summer of 1912... One day, as they pulled up to the pier after another failure, Curtiss asked the rest what they would think about putting a jog, or a wedge, on the bottom to break the suction. All judged it worth a try, and he dispatched Kleckler to saw some pieces of wood, which were then fastened to the hull like a shallow step."

Who invented the stepped float/hull is a long-discussed question, but one which has, this author strongly believes, now been proved beyond any reasonable doubt. Ian Gee, chair of the Lakes Flying Company and very much the man behind today's flying Waterbird replica, has undertaken considerable research on the subject over recent years. His conclusion is that the design, development and construction of the first stepped float took place on

RIGHT:
Waterbird on the water at Hill of Oaks, floating high as it is still on its launching bogie. FRANK HERBERT

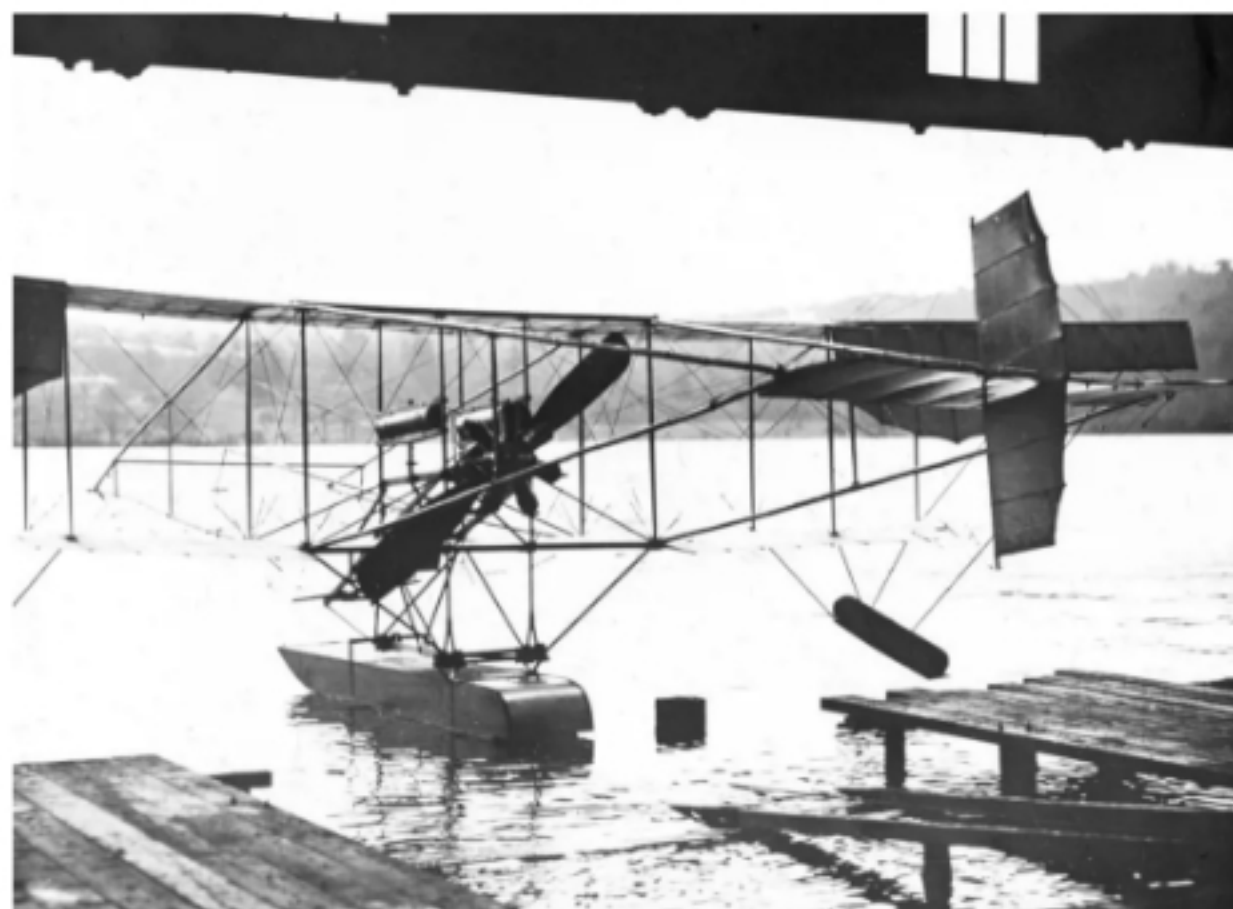


this side of the Atlantic and led to a successful first flight from water some eight months before Curtiss.

There were three and maybe more aviators in the UK who were building and testing seaplanes in the immediate aftermath of Fabre's first flight: Oscar Gnosspeilus, Oliver Schwann and Edward

Wakefield. Any one of them could have achieved the first successful flight from water with a stepped float, where 'successful' requires that both take-off and landing were achieved without mishap.

The inescapable conclusion from the timeline featured within this piece — even if it flies in the face of



previously accepted beliefs — is that Herbert Adams in Edward Wakefield's Waterbird made the first successful (take-off to landing) flight in a seaplane with a stepped float on 25 November

1911. Others, including Gnosspelius or Schwann, could have well got there first but, for a variety of reasons, did not. On the other side of the Atlantic, Glenn Curtiss was similarly

experimenting with stepped designs, but his first successful flight — in his 'Flying Fish' flying boat from Keuka Lake — took place in July 1912, some eight months later.

Fortunately, Waterbird (sometimes referred to as 'Water-Bird' or 'Water Bird' in some contemporary publications) was well photographed by Frank



STEPPING UP

Between the 1870s and 1910, experiments were being carried out by the boat-building industry to improve the performance and handling of hydroplane hulls. While a traditional hydroplane hull had no step, the addition of a suitably sculpted step was investigated by several pioneers including Charles Ramus, John Thornycroft, Albert Knight and William Fauber. In 1907, Knight was granted the first British patent for a stepped hydroplane. In 1908 and 1909, Fauber took out UK and US patents for multiple steps in a boat hull, "the bottom of the boat being made deeper in the centre than at the sides, so that its cross-section presented a shallow 'V'". A contemporary advertisement claimed Fauber's boats to be, "the fastest in the world". That said, the application of the stepped hull to seaplanes would come later. Not much later, but later. This timeline recounts progress towards a successful flight with a stepped float.

➤ 28 March 1910

Henri Fabre makes the world's first powered flight from water from the Étang de Berre, Martigues, in the south of France. His 'hydravion', powered by a 50hp Gnome with a two-bladed propeller, uses flat-bottomed floats of Fabre's own design. Its flight covered 500m.

➤ July 1910

Oscar Gnosspelius tests his design of stepped float on a monoplane of his own design, Gnosspelius No 1. But the aeroplane never becomes fully airborne, as the result of insufficient engine power.

➤ 26 January 1911

Glenn Curtiss makes a successful public flight from water, San Diego Bay, California. His aeroplane, the 'D Hydro', features a single main float without a step, 6ft in length and 5ft wide. There was also a second, smaller one several feet ahead of it to keep the nose of the aircraft up when accelerating for take-off, as the engine power tended to push it downwards.

➤ 18 November 1911

Oliver Schwann flies his twin-float Avro Type D biplane from sea water at Barrow-in-Furness. Its floats are stepped, and in the final version has 'air lubrication', where an air supply was fed through the floats to the side of the steps. This, though, cannot be considered a successful flight, as the landing is far from controlled and the aircraft capsizes.

➤ 25 November 1911

Herbert Adams flies from Windermere in 'Waterbird', an Avro Curtiss-type biplane, featuring a stepped float designed by Edward Wakefield. Until a second step had been added, Waterbird would not attain sufficient speed for take-off. This is the first successful flight in the world in a

seaplane with a step, and Adams confirms the success to Wakefield by telegram. Many further demonstration flights are made over the following months.

Earlier that day, Gnosspelius No 2 had flown from another part of Windermere but was struck by a crosswind. The *Westmorland Gazette* for 2 December 1911 reported, "Before he [Gnosspelius] had been going for a minute, the craft was noticed to swerve sharply to the right and then to the left. Portions of the propeller were then seen to fly high up into the air, and in a moment the aeroplane turned right over from back to front, and the luckless pilot was thrown into the lake."

➤ 11 December 1911

Edward Wakefield applies for two GB patents for stepped floats and their method of attachment — an "Improved Means Applicable for use in Enabling an Aeroplane to Travel Upon Water". The first application concerns only the method of attachment of the float to the aeroplane using bars and bungees but, crucially, the attached drawing shows a step.

➤ 20 December 1911

The Lakes Flying Company is formed at Hill of Oaks, Windermere to build and fly seaplanes. The present-day Lakes Flying Company, incorporated in 2009 and with Ian Gee as chair, is its spiritual successor.

➤ 20 January 1912

Lt (later ACM) Arthur Longmore test-flies Waterbird for the Admiralty. His report states, "Two steps occur in the bottom of the hydroplane, one at half way of 4" and the other 8" from the stern of 3 1/2".

➤ 1912

Curtiss 'Flying Fish' (also known as Flying Boat No 2) constructed at Hammondsport, New York. As built, its hull does not feature

a step. In testing, it fails to reach flying speed for take-off.

Incidentally, the 25 January 1912 issue of *The Aeroplane* reported, "During the past two months, in spite of bad weather, it [Waterbird] has made about sixty flights on thirty-eight days. Its greatest distance has been about twenty miles, and its best height 800 feet."

➤ 29 March 1912

Waterbird is written off at Windermere by a hangar collapse in a storm.

➤ July 1912

Its hull modified to incorporate a step, Curtiss's 'Flying Fish' (Flying Boat No 2) makes a first successful flight from water. 'Flying Fish' would be the precursor to Curtiss's Model E, generally accepted as one of the first successful flying boats.

➤ 12 September 1912

GB patent 27,770 granted to Wakefield for a float attachment to a seaplane.

➤ 18 March 1913

GB patent 27,771 granted to Wakefield for a stepped float for a seaplane. An extract from the court's decision states, "As amended the claim reads 'For use with an aeroplane, a float approximately rectangular in cross-section and in plan, and the underside of which constitutes a hydroplane, this hydroplane being formed with a series of transverse steps'. This claim is I think quite clear and one on which the Applicant is entitled to a patent."

➤ 4 June 1913

Glenn Curtiss applies for US patent for flying boat design featuring a hull with a step.

➤ 8 June 1915

US patent 1,142,754 for a flying boat with a stepped hull is granted to Curtiss.

RIGHT:
Gnosspelius No
2 on the water,
in one of the
numerous splendid
photos taken by
Frank Herbert and
reproduced here by
kind permission of
his daughter Joan
Ledger. FRANK HERBERT



Herbert, whose shop/studio was at Bowness-on-Windermere. In early 1912, his images of Waterbird occupied the entire front page of *The Car*, *The Aeroplane*, *Flight* and *The Aero* magazines. The glass slides have been preserved in the Wakefield family archive and have now been digitised.

Close examination of many contemporary black-and-white images of the early seaplanes is complicated by their often poor resolution, particularly where reproduced in magazines or newspapers. This can make it difficult to decide with any degree of certainty whether the featured seaplane's float/hull did, or did not, feature a step.

Although these early pioneers were rivals, there was a certain cross-fertilisation of ideas between them. Directly or indirectly, Curtiss's work influenced Wakefield. The dimensions of

Wakefield's stepped Waterbird float followed closely those of floats built by Curtiss. *The Aeroplane* of 25 January 1912 noted, "Waterbird's main float is 12ft long, 2ft wide, with a depth of 1ft". Curtiss had flown his A-1 Triad,

“We hope the question has been laid to rest”

the first successful amphibious aircraft, from San Diego Bay with "a single pontoon" of, yes, 12ft by 2ft by 1ft, with semi-retractable undercarriage legs mounted on the pontoon. Various dates are quoted for this flight, but 26 February 1911 is the consensus. While Curtiss

expressed satisfaction that he had solved the problems of take-offs and landings on water, his Triad's main float did not feature a step.

Waterbird itself — the original Waterbird — was a Curtiss-type biplane built by A. V. Roe (Avro) at Manchester to the order of Edward Wakefield and first flown, as was the 21st-century replica, as a landplane. Its floats, both the main float and the auxiliary wingtip ones, were constructed by Borwick & Sons, boat-builders of Bowness-on-Windermere, who also made floats for Oscar Gnosspelius.

Examination of virtually all subsequent designs of floatplanes and flying boats will show that the advantages of incorporating one — or more — steps in their float or hull have been universally recognised. Waterbird's historically important original stepped float has been well looked-after under different ownerships. It survived Waterbird's demise in the storm of 29 March 1912, and Wakefield stated in a *Westmorland Gazette* article of 22 March 1941, "The first successful float hangs above my head as I write". As of April 1962 it was still in the Wakefield family, Sir Wavell Wakefield having stored it in his garage. In July 1971 it was presented to the RAF Museum at Hendon, where it was displayed for a time before moving to Cardington, Henlow and then to the reserve collection at Stafford. A final homecoming occurred in 2022, when the RAF Museum transferred ownership to the Windermere Jetty Museum, where it now resides.



RIGHT:
Oliver Schwann
in his Avro Type
D, converted to
a seaplane with
stepped floats. The
location is Barrow-in-
Furness and the date
November 1911. GETTY



LEFT: Constructional detail of Waterbird's main float, as preserved at the Windermere Jetty Museum. Note the two steps, one at its mid-point and one 8in from the stern.

BENTHAM IMAGING

The final step — no pun intended — in this story is that Ian Gee (and the author, who became peripherally involved at a fairly late stage) decided to put together a dossier detailing the progress toward the stepped float on seaplanes, and submit it to the Glenn H. Curtiss Museum for its approval or otherwise. This package with its contemporary images, drawings, newspaper and magazine articles, patent applications, typed reports and telegrams would, we hoped, convince the museum of our contention that Wakefield's successful demonstration of the stepped float pre-dated Curtiss's by some eight months. It was couriered to Hammondsport late in 2025. We then sat back,

enjoyed the Christmas and New Year celebrations, and awaited a response.



An e-mail reply from the museum arrived in early January. It stated, "Based on the evidence you have provided [...] we can agree with Edward Wakefield being the first to patent the stepped float on an airplane, as well as being the first person to successfully test the concept". This was the response for which we'd been hoping. The reply also made the point that the museum itself, "does not contend that Glenn Curtiss was the first to invent the stepped hull". With this we'd absolutely agree, but many other references in specialist

publications in print and on the internet have for long perpetuated that very story.

Following Ian's exhaustive research, production of the dossier, the Curtiss museum's generous examination of the material and its most constructive response, we hope the question of 'who invented the step and first flew successfully with a step' has finally been laid to rest. Wakefield, Adams, Waterbird. And all three of them were British!



The author thanks the Glenn H. Curtiss Museum and in particular Andre Wigley, the Musée de l'Air et de l'Espace and the Musée de l'Hydravation. For further information see www.waterbird.org.uk/floats/boats

BELOW: Chris Götke approaches to land on Windermere during his flight demonstration of the Waterbird replica on 5 September 2025. This year's Wings over Windermere event is scheduled for 4-5 September.

DENIS J. CALVERT

