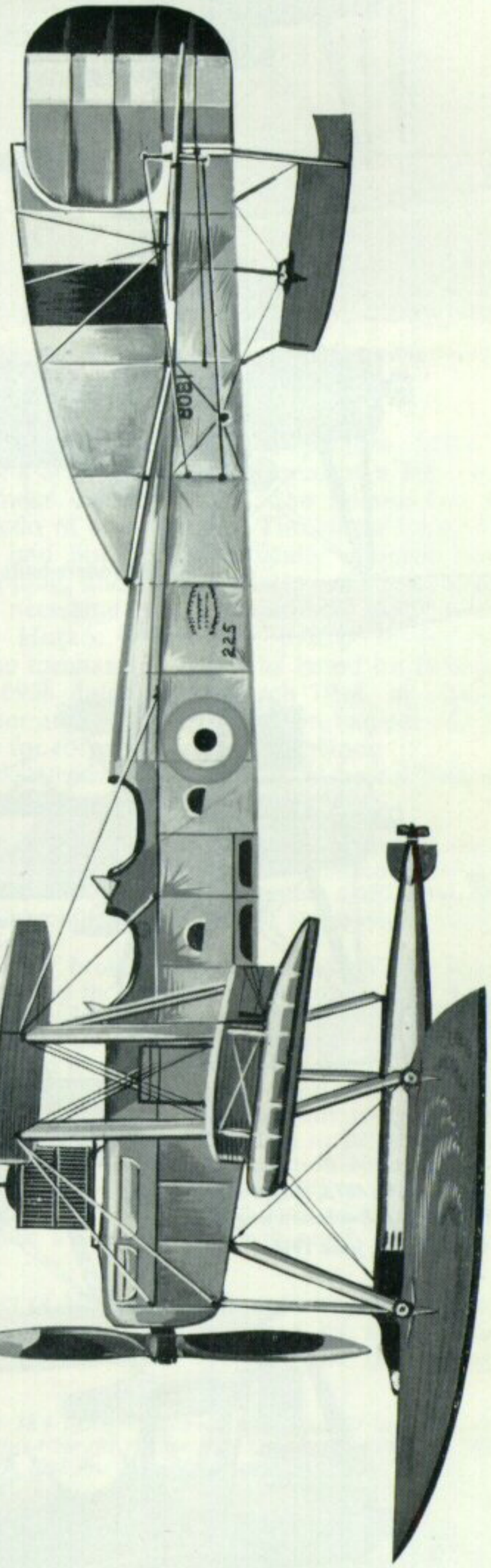
PROFILE PUBLICATIONS

The Short 184



NUMBER 74

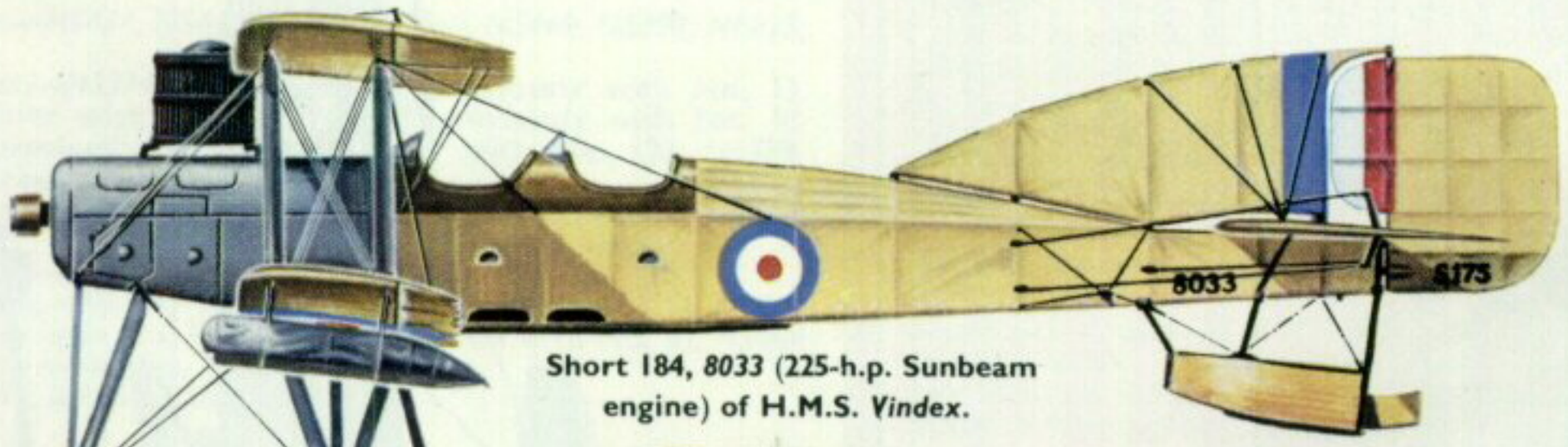
TWO SHILLINGS

Original Admiralty Type 184, *S.106*, with ailerons on upper wing only.

Roundel as displayed above upper and below lower wing of *S.106*.

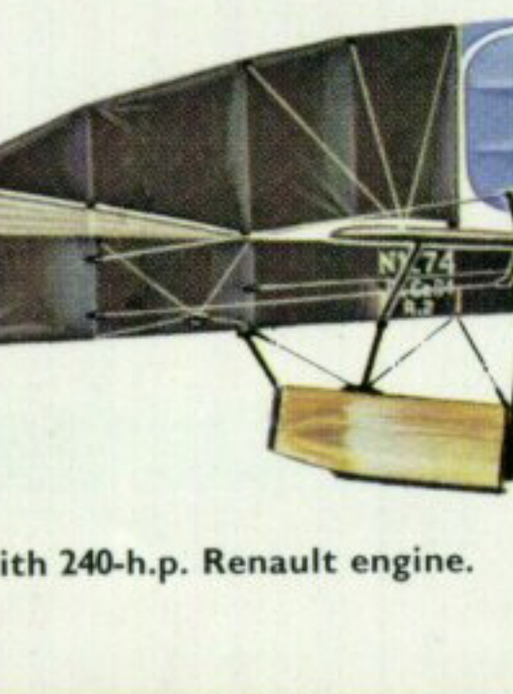
Saunders-built Short 184, *8027* (225-h.p. Sunbeam engine) of R.N.A.S. Calshot.

Manufacturer's plate displayed both sides of rudder (port shown) of *S.106* illustrated above.



Short 184, *8033* (225-h.p. Sunbeam engine) of H.M.S. *Vindex*.

Short 184 Type D, *8073*, single-seat bomber version (225-h.p. Sunbeam engine), Eastchurch, June 1916.



Manufacturer's legend on port side rear fuselage of *8073*.

Robey-built Short 184, *N1274*, with 240-h.p. Renault engine.

Rear fuselage legends of *N1274* (above) port side, (below) starboard side.

The Short 184

by J. M. Bruce

Short Improved 184 N1147 *here displays the revised aileron control system. This aircraft has a Maori I or II (the cowling panels have been removed), the original wing-tip floats, and the lengthened tail-float struts.*

It is difficult, more than fifty years after the event, to determine who was the first to make a successful drop of a torpedo from an aircraft. It has been said that this was first done in 1911 by Capitano Alessandro Guidoni, flying a Farman from which he released a 352-lb. torpedo. Guidoni's own account of early Italian experiments is very different, however. In his book *Aviazone—Idroaviazone* he states quite clearly that the idea of a torpedo-carrying seaplane was first proposed to the Italian navy by a lawyer, Pateras Pescara, in 1912, and that Guidoni's experiments with the Farman in that year were confined to proving the feasibility of dropping weights of up to 80 kg. (176 lb.) from the aircraft.

A remarkable monoplane designed by Pateras Pescara had to wait until 1914 for its two 160-h.p. Gnôme engines, and it was some time during that year that Guidoni successfully dropped a dummy torpedo weighing 375 kg. (825 lb.) from the aircraft. Unfortunately, Guidoni did not record the precise date, but claimed that his was "the first torpedo drop ever attempted and accomplished".

In the basic idea of dropping a torpedo from an aircraft the Royal Navy preceded the Italians by a year. Early in 1911 the subject was discussed by Captain Murray F. Sueter, Lt. Neville Usborne, Lt. L'Estrange Malone and Lt. D. H. Hyde-Thomson. The idea was developed by Hyde-Thomson in a paper that was submitted to the Admiralty by Captain Sueter, who used the opportunity to request that Hyde-Thomson be attached to what was then the Naval Wing of the R.F.C. to develop his proposals.

It seems that Hyde-Thomson's ideas were worked out and given specific form by an Admiralty draughtsman named Bowden, and Mr. (now Sir) T. O. M. Sopwith was then asked by Captain Sueter to build an aircraft incorporating the device.

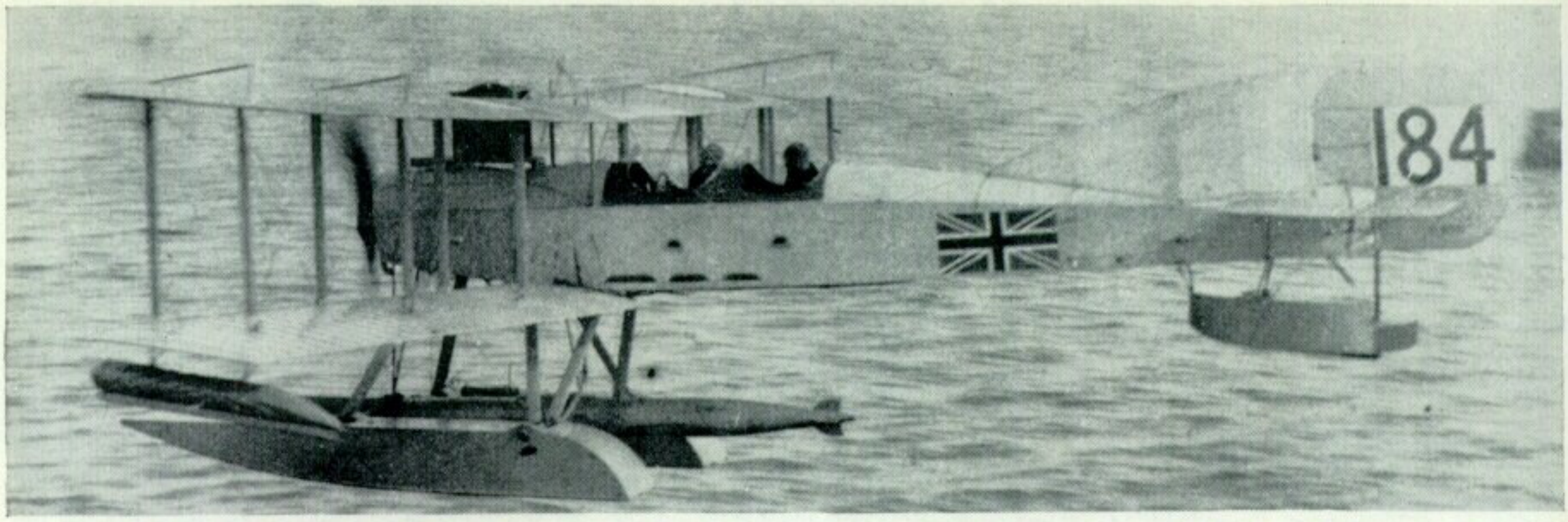
After feasibility trials with a non-flying twin-float hydroplane that incorporated aerofoil centre sections, presumably for structural reasons only, Sopwith built in 1913 a very large seaplane powered by a 200-h.p. Salmson engine. With this aircraft a 14-inch torpedo was successfully lifted late in 1913. For reasons that seem not to have been recorded, however, no drop was made from the Sopwith torpedo carrier. The first drop from a British aircraft was made on 28th July 1914 by Squadron Commander A. M. Longmore (now Air Chief Marshal Sir Arthur Longmore, G.C.B., D.S.O.), flying a Short seaplane powered by a 160-h.p. fourteen-cylinder Gnôme engine; the missile was a 14-inch torpedo of some 900 lb. The aircraft was of a type that had not been specifically designed for torpedo dropping, and the installation of the release mechanism necessitated modifications that were designed by Horace Short in a matter of hours. Doubtless the mechanism itself was based on British Patent No. 6938 dated 19th March 1914, in which Captain Sueter and Lt. Hyde-Thomson had set down their designs for torpedo-carrying seaplanes.

In his book *Airmen or Noahs* Rear-Admiral Sueter wrote:

> "Just before the war, I showed this machine [Longmore's 160-h.p. Short] to Mr. Churchill and Lord Fisher. . . . The latter was very much interested, and impressed upon Mr. Churchill and myself that we should develop these machines.
>
> After the war broke out, we required all Mr. Sopwith's efforts and those of his factory to produce high performance machines, then just beginning to show some promise. But Hyde-Thomson and myself were quite determined to succeed with a torpedo machine. So I sent for that fine pioneer seaplane constructor, the late Mr. Horace Short. When I explained my requirements to him and the great weight that had to be lifted with a 225-h.p. Sunbeam engine, in addition to pilot and petrol, Horace Short looked at me with a determined grin and said: 'Well, if you particularly wish this done, I will produce a seaplane that will satisfy you'; and he did."

The product of Horace Short's promise was a large, unlovely two-seat seaplane powered by a 225-h.p. Sunbeam Mohawk engine. To provide the lifting

The first Short 184 being launched, with torpedo in place, at Rochester. At this time the rudder bore the works number S.106 and the ailerons had not been fitted with their rubber return springs. (Photo: Flight 014)



No. 184 airborne with torpedo, pilot and observer. The rubber cords attached to the aileron control horns can be seen; the roundels on the upper wing consisted of a red outer ring and large white centre, the official R.N.A.S. national marking of early 1915.
(Photo: H. F. Cowley)

surface needed to get a torpedo, two souls and a worthwhile load of fuel airborne, three-bay wings more than 63 ft. in span were fitted. With shipboard operation in view these were arranged to fold, employing the folding mechanism devised by Horace Short in 1912.

The airframe of the 225-h.p. Short seaplane was made of the conventional materials of the time and followed earlier Short practice in most respects. Wood predominated, but the interplane and undercarriage struts were of faired steel tubing, and the trailing edges of the mainplanes were of wire; this produced the characteristic scalloped appearance under the pull of the doped fabric. The main floats were wooden pontoon-type structures, 16 ft. long and 2 ft. 10 in. in beam; their basic framework of ash, silver spruce and Canadian elm was covered with $\frac{1}{8}$-in. plywood on the sides and top, while the bottom planking was $\frac{3}{16}$-in. to $\frac{1}{4}$-in. thick. At each attachment point spools of rubber cord provided a measure of shock absorption. The tail float had a three-ply hull with metal sheathing of the underside; it supported the water rudder. It was mounted pivotally at about its mid-point on two steel-tube struts and was sprung fore-and-aft by rubber cord. As the stern of the float had appreciable vertical movement the shaft of the water rudder was telescopic. Under each lower wing tip was a small float consisting of a series of steel rings covered with balloon fabric, the whole being inflated through a Dunlop valve in the nose. A wooden keel and small horizontal fin surface of three-ply were fitted to the underside of the float.

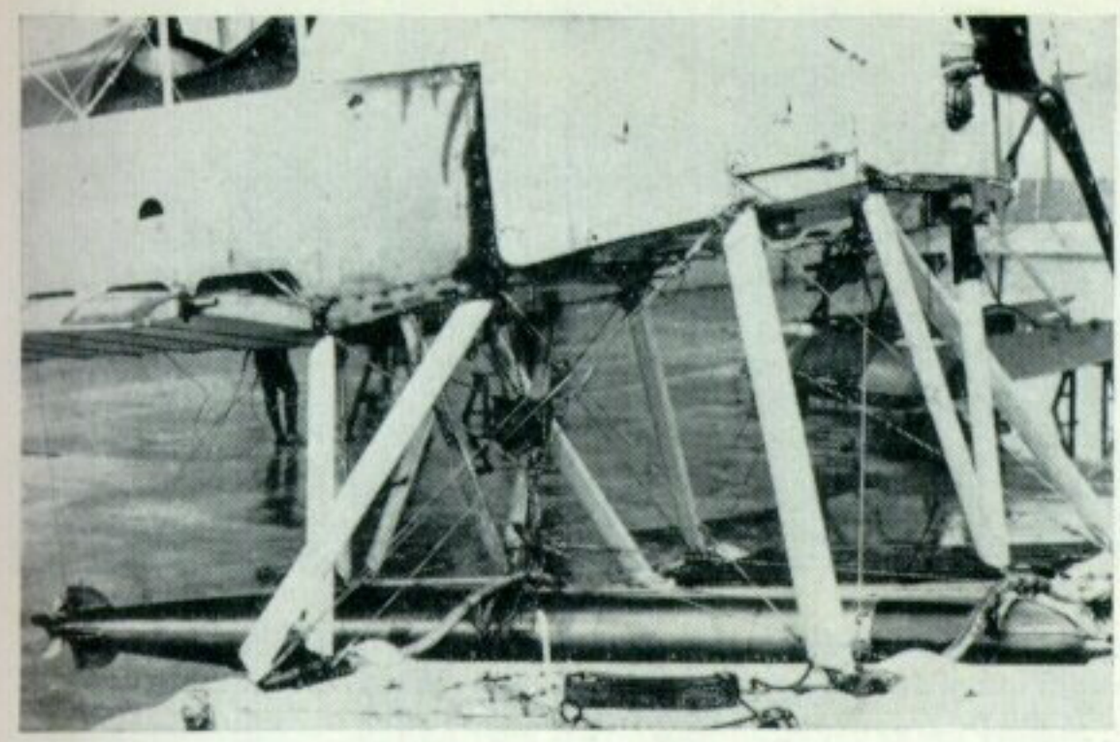
Numbered *184*, the first seaplane of the new type was completed at Rochester early in 1915. It was launched with a 14-inch torpedo in position between the main floats. Ailerons were fitted to the upper wing only and were of the single-acting type. Appropriate movement of the control wheel depressed the aileron on one side only; there was no spanwise balance cable connecting the ailerons; each was independently restored to the normal position by the spring action of two lengths of rubber cord pulling on control horns on the upper side of the aileron.

The official serial number *185* was allotted for a second prototype, which apparently was completed soon after No. *184*. Trials of the aircraft confirmed its ability to lift its designed load, and a small production batch of ten, *841–850*, were ordered. In accordance with the Admiralty's system of aircraft nomenclature the seaplane was officially designated Short 184 type, but in the R.N.A.S. it was usually known as the Short Two-two-five. This unofficial name was derived from the horse-power of its Sunbeam engine and continued in use long after the 225-h.p. Sunbeam had been superseded by other power units.

Batches of ten Wight 840 and Sopwith 860 seaplanes (respectively *831–840* and *851–860* were ordered at the same time as the Short 184s. All three types had the 225-h.p. Sunbeam Mohawk, and it seems likely that some comparative evaluation must have been contemplated. A few more Wights and Sopwiths were built, but clearly it was decided to standardise the Short 184. A further group of contracts for a total of 153 aircraft were given in mid-1915 to Shorts (*8031–8105*), Mann Egerton (*8344–8355*), Phœnix Dynamo (*8368–8379*), Sage (*8380–8391*), Saunders (*8001–8030*) and Westland (*8356–8367*). Of the additional contractors only Saunders had had experience of aircraft manufacture; nevertheless the first Sage-built Short 184 was completed late in September 1915 and delivered in November.

As there were no production drawings immediately available for distribution these were made "from life". Each of the contractors provided a draughtsman who, working from an actual Short 184, produced drawings of a group of components. Each firm then made enough sets of its draughtsman's drawings to send copies to the other contractors; in this way each firm received a full set of drawings.

The production Short 184s were substantially similar to the prototype. Initially, at least, the 225-h.p. Sunbeam Mohawk was the standard engine, and arched inter-float cross-bars with provision for torpedo crutches were fitted. A major innovation on the production aircraft was the provision of ailerons on the lower wings. Spanwise balance cables were still not fitted, and the revised aileron system would have won the approval of Mr. Heath Robinson. Cables from the control horns on the upper ailerons were taken forward and passed over upright pulleys mounted externally on the front spar; these cables were then led vertically downwards through the upper wing an inch or two ahead of and parallel to the interplane struts, passed through the lower wing, and then ran aft over pulleys under that wing to the control horns on the lower ailerons. Lengths of rubber cord attached to the upper surface of the lower ailerons were anchored to the tops of the two outer rear interplane struts on either side. The control cables from the pilot's wheel were led out along the



Details of the torpedo slinging gear on a single-seat Short 184 *at Felixstowe.*

upper surface of the lower mainplane, over pulleys at the lower ends of the two outer rear interplane struts, thence up to the underside of the upper ailerons. The inter-aileron cable ensured that depression of the upper surface produced a corresponding movement of the lower; conversely, the righting pull of the rubber cords acted directly on the lower ailerons and via the cable and pulleys on the upper.

It was a somewhat disquieting feature of this aileron system that, as the activated aileron was depressed the control cable to the opposite surface went slack. This engendered in Short pilots a fear that the slack cable would jump its pulleys.

The Short-built 184s of the batch *841–850* were mostly delivered by July 1915. As noted above, Sage deliveries began in November 1915. Mann Egerton 184s started to come along in December; deliveries from Westland and Phœnix started in, respectively, January and February 1916.

Before the production 184s appeared the two prototypes were on their way to war aboard the *Ben-my-Chree*, a former cross-channel ship that had been taken over by the Admiralty and converted into a seaplane carrier. The *Ben-my-Chree*, commanded by Squadron Commander C. J. L'Estrange Malone, sailed from England on 21st May 1915 and arrived at Iero Bay, Mitylene, on 12th June. According to A.P. 1344 (*History of the Development of Torpedo Aircraft*) the carrier went to the Dardanelles "with the unofficial intention of torpedoing the *Goeben* and the *Breslau*".

The Shorts had to be content with smaller fry than the two German cruisers then lying at Constantinople, but their early torpedo attacks were remarkably successful, in terms of direct hits. On 12th August 1915 Flight Commander C. H. K. Edmonds scored a hit at 350 yards range on a 5,000-ton Turkish supply ship off Injeh Burnu. At the time Edmonds did not know that his victim had been immobilised four days earlier by the submarine E.14. This did not diminish the significance of his achievement, which he repeated on 17th August when he torpedoed a Turkish supply ship bringing stores and reinforcements to Ak Bashi Liman. Both Shorts were out that day: the other, piloted by Flight Lt. G. B. Dacre, torpedoed a large steam tug in False Bay.

Worthy though these exploits were, they exposed the shortcomings of the seaplanes. On 12th August Edmonds had flown his Short solo with fuel for only forty-five minutes; even so, he was unable to coax his aircraft higher than 800 ft. The operational limitations of these early torpedo-carrying aircraft are made plain in *The War in the Air*, Vol. II (page 65):

> "Unhappily, the torpedo-loaded Short seaplane could only be made to get off the water and fly under ideal conditions. A calm sea with a slight breeze was essential and the engine had to be running perfectly. Further, the weight of the torpedo so restricted the amount of petrol which could be carried that a flight of much more than three-quarters of an hour was not possible. So it came about that while a number of torpedo attacks from the air were attempted, only three were successfully concluded."

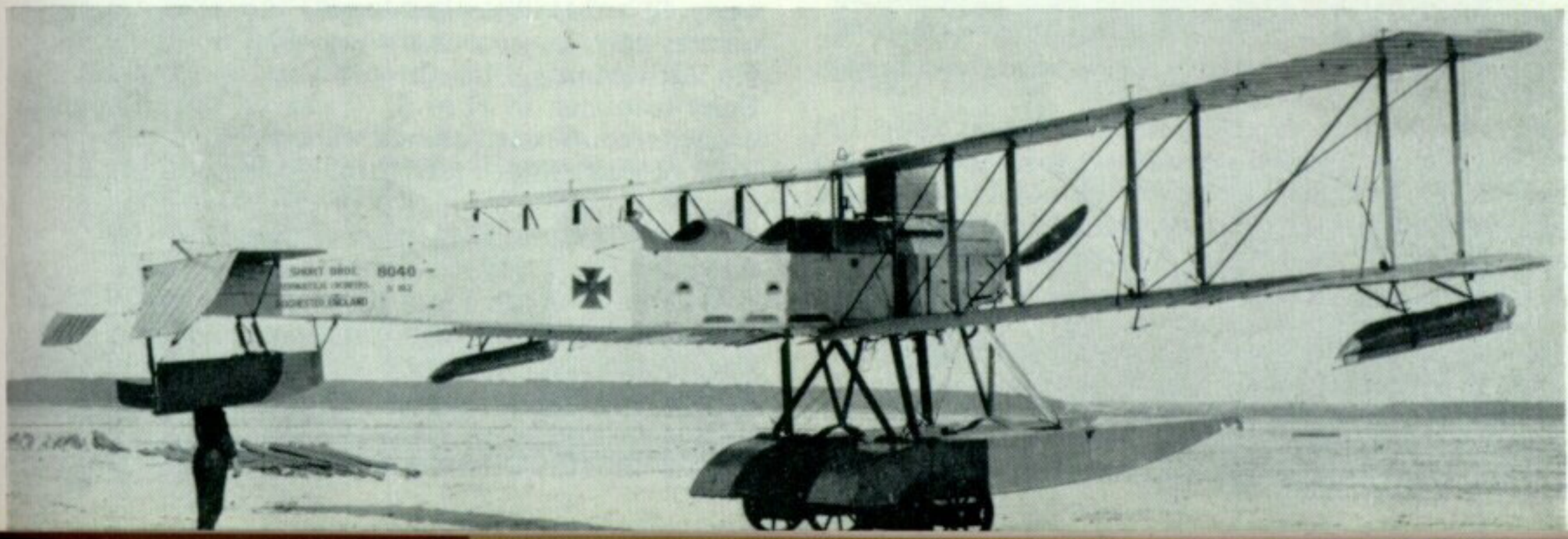
Thus it was that the Short 184 made no more operational torpedo attacks. Some were used in later torpedo experiments at Felixstowe; one such was No. *8349* which, on 28th May 1916, was flown carrying a 14-inch torpedo with the object of determining the aircraft's radius of action. The text of the report is interesting:

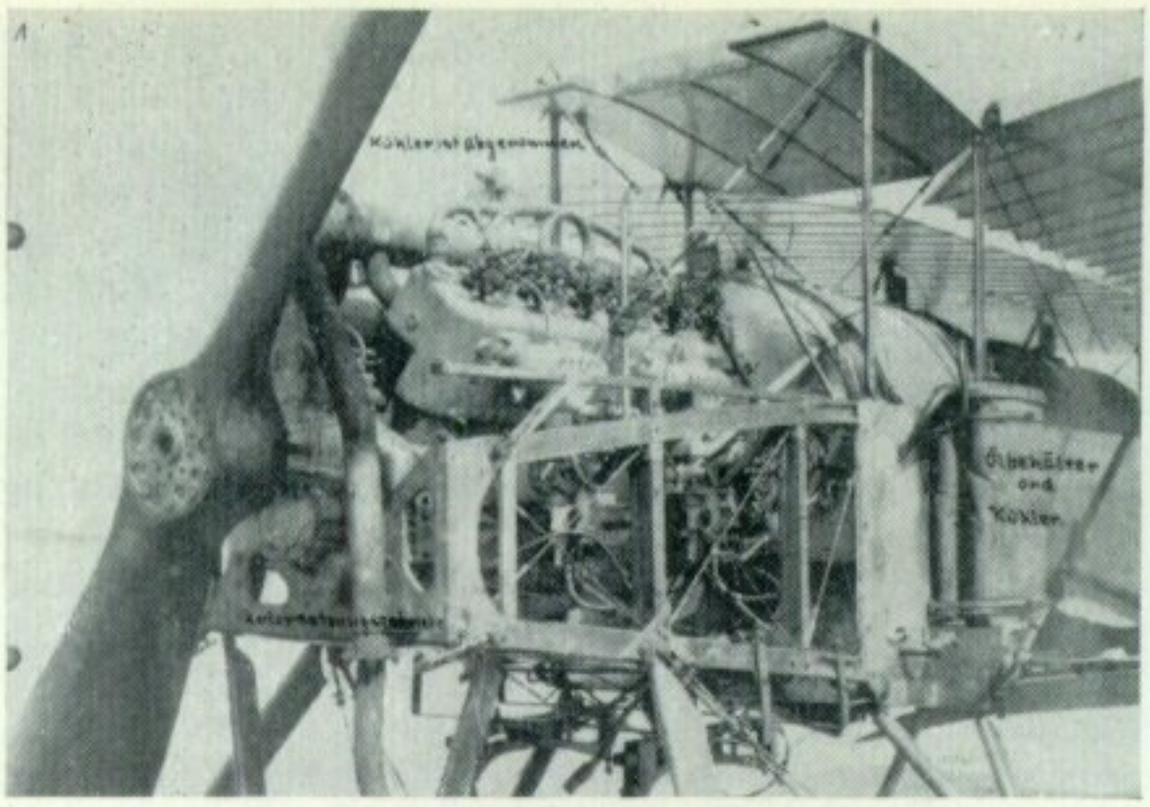
> "Difficult to get on her step—once there, got off easily at 46 knots (2,200 revolutions), climbed to 600 feet fairly well, then shut down to 2,050 revolutions and just flew level at 49 knots. Tried at 48 knots and became very soggy. After 1½ hours flying throttled down to 1,975 revolutions; landed owing to breakage of rubber water connection."

The aircraft had by then used 61 of the 84 gallons of fuel it was carrying and had been airborne for a total of 4 hr. 5 min. Poor though its performance may seem half a century later, the report concluded by stating that the test result was "Very satisfactory, and a great improvement on all previous attempts at torpedo carrying". One of Felixstowe's torpedo-trials Shorts was a single-seater, the rear cockpit having been faired over.

As the production Short 184s became available they

No. 8040 fell intact into German hands and was tested in German markings. In this photograph the rubber return springs attached to the lower ailerons can be seen as oblique lines leading up to the upper ends of the two outboard rear interplane struts. This aircraft had the 225-h.p. Sunbeam Mohawk engine. (Photo: Peter L. Gray)





A German photograph of the Mohawk installation in a captured Short 184, possibly No. 8040. *As noted on the photograph, the radiator had been removed and its recess in the leading edge of the centre section can be seen.*

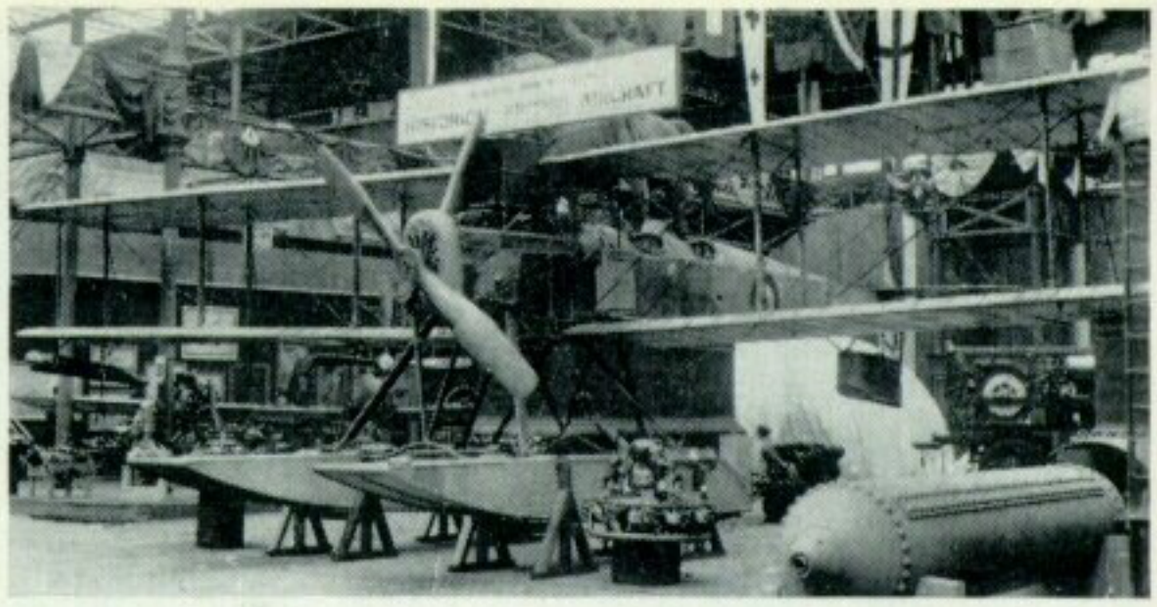
This rare photograph depicts the Short 184 that was modified by Cdr. C. R. Samson. Note the shortened lower wing, reduced fin area, king-post bracing of the upper-wing extensions, and the small ski-like replacements for the wing-tip floats. The aircraft retained the arched float cross-bars of the original design.

were issued to R.N.A.S. seaplane stations round the coasts of the United Kingdom and to the various seaplane-carriers then in use. Several went to the East Indies and Egypt Seaplane Squadron in the eastern Mediterranean; the squadron consisted of the seaplane carriers *Ben-my-Chree*, *Anne* and *Raven II*, later augmented by *Empress*. Shorts used by the squadron included *8004*, *8018*, *8021*, *8022*, *8080* and *8091*. Commander C. R. Samson, who took over command of this unit on 10th May 1916, quickly found that the climate imposed limitations on the use of the Shorts. In his book *Fights and Flights* he wrote:

> "I knew that our only chance of being able to fly with the Shorts was to try to get off very early in the morning or late in the afternoon, as the severe heat would inevitably not only boil all our cooling water away, but probably affect our lift.
>
> As it was, we had a terrible time getting the Shorts off the water under the existing conditions, and being unable to ascend beyond about 1,500 ft. we soon began to lose our water whilst flying.
>
> On several trips it was touch-and-go whether we would get back before the engine seized up through this cause."

Samson also recorded that on 8th June his Short 184 had required a take-off run of two miles. He went on to give this graphic picture of the conditions under which the Shorts of the East Indies and Egypt Seaplane Squadron operated:

> "I must inform my readers that we generally carried the 16-lb. bombs loose in the passenger's seat. I leave to the imagination the job the observer used to have. He was in a restricted space with a Lewis gun hitting him in the neck every time he moved, nursing a camera on his knees, with three or four 16-lb. bombs somewhere loose at his feet. Somewhere handy he had to have a pair



No. 8359, *the Short 184 that flew during the Battle of Jutland, on display at the Crystal Palace after the Armistice. By the time this photograph was made the aircraft had a 240-h.p. Sunbeam Gurkha in place of its original Mohawk; the stack-type exhaust was not always fitted to the Gurkha.*

(Photo: Flight International)

of binoculars, writing-pad, map, and pencil. Added to this he had to attempt to understand what an excited and, in his view, imbecile pilot wanted him to do. Of course, he couldn't often hear what the pilot said amid the noise of the engine and general turmoil of fight.

I may add as a finishing touch to complete this actual picture of real life, that the 16-lb. bombs had a safety device, consisting of a revolving fan retained by a pin. Once you removed the pin, the fan had a nasty habit of revolving. When it had completed about three revolutions the bomb was liable to explode on the slightest provocation. It will thus be seen that the observer's life was a hectic one.

The pilot, on the other hand, on one of the old Shorts in hot climates had no joy-ride. He had generally a really hard time. First coaxing, or most probably forcing, the seaplane off the water, he then had a tough job trying to make the machine climb in the gradually increasing heat of the atmosphere with the water in the radiator on the verge of boiling. He had to keep the engine at practically full revolutions the whole time to have sufficient power to maintain his meagre altitude, and to have some sort of control in the fierce *remous* that constantly were encountered. At the same time he had to seize every chance, when he gained a few hundred feet, to throttle down."

Determined to obtain better performance, Samson made extensive modifications to one of his 184s. He reduced the span, fitted two bays only of interplane struts and braced the upper extensions by cables and king-posts. He also reduced the fin area and replaced the wing-tip floats by flat plates. Samson claimed that his "Experimental Short" was 6 knots faster than the standard 184 and had a better climbing performance. The aircraft survived until March 1917, when it sank following float failure.

In more temperate climates the Short 184 gave good, if unspectacular, service, and efforts were made to extend the type's usefulness. With their torpedo-carrying capability abandoned, the 184s were used increasingly for reconnaissance and bombing duties. On 25th March 1916 three Shorts and two Sopwith Baby seaplanes of H.M.S. *Vindex* set out to bomb an enemy airship base believed to be at Hoyer. The bomb load of each Short was three 65-lb. bombs. Engine trouble brought down two of the Shorts and one of the Sopwiths; the Short that returned was No. *8346*, flown by Flt. Lt. H. F. Towler.

When the Grand Fleet and Battle Cruiser Fleet put to sea on 30th May 1916 to meet the German fleet in what was to become known as the Battle of Jutland, they should have been accompanied by H.M.S. *Campania* with her ten seaplanes, three of which were Shorts. But *Campania* did not receive her stationing

Short 184 Type B built by Mann, Egerton & Co. Ltd. On this variant the upper wing was of constant chord and revised ailerons were fitted.

and timing signal when the Fleets sailed, consequently the only carrier with the British force was the *Engadine* with her two Shorts and two Baby Sopwiths. One of the Shorts, the Westland-built *8359*, flown by Flt. Lt. F. J. Rutland with Assistant Paymaster G. S. Trewin as his observer, made the only reconnaissance flight of the battle from 3.8 p.m. to 3.48 p.m. on 31st May. A few observations were wirelessed back by the seaplane before a broken petrol pipe terminated the flight. The aircraft was later preserved in the Imperial War Museum but was seriously damaged by bombing during the 1939–45 war.

Production had again been expanded and modifications of the basic design were beginning to appear. An early general modification was the replacement of the wire-cable interplane bracing by Rafwires, which were of streamline section. Technical Memorandum No. 79 dated 15th September 1916 announced that "Fifty sets of streamline wires and the necessary fittings for fitting to Short 225-h.p. Tractor Seaplanes have been ordered to existing machines at present equipped with cable".

Twenty 184s (*9041–9060*) were ordered from Robey & Co. of Lincoln, a second batch (*9065–9084*) from Sage. Ten modified aircraft numbered *9085–9094* were ordered from Mann Egerton & Co.; these had shortened lower wings and cable-and-kingpost bracing of the extensions of the upper mainplanes. This variant was known as Type B: certainly Mann Egerton & Co. regarded it as their own Type B (their Type A was the standard Short 184), but it may well have been the Short 184 Type B also, for one official reference suggests that the Type B configuration was first applied to the Short-built 184 No. *8070*. As torpedo carrying was no longer a duty of the Short 184, all later aircraft had straight cross-bars between the floats.

The Type B seaplanes were specifically mentioned in an Admiralty instruction dated 1st February 1917, which stated that several cases of failure of compression ribs had occurred in "Short Seaplanes 184, Types A and B", and ordered the fitting of additional struts as opportunity offered. The Type B seaplanes *9085–9094*, however, were not to be flown until new inner front interplane struts were fitted; these were to be of steel tubing of the same external diameter as the original struts but of 17-gauge steel instead of 20-gauge.

The Short 184 Type D was a single-seat bomber version of the design. The official designation of this sub-type was "Short 184 single type". It was flown from what was ordinarily the rear cockpit; the space normally occupied by the front cockpit provided internal stowage for nine 65-lb. bombs. Several examples of the Type D were built: *8073*, *8103* and *9048* are known. On one occasion when it was rumoured that the German High Sea Fleet had put to sea a Short 184 Type D with eight bombs aboard, flown by Flt. Lt. S. T. Freeman, set out from R.N.A.S. Dover in company with other assorted aircraft. Another Type D was used by the R.N.A.S. Station, Dunkerque, in October 1916; and the four Dunkerque Shorts that bombed Ostend and Zeebrugge on 9th November probably included some Type D single-seaters.

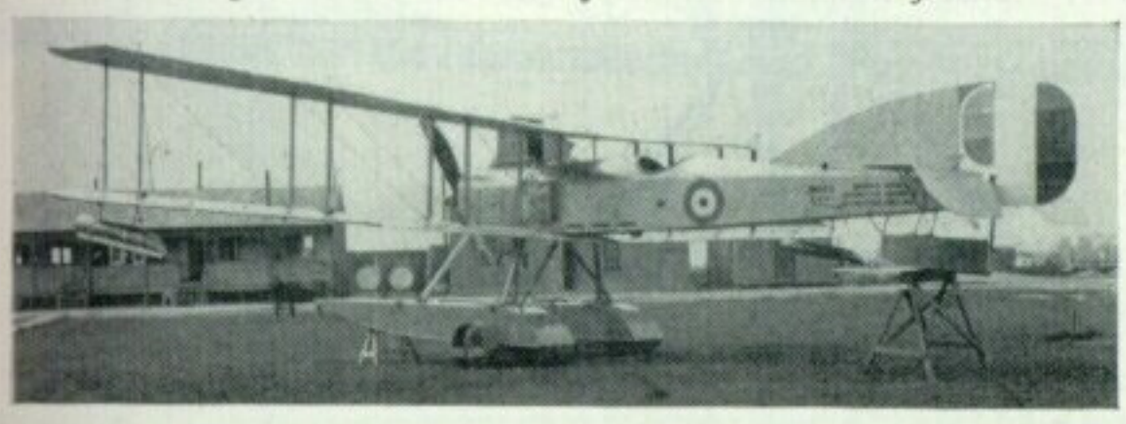
Alternative engines were fitted. No. *8104* had a 250-h.p. Rolls-Royce engine, its installation being remarkably bulky and ugly. This Short was at the Isle of Grain early in December 1916. The excellent Rolls-Royce engine was somewhat scarce, however, and it was not adopted as a standard power unit for the Short 184.

Many Shorts had the 240-h.p. Sunbeam Gurkha* which, like the 225-h.p. Mohawk, was a V-12 side-valve engine. The Gurkha had the same stroke (150 mm.) as the Mohawk but its bore (100 mm.) was greater by 10 mm. and it had two inlet and two exhaust valves per cylinder, whereas the Mohawk had only one of each. Many Short 184s that had been

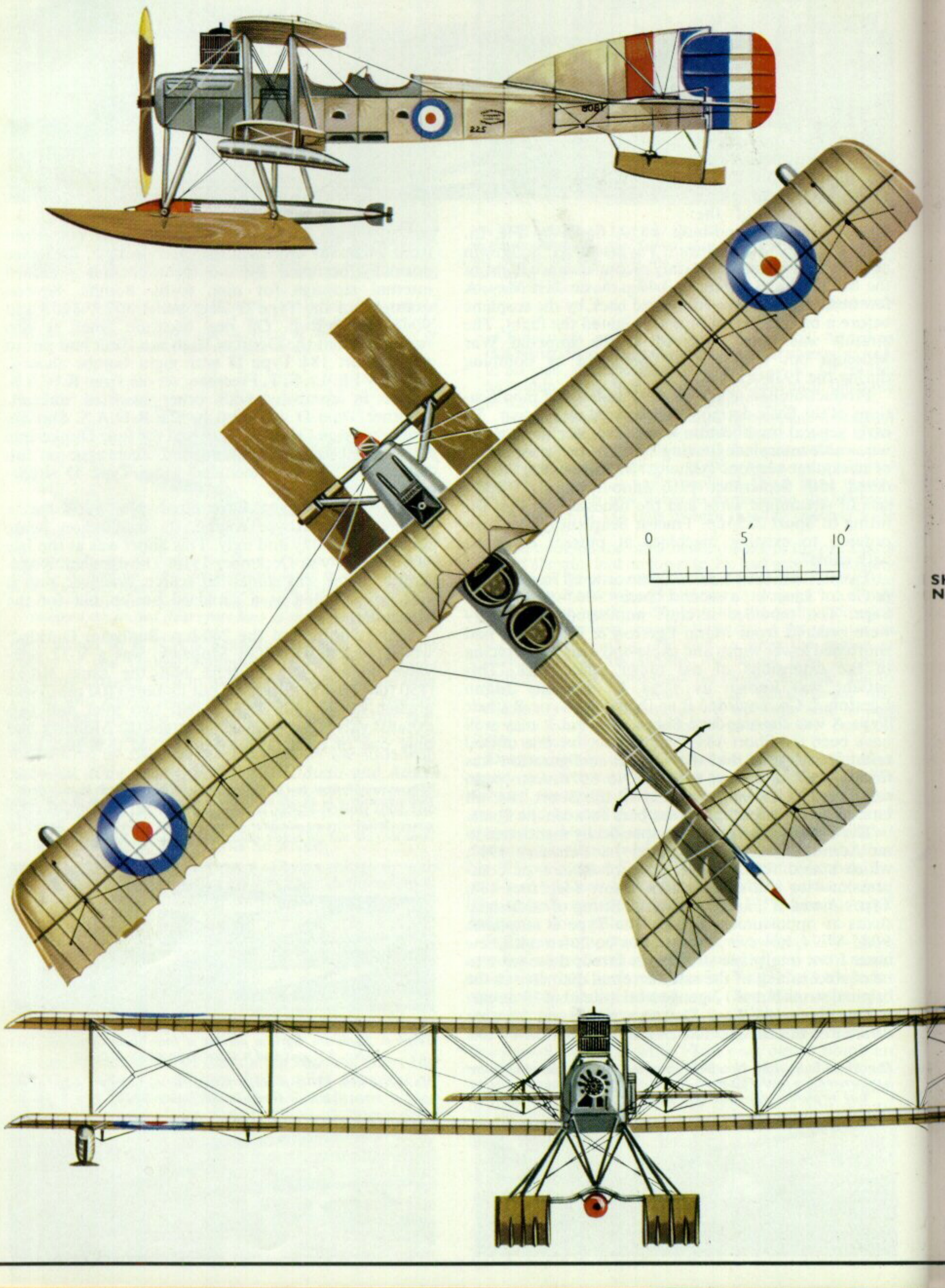
**The names Mohawk and Gurkha were little used in the R.N.A.S., despite their appearance in an official* Data Chart of Engines in R.N.A.S. *dated November 1917. In practice these engines were referred to simply by their power rating, as were the later Maori I and II. Not until the Maori III came into use was the engine name employed in the R.N.A.S.*

This Type D is No. 9048, built by Robey and powered by a 240-h.p. Sunbeam Gurkha driving a four-blade airscrew. Like No. 8359, it had a stack-type exhaust pipe.

The Short-built 184 No. 8073 was a Type D, the single-seat bomber version of the aircraft. It had a 225-h.p. Mohawk engine, and straight cross-bars were fitted between the floats.



No. 8104 with 250-h.p. Rolls-Royce engine, photographed at the Isle of Grain in December 1916.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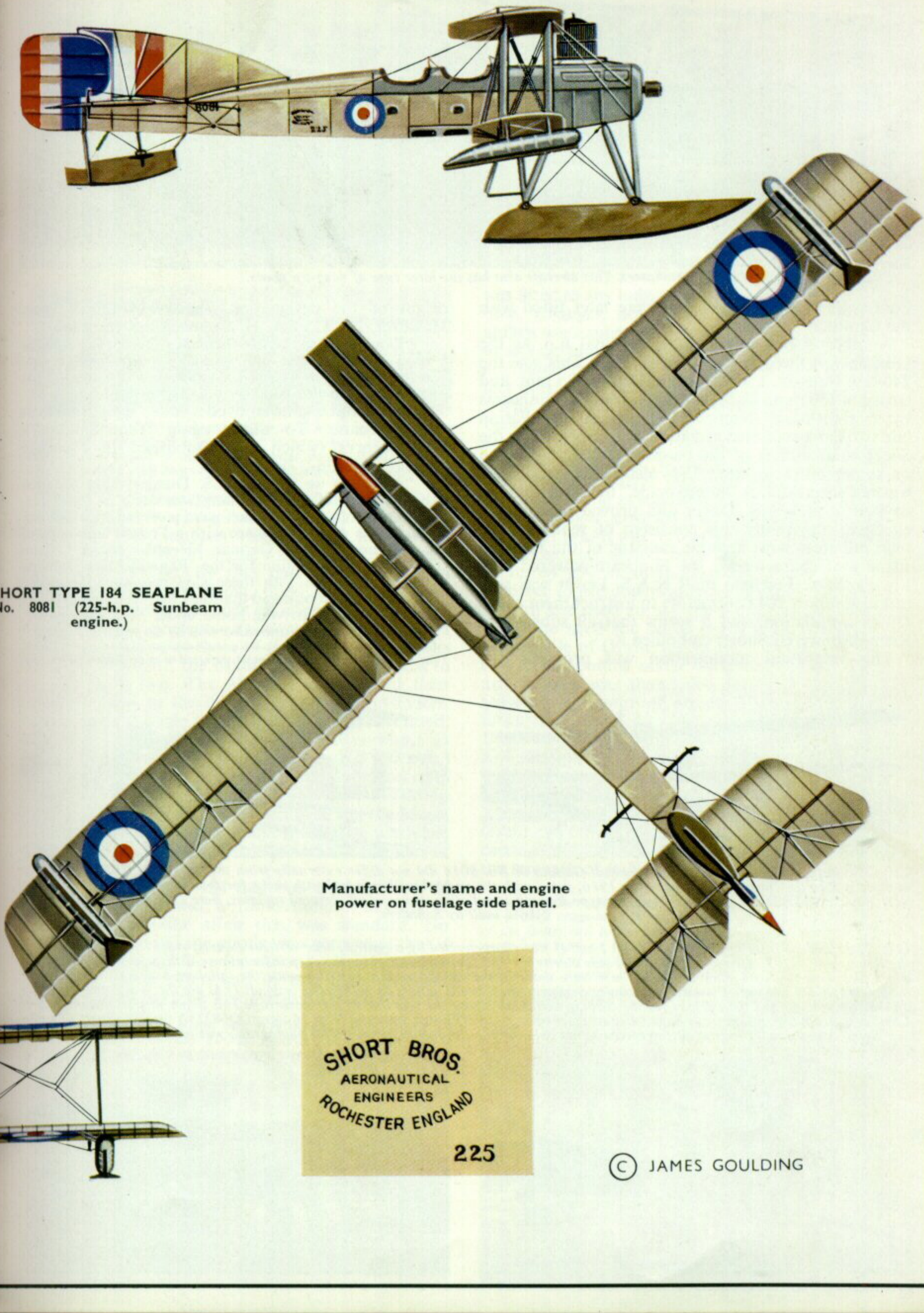
SHORT TYPE 184 SEAPLANE
No. 8081 (225-h.p. Sunbeam engine.)



Manufacturer's name and engine power on fuselage side panel.

SHORT BROS.
AERONAUTICAL
ENGINEERS
ROCHESTER ENGLAND

225

Sage-built Short Improved 184 powered by the 240-h.p. Renault engine with the original installation that embodied two flank-mounted radiators. This aircraft also has the later type of wing-tip floats.

built with the 225-h.p. engine were later fitted with the Gurkha.

Another engine of the same nominal h.p. as the Gurkha was fitted to many Short 184s. This was the 240-h.p. Renault, a V-12 with a bore of 125 mm. and stroke of 150 mm., distinguishable from the Sunbeams by its right-hand airscrew. The original installation had two flank-mounted radiators, and appeared on the Short-built aircraft of the batch *N1080–N1099* and on some contractor-built 184s also. This installation was not successful. A "home-made" modification was devised at R.N.A.S. Dover and proved to be more effective; apparently this consisted of replacing the twin radiators with a single radiator of the box-like shape that characterised the Sunbeam-powered 184. Flt. Lt. S. T. Freeman of R.N.A.S. Dover was sent round all Short 184 contractors to instruct them in the Dover installation, and it seems that all subsequent Renault-powered Shorts embodied it.

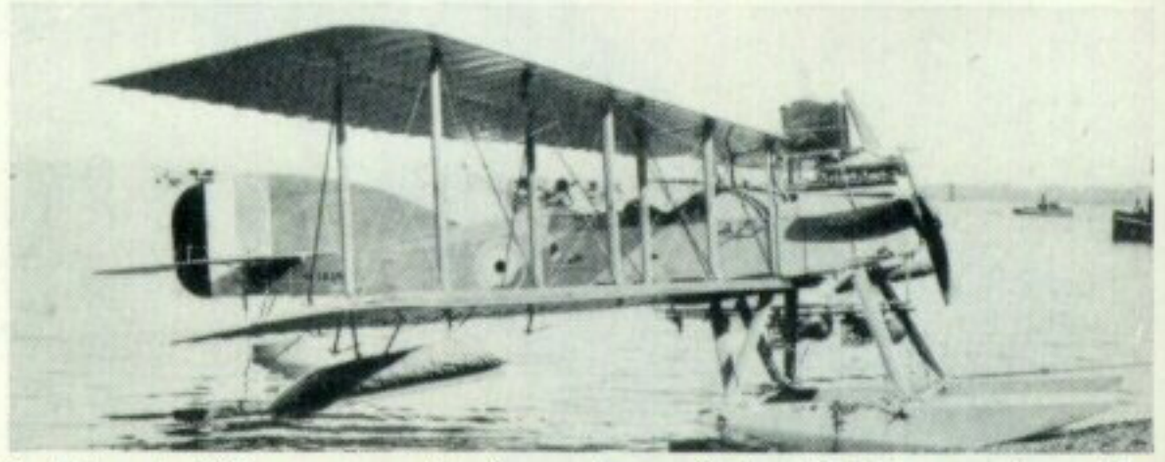
This important modification was probably the origin of the designation Short 184 Dover type. However, Flt. Cdr. A. H. Sandwell has recorded:

> "Dover was the repair depot for the Short seaplanes used at Dunkerque, and so many improvements were introduced from time to time that eventually the machines came to be known as 'Dover-type Shorts'."

The Renault engine enjoyed a better reputation than the Sunbeams. To quote again from Sandwell's reminiscences (which were published in *Canadian Aviation* in 1936–37):

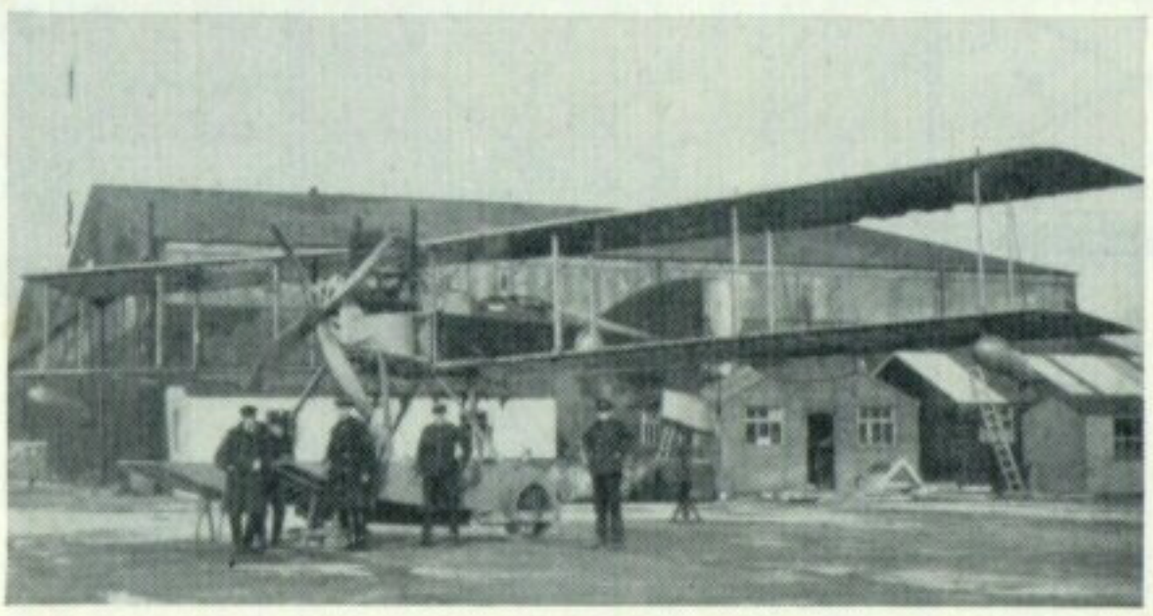
> "Although we [of R.N.A.S. Dundee] later acquired boats, most of our patrolling was done in Short seaplanes, about half of which were powered with 260-h.p. Sunbeams and the balance with a French-built copy of a captured 240-h.p. German Mercedes engine.* There was great competition for the 'Renault-Merks' among the pilots; since with these slow-revving and reliable engines, they considered that they had an almost 100 per cent chance of arriving home under their own power. Their faith in the Sunbeams was by no means so great."

**The 240-h.p. Renault was frequently referred to as the Renault-Mercedes.*



Left: *The installation of the 240-h.p. Sunbeam Gurkha in No. 8014 did not differ externally from that of the 225-h.p. engine. The aircraft is seen at Grain on 9th December 1916, fitted with the underslung bomb rail with racks for four bombs.* (Photo: Imperial War Museum MH2869.) Right: *The Dover-type Renault installation with central elevated radiator, here exemplified on Short 184* N1616 *built by Saunders.*

Left: *The standard installation of the Maori I and II was characterised by a central, near-vertical exhaust stack. Some aircraft, like the Robey-built* N2833 *seen here, had four-blade airscrews. This Short 184 displays the deep indentations of the upper-aileron trailing edges that were made on some aircraft. These were made in the rib spaces that rested against the tailplane bracing wires when the wings were folded and were intended to minimise chafing. Other details to note on* N2833 *(an original 184) are the Scarff ring mounting on the rear cockpit and the fairlead for the trailing aerial just above the rear end of the bomb rail. This Short was on the strength of Cherbourg seaplane station from September to December 1918.* (Photo: Imperial War Museum Q68223.) Right: *Short 184 with Sunbeam Maori III engine, distinguished by its twin outside exhaust manifolds. This photograph was made at Killingholme.*



N1098 *at the Isle of Grain, October 1917, with square frontal radiator on its Maori engine. This aircraft, although not originally built as an Improved 184, had the revised aileron system at the time when this photograph was made; it also had the longer tail-float struts.*

No. 8052 *with two 65-lb. bombs under each lower wing. This was an early attempt to fit bomb racks to the Short 184 but was abandoned in favour of the under-fuselage bomb rail. This Short still had arched float cross-bars when this photograph was made.*

Shorts of the late production batches were fitted with Sunbeam Maori engines. An official report dated 25th July 1917 suggests that one of the earliest installations of a Maori engine was made in the Robey-built Short *N1260*. By that date the aircraft had completed ten hours' flying, fitted with engine No. 436, and no trouble had been experienced. The Maori, like its Sunbeam predecessors, was a V-12; its cylinders had the same bore as those of the Gurkha but stroke was only 135 mm.; the Maori had four magnetos to the Gurkha's two. The Maori I and II had their exhaust valves on the inboard side of the cylinders, consequently a single central exhaust stack was fitted. The Maori III had only two H.C.7 carburettors as opposed to the four Claudel-Hobson C.Z.S. (38 mm.) of the Maori II; in the Maori III the compression ratio reverted to 5·2 to 1 (5·3 to 1 in the Mk. II) and an improved lubrication system was fitted. But the Maori III could be distinguished infallibly by its twin exhaust stacks, for its exhaust valves were on the outsides of the cylinders.

At least one Short 184 that had a Maori I or II (*N1098*) was fitted with a frontal radiator in place of the elevated box-like affair that was standard. No doubt this improved the pilot's view somewhat, but it was not so successful as the more primitive installation. The Shorts often had to taxi long distances before take-off and after landing, and at such times the original form of radiator was much more effective than the frontal surface. *N1098* was at the Isle of Grain in October 1917.

It is difficult to be specific as to which type of engine was fitted to any individual Short 184 at any particular time. Changes, doubtless dictated by engine availability, were apparently made during manufacture and in service, and one cannot be certain that the engines attributed to various batches of Short 184s were in fact fitted or, if fitted, retained.

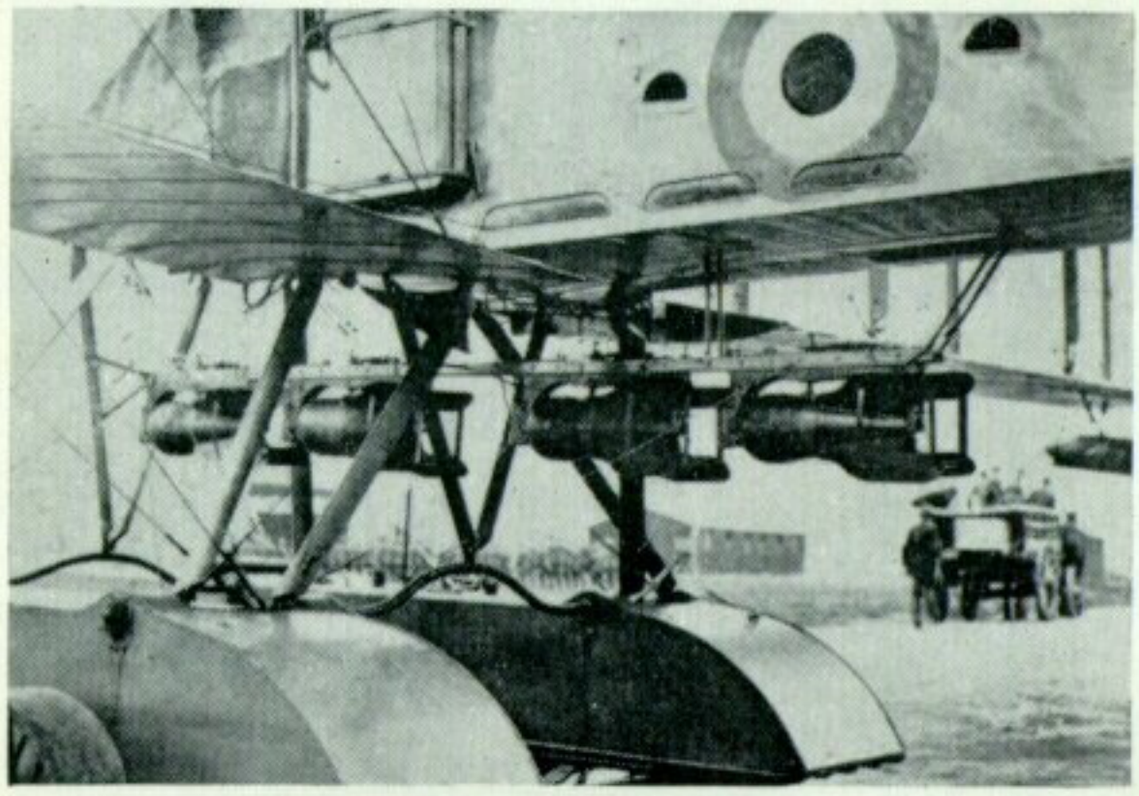
The airframe and its appurtenances underwent various modifications as time went on. The rear cockpit was modified to take a mounting for a movable Lewis gun. To some aircraft a Whitehouse mounting was fitted, but later Shorts had a Scarff No. 2 mounting as standard. The Whitehouse mounting apparently gave the gun considerable flexibility: in March 1917 it was recommended that Shorts having this mounting should be fitted with a sliding panel 13 in. by 25¼ in. in the fuselage floor to allow the observer to fire downwards under the tail float.

With the need to use the Short 184 as a bomber came the need for bomb racks. The Seaplane Test Depot, Isle of Grain, tested No. *8052* with racks for two 65-lb. bombs under each lower wing, but this arrangement was abandoned, probably for structural reasons, in favour of an untidy-looking rail slung under the fuselage, with accommodation for four 100-lb. bombs. In operational service alternative combinations of other bombs were carried.

Also flown at Grain was No. *8105*, which had a greatly heightened undercarriage; its tail float was also carried on lengthened struts. This aircraft was at Grain on 6th November 1916. Its ungainly undercarriage did not find favour. No. *8105* was later on the strength of R.N.A.S. Station Great Yarmouth.

No. 8076 *at the Isle of Grain with Whitehouse gun mounting on the rear cockpit and four 100-lb. bombs. This aircraft had a 260-h.p. Maori I or II driving a two-blade airscrew.*

A stage in the evolution of the bomb rail. As this Short still had the arched cross-bars it was possible to anchor the forward end of the bomb rail to the front V-strut; aircraft with the straight cross-bars had to be fitted with a small V-strut to hold the forward end of the bomb rail. On this aircraft the bomb load appears to consist of three 100-lb. and one 112-lb. bombs.



Dated 6th November 1916, this photograph depicts No. 8105 fitted with lengthened float struts and a four-blade airscrew. The struts supporting the tail float were also lengthened, and the aircraft retained arched cross-bars.

Later aircraft had enlarged wing-tip floats of more refined appearance and construction than the original inflatable floats. Some 184s had the tail float mounted on longer struts; this modification decreased the angle of the aircraft on the water and presumably helped to shorten the take-off run.

In the production batches numbered in the N series some aircraft were designated Short Improved 184. These were distinguished from the original 184 type by having aileron balance cables in place of the return springs, consequently the depression of the aileron on one side produced a corresponding upward movement of the control on the other. Upper and lower ailerons were interconnected by cables. Official listings indicate that the first ten aircraft of the batch *N1080–N1099* were Improved 184s, the remainder being of the original form; other known Improved 184s were *N1130–N1134* and *N1140–N1149*; some aircraft of later batches also had the modified aileron system. At least thirty aircraft (*N1240–N1259* and *N1260–N1269*) were described as Short Intermediate 184s but the significance of this designation has yet to be determined. Of these, *N1242* at least had the revised aileron arrangement.

In 1917 attempts were made to improve on the main floats. The Saunders company built enlarged floats, 18 ft. 11 in. long and 3 ft. in beam; as on the standard (16 ft. by 2 ft. 10 in.) float the sides and top were planked with $\frac{1}{8}$-in. three-ply, the bottom with $\frac{3}{16}$-in. to $\frac{1}{4}$-in. ply; the weight was 248 lb. as against 220 lb. for a standard Saunders-built float. These may have been the floats that were fitted to *N1086*: certainly that Short's floats were longer than standard.

Linton Hope, a well-known yacht designer of the pre-war period, served in the Air Department of the Admiralty during the war. He designed several flying-boat hulls and seaplane floats, all of characteristic circular or near-circular cross section and all of elegant lines and proportions. For the Short 184 he designed a float 19 ft. in length and 2 ft. 6 in. in beam (3 ft. across the planing bottom); this was a single-step float weighing 208 lb. The timbers were spaced $1\frac{1}{2}$ in. apart; the sides and top were planked with $\frac{1}{8}$-in. mahogany, the planing bottom with $\frac{1}{8}$-in. to $\frac{1}{16}$-in. mahogany. A pair of these floats were fitted to *N1081*, which had started life with standard pontoon-type floats. The Linton Hope float was not adopted for the Short 184, however.

In November 1917 No. *8076* was tested at the Isle of Grain with Martin automatic stabilisers on its upper wing tips. The wing was partly cut away to accommodate the device which, contrary to earlier belief, appeared to function independently of the ailerons. The Martin stabiliser was also tested on a Norman Thompson N.T.4a flying boat. It was apparently not regarded as sufficiently successful to warrant further development.

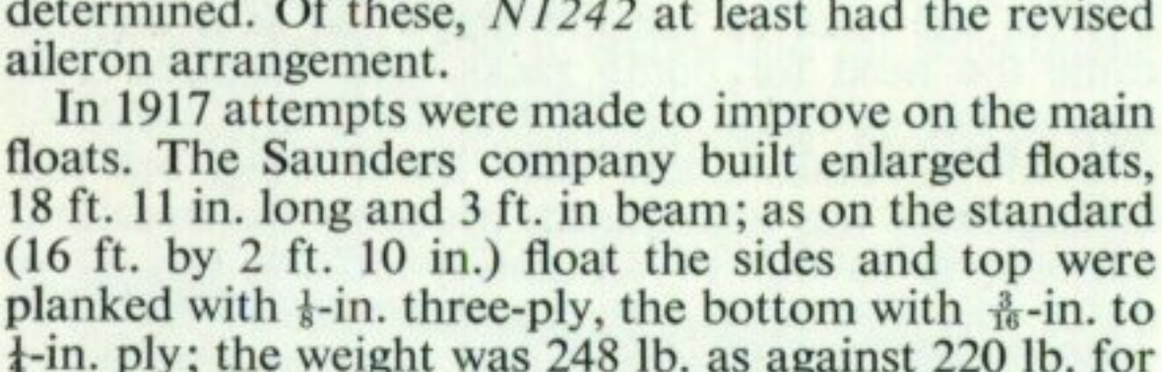
The R.N.A.S. was interested in the Davis gun, a recoil-less shell-firing weapon of American origin, and made protracted efforts to find a means of using it. One installation was made in a Short 184; the gun was arranged to fire over the upper wing. Some of the trials of this Davis-gun Short were flown by Flt. Lt. W. G. Moore, D.S.C. The Davis gun was a monstrously unwieldy weapon, however, and the R.N.A.S. wisely abandoned it.

Short 184s were flown from the decks of the carriers H.M.S. *Furious* and H.M.S. *Campania*. Wheeled dollies were fitted under the floats to permit take-off. At first these dollies were jettisoned from the seaplane once it was airborne, but subsequently they were arranged to run in a groove on the carrier's deck and were arrested and retained when the seaplane became airborne. The first take-off made by a Short 184 from the deck of *Campania* was accomplished on 3rd June 1916.

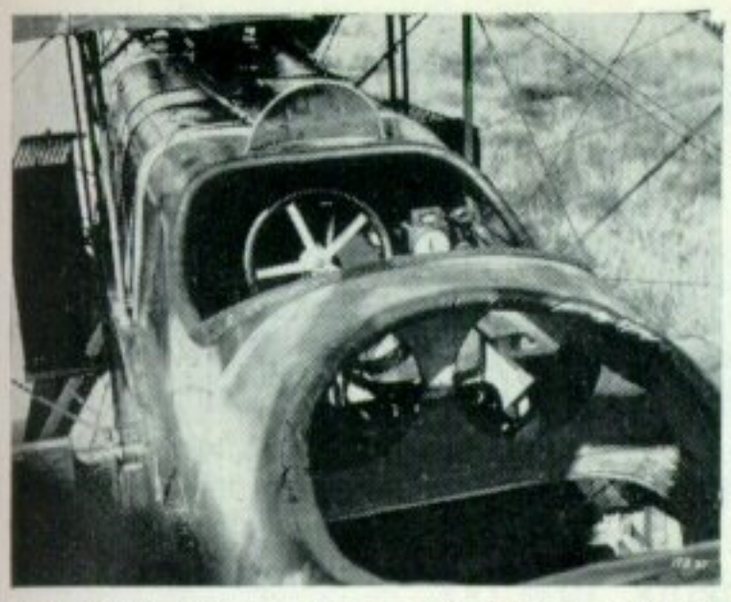
The Short 184 gave faithful service in most theatres of war until hostilities ended. In home waters the Shorts began anti-submarine patrols in 1916, and at the end of November a Short from Portland (Flt. Lt. J. R. Ross, Air Mechanic J. Redman) tracked down a U-boat off the Casquets and contributed to its destruction by a Q-ship. On two occasions, 28th November 1916 and 25th May 1917, engine failure resulted in Short 184 crews being taken prisoner by the U-boats they had been stalking.

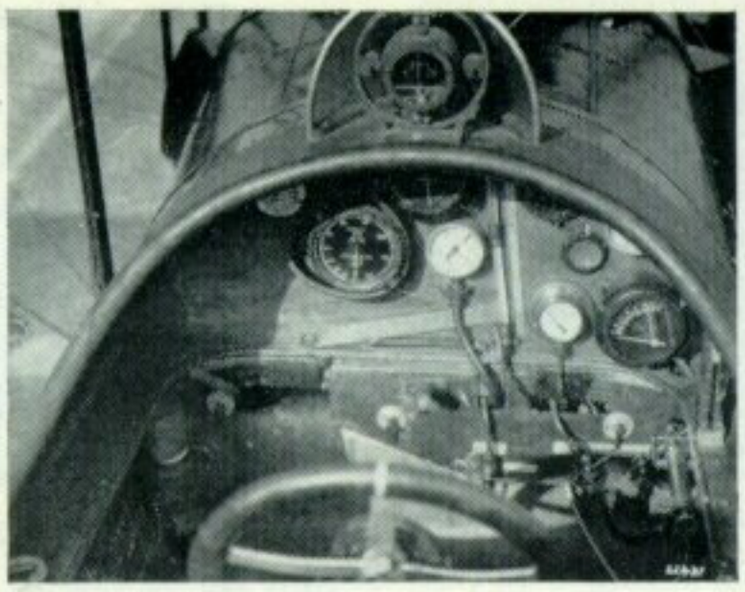
Short 184s sighted and bombed a considerable number of U-boats in the North Sea and the Mediterranean but positive success seemed to elude them. One occasion when the target was at least damaged occurred on 19th December 1917, when *N1606* of R.N.A.S. Newlyn (Flt. Sub-Lt. Hughes, Observer Sub-Lt. Spaight) dropped two 100-lb. bombs on a submerged U-boat 10 miles W.S.W. of the Lizard.

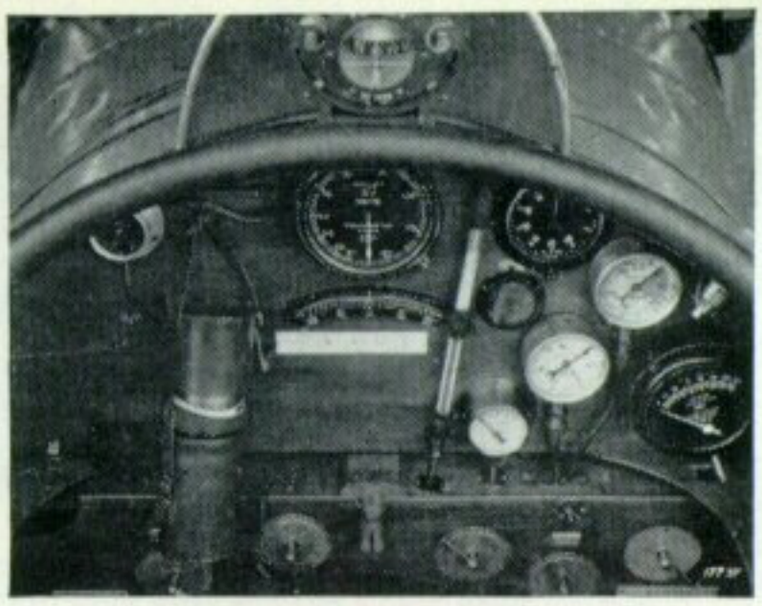
This front view of N1631 *shows how the absence of a spanwise balance cable allowed the ailerons on both sides to be depressed. This photograph also shows that the large radiator was much less substantial than it looked when seen at other angles: the camera here is looking straight through the vertical tubes and the radiator is scarcely visible.*



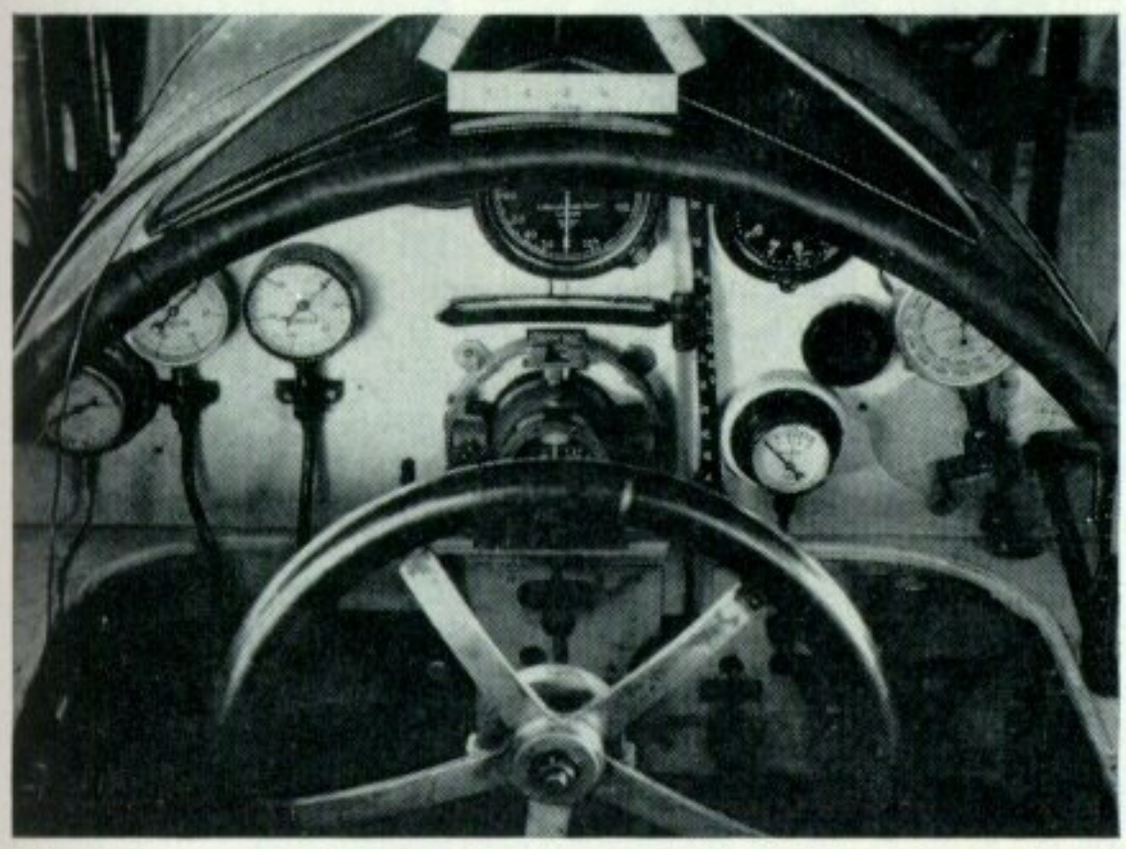
Short Improved 184 N1086 *with the original Short-designed Renault installation and lengthened floats, photographed at the Isle of Grain on 1st May 1917.*

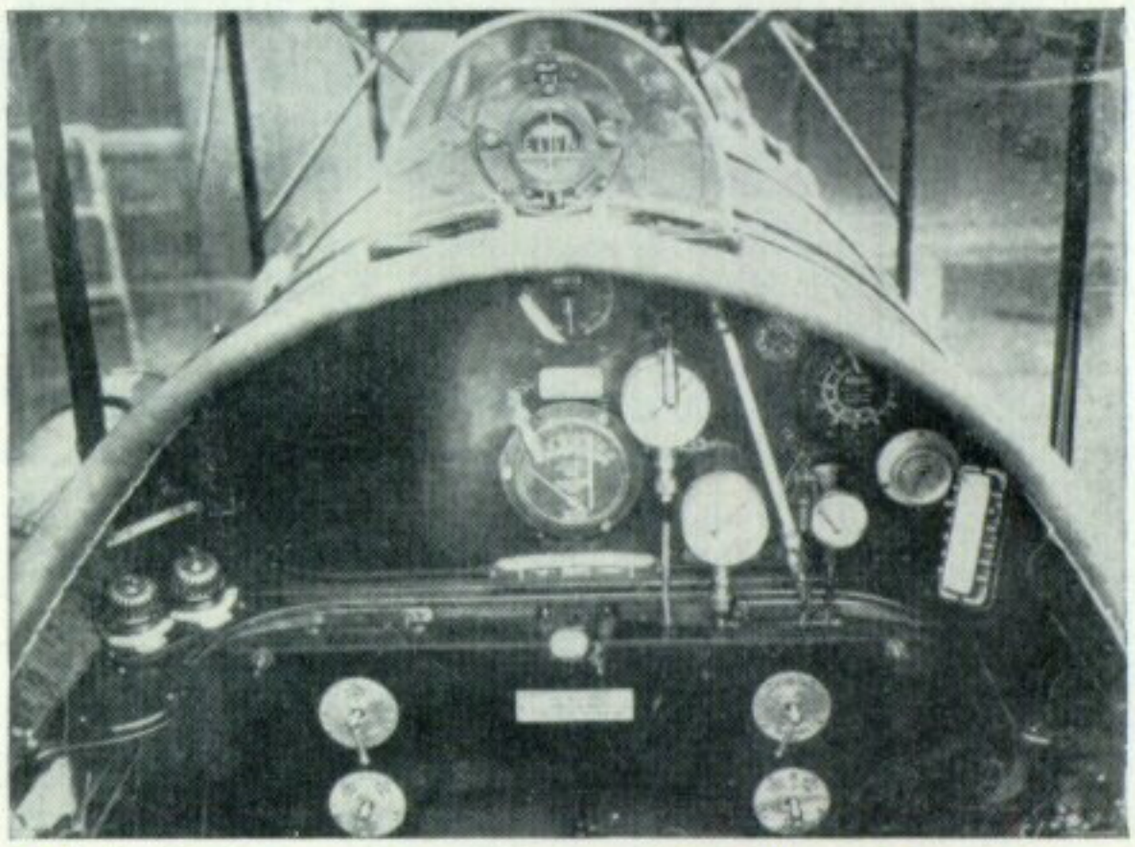






Left: *This view of the cockpits of* N1086 *suggests that one reason for reverting to the single central radiator for the Renault engine may have been to improve the pilot's view for landing.* Middle: *There was no truly standard cockpit layout for Short 184s, as these illustrations show. This is the dashboard of* 8076, *the Short-built Maori-powered 184 that appears in other illustrations.* Right: *The pilot's dashboard on* N1081, *Short-built Improved 184 with 240-h.p. Renault engine.*





Left: *Yet another layout of instruments in* N1260, *the Robey-built 184 that had an early installation of a Sunbeam Maori engine.* Right: *Dashboard of a Short 184 equipped for night flying.*

These exploded 8 yards apart on either side of the U-boat; large quantities of oil and bubbles came to the surface.

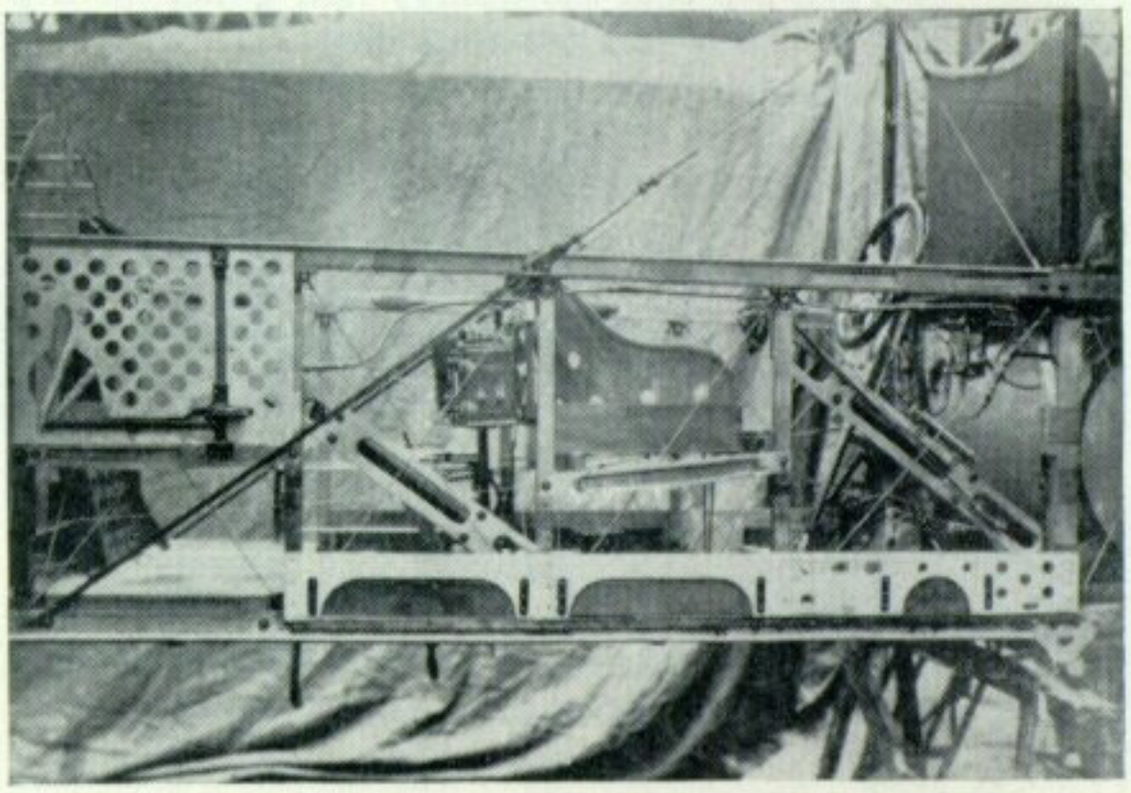
Official records show that during the period 1st May to 12th November 1918 two-seat seaplanes, the great majority of which were Short 184s, flew a total of 17,558 hours on anti-submarine patrols, averaging 35 patrols daily; 33 hostile submarines were sighted and 25 of them were attacked. The daily average number of aircraft on station strength was 176, but of these only 66 were, on average, serviceable. This poor proportion hints at the difficulties of operating seaplanes with wooden floats in British waters.

In the air the Short 184 was not the most manageable of aircraft. Flt. Cdr. A. H. Sandwell, writing in 1936, had this to say about flying the aircraft and attacking U-boats:

> "It was a physical impossibility to fly a Short at much more than 75 miles an hour. If you tried to dive it steeply it would start taking the control away from you at, say, 65 m.p.h., and would have flattened itself out before it picked up another ten miles an hour. No pilot was strong enough to hold the wheel forward so that it would continue to dive, and if he had been he would probably have broken the control wires, or the horns on the elevators or the elevators themselves. Consequently, even if you had the height to spare, you could not get anywhere in a hurry on a Short by 'stuffing its nose down' as you could with most land machines.
>
> Now the state of visibility over the North Sea is such that one could rarely spot a submarine on the surface very far away; two miles being perhaps a good average. The sub. could, of course, see you as soon as, if not sooner than, you saw it. The subs. used to come up at night, or in the early morning, and open up their hatches so that they could run the Diesel engines and recharge their batteries. There were often a few people on deck and it would take them from one minute to a minute and a half to submerge when surprised by a seaplane patrol . . . it was usually impossible for a Short to reach a submarine two miles away in a minute and a half, even if you had the height to spare and could coax 75 m.p.h. out of it. Unlike the English Channel, where the bottom can often be seen to a depth of 100 feet or so, the water in the North Sea is thick and muddy, and a submarine once submerged was gone for good."

In spite of his criticisms of its operational short-

Short 184 fuselage structure at the cockpits. The L-shaped fitting on the perforated plywood panel at extreme left was the pivoting mounting for the wind-driven generator. The mounting is here seen in the stowed position; it could be turned outboard through 90 deg. to bring the generator face on to the slipstream (the generator is not fitted here).



No. 8076 at the Isle of Grain, fitted with Martin stabilisers on the upper wings, 5th November 1917.

One of the five Short 184s that came on to the British civil register, G-EBBN *was originally* N9118*; it was powered by a Maori III.*

comings, Sandwell liked the Short 184 well enough as an aircraft to describe it as:

> ". . . the pilot's dream for putting in hours—docile, stable, obedient, and thoroughly deserving its affectionate nickname 'Home from Home'."

In the Eastern Mediterranean the Shorts of the *Ben-my-Chree* spotted for the guns of the monitors *M.15*, *M.23* and *M.31* and the sloop *Espiègle* in 1916. Short 184s from the carrier *Empress* bombed the railway and Turkish supplies at Tul Karm on 23rd June 1916, thus playing a small but important part in the events that led to the fall of Jerusalem.

Some four months earlier five 225-h.p. Short 184s had arrived in Mesopotamia for the use of the R.N.A.S. detachment. Operating from the River Tigris at Ora, three of these Shorts took part in the air-lift of food and supplies to the beleaguered garrison of Kut-al-Imara in April 1916.

A belated attempt to use a Short 184 as a torpedo aircraft came to naught in January 1918. When the German cruiser *Goeben* lay aground near Nagara one of *Ark Royal*'s Shorts was fitted with a torpedo in the hope that the enemy ship might be sunk. The Short, thus loaded, refused to leave the water. *Ark Royal*'s men succeeded in fitting a Short with a 300-lb. depth charge or an 18-in. warhead, and on 27th January Flt. Cdr. Malet dropped a warhead on the spot where the *Goeben* was believed to be. Visibility was poor, and Malet could not see that his quarry had gone, having managed to get away the previous day.

No other country used the Short 184 operationally during the war. Nos. *8083* and *8084* had been transferred to the French Government, presumably for evaluation, but nothing more was heard of them. No. *8057* was given to Japan and undoubtedly inspired the design of at least two of the Yokosho Rogo-Kogata seaplanes: these aircraft displayed many design characteristics of the Short 184.

A late experimental engine installation was that of a 300-h.p. Sunbeam Manitou in *N9135* in 1918, but no development ensued. The Manitou was dimensionally little different from the Maori, but the bore was increased to 110 mm.; like the Maori, it had outside exhausts.

The standard Maori-powered Short remained in service with the R.A.F. for some time after the Armistice, making mine-spotting patrols over British coastal waters. At least four (*N9290–N9293*) went to North Russia in 1919 but seem to have done nothing noteworthy there.

Other countries using Short 184s in the post-war period included Chile, Esthonia, Greece and Japan. The Chilean aircraft apparently had Maori III engines, and some of those used by Esthonia had Rolls-Royce Eagles. The Esthonian Shorts included *N9130* which, in the service of that country, was numbered 39.

Five Short 184s had a brief civilian existence for seaside pleasure flights. In 1919, *N2986* and *N2998* became respectively *G-EAJT* and *G-EALC* and apparently survived for about a year in the service of the Eastbourne Aviation Co. They were modified to carry four passengers, as were *N9096* and *N9118* in 1922, when they became *G-EBBM* and *G-EBBN* and were operated by the Seaplane and Pleasure Trip Co., Ltd. Last of the civil 184s was Manchester Airways' *G-EBGP* (ex-*N2996*), registered on 1st June 1923.

The Short 184 was one of the war's great workhorses. Its prosaic appearance matched the unspectacular nature of its duties; it served in one form or another from the spring of 1915 until the Armistice and beyond; it was still in production at the end of the war and deliveries continued at least until the end of December 1918. In that month 315 Short 184s were in commission and current orders for 259 were still outstanding. By the standards of 1914–18 this was a not undistinguished record.

SPECIFICATION

Power: 225-h.p. Sunbeam Mohawk, 240-h.p. Sunbeam Gurkha, 260-h.p. Sunbeam Maori I, II or III, 240-h.p. Renault, 250-h.p. Rolls-Royce (Eagle), 300-h.p. Sunbeam Manitou.

Dimensions: Span 63 ft. 6¼ in. (folded 16 ft. 4¾ in.); length 40 ft. 7½ in. (folded 44 ft. 2 in.); height (airscrew vertical) 13 ft. 6 in.; chord, upper (max.) 6 ft. 6 in., lower 5 ft.; gap 5 ft. 6 in.; stagger nil; dihedral 1 deg. 45 min.; incidence 5 deg.; span of tail 16 ft. 4¾ in.; airscrew diameter (A.D. No. S.93 for Mohawk engine and A.D. 572 R.H. for Renault) 3,280 mm. (10 ft. 9⅛ in.), (A.D. No. 501M for Gurkha engine) 3,200 mm. (10 ft. 6 in.). Wing area about 680 sq. ft.

Armament: One 0·303-in. Lewis machine gun on movable mounting on rear cockpit; on some Short 184s this was a Whitehouse mounting, but the Scarff No. 2 Ring Mounting was standardised for later aircraft. Three 97-round drums of ammunition were the standard provision. One 14-in. torpedo or bomb load that could consist of one of the following combinations of bombs: one 520-lb.; one 500-lb.; four 112-lb.; four 100-lb.; three 65-lb. and several 16-lb.; one 264-lb. and one 100-lb.; one 300-lb. depth charge; one 18-in. warhead.

PRODUCTION

Under wartime contracts a total of 1,095 Short 184s, Improved 184s and Intermediate 184s were ordered, and it seems likely that about 900 were delivered. On 31st October 1918 the R.A.F. had on charge only 312 Short 184s, of which all but thirty had the Sunbeam Maori engine.

Short Brothers, Rochester—184, 185, 841–850, 8031–8105, N1080–N1099, N1580–N1589.

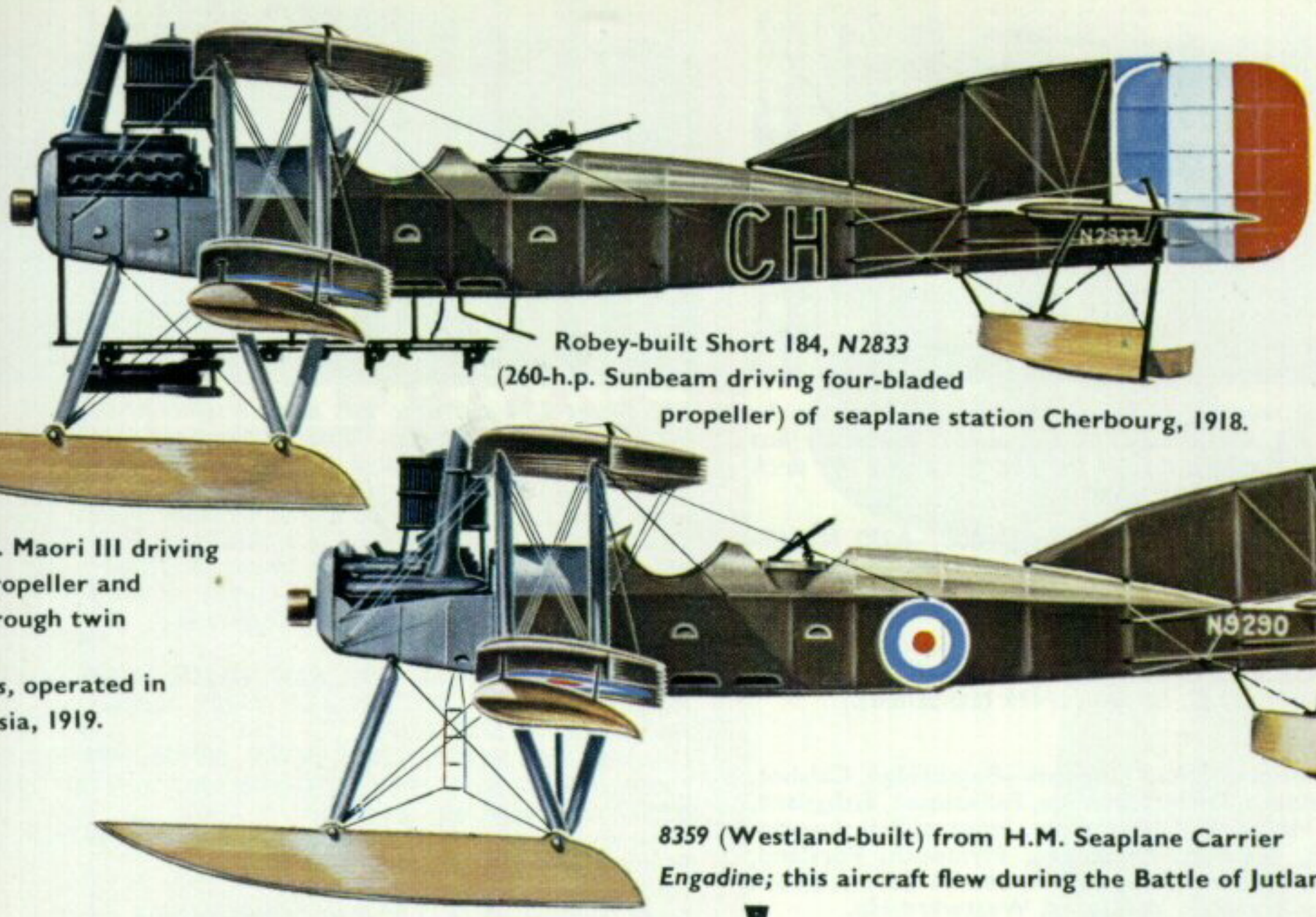
Brush Electrical Engineering Co. Ltd., Loughborough—N1660–N1689, N2600–N2659, N2790–N2819, N9060–N9099, N9260–N9289, N9350–N9399 (cancelled).

Mann, Egerton & Co. Ltd., Prince of Wales Road, Norwich—8344–8355, 9085–9094 (Type B).

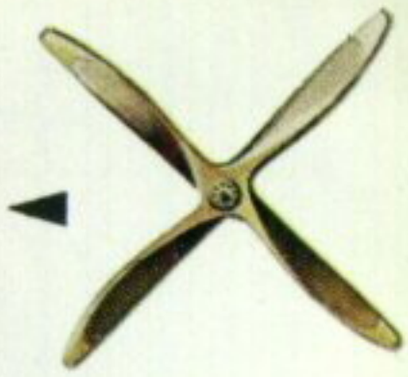
Phoenix Dynamo Manufacturing Co. Ltd., Bradford—8368–8379, N1630–N1659, N1740–N1759.

Robey & Co. Ltd., Lincoln—9041–9060, N1220–N1229, N1260–N1279, N1820–N1839, N2820–N2849, N2900–N2949, N9000–N9059, N9140–N9169, N9290–N9349.

Frederick Sage & Co. Ltd., Peterborough—8380–8391, 9065–9084, N1130–N1139, N1230–N1239, N1590–N1599, N1780–N1799.

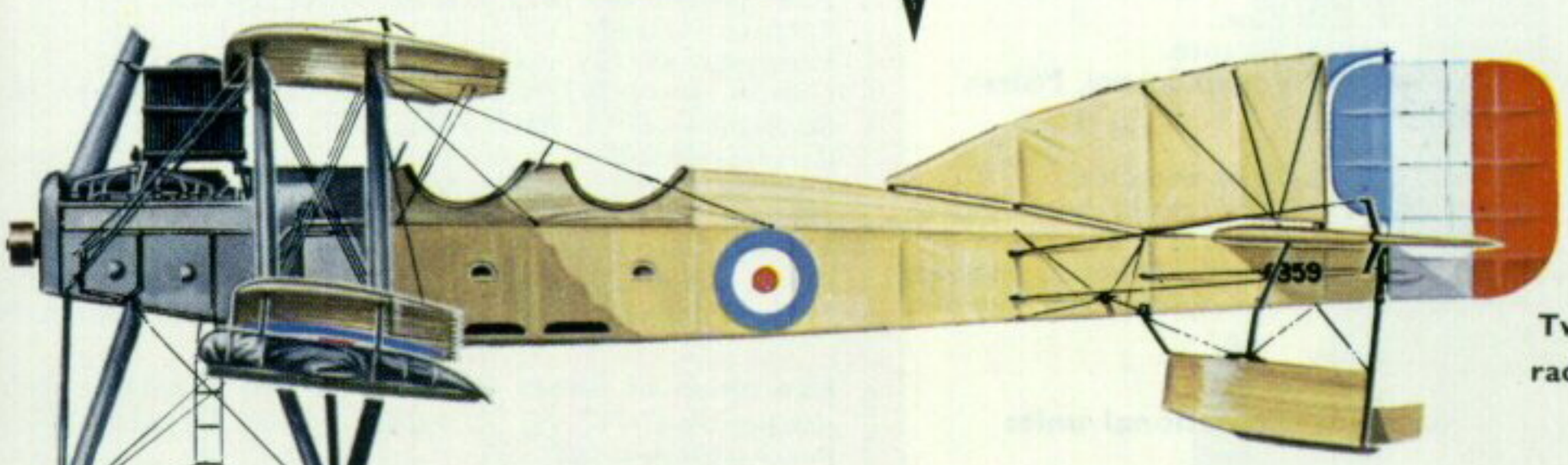


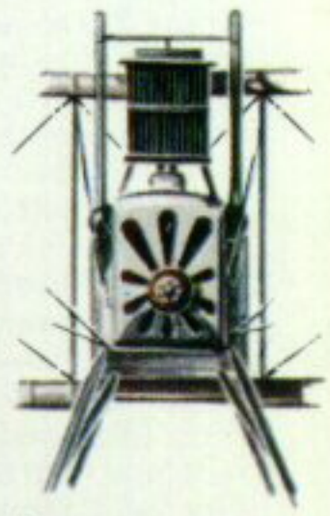
Robey-built Short 184, *N2833*
(260-h.p. Sunbeam driving four-bladed
propeller) of seaplane station Cherbourg, 1918.



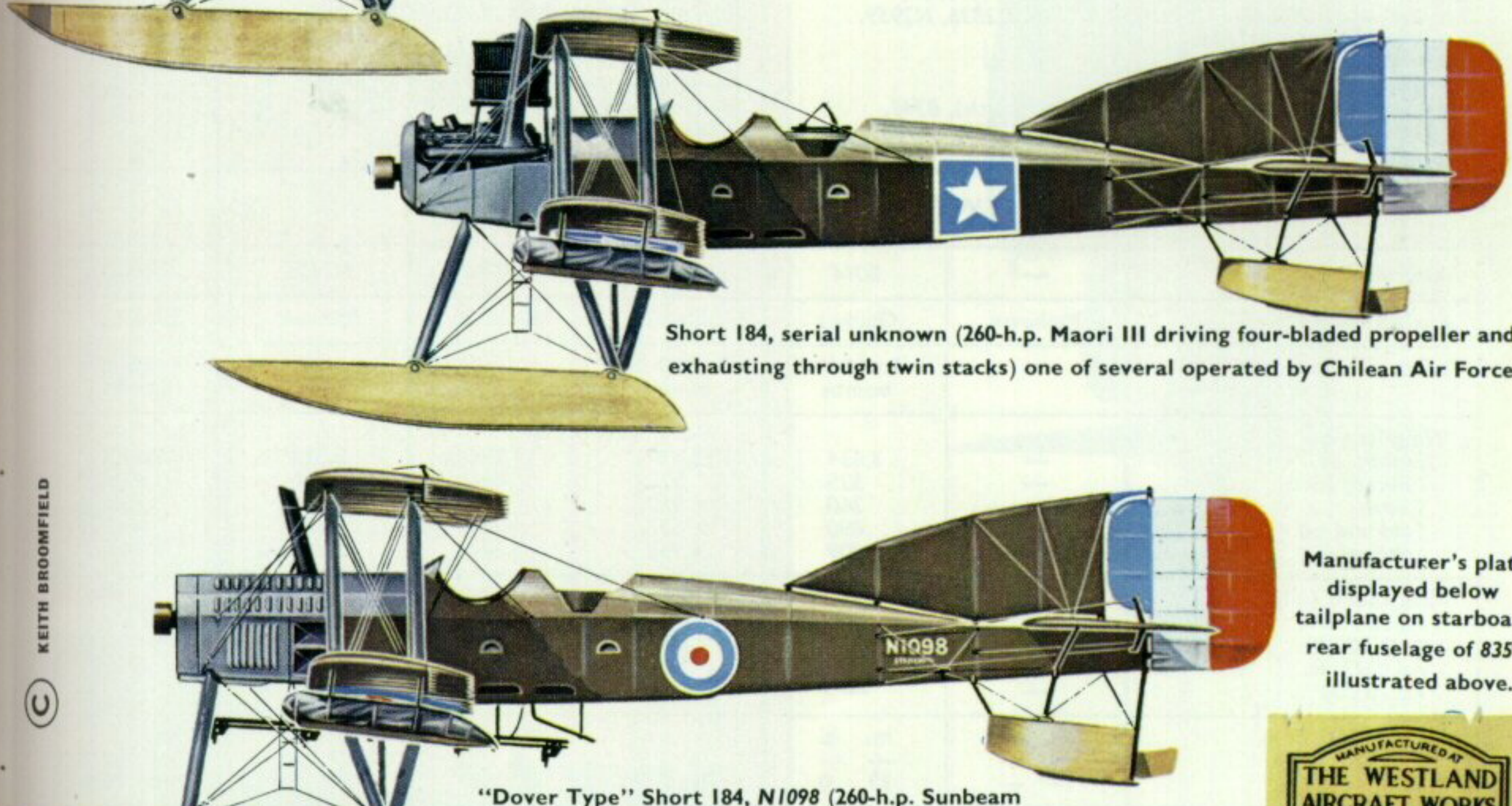
N9290 (260-h.p. Maori III driving
four-bladed propeller and
exhausting through twin
stacks) from
H.M.S. *Pegasus*, operated in
Northern Russia, 1919.

8359 (Westland-built) from H.M. Seaplane Carrier
Engadine; this aircraft flew during the Battle of Jutland.





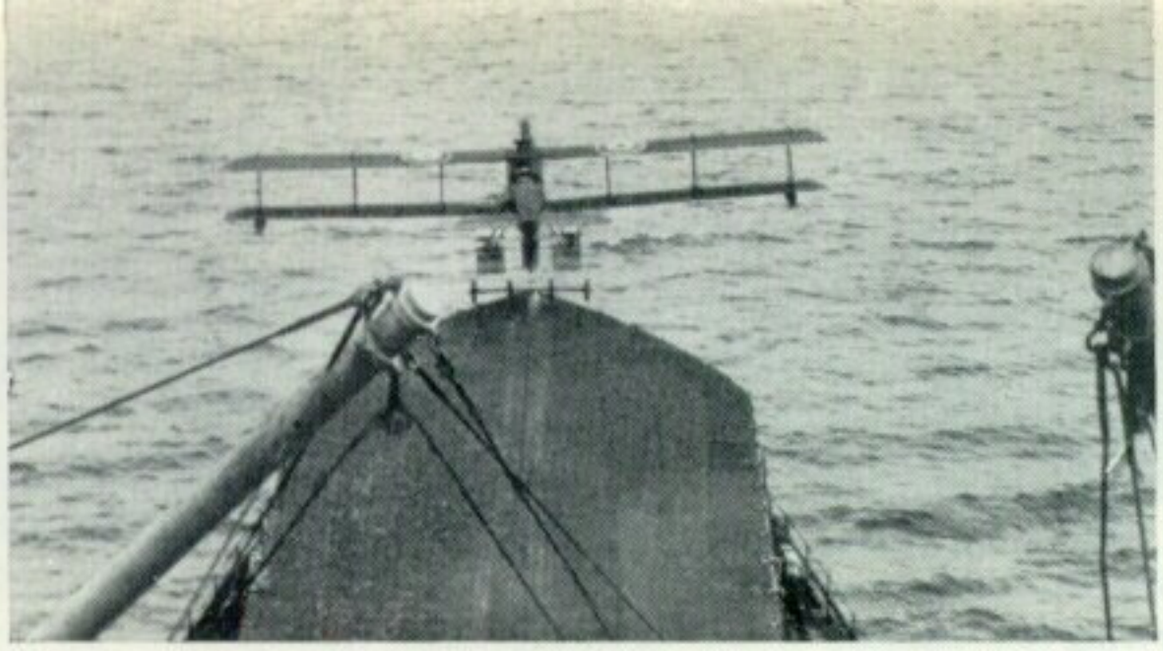
Twin exhaust stack and
radiator arrangement of
Maori III engine.



Short 184, serial unknown (260-h.p. Maori III driving four-bladed propeller and
exhausting through twin stacks) one of several operated by Chilean Air Force.

"Dover Type" Short 184, *N1098* (260-h.p. Sunbeam
with nose-mounted radiator); late production model.

Manufacturer's plate
displayed below
tailplane on starboard
rear fuselage of *8359*
illustrated above.



A Short 184 at the moment of leaving its captive dolly on the flight deck of H.M.S. Furious, *15th July 1917. The dolly has been arrested at the forward end of the channel along the deck centre line.*

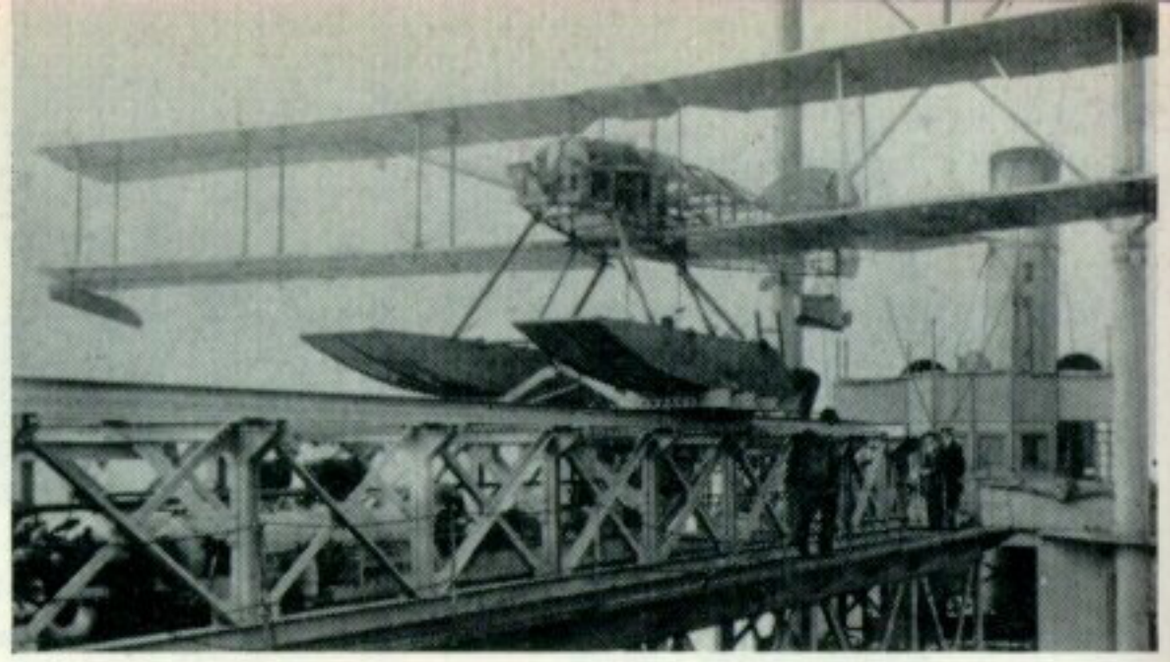
S. E. Saunders Ltd., East Cowes, Isle of Wight—8001–8030, N1140–N1149, N1600–N1624, N1760–N1774.
Supermarine Aviation Works Ltd., Woolston, Southampton—N9170–N9199.
Westland Aircraft Works, Yeovil, Somerset—8356–8367.
J. Samuel White & Co. Ltd., Cowes, Isle of Wight—N1240–N1259, N2950–N2999, N9100–N9139, N9400–N9449 (cancelled).

Service use

R.N.A.S. Seaplane Stations, United Kingdom—Bembridge, Calshot, Cattewater, Dartmouth, Dover, Dundee, Felixstowe, Fishguard, Great Yarmouth, Hornsea, Killingholme, Houton Bay, Lee-on-Solent, Newhaven, Newlyn, Pembroke, Plymouth, Portland, Prawle Point, Scilly (Tresco), Scapa Flow, Seaton Carew, South Shields, Strath Beg, Torquay, Westgate, Westward Ho.
France—Cherbourg, Dunkerque. *Gibraltar.*
Italy—Otranto, Santa Maria di Leuca, Taranto.
Malta—Calafrana (also used by the Torpedo School, Malta).
Aegean—Mudros, Suda Bay, Syra.
Egypt—Alexandria, Port Said.
Mesopotamia—R.N.A.S. Detachment, Basra and Ora.
North Russia—Aircraft carrier H.M.S. *Pegasus* with North Russian Expeditionary Force at Archangel.
Seaplane Carriers—Anne, Ark Royal, Ben-my-Chree, Campania, City of Oxford, Empress, Engadine, Furious, Nairana, Pegasus, Raven II, Riviera, Vindex.
Light Cruisers—Arethusa, Aurora.

Examples of Short 184s used by operational units

Bembridge—N1611, N1613.
Calshot—8365, N1621, N2975, N9018, N9091, N9176.
Cattewater—N1099, N1142, N1624, N1796, N2836, N2959.
Dartmouth—N1588, N1678.
Dover—8003, 8038, 9067.
Dundee—N1276, N1661, N1831.
Felixstowe—8066 (also used by Great Yarmouth), *8349.*
Fishguard—N1086, N1242, N1683, N2795, N2830, N2908.



This Short 184 airframe was used in trials of the early catapult fitted to H.M.S. Slinger. *With its fuselage fabric stripped and sacks of ballast lashed into the engine bay, it was launched at a weight of 5,000 lb. on 1st October 1917, its speed at the moment of release being 30 m.p.h. In these trials a pair of Short 184 floats, loaded with sand to a total weight of two tons, were also launched; their speed was 40 m.p.h. These trials paved the way for the successful catapult launch of the Fairey seaplane* N9 *on 14th May 1918.*

Great Yarmouth—8368, 8378, 8389, N1250, N1599, N1675.
Killingholme—8068, 8391, N1655, N1829, N2902.
Houton Bay—N1645, N2652.
Lee-on-Solent—N1640, N2984, N9071, N9106, N9142, N9181.
Newhaven—8348, N1244, N1246 (also used by Great Yarmouth), *N2827* (also used by Calshot).
Newlyn—N1255, N1607, N1616, N1618, N1767, N2958.
Plymouth—N1601.
Portland—N1259, N1794, N2965.
Scilly (Tresco)—N1622, N2828, N2955, N2963.
Torquay—N2962.
Westgate—N1229, N2938, N2939, N2977.
Cherbourg—N1793, N2805, N2900, N2981, N9021, N9170.
Dunkerque—8013, 9042, 9050, 9057.
Otranto—N1833.
Calafrana—9053, N1096, N1097, N1823.
Mudros—N1234.
R.N.A.S. Detachment, Basra—8047.
East Indies & Egypt Seaplane Sqn.—8080, N1668 (also *Ark Royal*).
(See also carriers *Anne, Ben-my-Chree, Empress* and *Raven II.*)

Examples of Short 184s used from seaplane carriers

Ark Royal—N1747, N1750, N2813, N2931, N2933, N2934.
Ben-my-Chree—184, 185.
Empress—8018, 8021, 8022, 8091, N1091, N1582.
Engadine—8050, 8065, 9073, N2822, N2944, N9000.
Manxman—N1788.
Pegasus—N9290–N9293 (1919).
Raven II—8004 (also used from *Empress*).
Riviera—N2929, N2930, N2943, N2948.
Vindex—8033, 8346, N1232.

WEIGHTS AND PERFORMANCE

Aircraft	—	*8014*	*8076*	*N1090*	*N1135*	Type D
Engine	Mohawk	Gurkha	Maori	Renault	Renault	Gurkha
Load	—	4 ×65-lb. bombs	4 ×100-lb. bombs	—	—	9 ×65-lb. bombs
Weights (lb.):						
Empty	—	3,634	3,479	3,798	3,514	3,620
Military load	—	325	512	668	650	673
Crew	—	360	360	360	360	180
Fuel and oil	—	690	637	734	666	690
Loaded	5,100	5,009	4,988	5,560	5,190	5,163
Max. speed (m.p.h.):						
At sea level	—	74	—	—	—	70
At 2,000 ft.	75	—	84	80	85	—
At 6,500 ft.	—	75	83	70	78	77
At 10,000 ft.	—	—	80·5	—	—	—
Climb to:	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
2,000 ft.	— —	— —	6 15	8 15	9 20	— —
6,500 ft.	— —	39 0	26 15	42 30	51 30	40 30
Service ceiling (ft.) ...	—	—	8,700	5,700	5,000	—
Endurance (hours) ...	—	—	—	4½	5	—