INSIDE the

Details of Vickers-Supermarine

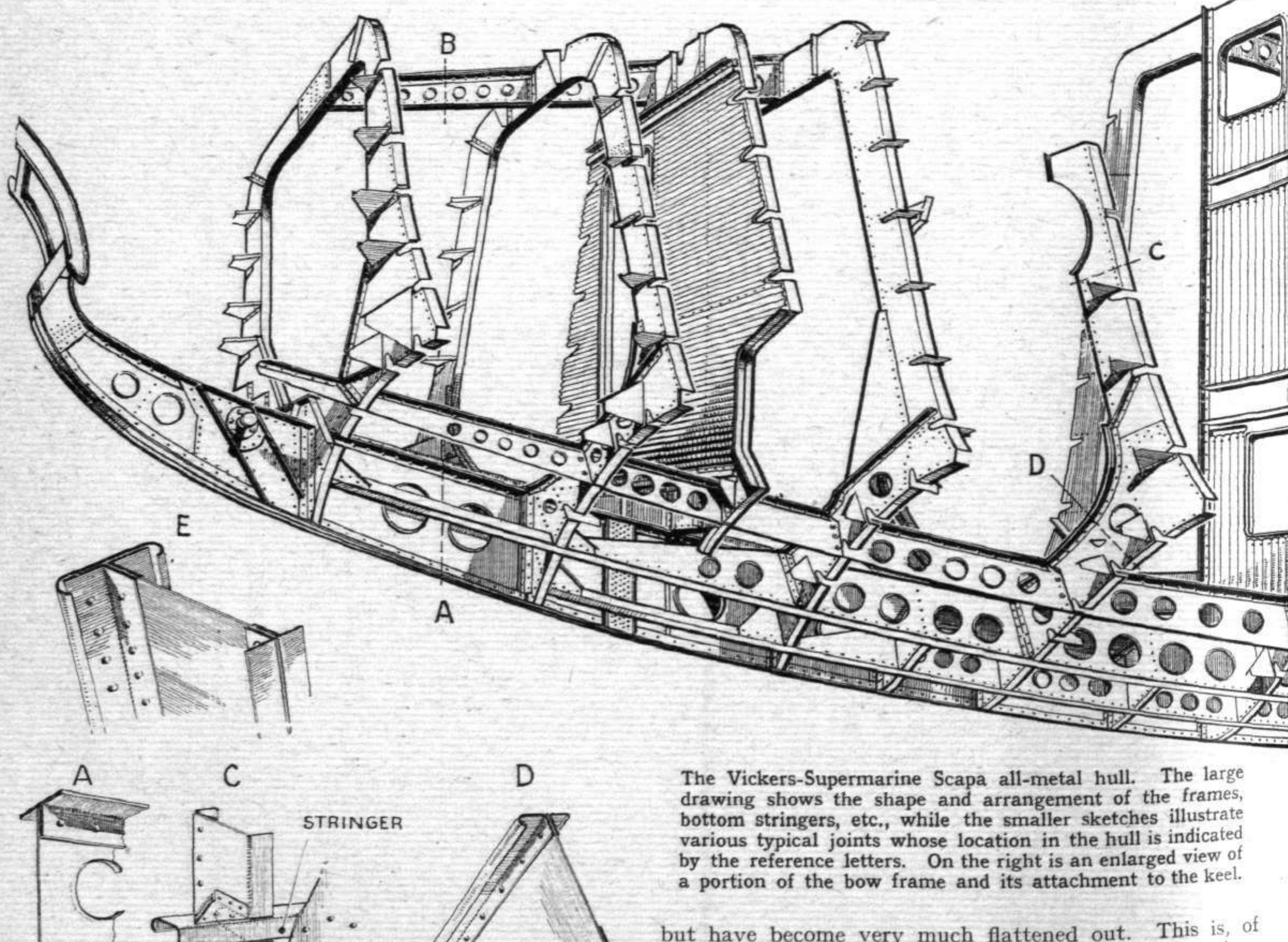
Feature

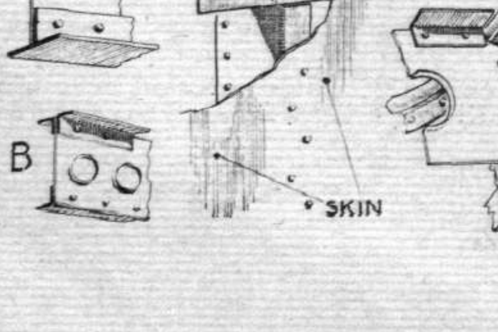
RARELY is it possible to see the inside of a flying boat hull. Particularly is this so when the hull belongs to a military flying boat, of which one usually sees only the outside aspect. It is, therefore, with considerable satisfaction that *Flight* is able to illustrate how a modern British flying boat is built. The subject of our illustrations is the Vickers-Supermarine Scapa, a biplane flying boat which has now been supplied in considerable numbers to the R.A.F. for reconnaissance, bombing and torpedo transport duties.

Of the military features of the Scapa there is little need to dwell here, as these were dealt with fully in a descriptive article on the prototype machine, which appeared in *Flight* of April 26th, 1934. Rather do we propose to confine ourselves in the main to structural features which it has not been permissible to disclose until now.

Fundamentally, the Scapa is a very "clean" biplane flying boat, driven by two Rolls-Royce Kestrel engines mounted in nacelles immediately underneath the upper wing. Light alloys are the materials mostly used in the construction, stainless steel fittings being used for highly stressed parts only.

For some years it was customary for British flying boats to have flaring chines, with the underwater body showing a flat vee curving sharply from keel to chine in order to keep down spray when the machine was taxi-ing and taking off. Modern tendency is towards flat sides and nearly straight-line vees in the hull bottom. The Scapa in this respect may be regarded as an intermediate type in that the curves of earlier machines are retained,





The Vickers-Supermarine Scapa all-metal hull. The large drawing shows the shape and arrangement of the frames, bottom stringers, etc., while the smaller sketches illustrate various typical joints whose location in the hull is indicated by the reference letters. On the right is an enlarged view of a portion of the bow frame and its attachment to the keel.

but have become very much flattened out. This is, of course, an advantage from a manufacturing point of view, as it avoids a great deal of panel beating. If a sheet of material, metal in this case, is bent simply, it will be found that a straight edge can be laid along it in such a way as to make continuous contact. If, however, one tries to bend the sheet in two directions, it is found that this cannot be done except by working on the sheet in such a way as to cause it to stretch in some places and contract in

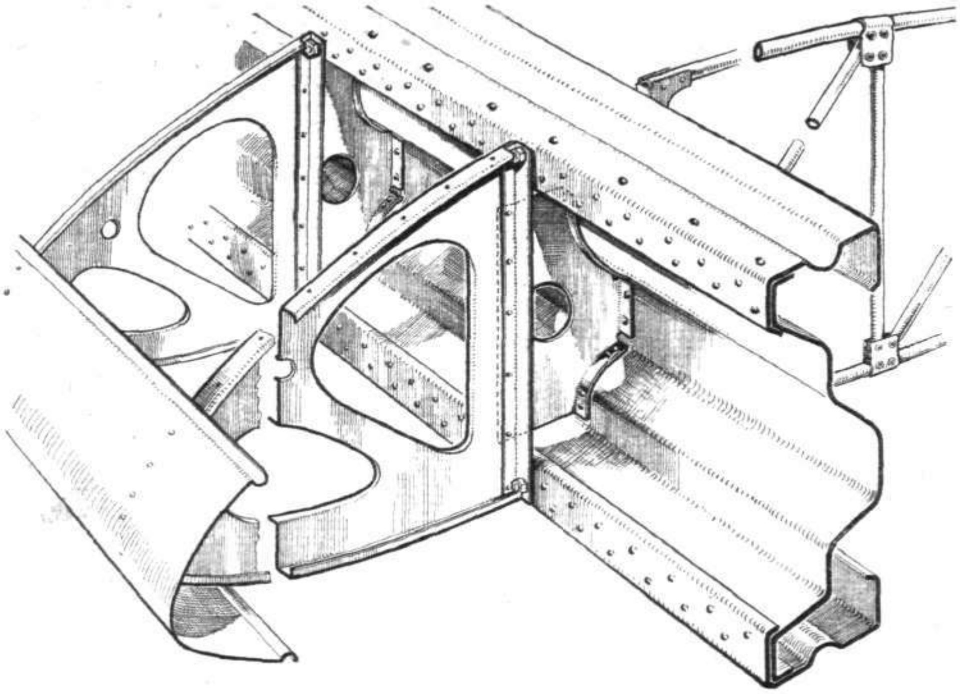
LANKING

t Construction : Structural

Scapa

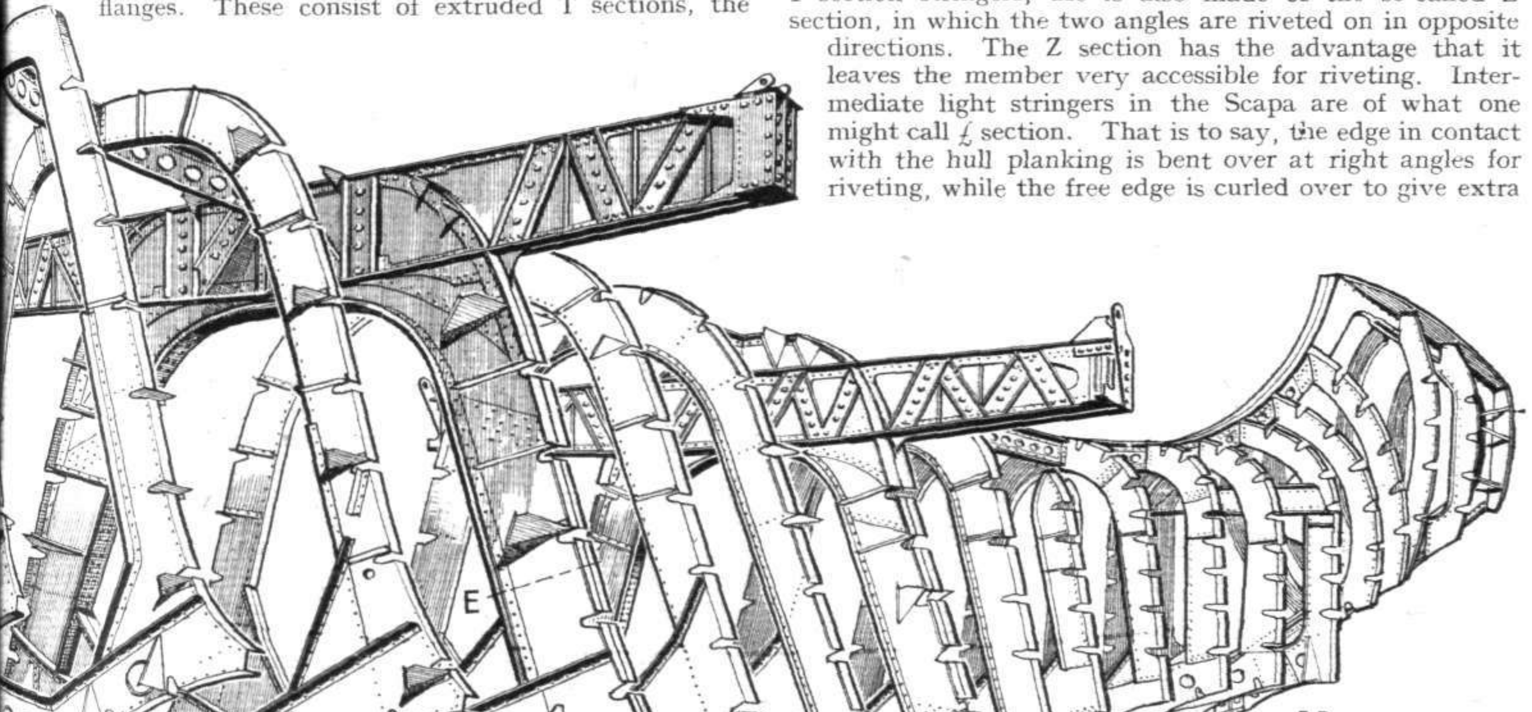
others. It is this process which is known as panel beating. Differently explained, one can bend a sheet of metal around a cylinder but not around a barrel.

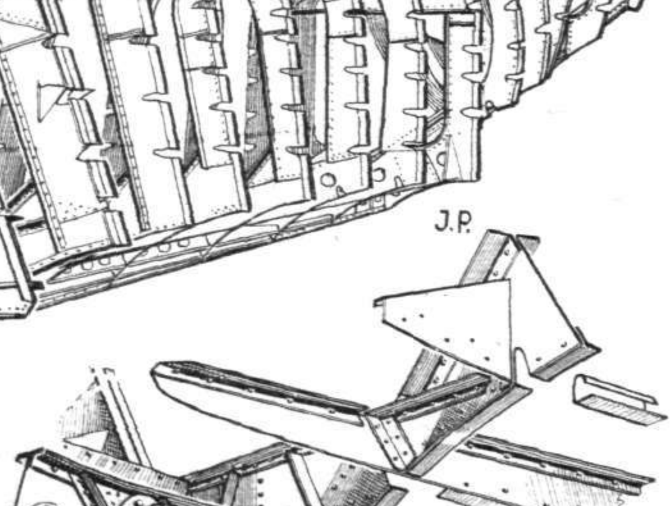
The sections of the Scapa have been so chosen that panel beating is almost entirely avoided, the main exception being the region around the extreme bows. For the rest, the sheet metal covering of the Scapa hull is put on in fairly large panels (roughly 4ft. 6in. long by 20in. wide), so that the number of joints which have to be made watertight is reduced to a minimum.



Details of the wing construction of the Scapa are shown in this sketch of a spar and a typical rib. Note the "Sigma" section of the spar, which is unusual.

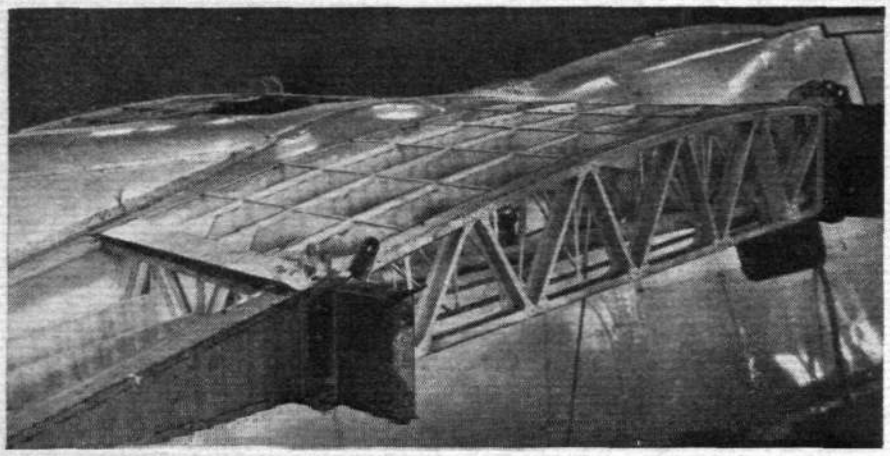
In building the Scapa hulls the keel is first secured on the stocks. The keel is built up to form an I section, and consists of a flat strip cut to the contour which the keel is desired to have, stiffened at top and bottom by flanges. These consist of extruded T sections, the

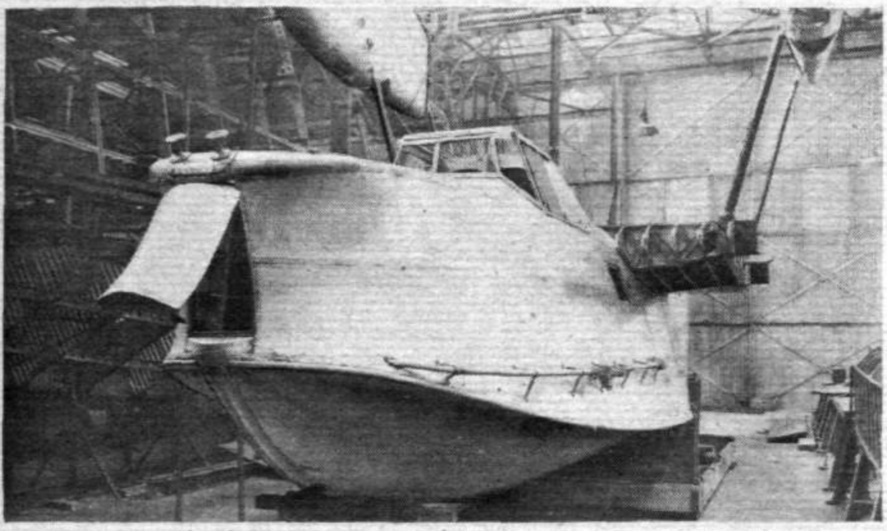




vertical limbs of the Ts being riveted to the edges of the keel web.

When the keel has been finished, the frames are erected on it in their proper positions and temporarily held in place while some of the fore-and-aft stringers are attached. The main stringers are of two general types: plain channel sections formed by bending the sheet itself to form the flanges, and T sections in which the edge farthest from the planking is formed by two L section strips riveted through the web of the stringer. The stringer edge in contact with the planking is usually bent over to lie flat against the planking being riveted to it. Apart from I section stringers, use is also made of the so-called Z section, in which the two angles are riveted on in opposite directions. The Z section has the advantage that it leaves the member very accessible for riveting. Intermediate light stringers in the Scapa are of what one might call £ section. That is to say, the edge in contact with the hull planking is bent over at right angles for riveting, while the free edge is curled over to give extra





The photograph on the left forms an interesting companion to the sketch on the previous page in that it shows the special ribs in the wing root. These ribs are of channel section. Below is a view of the hull, with wing roots in place.

stiffness. The stringers are attached to the frames by small gussets, flanged over to provide the necessary riveting area, as shown in the sketches.

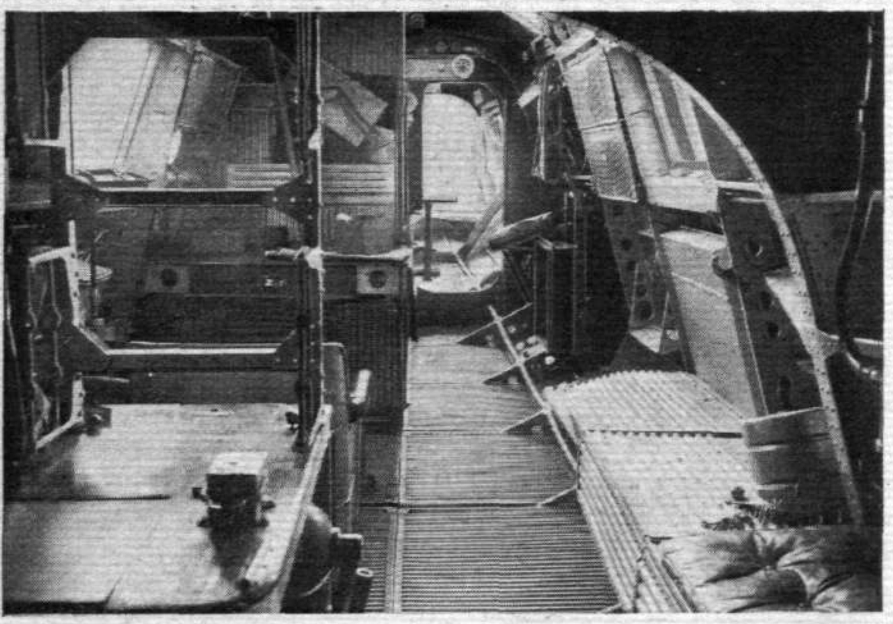
Several types of frame are used. The simplest is a plain channel section, having outer and inner flanges formed by simply bending over the edges of the fresh material itself. Others have the flanges formed by riveted-on angles. The spar frames are of slightly more substantial construction, having two angles riveted on at the planking, two at the free edge, the latter being further reinforced by a capping strip having its edges curled over for stiffness.

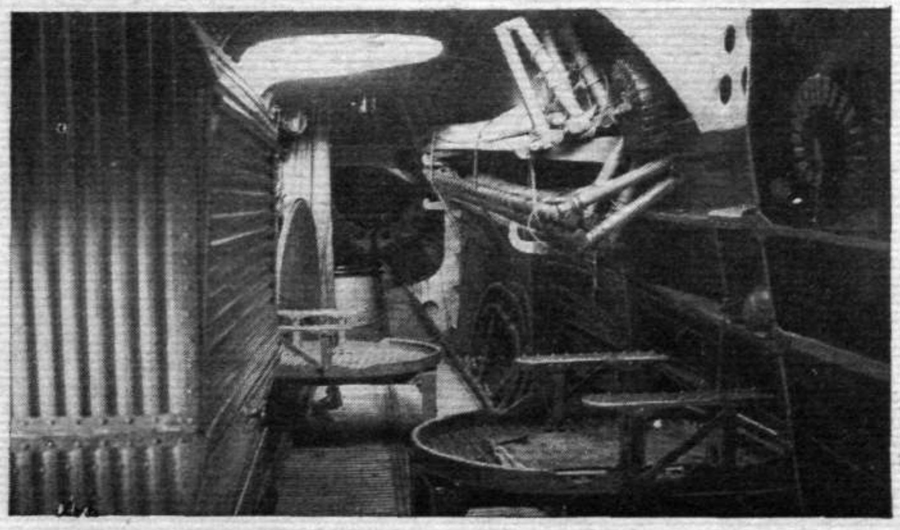
These spar frames have their webs extended upwards to form the webs of the main wing spars, so that the wing roots of the lower plane are actually integral with the hull. The details will be understood from a reference to the drawing on p. 221. It should be noted that the stringers of the Scapa are continuous from bow to stern, and that they are notched into the frames, as shown in the sketches. In another form of hull construction, the frames are continuous, and the stringers interrupted at the frames, being attached to them by gussets. At present it does not seem decided which form of construction is the most satisfactory.

When the frames and most of the stringers are in place on the hull, the planking begins. The chine is formed by an L section strip. This is temporarily held in place by screws to the frames, small pieces of metal of the same thickness as the actual planking being inserted to leave the necessary gap. The sheets of the planking are then "offered up" to the job, marked out, cut to size and fitted. When a perfect fit has been attained, the piece of sheet is taken to the anodising plant for treatment, and when that is finished it is brought back to the job, inserted in its proper place and finally secured by rivets to frames, stringers and chine. Where the plates overlap, the edge of the outer is "stepped" over the edge of the inner before they are riveted together, so that except at the seams the two adjacent plates are perfectly in line. Marine glue is brushed on the edges before the plates are riveted together to ensure watertightness.

At the two steps a transverse covering strip is used to ensure a watertight joint. This strip is of Z section, and conforms to the transverse shape of the hull at the steps.

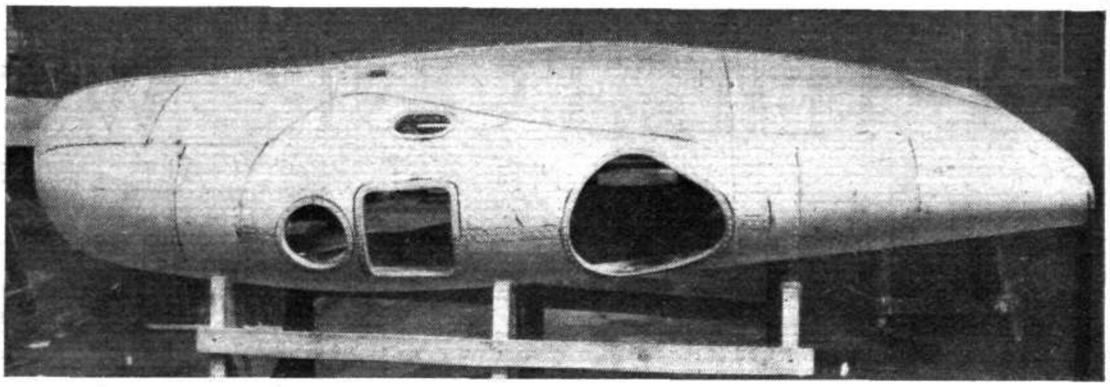
In the wing construction of the Scapa fairly normal practice is followed. An exception is, however, found in the wing spars, which are of very unusual section. Perhaps this section may be described as a Σ section resembling roughly the Greek capital letter sigma. It consists of a single corrugated web to which are riveted the two flanges.





Two interiors of the Scapa. In the upper one is looking towards the bows, while in the lower the camera was pointing towards the stern of the hull.

A Scapa engine nacelle. In this view the nacelle has been placed on its side in order to show the inspection doors in the floor by which engineers reach the engines. The nacelle is of all-metal construction.



Several advantages are gained by this very ingenious spar construction. As the spar is "open" from both sides, the riveting, holding-up, etc., becomes very easy. The sections are simple to form on rolling mill and draw-bench, the web by pressing, and finally the attachment of ribs and drag bracing can be very simply carried out.

It is obvious that the type of spar web used is not by itself able to resist any very considerable vertical loads without collapsing. On the side of the spar where the spar flanges are attached to the web, the necessary strength in a vertical direction is obtained by the angle strips used to attach and reinforce the ribs. On the "open" side, similar stiffening is introduced, and where local loads demand stiffeners in between rib locations, these take the form of simple channel section struts, riveted to the spar flange.

The wing ribs are mostly of duralumin tube construction, but some of the heavier ribs, such as those which form compression ribs, or which carry bomb loads, tanks, etc., have channel section flanges with channel section ties.

The gross weight of the Scapa is approximately $7\frac{1}{4}$ tons, and the wing span is 75ft.; the wing area is 1,300 sq. ft.

Numbers of these machines have now been in service for some time, and the manufacturers state that neither compulsory nor voluntary modifications have had to be made.

BOMBS and BIRDS: A DEPUTATION

VISCOUNT SWINTON, Secretary of State for Air, accompanied by Sir Philip Sassoon, Under-Secretary of State, the Duke of Northumberland, Parliamentary Private Secretary, and senior officials of the Air Ministry and Ministry of Agriculture and Fisheries, last week received representatives of the various national and local bodies interested in the proposal to establish an armament training camp and range on the Northumbrian coast (see leading article in last week's issue of *Flight*).

The Secretary of State reminded the meeting that the Air Ministry had originally chosen a site at Druridge Bay which was eminently suitable for the purpose from the service point of view, but that as a result of a suggestion made by local interests an alternative locality near Holy Island had been investigated. He was extremely anxious to come to a right decision in this matter, and he had therefore called together the interests who were concerned with either area. Whichever of the sites was chosen there would be no bombing practice with live bombs, and training would be confined to machine-gun firing and the dropping of practice bombs which contained no explosive.

The deputation was introduced by Sir Charles Trevelyan, Lord Lieutenant of Northumberland.

The majority of representatives strongly emphasised the national and local objections to a range being established in the neighbourhood of Holy Island in view of its ancient religious and historical associations, and of the fact that the Farne Islands were one of the most notable bird sanctuaries in this country or in Europe. Representations in regard to the Druridge Bay area were primarily concerned with the effect on the local fishing industry, including salmon fishing. It was urged that a number of fishermen would inevitably be displaced.

Viscount Swinton, in replying to the deputation, stated that, having heard all the representations and considered all the relevant facts, he had definitely come to the conclusion that he ought to adhere to the original choice of the Ministry and establish the range at Druridge Bay. The arguments which had been advanced against the Holy Island site were, in his opinion, convincing. Moreover, as he had previously mentioned, the Druridge site had great advantages from an Air Ministry point of view. He would, however, investigate what could be done in the interests of the local fishing industry.

The deputation withdrew after Sir Charles Trevelyan had thanked the Secretary of State.

For Aerodrome Owners Abroad

FEELING that it can be of assistance to aerodrome owners abroad, and particularly in the British Empire, the Aerodrome Owners' Association has decided to open associate membership to owners of aerodromes throughout the Empire and in foreign countries.

The associate membership fee for such owners has been fixed at £2 2s. per annum. Full details are obtainable from the Secretary, Mr. H. R. Gillman, Aerodrome Owners' Association, 32, Savile Row, London, W.1.

Forthcoming Events

Mar. 5. **R.Ae.S. Students' Section Lecture: "Airflow Experiments," by W. S. Coleman, 7 p.m. R.Ae.S. Library.**
Mar. 6. **Leicestershire Aero Club: Dinner and Ball, Grand Hotel, Leicester.**
Mar. 10. **Royal United Service Institution Lecture: "The Development of Civil Aviation," by Lt. Col. F. C. Shelmerdine, at 3 p.m.**
Mar. 19. **R.Ae.S. (Coventry Section) Lecture: "Type-Testing and Aircraft" by Flt. Lt. Bulman, 8 p.m., Armstrong Siddeley Canteen.**
Mar. 19. **R.Ae.S. Students' Section Lecture: "The Monoplane Solution," by R. C. Abel, 7 p.m., R.Ae.S. Library.**
Mar. 20-22. **Re-union of Halton Belgium Tour parties, High Leigh, Hoddesdon, Herts.**
Mar. 23. **R.Ae.S. Lecture: "Welding," by R. H. Dobson Institution of Electrical Engineers, 6.30 p.m.**
Mar. 26-29. **Yorkshire Gliding Club: Members' Meeting.**
Mar. 31. **R.Ae.S. Students' Section Lecture: "The Test Pilot's Job," by K. G. Seth-Smith, 7 p.m., R.Ae.S. Library.**
April 16. **R.Ae.S. (Coventry Section) Lecture: "Aircraft Instruments," by Mr. J. E. Chorlton, 8 p.m., Armstrong Siddeley Canteen.**
April 17. Norfolk and Norwich Aero Club: Annual Dinner and Dance.
April 20. "New Light on Strength of Materials Afforded by Modern Physics," by Dr. H. J. Gough. Institution of Electrical Engineers, 6.30 p.m.
April 24. Bristol and Wessex Aeroplane Club: Annual Ball.
April 28. R.Ae.S. Students Section Lecture: "Application of Aerodynamics to Mechanical Engineering," by J. L. B. Jones, 7 p.m., R.Ae.S. Library.
May 15-18. Yorkshire Gliding Club: Open Meeting and Competitions.
May 15-June 1. Stockholm Aero Show.
May 23. Empire Air Day.
May 27-June 4. Austrian Aero Club: Whitsun Tour.
June 6. R.A.F. Flying Club: Annual Display.
June 6-14. Czechoslovakia Aero Club: Tour.
June 20. Brooklands Flying Club: "At Home."
June 27. Royal Air Force Display, Hendon.
July 10 and 11. King's Cup Race.
August 1-2. Yorkshire Gliding Club: Open Meeting.
August 15-30. Yorkshire Gliding Club: Open Meeting and Competitions.
September 5-6. Aero Club of Hungary: Week-end Aerien.
Nov. 13-29. Fifteenth International Aero Exhibition, Paris.