BOBOLINK TO DELTA . . .

The P.10 as exhibited at the Paris Salon of 1919 was Boulton and Paul's first "all-metal" aeroplane—a description which must be qualified, however, with the remark that plastics were used for the covering of the rear fuselage! In this design, also, was incorporated the first swinging engine-mounting, a feature which was to be reproduced in a number of B.P. designs thereafter.

As the development of metal construction went ahead, the aerodynamic staff were concerned with the progressive improvement of twin-engined bomber design, the measure of which is apparent in the photographs on pages 45-47. In the wind tunnel they investigated the properties of various combinations of wing, body and engine-nacelle in order to minimize interference effects, and the fruit of their labours was the Sidestrand, of 1927, which achieved a performance, in terms of speed, climb and ceiling, comparable with the best single-engined bombers of the day. Such were the circumstances of the times, however, that only a single R.A.F. squadron—No. 101—was ever equipped with these fine machines.

Historical notes for which we are indebted to Mr. W. J. Pickthorn, remark that a notable contribution to the success of Boulton and Paul metal construction, and one which was patented by the company itself, was the continuous heat-treatment process, by which formed sections were drawn through electric furnaces, mounted on drawbenches, at speeds slow enough to enable the strip to soak at the appropriate temperatures. Rapid quenching for hardening was achieved by the use of water-cooled dies at the furnace exit. Formerly steel strip had been delivered from the makers hardened and tempered, and had been rolled or drawn in this state. This meant that, apart from the difficulty of forming, it was impossible to obtain uniformity of heat treatment throughout, and local variations in ductility caused distortion of sections in passing through the dies or rollers. The distortion had to be rectified by subsequent straightening operations which were delicate and costly.

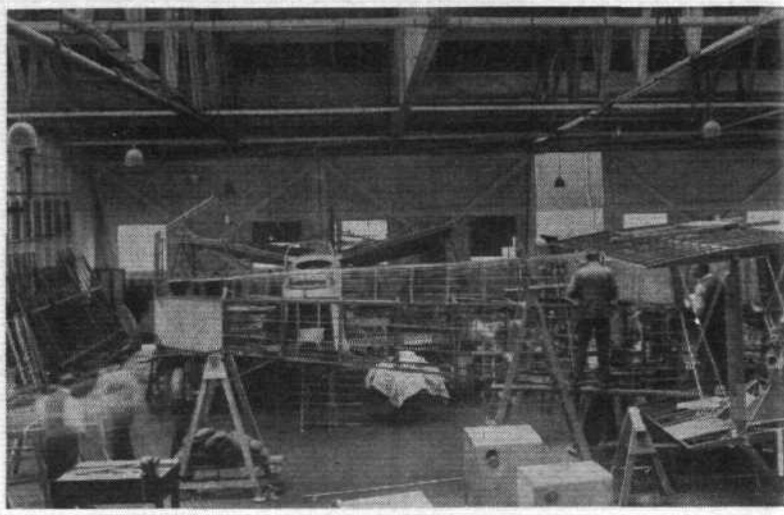
All these difficulties were solved by the new process, for the strip was formed in the soft state and was held straight throughout its heat treatment—itself controlled within very narrow limits to ensure uniformity.

Another of the company's inventions was the "locked-joint" tube, wherein strip was drawn to circular, or other tubular, sections, a bead being formed along one edge of the strip, around which the other edge was wrapped inside the tube. By this means tubular members could be produced in stainless steels and in other difficult materials which, at the time, could not be worked by the "solid-drawn" process. Moreover, some saving in weight resulted, since the limits of thickness in rolling strip were much finer than the limits of eccentricity specified for solid-drawn tubes. Thus, it was frequently possible to use locked-joint tubing in a lighter-gauge material than for its solid-drawn equivalent. The same means was extended to the uniting of two strips by means of locked joints at both edges, to form spars of figure-eight section, streamline struts and other shapes.

The company look back also with justifiable pride on the very large measure of standardization achieved with their metal sections. Box-type wing spars, for example, were made with a range of three standard web-section forms and six flange-section forms, providing eighteen basic spar shapes, each of which could be produced in strips of various thicknesses to cover a total range of some 2,000 spars, suitable for use in aircraft ranging in gross weight from 2,000 lb to 20,000 lb. Similarly standardized were struts, longerons and other members, and the system was applied successfully not only to the firm's own designs but also to such notable aircraft as the Blackburn Bluebird, B.2 Trainer, Ripon and Shark, and to the Saunders-Roe London flying boat.

The tendency in the later stages of development was to use high-tensile steels for the main structural members (wing spars, interplane struts, drag struts, longerons and the more heavily loaded struts in the front fuselage) and light-alloy for the secondary components such as ribs, leading and trailing edges, lightly loaded struts and fairing members. An exception was the all-steel system of light-aircraft construction developed for the Phoenix lightplane and widely used on the Blackburn B.2, wherein, instead of the normal riveting, spot-welding was employed, resulting in a very cheap and efficient method of manufacture.

The company's experience in metal construction, and particularly in the handling of stainless steels, was undoubtedly a deciding factor in its selection, in 1927, to collaborate with the Royal Airship Works in the design and construction of H.M. Airship R.101. Of five million cubic feet capacity, the R.101 was very much larger than any previous dirigible but departed



The Atlantic under construction, with the Bourges Ia in the background.

entirely from former practice in that steel was used for the main structural members of the frame instead of Duralumin. The detail design and manufacture of the entire main hull structure was carried out by Boulton and Paul, and Mr. North (by that time a director of the company) acted during this period as consultant to the Director of Airship Development. The great size of the ship and the multiplicity of frame members obliged the Boulton and Paul engineers to go to extraordinary lengths in the calculation of sizes of individual members to avoid cumulative errors and in the accurate setting of assembly jigs to suit. So meticulously was this pursued that, when the frame was erected at Cardington, every component went into place without the slightest hitch. The tragic loss of the great airship was in no way a reflection on its structural design or manufacture.

In the late 1920s also, by agreement with Dr. H. C. H. Townend and the Department of Scientific and Industrial Research, the company undertook the administrative and commercial exploitation of the Townend ring patents. Numerous forms of the ring—many of them combined with exhaust collector—were evolved and were widely employed, and patents were obtained and exploited in many countries. Experiments with the ring were made in numerous aircraft, including the company's Sidestrand bomber, a machine of notable efficiency in respect of design, construction and military effectiveness. As performance of the Sidestrand was progressively improved, so the difficulty of manning its guns became more pronounced. The company's answer to this problem, in respect of the front gunner, at least, was a power-driven turret, as applied to the Overstrand and later described. The success of this turret (and, the makers remark, the publicity it received) led to the acquisition, early in 1935, of the British rights for the de Boysson turret from the Société d'Applications des Machines Motrices, and this design formed the basis of subsequent Boulton Paul turrets. In his book *I Hold My Aim*, G/C. C. H. Keith remarks: "I think very great credit is due to North for his enterprise. In this and many other

The dirigible R.101, the entire main hull structure of which was the work of Boulton and Paul. The airship is seen moored at Cardington.