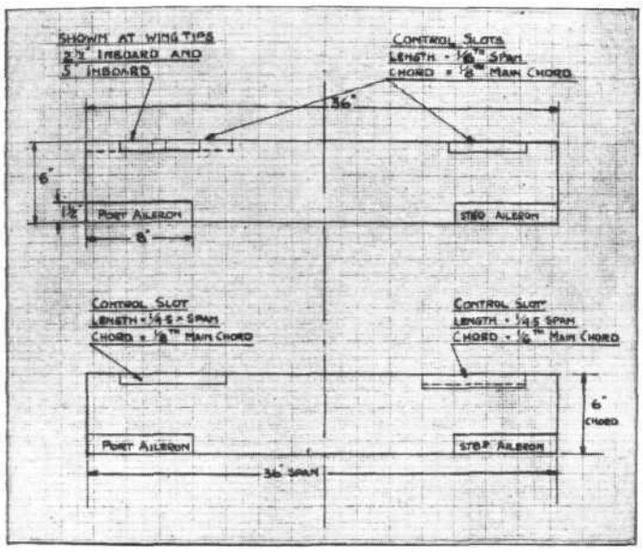
FLIGHT

WILBUR WRIGHT MEMORIAL LECTURE

Delivered by F. HANDLEY PAGE, C.B.E., F.R.Ae.S.

THERE was a very large and very distinguished attendance at the lecture by Mr. Handley Page before the R.Ae.S. and I.Ae.E. on May 30, when the Sixteenth Wilbur Wright Memorial Lecture was read. Col. the Master of Sempill was in the chair, and before asking Mr. Handley Page to read his paper he presented to Mr. Fage the Busk Memorial Prize for his paper on "Some Recent Experiments on Fluid Motion."

Mr. Handley Page's paper was one of the longest ever read before the society, and was illustrated by some 60 lantern slides. The subject chosen was the Handley Page slot, and in spite of the very highly technical nature of the



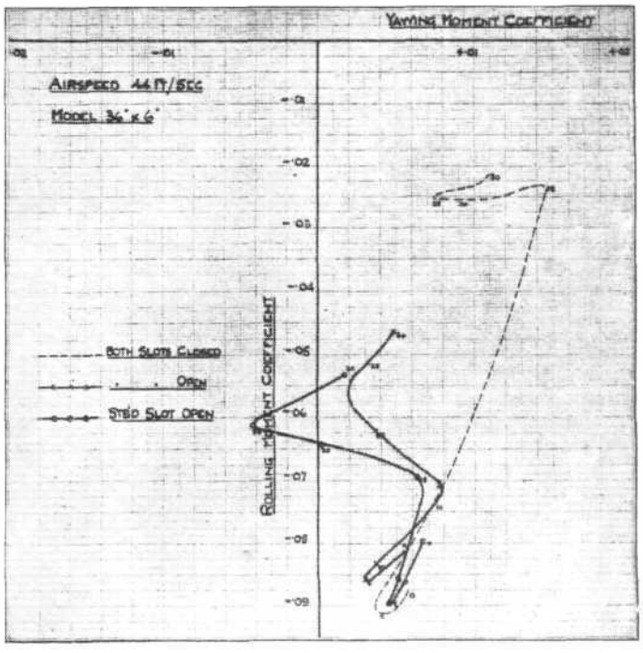
THE HANDLEY PAGE CONTROL SLOTS: Dimensions, etc., of the model, showing the various sizes and location of auxiliary aerofoil tested.

paper, Mr. Handley Page never for one moment lost the attention and interest of his audience. It is obviously impossible for us to attempt to give the paper in full, and the nature of the paper was such that a *résumé* would be of little value. Perhaps the best we can do will be to refer quite briefly to such passages and sections of the paper as appeared to contain references to the more recent developments, and which have not hitherto been described in print.

Pointing out that two courses lay open to the designer in the application of the slot, *i.e.*, using it over the whole span of the wing to get extra lift, and over a portion only to get control at and beyond the stall, Mr. Handley Page exhibited a series of slides showing how the flow is altered by the introduction of the slot, and the quantitative increase in lift that can be obtained. It may be assumed that readers of FLIGHT are fairly familiar with the wing slotted over its whole span, and it may thus be of more interest to record here some of the sections of Mr. Handley Page's paper which dealt with the control slot. The lecturer pointed out that in a wing provided with leading edge slots near its tips, and having ailerons behind the slots, when the centre portion of the wing stalls, the tips remain unstalled, the righting moment is similar to that on an ordinary aeroplane flying under normal conditions, and the machine answers the controls as in normal flight. Such a machine behaves, in fact, exactly similar to one having wings with an excessive "wash-out." Mr. Handley Page did not here point out, as he might well have done, that whereas the wing tip control slots, and particularly the automatic slots, do not affect the efficiency of the wing, wing tips with a "wash-out" sufficient to give corresponding lateral stability at large angles would reduce both the maximum lift coefficient of the wing, and also the maximum L/D. He did, however, state that an aircraft with excessive "wash-out" would have a reduced performance due to the negative angles of the wing tips at full speed.

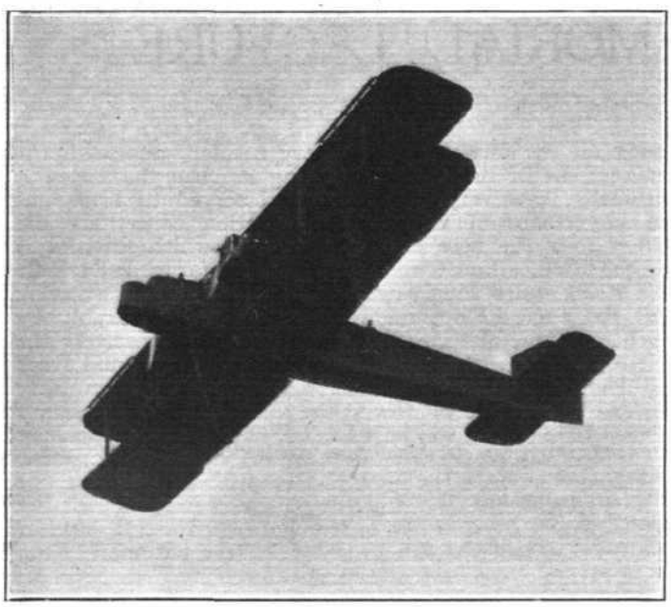
The section of the paper dealing with the resultant forces acting on the forward or auxiliary aerofoil, and with the arrangement of the links supporting it when the action is automatic, was very interesting and served to bring out the importance of very full information concerning the airflow over the nose of the section on which the slot is to be fitted. Lantern slides showing forward aerofoils not fitting quite snugly were very interesting in showing that the angle of opening can be varied considerably by "venting" the slot either in front or at the rear. If the "venting" is in front the opening is accelerated, and there will be a tendency for the slot to open too soon. By suitably "venting" the slot at the rear edge of the auxiliary aerofoil the opening can be retarded, and generally speaking this is an advantage in order to prevent the slot from opening during climb. Mr. Handley Page stated that it was not sufficient to ensure that in full-scale the slot opened at the correct angle, or to what *appeared* to be the full extent. Failure to obtain the full benefit from the automatic slots has in several cases been due to this.

The subject of where to place the automatic slots on a biplane has not, we think, hitherto been discussed in public, and consequently we propose to give the section of Mr. Handley Page's paper which dealt with that. Pointing out that in a biplane arrangement, particularly one with forward stagger or with a sesquiplane arrangement, the lower plane continues to lift at large angles and after the top plane has stalled, Mr. Handley Page said that slots needed to be fitted to the top plane only, and that as it was improbable that even in an involuntary stall the high angles of incidence would be reached at which the lower plane stalled, the use of the slot on the lower plane did not appear to be warranted in the ordinary type of biplane.



THE HANDLEY PAGE CONTROL SLOTS: Yawing and rolling moments on wing of R.A.F. 28 Section, with auxiliary aerofoil in its most inboard position, i.e., 5 in. from the leading edge. The auxiliary aerofoil in this test was one-sixth of the span of the main wing, and had a chord one-eighth that of the main wing. The ailerons were in the maximum position, i.e., at −20° and + 20°.

Having decided that the automatic slot should be fitted on the top plane only, in the case of a biplane, the next problem was what was the proper chord, span and position of the forward aerofoil in order to get the best results. A series of tests were carried out in the Handley Page wind tunnel on a model 36 ins. by 6 ins., of R.A.F. 28 section. For the purpose of the tests three sets of forward aerofoil were taken as follows: 1, forward aerofoil one-eighth of main plane chord and span one-sixth of main plane span;



["FLIGHT" *Photograph*

SLOTS AND THE SERVICE: A Handley Page "Hyderabad" in Flight. Note the automatic slots open at the upper wing tips.

2, chord of forward aerofoil one-eighth of main chord, and span two-ninths of main plane span; 3, chord of forward aerofoil one-sixth of main chord, and span two-ninths of main plane span.

Measurements of lift coefficient gave little indication of the relative value of the different arrangements, but there were great differences in the values of rolling and yawing moments with the different aileron settings. With the first two arrangements, rolling and yawing moments were measured with the ailerons set at $\pm 10°$ and $\pm 20°$, and these moments measured for three positions of the forward aerofoil; (*a*) at the wing tips, (*b*) with the outer edge 2·5 ins. from the wing tip, and (*c*) with the outer edge 5 ins. from the wing tip. In the case of the large-span, large-chord auxiliary aerofoil, the rolling and yawing moments were measured only at the midway position, *i.e.*, with the outer edge 2·5 ins. from the wing tip. In each case measurements were taken (1) with slots closed, (2) with both slots open, and (3) with one slot open and one slot closed, the last case being that in which a controlled type of forward aerofoil is used. It was found that as the forward aerofoil was moved inward from the tip so did the rolling and yawing moments improve from a control point of view, and almost as good results were obtained as from the mechanically-operated auto-slot, where one slot was closed by the upward movement of the aileron. This was particularly the case with the flaps up and down 20°, and with the auxiliary aerofoil in the farthest inboard position.

The main feature of the tests with both slots open was the improvement which resulted from fitting the forward slot inboard from the main wing tip. In this position there was a remarkable increase in rolling moment as compared with the unslotted section.

Obviously, Mr. Handley Page said, the best improvement in control would in all cases be obtained with the arrangement in which the slot was closed, or its effect neutralised, on one side of the wings by the upward movement of the aileron. Such an arrangement gave at large angles of incidence a yawing moment of the right sign.

An arrangement for inter-linking the slot and aileron was shown, but the lecturer pointed out that many variations were possible, notably by the movement of the link hinge point so that a closing torque was brought into action on the forward aerofoil.

Admitting that objection might be raised to the extra complication of interconnecting slot and aileron, Mr. Handley Page described and illustrated a method of effecting the same purpose by the use of an "interceptor" or "spoiler," which is a small strip placed on the upper surface of the aerofoil, and so hinged that it can lie flat against the wing or be raised at right angles to it. The action of this "interceptor" is to cause burbling, in the same manner as if the slot was closed. One of the slides illustrated the rolling and yawing moments on R.A.F. 28 section for: (*a*) both wing-tip slots open without interceptor; (*b*) both wing-tip slots open, with an "interceptor" fitted on one side; and (*c*) one wing-tip slot closed and no "interceptor" fitted. The moments were measured for the ailerons at 10° and 20°. With the "interceptor" there was a great improvement in control over the case of both slots open, and at the smaller angles (up to 20° incidence) over the case of one slot closed. Beyond this angle the rolling moments were not quite as large as with one slot closed. A similar arrangement was tested for a complete model biplane, and tested in full-scale free flight the model results were fully borne out. The control was no different in "feel" from the ordinary aileron, and no heavier to operate.

In all the tests described by Mr. Handley Page a forward or auxiliary aerofoil forming part of the original wing section was used. It was somewhat easier in construction to fit an additional forward aerofoil on top of the normal section, much in the way in which a plaster is fitted. Such a variation had been developed by Mr. Bruce, of the Westland Company, and had shown itself as effective as the type illustrated and tested by Handley Page.

Summarising the main points of his lecture on the slot, Mr. Handley Page said: (1) With thick wing sections an increase in lift coefficient can be obtained by the use of the slot, equal in magnitude to that obtained with thin wings.

(2) As the use of the slot for control purposes is dependent on the lift increase obtained, a similar result in stalled flight can be obtained with both thick and thin sections.

(3) Where the aerofoil is used for a portion of the span only, the best result for control is obtained when the auxiliary aerofoil is fitted in an intermediate position between the tip and the centre of the wing.

(4) With a correctly-designed and positioned auxiliary aerofoil opening and closing automatically, a very good control at and beyond the stall can be obtained without the added complication of control by the forward aerofoil.

(5) If increased control is required at and beyond the stall, particularly at very high angles of incidence, the controlled slot or the "interceptor" should be used.

It is the custom of the Royal Aeronautical Society, with which is incorporated the Institution of Aeronautical Engineers, that after a Wilbur Wright Memorial Lecture there is no discussion. Major Wimperis proposed a vote of thanks to the lecturer, and was seconded by Lieut.-Col. Moore Brabazon.

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The S.M.A.E. Journal

THE May issue of the S.M.A.E. Journal, the official organ of the Society of Model Aeronautical Engineers, is to hand, and it is quite an interesting number. Besides containing a diary of events, sundry Society notices, rules for the various forthcoming competitions, etc., it also gives the lecture on "Airscrews" which was read before the Society on March 23 last. This lecture is very instructive and should provide some useful data for model constructors. We are not certain whether the S.M.A.E. Journal is available to non-members, but no doubt a copy (price 6*d*.) would willingly be sent to any of our readers interested on application to the Hon. Secretary, S.M.A.E., 23, Mayfair Avenue, Ilford.

An Air Novel

As flying is rapidly becoming a fashion, there should be a wide interest in novels with an aviation appeal. Sampson Low, Marston & Co., Ltd., have published a novel by Faith Baldwin entitled "Departing Wings." (7*s*. 6*d*.) The flying interest is slight, being practically confined to the fact that the hero is an American service pilot; and he does not remain that very long. There is very little flying actually described, and although the authoress is not intentionally funny, we think that airmen readers will find her amusing when she treads the air. But as a novel it is very readable, if conventional. The scenes are laid in America, and the characters are Americans. Broadly outlined the story tells you that the flying hero fell in love, married, met trouble that never matured, and then lived happy ever after. After all, if that is what happened to everyone life would not be intolerable.

Australian Aerial Derby Mishap

DURING a race in the Victorian Aerial Derby at Essendon on May 27, Flight-Lieut. A. G. Wells, piloting a D.H.9, collided with a high-tension electric cable. The wings were torn off and the machine crashed to the ground, fortunately clear of the cables. The pilot was seriously injured.