EXPERIMENTAL STUDIES IN AERODYNAMICS.[1]

M. EIFFEL has contributed much to the experimental study of aerodynamics and aeronautics, and his experiments at the Eiffel Tower some years ago upon air resistance at high velocities will be recalled as establishing the truth of the squared law for velocities up to 40 metres a second. His subsequent researches at his laboratory in the Champ de Mars will be familiar to all students of the subject, and more particularly to those concerned with the more practical aspects of aerodynamics as pertaining to the design of aeroplanes. In this paper he describes some recent researches, and also the apparatus and equipment at his new laboratory in the Rue Boileau, Auteuil, which the writer has had the opportunity of inspecting, thanks to the courtesy of M. Eiffel and of M. Rith, his able collaborator.

This laboratory was designed on a more extensive scale than that of the Champ de Mars, for the wind tunnel in the latter only allowed velocities of 18 metres a second. As the speed of aeroplanes considerably exceeds this, it was deemed advisable to construct new apparatus to obtain velocities more nearly those attained in actual flight. The large wind tunnel in this laboratory consists of a tube provided with a fan, the tube being made on the Venturi pattern, and in that part corresponding to the "throat" is situated the room containing the delicate registering apparatus, in which the attendants can watch and work the tests upon aerofoils of large size suspended in the current (Fig. 1). The current traverses this room, the outlet and inlet being on opposite sides. The cone collector has diameters of 4 and 2 metres with a length of 3·30 metres, and the diffuser (or discharge end of the tube) has a length of 9 metres and ends with a fan 4 metres in diameter (Fig. 2). With this large tunnel velocities of 2 to 32 metres per second are obtained.

Parallel with this tube, and passing through the same instrument or measuring room, is another, 1 metre in diameter, by which velocities of 40 metres per second (89 miles per hour) can be obtained. The registering apparatus is carried upon a chariot running on rails, and may be moved from one tube to the other, as desired, across the instrument room. So much for the design of this laboratory, at present the largest of its kind in existence, and very complete in all that pertains to experimental aerodynamics.

The first tests made at the Auteuil laboratory and described in the paper before us were upon model aeroplanes to determine, if possible, the laws of similitude between an aeroplane and its model. For this purpose an *exact* model, constructed to a scale of 1 to 14·5, was made of the aeroplane used by Col. Bouttieaux and M. Meudon, of the military aeronautical laboratory at Chalais-Meudon, for experimental purposes and equipped with registering apparatus. By pressing a button the pilot, Lieut. Saunier, when flying on an absolutely calm day, could register photographically the following data:—(1) the kinetic thrust of the propeller, or head resistance, usually called "drift"; (2) the speed of the propeller; (3) the velocity of the aeroplane relative to still air; (4) the angle of attack or angle made by the chord of the aerofoils with the line of flight.

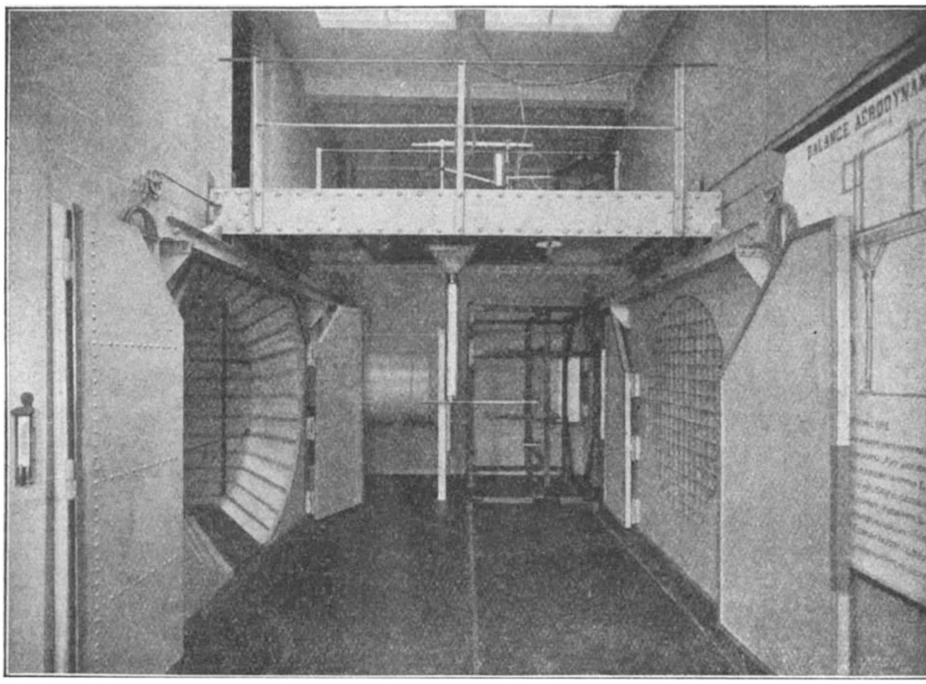

FIG. 1.—Dynamometer room through which the current of air passes from right to left (Auteuil laboratory).

The model of this aeroplane was subjected to tests in the laboratory at velocities about the same as those of the actual flight, and curves were drawn giving the values of lift and drift for different angles of attack. When these resistances, horizontal and vertical, are compared for the aeroplane and its model, they are found to

[1] "Les nouvelles recherches experimentales sur la Resistance de l'Air et l'Aviation faites aux laboratoires du Champ de Mars et d'Auteuil." Par M. G. Eiffel. Extrait des Memoires de la Societe des Ingénieurs Civils de France. (Bulletin de Juillet, 1912.)

lie on the same curve, taking account, of course, of the scale of the model. All the values of the vertical components for the aëroplane fall exactly upon the curve for the model, and five out of seven for the horizontal components likewise, the other two showing but slight difference. The paper contains other results obtained in this new laboratory from which much may be expected in the future.

In his paper[2] M. Gandillot makes frequent calls upon the experimental results obtained by M. Eiffel to support the mathematical analysis he gives of the action of bodies moving through the air and the thrust of aëroplane propellers. He considers the air as an elastic medium in which disturbances are propagated according to well-known laws. The mass of air acted upon by a plane surface moving through it may be calculated by these considerations, and the deductions are supported by M. Eiffel's results. Thus a plane surface moving at a constant velocity at a known gradient acts upon a mass of air greater than the volume swept through, as is shown by the fact that the force necessary to move the plane is greater than would be accounted for by displacement. In the light of the experiments of M. Eiffel on propellers in a current of air, the discussion of the action of propellers during flight is interesting, especially the law connecting speed of flight with angular velocity of propeller. This mathematical summary is a valuable work taken in connection with the researches at the Champ de Mars and Auteuil. R. S. B.

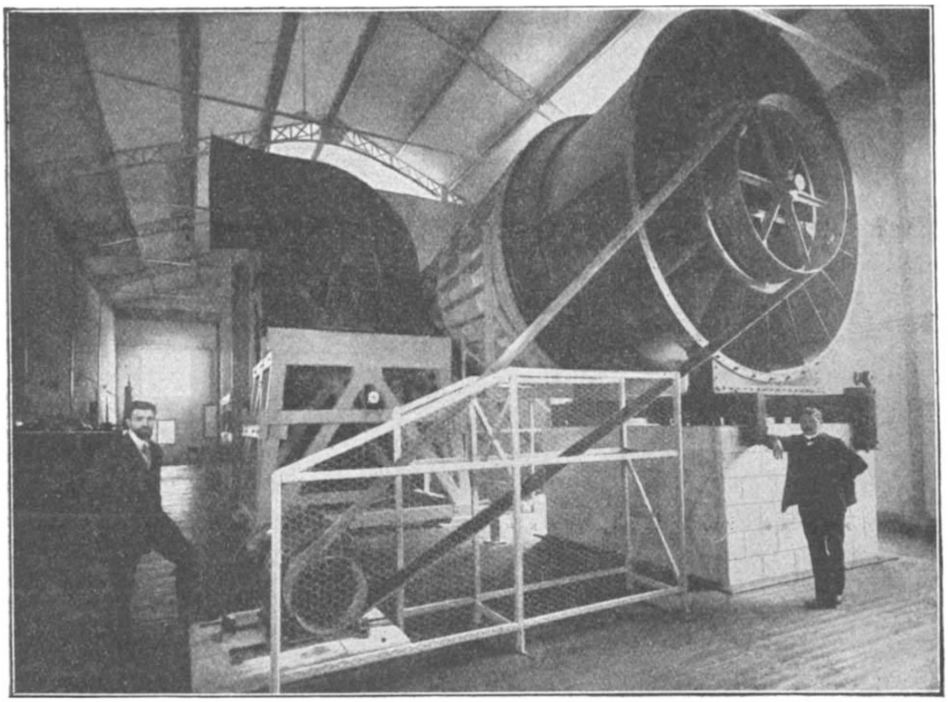

FIG. 2.—Discharge end of the Venturi tube (Auteil laboratory)..

[2] "Abrégé sur l'Hélice et la Résistance de l'Air." Par Maurice Gandillot. (Paris: Gauthier-Villars.)

THE WHEAT SUPPLY OF GREAT BRITAIN.

THE recent announcement by Mr. R. H. Rew that this country produces about one-half of its own food lends interest to the volumes of statistics periodically issued by the Board of Agriculture, setting forth the respective amounts of agricultural produce raised at home and imported from abroad, and the home production of agricultural produce. Even those who professed to be experts in the matter were not prepared to find that so much of our food was home-grown. There is no doubt that the wheat statistics had been responsible for the misconception. Only about one-fifth of our wheat is supplied by the British farmer, the rest all coming from abroad. It had been too hastily assumed that the other imports of food supplies worked out in the same proportion.

In the latest figures published in the Journal of the Board of Agriculture (No. 6, 1912), it is shown that the home crop amounted to more than 8 million quarters for the previous season (1911–12). Although this is far below the 10 million quarters raised in 1885, it is, nevertheless, the highest crop obtained for many years, a highly satisfactory result on which agriculturists are much to be congratulated. The total imported was roughly 27½ million quarters, which came most from India, next from Canada, followed by the United States, Argentina and Australia, and least (among the principal countries) from Russia. One of the most remarkable developments has been the Indian supply. So recently as 1908–9 India came rather a bad fourth on the list of wheat-supplying countries, Canada third, and the Argentine and the United States respectively first and second. But the Indian export made a big jump up in 1909–10, and a further one in 1910–11, and it maintained this new high level in 1911–12.

So much admirable work has been done at Pusa on the production of Indian wheats for the British market, and so much interest has been aroused among the more progressive cultivators, that we may confidently expect India to maintain a high position among wheat-producing countries.