CORRESPONDENCE

Editor of the Journal,

Royal Aeronautical Society.

RE JET PROPULSION.

Dear Sir,—There are one or two points I should like to raise in connection with the article on "Jet Propulsion" by Dr. Richardson, B.A., Ph.D., D.Sc., in the January issue of the JOURNAL.

The experiments described do not indicate an induced velocity in fluid external to the jet, due to the entraining of the external air by the jet. This is possibly due to the low velocities employed, but this entraining must occur, as shown by the false readings obtained with the impulse plate method of testing the performance of turbine nozzles, when special steps are not taken to prevent the jet fluid from entraining air from the side of the plate opposite from the jet, and thereby causing a low pressure distribution on that side. The steam jet air pump should also be quoted as an example of this phenomenon.

In this connection the two following simple experiments were performed by myself. In each case a car tyre pump was used to produce the jet.

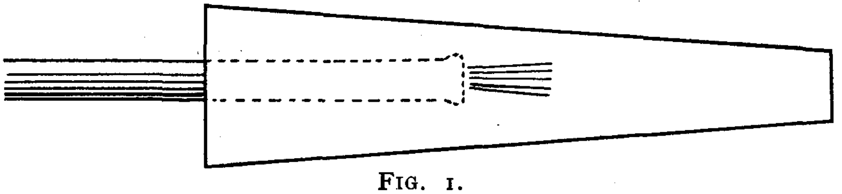

FIG. 1.

In the first, the "jet" was placed in a paper cylinder as illustrated and a source of smoke (a cigarette) was held in the position shown. On slowly depressing the piston of the pump, the smoke was drawn through the tube by the jet; proving conclusively that a jet induces a velocity in the air external to the jet. This effect was also obtained to a smaller degree without the paper cylinder. It is clear, therefore, that the pressure distribution over neighbouring surfaces is affected, and in the case of a jet situated at the apex of a cone as shown in Fig. 2 (as it probably would be in the case of aircraft),

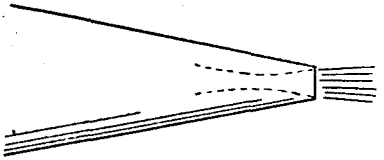

FIG. 2.

the pressure distribution will be such as to constitute a drag. This fact must be allowed for in the estimation of the performance of a jet.

In the other experiment, a hollow cone was substituted for the cylinder. The arrangement is shown in Fig. 3.

The cone was free to move. On pushing down the pump piston, the cone moved vigorously in the direction opposite to the jet, that is from right to left in the figure. It should be added that this effect was only obtained when the nozzle was inserted about or more than one-third the length of the cone. If it were inserted less than this, the cone was blown off, as would be expected.

The behaviour of the cone is very surprising to watch, and clearly demonstrates the existence of a low pressure distribution over the inside surface of the cone as a result of the entraining of external air by the jet. This experiment indicates a method of neutralising the drag induced by a jet.

Dr. Richardson does not indicate the type of compressor used in his experiments, nor does he say whether the temperature of the jet was measured, and since this will affect the density, and further, since the mass discharge appears to have been computed by integrating the jet velocities, the density is very important.

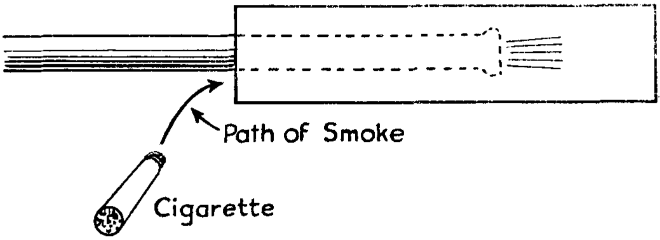

FIG. 3.

Dr. Richardson states at the foot of Page 31, ". . . . while a compressor would not give sufficient power in relation to its weight, we are led to the combustion of solid or liquid fuel as the only practical solution, which means in practice that the jet propeller must be a rocket."

This is a surprising statement, because when the propelled object depends on the product of jet velocity and rate of mass ejection for its thrust, then either the jet velocity must be very high, or the rate of mass ejection must be large. In the first case the jet is very inefficient, and in the second, enormous quantities of "rocket mixture" must be carried for very short flights.

On the other hand, if the external air is to be taken in and expelled with increased velocity, only the means of supplying the energy to the expelled fluid must be carried, namely fuel and the mechanism. The power required by the compressor is of course in proportion to the work it does on the air in increasing its velocity, and if the right type of compressor is selected the weight would not be excessive. The turbo-compressor driven by an engine is clearly one method of applying jet propulsion, and the turbo-compressor is very light in proportion to the work it has to do, principally because it is a high speed mechanism. It also has an enormous capacity in proportion to its size. For example, a turbo-compressor with a 9 in. diameter rotor and peripheral speed of about 1,000 ft./sec. has a capacity of 9 - 12 cubic feet of free air per second.

The ability of a turbo-compressor to deal with such large volumes means that to produce a given thrust quite low jet velocities will suffice, and consequently there is hope of reasonable efficiency.

Another method of applying jet propulsion which appeals to the writer, is the incorporating of the jet as the final expansion in a thermal cycle, as illustrated in the Pressure-Volume Diagram, Fig. 4. Where AB represents the compression of air, $AFHB$ the work of compression, BC heat addition, CD expansion through mechanism designed to perform the work of compression, and DE the final expansion through the propelling jets.

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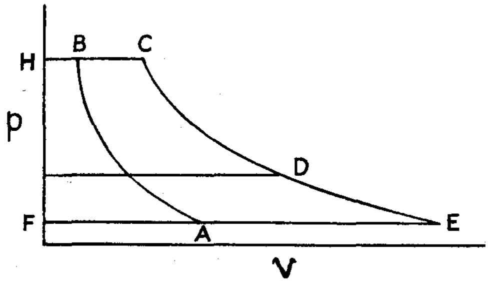

FIG. 4.

The writer believes that this incorporation of the jet as part of a heat engine would result in a much lighter mechanism than the combination of a normal engine and turbo-compressor.

Yours faithfully,
J. WHITTLE.
Flying Officer, R.A.F.

January 24th 1931.

REVIEWS

Jane's All the World's Aircraft, 1930

Edited by C. G. Grey. Sampson Low, 42/- net.

This is the twentieth year of issue of the most useful record of aircraft development published in any country. A history of the development of aircraft since that day in December, 1903, when the Brothers Wright made the first controlled flight in a power-driven heavier-than-air craft, comparable with Mr. J. E. Hodgson's comprehensive history of earlier years, is now badly needed. When it comes to be written one of the most valuable sources of information will be the work started by the late F. T. Jane, and now so admirably carried on by Mr. C. G. Grey.

The year under review has been a quiet one, but every section of the book shows an increase. One predicts that it will not be many years before it must either be curtailed in the immense range it covers, or be issued in more than one volume. The analysis of civil aviation is very thorough and extraordinarily useful and the editor is to be congratulated upon the fullness of it, despite the difficulties of obtaining it. The more difficult information is to obtain, however, the more worth while it is. All praise and no criticism is not good for publisher or editor, so one might add that in the list of Aeronautical Publications in Great Britain appears no notice of *Aircraft Engineering* and the price of the *Journal* is given as 2/6 monthly instead of 3/6, and the price of *Airways* as 6d. instead of 1/-.

Aviation of To-day. Its History and Development

J. L. Nayler and E. Ower. 208 illustrations. Warne & Co., 15/- net.

The names of Mr. J. L. Nayler, Secretary of the Aeronautical Research Committee, and Mr. E. Ower, Assistant Secretary, on the cover of a book, are a sufficient guarantee that that book will be worth reading. Few better collaborators could have been found. The book is a vast survey, an orderly survey, a mass of digested information on aviation which will prove palatable to most. It begins with the Bible " the way of an eagle in the air " and ends with the Royal Air Force Pageant at Hendon. Between such an excellent beginning and

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