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## AERODYNAMICS.

*Resistance of Air.* By Lt.-Col. R. de Villamil. Pp. x+192. (London: E. and F. N. Spon, Ltd., 1917.) Price 7s. 6d. net.

THE phenomenon of the resistance of a fluid to a body moving through it is complicated by the fact that it must depend not only on the density and elasticity of the fluid, but also on its viscous properties and on the nature of the relative motion. Mathematical investigations cannot at present lead to results that can be usefully applied, say, in aeroplane construction. Recourse must be had to experiment. During the past century many results have been obtained bearing on gunnery and navigation, whilst the great progress in aeronautics has been possible only because of the experiments of pioneers like Lilienthal, Langley, and Eiffel, and the systematic wind-tunnel researches at the National Physical Laboratory and elsewhere.

One of the most generally accepted conclusions is that fluid resistance is approximately proportional to the density, the square of rate of displacement, and the square of linear dimension. It is realised that this represents only a rough presentation of the actual state of affairs, and to take account of this fact it has been usual to consider the constant of proportionality "K" as a variable constant, depending on the nature of the fluid, the shape of the body, and the circumstances of the motion.

Col. de Villamil discusses the question in the light of the available experimental evidence, and in order to prevent the intrusion of irrelevant factors he very wisely restricts himself to a consideration of "the law of the resistance [in air] and the coefficients to be used for flat, square, or circular plates—with one or two small exceptions." There are three main questions: (1) Can the elasticity of the air be neglected? (2) Is there a "dimension effect"—i.e. does K vary if the only variable factor is size? (3) How does viscosity affect the resistance?

The author's conclusions can be summed up symbolically in the formula

$$R = K\rho(vl)^2(v/vl + c + bv/V),$$

where  $\rho$ ,  $v$  are the density and kinematic viscosity,  $v$ ,  $l$  are the relative speed and a dimension,  $V$  is the "velocity of flow of the fluid into a vacuum at the pressure of the fluid experimented with,"  $b$ ,  $c$  are constants, and  $K$  is a coefficient of shape. He thus differs from Lanchester, who declares that the elasticity of the air can be neglected, and, though only formally, from Eiffel, and from Bairstow and others at the National Physical Laboratory, who assert the existence of a dimension effect.

Col. de Villamil bases much of his argument on dynamical similarity, and therefore devotes considerable—perhaps too much—space to an elucidation of the fundamental units of mechanics. His manner is vigorous and unorthodox, and his

trenchant criticism of the professional mathematician is sometimes deserved and always enjoyable. Yet if the author desires to be read by "young people" he should pay less attention to polemics and more to notation. Not only is it bad pedagogy to present the innocent beginner with long and detailed criticisms of the false views held by others; but it is also very confusing when, after emerging from this thicket, he is brought up against a peculiar symbolism that suffers unexpected and unexplained changes.

With reference to his explanation of dynamical similarity the author says (p. 5): "I suppose I shall stand to be shot at; and I, equally, suppose I shall deserve it, since I am doing my best to 'give the show away.'" His first sentence on the principle as applied to air resistance runs as follows: "We first ask ourselves, Does the resistance due to viscosity cause change of momentum or not? We know perfectly well that it does: hence it is a 'Force.' We may consequently equate  $\mu^2 L^3 V^2 \rho^n = \text{Force} = MLT^{-2}$ ." Why is this array of symbols used to represent the resistance? Not a word of explanation is given. Why does the author violate his own dictum that symbols of dimension must not be regarded as algebraic symbols? Col. de Villamil need stand in no fear of the consequences of having "given the show away." S. B.

## MILITARY PSYCHOLOGY.

*Il nostro Soldato. Saggi di Psicologia Militare.* By Fr. Agostino Gemelli. Con prefazione del Padre Giovanni Semeria. Pp. xii+339. (Milano: Fratelli Treves, 1917.)

THIS work is a study of the psychology of the soldier, and embraces an analysis of the various psychological processes which come into play during the events of the war. The author, who has made the most of his opportunities during the periods of mobilisation, preparation for fighting, and actual warfare, has conducted a careful inquiry into the causes predisposing to cowardice as well as heroism. Every possible condition which influences the soldier's life has received attention at the writer's hands: the combatant's original bias of mind, his antecedent social life and habits, his training in camp and in the trenches, and all forms of discipline which teach him to consider himself one of a crowd united by spiritual bonds to each other for a common purpose.

There is a very interesting chapter on the psychic factors underlying courageous actions. Many soldiers, having passed safely through several dangers, at length develop the conviction that they have acquired an immunity to death. Some become persuaded that their vital parts will escape injury. Others are buoyed up by religious feelings and formulæ, while others again are sustained by superstition or the war-cries of their regiment. The feeling of danger when shared in common loses in gravity the greater the numbers engaged.