MODERN HYDRODYNAMICAL THEORY, WITH SPECIAL REFERENCE TO AERONAUTICS*

BY F. D. MURNAGHAN

A. General Notions and Theorems

1. *Particle and Local Differentiation.* In hydrodynamical theory matter is regarded as distributed continuously, but its various points are supposed to be capable of identification; we shall refer to them as particles. In order to identify a particle, a material reference frame is introduced, and we shall suppose for simplicity that this is a rectangular Cartesian frame. At any convenient initial instant $t=t_0$, the coordinates of a particle may be denoted by (a, b, c); and at any later instant the coordinates of the same particle may be denoted by (x, y, z). We make the assumption that (x, y, z) are differentiable functions of a, b, c, and t. This assumption

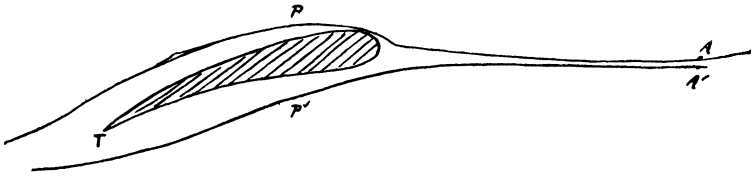

Fig. 1

must be carefully noted since the principal object of interest to us later on will be the flow of a fluid around an obstacle and the fluid will divide at the obstacle. Thus two particles initially adjacent (as A and A' in Fig. 1) will not be adjacent when separated by the obstacle as at P and P'. Our subse-

* This paper is a somewhat formal and detailed presentation of the contents of an address delivered at the invitation of the program committee at the meeting of this Society on October 29, 1927. The adjective modern in the title of the address refers to the first quarter of the present century, but in order to make the paper easily intelligible to mathematical readers who have not specialized in hydrodynamics, I give a statement of the more important results which had been previously obtained.