The example of Denmark has proved a potent influence in the measures which have been taken to develop the agricultural resources and products of Ireland. The export value of eggs, butter, beef, mutton, pork, bacon, and hams from Ireland was in 1912 11,820,356*l*., but in 1913 we received from Denmark alone butter, eggs, and bacon to the value of nearly twenty-two millions sterling.

It cannot be said that this huge difference in value is attributable to a better soil or climate, and, as a matter of fact, it is entirely due to the better education of the people, to a more scientific treatment of the soil and of the animals concerned, and to a stronger sense of the advantages of co-operative effort. It is clear that given these conditions, Ireland, with its much larger acreage and more productive soil, could raise for export the greater part of this importation of food products; and as with agriculture, so with the smaller factory and cottage industries. It is made clear in Mr. Fletcher's address that there is abundant scope for their establishment and development, of which Belgium affords a striking and pregnant example, which the people of Ireland would do well to follow, and thus bring the small town and the countryside into close and harmonious relation.

J. H. REYNOLDS.

AEROPLANE STABILITY.

SOME phases of fore-and-aft or longitudinal equilibrium in flying are discussed by Dr. Orville Wright in a recent publication of the Smithsonian Institution, entitled "Stability of Aeroplanes." Although a beginner finds most difficulty in mastering the lateral control, it is his lack of knowledge of certain features of the fore-and-aft equilibrium which leads to most of the serious accidents.

In an ideal flying machine the centre of gravity would lie in the line of the centre of resistance to forward movement and also in the line of thrust, but in practice this is not always feasible, since the machine must be built to land safely as well as to fly. In flying, a low centre of gravity—that is, one below the centre of support, causes an oscillating movement about the lateral axis like that of a pendulum. On the other hand, a high centre of gravity tends to cause the machine to roll over in landing, and consequently a compromise is adopted.

The two principal methods used in preserving fore-and-aft equilibrium have been the shifting of weight so as to keep the centre of gravity in line with the changing centre of lift, and the utilisation of auxiliary surfaces, known as elevators, to keep the centre of pressure in line with a fixed centre of gravity. The first method has been found impracticable on account of the impossibility of shifting large weights quickly enough, but the second is used in most of the modern flying machines.

Flying machines of the latter type should have their auxiliary surfaces located in the front or rear as far as possible from the main bearing planes, because the greater the distance the greater is the leverage, and consequently the smaller the amount of surface required. No part of either the main surface or auxiliary surface should be exposed on their upper sides in a way to create a downward pressure for maintaining equilibrium.

The downward pressure of air is used to some extent, however, on account of its adaptability, in producing more or less inherent stable aeroplanes. Dr. Wright describes an aeroplane in which equilibrium is maintained by an arrangement of surfaces so placed that when a current of air strikes one part of the machine, creating a pressure that would tend to disturb the equilibrium, the same current striking another part creates a balancing pressure in the opposite direction. This compensating or correcting pressure is secured without the mechanical movement of any part of the machine. While this system will control a machine to some extent, it depends so much on variation in course and speed as to render it inadequate to meet the demands of a practical flying machine.

In order to secure greater dynamic efficiency and greater manœuvring ability, auxiliary surfaces mechanically operative are used in present flying machines instead of the practically fixed surfaces of the inherently stable type, but they depend to a greater extent upon the skill of the operator in keeping equilibrium. If the operator were able to "feel" exactly the angle at which his aeroplane meets the air, at least 90 cent. of all aeroplane accidents would be eliminated. Instruments for this purpose have been produced, but they are not in general use. The average flier does not realise how dangerous it is to be ignorant of this angle, nor does he know when he is "stalling." By "stalling" Dr. Wright means coming to rest in the air, or nearly so.

The danger from "stalling" comes when the operator attempts to check the machine's downward plunge by turning the main bearing surfaces to still greater angles of incidence, instead of pointing the machine downward, at a smaller angle of incidence, so that the speed can be recovered more quickly. Most of the serious accidents in flying occur, after long glides from considerable heights with the power reduced, when an attempt is made to bring the machine to a more level course several hundred feet in the air. The machine quickly loses its speed and becomes "stalled." Those who have seen the novice make a "pancake" landing have seen the beginning of a case of "stalling" which might have been fatal had it taken place at a height of 100 or 200 ft. in the air.

The greatest danger of flying comes from misjudging the angle of incidence. If a uniform angle were maintained, there would be no difficulty in securing fore-and-aft equilibrium. Experiments made during the past year or two have brought about a considerable advance in the development of automatic stability. A device described by Dr. Wright comprises a small horizontal wind-vane so mounted on the machine as to ride edgewise to the wind when the machine is flying at the desired angle of incidence. In case the machine varies from the desired angle, the air will strike the vane on either its upper or lower side. The slightest movement of the vane in either direction brings into action a powerful mechanism for operating the controlling surfaces. If the wind strikes the vane on the underside the elevator is turned to cause the machine to point downward in front until the normal angle is restored, and if the air strikes the vane from above, an opposite action upon the elevator is produced. The author maintains that a machine so controlled is not liable to "stalling." Another method for maintaining fore-and-aft equilibrium utilises the force of gravity acting on a pendulum or tube of mercury, and a second employs the gyroscopic force of a rapidly revolving wheel. In both these systems, however, the angle of the machine is regulated with reference to the horizontal, or some other determined plane, instead of the angle of the impinging air. Other faults render the pendulum and mercury tube useless in regulating fore-and-aft equilibrium, although the pendulum is found to be useful in regulating the lateral stability.

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