THURSDAY, FEBRUARY 5, 1920.

THE NEED FOR AIRCRAFT RESEARCH.

UNDER the stimulus of war the development of aircraft was marvellously rapid, so much so that it not infrequently happened that by the time a squadron of aeroplanes of new and improved design was ready to take the air it was regarded as little else than an obsolete type by its own designers. But with a rate of wastage so high as war conditions made inevitable, one had to get accustomed to such an advance every six months as only the new mental attitude to mechanical developments that the war forced upon us could grasp without surprise. All this is now past. The factories are largely turned to fresh uses, and their skilful staffs scattered to new fields of labour. Even the scientific force of the Government has for the most part returned to the Universities from which it came- notably Cambridge and Oxford.

What is now to happen? Before this question can be answered it must be premised that consequent on the purpose of all this tremendous effort—the defeat of the enemy—having been finally achieved, the diversion of the means to other purposes is no more to be wondered at than regretted; furthermore, we may hope that the need for the re-creation of any such force is remote enough to enable us "to sleep o' nights." The validity of this hope must, however, depend on the sway of politics, and on the political methods followed by the Great Powers—whether a chauvinistic policy be adopted or earnestly avoided.

The enemy to-day is the geographical position with which this country is endowed: as unfavourable for air developments as it is favourable for maritime power. England is not on any air route to anywhere, and its climate deserves, from the air navigator's point of view, all that has been said against it. The sheer march of natural events will not make us an air Power as it has made us a naval Power. Any such result will need to be the consequence of intensely directed effort. But if such an effort can be presumed, then great consequences will ensue, for an air force which can be taught to encounter British climatic conditions and rise superior to them—with the implied possession of the best scientific means of assistance on the ground and in the aircraft—will have been trained in as hard a school as any in the world, and therefore be ready to gain an ascendancy in the easier conditions to be found almost everywhere else.

The experience of the last five years has shown that we have exactly the right kind of *personnel* for air endurance and skill; the work is temperamentally suited to the British type of youth. The aircraft themselves are the best to be found anywhere, and although this does not imply finality it is probable that future important developments will lie in some change of principle, whether thermodynamic (by modification of cycle or change of fuel) or aerodynamic, rather than in greatly improved efficiency in detail. We may, in fact, have to repeat in another fashion our war experience and once more face fundamental problems; we shall not be pressed for time, which will be a great gain, but we shall need all the assistance which can be got from minds trained in the fundamentals of science and as ready as heretofore to face entirely novel conditions. The Universities, at which many of such minds are now again engaged, must help. This, however, is not the most pressing problem; the urgent need is for the provision of means with the utmost rapidity to enable flying in this country, whatever its climate, to be as regular and safe for the traveller as it will surely become in the very near future in other countries.

When the weather is reasonable it is the custom to select that altitude of flight which enables best advantage to be taken of a favourable wind, and perhaps, when flying over Central Africa, that height which adds a pleasant temperature. Under normal winter conditions in this country quite other considerations apply. If the conditions are such as to create, or even to suggest the creation of, local fogs, pilots will choose their altitude from quite another motive; their aim will be to select that altitude which keeps them always within sight of the ground, so that if a fog, or heavy mist, is encountered at ground level, a landing can at once be made. Very often the fog or cloud is not of great thickness, and it would be easy to climb right through it and so to fly in sunshine under a blue sky. By astronomical means the position of the craft could be checked from time to time, and there need be no fear of being blown out to sea when prepared only for a limited number of hours' flight. What makes such flying impossible is not the uncertainty of position, but the doubt whether, when the pilot wishes to land, he will find the lower cloud- or fog-level actually resting on the ground. It is unpleasant enough to walk even a hundred steps along an empty road with one's eyes shut—how much less attractive when one's speed is 100 miles an hour and the feeling of having one's feet on the ground is absent! Unless

this difficulty can be removed, the kind of flying which the future demands and other countries can give can never be learnt or practised in this country.

The first need is for some means of flying steadily through thick cloud, either for the purpose of climbing above it, or to approach through it nearer to the destined aerodrome. This problem has lately been solved by the invention of a "turn indicator" which enables the pilot, whether he can see the ground or not, to know when the machine is being flown straight, and it has the valuable effect of allowing the readings of the compass to be relied on; so the gain is double. But in addition to this it is necessary to provide close co-operation with the ground whenever it is wholly or partially fog-enshrouded. The pilot must be told whether his intended aerodrome is fog-free, and, if not, what other aerodromes near his route are sufficiently clear of fog to be safe havens; this will presumably be by means of some increased efficiency in the wireless telephone. Next to this in importance is some means of indicating or conveying to the pilot his height above the ground that happens to be immediately below his machine. These and other such aids are the kind of requirements needed to make all-the-year-round flying possible in this country. It is only a part of the wide field for research, but it is of vital consequence, and it certainly needs (as it is, of course, receiving) Government support, since the immediate financial reward of success must be slight. Moreover, the work is one of public utility, and should be so treated.

Force is lent to what is here urged by the consideration that the air fleet to be maintained by the Government in the near future is so small that it is only by calling in the aid of private craft that the possible needs of an emergency can be met. For this economical procedure to prove a success it is necessary that civil aircraft should exist in sufficient numbers. To facilitate this calls for the encouragement of all who have ability to assist in making flying safe, in making it popular, in making it efficient.

PHYSIOLOGY OF MUSCULAR EXERCISE.

The Physiology of Muscular Exercise. By Prof. F. A. Bainbridge. (Monographs on Physiology.) Pp. ix+215. (London: Longmans, Green, and Co., 1919.) Price 10*s.* 6*d.* net.

IT may reasonably be doubted whether any two physiologists would deal with the subject of muscular exercise along similar lines, nor is it desirable that this should be so, the subject being so complex and presenting so many different points of view. A comparison of the present volume with the writings of thirty years ago on the same subject is an instructive demonstration of the fact that physiology, as regards certain of its branches at least, has in the course of a generation reached a stage at which experimental results begin to show an integrative connection with problems of a broad and complex nature.

It is with the wonderful co-ordination of functions which is displayed in muscular exercise that the book chiefly deals. The energy usage of the body in exercise may be from eight to twelve times that during rest, and of this about one-third may, in the most favourable circumstances, appear as work; this energy is ultimately supplied by oxidation, chiefly of carbohydrates, and the central point of the problems of the physiology of muscular exercise is that the muscles suddenly demand from the blood a supply of oxygen which is from ten to twelve times what they receive when at rest. "If the body is to work efficiently and to develop its physical powers to their full extent, it is absolutely essential that the movements of the muscles on the one hand, and the activities of the circulatory and respiratory systems on the other hand, should be co-ordinated and integrated into a harmonious whole" (pp. 3–4).

The complex co-ordination of circulation and respiration is to a great extent effected by the central nervous system, though the heart and blood-vessels are to some extent autonomous. Chaps. ii. to vii. deal with an analysis of the changes by which the blood and the organs of circulation and respiration are adapted to their several needs. The heart is itself a muscular machine working with a gross efficiency of 20–30 per cent., and the adaptation of this organ is very fully discussed. This is important, since, in ordinary circumstances, it is the working power of the heart which is the limiting factor to the amount of exertion which is possible in any individual; though training may improve the heart, "no man can be an athlete who does not possess a powerful (*i.e.* a muscular) heart." At high altitudes, on the other hand, the limiting factor seems to be the rate at which oxygen can diffuse through the pulmonary epithelium into the blood.

In the eighth chapter the manner of the exact balancing of the various partially autonomous systems by means of the central nervous system is discussed, and it is shown that, as in so many other instances in the body, the promptness in response to altered conditions is owing to the control of the central nervous system, while the coarser adjustment is effected by the influence of