

consequent improvement in health. The opening of a special station for the study of several obscure stock diseases, committees for the investigation of virus diseases, the preservation of grass and other fodder crops, the addition to the entomological and mycological staffs, and the assistance to fruit research may be mentioned among further efforts on the scientific side.

Finally, the address deals with the role which British agriculture should play in the event of war, and here Sir Thomas would strongly advocate an agricultural policy that would enable the country to produce more food than it now can. The storage of food materials and the ensuring of imports by keeping the seas open, will by themselves not be sufficient and in spite of superior antisubmarine methods in a protracted war the call on the land would be at least as great as it was in the Great War. Much controversy notwithstanding, grass land will have to be broken up and an even more intensive "speed the plough" campaign will have to be carried out, because compared with 1917 and 1918 the arable area has gone down by 3,900,000 acres which is now all under grass. A change in the method of farming is also necessary, *viz.*, a system which under peace conditions would provide about from 35 to 40

per cent. of the requirements and in an emergency would enable us to rapidly increase it to about 50 per cent., that is to say, a system of temporary grass to replace part of the present permanent grass, as is already in vogue in Scotland. The flexibility of the system which makes it suitable both for peace time as well as for war time, is a great advantage in its favour. Many problems would arise in connection with such a change-over from an old established practice of the country and in addition to enlisting the confidence of the farmer much intensive research at a special central research station will be necessary, which will include economic studies and a dissemination of the results of such studies among the younger folk. Sir Thomas is convinced that the change-over will result not only in a larger output of production, but also improve the prospects of farming. The nation, however, will have to pay and as it is for services rendered in connection with defence the farmer's claim will be quite as legitimate as those of others similarly engaged. The address, it must be stated, was written before the war clouds burst over Europe and now that the dreaded situation has actually arisen, the address gains added significance.

A. K. Y.

## Instruments in Science and Industry\*

IN the past, although none too frequently, has the invaluable help rendered by the instrument maker attached either to the laboratory or to a commercial firm, been gratefully acknowledged in many scientific publications. The probable soundness of a theory largely depends upon the accuracy of the data discussed, and among the mathematician's first needs are reliable physical facts. The requirements of the present day are rather exacting and to meet them, all observers now demand far more from their apparatus than was formerly possible, but few realise the amount of thought and labour involved in raising the accuracy obtainable from one per cent. to one tenth of one per cent.

"The development of a particular subject has grown largely with the perfection of the instruments used to investigate it. It is in every way a reciprocal process. By means of an instrument certain evidence is obtained; this evidence does not go far enough, and the instrument must be improved to enable further facts to be found. If, for example, the biologist requires to examine small bodies beyond the range of his microscope, he appeals to the physicist to help him, and the appeal is not in vain. Most probably, as the result of the work on his colleague's problem, the physicist develops a

technique which will be of service either to him or to a fellow-physicist."

Mr. Whippley has chosen for his presidential address, the fascinating, but rather wide theme of the help that instruments have given during the centuries to the development of science. The histories of the microscope, telescope, and spectroscope are recounted in a brief but very interesting manner. Mr. Whippley then deals with the modern auxiliary devices such as the fine dividing engines, temperature measuring instruments, galvanometer and thermionic valve appliances.

"In preparing the design of an instrument it must never be forgotten that a good design helps production. It always pays to spend time in the drawing office rather than in the workshop. The application of geometric design often reduces the cost of manufacture, and makes a better instrument. The experimentalist, in making up his own instrument, should consider whether he can obtain the same result by a simply designed geometric piece of apparatus, rather than the more elaborate design to which he may be attracted.

"The instrument maker constantly receives incentives to progress from the scientific worker to whom he owes not only suggestions, but many of his new materials. If knowledge is to progress, it is essential that theory and practice advance together. Nowhere is this more true than in the development of scientific instruments."

\* Summary of the Presidential Address by Dr. Robert I. Whippley, British Association for the Advancement of Science, Dundee, 1939.