

Agricultural Research at Rothamsted.

THE Lawes Agricultural Trust has recently issued a useful index to the activities of the Director of Rothamsted and his colleagues. The index is described as a "Report" for 1918-20; but within its 86 octavo pages it would be impossible to report adequately on the work now in progress. The pamphlet states the aims of Rothamsted, indicates the methods adopted in its scientific work, and mentions the sources to which those interested in the investigations may go for fuller information.

The aims of Rothamsted have not changed, but in recent years the soil and fertiliser problems investigated by Lawes and Gilbert have been studied in new aspects; the Rothamsted team now numbers nearly forty scientific workers, and includes chemists, physicists, biologists, pathologists, and statisticians. Whereas formerly the chief work might best have been described as the study of the soil, stress is now laid rather on crop production. No possible means of throwing light on the reasons for high or low yield is neglected. The physical condition of the soil; the factors which influence the supply of water to the plant or determine the mechanical effort required in tillage; the character of the soil population and the possibility of control; the gains and losses of fertilising substances; the precise quantities of fertilisers which different crops require; the effects on production of competition within the soil and between the individual plants of a crop, or between cultivated plants and weeds; the effects of overcrowding on the aerial development of crops; the extent to which attacks of insects and fungi reduce the yield; the influence of the year's weather and the cumulative effect of several favourable or unfavourable seasons—all these questions and many ancillary subjects are now engaging attention.

With so many subjects under investigation, the methods of work required of the Rothamsted staff offer many contrasts. No contrast is sharper than that which the element of time introduces. A "time" distinction may not have much importance for those interested only in the results of scientific work; but in dealing with such problems as those which Rothamsted tackles, it raises considerations of very practical moment to the Director and his staff. The study of the organisms present in soils has recently

engaged much attention. Changes in the soil population were so rapid that little light was thrown on their development by the examination of an occasional sample. For a year, therefore, on every day, counts were made of certain species, and now that the year's results have come in it is found that even more frequent sampling and counting will be necessary. In a building adjoining the laboratory, in which a team of workers has been handling samples and studying the ceaseless changes in these Rothamsted soils for 365 days in succession, without even Christmas Day for holiday, there are other samples, faithfully collected and stored by Lawes and Gilbert year after year for more than half a century, which are now awaiting the time when some chemist will turn to them for aid in unravelling the story of the changes in land in which wheat has been growing continuously since the autumn of 1843!

The fate of these old soil samples suggests that problems are not lacking at Rothamsted. There has been a large increase in the staff in recent years; but with agricultural science—as with its raw material, the soil—intensive cultivation increases output. The results, in a sense, are embarrassing. No sooner is a laboratory ready than its accommodation is exhausted, and the Trustees and Director must find more space or see the problems of their staff condemned to involuntary "pupation." It is understood that the entomological staff has, for some time, been awaiting a new laboratory, and that its construction must be put in hand without delay if a "resting stage" is to be avoided.

Not the least satisfactory feature of the work at Rothamsted is the care and trouble taken by the staff to explain the bearing of its studies. This readiness must have been remarked by many recent visitors, and it is reflected in the admirably clear abstracts which the report contains of the more important of the sixty-one papers published within the past two years. The abstracts are arranged in two groups—scientific and technical. A subject is not necessarily dealt with in each series; frequently publication in one or other form suffices. But nearly all the material embodied in the scientific papers is ultimately used in papers suitable for farmers' journals.

Scientific Research in the United States.¹

By J. W. WILLIAMSON.

THE two papers referred to below, written by the Chief Physicist of the Bureau of Standards, whose recent death is widely deplored, though dealing only with the question of scientific research as it affects the United States of America, will well repay the careful study, not only of British scientific workers, but also of all British citizens who wish to form a just estimate of the part that scientific research should play in the national economy. In the first of the papers Prof. Rosa set himself to answer the inquiry: "Whether scientific research as carried on by the Federal Government is a luxury or a necessity; whether it is something to be enjoyed when taxes are

light, and curtailed when taxes are heavy; or whether it is creative and wealth-producing, and therefore to be increased and developed when expenses are abnormally large and a heavy debt must be liquidated?" In an interesting and informative examination of the national Budget he shows that the appropriations for obligations arising from recent and previous wars and for the War and Navy Departments amount to 92.8 per cent. of the total, public works to 3 per cent., primary Governmental functions to 3.2 per cent., and research, education, and developmental work to 1 per cent.

Prof. Rosa pregnantly observes: "One is led to wonder whether the total burden of taxation would not be lighter if the expenditure for scientific and developmental work were increased; if, for example, it were one dollar per year *per capita* instead of fifty cents." He answers the question by a detailed account of how the fifty cents *per capita* is expended

¹ (1) "The Economic Importance of the Scientific Work of the Government." A lecture given before the Washington Academy of Sciences on May 20, 1920. Reprinted from the Journal of the Washington Academy of Sciences, vol. 10, No. 12. By Edward B. Rosa.

(2) "Scientific and Engineering Work of the Government." Reprinted from the February, 1921, issue of *Mechanical Engineering*. By Edward B. Rosa.

and what is accomplished thereby. We have not space to dwell on his review of the work of the various Government Departments included in the classification of "research, education, and developmental work." It embraces the activities of the Agricultural Department, the Geological Survey and the Bureau of Mines, the Bureaux of Standards and of Foreign and Domestic Commerce, the Coast Survey and the Bureau of Fisheries, the Bureau of Labour Statistics, the Woman in Industry Service and the Children's Bureau, Educational Work, the Public Health Service, and co-operation by the Government in Industrial Research and Standardisation. We may note, however, that nearly two-thirds of all the expenditures made under this group of services are for the work of the Agricultural Department.

To the scientific research designed to develop the industries of the country Prof. Rosa refers in more detail. He has no difficulty in showing the necessity and the value of an increased expenditure, wisely applied, in this field. In the course of a summary of his argument he well says: "It is stupid and blind to think that because taxes are heavy we cannot afford to do things intelligently. If a farmer's barn burns down, he would not sell half his supply of seed and fertiliser to buy lumber, and then plant only half a crop. He would, if necessary, borrow money to buy more seed and plant a larger crop than usual in order to increase his income and pay for the new barn more easily. Intelligent research by the Government, in co-operation with the industries, is like seed and fertiliser to a farmer. It stimulates production and increases wealth, and pays for itself many-fold. It is as productive and profitable in peace as in war."

If we put aside the temptation to ask why the barn was not insured against fire, the illustration is apt enough for a world painfully recovering from the ravages of war. But America is not the only country

where the superficial economists, appalled by the weight of taxation, begin to economise by cutting down expenditure in the productive services of "research, education, and developmental work." It is a pity that Prof. Rosa's paper will not be read by the "anti-waste" apostles. It is easy to gain a reputation for economy by shouting loudly "We cannot afford it," and difficult to realise that there are some things we cannot afford not to afford.

In his second paper Prof. Rosa usefully supplements his general argument in the first paper by a careful inquiry into the actual expenses of the various departments of bureaux of the Government. He begins by admitting that there is in the mind of the general public a feeling that the scientific work of the Government is not carried on so successfully or so efficiently as it should be, and that it probably costs too much. In order to get an accurate knowledge of Government expenditures and to ascertain how they have increased in recent years, the receipts and expenditures of all departments for the last ten years were analysed. The analysis given by Prof. Rosa is full of interest, and is illustrated by several ingenious diagrams. We have not space to review this analysis, but we may note one conclusion: "The *per capita* cost of the civil side of the Federal Government in 1920 was only a little more than half of what it was in 1910 if measured in commodities or in money of equal purchasing power. During this ten-year period the wealth of the country had greatly expanded, the war had come and gone, the problems of Government had enormously increased, and yet the *per capita* cost of these civil activities measured in commodities had fallen to a little more than one-half. In face of these facts people are saying that the Government is extravagant, inefficient, and overdeveloped." That sort of criticism is not peculiar to the people of America.

Cotton Research in Egypt.

THERE has been for many years a great deal of talk about research work on cotton. The Empire Cotton Growing Committee put research in the forefront of its programme, and it was originally suggested that a research institute should be established in Egypt. About the same time the British Cotton Industry Research Association was established in Manchester, but so far it has not done anything in the way of cotton-growing except to discuss methods of co-operation with the Empire Cotton Growing Committee. The latter has, of course, not been able to do much yet, owing to the time necessarily involved in its reconstruction into the new Empire Cotton Growing Corporation.

In the meantime, the Egyptian Government took its own steps by setting up in May, 1919, a Cotton Research Board, consisting of representatives of all the Departments of the Government which are interested in cotton-growing. A very brief preliminary report was published by the Research Board in March, 1920, and the first annual report embodying a review of the work done up to this date is now before us.¹

The report proper deals in about fifty pages with the experimental work which has been done on cotton during the year 1920. This work has covered a very wide field, including botanical work on cotton and cotton-breeding (in which selection has apparently

played a very much larger part than hybridisation), the selection and propagation of seed by the State domains, and a number of variety tests. Experiments on spacing and on the effect of water on the crop are described, as well as the work done in connection with insect pests, especially the pink boll-worm, and some mycological research. The programme of experimental work for 1921 is also outlined. Much of the work is still unfinished, and certain parts of it will be published by the Departments concerned in other forms as soon as results are available.

The Research Board has, however, very wisely not confined this report to its own work, but has added about 75 pages of reports on special questions considered by the Board, many of these more of an economic than of a purely scientific character, and a number of useful summaries of various publications of the Ministry of Agriculture made within the last few years on subjects affecting cotton. There are also reviews of publications from other sources affecting cotton and some very useful appendices. This supplementary matter deals with such questions of direct economic importance as the development of Pillion cotton in Egypt and its threatened supersession of the superior variety known as Sakel. It also covers the development of Pima cotton in Arizona, U.S.A., which looked for a time as if it might prove a serious rival to Egyptian. On the latter point, however, Egypt has probably derived considerable reassurance from the very marked reduction of the Pima crop this year owing to the fall in prices

¹ First Annual Report (1920) of the Cotton Research Board, Ministry of Agriculture, Egypt. (Government Publications Office, Cairo.) 10 piastres (2s. 1d.).