Letters to the Editor.

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Agricultural Research.

ON returning from a lecturing tour in Canada and the United States, I find among the files of NATURE "Cantab's" interesting letter in the issue of September 27.

I had no intention of being despondent in my address to Section M (Agriculture), nor is there occasion for despondency. It is true that science has given only few aids to agriculture of the order of 100 per cent. increase in yield, but much has been done of a less spectacular nature, and agricultural experts are now able to advise farmers with considerably more certainty than was the case even thirty years ago. There have been great changes in practice, and science has helped considerably.

The history of agriculture shows that advances have come in three ways: from purely empirical methods tried by farmers with no definite scientific plan; from experiments on empirical lines made by trained workers: and from advances in pure science, whether initiated in a purely scientific, or, as has often happened, in a technical laboratory. It is a fact that in the past some of the biggest advances have been made by empirical methods, but one cannot infer that scientific methods are therefore inferior; only in recent years have they been adequately tried. Our knowledge of the biochemical changes in the soil, of the soil micro-organisms, the soil solution, and the soil colloids, quite apart from the genetical work to which "Cantab" referred, has all come as the result of purely scientific work, done solely with the view of gaining information, and with no idea of practical applications. Little of this knowledge is yet used in practice, for the simple reason that no one has found a way of using it, but all history shows that the application comes sooner or later once the scientific discovery is definitely established. There is every reason to hope that agricultural science has fresh triumphs in store.

In recent years it has been easier to apply scientific methods in agricultural investigations because many of those responsible for the management of agricultural institutions, and especially the younger men, appreciate their value and realise the necessity for the so-called "academic work." No honest person working on scientific lines would ever commit himself to a definite promise that a particular investigation would have practical results; he can, however, so conduct it that it will yield sound knowledge. It is of course true, as "Cantab" points out, that epoch-making discoveries have not yet come direct from team work or directed research. But it must also be recognised that advances of this order are in any case very rare, and when they come it is largely as the result of the less spectacular, but none the less real, advances in knowledge which can be made in the well-equipped organised institution. No research institution can do more than hope for first order discoveries, but the staff can, at any rate, ensure good development work, and secure advances which in the aggregate count for much.

Like all other forms of research, agricultural research is finally limited by the state of knowledge of other branches of science; and a logical scheme of assistance would recognise the claims of all pure science. The present schemes may not be very logical, but knowing something of the methods by which a research institute has to be sustained, I am not sure that the departments of pure science have always adopted the best methods for obtaining assistance. A great difficulty of research institutions—and it must be far greater to the layman—is to know just what are the methods and the results of science, in other words, whether the limitation imposed by lack of knowledge in pure science lies in the man or the science. The agricultural investigator received his training in pure science it may be ten or twenty years ago; he tries to keep up, but is overwhelmed by the enormous and ever-increasing volume of papers of very varying merit and lucidity. The Chemical Society facilitates his task by issuing annual reports on the different branches of chemistry, but many other scientific societies have not followed this good example. There must be many papers in pure science buried in the libraries which would prove of great value to agriculture if they were known, but they are not. At Rothamsted we have adopted various devices for keeping in touch with pure science, one of the best of these being to bring young men and women from the purely scientific laboratories from time to time to take part in our work. This is one example of the "team work" to which I referred in my address as being among the hopeful ways of securing advances in agricultural science, another being co-operation between institutions engaged on different aspects of what may be fundamentally one and the same problem.

Team work makes it possible for the different workers to keep in touch, and to utilise advances made in other subjects. It has other advantages too, for even the wisest of mortals will never see a scientific problem as a whole, but only in part.

E. J. RUSSELL.

Rothamsted Experimental Station,
Harpenden, October 20.

Series in the Spectra of Aluminum and Magnesium in the Extreme Ultra-Violet.

PASCHEN (*Ann. d. Phy.* 71, p. 152, 1923), in his investigation of the spectrum of doubly ionised aluminum (Al. III.), and Fowler ("Series in Line Spectra," p. 120), in his study of ionised magnesium (Mg. II.), have pointed out the type of series relations which exist in these substances, and have arranged many lines to conform to them. In a study of the spectra of both aluminum and magnesium in the extreme ultra-violet, under various forms of excitation, I have recently observed certain lines which appear to be higher members of some of the series discovered by Paschen and by Fowler; Millikan has already identified the two strongest, but the remainder seem to have escaped observation. The wave-lengths and the series to which these lines belong are given in the following tables.

Al. III.

$3p - md.$				$3p - ms.$				$3s - mp.$			
Obs. λ	Int.	Calc. λ	*m.*	Obs. λ	Int.	Calc. λ	*m.*	Obs. λ	Int.	Calc. λ	*m.*
891·9	(1)	892·0	4	855·0	(3)	855·02	5			695·8	4
893·8	(2)	893·9		856·7	(4)	856·76		696·0	(6)	696·2	
				725·7	(1)	725·6	6			560·3	5
				726·7	(2)	726·8		560·3	(3)	560·4	
								511·1	(1)	511·2	6