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Farming will never be a success unless the farmer had more voice in the disposal of his produce.—P. Morrel.

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THE DEVELOPMENT OF AGRICULTURAL CHEMISTRY

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The study and understanding of Chemistry as we know it to-day emerged from the mists of alchemy towards the end of the 16th and the beginning of the 17th centuries, when Paracelsus introduced a system of experimentation to science and taught for the first time that life was a chemical process and the bodies of men and plants chemical laboratories. Experimental and Inorganic Chemistry grew rapidly, the elements and their compounds were studied and analysed, and great advances in knowledge of the material universe around us were made. But for a long time a hard and fast line was drawn between what we now call Inorganic and Organic Chemistry, and the belief was held that compounds manufactured by the life processes in the bodies of animals and plants could not be made in the laboratory. This theory was held till 1828 when Wöhler synthesised urea in the laboratory and opened up an entirely new field of discovery. This led Liebig in 1840 to turn his attention to agricultural Chemistry and expound views of soil fertility. He tested out his theory on a piece of barren land at Gissen and discovered by actual experiment that by feeding the soil with nothing but mineral fertilizers he could turn it into as fertile a spot as could be found in all Germany. He discovered that plants could manufacture their organic materials from air and water. This pioneer work was followed up by Sir John Lawes, who started the Experiment Station at Rothamsted, in 1834, a station which has become famous all over the world.

Thus was the systematic study of agricultural Chemistry begun and the writer feels sometimes that on a quiet moonlight night one ought to meet wandering round some of our modern Experiment Stations two old gentlemen in old fashioned dress, nodding their heads and gravely looking at our development in the lay-out of plots, command of fertilizers, and plant-breeding successes with quiet satisfaction—Liebig and Sir John Lawes. To them we owe the foundations of our present knowledge.

The Rothamsted Experiment Station soon led to a great belief in the efficiency of mineral fertilizers for increasing the vigour and yield of crops. Steps were taken to manufacture them, first of all superphosphate, and then through a long series of wonderful engineering feats, aided by high power electricity till to-day, we have great organisations like Imperial Chemical Industries Ltd. making sulphate of ammonia and other nitrogenous fertilizers from the nitrogen in the air.

In those early days men held the belief that farming might be only Chemistry and a question of the supply of mineral salts to the soil in the right quantities and proportions.

Gradually, however, with the increase of knowledge, these hopes were modified and it was discovered that soil fertility was not quite such a simple matter as that. By the middle of the 19th century, led by Pasteur, the discovery of bacteria and the mechanism of fermentation processes was made, and this threw a new flood of light on processes which take place in the soil. The importance of soil bacteria and organic matter became apparent, and chemists and bacteriologists realised that something more was involved than mere constant supply of mineral fertilizers. Even in face of the Rothamsted experiments, farmers were puzzled by the fact that manures like dung, relatively poor in actual mineral plant foods, produced wonderful results and that equally good results could be produced by green manures. Thus results, like the following were obtained :—

	Yield per acre		
At Rothamsted	Wheat Average of 71 seasons	Barley Average of 70 seasons	Mangolds Average of 45 seasons
14 tons of farm yard manure ...	34 bushels	46 bushels	18 tons
Complete artificials	31 ,,	41 ,,	18 ,,
At Woburn			
7 tons of farm yard manure ...	20·6 bushels	27·7 bushels	...
Complete artificials	18·4 ,,	18·7 ,,	...

	Grain per acre in lb.	
At Pusa	Maize	Oats.
Farm-yard manure to supply 20 lb. N. per acre...	98[illegible]	852
Sulphate of ammonia to supply 20 lb. N. per acre	59[illegible]	472
Complete minerals equivalent to the farm-yard manure	984	908
Green manures with superphosphate ...	,367	1,288

Artificial fertilizers undoubtedly do produce practically the same results as dung, but not better results as was at one time hoped, and so it becomes largely a matter of economics. If artificials can be bought more cheaply than dung, or if the latter cannot be obtained in sufficient quantities it would appear that it should be possible to use them instead and make them profitable from the yield point of view.

Gradually, knowledge accumulated which began to make the soil processes and the nitrogen cycle clear, and mineral fertilizers began to fall into their place as immensely important, but not all-important. Then came minute studies of human and cattle diets and the modern discovery of vitamins, and once again vistas were opened up the end of which are not yet clear.

Work in which the Research Institute at Coimbatore has taken a part of which it may well be proud, has begun to show us that organic fertilizers play a part hitherto unsuspected in the manufacture of elusive bodies the composition and functions of which are not yet fully understood. These we call vitamins. The plant absorbs them, being apparently unable to manufacture them for itself, and on their presence or absence depends the feeding value of the resulting grain or fruit or vegetable as the case may be. Animals, including man, get their vitamins from the vegetable world which they use as food and again are apparently unable in most cases to manufacture them for themselves, except perhaps through the medium of certain rays in sunlight falling on the skin. If these vitamins are absent, or not present in sufficient quantities, a group of diseases are apt to develop, known as deficiency diseases, of which rickets and beri-beri are typical examples. All of which goes to show that soil fertility is a most complicated business which ramifies into the quality of the food products produced and the ultimate effects of this on diet and disease.

We have by no means come to the end of our knowledge on this subject; possibly we are only at the beginning of it and the future may open up to us an entirely new view of agricultural Chemistry and the management of the soil, into which organic and inorganic fertilizers will fall into their proper places as nicely-balanced supplementing aids to crop production. Already our ideas have undergone vast changes since Liebig's days and they may undergo in the distant future still more drastic changes as knowledge accumulates, and we gain power and control over natural laws and learn to obey them. However that may be, we cannot be too grateful to the pioneers to whose devotion to science we are indebted for our present knowledge and their memory should be ever kept warm in our hearts as examples of whole-hearted devotion to the pursuit of truth and knowledge.

HINTS FOR FITTING PLOUGHS

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When fitting ploughs, the shares should be fitted first. If the share has more than one bolt, both bolts should be fitted with their respective nuts and tightened up as far as possible with the fingers. In the final tightening up with a spanner, both nuts should be slightly tightened, one at a time until the nuts are bearing the same pressure and a final pull on each in turn will finish the job without fear of breakage. *When fitting Chilled cast shares, never tighten one nut up tight and leave the other loose because if there is the very slightest irregularity in the casting, it will crack as soon as the second nut is tightened.*

(2) Mouldboard should be fitted after fitting the share, and the very same precaution should be taken while tightening up the nuts, in order to