# GENERAL.

## AGRICULTURAL RESEARCH IN RELATION TO THE COMMUNITY.*

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It is a common reproach that agriculturists have not made the same use of science as have those engaged in the other great industries—that farming is still a rule-of-thumb process carried out by methods which have their origin in the dark backward and abyss of time. In some respects this is indeed true. One has only to read Cato or Columella to realise that the Italian peasant of to-day is working and living in very much the same way as his Roman forbears, and even the more highly organised farming of Great Britain or Denmark or Holland is carrying on many of the essential operations of cultivation on lines that were laid down by the first great civilisers—the Romans. It is easy in fact to trace modern agriculture to a Roman ancestry; in Britain, for example, by the transplantation from the fifteenth century onwards of the traditions and practices that persisted through the Dark Ages in the Low Counties.

None the less progress has taken place and scientific development is going on. Under mediæval systems of agriculture the yield from England's land was of the order of six to eight bushels of wheat to the acre. The enclosure of common lands, the introduction of a recuperative clover crop into the rotation and of forage crops like turnips for the winter feeding of cattle and the making of farmyard manure, the return to Roman methods, in fact, raised the level of production to about twenty bushels of wheat per acre. This was about the average when agricultural science dawned nearly a hundred years ago—say about 1840, when Liebig exposed his theory of plant nutrition and Lawes began his experiments at Rothamsted. Growing scientific knowledge and the introduction of fertilisers raised the level of English production by 50 per cent. during the next generation, so that by 1870 the average yield of wheat per acre in England had become thirty-two bushels. At that level it has more or less remained down to the present day because a new factor then came into play, the importation of cheap wheat through the opening up of the Middle West of the United States, and of Argentina and Australia. The economic factors of gold scarcity and rising costs of labour co-operated to limit the profit attached to high farming: the English farmer had to cheapen his production and lower his standard so that he only obtains the same yield to-day, though the acreage under wheat has shrunk on to the better land. Latterly we have seen the yield creeping up a little through the introduction of heavier cropping wheats—the products of scientific research.

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In other directions there has been progress. The introduction of the self-binder alone has meant great economies in man power. I estimate that by the use of machinery in one way or another English farming with an equal or greater output, employs some 25 per cent. less labour than it did fifty years ago. Cattle feeding is more economic. Breeding for early maturity, better adjustment of rations either for meat or milk production, have all tended to a cheaper output. There is still an immense margin for improvement. From scientific experiments one may calculate with some degree of confidence how much meat and milk a given quantity of fodder of one kind or another ought to yield. Yet when in the dark days of the war we took stock of our resources of cattle food, because tonnage could no longer be spared for aught but human food, soldiers or munitions, it was estimated that in the five years before the war the farmers of the United Kingdom at large only realised one-third of the meat and milk that was theoretically possible from the fodder that had been then available.

Disease amongst animals is another field in which research has not been idle; enormous savings have been effected in the average efficiency of our flocks and herds. Yet last year Great Britain had to pay a bill approximately $20,000,000 to stamp out foot-and-mouth disease, and this was compensation only for slaughtered animals and took no account of the losses the farmers endured by the break-up of their businesses.

Great are the achievements and still greater the possibilities of agricultural research, but we must recognise that there are limitations to the effect of science upon agriculture which do not hold for the other industries. In the first place, in agriculture we are dealing with a living organism and the amount of control that we have obtained over plant or animal, over that stubborn essence we call life, is far less than we can exercise over inanimate nature, over iron or cement, over even the ether or the atom. When we attack vital problems we find that we cannot speed up processes or enlarge the unit in the way we can deal with the dynamo or spinning frame. It still takes the wheat plant six or nine months to develop, and cows bring forth their calves neither more quickly nor more numerously for us than they did for Abraham. We see no way of growing three or four crops a year under temperate climatic conditions. The organisms we are dealing with will go through their cycle and you cannot hurry them. When you start hustling you find you let in secondary troubles of all sorts.

These limitations lie in the nature of things, and though on looking back we can count up the immense advances that agriculture owes to the application of knowledge we must not hope for sudden developments or revolutionary changes such as have been seen in flying or wireless telegraphy. In fact, for the time being I am bound to say that agriculture is actually suffering from the rapid developments and scientific achievements that have distinguished other industries. I say this advisedly and most solemnly. Agriculture is the fundamental industry, because we must all be fed, and yet you cannot point to any part of the world where agricultural wealth is being turned out and find the producers in a flourishing condition.

The rewards in agriculture, whether to the capitalist entrepreneur or to the laburing man, are not commensurate with those obtainable in industry or commerce, and so men are being drawn away to the towns and capital

is being diverted from the farms. The movement is one common to all civilised countries, its sources are social as well as economic. The lure of the town has been secular, but modern facilities of communication and transport have given it a range of action hitherto unknown; yet it cannot go on for ever, for the world must be fed. One must interpret the steady rise of food prices which has marked this century, a rise now being resumed after the excessive fluctuations caused by the war, as evidence that we are approaching a limitation to the development of the towns because there is not food enough to go round.

The old economists would see a simple solution to this impasse ; prices of food have only to rise sufficiently and men will be attracted back to the land in order to secure the profits it promises—the balance will be restored. But, looking back historically, has this ever happened? I can find no example of an urban population migrating into the country. If the country-side does replenish itself in men it is by breeding and by finding space in the country for the country bred. The great increase in the food supplies of the world the last half century has witnessed has been due to the new countries becoming accessible, whereby opportunities were given to the rural population to put their sons on new land. But that process is nearly at an end, there are no longer the great vacant areas waiting for men.

Are we not to look for progress in another direction ; can we not so intensify the farming of our existing land by taking advantage of science, machinery and organisation that agricultural production will become an industry capable of competing against other industries for men and capital ? It was by a process of this sort, by enclosing the common lands and building up small capitalist businesses, that Britain succeeded a century and a half ago in meeting the needs of a population which was then beginning to expand as the industrial age approached. Our businesses have remained small, too small to be efficient to-day perhaps, and I can point to few examples of large scale industrial farming in successful operation.

In fact, though I pin my faith to big business on the land as necessary to the future production of food in order to meet the growth of cities, I am bound to say that the current seems sweeping in the other direction. Agricultural businesses, such as we have, find it difficult to pay the wages that will retain men on the land, with all its disadvantages of quietness and lack of amusement. Social and economic motives in our country are working towards the break-up of farming businesses into single-man or rather family farms, and similar forces have been even more powerfully at work in Continental countries in dividing up the land. The desire of men for independence, the determination to call no man master, the innate feeling among country folk that a man has a right to a bit of land of his own as he has a right to vote or to a soul of his own, makes in many countries the single-man holding a burning political question. And the man is ready to pay— to pay in labour, in days that endure from dawn to dark, in days that include the hours of his wife and children; in toil as against the regular pace of a factory, for the privilege of being a landowner.

But I doubt whether the process is fundamentally economic. Farming may become immediately more intensive when a great estate is cut up into

small holdings, but the community so created becomes an unprogressive one, little fitted to take advantage of modern science, modern machinery, modern organisation. It is fundamentally uneconomic because it is employing more men than are necessary to produce the food on which the community can be supported. I conceive it to be possible for 15 per cent. of the working population to be able to produce the necessary food for the rest of the nation, and the larger the margin that remains after this prime task has been performed of men who can be making boots and clothes, houses and motor cars, the greater the divisible wealth of the community.

But the only hope I can see at present for large-scale production for organized industry on the land, lies in the advances that science can make. It is research alone that will enable the big agricultural business to compete with the excessive labour of the one-man farm, to pay wages and give conditions of life to its workmen equal to those prevailing in the urban industries. It becomes then a matter of the first import to the growth of civilization itself, not merely to agriculture, that agricultural research should be encouraged.

We may consider research from two points of view. In the first place, it is an intellectual affair carried out by the individual in response to the insatiable curiosity of the mind about its surroundings and its own existence. As such, it proceeds from an artistic impulse, it is not under control and it is not amenable to considerations of utility. Just as some men must write poems or paint or make music, as other men find themselves compelled to speculate, to become philosophers or metaphysicians, so similarly the class of men we are considering must investigate nature.

The passion to do this is part of the man's make-up and cannot be created by any act of will on his part. I may remind you of the story of the old school-fellow who met Dr. Johnson at the height of his fame. "Doctor," he said, "I have often tried to become a philosopher myself, but cheerfulness will keep breaking in." And as a man cannot deny himself a desire to investigate, so he is not drawn to investigation by any ulterior motive.

I may take an illustration in the science of astronomy. Historically the study of the stars would appear to have had its beginnings in the search for useful knowledge. In the early civilisation of Egypt it was necessary to find out a means of determining exactly the length of the year and the recurrence of the seasons. Later on the delusive promises of astrology led to further observation, and as we know, the first organised observatories were built for the service of the sailor for the drawing up of what we call a nautical almanac. But these prime necessities were easily satisfied and the real science of astronomy cannot for the last hundred years have served any useful purpose to any man. None the less, the development of the science and the foundation of observatories has proceeded at a greater pace than ever before, purely in response to the universal feeling of curiosity. Oddly enough, this kind of knowledge has proved itself singularly attractive to the American millionaire, who has latterly been the great founder of observatories. Indeed the uselessness of astronomy is to many people one of its great attractions. A great astronomer once said to me:

"One advantage I enjoy is that my science cannot make money for anybody. At least no merchant traffics in my heart." We may parallel this feeling with the remark of some noble lord who was being congratulated on his elevation to the Garter. "The best of the Garter is that it implies no damned nonsense about merit."

Research again possesses this quality in common with what are usually called the arts—its characteristic mental process is intuition. When we were students we used to be told that the two processes of thought by which science proceeded were deduction and induction. It was pointed out that the barrenness of the mediæval school-men was due to the fact that they worked by deduction alone from imperfect premises. Bacon became the father of modern science by recalling it to induction and to the painful collection of facts. Bacon's apothegm was recalled, "Hypotheses non fingo," and it was suggested that the method of science was to collect an assemblage of facts and put them into some kind of sorting machine, whereupon a theory will emerge. However, a little examination of the actual history of discovery soon shows that it does not proceed in such a fashion. The function of facts is to provide tests for your hypotheses, but you cannot begin to collect the facts unless you have a preliminary hypothesis.

Let me take an example in the science of meteorology. For generations people made observations of the weather, set down the records of temperature, rainfall, barometric height and so forth. Nothing whatever came of these facts until in the study one or two workers evolved from their own consciousness the theory of the cyclone. Induction in fact failed. Bacon's other great catchword, "Experimentum crucis," showed that he really had a better appreciation of the true processes of science, and the really beneficial influence he exerted upon the early science of the seventeenth century was that he directed men's attention to experiment and to the mechanic arts as the sources of knowledge. To come back to our text, neither induction nor deduction complete the story of the mental processes by which investigation proceeds. We now realize a third category in the shape of intuition, the power of seizing the truth by a sudden flash of illumination. Indeed, the great discoverer may be a man in whom what is commonly called the scientific habit of mind is imperfectly developed. He may not be severely logical, methodical in his arrangement of facts, meticulous in accepting deductions.

As a recent example we may instance the late Sir William Crookes, whose marvellous discoveries certainly did not proceed by a process of minute but steady accretions from known foundations. By a sudden jump of mind he invented the radiometer, regarding which his explanations were mistaken, but his intuition led him from this point on to the whole gamut of high vacuum discovery which has resulted in such developments as the Rontgen rays, the elucidation of the structure of the atom, wireless telephony, etc. Sir William Ramsay provides another instance. In the eighteenth century Cavendish had noted that after removing all the oxygen and nitrogen from air a small residuum was left uncombined. In true scientific spirit he puts this down to the inevitable errors of the experiment. But working on the same track and worrying over the discrepancy between the atomic weights of nitrogen from different sources, Ramsay's intuition led him on to the discovery of argon and the range of new light elements.

So far I have only been considering research from its intellectual side as a response to man's curiosity, but the nineteenth century proved it had also a practical side inasmuch as it led to an enormously increased control over the forces of nature. I need not sing the praises of what had been effected by steam, by electricity, by modern medicine: willy nilly the results are being incorporated into our daily life. Research leads to efficiency, and efficiency is a means of making money. The modern State must cultivate research if it is to become efficient and survive in the world's competition; hence all are agreed now on the endowment of research, and since in farming there are no great business corporations, agricultural research must for many years to come be maintained by the State.

If, then, research is to become of such importance to the State, it behoves us to ensure conditions for the research worker under which discoveries are likely to be produced. To do this properly we must understand the psychology of the investigator. If it is true that research, like art, grows by a process of intuition, we can no more organize it into existence than we can organize the output of poetry. Nor are we likely to obtain it by a system of prizes, of rewards, commensurate to those obtained in the great professions, in industry or commerce. What we can do is to contrive sheltered places in our community in which research workers can live. We cannot guarantee results but we may wait in faith because, as we have said, the impulse to make discoveries is fundamental in man's mind. Now the sheltered places in which the research worker can live are the universities.

One last word, the State must have research in order to obtain efficiency, but does mankind really care about efficiency? At bottom man does not, he wants to "loaf and possess his soul." Efficiency is a beautiful word, but efficiency to what end? If pursued for its own sake it may become a curse. Many people have vivid recollections of the sufferings they endured under a really efficient parent in an efficient household. I myself, am officially engaged in promoting efficiency, in bringing up the efficient farmer and in insuring the efficient use of the land. But I cannot help having a great deal of sympathy with the old-fashioned farmer, who is content with what the land brings him, who is making his living but not worrying overmuch about making money. He is often inefficient, but again he is often a very worthy human being.

To take another illustration, I have a vivid recollection years ago of a little piece of swampy meadow, half encircled by a brook, which after other wanderings found its way into the Thames. There was a patch of reeds and willows, and old salley garden, where the reed-warbler swung her nest and flitted through the tangled herbage. The wet meadow itself was starred over in August with Grass of Parnassus. It was indeed one of the most southern holds of that flower of the cool northern hillsides. Well, the efficient man came along, saw his opportunity, grubbed up the willows and laid out the meadow in water-cress beds. He is a benefactor of his kind and has caused millions of blades of an edible kind to grow where there was none before; but I have a sore spot in my heart for the vanished warblers and the lost Grass of Parnassus. I fear, however, that the pursuit of efficiency is one of those contradictory elements in man's make-up

that won't let him rest, that is always urging him against his will towards further attainment. What a dreary prospect if it only results in adding an ever greater and greater population to a world always working harder and harder! Is there any way out of this impasse? I can only again suggest the kindly force of that other element in the texture of men's minds, the passion for artistic expression. The winds of beauty come and go, but as they rustle through the tree of life, among the dropping leaves that are ourselves, men will cease from their toil to listen and pause to retell in song or story, in paint or stone, the message they bring.—The Journal of the Ministry of Agriculture, Vol. XXXII, No. 4.

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# ESTATE ACCOUNTING.

## AN ADDRESS TO PLANTERS.

On the 15th June the members of the Rantau-Port Dickson Club were entertained to a lecture on "Estate Accounting" by Mr. Monilaws, of Jemima Estate, F. M. S.

In introducing his subject Mr. Monilaws pointed out that he was to speak not so much on Estate Cost Accounting as simply Estate Accounting, the interpretation of "Cost" being usually recognised in accounting circles as the aggregate cost of parts in their course of manufacture. Proceeding, Mr. Monilaws said:—

I do not propose to take you into all the intricacies of book-keeping, but will treat the subject in as elementary a manner as possible. On estates we are only concerned with what is known as the f. o. b. cost, that is the cost of placing your rubber, tea, coconuts, etc., free on board, after which the Manager's responsibility ceases, further charges being known as "Overhead," and as these do not concern the actual estate account, they can be passed over.

Now I take it that all of you have at least seen an estate account form. These vary on different estates, as do the systems of book-keeping and the books employed. But the principle throughout is the same wherever you go. You cannot alter that. If you have $200 and spend $150 you must have $50 left and should be able to vouch for what has been done with the other $150. For instance, you might open accounts on your own with $200 to start with. You paid $50 to your cook, $20 to the Rantau Club, and $100 for a trip to K. L.—expenditure $170, balance in hand $30. If you carried this on month by month you could see after a year how your own personal expenditure for that year had been divided up, that is, so much for makan, club bills, car hires, subscription to the I. S. P., and so on, and be able to gauge where you were spending too much money and on the other hand to see whether perhaps you might not be able to spend a bit more on something else.

## THE SAME PRINCIPLES.

Now exactly the same principle applies to estate accounting. You have to find out how much money is being spent, whether it is under weeding, cultivation, tapping, or anything else connected with estate