

Soil Fertility And Nutrition

Economic Aspects of Problem Common
To Modern Farm Methods Discussed In
Great Britain.

Of great interest to Canadian as well as British agriculturists is the following informative paper on "Economic Aspects of Soil Fertility and Nutrition," read by Mr. F. C. R. Douglas, M.A., M.P., at a recent meeting in London, Eng., of the Royal Society of Arts. Many of the points discussed are of direct concern to Prince Edward Island farmers:

MR. DOUGLAS: The Thesis of which I propose to examine some economic aspects may be formulated in these terms:

The methods of agriculture now practiced in this country fail in greater or less degree to return to the soil the organic waste materials which are a by-product of the life of plant, animal, and man. This organic waste is the source of the humus which plays an important and essential part in soil fertility and in the nutrition of plants. Artificial fertilisers are applied to the land and these in many cases hasten the loss and destruction of humus. For the soil itself the most serious consequence is erosion, which may proceed to such a point that the cultivable layer is wholly lost and formerly fertile tracts become desert. Before this point is reached the conditions of life to which the plant has become accustomed during its long evolution are so changed by the lack of humus and the application of artificial fertilisers that its constitution is affected; it becomes susceptible to disease, and its value as food for man (whether directly or through animals nourished upon it) is deteriorated. The ill effects upon man are further accentuated by the use of foods which have been altered by the abstraction or modification or destruction of essential constituents in processes of manufacture, preservation, or storage, while the poor quality of the food is concealed by elaborate seasonings and artificial flavouring that deceive and pervert natural instincts in feeding.

All these things are at least in a large degree, if not entirely, the result of economic changes which have taken place within the last two centuries. In the latter part of the eighteenth century the enclosure of the common lands moved towards its climax. A new incentive to enclosure arose from the development of new methods in agriculture which were quite unsuited to the primitive economy of the three-field and strip systems. The great landowners reaped a double gain in the acquisition of the common lands at a small cost and in the larger return which could be got from them. The substantial part of the people who, up till then, had been secure in the possession of a share in the land—the one ultimate source of life and livelihood—lost their hold upon it, and became a landless proletariat.

NEW PRODUCTIVE METHODS

At the same time, new methods of manufacture began to be devised which much increased the productivity of labour and gave employment to large bodies of men. The new technique in agriculture made it possible for those who remained in the country, and who became more and more reduced to the status of labourers, to feed the increased population of the towns. Moreover, as sea transport improved in speed and cheapness, more food was imported from abroad in exchange for exports of British manufactures. The reform of our fiscal system and the almost complete abolition of protective tariffs during the first half of last century stimulated this development.

For economic reasons which are familiar to us the manufacturing population congregated into the towns. The population of the towns grew rapidly. Some of them were still incomers from the country, but many were born in the towns and grew up knowing no other way of life. Thus one generation followed another each knowing less and less of the traditional ways of the countryside and becoming more and more subject to unwholesome conditions.

This new way of life, characterised by the growth of large cities and the aggregation of a large proportion of the population into them, created fresh problems. The waste matter could no longer be conveniently and cheaply returned to the soil, where it becomes not only innocuous but useful as well. It became a menace to the health of the city population, and novel methods were devised for dealing with this sanitary problem. A part of this waste matter goes down the sewers and is poured into the sea or otherwise destroyed and lost to the soil. Another part is buried in the dumps of household refuse and becomes more or less completely lost, or else is incinerated and wholly destroyed. Moreover, these two kinds of waste matter become separated from one another, and their interaction, which is a characteristic of ancient systems of agriculture, is lost. These methods of disposal were adopted because they appeared to be the least costly means available for ridding the towns of what was at the least a nuisance and at worst a serious danger to public health. Indeed, it is an historical fact that the modern local authority was brought into existence in order to be a public health authority, and a large part of its powers and duties were framed with this end in view.

This, then, is one important reason why the soil ceased to be replenished, but there are others. Specialisation in production was not confined to manufactures. In agriculture also some farmers, and sometimes whole districts, devoted themselves to certain branches of agriculture. Some concentrated upon arable farming and others upon animal husbandry. Where large numbers of cattle were kept and there was little tillage, probably sufficient manure was returned to the land in most cases to keep it in fair condition. This may be one of the reasons why we are now urged to find salvation in the ploughing up of grass lands.

ARTIFICIAL FERTILISERS

On the other hand, where arable farming predominated the supply of manure diminished, for it is expensive as well as inconvenient to transport manure for long distances. At the same time, the farmer was presented with a substitute for manure in the form of artificial fertilisers. He was assured by chemists and biologists, who had not yet realised the infinite complexity of processes which they thought could be reduced to terms of elementary chemistry, that these fertilisers contained all that the plant required. The manufacture of artificial fertilisers became a new and profitable industry, using up in some cases the by-products of other chemical industries. These fertilisers were concentrated and compact; they could be placed in bags and readily transported; they could be reduced to a powder which facilitated the spreading of them over the land by rapid and cheap mechanical processes; and they could be stored indefinitely without losing their potency.

Still more attractive was the fact that artificial fertilisers often gave more luxuriant growth and larger crops, and hence a larger return to the farmer. They were especially in the initial period, merely a supplement to manure. The humus in the soil was not rapidly depleted. No danger signal manifested itself to the farmer, and still less to the urban population. It is only recently that serious anxiety has become aroused about the condition of the land and its consequences for agriculture and health.

The separation in space of the point of production of foodstuffs from the point of consumption was accentuated by a number of technological discoveries which facilitated the importation of more and more food from abroad. At first it was mainly citrus fruits and grains that were imported, because they could best be stored and transported over long distances without artificial methods of preservation. The storage of wheat is made difficult by the tendency of wheat in bulk to "heat," but about a century ago new

processes of milling with steel rollers were invented. They lent themselves to cheap, large-scale production of flour, and they had the incidental result of producing a pure white flour. The germ of the wheat, instead of being cut, was brushed into flakes and sifted out with the bran. The flour so produced kept better than whole-meal flour and better than the uncrushed wheat. It could, therefore, be produced in bulk, stored for long periods and carried over long distance. Both the miller and the baker were subjected to less risk of loss by deterioration. The farmers in distant lands were assured of a more extended market. The miller was left with a valuable by-product which he could sell for animal feeding. The baker produced a pure white bread which was attractive to his customers who believed it to be better than other bread. But the consumer of bread lost some things which were necessary for nutrition and for the proper functioning of his digestive and excretory system, and, not knowing the cause of the ill health from which he suffered, endeavoured to cure himself by remedies which produced other injurious effects upon his system.

COLD STORAGE AND CANNING

At the same time the development of cold storage and of canning aggravated the trouble, for they made possible the transportation all over the world and the storage for long intervals of time, of meat, soft fruits, and other perishable articles. Thus the products of agriculture were consumed thousands of miles from the point of production, and the possibility of returning a corresponding portion of waste matter to the soil from which it had originally come, disappeared. The farmers of this country complained bitterly of foreign competition but the farmers of the Americas saw themselves placed in possession of an enormously extended market and thought that their fortunes were made. The consumers saw their food cheapened, and generally believed that its quality was maintained, if not improved.

One other illustration may be given, for it concerns an article of universal consumption and the one of most importance for infants and young children. Milk is notoriously susceptible to contamination and difficult to store for anything but very short periods. With the growth of towns the supply had inevitably to be drawn from wider areas and a longer time was needed for it to reach the consumer. This difficulty was in part overcome by the production of tinned milk, whether "condensed" or "evaporated," but this process yielded a product which was not agreeable to many people. Then pasteurisation was introduced and the difficulties of handling milk on a large scale were much reduced. It could be stored for longer periods without evincing obvious signs of deterioration. It could be handled in bulk in large tanks, and this reduced transport and distribution costs. Bulk transport entailed the mixing of good and bad milk together and the reduction of it all to one grade of infection, but the public was taught that in practice good milk was unobtainable, that there were merely varying grades of badness, and that it was essential for the public health and in order to save the population from tuberculosis, undulant fever and other ills that all milk should be pasteurised. This pernicious doctrine has been within an ace of being completely successful. It is only a small minority, which is able and willing to pay a very high price for it, that is able to enjoy pure, fresh, and untreated milk.

Nevertheless, the agitation for pasteurisation did make use of a fact which is indisputable. It is true that the health of the animal population of this country is not what it should be. Large sums of money are lost every year through animal diseases such as tuberculosis, foot-and-mouth disease and contagious abortion. The loss is not confined to the animals which die or have to be slaughtered, but extends to loss of productivity, and infertility caused by ill health. It is also true that many cultivated plants and trees show signs of weakness and liability to disease. They become infected, and attacked by pests. The cultivator spends large sums of money and much labour upon multiple sprays and disinfection in order to combat these ailments, and all this adds to his cost of production and has to be paid for by the consumer. Men, too, suffer by the deterioration of their foodstuffs, and although the average age at death is rising, a larger part of the population has sub-normal health and suffers from chronic ailments which impair efficiency and reduce the enjoyment of life.

ECONOMIC CONSEQUENCES

The economic loss involved in all this is enormous, and a gigantic industry has grown up engaged in producing many kinds of elaborate drugs and other remedies for the illnesses of plants, animals, and man. Preventive medicine has hardly yet justified its name; a large part of its energies are devoted, not to investigating, exposing and removing the causes of these troubles, but to a narrow specialism engaged in the vain attempt by means of antiseptics, serums, inoculations and vaccines to prevent one plant, animal, or person from infecting another. This is, perhaps, inevitable. The solution of the problem involves many factors which are beyond the scope of medical practice. It is to be found in a wider synthesis which will take account of how the lives of plants, animals and men are interrelated and interdependent.

The remedy for these evils must be sought for in rational and economic principles. It is not possible to reverse the course of history and to retrace the steps by which we have got to where we now are. Neither is it desirable to resort to arbitrary and ad hoc methods, protective tariffs, subsidies, and other restrictive devices by which the consumer is obliged to pay a higher price for the articles he buys or the tax-payer is obliged out of his earnings to increase the income of another, are inherently unsound. Such plans are unlikely permanently to command the assent of a majority of the population and are therefore liable to constant change which does not make for the prosperity of agriculture. It is far better for the farmer that he should have an assured market in this country because people understand why they should buy freshly gathered and properly nurtured foodstuffs, than that he should have an insecure, even though temporarily profitable, market dependent upon arbitrary prohibitions.

A large part of the solution therefore, must depend upon a re-education of the people so that they may understand what are the essential conditions of that way of living which men have grown into as the result of a long evolution. They must learn that it is not possible in the course of a few generations to readjust men's bodies to very different foods and habits. To attempt to do so must be extremely destructive, if not fatal.

PRICE AND QUALITY

Men do not purchase commodities merely because they are cheap and plentiful. They purchase goods because they want them. If alternative means of satisfying a given want are available, that one no doubt will be preferred which is cheapest, provided it is believed to be equally efficacious. In fact, the alternatives are seldom of identical quality, but people frequently do not realize this. Condensed milk, pasteurised milk, and fresh milk are three different commodities. If people regard them merely as milk, and no more, they will purchase whatever is the cheapest.

Unfortunately, taste does not play the guiding part among men that it does among animals. Instinct does not appear to impel mankind to choose the best foods, but that is perhaps partly because so many people brought up under conditions of Western civilization have never had the opportunity of tasting the natural and unsophisticated foods to which their ancestors were accustomed. Nevertheless, it is true that on the whole people buy the things which they think are good for them, or when they consciously buy something which is less nutritive they believe that this is compensated by the difference in price. If they thought that the difference in quality involved serious danger to health, they would be much more inclined to pay the higher price. But the results of improper feeding manifest themselves so gradually, that no danger signal warns the traveller along the path of ill health. The need

for enlightenment in the elements of food and health is therefore imperative, and it has many prejudices and vested interests to overcome.

So far as men know to demand the right things and to eschew the wrong ones, the shift of demand will encourage the right kind of production and discourage the wrong. It may well lead to an improvement in the technique of production of the article which before was least in demand, and that in turn to a cheapening of it. Nor is it necessarily true that a better dietary is in all respects more expensive. So far then as alternative commodities are available the problem is largely one of informing the public so that it prefers and demands the better.

But this is only part of the solution. If we must eat more fresh, and therefore home-grown, food instead of imported and preserved foods, then we must make certain that the soil is sufficiently fertile to produce the volume that is needed. If the home-grown food that is produced is lacking in nutritive quality because the soil is impoverished of humus, then we must devise means of replenishing it with this essential constituent. The only obvious way of doing this is by returning to the land the city waste which is at present destroyed on sanitary and aesthetic grounds.

The method of doing this has not yet received a full scale and completely satisfactory solution, but there are certain elements which can be laid down with certainty. The matter will have to be handled by the local authorities of this country, for they are responsible for dealing with sewerage and refuse disposal. The problem cannot be solved by merely dumping sewage and house refuse upon the land primarily because neither of these are in a condition in which within a reasonable time they will turn into humus, and secondly because they are not as they are produced, in a condition which is agreeable or pleasant to handle. What is required is that both these forms of waste matter should be handled and treated on a fairly large scale so that they are turned into humus before they are offered to the farmer. They must be combined to form a manure which is cleanly and convenient to handle which can be stored for a reasonable period of time without being offensive, and which is ready to perform its beneficial work for the plant as soon as it is applied to the land without undergoing a further process of composting before it becomes available to the plant. It is also necessary that the value of the product should be tested and demonstrated by properly conducted experiments in the cultivation of the principal crops of commercial importance.

THE COST PROBLEM

A fertiliser which conforms to the conditions indicated is certain to command a substantial price when the prices now paid for artificial fertilisers are borne in mind. This should afford a sufficient margin to cover the additional costs over its present methods of sewage and refuse disposal which the local authority will have to bear, and in my opinion it is highly probable that when suitable plant has been designed for performing the necessary operations on a large scale, this method of disposal will actually show a profit to the ratepayers instead of imposing upon them the substantial burden which present methods do.

It may be said that many farmers will prefer artificial fertilisers to a product of this nature. So far as they are owners of their farms, it is in the long run to their advantage to adopt methods of farming which will conserve the fertility of the land and enable them to hand it on unimpaired to their children. So far as they are tenant farmers, the position is not quite so simple. They may hope to squeeze the fertility out of the soil and then to quit their holdings. This is a possibility which should be guarded against by proper methods of tenant right valuation which would take account of the advantage to the soil of manuring and the detriment, to the soil of artificial fertilisers. It might also be guarded against by a proper system of valuation for rating and taxation. In this connection it is of interest to observe that in Denmark local rating in the country districts is mainly based upon the land value, and in estimating this the value is directed to assume that the land is in a normal condition of fertility; the owner, therefore does not escape payment of part of the rates by allowing his land to deteriorate, nor does he pay more if by exceptional efforts he raises the productivity of the soil above the average. It is beyond the scope of this paper to discuss questions of land tenure and taxation and I will only remark that all problems of agriculture would be greatly simplified if we had in this country a system of collecting (whether by rates or taxes) the value of the land for public revenue and exempting from public burdens the houses, buildings and other improvements. Fluctuations in the basic conditions affecting the prosperity of agriculture would then be adjusted by variation in the assessment of the amount payable to the state, whereas at present they are either reflected in violent fluctuations in the selling value of land owned by owner-occupiers or in a struggle between the tenant-farmer and his landlord for a suitable readjustment of his rent. It is the endeavour to maintain land value at a high level which is the ultimate reason for the application of protective tariffs, price stabilization schemes, and production quotas to agriculture; and these in turn have created a sharp antagonism between the urban population and the agricultural population that is not likely in the long run to be to the advantage of agriculture.

Apart from the matters to which I have just alluded, the task before us is; to educate the public to understand the basic conditions with which a healthy supply of food must conform; to educate the farmer to understand the conditions with which a healthy agriculture must comply; and to educate the local authorities to understand the important role which they must fulfil in providing the farmer with the humus which he requires. These are not easy tasks—there are prejudices and vested interests to overcome—and they will require all the self-sacrificing effort of men of goodwill, but the benefit to mankind will be immeasurable.

DISCUSSION

MR. PHILIPS PRICE, M. P. said: I am very interested in what Mr. Douglas has said and am in general agreement with it. As I farm in the west country, I naturally appreciate the importance of soil fertility, and all those of us who have to do with the industry realise, I think, that that is the big problem before us. Mr. Douglas, has, however, in my opinion a little over-simplified the matter. It is not merely a question of returning to the soil the humus which was there; there is also the question of getting the soil to develop its own humus and the discovery of the fixation of nitrogen from the air by leguminous plants, and particularly the clovers, which was one of the great scientific discoveries of the last century, has to some extent eased the farmer's problem. A further contribution has been made by the great discoveries of Sir George Stapledon in his development of new types of grasses.

We are ploughing up our pasture lands now, in view of the national emergency, but coupled with that there is the process of laying down the old arable lands to clovers again, in order to restore to the soil the nitrogen of which it was robbed by the cereal crops. Even so, I think that what the author has argued is probably true, viz., that on balance there is a loss to the soil, particularly at the present time, in view of the great pressure that is put on the farmer by the War Agricultural Executive Committees to grow crops of cereals.

It is therefore increasingly important to find a further way of bringing back nitrogenous fertilisers in the form of humus, and we must do everything that is possible to induce the local authorities to change their methods of sewage disposal, in which there are enormous vested interests involved. I went to Maidenhead not long ago to see a plant there which is worked by the local authority and a private company and which combines the sewage sludge from the sewage farm with household waste; the two together, decaying in heaps, create after several weeks a kind of mould, which I am told is being used by the local market gardeners. I have raised this matter in the House of Commons on two or three occasions with a view to finding out whether the Ministry of Agriculture is

prepared to do anything about it, but they are very reticent and will not commit themselves as yet, because, they say, certain experiments are being carried out in the agricultural department of the University of Reading. It seems to me that these experiments ought to be accelerated so that we can learn the results of them as soon as possible.

MR. W. R. LESTER said: I gather from Mr. Douglas's very informative paper that he considers all artificial manures tend to soil exhaustion. At least, I did not notice that he drew any distinction in this respect between the nitrogenous and the phosphatic manures. My experience of farming on a small scale demonstrates that only against the former can the charge be laid. Perhaps, in his summing up, Mr. Douglas may deal with this point.

DR. W. S. ROGERS (East Malling Research Station) said: I agree with the author that the organic waste products of the town should be returned to the country; but the local authorities must arrange for these products to be supplied at a cost which the farmer can afford to pay. At present they are very much more expensive per unit of manurial value than concentrated chemical fertilisers. I would point out also that this is not the only way of getting humus back into the soil. Various methods, including composting and cover cropping are under investigation at the research institutes, and as Mr. Philips Price pointed out, the valuable effect of clovers has been known for many years. At the moment, we are growing in some of our plantations leguminous cover crop mixtures, which are supplying humus to the soil at a cost of considerably less than 4s. per ton, and grass mixtures under orchard trees produce humus at a very much cheaper rate. Do not let us lose sight of the relative value of these things, although by all means let us try to avoid the shocking waste of town materials that is going on at the moment and to secure the adoption of a long term economic policy of getting those materials back to the land at a reasonable price.

SOCIAL IMPLICATIONS

SIR ALBERT HOWARD, C. I. E., said: I should like to offer my congratulations to all concerned in the presentation of this paper—to the author, to his colleagues and to the society, I have been studying the subject of soil fertility for about forty years and have read a large number of documents about it, but I consider that this paper is among the very best and most statesmanlike essays on the social implications of soil fertility that I have so far seen. It is certain to arouse widespread interest and considerable discussion, and I hope it will also bring about a very much needed administrative reform, viz., the amalgamation of the Ministries of Agriculture, Food and Health into one body, under a thoroughly competent man. These three Ministries deal with one and the same subject, food, a vital matter which affects not only the present population of the Empire, but also its whole future, and it is a serious disadvantage to have it divided up and dealt with in piecemeal fashion.

Unquestionably the wastes of our towns and cities must be converted into humus for the benefit of the land. Much of this work will have to be done by the municipalities. We must remember, however, that our water-borne sewage system has done one irreparable mischief—it has destroyed the most important factor in the synthesis of humus, the urine of the population. The very best quality humus cannot, therefore, be made from sewage sludge and town wastes only. On the farms near our cities, however, there is plenty of animal urine but insufficient vegetable waste. Arrangements should therefore be made to give the farms the first call on our town wastes and then to convert what remains by means of sludge. The Borough Council of Southwark has led the way by providing the farmers near London with pulverised town waste for the reform of their manure heaps. This is exactly what is needed to strengthen the weakest link in British agriculture and in all western agriculture, viz., the manure heap.

The seaside towns ought to take the lead in the manufacture of humus, because they have available a valuable additional item in the form of seaweed. If they would make humus properly and use it to produce the milk, meat and vegetables required for feeding their visitors, the holiday makers from the towns would reap a double advantage: they would benefit from the change in the climate and also from consuming food grown in a fertile soil.

I should now like to suggest three points which should be borne in mind in our efforts to educate the nation generally and the farmer in particular in the dependence of good food and robust health upon the existence of a fertile soil.

The first is that the value of the humus manufactured by the municipalities cannot be ascertained by chemical analysis. The units of nitrogen, phosphorus and potash are about two-and-a-half times more valuable in the organic than in the inorganic condition. The worth of humus can be proved only by use and experience.

My second suggestion is that a beginning should be made in the marketing and sale of food according to the way the soil from which it is produced is manured. This would have great publicity value; the consumers interested would be assisted in obtaining high quality produce, and the humus-minded farmer would get a better price. I am sure that once people began to buy food produced from fertile soil they would go on buying it.

My last suggestion is based on ten years' work. It has been my experience in getting the Indore process (a method of composting) taken up all over the world that the vested interests which endeavour to obstruct the onward march of humus can easily be sidetracked by making the fullest use of the live wires who are to be found in agriculture, in horticulture, in the medical and teaching professions and among the officers connected with public cleansing. One practical example of the effect of humus on the soil, the crop, the animal and mankind are available, all opposition rapidly withers and arguments based on elementary chemistry cease to be advanced.

AN ECONOMIC QUESTION

MR. J. O. STEED said: The question of food production in this country is not an agricultural question at all, or only in a secondary way; it is an economic question. Therefore it is from the economic standpoint that my mind has approached the subject for many years past, and I was very much cheered when I saw that the author of this paper introduced the word "economic" as the first word in its title. I am struck however, by the fact that in the year 1941, with the second great world war raging among us and threatening us with starvation, this paper is still based upon the commercial point of view. That is modified at the moment by the force of circumstances, but the whole idea of the paper derives from the conception that unless the people can be induced to buy the more expensive products of the land of this country the situation of the food producer will be hopeless.

Our main foodstuffs cannot be, and never will be, produced in this country as cheaply as we can import them. We may utilise our town wastes, and that is a desirable method of effecting economy, but that will not provide the difference between the extraction of capital value from virgin soils overseas, and the restoration of fertility to our native soil, and until we can provide that difference in the form of price we shall not be able to re-establish food production in this country on a commercial basis. After the last war we were assured that never again should this country be exposed to the danger of starvation, and the Corn Production Act of 1917 was passed through Parliament with acclamation. But in less than five years the whole thing was scrapped, because the Bank of England wished to return to the gold standard and because the price of all commodities had to come within the limit of gold.

The proposition that I wish to submit is that if Great Britain is to continue to carry a larger population than its present home production can feed (we could feed ourselves if we would) we can no longer afford to regard the matter as a commercial proposition. There are many uses to which the land of Britain can be put. We can, for example grow apples, and there is much to be said for the English apple. But if the land of this country will produce a unique flavour in apples it will also produce unique characteristics in the race, and I want to regard the land of this