

# **Soil and Health Library**

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## **Nutrition And Health**

By SIR ALBERT HOWARD, C.I.E., M.A.

IF we look at the history of England with a fresh eye and consider it from the point of view of soil fertility, some interesting facts emerge which, I think, bear not only on the origin, but also on the prevention, of disease.

The governing event in the history of our country is the Saxon Conquest. England made a fresh start; an agricultural unit--the manor--was slowly developed which, for purposes of taxation, was later on transformed by the Normans into a rigid feudal system. The main features of manorial farming were two: (1) the open-field strip method of tillage which always included the fallow, and (2) the use of the heavy soil-inverting plough drawn by several pairs of oxen. The Saxons started with a fertile surface soil containing abundant supplies of humus left by the recently cleared forest, and with a sub-soil which had been broken up in all directions by the roots of the trees. The mould board plough enabled them to convert these reserves into wheat and other grains. To maintain the yield, however, it would have been necessary to replenish the supply of humus and to restore from time to time the aeration of the lower layers of soil. But both of these essentials were neglected. The volume of manure was small, because there were no root crops for wintering the live stock, large numbers of which had to be slaughtered and salted down every autumn: what supplies were available had to be applied in large part to the lord's demesne: the open fields were never grassed down, when they could have had a rest and built up stocks of humus under the turf. An effective system of sub-soil drainage did not exist: the sub-soiler had not been invented. The inevitable consequence was the slow wearing out of the surface soil as the gap between the fertility used up and that restored widened, and as the permeability of the sub-soil was gradually lost. The result was, the yield of crops like wheat slowly fell. Some time before the Black Death the old records show that it had reached some six bushels to the acre. That these diminishing yields were accompanied by a deterioration in the quality of the grain is suggested by the frequent outbreaks of rural unrest and by the growing toll of disease in crops, live stock, and mankind. Under a cast-iron regime like the Feudal System and a method of farming which allowed no latitude, the innovator and the experimentalist were automatically deprived of that freedom essential for progress to take place. Stagnation was the inevitable result.

Where mankind failed, Nature, in 1348-49 and succeeding years, provided a remedy in the shape of the Black Death which, by destroying two-thirds of the rural population, accelerated the decay of the manorial system and stimulated the enclosure movement. The worn-out arable was laid down to grass to nourish the flocks of sheep whose wool was in such great demand in Flanders and Italy. Under grass the land slowly recovered, and after a century or so had accumulated sufficient humus under the turf, so that the yield of wheat increased to eighteen bushels to the acre, or even more when these rested areas once again came under the plough. Epidemic disease at the same time diminished in intensity and tended to be restricted to the towns. The slow restoration of soil fertility which took place after the Black Death was followed by some interesting developments in the intellectual domain, as is shown by the achievements of the Tudor period. The restoration of the fertility of the open fields of

the manors produced in due course some outstanding men and women-the soil's most important crop.

The restoration of fertility continued after Tudor times till the Great Depression of 1879. During this period British farming produced many notable pioneers, including Robert Bakewell, Coke of Norfolk, and Turnip Townshend, whose labours were embodied in the Norfolk four-course system, by which the fertility of the soils of this island reached their highest level.

But while the Black Death helped to restore our agriculture, it also sowed the seeds of a calamity which, although slow and insidious in its manifestations, is likely to prove one of our greatest afflictions. The dispossessed craftsmen maintained formerly by the manors lost their employment and were driven to the towns, where they began to start industries which, in the course of years, became an avalanche in the shape of the Industrial Revolution. The workers of the growing factories had to be fed: their machines needed more and more raw materials: the strain on the land increased. All this development was purely parasitic. The land fed the towns, but the towns did little or nothing to return their wastes to the soil which nourished them. Eventually the land was unable to meet the urban demands and a gap was developed, which was met by the importation of food and raw materials from overseas. Prices fell and the farmers were hard put to it to survive. Science was then called in to stimulate production and the artificial manure industry was born, which has now grown into a vast and powerful cartel-like organisation and is now linked up with the production of poison sprays to protect the crops, and every kind of dope to assist live stock and mankind to escape the consequences of a malnutrition which need never have developed. While all this was in progress, the virgin lands of the New World and elsewhere, which produced our cheap food, were being one after another worn out and converted into dust bowls. The Industrial Revolution became a boomerang.

The response of Mother Earth to all this exploitation is disease. As the fertility of the soil is worn out and as humus is replaced by artificials, the power of the crop to reproduce itself and to withstand the inroads of pests soon falls. This weakness has duly passed on to the live stock and to ourselves. The stage is therefore being set for another visitation of the Black Death type.

If the above is a true picture of events, detailed evidence must be available in support. In a book now in the press, entitled "Farming and Gardening for Health or Disease," I have endeavoured to set out this evidence and to point the road out of the abyss.

If a connection exists between the condition of the soil, the behaviour of crops and live stock, and the welfare of mankind, surely there must be some principle running through the whole cycle which furnishes a simple explanation of the facts. Such a thread appears to exist. It is, I think, to be found in the condition of the proteins which everywhere are the regulators of infection. If anything untoward happens to the proteins, either in the way they are synthesised or as a result of extreme climatic conditions, then we must expect disease. It would naturally follow from this that there is only one basic disease in the world which, however, will manifest itself in many different ways according to circumstances. It seems so. We can prevent much of this disease by seeing to it that our soils are fertile. Other groups of disease caused by the

disruptive effect on the proteins of extreme climatic conditions cannot always be controlled.

It would follow, therefore, that there will always be some disease, however fertile the soil may be. All we can do is to reduce it at the source by the faithful adoption of Nature's law of return. This, in brief, is the view of one of our pioneers in medical research--Mr. J. E. R. McDonagh. My own experience of disease, which covers a period of nearly fifty years spent in research all over the world, supports Mr. McDonagh's thesis.

Has all this been confirmed? It has. Case after case has been reported where the adoption of the law of return has been followed by an almost instant response in the shape of disease resistance in crops, animals, and mankind. The world unfortunately also supplies many examples of the harm which results from the replacement of humus by the manure bag.

In the interpretation of Nature's verdict between crops grown by organic and inorganic methods two important agents, hitherto unused, are doing yeoman service. The instinct of our live stock can instantly distinguish quality in their food: the lowly earthworm is turning out to be the perfect soil analyst.

Naturally the work in progress all over the world on the restoration and maintenance of soil fertility by means of organic farming and gardening has disturbed the artificial manure interests and their supporters. What has been described as the war in the soil has broken out and is now in full swing. The first pitched battle has just ended in South Africa. Artificialists have taken the count: the Government of the Union and most of the farmers have become compost-minded. Even in this expert-ridden island of Great Britain, where the statistical elaboration of the obvious is considered to be an essential preliminary for action, progress is being made. But most of the pioneers are to be found in the new countries.

### **Health Building For The Future** By SIR ALBERT HOWARD, C.I.E.

LONG Dene School, in 1939, boasted no more than twenty young scholars, at which period of its history it passed into the hands of Mr. and Mrs. John Guinness. From this nucleus they set out to build up a community in which parents and children alike should share the activities of hand and brain, and become both craftsmen and teachers, living and educating themselves together.

The project had its war-time difficulties. The 1940 evacuation of London swelled the ranks of Long Dene, and to the problems of additional accommodation, extra furnishings, and so forth, was added the expansion of food production on a limited area of land. One of the foremost aims of this experiment in community, described in *Sport and Country* of December 8th 1944 under the title, "Community Adventure", had from the outset been 'to raise as much as possible of its own food, so as to be sure of having at hand the fresh basic ingredients of a health-giving diet, grown on a well-cared-for and properly nourished soil.'

At the Manor House, Stoke Poges, Buckinghamshire, to which Long Dene School moved in September 1940, there was insufficient grass to feed cows, so goat-breeding was undertaken instead to supplement the younger children's milk supply. A chicken co-operative came into being, and a few stocks of bees added their quota to the register of garden produce. Meanwhile, a system of compost heaps had been organized, and home-grown food greatly improved, both in quality and quantity, as the composted garden came into yield. 'The soil on this property,' writes Mr. Guinness, 'is far from good, yet in 1943 the produce from one section of the garden included 1,000 lb. of tomatoes, 4,000 odd lettuces, 12 cwt. of onions, a ton and a half of cabbages, 2,000 lb. of spinach, sprouts, peas, and beans, and half a ton of early potatoes. These crops, plus some roots and marrows. were grown on one acre, part of the tomatoes and a few early lettuce being under glass.

'That ample, fresh and unspoiled contribution to the balance of the community's diet has had the most interesting effect on its general level of health. It has been one of the factors instrumental in producing, among adults and children alike, an unusual degree of disease resistance, amounting in some cases to complete immunity from colds, influenza and the common infectious ailments; and that without special precautions to isolate the children from contacts, in an overcrowded industrial neighborhood. Such an experiment in the creation of positive health needs to be continued over a longer period and on a larger scale than is possible in the present buildings; yet it is only one of a number that are waiting to be tried. Long Dene has clearly reached the time for another stage in its growth. More workers and their families are waiting to join than the restricted space can accommodate, so a house is urgently being sought where land is available for agriculture, and there is room also for research and for the development of rural crafts and industries.'

Here is a practical experiment of great promise. Already important results are being obtained on the influence of properly grown food upon nutrition and health--results which, perhaps, will never satisfy the modern scientist who must calculate every minute detail and tabulate it, but results which may be seen and understood by the man in the street. Great things may be looked for from Long Dene community when peace-time brings an end to present restrictions. Many more such pioneering enterprises are needed which will build up on the sound foundation of soil fertility disease resistance and positive health in the future citizens of Great Britain.

### **Farming and Gardening for Health or Disease** By SIR ALBERT HOWARD, C.I.E.

FARMING and gardening for disease owes its origin partly to Baron Liebig and the Broadbalk wheat plots at Rothamsted, and partly to the urge of the profit motive. The latter has compelled agriculture to join the ranks of industry and to work for a profit at all costs. From the former the vast artificial manure industry has arisen. Various chemicals like superphosphate, sulphate of ammonia, and potash salts from Strassfurt in Germany, or a combination of these or of similar substances. are used to stimulate crop production. They have certainly achieved this result as far as quantity is concerned and at first sight they appeared to be helpful to the farmer and gardener and to constitute an advance in crop production.

As the years passed, however, chemical manuring developed a fundamental weakness. The results obtained proved to be only transitory: the method completely failed to pass the test of time. While the vast stores of humus left in our soils by the farmers and gardeners of the last century lasted, all went well.

But the advocates of chemical manuring forgot an important factor--the necessity of keeping up the humus content of the soil. Soon the land began to go on strike. Tilt and permeability were lost. The chemical farmers then began to change their ground. The place of the formerly despised humus had to be admitted. Now the farmers and gardeners are urged on all sides to base their manurial policy on humus supplemented by suitable artificials. This is the gist of the advice which is now rained down on us like hailstones from heaven by the vast hierarchy of officialdom ranging from the Ministry of Agriculture, the experiment stations and agricultural colleges down to the local war agricultural executive committees.

How can the average man resist this spate of high-pressure salesmanship? He can do very little. But in Mother Earth he has a silent but very stern ally.

Under repeated dressings of artificials the soil gradually loses its texture and refuses to drain: the crops soon fall a prey to insect, fungous and virus diseases. These have to be kept in check by a regular galaxy of poison sprays. Our dairy herds suffer more and more from such diseases as foot-and-mouth, tuberculosis, mastitis, contagious abortion, and so forth. The maladies of mankind increase in intensity: the hospitals fill up with patients, lunatic asylums are overcrowded; more and more money has to be devoted to medical care, as witness the National Health Insurance Act and its present-day developments.

How can the adverse verdict of Mother Earth on chemical farming be obtained? How can it be interpreted? If we put to the earth itself the question--What is your verdict on the war of the soil: on this controversy between inorganic and organic farming and gardening?--we shall very quickly obtain an answer. This reply must then be interpreted. For this we must make the fullest use of our best experts who are quite convinced that such produce is not worth eating. Their verdict is deliberate, final, and crushing.

Such expert testimony is easily obtained. Take any average permanent pasture, under the turf of which humus is constantly being made by natural agencies. Divide it fairly into three equal strips: manure the middle plot with a conventional dressing of mixed artificials containing sulphate of ammonia; treat the two outside plots with an equivalent amount of freshly prepared compost made from animal and vegetable wastes. We shall then have a comparison between humus supplemented by chemical manures and humus alone.

Everything will soon be ready for the verdict of our best experts on nutrition--not statistically minded bipeds, as we might at first expect, but quadrupeds in the shape of the grazing animal. The live stock will concentrate on the two humus areas and graze the herbage down to the roots; they will only lightly pick over the produce of the poisoned soil.

That the middle strip has indeed been poisoned will be evident from the response of our chief soil conditioner and humus distributor--the lowly earthworm. These creatures will leave the plot treated with sulphate of ammonia, but will multiply in the two humus-filled areas. This can be determined by a simple examination of the upturned turves, or better still, by counting the molehills on the three plots. Earthworms, as is well known, provide a part of the food of the mole. Often, when these animals pass from one of these humus plots to the other, they go straight across the artificially manured area and seem to know by instinct that they are not in one of their usual feeding grounds. Consequently many fewer molehills are to be found on this strip.

A few words are needed at this point to emphasize the importance of the earthworm in providing our crops with food. The casts of the earthworm are 50 per cent richer in humus, five times richer in available nitrogen, seven times richer in soluble phosphate, and eleven times richer in replaceable potash than the upper soil. It is little wonder, therefore, that the roots of crops like the potato are always attracted to worm casts and penetrate them in all directions. The weight of such worm casts per acre per annum may run to 25 tons in land in good heart.

The much vaunted and much advertized chemicals, therefore, stand condemned. Our live stock despise the resulting produce; the earthworm goes on strike. Why, therefore, pursue this subject any further and spend time on what has been described as the statistical elaboration of the obsolete? The present methods of farming and gardening are harmful, as is obvious from the general standard of health in this country compared with that of the peoples who are fed on the produce of humus-filled soil. In the nutrition of our population at least two mistakes are made: the food is grown for the most part on poisoned soil; it is afterwards refined, processed, and preserved in various ways. Both these factors cause untold mischief.

The Real Basis of Public Health  
By SIR ALBERT HOWARD, C.I.E.  
From a lecture given before the Home Counties  
Branch of Medical Officers of Health

*Woodland Humus*

WHAT is a fertile soil and what produces fertility in a soil? The answer is: the quality of the humus it contains. What is this humus on which so much depends? Humus is a very wide term covering material ranging from peat in a bog to the sweet-smelling leaf mould found on the ground in a mixed wood. To secure a fertile soil we must furnish it with abundant supplies of humus of a quality as near as possible to the best leaf mould. We can more easily understand the nature of humus and how to make it in a garden if we observe how it arises by natural means. Humus formation is particularly active in any wood during the late spring and summer. If we examine the litter under the trees, we shall find that this material is made up of two constituents: (1) all kinds of vegetable wastes such as dead leaves, fragments of bark, twigs, and so

forth from the trees and undergrowth; and (2) animal waste provided by the extensive animal population, many of which are minute, which lives in every wood. There is much more vegetable waste than animal waste--the proportions are at least four vegetable to one animal. The point to remember is that both classes are thoroughly mixed, kept moist by rain, and lightly packed so that ample access to air is easy. Soon a transformation begins. Moulds appear which begin to rot the wastes. The moulds are succeeded by bacteria, and soon the mixed wastes are changed into dark, sweet-smelling leaf mould. Humus has been synthesised. It is made up of the undecayed portions of the mixed wastes and the remains of the moulds and microbes which have fermented these wastes. But the leaf mould does not remain long on the ground. It is distributed throughout the top soil by Nature's manure distributors, of which the earthworm is the chief. The roots of the trees and undergrowth then make use of the humus for growth. In this way the wood manures itself. It first converts its wastes into valuable humus, distributes this humus by means of its unpaid labour force, and then uses the humus for growth.

There is one method by which Nature uses this humus for the nutrition of plants which will interest the medical profession now that the use of penicillin and penicillin-like substances has become so universal. The soil humus and the living cells of the active roots are connected up by means of certain fungi, the mycelium of which invades the roots and lives in symbiotic relationship therewith. This partnership is known as the mycorrhizal association. Eventually the fungous threads, which are rich in protein, are digested by the roots, when the soluble products pass into the sap and are carried to the green leaves, where they are used in building up fresh protein. It is only when this absorption of the digestion products of proteins takes place in the soil that the crops possess the full power of reproduction and resistance to disease as well as high quality. All these important properties are then passed on to the animal and to ourselves. In this fungous-plant association I suggest we shall find the key to the public health system of tomorrow.

### *The Waste Products of London*

We have seen how Nature in our woods makes use of her wastes to provide first the perfect manure and then the ideal manure distributors. How does the capital city of the Empire--London--manage these matters? Its waste products are destroyed, and fresh food has to be imported daily to keep the population alive. Moreover, the work of destroying the wastes of the city involves an enormous expense, which is recovered from the population in the shape of rates for paying salaries and wages and providing the gear for a work of pure destruction. We justify all this on the grounds of sanitation and the prevention of disease. But Nature does not worry about sanitation and disease prevention, for the simple reason that she converts her wastes into a valuable material in a perfectly healthy way. We can enjoy a summer holiday in a wood when her humus manufacture is in full swing and sleep on a ground sheet spread over a bit of her manure factory with perfect safety. Only a lunatic would ever think of camping out on one of the manure heaps of our farms and of spending the night on one of these evil-smelling abominations. I wonder how many of our city fathers and their staff, or of our farmers, have compared some of their activities with those of Nature.

### *Humus-Making*

How can we make humus for our farms and gardens like that found in the wood? We cannot, of course, turn our farms and gardens into woods and work exactly as Nature does. But we can copy Nature by rolling up the fermenting carpet of litter and making it take much less room. If we arrange our mixed vegetable and animal wastes in layers one above the other and look after the ventilation and moisture supply of the heap, we can make excellent humus in three months in any garden or allotment. Full details of how to proceed in this composting process and how to use the humus to the best advantage are to be found in *The Compost Gardener* by F.C. King, and in the same author's *Gardening with Compost*.

### *Work in the Dominions and U.S.A.*

The most spectacular progress in the work is being made in South Africa and in New Zealand. Southern Rhodesia for some years has published a return of the number of cubic yards of compost made annually on the farms. It is going up by leaps and bounds. The Union of South Africa has created a special department for converting the wastes of the towns and cities into compost for the benefit of the surrounding land. More than a hundred municipalities are now converting all their wastes, including the night soil, into compost. New Zealand has a very flourishing Compost Club with its own publications and a membership which has long passed the 5,000 mark. The United States of America is going into these matters with a will, and will soon have at least 100,000 active members in the new movement.

### *Results of Good Compost*

Once we convert the wastes of a garden, a farm or of a municipality into humus in the form of compost and return this to the land, the results on the crops are instant and immediate. Soon diseases begin to disappear of their own accord without any assistance from fungicides, insecticides, and germicides. The crop soon becomes immune to pests. The really healthy plants protect themselves. This is a most important point which anyone who has a garden or allotment can verify for himself or herself. Make compost properly and then grow crops like lettuces, radishes, or potatoes in soil enriched with humus. Good yields of high-quality produce, resistant to disease and of good keeping power, follow. Similar results are obtained on a farm in the growing of the grain, fodder, and forage needed by the livestock. The animals soon possess the bloom of health. The milk and meat they produce is also of the highest quality. When the produce of a fertile garden and a fertile farm is used for feeding the human population, robust health is the result.

If a fertile soil is the basis of healthy crops, healthy livestock, and healthy human beings, there must be some simple principle underlying all this. It is to be found in the condition of the proteins, which are the real regulators of infection. As is well known, the protein molecule is a very large one and is therefore liable to injury. Once it is weakened either through imperfect synthesis in the green leaf or by adverse climatic conditions, it is unable to withstand the attacks of parasites. Disease results. However, by seeing to it that the proteins formed in the plant are properly prepared, we can prevent much present-day disease at the source. We shall never abolish disease

altogether, because some of this disease is due to the action of extreme climatic conditions.

## **The Purpose of Disease**

By SIR ALBERT HOWARD

IN the end Nature always takes us in hand and teaches us that it does not pay to disregard her rules. Disease is her reply to those whose actions are in flagrant contradiction to her laws, one of which is the law of return. This law holds good in crops, in live stock, and in mankind. The relation of disease to the law of return must therefore be understood.

Disease is not created by mankind. It occurs in Nature and always has and always will. It is a part of the Creation. It is met with everywhere--in the primeval forest; on the prairies; in streams, rivers, lakes, and the ocean; it is by no means unknown among wild animals. Disease has a very definite place in the natural order. This is significant. For this reason man cannot hope to eliminate it.

Disease is the means adopted by Nature for the removal of the unfit. It is also the normal accompaniment of old age when the organism is worn out. It is perhaps most easily seen at work on old trees where the diseased condition steadily advances until finally the tree ceases to live. Because the tree is so well furnished with reserve food and very effective arrangements for resisting parasites, its death is a slow process and one which can easily be watched. But smaller plants and in particular, the microscopic forms of the vegetable kingdom are not so well provided with defences and perish much more dramatically.

"The commonest agents involved in plant diseases are insects and fungi; in animals and man, various types of bacteria are the usual invaders.

The course run by disease is generally the same. A struggle for the mastery takes place between the host and the parasite. It is not a case of two organisms living together, but a battle.

Disease is the beginning of Nature's composting. The inefficient or wornout organism is converted into material from which humus can be synthesized to feed a new generation of plants. The insects, fungi, or bacteria involved in this work may be regarded as Nature's censors whose duty it is to mark down the imperfect organism, condemn it, and then start the execution of the sentence by preparing it for transformation into lower forms of life from whose wastes and remains humus can be synthesized for re-starting the wheel of life.

Now we see why Nature has no arrangements like the burning of infected material, poison sprays, insecticides, sera, or vaccines for checking disease. Why should she fight what is her own arrangement? Why should she burn diseased material or institute quarantine arrangements? The diseased plant or animal continues in free and close contact with its fellows who are always exposed to full infection. The infection spreads only to what is already unfit. If it could spread to the fit, all life would soon

cease. The parasites would overrun their victims like a forest fire. But life does nothing of the sort, it continues richly and abundantly. This is the one proof we need to tell us that disease can not attack the healthy organisms. Why, therefore, should we fear it?

Disease is no enemy; it is part of the natural cycle; it has a definite and useful function in Nature; it enters into the wheel of life. All that mankind can do by means of agencies like the medical and veterinary professions is to help the valuable but stricken organism to become whole and to have a fresh start.

But the alleviation and cure of disease do not end the matter. We are only dealing with a portion of the subject--the casualties, most of which need never have occurred. One important question has still to be answered: How does disease arise?

We have dealt with the apparent causes--insects, fungi, and bacteria; but what is it that invites them to attack certain hosts only and leave the rest alone? If we could answer this question, we could take up preventive measures with every hope of success.

A satisfactory answer has, I consider, been found. It has been furnished by the work of Mr. J. E. R. McDonagh, one of the pioneers in medical research. This investigator considers that the nature of disease is to be found in a study of the protein complex, that constituent of the vegetable and animal kingdoms in which life resides. It will be evident that in plant diseases everything depends on the way the proteins are formed in the green leaf by methods which conform closely to those in operation in Nature. Nothing more is needed to keep diseases in check. But the moment we try to improve on Nature's methods or attempt short cuts, trouble begins. The introduction of a substitute phase (in the form of artificial fertilizers) in the nitrogen cycle is one certain method of bringing about improperly synthesized protein followed by loss of quality and finally disease.

Mr. McDonagh's detailed presentation of the normal working of the green carpet and his explanation of the irreparable damage now being done by artificial manures constitute a challenge.

This challenge has already been taken up by a few of the pioneers in the farming community. The practical results obtained on the land amply confirm the theory.

### **Life and Health Restored to a Dead Farm** By SIR ALBERT HOWARD

I have delayed my reply to the letter of Mr. W. C. Nachemius in *The Farmer's Weekly* (Bloemfontein, South Africa) of December 5 on the subject of plants and their food until, now, as I have been expecting a report on a large-scale experiment on a dairy farm in Somersetshire which will demolish the position recently taken up in your columns by Dr. Ogg and Dr. Nicol of Rothamsted, and in the letter under reply.

The question at issue is this: The pioneers of organic farming and gardening maintain that all that is necessary to grow healthy crops of good quality and of a very high degree of disease-resistance is to follow the lead of Nature and to return to the soil, in the shape of properly made compost, all available vegetable, animal and human wastes. When this is faithfully carried out and suitable methods of soil management are adopted, there is no need of chemical manures of any kind to supplement this compost. In due course the virtues of the crops so grown are passed on to the livestock and to ourselves. Organic farming and gardening thus lead to healthy crops, healthy livestock and healthy men and women.

The position taken up by the Rothamsted workers and by Mr. Nachemius is that the amount of compost available is insufficient and that organic matter must be supplemented by chemical manures. They maintain that these chemicals are not harmful in any way and that they should no longer be described as artificials.

The lawyers on either side are therefore at loggerheads. Both groups are waiting to get in a knock-out blow. This has now been provided by Mr. F. Newman Turner of Goosegreen Farm, Sutton Mallet, near Bridgwater, Somersetshire, who in a recent report wrote:--

'When I came to this farm the first calf born was dead. This was the beginning of a long chapter of disaster. Disease drained my resources for five years and nearly ruined two herds of cattle.

'I then decided to get my farm and its livestock back to Nature. I manured my fields as Nature intended. I stopped exhausting their fertility by means of artificials and gave them the recuperative benefit of variety. My cows were all given the fodder they needed from land filled with farmyard manure, compost and catch-crops. Artificial fertilisers were dispensed with entirely.

'Three or four years of this kind of farming have restored life to a dead farm. Everything on the farm, from the soil teeming with life to the cows all pregnant or in full milk, to the farmer and his family full of energy and good health, acclaim the rightness of this policy.

'Many of my neighbours questioned the financial wisdom of such a system of farming. They said the cost of compost farming would be higher than chemical farming and yields could not possibly compare. Costs did increase, but so did yields. My threshing contractor tells me my yields are not equalled in the district.

'But it is not the increased yields, important as these are, that I measure the success of natural farming. It is the health of all living things on the farm that proclaims Nature's answer to our problems. From a herd riddled with contagious abortion and tuberculosis, in which three years ago few calves were born to full time and most of those few that reached due date were dead, I can now gaze on a group of healthy young heifers and on cows, formerly sterile, heavy in calf. And the herd has been attested as free from tuberculosis for two years.

'In recent months cows that have been sterile for two or three years have given birth to healthy calves. I have one cow, aged fourteen years, which, after being barren for three years, is now due to calve once more.'

The proof of the pudding is in the eating and not in the statements of the cooks! Here is a clear case where the substitution of humus for artificial manures has restored health and the lost power of reproduction.

If Dr. Ogg and Dr. Nicol or Mr. Nachemius can provide practical examples where the change back from organic farming pure and simple to a combination of humus and artificials has produced results equal to or better than those of Mr. Newman Turner, now is the time to translate their theories about plant food into results which any farmer can understand. If they decline to take up this challenge, they stand self-condemned. It is now a case of root hog or die for the protagonists of the manure bag. Snips and snails of chemistry, even when supported by the yields of small pocket handkerchiefs of land and fortified by the fastidious approval of the higher mathematics, will no longer meet the case. The time has now come for Rothamsted and the artificial manure interests to stage a come-back on the land itself.

**Dried Activated And Digested Sewage  
Sludge For The Compost Heap**  
By SIR ALBERT HOWARD, C.I.E.

I SHOULD like to add a brief postscript to Mr. Cecil D. Bachelor's timely article in the July 1946 issue of *Organic Gardening*, in which he stressed the implications of a modern sewage disposal plant like that at Mogden and Perry Oaks on the outskirts of London which is operated by the Middlesex County Council.

Admirable as are the arrangements at this centre, I felt after visiting these works with Mr. Bachelor a few months ago that Mogden and Perry Oaks could be still further developed in at least two directions: (1) by converting the sludge into a fine powder suitable for composting, containing some 10 per cent. of water and at least the same percentage of ground limestone or chalk, and (2) by the interception, by means of water plants, of the dissolved plant food materials such as combined nitrogen, phosphates, and potash at present lost in the clear effluent.

All that is necessary to convert the present rather intractable and lumpy sludge, with a high content of water, into a fine inoffensive powder which, when added to the vegetable wastes in a compost heap, would distribute itself naturally throughout the mass and so save much labour, is to reduce the moisture content to some 10 per cent. or so. This can be accomplished by introducing a drying plant after the sludge leaves the secondary digestion tanks. If the necessary amount of ground limestone needed to raise the final content of calcium carbonate to 10 per cent, were added before the sludge is dried, we should have the ideal activator for the urban gardens of the United States.

For the last two years I have been using with great success such dried digested sludge in my own garden at Blackheath. It proved to be the ideal activator. It was produced at the Dartford sewage works at Long Reach operated by the West Kent Main Sewerage Board. The material cost me 2/6 per cwt. (60 cents per 112 lb.) at Blackheath. At these works they digest the sludge and recover the methane; but they do not use the activated sludge process as at Mogden. If they did, the final product would, I consider, be even better than it is now.

So far no one in Great Britain at any rate has yet taken up the problem of extracting the plant food materials lost in the clear effluent from sewage works. But work has already been done on this subject at Durban in Natal which proves how remarkably useful the water hyacinth is for this purpose. This floating water weed removes all the dissolved salts in the effluent and converts them into easily composted vegetable matter containing all the water needed in making humus. At the same time, the effluent is naturally aerated and also rendered unfit for the breeding of the malarial mosquito.

While in Assam in December 1937 I obtained interesting confirmation of the value of the water hyacinth in malaria control. While visiting a series of tea estates in Bengal and Assam, one of my hosts was a very keen sportsman who every autumn shot large numbers of the migrant wild ducks on their annual journey southward from the lakes of Central Asia to the inland waters of India. These birds invariably halt for food and rest on the rice fields of North East India. My host, on these shooting excursions, usually slept in the open air without a mosquito net on the small islands in the vast rice fields which are plentifully stocked with water hyacinth. He was never troubled by mosquitos and never had malaria on his return.

At the time of my visit many tea estates, as well as the local inhabitants, were making full use of the water hyacinth for their compost heaps. I saw many fine samples of Indore compost made from this and other weeds which were activated by cow dung and urine earth.

It is still usual all over the world to regard the water hyacinth as a pest--as something to be destroyed. In reality it is a heaven-sent gift of Providence and the ideal constituent of the compost heaps of those areas which suit this plant. It is Nature's device for recovering the plant food materials that would otherwise run to waste. In more temperate regions other water weeds like the water cress can be used instead.

The United States, and indeed many other countries, are now suffering from soil erosion, a consequence of misuse of the land in the past. To put matters right we must restore the texture of the soil by re-creating the compound soil particles which alone will enable the earth to absorb and retain the rainfall. For this, vast quantities of humus are needed. This is only possible if we make use of all possible vegetable, animal, and human wastes.

One neglected source of unused waste is the sewage of our large towns and cities. Surely, in an alert country like the United States of America, at least one progressive community can be found which will set up a pioneer plant to recover the whole of its sewage in the form of methane (for power purposes), dried sewage sludge (for

composting), and water hyacinth or other suitable plants (for large-scale municipal composting). The results of such an up-to-date plant would soon sweep the world. I look forward with confidence to reading about this before long in a forthcoming issue of *Organic Gardening*. Then it will be possible profitably to discuss this matter with the various authorities in Great Britain and the Empire.

### **The Leguminous Crop**

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THE role of the leguminous crop in agriculture is everywhere understood and welded into local practice. Nevertheless outside the Far East one of the essential needs of this group of plants is not realized.

To express themselves fully as producers of seed, fodder or forage leguminous crops must, as a general rule, be grown in soil enriched with farmyard manure, or better still with high quality compost. If this condition is not fulfilled trouble of some kind often results. The yield of seed may fail, the crop may become sick, as in red clover, and fade out altogether.

Legumes are invariably sensitive to soil conditions. A careful observer in the West Country, Mr. F. Newman Turner, recently informed me that the honey bee is able to distinguish between two bean crops of the same variety grown side by side on the same type of humus-filled land--one sown with seed raised with farmyard manure, the other with the help of artificials. The bees worked over the former and a good crop of seed was obtained. They avoided the latter and little seed was produced. Obviously some important factor in the nutrition of the bean was conveyed from manure of animal origin to the flower, then to the seed and finally to the following crop.

The cultivators of the Far East know the value of farmyard manure for raising seed of this group of plants. So did our grandfathers who invariably manured the land with ample muck if a good crop of clover hay followed by a second crop of seed was required.

But towards the end of the last century agricultural science intervened and insisted that such manuring of the leguminous crop was unnecessary as the organisms in the root nodules would not only fix all the nitrogen these crops required but would also add to the store of residual nitrogen in the soil. This advice was based on the work of the Bernberg Experiment Station where it was proved that the root nodule fixes free atmospheric nitrogen. By such means nitrogen starvation is indeed prevented but this is only one factor in a much larger problem. The mistake our agricultural instructors made was to argue from the particular to the general without first of all ascertaining the real needs of the leguminous crop.

Any farmer can satisfy himself about the limitations of the nodule factor by growing a crop of alfalfa in a soil rich in properly made compost and top-dressing with the same manure after every cut. There will be few or no nodules on the roots but there

will be nothing wrong with the yield or the quality of the produce. The same thing happens when a heavy crop of seed of clover or beans is raised by organic farming methods.

The root nodule begins to fade from the picture the moment the humus content of the soil is increased.

A question will at once be asked--Could not seed formation be improved by the use of artificial manures? The answer is that the plant objects. Anybody can verify this by trying to grow a crop of beans on strong land with the help of such artificials.

Besides supplying the protein needed by man and beast several leguminous crops, like ground nut and soya bean, produce oil as well. Much of the oils and fats now in such short supply in Great Britain come from the ground nut.

To increase the supply of oils and fats an interesting development in Tanganyika, Southern Rhodesia and Kenya is in progress. An area of some 3,210,000 acres, subdivided into 107 units each of 30,000 acres, is to be cleared of forest, scrub and grass and put under ground nuts. It is expected to produce from 600,000 to 800,000 tons a year by the help of mechanized cultivation, the use of a rotation crop of grass to provide organic matter, and plenty of artificials to stimulate the ground nuts. It is not proposed to introduce livestock on account of the danger of tsetse-fly infection. These parasites are now in possession of most of the wooded areas which have to be cleared, but it is hoped with the help of entomologists that this adverse factor can be controlled.

The usual procedure in such developments as this is to begin in a modest way and to write the preliminary results on the land itself. This provides the necessary time and experience before any subsequent large scale developments are attempted. But the need is so urgent that it has been decided to risk proceeding straight from the paper project to the unit of 30,000 acres.

Such large scale, farming schemes by means of tractors and the manure bag and without the help of livestock are not new. They were tried in Russia after the Revolution but were soon given up. In Africa the Empire Cotton Growing Corporation attempted to produce cotton without farmyard manure but the results have not been impressive. The tea planters in Nyasaland and Kenya began to grow tea with the help of artificials, but they soon had to maintain cattle for the sake of their manure.

It will be interesting to watch this new African development in the culture of a leguminous crop and to see for how long the crucial result--the setting of seed--can be maintained without farmyard manure. It is an excellent method of putting the new slogan of the vested interests--*organic matter supplemented by artificial*--to the long term acid test.