Farming and Gardening for Health or Disease (The Soil and Health)

by

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Preface

The earth's green carpet is the sole source of the food consumed by livestock and mankind. It also furnishes many of the raw materials needed by our factories. The consequence of abusing one of our greatest possessions is disease. This is the punishment meted out by Mother Earth for adopting methods of agriculture which are not in accordance with Nature's law of return. We can begin to reverse this adverse verdict and transform disease into health by the proper use of the green carpet -- by the faithful return to the soil of all available vegetable, animal, and human wastes.

The purpose of this book is threefold: to emphasize the importance of solar energy and the

vegetable kingdom in human affairs; to record my own observations and reflections, which have accumulated during some forty-five years, on the occurrence and prevention of disease; to establish the thesis that most of this disease can be traced to an impoverished soil, which then leads to imperfectly synthesized protein in the green leaf and finally to the breakdown of those protective arrangements which Nature has designed for us.

During the course of the campaign for the reform of agriculture, now in active progress all over the world, I have not hesitated to question the soundness of present-day agricultural teaching and research -- due to failure to realize that the problems of the farm and garden are biological rather than chemical. It follows, therefore, that the foundations on which the artificial manure and poison spray industries are based are also unsound. As a result of this onslaught, what has been described as the war in the soil has broken out in many countries and continues to spread. The first of the great battles now being fought began in South Africa some ten years ago and has ended in a clear-cut victory for organic farming. In New Zealand the struggle closely follows the course of the South African conflict. The contest in Great Britain and the United States of America has only now emerged from the initial phase of reconnaissance, in the course of which the manifold weaknesses of the fortress to be stormed have been discovered and laid bare.

I am indebted to some hundreds of correspondents all over the world for sending me reports of the observations, experiments, and results which have followed the faithful adoption of Nature's great law of return. Some of this information is embodied and acknowledged in the pages of this book. A great deal still remains to be summarized and reduced to order -- a labour which I hope soon to begin. When it is completed, a vast mass of material will be available which will confirm and extend what is to be found in these pages. Meanwhile a portion of this evidence is being recorded by Dr. Lionel J. Picton, O.B.E., in the *News-Letter on Compost* issued three times a year by the County Palatine of Chester Local Medical and Panel Committees at Holmes Chapel, Cheshire. By this means the story begun in their Medical Testament of 1939 is being continued and the pioneers of organic farming and gardening are kept in touch with events.

The fourth chapter on "The Maintenance of Soil Fertility in Great Britain" is very largely based on the labours of a friend and former colleague, the late Mr. George Clarke, C.I.E., who, a few days before his untimely death in May 1944, sent me the results of his study of the various authorities on the Saxon Conquest, the evolution of the manor, the changes it underwent as the result of the Domesday Book, and the enthronement of the Feudal System till the decay of the open-field system and its replacement by enclosure.

The spectacular progress in organic farming and gardening which has taken place in South Africa and Rhodesia during the last few years owes much to the work of Captain Moubray, Mr. J. P. J. van Vuren, and Mr. G. C. Dymond, who have very generously placed their results at my disposal. Captain Moubray and Mr. van Vuren have contributed two valuable appendices, while Mr. Dymond's pioneering work on virus disease in the cane and on composting at the Springfield Sugar Estate in Natal has been embodied in the text. For the details relating to the breakdown of the cacao industry in Trinidad and on the Gold Coast and for a number of other suggestions on African and West Indian agriculture I am indebted to Dr. H. Martin Leake, formerly Principal of the Imperial College of Tropical Agriculture, Trinidad.

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I owe much to a number of the active members of the New Zealand Compost Club, and in particular to its former Honorary Secretary, Mr. T. W. M. Ashby, who have kept me fully informed of the results obtained by this vigorous association. The nutritional results obtained by Dr. G. B. Chapman, the President, at the Mount Albert Grammar School, which show how profoundly the fresh produce of fertile soil influences the health of schoolboys, have been of the greatest use. In Eire the Rev. C. W. Sowby, Warden of the College of St. Columba, Rathfarnham, Co. Dublin, and the Rev. W. S. Airy, Head Master of St. Martin's School, Sidmouth, have placed at my disposal the results of similar work at their respective schools. These pioneering efforts are certain to be copied and to be developed far and wide. Similar ideas are now being applied to factory canteen meals in Great Britain with great success, as will be evident from what Mr. George Wood has already accomplished at the Co-operative Wholesale Society's bacon factory at Winsford in Cheshire.

For furnishing full details of a large-scale example of successful mechanized organic farming in this country and of the great possibilities of our almost unused downlands I owe much to Mr. Friend Sykes. The story of Chantry, where the results of humus without any help from artificial manures are written on the land itself, provides a fitting conclusion to this volume.

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Chapter 1
Introduction

An Adventure in Research

My first post was a somewhat unusual one. It included the conventional investigation of plant diseases, but combined these duties with work on general agriculture; officially I was described as Mycologist and Agricultural Lecturer to the Imperial Department of Agriculture for the West Indies.

The headquarters of the department were at Barbados. While I was here provided with a laboratory for investigating the fungous diseases of crops (mycology) and was given special facilities for the study of the sugar-cane, in the Windward and Leeward Islands my main work was much more general -- the delivery of lectures on agricultural science to groups of schoolmasters to help them to take up nature study and to make the fullest use of school gardens.

Looking back I can now see where the emphasis of my job rightly lay. In Barbados I was a laboratory hermit, a specialist of specialists, intent on learning more and more about less and less: but in my tours of the various islands I was forced to forget my specialist studies and become interested in the growing of crops, which in these districts were principally cacao, arrowroot, ground nuts, sugar-cane, bananas, limes, oranges, and nutmegs. This contact with the land itself and with the practical men working on it laid the foundations of my knowledge of tropical agriculture.

This dual experience had not long been mine before I became aware of one disconcerting circumstance. I began to detect a fundamental weakness in the organization of that research which constituted officially the more important part of my work. I was an investigator of plant diseases, but I had myself no crops on which I could try out the remedies I advocated: I could not take my own advice before offering it to other people. It was borne in on me that there was a wide chasm between science in the laboratory and practice in the field, and I began to suspect that unless this gap could be bridged no real progress could be made in the control of plant diseases: research and practice would remain apart: mycological work threatened to degenerate into little more than a convenient agency by which -- provided I issued a sufficient supply of learned reports fortified by a judicious mixture of scientific jargon -- practical difficulties could be side-tracked.

Towards the end of 1902, therefore, I took steps which terminated my appointment and gave me a fresh start. My next post was more promising -- that of Botanist to the South-Eastern Agricultural College at Wye in Kent, where in addition to teaching I was placed in charge of the experiments on the growing and drying of hops which had been started by the former Principal, Mr. A. D. (later Sir Daniel) Hall. These experiments brought me in contact with a number of the leading hop growers, notably Mr. Walter (afterwards Sir Walter) Berry, Mr. Alfred Amos, and Colonel Honyball -- all of whom spared no pains in helping me to

understand the cultivation of this most interesting crop. I began to raise new varieties of hops by hybridization and at once made a significant practical discovery -- the almost magical effect of pollination in speeding up the growth and also in increasing the resistance of the developing female flowers (the hops of commerce) to green-fly and mildew (a fungous disease) which often did considerable damage. The significant thing about this work was that I was meeting the practical men on their own ground. Actually their practice -- that of eliminating the male plant altogether from their hop gardens -- was a wide departure from natural law. My suggestion amounted to a demand that Nature be no longer defied. It was for this reason highly successful. By restoring pollination the health, the rate of growth, and finally the yield of hops were improved. Soon the growers all over the hop-growing areas of England saw to it that their gardens were provided with male hops, which liberated ample pollen just as it was needed.

This, my first piece of really successful work, was done during the summer of 1904 -- five years after I began research. It was obtained by happy chance and gave me a glimpse of the way Nature regulates her kingdom: it also did much to strengthen my conviction that the most promising method of dealing with plant diseases lay in prevention -- by tuning up agricultural practice. But to continue such work the investigator would need land and hops of his own with complete freedom to grow them in his own way. Such facilities were not available and did not seem possible at Wye.

Then my chance came. Early in 1905 I was offered and accepted the post of Economic Botanist at the Agricultural Research Institute about to be founded by Lord Curzon, the then Viceroy of India, at Pusa in Bengal. On arrival in India in May 1905 the new institute only existed on paper, but an area of about seventy-five acres of land at one end of the Pusa Estate had not yet been allocated. I secured it instantly and spent my first five years in India learning how to grow the crops which it was my duty to improve by modern plant-breeding methods.

It was a decided advantage that officially my work was now no longer concerned merely with the narrow problem of disease My main duties at Pusa were the improvement of crops and the production of new varieties. Over a period of nineteen years (1905-24) my time was devoted to this task, in the course of which many new types of wheat (including rust-resistant varieties), of tobacco, gram, and linseed were isolated, tested, and widely distributed.

In pursuance of the principle I had adopted of joining practice to my theory, the first step was to grow the crops I had to improve. I determined to do so in close conformity with local methods. Indian agriculture can point to a history of many centuries: there are records of the same rice fields being farmed in north-east India which go back for hundreds of years. What could be more sensible than to watch and learn from an experience which had passed so prolonged a test of time? I therefore set myself to make a preliminary study of Indian agriculture and speedily found my reward.

Now the crops grown by the cultivators in the neighbourhood of Pusa were remarkably free from pests: such things as insecticides and fungicides found no place in this ancient system of cultivation. This was a very striking fact, and I decided to break new ground and try out an idea which had first occurred to me in the West Indies and had forced itself on my attention at Wye, namely, to observe what happened when insect and fungous diseases were left alone and allowed to develop unchecked, indirect methods only, such as improved cultivation and more efficient varieties, being employed to prevent attacks.

In pursuit of this idea I found I could do no better than watch the operations of the peasants as aforesaid and regard them and the pests for the time being as my best instructors.

In order to give my crops every chance of being attacked by parasites nothing was done in the way of direct prevention; no insecticides and fungicides were used; no diseased material was ever destroyed. As my understanding of Indian agriculture progressed and as my practice improved, a marked diminution of disease in my crops occurred. At the end of five years' tuition under my new professors -- the peasants and the pests -- the attacks of insects and fungi on all crops whose root systems suited the local soil conditions became negligible. By 1910 I had learnt how to grow healthy crops, practically free from disease, without the slightest help from mycologists, entomologists, bacteriologists, agricultural chemists, statisticians, clearing-houses of information, artificial manures, spraying machines, insecticides, fungicides, germicides, and all the other expensive paraphernalia of the modern experiment station.

This preliminary exploration of the ground suggested that the birthright of every crop is health.

In the course of the cultivation of the seventy-five acres at my disposal I had to make use of the ordinary power unit in Indian agriculture, which is oxen. It occurred to me that the same practices which had been so successful in the growing of my crops might be worth while if applied to my animals. To carry out such an idea it was necessary to have these work cattle under my own charge, to design their accommodation, and to arrange for their feeding, hygiene, and management. At first this was refused, but after persistent importunity backed by the powerful support of the Member of the Viceroy's Council in charge of Agriculture (the late Sir Robert Carlyle, K.C.S.I.), I was allowed to have charge of six pairs of oxen. I had little to learn in this matter, as I belong to an old agricultural family and was brought up on a farm which had made for itself a local reputation in the management of cattle. My work animals were most carefully selected and everything was done to provide them with suitable housing and with fresh green fodder, silage, and grain, all produced from fertile land. I was naturally intensely interested in watching the reaction of these well-chosen and well-fed oxen to diseases like rinderpest, septicaemia, and foot-and-mouth disease which frequently devastated the countryside. (These epidemics are the result of starvation, due to the intense pressure of the bovine population on the limited food supply.) None of my animals were segregated; none were inoculated; they frequently came in contact with diseased stock. As my small farmyard at Pusa was only separated by a low hedge from one of the large cattle-sheds on the Pusa estate, in which outbreaks of foot-and-mouth disease often occurred, I have several times seen my oxen rubbing noses with foot-and-mouth cases. Nothing happened. The healthy, well-fed animals failed to react to this disease exactly as suitable varieties of crops, when properly grown, did to insect and fungous pests -- no infection took place. These experiences were afterwards repeated at Indore in Central India, but here I had forty not twelve oxen. A more detailed account of the prevention and cure of foot-and-mouth disease is given in Chapter 9.

These observations, important as they appeared both at the time and in retrospect, were however only incidental to my main work which was, as already stated, the improvement of the varieties of Indian crops, especially wheat. It was in the testing of the new kinds, which in the case of wheat soon began to spread over some millions of acres of India, that there gradually emerged the principle of which my observations about disease did but supply the first links in evidence: namely, that the foundations of all good cultivation lie not so much in

the plant as in the soil itself: there is so intimate a connection between the state of the soil, i.e. its fertility, and the growth and health of the plant as to outweigh every other factor. Thus on the capital point of increase of yield, if by improvement in selection and breeding my new special varieties of wheat, etc., might be estimated to produce an increase of 10 to 15 per cent, such yields could at once be increased not by this paltry margin, but doubled or even trebled, when the new variety was grown in soil brought up to the highest state of fertility. My results were afterwards amply confirmed by my colleague, the late Mr. George Clarke, C.I.E., who, by building up the humus content of his experiment station at Shahjahanpur in the United Provinces and by adopting simple improvements in cultivation and green-manuring, was able to treble the yields of sugar-cane and wheat.

Between the years 1911 and 1918 my experience was considerably enlarged by the study of the problems underlying irrigation and fruit growing. For this purpose I was provided with a small experimental farm on the loess soils of the Quetta valley in Baluchistan where, till 1918, the summer months were spent. After a supply of moisture had been provided to supplement the scanty winter rainfall, the limiting factors in crop production proved to be soil aeration and the humus content of the land. Failure to maintain aeration was indicated by a disease of the soil itself. The soil flora became anaerobic: alkali salts developed: the land died. The tribesmen kept the alkali condition at bay in their fruit orchards in a very suggestive manner -- by means of the deep-rooting system of lucerne combined with surface dressings of farmyard manure. Moreover they invariably combined their fruit growing with mixed farming and livestock. Nowhere, as in the West, did one find the whole farm devoted to fruit with no provision for an adequate supply of animal manure. This method of fruit growing was accompanied by an absence of insect and fungoid diseases: spraying machines and poison sprays were unheard of: artificial manures were never used. The local methods of grape growing were also intensely interesting. To save the precious irrigation water and as a protection from the hot, dry winds, the vines were planted in narrow ditches dug on the slopes of the valley and were always manured with farmyard manure. Irrigation water was led along the ditches and the vines were supported by the steep sides of the trenches. At first sight all the conditions for insect and fungous diseases seemed to be provided, but the plants were remarkably healthy. I never found even a trace of disease. The quality of the produce was excellent: the varieties grown were those which had been in cultivation in Afghanistan for centuries. No signs of running out were observed. Here were results in disease resistance and in the stability of the variety in striking contrast to those of western Europe, where disease is notorious, the use of artificial manures and poison sprays is universal, and where the running out of the variety is constantly taking place (see also Chapter 8, Vine).

These results and observations taken together and prolonged over a period of nineteen years at length indicated what should be the right method of approach to the work I was doing. Improvement of varieties, increased yields, freedom from disease were not distinct problems, but formed parts of one subject and, so to speak, were members one of another, all arising out of the great linkage between the soil, the plant, and the animal. The line of advance lay not in dealing with these factors separately but together. If this were to be the path of progress and if it was useless to proceed except on the basis of crops grown on fertile land, then the first prerequisite for all subsequent work would be just the bringing of the experiment station area to the highest state of fertility and maintaining it in that condition.

This, however, opened up a further problem. The only manure at the command of the Indian cultivator was farmyard manure. Farmyard manure was therefore essential, but even on the experiment stations the supply of this material was always insufficient. The problem was how

to increase it in a country where a good deal of the cattle-dung has to be burnt for fuel. No lasting good could be achieved unless this problem were overcome, for no results could be applied to the country at large.

The solution was suggested by the age-long practices of China, where a system of utilizing farm wastes and turning them into humus had been evolved which, if applied to India, would make every Indian holding self- supporting as regards manure. This idea called for investigation.

I now came up against a very great difficulty. Such a problem did not fall within my official sphere of work. It obviously necessitated a great deal of chemical and agricultural investigation under my personal control and complete freedom to study all aspects of the question. But while my idea was taking shape, the organization of agricultural research at Pusa had also developed. A series of watertight compartments -- plant breeding, mycology, entomology, bacteriology, agricultural chemistry, and practical agriculture -- had become firmly established. Vested interests were created which regarded the organization as more important than its purpose. There was no room in it for a comprehensive study of soil fertility and its many implications by one member of the staff with complete freedom of action. My proposals involved "overlapping", a defect which was anathema both to the official mind (which controlled finance) and to a research institute subdivided as Pusa always had been.

The obvious course was to leave the institute and to collect the funds to found a new centre where I could follow the gleam unhampered and undisturbed. After a delay of six precious years, 1918-24, the Indore Institute of Plant Industry (at which cotton was the principal crop) was founded, where I was provided with land, ample money, and complete freedom. Now the fundamental factor underlying the problems of Indian cotton was none other than the raising of soil fertility. I might therefore kill two birds with one stone. I could solve the cotton problem if I could increase the amount of farmyard manure for India as a whole.

At Indore I had a considerably larger area at my disposal, namely, 300 acres. From the outset the principles which I had worked out at Pusa were applied to cotton. The results were even better. The yield of cotton was almost trebled and the whole experiment station area stood out from the surrounding countryside by reason of the fine crops grown. Moreover these crops were free from disease, with only two exceptions, during the whole eight years of my work there, exceptions in themselves highly significant. A small field of gram, which had become accidentally waterlogged three months before the crop was sown, was, a month after sowing, found to be heavily attacked by the gram caterpillar, the infected areas corresponding with the waterlogged areas with great exactness, while the rest of the plot remained unaffected: the caterpillar did not spread, though nothing was done to check it. In the second case a field of *san* hemp (*Crotalaria juncea,* L.), originally intended for green-manuring, was allowed to flower for seed; after flowering it was smothered in mildew and insect pests and no seed set. Subsequent trials showed that this crop will set seed and be disease free on black soils only if the land is previously well manured with farmyard manure or compost.

These results were progressive confirmation of the principle I was working out -- the connection between land in good heart and disease-free crops: they were proof that as soon as land drops below par, disease may set in. The first case showed the supreme importance of keeping the physical texture of the soil right, the second was an interesting example of the refusal of Mother Earth to be overworked, of her unbreakable rule to limit herself strictly to that volume of operations for which she has sufficient reserves: flowers were formed, but

seed refused to set and the mildew and insects were called in to remove the imperfect product.

These were the exceptions to prove the rule, for during the eight years of my work at Indore it was assumed by me as a preliminary condition to all experiments that my fields must be fertile. This was brought about by supplying them with heavy dressings of compost made on a simple development of the Chinese system. As I was now free, it was possible for me to make these arrangements on a large scale, and in the course of doing so it seemed well worth while to work out the theory that underlay the empiric Chinese practice. A complete series of experiments and investigations were carried out, establishing the main chemical, physical, and biological processes which go to humus formation in the making of compost. In this work I received valuable help from Mr. Y. D. Wad who was in charge of the chemical side of the investigation. On my retirement from official service in 1931 I assumed that the publication of this joint work in book form would be the last scientific task which I should ever undertake.

It proved instead to be the beginning of a new period which has been based on the long preparation which preceded it: the years of work and experiment carried out in the tropics had gradually but inevitably led me up to the threshold of ideas which embrace and explain the facts and the practices, the theory and also the failures, which had met me in the course of these thirty-two years. Our book on *The Waste Products of Agriculture; Their Utilization as Humus,* designed to be a practical guide to assist the Indian cotton cultivators, evoked a much wider interest. The so-called Indore Process of making compost was started at a number of centres in other countries and interesting results began to be reported, very much like what I had obtained at Indore.

Two years after publication, in February 1933, I saw the inception of a compost-making scheme at Colonel Grogan's estate not far from Nairobi in Kenya Colony. During this visit it first occurred to me gradually to terminate all my other activities and to confine myself to encouraging the pioneers engaged in agriculture all over the world to restore and maintain the fertility of their land. This would involve a campaign to be carried out single-handed at my own expense as no official funds could be expected for a project such as mine. Even if I could have obtained the means needed it would have been necessary to work with research organizations I had long regarded not only as obsolete, but as the perfect means of preventing progress. A soil fertility campaign carried on by a retired official would also throw light on another question, namely, the relative value of complete freedom and independence in getting things done in farming, as compared with the present cumbrous and expensive governmental organization.

By the end of 1933 matters had progressed far enough to introduce the Indore Process to a wider public. This was done by means of two lectures before the Royal Society of Arts in 1933 and 1935, some thousands of extra copies of both of which were distributed all over the world, and subsequent contributions to the *Journal* of that society, to a German periodical -- *Der Tropenpflanzer* -- and a Spanish review -- the *Revista del Instituto de Defensa del Café* of Costa Rica. The process became generally known and was found to be a most advantageous proposition in the big plantation industries -- coffee, tea, sugar, maize, tobacco, sisal, rice, and vine -- yields and quality alike being notably improved. I devoted my energies to advising and assisting those interested, and during this period became greatly indebted to the tea industry for material help and encouragement.

In 1937 results were reported in the case of tea which were difficult to explain. Single light dressings of Indore compost improved the yield of leaf and increased the resistance of the bush to insect attacks in a way which much surpassed what was normally to be expected from a first application. While considering these cases I happened to read an account of Dr. Rayner's work on conifers at Wareham in Dorsetshire, where small applications of humus had also produced spectacular results. Normally humus is considered to act on the plant indirectly: the oxidation of the substances composing it ultimately forming salts in the soil, which are then absorbed by the root hairs in the usual processes of nutrition. Was there here, however, something more than this, some direct action having an immediate effect and one very powerful?

Such indeed has proved to be the case and the explanation can now be set forth of the wonderful double process by which Nature causes the plant to draw its nurture from the soil. The mechanism by which living fungous threads (mycelium) invade the cells of the young roots and are gradually digested by these is described in detail in a later chapter (Chapter 2, The Living Soil). It was this, the mycorrhizal association, which was the explanation of what had happened to the conifers and the tea shrubs, both forest plants, a form of vegetation in which this association of root and fungus has been known for a long time. This direct method of feeding would account for the results observed.

A number of inquiries which I was now able to set on foot revealed the existence of this natural feeding mechanism in plant after plant, where it had hitherto neither been observed nor looked for, but only, be it noted, where there was ample humus in the soil. Where humus was wanting, the mechanism was either absent or ineffective: the plant was limited to the nurture derived by absorption of the salts in the soil solution: it could not draw on these rich living threads, abounding in protein.

The importance of the opening up of this aspect of plant nutrition was quite obvious. Here at last was a full and sufficient explanation of the facts governing the health of plants. From this point on evidence began to accumulate to illumine the new path of inquiry, which in my opinion is destined to lead us a very long way indeed. It was clear that the doubling of the processes of plant nutrition was one of those reserve devices on which rests the permanence and stability of Nature. Plants deprived of the mycorrhizal association continue to exist, but they lose both their power to resist shock and their capacity to reproduce themselves. A new set of facts suddenly fell into place: the running out of varieties, a marked phenomenon of modern agriculture, to answer which new varieties of the important crops have constantly to be bred -- hence the modern plant breeding station -- could without hesitation be attributed to the continued impoverishment of modern soils owing to the prolonged negligence of the Western farmer to feed his fields with humus. By contrast the maintenance of century-old varieties in the East, so old that in India they bear ancient Sanskrit names, was proof of the unimpaired capacity of the plant to breed in those countries where humus was abundantly supplied.

The mycorrhizal association may not prove to be the only path by which the nitrogen complexes derived from the digestion of proteins reach the sap. Humus also nourishes countless millions of bacteria whose dead bodies leave specks of protein thickly strewn throughout the soil. But these complex bodies are not permanent: they are reduced by other soil organisms to simpler and simpler bodies which finally become mineralized to form the salts taken up by the roots for use in the green leaves. May not some of the very early stages in the oxidation of these specks of protein be absorbed by the root hairs from the soil water?

It would seem so, because a few crops exist, like the tomato, which although reacting to humus are not provided with the mycorrhizal association. This matter is discussed in the next chapter.

These results set up a whole train of thought. The problem of disease and health took on a wider scope. In March 1939 new ground was broken. The Local Medical and Panel Committees of Cheshire, summing up their experience of the working of the National Health Insurance Act for over a quarter of a century in the county, did not hesitate to link up their judgment on the unsatisfactory state of health of the human population under their care with the problem of nutrition, tracing the line of fault right back to an impoverished soil and supporting their contentions by reference to the ideas which I had for some time been advocating. (See Medical Testament.) Their arguments were powerfully supported by the results obtained at the Peckham Health Centre and by the work, already published, of Sir Robert McCarrison, which latter told the story from the other side of the world and from a precisely opposite angle -- he was able to instance an Eastern people, the Hunzas, who were the direct embodiment of an ideal of health and whose food was derived from soil kept in a state of the highest natural fertility.

By these contemporaneous pioneering efforts the way was blazed for treating the whole problem of health in soil, plant, animal, and man as one great subject, calling for a boldly revised point of view and entirely fresh investigations.

By this time sufficient evidence had accumulated for setting out the case for soil fertility in book form. This was published in June 1940 by the Oxford University Press under the title of *An Agricultural Testament.* This book, now in its fourth English and second American edition, set forth the whole gamut of connected problems as far as can at present be done -- what wider revelations the future holds is not yet fully disclosed. In it I summed up my life's work and advanced the following views:

1. The birthright of all living things is health.
2. This law is true for soil, plant, animal, and man: the health of these four is one connected chain.
3. Any weakness or defect in the health of any earlier link in the chain is carried on to the next and succeeding links, until it reaches the last, namely, man.
4. The widespread vegetable and animal pests and diseases, which are such a bane to modern agriculture, are evidence of a great failure of health in the second (plant) and third (animal) links of the chain.
5. The impaired health of human populations (the fourth link) in modern civilized countries is a consequence of this failure in the second and third links.
6. This general failure in the last three links is to be attributed to failure in the first link, the soil: the undernourishment of the soil is at the root of all. The failure to maintain a healthy agriculture has largely cancelled out all the advantages we have gained from our improvements in hygiene, in housing, and our medical discoveries.
7. To retrace our steps is not really difficult if once we set our minds to the problem. We have to bear in mind Nature's dictates, and we must conform to her imperious demand: (a) for the return of all wastes to the land; (b) for the mixture of the animal and vegetable existence; (c) for the maintaining of an adequate reserve system of feeding the plant, i.e. we must not interrupt the mycorrhizal association. If we are willing so far to conform to natural law, we shall rapidly reap our reward not only in

a flourishing agriculture, but in the immense asset of an abounding health in ourselves and in our children's children.

These ideas, straightforward as they appear when set forth in the form given above, conflict with a number of vested interests. It has been my self-appointed task during the last few years of my life to join hands with those who are convinced of their truth to fight the forces impeding progress. So large has been the flow of evidence accumulating that in 1941 it was decided to publish a *News-Letter on Compost,* embodying the most interesting of the facts and opinions reaching me or others in the campaign. The *News-Letter,* which appears three times a year under the aegis of the Cheshire Local Medical and Panel Committees, has grown from eight to sixty-four pages and is daily gaining new readers.

The general thesis that no one generation has a right to exhaust the soil from which humanity must draw its sustenance has received further powerful support from religious bodies. The clearest short exposition of this idea is contained in one of the five fundamental principles adopted by the recent Malvern Conference of the Christian Churches held with the support of the late Archbishop of Canterbury, Dr. Temple. It is as follows: "The resources of the earth should be used as God's gifts to the whole human race and used with due consideration for the needs of the present and future generations."

Food is the chief necessity of life. The plans for social security which are now being discussed merely guarantee to the population a share in a variable and, in present circumstances, an uncertain quantity of food, most of it of very doubtful quality. Real security against want and ill health can only be assured by an abundant supply of fresh food properly grown in soil in good heart. *The first place in post-war plans of reconstruction must be given to soil fertility in every part of the world.* The land of this country and the Colonial Empire, which is the direct responsibility of Parliament, must be raised to a higher level of productivity by a rational system of farming which puts a stop to the exploitation of land for the purpose of profit and takes into account the importance of humus in producing food of good quality. The electorate alone has the power of enforcing this and to do so it must first realize the full implications of the problem.

They and they alone possess the power to insist that every boy and every girl shall enter into their birthright -- health, and that efficiency, well- being, and contentment which depend thereon. One of the objects of this book is to show the man in the street how this England of ours can be born again. He can help in this task, which depends at least as much on the plain efforts of the plain man in his own farm, garden, or allotment as on all the expensive paraphernalia, apparatus, and elaboration of the modern scientist: more so in all probability, inasmuch as one small example always outweighs a ton of theory. If this sort of effort can be made and the main outline of the problems at stake are grasped, nothing can stop an immense advance in the well-being of this island. A healthy population will be no mean achievement, for our greatest possession is ourselves.

The man in the street will have to do three things:

1. He must create in his own farm, garden, or allotment examples without end of what a fertile soil can do.
2. He must insist that the public meals in which he is directly interested, such as those served in boarding schools, in the canteens of day schools and of factories, in

popular restaurants and tea shops, and at the seaside resorts at which he takes his holidays are composed of the fresh produce of fertile soil.

3. He must use his vote to compel his various representatives -- municipal, county, and parliamentary -- to see to it: (a) that the soil of this island is made fertile and maintained in this condition; (b) that the public health system of the future is based on the fresh produce of land in good heart.

This introduction started with the training of an agricultural investigator: it ends with the principles underlying the public health system of to-morrow. It has, therefore, covered much ground in describing what is nothing less than an adventure in scientific research. One lesson must be stressed. The difficulties met with and overcome in the official portion of this journey were not part of the subject investigated. They were man made and created by the research organization itself. More time and energy had to be expended in side-tracking the lets and hindrances freely strewn along the road by the various well-meaning agencies Which controlled discovery than in conducting the investigations themselves. When the day of retirement came, all these obstacles vanished and the delights of complete freedom were enjoyed. Progress was instantly accelerated. Results were soon obtained throughout the length and breadth of the English-speaking world, which make crystal clear the great role which soil fertility must play in the future of mankind.

The real Arsenal of Democracy is a fertile soil, the fresh produce of which is the birthright of the nations.