Towards a Sustainable Agriculture--The Living Soil

By Lady Eve Balfour

The following classic text in the organic movement is an address given by the late Lady Eve Balfour to an IFOAM conference in Switzerland in 1977

In order to set the scene for this historic conference, and for the benefit of the younger participants, I think it might be helpful to start by sketching, briefly, the origins and development of the, now world-wide, organic movement. After that I propose to explain how my own involvement in the movement led to the so-called 'Haughley Experiment', and outline the contribution which that experiment made towards today's recognition of the importance of ecological awareness in Agriculture. Finally I want to share with you some of my thoughts on what I believe should be our approach, both philosophical and pragmatic, in working for a Sustainable Agriculture.

I do not know where or when the ideas that have brought us together here were first called a movement, but I have little doubt that the main inspiration derived from the work of the early research pioneers in the first quarter of this century, though this is not to discount the influence of one of the most important, who was even earlier, namely Rudolf Steiner.

Those I particularly have in mind were: in the medical field, Sir Robert McCanison, Drs. Francis Pottinger Jnr. and Weston Price, and in the agricultural field, Sir Albert Howard, Dr. William Albrecht, and Dr. E. Pfeiffer.

Following these, and overlapping with them to a certain extent, came another wave of giants--men like Dr. George Scott-Williamson, Dr. Lionel Picton, Dr. Dendy, Prof. Barry Commoner and the courageous Rachel Carson, and among the list of departed great ones, I must, sadly, now add Dr. Schumacher.

These pioneers had one thing in common--they were what we should now call Ecologists. They all succeeded in breaking away from the narrow confines of the preconceived ideas that dominated the scientific thinking of their day. They looked at the living world from a new perspective--they also asked new questions. Instead of the contemporary obsession with disease and its causes, they set out to discover the causes of Health. This led inevitably to an awareness of wholeness (the two words after all, have the same origin) and to a gradual understanding that all life is one.

Although I started farming in Suffolk in 1919 my own interest in the ecological approach only began in the early 19?0's. By that time local societies had been formed in more than one country to promote organic husbandry and whole food, though I was not aware of this until 1945 when plans were under way for forming the Soil Association, the first society in the movement aiming at a world membership, and with research high on its list of priorities, which brings me to the Haughley Experiment.

This was started in 1939 on my farm and taken over by the Soil Association in 1947 which for the next 25 years directed and sponsored it. This pioneering experiment was the first ecologically designed

agricultural research project, on a full farm scale. It was set up to fill a gap in the evidence on which the claims for the benefits of organic husbandry were based. It was decided that the only way to achieve this was to observe and study nutrition cycles, functioning as a whole, under contrasting methods of land use, but on the same soil and under the same management, the purpose being to assess what effect, if any, the different soil treatments had on the biological quality of the produce grown thereon, including its nutritive value as revealed through its animal consumers. This had never been done before.

Three side-by-side units of land were established, each large enough to operate a full farm rotation, so that the food-chains involved--soil--plant--animal and back to the soil, could be studied as they functioned through successive rotational cycles, involving many generations of plants and animals, in order that interdependences between soil, plant and animal, and also any cumulative effects could manifest.

In order that you may understand the significance of some of the results I cannot avoid a short summary of how these units were operated. One was a stockless arable farm which for the purpose of this talk I shall ignore--the other two were both ley farms (temporary pasture alternating with arable) operating the same rotation. Each carried a herd of dairy cows, a flock of poultry and a small flock of sheep. All livestock was fed exclusively on the produce of its own unit, replacements were home bred and cereal and pulse crops raised from home-grown seed. All wastes of crops and stock were returned only to its own unit. Only livestock products and surplus animals were sold off the farm. All crops were put through the animals. On one of these two comparable units supplementary chemical fertilizers were used, as well as herbicides, insecticides and fungicides when thought necessary. This unit was called the Mixed Section.

On the other unit, called the Organic Section, no chemicals were used. It was thus entirely dependent on its own biological fertility. As nearly as possible a closed cycle was maintained so that a minimum of unknown factors should be introduced into the food chain to confuse the issue.

You can see, I expect, why such an exploration into the unknown was left to the private enterprise of a charitable society with small resources. It was at total variance with the fragmentary techniques of orthodox agricultural research, which is based on randomised small plots--a technique quite incapable of throwing any light on biological interdependencies in a functioning whole. The establishment of the day even went so far as to declare that there was no case to investigate--they were particularly critical of the closed system on the organic section, yet most of the significant findings were the outcome of this, and would not have been revealed without it. I will attempt to summarise a few of the more important findings, concentrating on those that have special relevance for the subject matter of this conference.

In addition to carefully recorded field observations, an extensive range of sample analyses (soil and products) was carried out by the consultant bio-chemist, Dr. R.F. Milton. These included analyses for available plant nutrients in every field every month for a period of over 10 years.

The outcome of this huge number of individual analyses, running into thousands, was a new discovery. It was one of the most important single findings to come out of the experiment, because it was so conclusive and, surprisingly, hitherto unsuspected by orthodox agricultural chemists--namely that the levels of available minerals in the soil fluctuate according to the season, maximum levels coinciding with the time of maximum plant demand. These fluctuations were far more marked on the Organic Section than on the other two, where, moreover, they could be partly related to fertilizer application.

On the Organic Section, which received no fertilizers, the fluctuation was so marked that, for example, in The field with the highest humus content and the longest history of no chemicals, as much as 10 times more available phosphate has been recorded in the growing period of the year than in the dormant period. Potash and nitrogen followed the same general pattern. It was clear, from the fact of the closed cycle, that this seasonal release of minerals could only have been brought about by biological agencies, and it appears to be a natural action-pattern of a biologically active soil.

When this finding was first published it was taken up by a Scottish University, repeated, confirmed, and is now generally accepted. Previously it had been assumed that a single spot analysis at any time of year could show what the soil required.

The many different chemical analyses, carried out on crops and livestock products, revealed no consistent or significant differences between the sections, other than the usually higher water content of the chemically grown fodder. Seasonal variations, and those between fields in the same section, often exceeded average sectional differences. But this lack of difference was in itself significant in that on the organic section, receiving no added minerals the analysis of soil and crops showed a nutrient status that remained consistently as high as that of the others.

This indicates how little of the minerals applied as fertilizers are recovered in crops, and is important in relation to the purpose of this conference. Dr. Milton has summed it up thus: "The analytical work carried out in connection with the Haughley Experiment has shown how wasteful of natural resources is modern commercial farming and how with a closed-cycle technique nutrients are recycled and moreover become available in situ provided that an ecological approach is made to the methods of cultivation and farm management."

Although analytical difference between the sections was negligible, there were functional differences of some significance, such as the relative freedom from insect pest damage of the organic section crops, and the longer working life of its livestock. A number of the functional differences noted threw up unanswered questions and so point the directions for useful future research.

Three examples must serve to illustrate what I mean:

1. In spite of the mixed section receiving no less organic return than its organic counterpart it could be clearly demonstrated that its fields had become dependent on their fertilizer supplements in a manner suggestive of drug addiction. By contrast the organic fields developed an increasing biological vigour which enabled them to be self-supporting. Had we not operated the closed cycle policy, this surprising result would almost certainly have been attributed to whatever importation had taken place. I shall be referring later to research work carried out during the last year and not yet published in detail that may provide at least a partial explanation for this and my next example.

2. A consistent finding, particularly with autumn sown cereals, was a visual observation of an apparently much delayed growth in the early stages on the Organic Section. Further examination, however, showed that in this initial period the plant in an organic environment is 'concentrating' (if I may so put it) on establishing a vigorous root system. Having done so, but not before, it is ready to make top growth (i.e. the behaviour pattern of growth is quite different to that of plants growing in a chemical or 'mixed' environment). This interpretation is supported by the fact that before the end of the growing season the 'organic' crops caught up the others and, as I have stated, remained able to look after themselves.

3. With the livestock, the temperament of the animals composing the herds and flocks exhibited sectional differences, those belonging to the organic section being noticeably more contented. Our findings also confirmed the many reports received from organic farmers in different parts of the world, that a given output of animal products--milk, meat, eggs etc. required from 12-15% less input of food when this was grown organically.

At Haughley for example, though the organic herbal leys were of clearly sparser growth than the much lusher mixed-section leys, the cows on the former gave, over a 20 year period, around 15% more milk than the other. (To forestall the obvious comment, we were able to show that this contrast was not due to a genetic factor.)

Once more this finding is relevant to any discussion about an alternative and sustainable Agriculture, and this is what I now want to talk about. To start with, I want to answer three widely held objections to the idea that organic farming on a world scale can ever be possible.

The most frequently heard argument is that intensive chemical farming provides the only hope of feeding the expanding world population and has therefore to be accepted whether we like it or not. To me it seems probable that the exact opposite could prove to be the case, and that it is an alternative and largely organic agriculture that will be forced upon us whether we like it or not. This is because, as is becoming increasingly apparent, the days of the former are numbered. One reason is the enormous demands on the

world's non-renewable resources of energy, made by our Western life-style in general, and modern farming techniques in particular. Another is that modern methods are putting strains on the biota which is causing it to collapse.

Thus it is only common sense to look at alternatives, and in all seriousness study their potential viability.

It is not yet, however, generally accepted that the days of our present methods and behaviour are numbered. Even where it is, it is too often regarded as a long term problem which must not be allowed to obscure the immediate problem, namely the need to increase quantitative food production now. Here it is argued that organic farming is less efficient, that it has to rely on re-cycling which is wasteful, so that were it to be adopted, world food production would inevitably be lower, particularly production of protein, at a time when what we need is to produce ever more per acre.

To this I would like to point out three things:

1. A common view among nutritionists today is that the amount of protein (especially animal protein) hitherto thought to be required by man has been greatly over- estimated. (Organic farmers have found this also to be true for livestock).

2. There need be little loss in re-cycling if we did not waste so much.

3. Certainly we need to produce more per acre. Unfortunately the yardstick of modern economics is to measure the efficiency by production per man.

Labour-intensive small units will always be able to produce spectacularly more per acre than the large mechanised farms, apart from the finding that organically grown food goes further. When the inevitable change in life-style takes place I predict that we shall find it easier to feed the world population than we think, perhaps easier than now because Western Nations will presumably have become less gluttonous. I predict also that we shall all be healthier!

We still hear, though less frequently than we used to, the argument that there is no scientific basis for advocating exclusive use of organic manures, such as FYM and compost, because 'there is absolutely no difference between a plant nutrient contained in organic materials and the same nutrient in in-organic chemical form'. There may be no chemical, or other easily analysable, difference, but there is a demonstrable functional difference. Anything having an effect on root distribution, for example, may have an effect on plant nutrition because it will influence the volume of soil explored.

Thus good soil structure in depth, such as is obtained in a biologically active soil, can improve productivity simply by increasing the depth of soil exploited for water and nutrients. There is now well documented scientific evidence that fertilizer concentrations of N and P have an influence on localised root branching. They induce it at the expense of deep rooting exploration. This could well lead to luxury uptakes of N and P linked to inadequate uptake of other nutrients.

There are implications in this for nutrient unbalance in the crop and thereby some risk of nutrient unbalance in the animals and humans feeding upon it. If root activity is a factor in the development and maintenance of soil structure, there are also implications in this for the overall pattern of soil development.

This is the work I was referring to earlier as possibly throwing light on some Haughley findings. (A reference to it is M.C. Drew Ag. Research Council Letcome Laboratory Annual Report for 1975-1976).

In a biologically active soil, which implies one adequately provided with organic matter and natural rock minerals, the latter are released as the plant want them, moreover the roots are presented with a complete diet from which they can pick and choose.

Plants are highly selective in such circumstances, hence the value of some of the deep rooting weeds (which the organic farmer calls herbs when he sows them deliberately). Normal chemical fertilizers, apart from the disadvantage just mentioned are far too simple: A plant's mineral requirements are many times wider in range. By giving only two or three which stimulate bulk growth, others, equally important, are

exhausted, or locked up in the immediate neighbourhood of the rhizosphere, thus leading, as already mentioned, to unbalanced nutrition of the plant and often, through their solubility, to serious environmental pollution.

Plant nutrients do not, as was once taught, all have to be reduced to simple inorganic solutions in order to be absorbed. Plants can ingest quite complex organic molecules, unbroken. The history of D.D.T. provides irrefutable evidence for this. So do such symbiotic mechanisms as mycorrhizal association, whereby the plant may well derive some nutrient equivalent to vitamins in animal nutrition.

A possible additional factor for which, I readily admit, there is at present no scientific proof but which seems to me to provide an interpretation consistent with many observations, is that, in nature's food-chains, a plant's normal method of mineral intake is not direct, but second-hand, the mineral plant-foods being, as it were, by-products of the activity of the soil micro-flora and other members of the soil population.

Such by-products have a far more complex and comprehensive formula than N, P and K and moreover are living substances. Inorganic chemicals are inert. A food-chain is not only a material circuit, but also an energy circuit. Soil fertility has been defined as the capacity of soil to receive, store and transmit energy. A substance may be the same chemically but very different as a conductor of living energy. The hypothesis is that the energy manifesting in birth, growth, reproduction, death, decay and rebirth, can only flow through channels composed of living cells, and that when the flow is interrupted by inert matter it can be short-circuited with consequent damage to some part of the food-chain, not necessarily where the block occurred. The Anthroposophical Society's Research establishment at Dornach in this country (Switzerland) has provided some evidence in support of such a view.

I would like to see much more research undertaken in this field.

Now I want to put forward what I believe our aims should be in evolving a sustainable agriculture, and then, finally, pass on to you some thoughts on organic farming as I see it.

The criteria for a sustainable agriculture can be summed up in one word--permanence, which means adopting techniques that maintain soil fertility indefinitely; that utilise, as far as possible, only renewable resources; that do not grossly pollute the environment; and that foster life energy (or if preferred biological activity) within the soil and throughout the cycles of all the involved food-chains.

This is what biological husbandry sets out to attempt--with an increasing degree of understanding and success among its practitioners. Throughout the world, as a result of their own experience, these sincerely believe that they can offer a genuine and viable alternative agriculture, capable of solving many of the problems of mankind. This possibility, as well as the need for it, is becoming increasingly recognised in academic and scientific circles.

I am often asked how, in a broad sense, I define Organic Farming as opposed to conventional farming. Though I prefer the term biological husbandry because of its emphasis on life, the short answer is balance; however I think it is necessary to amplify a little.

Contrary to the views held by some, I am sure that the techniques of organic farming cannot be imprisoned in a rigid set of rules. They depend essentially on the outlook of the farmer. Without a positive and ecological approach it is not possible to farm organically. The approach of the modern conventional farmer is negative, narrow and fragmentary, and consequently produces imbalance. His attitude to 'pests' and 'weeds', for example, is to regard them as enemies to be killed--if possible exterminated. When he attacks them with lethal chemicals he seldom gives a thought to the effect this may have on the food supply or habitat of other forms of wildlife among whom he has many more friends than foes. The predatory insects and the insectivorous birds are obvious examples.

The attitude of the organic farmer, who has trained himself to think ecologically, is different. He tries to see the living world as a whole. He regards so-called pests and weeds as part of the natural pattern of the Biota, probably necessary to its stability and permanence, to he utilized rather than attacked. Throughout

his operations he endeavours to achieve his objective by co-operating with natural agencies in place of relying on man-made substitutes. He studies what appear to be nature's rules - as manifested in a healthy wilderness--and attempts to adapt them to his own farm needs, instead of flouting them.

One of the first things be will notice about a natural eco-system such as a Wilderness or a Natural Forest is Balance and Stability. The innumerable different species of fauna and flora that go to make up such a community, achieve, as a result of their interdependence, whether in cooperation or competition, collective immortality. Seldom, if ever, is any species eliminated; seldom, if ever, does any species multiply to pest proportions. Thus the organic farmer, if he has a crop badly attacked by some pest, let us say, (and this can happen, even to organic farmers!) recognises that this is a symptom of imbalance in his local environment, and he first looks to see if some faulty technique of his own has been responsible--often it has.

This does not mean that he can always avoid emergency remedial measures but these he employs only when there is a real emergency, not as a routine. He strives instead to bring about biological balance, and it is remarkable the extent to which organic farmers and growers do in fact achieve this. I could give you several examples, but one must suffice.

Some years ago a large scale organic commercial grower of my acquaintance, growing vegetables, fruit and flowers was visited by a team of scientists from Cambridge University--they included plant pathologists and entomologists. They knew it was an unsprayed holding and they came looking for disease and pests. They found isolated examples of everything they expected to find, but, as they put it, they failed to find a single case of crop damage.

Besides biological balance, the ecologically minded organic farmer takes note of, and tries to apply, other apparent biological roles. For example nature's diversity of species he adapts through rotations, under-sowing, and avoiding monoculture of crops or animals. Nature's habit of filtering sunlight and rain through some form of protective soil cover, he adapts by such practices as cover-cropping and mulching. Top soil on the top appears to be nature's plan. Organic matter is always deposited on the surface. It is left to the earthworms and some insects to take it below. The organic farmer also puts his compost and farmyard manure on, or very near, the surface and in carrying out mechanical cultivations keeps soil-inversion to a minimum, the tine cultivator being preferred to the plough.

Nature's highly efficient re-cycling system ensures provision of living food for all organisms in the food chain from soil bacteria and fungi to large fauna; the organic farmer therefore lays great stress on the conservation and return to the soil of all organic residues. His aim is to feed and to assist proliferation of the soil population and to leave it to feed the crop.

Finally, and of equal importance, he notes, and tries to reproduce, the almost perfect structure of a biologically active soil which alone ensures the three most important characteristics of a fertile soil--good aeration, water-holding capacity, and free drainage.

It is quite astonishing the extent to which this all-important property of good soil is neglected in modern agriculture. Poor soil structure leads to imbalance between water and air in the pore spaces of the soil. Many apparent mineral or trace mineral deficiencies in the soil turn out to be oxygen deficiencies. When that is corrected the others disappear.

In most agricultural soils there is really plenty of mineral plant food for the nutritional requirements of plants, even when continuously cropped, if their roots are allowed to exploit it downwards. The key to this is good soil structure which is greatly influenced by the activity of earthworms. The techniques of modern farming tend to destroy good structure in a number of ways, such as by the impaction of heavy implements, by carrying out cultivations in unsuitable weather conditions, and by failure to provide sufficient organic food and/or a suitable lime status for the earthworm population.

All these faults are the outcome of failure to think ecologically--they are symptoms of a degree of fragmentation in our approach to the living world which has become a real threat to our survival. Throughout biological evolution, starting from single celled organisms right up to the complexity of rain forests, the process has been characterised by increasing diversity among species, lengthening of the food

chains, and progressive enrichment of the environment.

For the first time in the history of the planet the actions of modern man appear to be putting this process into reverse. Whole species of fauna and flora are being eliminated, the food-chains are becoming shorter, and the environment progressively impoverished. It only takes a little imagination to picture what could happen if the trend continues.

What are we going to do about it? This is the real challenge for the International Federation of Organic Agriculture Movements, and in my view it is one of education. The Soil Association is doing an excellent pioneering job in adult education into the principles and practice of biological husbandry. It is now urgently necessary that a still wider aspect of ecology should also form part of the regular curriculum of all schools, starting at the primary stage. The trouble is we have first to teach the teachers, and here, I think, we must be agreed on what we want to teach.

There are two motivations behind an ecological approach--one is based on self interest, however enlightened, i.e. when consideration for other species is taught solely because on that depends The survival of our own.

The other motivation springs from a sense that the biota is a whole, of which we are a part, and that the other species which compose it and helped to create it; are entitled to existence in their own right. This is the wholeness approach and it is my hope and belief that this is what we, as a federation, stand for.

If I am right, this means that we cannot escape from the ethical and spiritual values of life for they are part of wholeness. To ignore them and their implications would be to pursue another form of fragmentation. Therefore, I hold that what we have to teach is the attitude defined by Aldo Leopold as 'A Land Ethic'. This requires that we extend the concept of Community to include all the species of life with which we share the planet. We must foster a reverence for all life, even that which we are forced to control, and we must, as Leopold put it--'Quit thinking about decent land use as solely an economic problem, but examine each question in terms of what is ethically and aesthetically right, as well as what is economically expedient. A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise'.

That quotation expresses what I believe should be our guidelines.
