put it rather delicately back on the hinges without any movement at all. These are people who are obviously muscular. The endomorph has a problem for he has a different weight of gut and length of gut, and whether this has anything to do with his fuel requirements is uncertain. The work of the American, Sheldon, bears on this. His book, *The Varieties of Human Physique*, is the one to consult for information on variety of human constitution and he deals with the varieties of human personality in another work. These are the only scientific studies available. Pick up a skin-fold to find out if a person is fat. Feeling one fold is quite enough. There is no fat there, in a healthy person. The best guide is the latest tables of the Metropolitan Life Office, based on a huge experience scientifically analysed.

## SOIL, NUTRITION, AND HEALTH

**Lady Eve Balfour**

The first thing I want to say is that the extraordinary complexity of cell nutrition revealed by scientific research year by year, ever since the discovery of vitamins, has produced a crying need for the establishment of a new kind of ecological research which one should perhaps call " agro-medical research." The habit, largely followed up to now, of separating off all the different sectors of the nutritional cycle into unco-ordinated compartments, has become a great handicap to progress. Professor Darlington recently (*New Scientist*, 11 January, 1962) put it like this: " The fragmentation of science which has led to an artificial separation between the plant kingdom, which ' belongs ' to botany, and the animal kingdom which ' belongs ' to zoology, and man, who ' belongs ' to medicine, has had the effect of delaying the advance both of biology and of medicine." The point I want to make is that the time is over-ripe for an integration between these various specialisms.

We have not lacked pioneers to point the way. The now classic experiments of the late Sir Robert McCarrison, described originally in his Cantor lectures and recently republished by Faber and Faber, demonstrated convincingly the connection between what we eat and the standards of health we enjoy. The thing that made these experiments unique at the time was that they reversed the usual research procedure, of first using laboratory animals, in that his observations were first made on human groups. McCarrison felt that the extra-

ordinary differences existing in the pattern of health and disease between different Indian races were not due either to climate or genetics, but to their different food habits. To test this he took a number of colonies of long-established strains of laboratory white rats and proceeded to feed each group, through several generations, on the exact diet as consumed, grown, and prepared by the different Indian peoples he had observed. All other living conditions, such as cleanliness, good water supply, attention, and so on, were the same. In every single case his rat families reflected, almost like a mirror, the health of the human families on whose diet they were living, even to the same percentage incidence of characteristic diseases associated with particular groups, and including the absolutely healthy ones bred from generation to generation on the diet of the healthiest races in the Northern Territories.

About that same period, also in India but completely separately, the agricultural research work of the late Sir Albert Howard was revealing the connection between fertile balanced soil, (biologically active, rich in humus and minerals) and disease resistance in plants and animals. The principles of positive health evolved by these two men were put into practice for over 25 years by that great general practitioner, the late Dr Lionel Picton, who persuaded many families to follow them and observed the effect over more than one generation. His striking results have somehow or other been forgotten, but they are very important, and are most readably told in his delightful book *Thoughts on Feeding* (Faber). Somewhat later in the chain of evidence that was building up, came the practical studies of the late Dr Weston Price, who gave up a successful professional practice in America to spend the last 10 years of his life making a study of health, a subject which, as he came to realize rather late in life, is wholly omitted from the curriculum of medical training! The medical student studies the causation of disease rather than the causation of health, and all the materials he handles, both while a student and in his professional career, are pathological materials. Price travelled all over the world during the last ten years of his life, searching for and finding (I do not know whether we could today) healthy communities in every ethnic group of the human race and in every continent of the world.

Wherever these communities were dwelling in sufficient isolation to be living on the indigenous produce of their local soil or sea, so that their food was mostly fresh, whole, and unprocessed—they were healthy; wherever these human races (and that included all the European groups as well as in every other continent) were absorbed by, or came in close contact with, so-called " civilization " and partook of the refined devitalized, adulterated, and packaged foods of commerce, in particular the refined carbohydrates, their health

declined progressively with successive generations. The first symptom was invariably dental decay, but in the second generation skeletal malformation of various types appeared, with many deformities and diseases, some of which are still unassociated in most people's minds with nutrition at all. These occurred in increasing numbers. Price's report of his findings, a monumental tome called *Nutrition and Physical Degeneration*, still unpublished in this country, should be studied by all students of nutrition. It is not very well written, but its photographs are so striking that you do not need to read anything at all except the captions to the photographs and study the latter, to learn an enormous amount.

More recently still, the medical research of Dr F. M. Pottinger in California and the agricultural research of Dr William Albrecht in Missouri has resulted in evidence that lends very strong support to the hypothesis that soil, plant, animal, and man form part of the same nutrition cycle, which is one and indivisible, and that anything which affects for good or ill any part of this cycle can affect for good or ill any other part. Just as within the body itself a symptom or a pain may be in one part and the cause in another, so in this living chain of interdependencies the symptom may be in one part of the cycle—soil, plant kingdom, animal kindom—and the cause in another. Perhaps the most important part of Albrecht's pioneer work was concerned with the study of the quality of proteins, on which he was one of the earliest workers at a time when protein was thought of as simply protein, and had not been divided into its component parts or studied as good-quality or bad-quality protein. In the course of that work he also did some fascinating research in which he showed the extraordinarily close relationship between the soil micro-organism and trace minerals, which relationship is linked up with the ability of the plant to produce protein of high or low quality. Arising out of this work he found, for example, that with Bang's bacillus which causes contagious abortion in cattle, the micro-organism did not cause abortion unless there was previously a deficiency in the food of those animals, of a specific group of trace minerals (I believe they were cobalt, manganese, copper, and zinc). It was not sufficient to give these to the beasts in synthetic form, but when crops rich in those elements were grown through appropriate treatment of the soil, this not only cured but also prevented contagious abortion in cattle. He and Dr Pottinger did a little agro-medical research together, because, following this work, Dr Pottinger found that by following this clue with human patients he succeeded in rapidly curing undulant fever, caused by the same bacillus.

I want to outline one of Dr Pottinger's more famous experiments together with Dr Albrecht's interpretation of the sequel to it, because

it seems a good illustration of the interdependence of species I am talking about. The full details of this experiment, completed as far back as 1946, were described in the *American Journal of Orthodontics and Oral Surgery*, Vol. 32, August 1946. It was an animal experiment connected with a piece of research work being done in a big Californian hospital. The experimental animals were cats, and the experiment extended over 10 years and involved 900 animals. Its main purpose was a comparison between cooked and raw food, though there were various sub-divisions using different combinations, for example, groups of cats fed on raw meat with pasteurized milk, and others on cooked meat with raw milk. The animals who received an all-raw-food diet, both milk and meat (cats, of course, being carnivorous, cannot very well manufacture their own vitamins), remained healthy and bred normally from generation to generation healthy litters of kittens, while all those in which cooked foods formed the major portion of the diet, whether milk or meat, became progressively degenerate through succeeding generations. For example, 25 per cent of abortions occurred in the first and second generation, and this rose to something like 70 per cent in the second or third. The animals also fell prey to a number of diseases, some hitherto regarded as infectious. In a great many cases by the third and fourth generations the kittens had become so degenerate that they either failed to survive six months or completely failed to breed. A further experiment was concerned with different kinds of milk, and it produced exactly the same result; the raw-milk-fed cats remained quite healthy and bred from generation to generation, while all those fed on other forms of milk suffered from increasing degrees of sickness and degeneration, with skeletal malformation in this order: the raw-milk-fed animals were perfectly healthy, and progressively sick were those on pasteurized milk, then those on evaporated milk, and finally those on sweetened condensed milk. It was some of the last group that failed to survive six months in the third generation. Complete regeneration back to healthy animals, where it was not too late, took place when they were put back on to an all-raw-food diet. It took four generations, but by the fourth generation they were back to full health. The report ends with this significant statement: " The principles of growth and development are easily altered by heat and oxidation which kill living cells at every stage of the life process from soil through the plant and through the animal. The change is not only shown in the immediate generation, but as a germ-plasm injury which manifests itself in subsequent generations of plant and animals."

At the close of the experiment, the exercise pens being left empty, weeds grew up. The flooring material of the pens was clean quartz sand and the vigour of the weed growth followed exactly the same

pattern as the health of the cats who had occupied the pens. In the case of the milk pens, all the evaporated and heat-treated milks, coming by way of the cat dung, apparently did not put into the quartz sand enough fertility to invite even weed growth. Raw milk, on the other hand, had put so much back, even after feeding the cats better, that the weed growth filled the pens completely. As a further test, the weeds were dug in and Michigan white dwarf beans planted in all four pens. They, too, followed the same pattern as the weeds, but in this case even the growth habit was changed, for in the raw milk pen the beans ceased to be dwarf and climbed the wire 6 ft. high. All these beans were left to ripen and the seed was harvested. Commenting on this experiment, Dr Albrecht stated, in a work he wrote called *Protein Deficiency via Soil Deficiency*, that all harvested seed, except that from the raw-milk pen, smelt of cat excreta and that this odour is caused by the common faecal excretions indol and skatol, which are ring compounds unbroken by digestion. Indolacetic acid is a plant hormone giving pronounced growth of roots and shoots. Indol becomes this hormone by addition to the indol ring. With little further change it becomes tryptophane, that essential amino-acid which is in fact so often absent in plant protein, its presence or absence appearing to depend on how the plants are grown. Indol was present in the cat dung, and there is a suggestion that a hormone changed the dwarf beans into pole beans; there was also an indol odour in all the ripe seeds except those from pole beans in the raw-milk pen. Dr Albrecht's suggestion is therefore that the beans took up the indol in unbroken form, but that in those growing on the dung of raw-milk-fed cats it was converted into indolacetic acid and possibly tryptophane as part of the bean protein, hence of course eliminating the smell. He further suggested that this may very well be the normal route of travel of organic compounds in the cycle from soil to plant to animal and back to the soil. In this particular case, two animals were involved, the cow and the cat, and the effect of merely sterilizing the milk was, apparently, in some way to upset the normal flow of these organic compounds in the cycle.

This illustration of some of the complexities of the inter-relationships in the food chain serves to highlight Professor Sir Stanton Hicks' definition of nutrition as " a flow of vitalized materials from the soil through plants, animals and man, and back to the soil, each organism involved in the cycle being the channel through which for the moment it happens to be passing, for the flow is continuous from conception to the grave." How very recent is this changed thinking about nutrition he made clear in 1950 in a lecture at London University:

Until the recent war, the body was pictured as a machine, the structure of which, once completely developed, would, if wear and tear were replaced and

vitamins thrown in as an anti-knock remedy, remain in going order. Today the whole concept has been swept away by the application of isotopes in metabolic research. Instead of a machine that is built and maintained in repair, the body as seen through the eyes of a new observational procedure is an appearance resulting from equal rates of comings and goings of the material substance that is our food. As a whirlpool remains so long as the stream flows, so does the living body of an organism remain so long as the flow of material substance is appropriately maintained.

This new outlook quite alters our basic notion of nutrition, for it becomes easier to see that health depends on the material nature of the stream of nutrients. Concerning the quantitative and qualitative nature of this stream we have but the vaguest notion. We know a little more since he wrote that, but every new discovery seems to show how much more remains to be discovered. Vitamins and trace elements begin to appear as a vitally important key to the dynamic interchange within the cell itself.

" I have always thought," Hicks said, " that the discovery of vitamins was in the nature of a warning that food is a much more complex matter than we have ever thought, and that individually, vitamins are but another scientifically interesting observational item. If we proceed to the soil whence comes this stream of being, we find ever-increasing evidence of biological complexity where chemical simplicity had for so long been postulated and made the basis for action. It is no more true today to assume that the soil maintains plant and animal life by being an inert store of chemical elements than it is true that food is merely a source of energy and repair material for the completed adult body structure."

I hope that I have succeeded in making my case and have convinced you of the need for more ecological research. I am going to call to my support the words of one more authority with a very wide international experience, Professor Lindsay Robb, one of the agricultural advisers working for F.A.O. In the course of a lecture delivered in 1957, also at London University, he said: " Since soil fertility and human health are integral parts of the fundamental soil-plant-animal-man relationship, the need for the medical profession and agriculture to join forces in ecological research requires no emphasis." In the same lecture, speaking about the Haughley experiment (which is the particular piece of ecological research with which I have been associated for 25 years, and which was not established with a view to proving any thesis but as a contribution to the search for quality in food), he said: " The work initiated (at Haughley) is a beginning, however modest, to provide material for a study of the quality, or health-value, of food and its relationship with soil fertility, one of the most important and also one of the most neglected studies in the realms of medicine and agriculture." I firmly believe that there is a very close link between the way we treat our soil and the quality of the crops it produces, and that it is the quality of food that largely determines the standard of health and well-being of the animals and humans who consume it. There

is a tremendous amount of work to be done, and I put to you the need for this agro-medical type of ecological research and ask you to support it whenever you get the opportunity.

## DISCUSSION

**Dr Playfair:** I am left with a slight feeling of depression. What can one do immediately about this, in one's home life? As cardboard packets come out at the breakfast table containing cardboard cornflakes and plastic things and one is surrounded by this sort of medium, how can one within one's own family do anything about it?

**Lady Eve Balfour:** Dr Playfair's question is a comparatively easy one, because I expected the very opposite, " What can we do collectively? " If he had said to me: " What can we do about all of our patients? ", that would be a very difficult question, because it is a slow educational job to a large extent, but individually I think there are few of us who cannot do something if we want to. One could certainly get less processed and debilitated food and more whole food. Even if you do not want to go to the labour of making your own bread, it is fairly easy nowadays to get quite good kinds of wholemeal bread. There are certain shops that specialize in organically grown food, but one can avoid the worst sinners, the refined carbohydrates, even if one uses the ordinary goods of commerce. You could make an extraordinary difference to your state of health by substituting fruit, fresh vegetables, salads, and raw food for some of the sugars and other debilitating foods so many of us eat. I believe that, even without the introduction of my own hobby-horse, the organic treatment of soil, we could aim at having 25 per cent of our food intake raw and whole, and would find an astonishing difference in standards of health. I believe that there is invariably an increase in the leucocyte count following the ingestion of a cooked meal but that no increase in leucocyte count takes place after a raw meal, and that if a meal starts with one good course of raw food and thereafter goes on to cooked food there is still no increase in the count; which is something which might give one cause to think.

***Question:*** Our criterion of health is longevity, and we are living longer and longer. Why?

**Lady Eve:** First of all, it is doubtful whether our criterion of health should be longevity, but that is a different subject. Is it not a fact that our expectation of life has enormously increased up to the age of 50 or 60, but that it has not increased at all beyond that stage? That is to say our chances of not dying before 50 are greater, but having reached 50 our chances of not dying before 60 or 70 are