

## SCIENCE OF NUTRITION

### Its Importance to India

BY

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I have chosen to speak on Nutrition, believing that for no country in the world has this Science a greater importance than for India; and for no part of India a greater importance than for the Madras Presidency. No country has more need to profit by the newer knowledge of Nutrition, and none more opportunity to add to it. Millions of the Indian people are living on restricted diets which are either incapable of maintaining them in a state of normal nutrition and health, or capable only of sustaining them at a low level of physical efficiency. Malnutritional diseases are rife, while the great scourges of the Tropics—malaria, cholera, dysentery, leprosy—exact an immense toll from India's malnourished multitudes. In this Presidency alone 'deficiency diseases' of almost every kind abound, and the level of physical efficiency of the masses is, in general, low. But while this is so in certain parts of the Peninsula there are others where the inhabitants are unsurpassed by any race of mankind in physique and capacity for endurance and hard work. Nowhere is the composition of human dietaries more influenced by racial, religious, economic and climatic considerations and nowhere have foods and food-habits remained more consistently the same from one generation to another. So it is that the diverse races, comprising the population of India, afford an unrivalled, and almost wholly unexplored, source of information regarding the effects of diet on the physical efficiency of human beings. India has thus not only much to do in applying the newer knowledge of Nutrition and in surveying, in the light of this knowledge, the foods available for the use of her immense populations, but much to learn regarding their nutritional needs, and much—by such learning—to teach the rest of the world.

I venture to hope that the subject may prove of interest to Government officials, business men, private individuals and members of the medical and other professions. In one way or another—social, political, economic, mercantile or hygienic—Nutrition is a matter that affects them all; the medical men, perhaps more than any other since his intimate acquaintance with it provides a shrewd instrument wherewith 'to tune this curious harp of man's body and reduce it to harmony.'

Let me, in as few words as I can endeavour to explain to you why this is so.

'La vie est une fonction chimique.' So said Lavoisier in 1780 (He it was who inaugurated the modern era of the Science of Nutrition and who first applied the balance and the thermometer to the investigation of the phenomena of life. He was executed by the 'Powers-that-be' of his time; but his work still lives and that of to-day is but a continuation of it). To his dictum it may be added that everyone of the myriad cells of which the body is composed is a

chemical laboratory wherein the materials provided by the food are, with the aid of the oxygen derived from the respired air, broken down or built up into substances required for the nurture and energising of the body as a whole. The sum of these chemical changes—whereby the function of nutrition is effected—is known as *metabolism*: health accompanies its perfection, ill-health is the sequel of its imperfection.

The food, then, must provide all the substances needed by the living cells for the proper exercise of their chemical processes: there must be none that are in deficiency and none, if the cells are not to be burdened with a maximum of labour, that are, in excess. For if there be some that are deficient or lacking in the food, then do the chemical changes with which these substances are concerned become impaired or fail; with the resultant impairment or failure in function of some corresponding organ or tissue of the body. While if there be some that are continually in excess certain cells will ultimately fail from exhaustion brought about by overwork, and disease of the corresponding organ or tissue will result. There are thus two directions in which nutritional disorders may arise: the one by deficiency of essential elements in the food; the other by excess of certain ingredients of the food; and these two by their combination may provide a third. The ideal food is, therefore, a palatable mixture of essential food-stuffs arranged in such proportions as to satisfy every need of the body without overburdening it with work.

The essential food-stuffs are nitrogenous substances called *proteins*, starches and sugars, called *carbohydrates*; *fats*; *mineral salts*; and *water*. The amounts of these required for each sex, from infancy to old age and under varying conditions of rest, work, climate and temperature are now fairly well known though there is still much to be learned especially in regard to the quantities of them that are needed in Tropical countries for various classes of labour. All these food-stuffs exist, some in greater proportion than others, in the food-materials which Nature provides for our use: the proteins principally in animal foods, such as meat, fish, fowl, egg and milk but also in vegetable foods, such as pulses and cereal grains, though in less suitable form and in less proportion than in animal foods. The carbohydrates exist principally in vegetable foods, such as cereal grains, root-vegetables and fruit; the fats in the flesh of animals, milk, egg and certain fish as well as in various nuts and seeds; while the mineral salts—of which there are some 20 essential kinds—are derived both from animal and from vegetable sources. The essence of successful nutrition is so to combine these natural foods as to provide a sufficiency of all essentials without excess of any.

The five essential food-stuffs or 'proximate principles' as they are called—proteins, carbohydrates, fats, mineral salts and water—can be prepared in the pure state and set out, as it were, in bottles in one's laboratory bench. Not so very long ago—only a few years before the Great War, in fact—it was thought that these 'proximate principles' were all that the body needed for the normal processes of Nutrition. But it was found by Gowland Hopkins of Cambridge, that if they be combined in due proportion and given as food to young rats—the animals usually for nutritional work—the food mixture did not admit of growth nor sustain life. But if to it a little whole-milk were added then growth proceeded and health was maintained. Later it was shown that if the milk were subjected to heat, in the presence of air,

growth again failed and the animals died. There was 'something' in the milk other than proteins, fats, carbohydrates, salts and water, which was essential to life. The something is 'vitamin.' Soon it became known that there are more 'vitamins' than one: some soluble in water, others soluble in fats; some destroyed by heat, oxidation, and certain chemical agents, others not; some contained in one kind of food-material, others in another. To distinguish them they were named after the letters of the alphabet and designated vitamin A, B, C, D and E. At the present time there are known to be six; B having recently been divided into two (B1 and B2). Twenty years hence this number may have increased several-fold. But whether there be six or sixty they will all be found to exist in the simple foods made in Nature's Laboratory—whole cereal grains, milk, milk-products, fresh fruit, and green leafy vegetables—and in quantities and combinations adequate for the due digestion and assimilation of the natural food-stuffs with which they are associated in Nature. Their multitude need cause the layman no anxiety provided he remembers that it is only by the purification, sophistication, storage, and excessive cooking of Nature's foods that they become deficient in these elusive and most necessary substances. Now-a-days it is possible to buy concentrates of some of them over the counter of druggists' shops, but the wise man will rely on Nature and not on the druggist for their provision; for no synthetic diet, which it is possible to prepare in the Laboratory, is in my experience as good as one made from a proper combination of natural foods.

The 'proximate principles' are the substances from which the body is built and repaired and from which it derives energy and warmth; the vitamins are substances which enable these principles to be properly utilised. Some years ago I likened the action of vitamins to that of the spark which ignites the fuel mixture of a petrol driven engine liberating its energy. The spark is of no use without the fuel nor the fuel without the spark; nay, more! the efficacy of the spark is dependent on the composition of the fuel-mixture. This simile has its limitations: but so far as it is applicable it will serve to fix the function of vitamins in the mind.

With the discovery of 'vitamins' and with more exact methods of experimentation, knowledge of nutrition progressed rapidly: experiments, as is the way of Science, revealing causes and causes inventing new experiments. Presently there arose the conception of disease as being due to negative as well as positive causes: a conception slow to gain general acceptance no doubt because 'it is the peculiar and perpetual error of the human intellect to be more moved and excited by affirmatives than by negatives; whereas it ought properly to hold itself indifferently disposed to both alike' (Francis Bacon). At the present time there are few who would dispute the influence of either. The negative factors are lack or deficiency of certain essential elements in the food; the positive factors are, for the most part, pathogenic agents such as bacterial and protozoal organisms. Sometimes one or other of these factors may operate alone in disease-production; but more often they join forces. And it is not only in those whose food is insufficient in quantity, but in many whose food is sufficient or even excessive in quantity while lacking in quality that these forces operate to cause disease.

Let me now attempt to describe the sequence of events leading to disease as a result of deficiency of a single factor in the food. For this purpose



I shall choose 'vitamin A' one of the most common of all deficiencies in the dietaries of India's inhabitants: indigenous as well as non-indigenous. But before I do so I would emphasize that it is rare to find only one substance deficient in a diet; more often there are several and more often still the deficiencies of some essentials are combined with excess of others. Balance of the food in every essential is a principle as important as the avoidance of deficiency in any. And if I select for this story of pathogenesis a Vitamin-deficiency it is not to say that an equally impressive one could not be told in regard to deficiency of some 'proximate principle' such, for example, as of the mineral elements: lime, phosphorus, iron or iodine. To limit my story to a reasonable compass I will not only select a single deficiency—vitamin A—but will tell of its effects on only one tissue of the body: mucous membrane. As you know it is with mucous membrane—a highly specialized skin—that various cavities and passages communicating with the outside air are lined; the conjunctiva, the alimentary tract, the passages from the kidneys to the bladder, the bladder itself and the respiratory passages. To protect it, and through it the body, against attack by pathogenic organisms Nature has endowed mucous membrane with a very wonderful defence mechanism. It is unnecessary to enter on a description of this mechanism, suffice it to say that the cells covering the mucous membranes produce certain secretions and possess certain qualities antagonistic to harmful bacteria. When vitamin A is absent from, or deficient in, the food the cells covering the mucous membrane dry up and become what is called keratinised. The mucous and other secretions are either no longer produced or such as are produced are lacking in protective quality; the outward defences of the body are thus broken down, and a door is opened for the entry of bacterial and other pathogenic agents into the tissues of the body. This door they are not slow to use. When this sequence of events takes place in the conjunctiva and the nearby tear-producing glands, infection of the eye is likely to occur, especially in a dusty land like India, and the whole organ may be rapidly invaded and destroyed. In this Presidency alone there are thousands of people who have been wholly or partially blinded in this way. Your distinguished ophthalmologist—Lt.-Col. Robert Wright—has recently emphasized this cause of blindness in Madras: a cause discovered by patient experiment on rats. Or if the respiratory tract be affected in a similar way the bacteria which cause such diseases of the lungs as pneumonia and tuberculosis have the way made ready for their ravages. Herein is one cause of the wide prevalence of tuberculosis and an illustration of the way in which dirt and diet combine to cause disease. Or if the urinary tract be similarly involved infection is likely to occur therein chemical changes are brought about in the urine, and its contained salts and other substances no longer remain in solution but are deposited in the kidney or bladder with the formation of that common and distressing malady: 'stone'. In my own laboratory stone-in-the-bladder and kidney have been produced in this way and prevented as easily by adding whole-milk containing vitamin A, to the stone-producing diet; while many disorders of the gastro-intestinal tract have been shown to have a like causation.

There is no organ nor tissue of the body which is not affected in some similar kind of way by one deficiency or another or by the combined action of such deficiencies and pathogenic agents: the nerves, the bones and teeth, the stomach and intestines, the reproductive glands, the thyroid, the adrenals, the liver, the kidneys, the spleen, the blood and skin. And according as one

or other or several of these are affected there appear certain clinical pictures which we recognise as disease entities: keratomalacia, beri-beri, scurvy, rickets, osteomalacia, pellagra, anaemia and so on. But underlying them all, and causing many conditions of ill-health for which we, as physicians, have no hagnostic label, there is depreciation of chemical and cellular functions: the foundation upon which disease is built.

Not long ago I had occasion to survey the incidence of lung diseases in the rats I use so largely for experimental work. I found in 2,000 odd post-mortem examinations carried out in deficiently-fed animals that no less than 35 per cent had died of lung diseases; while in an average daily population of 800 or more well-fed animals the incidence of lung disease was less than one per cent. An observation of this kind has an immense significance. The final cause of the lung disease was a microbic agent but it was the defective food which enabled it to overrun and kill the host. Ten years ago I made a similar observation in regard to dysentery. Such experiences lead one to think that sometimes we, as physicians and investigators of disease, fail to see the wood for the trees and that by singling out for meticulous study the pathogenic organisms associated with certain diseases we often neglect to consider the influence on their growth and disease-producing potency of the human soil in which they may become implanted. For myself I do not doubt but that faulty nutrition is the prime means whereby the soil is made ready for the rank growth of morbid organisms.

It is not only in regard to man but in regard also to his domestic animals that the study of nutrition is of such vast importance. Time does not permit me to dilate on the veterinary and stock-rearing aspects of the matter. It is sufficient to say that animals are no less subject to dietary diseases than man himself and that the future of the Veterinary Science, like the future of Medical Science, lies largely in the study of nutrition. Nor do the ramifications of the science of nutrition end with man and his domestic animals: they extend to his crops and to the very soil itself. Soil, irrigation, manure: all these have their influence not only on the quantity but on the quality of the crops as food. So it is that nutrition has its human, its animal and its plant aspects and its proper study must embrace them all.

In this brief sketch of so wide a subject I trust I may have said enough to convince you that it is one having an interest for everyone: laymen as well as medical men; rich as well as poor. Fortunately, like the principles of true religion, those of nutrition are simple and easy of comprehension. It is not my purpose here to expound them. I have done so lately in a little book called *Food* which I hope some of you may be sufficiently interested to read. It is the answer, so far as I am able to give it, to a question put to me twenty-seven years ago. At that time, and shortly after my entry into the Service, I had in the Hindu Khush my first private patient: a Mullah whom I afterwards came to number amongst my friends. He was suffering from 'gravel'. Ripe from the University and full of the medical lore of my day I disposed of his case with the confidence of youth, insisting magisterially on a certain line of treatment. He heard me with becoming courtesy not to say deference and then remarked: 'But Sahib, what shall I eat?' I did not know! I had been taught much, some of it of doubtful utility, but not this essential thing. Now after 27 years devoted to research some glimmering

of the predominant part played by diet in causing his condition is being revealed to me. But still his salutary question—'what shall I eat?'—recurs to me in connection with many other states of ill-health; and I realise that my days of research must come to an end before I can learn its complete answer. 'What shall I eat?' is a problem that has exercised the minds of many since the dawn of Medical History. Its full solution lies in the future and goes to the very root of Medical Science. Indeed the prophetic words of Hippocrates spoken in regard to the nutritive quality of different breads, are as apt to-day as they were 2,000 years ago: 'Whoever pays no attention to these things, or paying attention does not comprehend them how can he understand the diseases that befall a man?'

In view of the importance of this subject is it not a little remarkable that while India—and to go less far afield: Madras—has her great and essential organisations dealing with the nurture of the fruits of the earth and of the trees of the field, she has, as yet, none dealing with the nurture of man himself and of his domestic animals? It is true that she has her Medical, Veterinary, and Public Health Departments: all beneficent in their own sphere and effecting great good. But the two first are for the most part engaged in the salvage of wrecks, while the last, though brilliantly successful at times in its skirmishes with disease, must continue to fight a losing battle until it is recognised that malnutrition is the root cause of the vast proportion of human and animal disease in this country, and until means are found for improving the standard of the living of the masses.

What then should India, what should Madras, do in this matter? Mindful that the business of the Scientist is to stick to his Science, I say nothing of means for improving the standard of living of the masses; but there are two adjuvants to that end: education and the development of Research. India should see to it that the elements of Nutrition are taught in her schools and that this subject occupies a prominent place in the medical curriculum of her Universities. She should find amongst her own sons and daughters those capable of undertaking, and desirous of devoting themselves to, Nutritional Research; those actuated by the spirit of inquiry and possessed of a fitting humility, 'the entrance into the kingdom of man, founded on the Sciences, being not much other than the entrance into the Kingdom of Heaven, whereunto none may enter except as a little child' (Bacon). Following the example of Japan she should house these votaries of Science in her own National Institute for Nutrition; where they are taught, trained and tried and where they in their turn train and teach; where every aspect of Nutrition is ardently explored; 'where tireless striving stretches its arms towards perfection; where words come out from the depths of Truth; where the clear stream of reason has not lost its way into the dreary desert sand of dead habit' (Tagore). *Madras Mail*.

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