THE NATION'S LARDER IN WARTIME

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MEDICAL ASPECTS OF THE USE OF FOOD

BY

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The medical aspects of the use of food are manifold, and include such matters as food allergy, food poisoning, microbic and parasitic agents conveyed to man in food, and the treatment of disease by food. I shall confine myself to the relation of food as a whole to the preservation of health, the constituents of a properly constituted diet, the relation of such constituents to the structure and functions of the living body, and the effects of the inadequate supply or utilization of these essentials in causing disease.

Food may be defined as anything which when taken into the alimentary tract provides, on digestion, materials for the energy requirements, growth, maintenance, repair, and regulation of the vital activities of the body. The materials are many: proteins, fats, carbohydrates, minerals, vitamins, pigments, blood-forming substances, extractives, and flavouring matters. The food must also contain a certain amount of roughage to stimulate intestinal movements, and there is something, again, in the freshness of food which gives it a health-promoting influence. No single foodstuff contains all these properties. Even milk, which is the nearest approach to a complete food, lacks one and may lack more of them. A properly constituted diet is such a combination as contains them all in proper quantity and proportion.

Natural Foodstuffs

In order to learn what a properly constituted diet is we may consider the diet of the peoples of India, as it was among them that most of my own work was done. With the exception of the races whose staple article of food is rice—the nutritive value of which is usually debased by various treatments before use—the Indian peoples have national diets composed of the unsophisticated foodstuffs which their fields and pastures provide. Some of the peoples of Northern India are unsurpassed for perfection of physique, powers of endurance, and resistance to disease. Others, particularly the rice-eating races of the west and south, are of poor physique, low powers of endurance, and subject to much disease. Maladies such as tuberculosis, leprosy, dysentery, and many others are more common in the south and east than in the north. McCay came to the conclusion that food was the all-important determining influence, and the conclusion has been confirmed by the results of my own experiments.

[Here Sir Robert McCarrison described his well-known experiment with young rats, groups of which were fed on one or other of the chief national diets of India, proving that good or bad physique, as the case might be, was due to good or bad diet, all other things being equal.]

The best diet was found to be one similar to that used by certain hardy, agile, vigorous races of Northern India—a diet composed of freshly ground whole-wheat flour

made into cakes of unleavened bread, milk, butter, pulses, fresh green leaf and root vegetables, and fruit, with meat occasionally. Many other experiments were made which showed that when previously healthy animals were fed on improperly constituted diets, such as are habitually used by human beings, they developed many of the diseases from which these human beings tend to suffer—diseases of the bony framework of the body, of the skin and membranes, of the glands, of the gastro-intestinal tract, of the lungs, of the nerves. All these were produced in animals under experimental conditions by feeding them on faulty human diets.

A properly constituted diet is one made up of whole cereal grains, milk and its products, pulses, green leaf and root vegetables, fruit, with eggs or meat, or both, on occasion. The dependence of health on a diet composed of these natural foodstuffs or others of like nutritive value is the essence of the whole matter of food in relation to health and of food deficiency in relation to disease. It relieves the layman, or for that matter the doctor, of all or nearly all anxiety as to whether the food contains this or that constituent. It provides both for essential constituents of food already known and for those not yet known. There is, however, this proviso—that the foodstuffs must be produced on soils that are not themselves lacking in essential mineral and other substances, nor themselves rich in substances harmful to the body. Another proviso is that, owing to lack of sunshine at certain seasons of the year in this country, and to the sparse distribution of vitamin D among foodstuffs, it is necessary to add cod-liver oil or halibut-liver oil to the list given above.

For many years it was thought that proteins, minerals, fats, and carbohydrates sufficed for the growth, maintenance, repair, and energy requirements of the body. It is now known they do not suffice, and with new analyses and methods of investigation many other essential constituents of food have been found. Nevertheless, this older knowledge showed the fundamental relations of energy-yielding constituents to vital processes, also the importance of the protein factor in nutrition, and this older knowledge still stands.

The Vitamins

[Sir Robert McCarrison gave a brief account of the history of the discovery of vitamins and the descriptions attached to them.]

For some years following the discovery of vitamins and of their deficiency in the food as the cause of the maladies now known as the deficiency diseases, certain limiting terms—anti-this and anti-that—were attached to them. But further research showed that they had much else to do besides the prevention of these diseases. It is this “much else” that concerns us, for these maladies result from the complete or almost complete absence of the respective vitamins from the food, a contingency rarely met with in this country. It is not with complete but with partial deficiency that we are chiefly concerned. This partial deficiency is relatively common, certainly among the poorer classes, and it is becoming generally recognized that much subnormal health and development and even incidence of disease are associated with it.

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It is well, therefore, to have a working knowledge of the functions of the more important vitamins and minerals and of the effects on the body of their insufficient supply or utilization. For just as the knowledgeable gardener knows when his plants are not thriving for want of some nutrient, so should the knowledgeable parent know when her children are not thriving for the same reason. It is extraordinary how quickly one's powers of observation grow in this respect. I find myself saying of this or that child or young person: You need lime, you iron, you vitamin B₁, you vitamin A, you vitamin C, and you all of them.

Vitamin A is essential to growth and development of the young. It maintains the normal structure of mucous membranes, protecting them against infection. It controls the content of visual purple in the retina and has important relations to the enamel-forming organs of the teeth and to the structure of the blood, bone marrow, certain glands, and the nervous system. Its deficiency gives rise to poor growth of the body, eye affections, night blindness, dry or scaly skin, enamel-poor teeth, and to inflammatory states of mucous or other membranes. Rich sources of the pre-formed vitamin are animal fats, cod-liver oil, milk, butter, cream, liver, egg, and herring. Rich sources of its precursor—carotene—from which it is formed in the body itself, are carrots and fresh green vegetables.

Vitamin B is a complex of many vitamins. Vitamin B₁,—now known as aneurin or thiamin—is necessary for the structural and functional efficiency of the nervous system; consequently its adequate supply is essential to all neuro-muscular activities, including those of the heart, the stomach, and the bowels. The structural and functional efficiency of the adrenal gland depends largely upon it. It is related in a specific way to carbohydrate metabolism and is essential to growth. When absent from or very deficient in the diet the disease known as beriberi arises. Its insufficient consumption or utilization may give rise to anorexia, poor growth, lack of vigour, fretfulness or nervousness, cardiac and bowel irregularities, and neuritis. The chief sources of vitamin B₁ are yeast, marmite, whole cereal grains, egg yolk, liver, fresh green vegetables, and tomatoes. The body, in the course of its chemical activities, uses up the vitamin and does not store it to any extent; its constant and liberal replacement is therefore necessary. The chief cause of its insufficiency in the diets of our people is the almost universal use of white flour, from which it is lacking, in preference to whole-meal flour, in which it is abundantly present, and the excessive consumption of vitaminless sugar.

The other fractions of the vitamin B complex may be grouped together. Their functions include the activation of combustion processes, the promotion of growth, blood-forming activities, and a very important contribution to the maintenance of health of the skin, the mucous membranes, the gastro-intestinal tract, liver, heart, nervous system, and mind. One or more fractions are concerned in preventing pellagra; another appears to have something to do with the prevention of cataract; and a third has blood-forming functions. Deficiency may give rise to buccal, lingual, and gastro-intestinal ailments and to anaemia. The chief sources of the complex are yeast, liver, kidney, muscle meat, egg, milk, and green vegetables.

Vitamin C (ascorbic acid) has an important part to play in the chemistry of oxidation-reduction processes. It maintains the structural integrity of the cement substance which holds the cells of the body together. Consequently it has a close concern with the structural integrity of the capillaries, bones, teeth, gastro-intestinal tract, and mucous

membranes. Its absence from the diet gives rise to scurvy. Its insufficient supply may cause haemorrhage into, or easy bruising of, exposed parts of the body, sallowness and unhealthiness of the skin, imperfections of the teeth, fragile bones, unhealthy gums, and gastro-intestinal disorder. Rich sources of the vitamin are parsley, chillies, orange and lemon juice, green leaf vegetables, and potatoes.

Vitamin D (calciferol) controls the absorption and utilization of calcium and phosphorus. Its adequate supply is therefore of the utmost importance to the normal structure of the bones and teeth. Its deficiency gives rise to rickets, dental disease, and to slow healing of fractures. It is sparsely distributed among foodstuffs, occurring in considerable quantities only in fish oils, egg, liver, milk, and butter, and therefore it is deficient in the diet of many people.

Vitamin E is the so-called "anti-sterility vitamin," but it has other relations besides those to reproduction. It is indispensable to growth and to bodily functions generally. Research tends to connect it with the pituitary body, that master-gland of the endocrine system. Its chief source is wheat-germ oil.

The other vitamins I must pass by with the general remark that between them they contribute a considerable share to the health of the skin, the efficiency of the functions of reproduction and lactation, the maintenance of the normal composition of the blood, the prevention of haemorrhage, and the promotion of growth.

Mineral Constituents

The mineral constituents of food consist of some twenty elements, of which eleven are known to be essential to vital processes. In general their functions are to provide building materials for the fabric of the body and to regulate various functions. Some enter into the composition of all cells; others form the major part of the skeleton and teeth. In fulfilment of their regulating functions they have various parts to play: all are concerned in controlling the normal exchanges of body fluids and the permeability of the cell membranes; some maintain and regulate the neutrality of the blood, others the normal contractility of the muscles and excitability of the nerves; some enter into the composition of the digestive juices, others take part in the transport of oxygen from the lungs to the tissues and of carbon dioxide from the tissues to the lungs, thus making oxidation processes possible. Indeed, the more the mineral constituents of food are studied the more important is their role in nutrition found to be.

From the point of view of dietary construction four of these mineral elements—calcium, phosphorus, iron, and iodine—are of outstanding importance, not only because of their own functions but because they are those most likely to be present in the average diet in insufficient quantities. In the diet the amounts of these minerals should be adjusted with the same care as is given to those of proteins, carbohydrates, fats, and vitamins, and in estimating the quantities of essential components in any diet the calculations should always include these four elements. By making provision for their ample supply no serious deficiency of any other mineral essential is likely to arise.

Calcium is a chief constituent of the bones and teeth. It controls the contractility of muscle, and the rhythmic beat of the heart depends to a great extent upon it. It maintains the normal response of the nerves to stimuli, preventing their hyper-irritability, preserves the clotting

power of the blood, and sustains the capillary circulation. Calcium is made use of in the body to the extent of about 0.68 gramme daily, but to allow a fair margin the food should provide at least one gramme a day, and even more for expectant mothers and growing children. The insufficient supply of calcium is one of the commonest of all food faults in this country. It is difficult for the growing child under modern conditions to obtain enough calcium unless the diet contains at least a pint of milk a day. The diet of pregnant women is often dangerously low in calcium. Recent researches in America have shown that such women need 1.6 grammes daily; often they do not receive one-half of this amount. Deficiency leads, in growing children, to imperfect building of bones and teeth, to rickets and all its attendant consequences, and to malformation or mal-alignment of the vertebrae. Not infrequently the normal calcium content of the blood, on which so many bodily activities rely, is being maintained at the expense of decalcification elsewhere—of teeth, alveoli, and bones. Want of calcium leads also to nervous excitability and to tetany, to impaired muscular activity, and to disturbance of cardiac rhythm and of the neutrality of the blood. Foods rich in calcium are (weight for weight and in descending order of richness) cheese, turnip-top greens, black treacle, almonds, watercress, dried figs, egg yolk, milk, beans, lentils, oatmeal, turnips, whole wheat, and green leafy vegetables.

Phosphorus is an essential component of the nuclei of all cells, and therefore plays a conspicuous part in all cellular activities. It should be provided in the diet to the extent of 1.5 grammes daily, and increased during pregnancy. Deficiency may lead to stunting of growth, poor bone formation, softening of bone, a type of rickets, tooth decay, disturbance of neutrality of blood, and depression of vital processes generally. Foods rich in phosphorus are cheese, egg yolk, oatmeal, lean meat, chocolate, almonds, nuts, dried peas and beans, whole wheat, liver, milk, fresh beans, spinach, brussels sprouts, currants, raisins, and potatoes.

Iron is also concerned in the control of all cellular activities. It is a component of haemoglobin, the carrier of oxygen from the lungs to the tissue cells. The diet should contain at least 15 milligrammes of iron daily, increased to 20 during pregnancy. It is estimated that the iron content of the average diet in this country is rarely more than 100 milligrammes, frequently as low as 5. In these circumstances anaemia is likely to arise. Foods rich in iron are lentils, egg yolk, liver, dried peas and beans, black treacle, oatmeal, whole wheat, dried currants, almonds, turnip-top greens, spinach, dried prunes, dates, figs, and raisins.

Iodine is an essential constituent of the thyroid gland and of its active principle, thyroxine. In normal circumstances the daily requirements of iodine are about one-thousandth of a milligramme. Growing children and pregnant and lactating women need more of it than others. Its deficiency or inadequate absorption or utilization gives rise to goitre and its tragic sequel, cretinism, in which bodily and mental development are gravely retarded. Foods rich in iodine are sea foods, cod-liver oil, eggs, goat's milk, fresh vegetables, and some condiments.

The Function of Proteins

Apart from water, proteins are the most abundant constituents of living cells. Their chief role in the body is to provide materials for its growth and for the repair of its tissues. Their continuous supply is, therefore, necessary, and this supply must be of the right kind, to furnish the

requisite amino-acids, derivatives of proteins, from which the various tissues are built up. Besides their function as providers of building materials they also furnish a certain amount of energy. They are the source from which the body elaborates some enzymes or ferments, such as those concerned in the digestive processes, and catalytic agents needed for the speeding up of chemical processes.

The daily requirement of the body for proteins is approximately one gramme per kilogramme of normal body weight. More than this is an undesirable excess. Sources of them among animal foods are milk, meat, glandular organs, eggs, and fish; and among vegetable foods, legumes, whole cereal grains, seeds, nuts, and green vegetables. Those derived from animal sources are, in general, more suited to the needs of the human body than those derived from vegetable, but it is not necessary that the protein requirements of the body should be derived mainly from animal sources; it is sufficient if one-third is so derived. Nor is it necessary that "good" proteins as distinct from second-class should be derived from meat. Those of milk are among the best of all proteins and well able to leaven the whole lump of those derived from vegetable foods. For this reason, among others, the use of milk and cheese as articles of diet should be greatly extended. Much greater use should also be made of the better-class vegetable proteins, such as those of the soya bean and whole wheat, and much less use of the flesh of animals. Apart from every other consideration, the use of meat as the main source of proteins is as uneconomical as it is unnecessary—but where flavour is, there will desire be also.

Insufficient ingestion, absorption, or assimilation of proteins, or of proteins of the right kind, will tend to degradation of vital processes—a degradation manifested in stunting of growth, poor physique, lack of energy, resource, and initiative, digestive disturbances, and impaired action of glandular organs. To these may be added a lowered resistance to infection. Severe degrees of protein starvation, associated as they often are with want of food in general, may give rise to a condition known as "malnutritional oedema," "war oedema," or "famine oedema," in which the body, in part or in whole, becomes water-logged.

Protective Foods

It will have been noted how frequently the names of certain foodstuffs—such as milk, green and root vegetables, and whole cereal grains—recur in the lists I have given of those rich in vitamins, minerals, and proteins. These are the protective foods, so called because they are rich in those substances which protect the body or its constituent parts against disturbance of structure or of function, or of both—that is to say, against disease. It is these foodstuffs which must be brought within the financial reach of everyone in the country and used by everyone if health is to be maintained. The last war resulted in a great increase in knowledge of the relation of food to nutrition and health; the present war already demonstrates the need to apply it—a need which day by day becomes more urgent.

Many factors interfere with the adequate supply or utilization of essential nutrients. Poverty, ignorance, indifference, habit, soil deficiencies, sophistication of natural foodstuffs, bad cooking, fads and fancies—all may interfere with adequate supply. Gastro-intestinal disorder and other bodily conditions may interfere with adequate utilization. In the presence of gastro-intestinal disorder

defective utilization becomes dominant. Inadequate supply may itself impair appetite and set up gastro-intestinal disorder, thus interfering with utilization and establishing a vicious circle. It is rare that we have to deal only with a single deficiency in the diet. It is more usual for deficiencies to be multiple, and more usual still for multiple deficiencies—whether of vitamins or minerals or both—to be associated with the excessive richness of the food in carbohydrates. Thus the manifestations of ill-health resulting from the faulty food are compounded of the several effects of varying degrees of vitamin and mineral deficiency on the one hand and of carbohydrate excess on the other. Nor is this all, for infection by microbic agents usually contributes to the general morbidity.

Dietetic Malnutrition

Malnutrition produced by faulty food should be spoken of as "dietetic malnutrition." It is widespread in its distribution, and is preventable only by readjusting our ways of life—social, agricultural, and economic—so as to ensure for everyone a diet that will satisfy physiological needs. Owing to the substitution of artificial feeding for mother's milk infants become subject to gastro-intestinal and pulmonary disease, to which they frequently succumb. Fretfulness, restlessness, anaemia, imperfect calcification and growth are other symptoms of malnutrition in infants. In early childhood malformation of the bones, dental defects, and abnormalities of the pharynx are alarmingly common and are consequences of dietetic malnutrition and faulty nurture. Consequent on malnutrition, children of this age have a lowered resistance to infections, are poorly grown, under height and weight, and have nervous systems that lack stability.

During adolescence the lowered resistance of the malnourished fosters the occurrence of tuberculosis. Girls reach womanhood with deformed pelvis which make child-bearing difficult or precarious, while faulty nutrition during pregnancy is a serious menace to both mother and child. Middle life and advancing age is for many a period of physiological decay and long suffering caused by chronic illness.

So from infancy and childhood through adolescence to adult life, dietetic malnutrition, aided often by infection, leaves its trail of morbidity, and this although the food faults may not be extreme. So long as they are sufficient in degree to impair the function of nutrition they will, sooner or later, directly or indirectly, give rise to disease. The constant drip will wear away the stone; the constant imperfection of nutrition, though this be relatively slight, will wear away the body. This dietetically caused imperfection of the function of nutrition and the ailments resulting from it can be prevented by the use of a diet into which milk and its products, fresh green vegetables, root vegetables, particularly potatoes, and whole cereal grains, either in the form of oatmeal or of wholemeal bread, or both, largely enter. Thus we arrive, though by another path, at the same conclusion to which Professor J. C. Drummond's historical survey¹ had led us.

¹ *British Medical Journal*, June 8, p. 941.

The Educational Advisory Board of the British Social Hygiene Council is arranging a summer school for teachers to be held at Westminster College, Cambridge, during August 1-8. The school is to focus on "Social Biology in the School: Wartime Problems." Further information can be obtained from the Education Office, Educational Advisory Board, Tavistock House South, Tavistock Square, W.C.1.

TRENCH NEPHRITIS

IMPORTANCE OF EARLY DIAGNOSIS

A return of war conditions brings with it the possibility of nephritis occurring again on a large scale in the Army. During the last war, by the end of 1914 and the beginning of 1915 there was already a high incidence of nephritis in all the armies except those operating in warm climates. It soon became clear that it was not a new form of nephritis but the familiar diffuse glomerulonephritis as seen under peace conditions. The common aetiological factor appeared to be cold and damp. It was commoner in the infantry than in other branches of the Services and occurred mostly among men in the trenches.

Volhard¹ has recently given a valuable survey of the subject. As in the familiar forms of nephritis, there is usually a febrile illness starting with a chill and short period of fever two or three weeks before the nephritic symptoms appear. This illness is probably of streptococcal origin and the upper respiratory tract is nearly always affected, especially the tonsils, though there may sometimes be bronchitis or even bronchopneumonia. Occasionally the nephritic symptoms appear suddenly immediately after exposure to cold or damp. Clinically the nephritis is characterized by a great tendency to oedema, and the blood pressure, where taken, has been high from the beginning. Pathologically the essential lesion appears to be damage to the renal circulation, causing ischaemia of the kidney. The body reacts to this by a rise of blood pressure associated with general contraction of the vessels. There is, therefore, a reduction in the urinary volume, which may lead to a temporary increase of non-protein nitrogen and other retention products in the blood. The later morphological changes in the kidney are the result of the general vasoconstriction. The fall of blood pressure in favourable cases denotes the passing off of the ischaemic process and is soon followed by diuresis and a reduction or disappearance of the albumin in the urine. Treatment must therefore be directed to bringing down the blood pressure as soon as possible so that the kidney does not remain in an ischaemic state and pass on to the stage where the pathological changes are no longer recoverable. Volhard restates the description of the disease and its treatment which he gave in 1916, and this seems to be worth summarizing in view of the possible importance of the malady within the next few months.

Essential Features of the Disease

1

War nephritis is an acute diffuse glomerulonephritis with great tendency to healing.

2

Chronic diffuse nephritis and secondarily contracted kidney are the result of acute nephritis which has not healed in its early stages. This development is usually preventable.

3

The acute disease is curable so long as the histological changes in the kidney remain of a reversible nature.

4

It therefore follows that treatment must be begun as early as possible.

¹ *Dtsch. med. Wschr.*, 1939, 65, 1649.