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The Elusive Vitamin

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INVESTIGATIONS on nutrition during the latter part of the last century and the earlier years of this century seemed to have established that if one had the proper kinds and the correct relative amounts of proteins, fats, carbohydrates and mineral salts, and there was an adequate amount of energy in the food supplied, everything was all right and there was nothing further to think about. There was, however, evidence available that this did not represent the whole truth, and that something else might be necessary for growth and for the maintenance of health. Thus, scurvy was the bane of sailors taking long voyages right through the centuries, and it has long been known that it occurred after deprivation, for long periods, of fresh foodstuffs, and that it could be prevented and rapidly cured when fresh vegetables and fruit were available. It is of interest to us here that the first very long voyage undertaken in which scurvy did not appear was that on which Captain Cook visited Australia. Captain Cook took care to obtain fresh vegetables at every possible opportunity. Soon after this it was found that lime juice was a very good thing for preventing scurvy, and in 1804 its use was made compulsory in the British Navy, and remained so until comparatively recently. But a curious thing happened in this connection. Until about the middle of the nineteenth century, the so-called lime juice was really lemon juice; then lime juice from the West Indies was substituted. During this period the general diet of the sailors had been very greatly improved, and scurvy still did not appear in the Navy. The interesting thing is that while lemon juice is one of the best of anti-scorbutics, the preservatized West Indian lime juice is practically devoid of preventive activity.

There was also evidence from other quarters that special chemical substances were necessary for well-being, but the time was not ripe, and the days of animal experiments in nutrition had not yet come.

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The real beginning of the concept of vitamins had its origin in experiments done by a Dutch physician, Dr. Eijkmann, in the Dutch East Indies, on the disease beri-beri. This, he showed, was brought about by feeding on a too exclusive diet of polished rice, whereas if the polished rice were replaced by raw rice, the disease did not develop. This idea was followed up by a number of workers, and in 1912 Casimir Funk, in London, showed that an analogous condition in pigeons could be prevented and cured by a substance present in an extract of the polishings of the rice. This substance he called *vitamine*. At about the same time other workers in England and in America were demonstrating that substances, other than Funk's *vitamine*, were also necessary for the well-being of animals fed on synthetic diets. Within a few years a number of these substances were known to exist, and the conditions produced in animals by their absence studied. Since none of the substances had, at this time, been obtained in pure form, and nothing was known about their chemistry, they were all classed as vitamins, and letters of alphabet given to distinguish them. We now recognize definitely six different vitamins, and there is evidence for the existence of still more. These are vitamins *A*, B_1 , B_2 , *C*, *D* and *E*.

Now that we know the chemical constitution of five of these, and have prepared three of them synthetically, the reason for the alphabetical naming is less real, and in a very few years should disappear. Each vitamin will then have its own proper name.

As food constituents, vitamins are characterized by the disproportion between the great importance of their nutritional functions and the very small amounts necessary for the adequate fulfilment of these functions. In the normal diet they are present in quantities far too small to yield any appreciable contributions to the energy supply of the body.

Now let us consider the different vitamins.

Vitamin *A* is soluble in fats and fat solvents, not in water to any extent. It is stable to heat, and is not easily destroyed in ordinary cooking processes. It is, however, readily oxidized, so does not keep well in the presence of air. Chemically it is a derivative of the substance called carotene, which is responsible for the yellow colour of carrots, vegetable marrow and other yellow vegetables, but is also present in appreciable quantities in all green vegetables, the colour being masked here by the green colouring matter. Carotene can replace vitamin *A* in the diet, and indeed almost all of our vitamin *A* is taken in the form of carotene. It is converted in the liver into vitamin *A*. The richest source of vitamin *A* itself is the fish liver oils, but there is some also in butter and eggs. Animals fed on a diet deficient in this vitamin soon cease to grow, and infections in various parts of the body soon appear. One of these is an inflammatory condition of the eyes, which, if not attended to, leads to blindness. This occurs from time to time among children fed on deficient diets, e.g. in Denmark and in Japan. In adults a condition of night blindness generally results. These and many other inflammatory conditions in different parts of the body are rapidly cleared up by giving food rich in this vitamin. This is one of the principal reasons why cod-liver oil has been so useful in the past.

We recognize two different *B* vitamins, B_1 and B_2 , which are quite different chemically, and have different effects on the body, but as they practically always occur together, it is only recently that they have been separated. Vitamin B_1 is

Funk's original vitamin, and is so called the anti-neuritic vitamin, for lack of it brings about degeneration of nerves in man and animals. Insufficient amounts of it in the diet lead to lack of growth or loss of weight, and loss of appetite. This substance has been obtained in pure form. It is soluble in water, and is resistant to heat, except in alkaline solutions. Boiling the cabbage with soda will destroy most of this vitamin present, but this does not matter much if one has a well mixed diet. By far the best sources of this vitamin are the embryos of cereals and yeast, and certain yeast products which find a ready sale nowadays under various trade names. Eggs, liver and the pulses are also rich, so that on a mixed diet this vitamin should never be lacking.

Vitamin B_2 has recently been made artificially. It is soluble in water, and is not easily destroyed by heating, so is not lost in cooking. This is necessary for growth, and when seriously lacking, brings about a condition called pellagra, which is not uncommon among the poorer people in such places as Italy, Egypt and the Southern United States, where the diets are exceptionally poor. The richest sources of this vitamin are liver, yeast, milk and green vegetables.

Other B vitamins have been described, but their existence is doubtful.

Vitamin C is the anti-scurvy vitamin. It has been made synthetically, and the artificial product, ascorbic acid, is now a regular article of commerce at quite a low price, a thing which is going to be extremely useful for explorers in the future, for the provision of this vitamin when one is a long way from sources of fresh food has always been a matter of difficulty. It is soluble in water, and is very easily destroyed, so that much of it is lost in cooking, and most preserved foods soon lose this vitamin. There are some fortunate exceptions, however. Canned tomatoes are particularly rich in this vitamin, and could, with great advantage, be used in large amounts in those parts of this country where it is difficult to get fresh vegetables and fruit. It is as a source of this vitamin that fresh fruit and vegetables are so necessary in the diet. One of the richest sources is the citrus fruit—oranges and lemons—and the giving of orange juice to babies fed on dried milk foods is really necessary, for the drying process destroys the vitamin in the milk, which never contains much. Of all the foods I have examined, parsley is the richest.

Apart from scurvy, a relative lack of this vitamin causes a weakness of the walls of the small blood vessels, and hæmorrhages easily occur. This is not uncommon in Sweden in the winter months, when fresh fruit and vegetables are scarce, and I strongly suspect that it would be found in some of our western districts if looked for.

Vitamin D is particularly related to the salts of lime and phosphorus in the body, and the proper formation of bone. This is a fat-soluble vitamin, not easily destroyed, and its distribution in foodstuffs is not very great. The chief food sources are butter, milk and eggs. Vegetables are very poor, and so is meat. If this vitamin is deficient in infants, a condition of rickets may be set up. Lime salts, or phosphorus salts, have also to be deficient for the production of rickets. In adults, the same deficiencies bring about a softening of the bones, which leads to gross deformities. This condition is not uncommon in China and India. Among the well-to-do Chinese in country districts, the women live an indolent life indoors, on a diet which consists mostly of cereals, with no milk or eggs, and among these bone softening is very common. Similar conditions are set up in India by the custom of "purdah". Fortunately we can do

without vitamin *D* in the diet, for under suitable conditions we can manufacture it in the body. When the skin is exposed to sunlight, or to ultra-violet radiations, a substance present there is changed into vitamin *D*, and passes into the body. There should be no shortage of vitamin *D* in Australia, for a few minutes a day exposure is sufficient. Rickets is a disease particularly characteristic of relatively sunless places, and that it occurs at all in Australia, even though it is mild, is rather a disgrace.

Vitamin *D* has been prepared artificially, and is on regular sale as calciferol. The richest natural sources are cod-liver oil and other fish liver oils, and this explains the value of cod-liver oil for infants in Northern European countries.

Vitamin *E* is the anti-sterility vitamin necessary for normal fertility. Not much is known about its nature, but it has recently been isolated. It is widespread in food-stuffs, and there is very little possibility of lack of it in ordinary diets. It is also not easily destroyed.

Other substances have also been classed as vitamins, but if one classed all the substances which we know to be essential in the diet as vitamins, the list would become very large and quite meaningless. As it is, it seems almost a pity that the substances we call vitamins are classed together, for they differ very considerably in chemical composition, in properties, and in their effects in the body. The only thing really common to all of them is that very small amounts are necessary in the diet. The vitamin required in greatest amount by man is vitamin *C*, and of this man requires per day about one-third of a grain, which would be contained in about two table-spoonsful of orange juice. In the case of vitamin *D*, cod-liver oil is about the richest source, and one grain of pure vitamin *D* or calciferol is equivalent to about 30 gallons of first-grade cod-liver oil, or about 3,500 pounds of the best butter. One cannot give figures for the other vitamins, but the amounts required are all much less than of vitamin *C*.

Vitamins *B*₂, *C* and *D* are now manufactured artificially, so that one can, if necessary, give these in relatively large doses free from extraneous substances. This is, of course, of greatest advantage in the case of vitamin *D*, for cod-liver oil is nasty stuff, and the oil may upset the digestion. So far as we know at present, excessive doses of none of the vitamins, except vitamin *D*, cause any harm. Relatively very large doses of pure vitamin *D*, many thousand times the therapeutic dose, will cause serious troubles, but one could not get anything approaching these amounts from ordinary foods, or even from cod-liver oil.

One of the greatest misfortunes which comes from classifying all the vitamins together comes from the fact that one is liable not to consider them individually, and we hear much talk of vitamin-rich foods, and so on. In building a house, one may have excess of bricks and stones and sand and cement, but if you have no timber you get a queer house, at any rate according to modern practice. Yeast, for example, is said to be a vitamin-rich food. So it is in the *B* vitamins, but it has little or no *A*, *D* or *C*. Tomato is better, but still incomplete, for it has a lot of vitamin *C*, a fair amount of vitamin *A*, and a little vitamin *B*.

A common belief is that vitamins are destroyed by cooking food. Vitamin *C* is very largely destroyed, but not wholly, for one can get all the vitamin *C* one requires

from boiled potatoes, if you eat a good deal. The *A* vitamin is to some extent destroyed on cooking, but not much. The *B* vitamins are not appreciably affected by ordinary cooking, unless soda is used, and then not wholly, and the *D* and *E* vitamins not at all.

The discovery of vitamins has been a godsend to the food faddists, and very much misleading or inaccurate information is propagated by many of them. One does not have to worry about one's supply of vitamins under ordinary conditions. Provided the diet is well mixed, well balanced and has a certain amount of vegetables and fruit in it, all the vitamins necessary will be supplied without one having to think about the matter. On the other hand, if one tries to live on white bread and tea and wholly tinned products, there is a strong possibility that one or more of the vitamins will be present in insufficient amount. But supplying this vitamin in a concentrated form will not make such a diet adequate, for it is lacking in other things, too, just as important as the vitamins. The only shops the ordinary person requires to visit to buy vitamins are the grocer's, the greengrocer's and the butcher's or egg and butter man. The vitamins are popular just now, and naturally manufacturers are going to cater for this popularity. Except under special conditions, people who suffer from lack of one or more of the vitamins are too poor to buy the right foods, or too foolish to do so, or they are suffering from some complaint which prevents them from taking ordinary mixed foods in adequate amounts.
