CHAPTER IX

THE VITAMINS AND THEIR IMPORTANCE IN HEALTH

LET us go back in imagination to the year 1250, when the Seventh Crusade under that noble king, Saint Louis, was invading the Near East. A happy, hopeful band—it had left France a short time before, each member sure that he would win his heart's desire, whether it was wealth, fame, love or oblivion. Most of them were young and all were tightly bound together by two of the strongest ties—religious fervor and vibrant health.

How the picture changes when once the deserts of Egypt are reached! But let de Joinville, who was Louis' biographer, tell us the story.

> "While we were in camp," he wrote, "the only fish we ate during the whole Lenten season were mudfish and the mudfish ate the dead. . . . And because of this misfortune, as well as the evilness of the country where not a single drop of rain falls, we fell sick . . . with a sickness that made our flesh and limbs dry all up, and the skin of our limbs become spotted with black and the color of the soil, just like an old boot . . . and the gums rotted; and no one contracted this malady but that he had to die of it. When the sign of death came—a bleeding nose—one had to die . . . there was so much dead flesh on the gums that the barbers had to cut it away so that our men could chew their food and swallow. It was horri-

ble to hear the men moaning when their flesh was cut away, for they moaned like women suffering the pangs of childbirth. . . ."

This is one of the earliest descriptions of scurvy or scorbutus, a disease caused by the lack of Vitamin C. It was probably known in the northern parts of Europe and Asia ever since they were occupied by man—and it still menaces us.

Our knowledge of beriberi, another vitamin-deficiency disease, goes back even further. In old Chinese chronicles written almost 4000 years ago we find vivid descriptions of that disease.

Nevertheless vitamins themselves remained undiscovered and a mystery until 1912. Indeed their magic and mystery haven't been yet fully solved; so that anything we say today may be disproved, or at least modified, tomorrow by further revelations of medical science.

The vitamins, like the proteins and other food essentials, are chemical compounds. They differ from the elements that build tissue and supply energy, however, in that there is a far greater difference in the proportion between their nutritional functions and the amount necessary to perform them adequately. A man weighing 160 pounds has been estimated to require about 70 to 100 grams of protein daily, but his vitamin requirement is expressed in terms of milligrams! Sir Francis G. Hopkins, who has done much to help the cause of vitamins, as we shall see, estimated that a single ounce of Vitamin C would be sufficient to prevent 500 human beings from getting scurvy for a whole year.

Today we know of at least thirty vitamins, each of which has its own chemical structure and its own definite functions to perform in the human body. Taking them as a whole, however, their functions may be divided into three broad classes. They promote the normal growth and development of the body, they protect the body against diseases and then insure the proper functioning or regulation of the bodily processes, including metabolism. And when the diet is deficient in one or more of the vitamins for a sustained period of time, grave diseases develop which may result in death.

The discovery of the vitamins is a fascinating story, and as it is one that helps to clarify their significance, let us pause here to relate the history of the discovery of these tiny but supreme rulers of our bodies.

The first glimmering that we needed something more than proteins, fats, carbohydrates, minerals and water in our diet to maintain life came in the 1880's. Before then chemists and physiologists had devoted their time to the study and analysis of proteins, carbohydrates and fats and it was the prevailing belief that they alone were essential to maintain health. But as time went on and experimental methods improved, it became obvious that a diet may contain the correct amount of calories and the proper balance of proteins, fats and carbohydrates and yet fail to meet the full demands of nutrition. To be sure, it had been observed for centuries that a diet of preserved foods or old foods would cause scurvy amongst soldiers, persons on long sea voyages and inmates of prisons. Experience had proved, too, that if certain fresh vegetables or fruit, such as oranges and lemons, were

added to the diet, scurvy disappeared or was prevented. It was observed also that beriberi developed amongst the rice-eaters of the Orient. But no one had been able to find out why this was true and most persons still held to the belief that these diseases were caused by "germs".

Then, about 1880, a quiet young scientist, but one with imagination, who was working in the laboratory of Dr. Bunge at the University of Basle in Switzerland, began experimenting with mice on a diet of milk. He fed some of the animals on natural milk and others on synthetically prepared milk containing all the elements in exactly the proportion as they occur in natural milk. The mice fed on the natural milk thrived but those fed on the chemically prepared milk soon died. He repeated the experiments, only to get the same results. He came to the conclusion that natural milk contained some mysterious, elusive substance—a substance which was absolutely indispensable to life and which was undoubtedly destroyed in the process of preparing the synthetic milk. While these experiments of Lunin did not create much excitement, they reawakened an interest in nutrition and it marked the beginning of a series of dramatic discoveries that have offered new life and hope to humanity.

Such was the beginning of the discovery of what was first called "accessory food factors" by the chemists. The medical profession, however, especially in the East, was constantly coming in contact with gruesome, death-causing diseases which were apparently due to dietary deficiency. About the time that Lunin was working in Switzerland, Takaki, the medical inspector-general of the Japanese navy, was making a study of

beriberi which was playing havoc with the Japanese navy. Beriberi is characterized in its initial stages by a catarrh and swellings and pains in the limbs which soon become paralyzed. As the paralysis gradually creeps over the whole body breathing becomes very difficult and before long the victim dies.

Takaki, firmly believing that the disease was not an infection, as was generally believed in his day, but was of dietary origin, made a comparison of the diet of the Japanese navy when it was on long voyages and those of the European nations. He found that the Japanese diet, consisting largely of "polished" rice, contained a much greater amount of carbohydrate and a much smaller amount of protein than those of the Europeans. He therefore recommended that the Japanese cut down on the polished rice ration and substitute unpolished rice and a larger complement of foods richer in proteins. Of course, his advice was scorned. He bided his time, however, for an opportunity to put his theories to a crucial test. The opportunity soon came.

While taking a nine months' cruise twenty-five men died on board a Japanese training ship. Shortly after another ship was sent on a cruise over the same route. This time the navy acceded to Takaki's earnest pleas. The ration contained fresh milk and meat and unpolished rice—that is, rice not deprived of the husk. As a result, during the whole ten months that the crew was at sea only fourteen cases of beriberi developed and only in those men who had refused to accept the changed diet. Needless to say Takaki became a national hero.

Takaki, however, believed that protein—as con-

tained in milk and meat—was the cause for the decrease of beriberi. He had missed this important fact, that it was the unpolished rice which contained "the preventive factor".

Then, in 1897 a startling discovery was made by a Dutch physician, Eijkman, who was stationed in the island of Java in care of prisoners. Among his prisoners Eijkman had many patients suffering from nervous disorders, strange swellings on their limbs and a certain incoordination of movements, symptoms similar to those of the Japanese sailors. It happened that he had a large number of fowls which he was using for some experiments. One day they all fell sick with much the same symptoms that his patients had. He called the disease polyneuritis to distinguish it from the form found in human beings. Learning that they were being fed cooked rice left over in the hospital kitchen, he replaced their diet with one of raw, unhusked rice and the fowls quickly recovered.

Eijkman then tried substituting unpolished rice for the polished rice amongst his patients who were suffering from the same disease, with the same result. He came to the conclusion—missed by Takaki—that the outer covering of the rice kernel contained some substance which acted as a protector against polyneuritis, although he did not know it as a vitamin.

In succeeding years further studies were made by physiologists and biochemists in addition to the research done by doctors.

In the meantime, however, this latter group of scientists continued their researches and as early as 1905, Pekelharing of Holland observed that if a little natural milk was added to a diet which contained well-

balanced proportions of proteins, carbohydrates, fats and minerals, mice would not only live but would achieve a remarkable growth. The following year, Hopkins of England wrote that some minor factors in the diet were essential to life and the prevention of diseases such as scurvy. Six years later he published an account of his findings and called the substances in milk which were necessary for life, "accessory food factors". The year before, however, a German by the name of Funk, who was making a study of polished rice as a cause of beriberi, gave the name to the missing factor, "vitamine", derived from the Latin word for life and *amine,* because he thought the missing factor had something to do with protein and nitrogen. The word was soon accepted by the world of science and the factor necessary for the prevention of beriberi became known as Vitamin B. It was soon discovered that protein had nothing to do with vitamins, so, in 1922 Drummond suggested that the "e" be dropped in order to avoid confusion.

In the meantime in the United States two groups of experimenters were working independently on "the unknown substances essential to life". Osborne and Mendel at Yale devised a preparation of "protein-free" milk to which they added mixtures of pure starch, sugar and fat. They fed this mixture to white mice who kept alive for a longer period of time than ever before. But after a period of about 100 days, it was impossible to induce any increase in weight in the animals. When whole milk powder was substituted for the protein-free milk, the animals survived two generations.

They concluded that the difference was in the milk

fat and substituted butter for lard. Those fed on butter-fat attained normal size.

While Yale scientists were proving that milk fat contained an element essential to growth, McCollum and Davis at the University of Wisconsin were experimenting along the same lines, and found that animals fed on purified casein, carbohydrates, lard and various salt mixtures were stunted in their growth, but that the same animals regained their vigor and normal growth when fed on egg-yolk fat or butter. They called this essential accessory food factor "Fat-soluble A". It is now generally known as Vitamin A. Many long and weary years had been consumed in the search for this unknown, but the scientists were amply rewarded: it was now established beyond doubt that butter fat and egg-yolk contained something necessary for normal growth that was not found in lard and the common vegetable fats.

Two years later the same experimenters, McCollum and Davis, discovered that if they replaced the milk sugar in their ration with starch, the animals no longer continued to grow, in spite of the fact that the diet contained sufficient butter fat. Moreover, the animals developed a paralysis which closely resembled the polyneuritis of the fowls with which Eijkman had experimented. When natural foods were added to the diet, the paralysis disappeared and the animals assumed their normal growth. The scientists discovered this time that the curative substance could be extracted with alcohol from the wheat germ or embryo. They called it "Water-soluble B" to distinguish it from Fat-soluble A. It was soon found that it was identical with Funk's substance and is, as we have

said, now known as Vitamin B. Since that time, it has been found that Vitamin B is in reality a complex made up of more than one substance, each of which, as we shall later see, having its chemical characteristics and functions.

Oddly enough it was not suggested, however, that scurvy was due to a lack of a third essential food factor until 1913, and not until two years later was it pointed out by Dr. Alfred F. Hess that this potent factor was also contained abundantly in tomatoes. Some years passed and in 1919 it was definitely established that there really was a third accessory food factor—Vitamin C.

During this time research was being carried on in another direction—research on the relation between bone growth in children and their diet. This led to the identification of Vitamin D in 1922. The following year Vitamin E, necessary for reproduction, was discovered. Since then many new important discoveries have been made about the nature of the vitamins and their functions, such as the discovery of the pellagra-preventing vitamin G or B-2 by the late Dr. Joseph Goldberger in 1926. Nevertheless, there is still much to be learned, and probably much to be unlearned. Bearing in mind what has just been said, let us examine each of them in turn and see what, in light of present knowledge, they do for us and where we can best find them in our foods.

As all-efficient as man likes to believe himself to be, he could not exist without the aid of plant life, for the ultimate source of all vitamins and other necessary organic substances is the plant. This is true even when we eat the flesh of an animal or fish, or butter or milk.

The cow, for instance, eats the fresh sweet meadow grass that contains the vitamins or their precursors and then metabolizes them in a concentrated, convenient form for us. Neither we nor the vast majority of animals can synthesize all the vitamins or other organic substances necessary for the maintenance of life. We are therefore ultimately dependent on the plant world for our very existence.

Vitamin A perhaps illustrates this point better than any others. Besides the two forms of vitamin A—A_1 and A_2—there are at least nine precursors of vitamin A, of which only five are known to be in our ordinary foods. These five are the carotenes, alpha, beta, gamma and kappa; and cryptoxanthene. These precursors, or provitamins, are converted by the liver into vitamin A, and it takes many more units of these to equal a given unit of vitamin A.

Carotene is the yellow pigment in green, yellow, orange and bright red fruits and vegetables; the deeper the color is, the richer the food source. Indeed, the very name "carrot" calls to mind the word "carotene."

Vitamin A has a potent influence on general growth and vigor and is believed to increase the span of life. It is mainly a stimulus for the formation of new cells. It helps to preserve the normal vitality of epithelial tissue, aids in maintaining a normal functioning of the glands, and—what is very important—it helps to maintain resistance against many dread diseases, such as xerophthalmia, a horrible disease of the eyes which may result in blindness; tuberculosis, influenza and other respiratory diseases. To motorists, aviators and others who use their eyes a great deal in varying

conditions of lightness and darkness, vitamin A has great import for visual keenness and ready adaptation to semi-darkness. This vitamin also plays an important part in the formation of tooth enamel.

By influencing and preserving the normal growth of epithelial cells, vitamin A acts as a first line of defense against the invasion of disease-bearing bacteria. When there is a deficiency of this vitamin, the epithelial cells not only begin to lose their power as defenders against disease, but they also become hard and horny and offer an ideal opportunity for the growth and development of germs. The delicate mucous membrane linings of the mouth, the alimentary canal, the nose and sinuses, the kidneys and gall bladder are among the first to suffer. The tear glands, too, no longer produce tears and as a result, the eyeball and tissues of the underlying glands dry up. Xerophthalmia develops and if the cornea is attacked, the victim becomes blind.

Fortunately there are but few instances of xerophthalmia in the United States, although cases of night-blindness caused by a mild deficiency of vitamin A are frequent. Children, especially, seem to be victims of night blindness, but when a carefully selected, well-balanced diet to which cod liver oil is added, is given them, this clears up.

Before continuing the discussion of vitamin A, we should give a word of warning regarding the popular misconceptions of the role that vitamin A plays in the warding off of respiratory infections and in the promotion of normal growth and vigor. These misconceptions are largely due to advertising, probably the principal source of the average person's knowledge

of vitamins. It is rarely, particularly in the wintertime, that one can pick up a newspaper or magazine without seeing glaring headlines commanding us to eat such-and-such food if we wish to go through the season without catching cold; or, if not commanding us, threatening us with this uncomfortable nuisance or even worse. As a result, most of us get the erroneous idea that vitamin A acts more or less like an antitoxin for diphtheria or smallpox. This is far from the truth.

For the present, at least, we can only say that vitamin A merely aids in establishing bodily resistance to infections. And, an additional intake of this vitamin only aids when the supply stored in the body has been exhausted and foods eaten are inadequate in vitamin A or its provitamins.

"It certainly has not been shown to be a specific in the prevention of colds, influenza and such infections," observes the American Medical Association, "nor has it been demonstrated that ingestion of vitamin A far in excess of that necessary for normal body function and readily obtained from a properly selected diet is an aid in preventing various types of infections."

The same erroneous conceptions are met with concerning the growth-promoting powers of vitamin A. While it is true that a deficiency of vitamin A slows up normal growth when the body store of it has been exhausted, it is also true that the other vitamins, as well as the amino acids and other food elements are equally important in the attainment of normal growth.

"Statements conveying the impression that vitamin A is more important in promoting growth than any other food essentials are therefore considered misleading and objectionable," is the verdict of the American Medical Association.

We have briefly summarized the functions of vitamin A and the symptoms which result from its deficiency in the diet. They are mighty serious, of course, but don't be alarmed if perchance you haven't had your weekly quota, for xerophthalmia won't result right away, although within a short time visual acuity may diminish and night-blindness may be incurred. As the deficiency progressed, there would be a loss of appetite and a lack of vigor, accompanied by diarrhea; your skin would become dry and your body would offer poor resistance to infections; if you were still in the growing state, your growth would show signs of retardation. Not until the deficiency became very marked would xerophthalmia develop and the various infections enter through the epithelial tissues. Loss of weight, debility, and atrophy of the glands are also the result only when the vitamin deficiency is very marked.

While the ultimate source of vitamin A is the green leaves of plants, which are outstanding in their content of provitamins, in proportion to their depth of color, it was first discovered in combination with fats —butter, egg yolk and cod liver oil, all of which are rich in vitamin A. Other animal products which are excellent sources are cheese, cream and milk, fish roe, shark and halibut liver oils, and liver; good sources are beef fat, kidney, sweetbreads, the heart, herring, and oysters. These animal products cannot be judged for their potency by color.

In the vegetable kingdom we find kale, escarole, green lettuce, string beans, spinach, watercress, Brussels sprouts, broccoli, and parsley. All yellow fruits and vegetables are rich in this vitamin—yellow turnips, corn and sweet potatoes. White or pale-colored

vegetables are a poor source and, with the exception of the carrot, roots and tubers are likewise a poor source. Among the fruits the apricot and the tomato have a high vitamin A content, the latter having almost eight times as much as the orange.

Since the temperatures used in canning do not destroy appreciable amounts, the vitamin A content of most canned foods is practically the same as that of the fresh foods. It is moderately sensitive to oxidation and, therefore, when butter, for example, is exposed to sunlight for a long period, much of its vitamin A content is destroyed. Likewise, the vitamin A content of cod liver oil becomes unstable when exposed to sunlight, especially in the presence of oxygen. It is for this reason that it is sold in dark bottles and stored in a dark place.

As to the amount of vitamin A one should eat, don't bother your head about the puzzling "units" and milligrams. If you eat plenty of fresh vegetables and fruits and eggs and milk, you'll get all you need. *Just remember to eat a balanced diet with plenty of fresh, colorful, appetizing fruits and vegetables that are to your liking and the vitamins will take care of themselves.* But remember, too, that vitamin A can be stored and that when you are storing vitamin A, you're storing vigor, resistance to disease, and consequently happiness.

As told before in this chapter, vitamin B was discovered as affecting the health of nerves and joints and a preventive of beri-beri and pellagra. However, during the 1930's and early 1940's, research work brought to light the fact that the so-called vitamin B was really a whole family of vitamins that were quite similar in their effect in man, occurred in many

of the same foods and had similar chemical structure.

Since a discussion of each of the thirteen members of the B complex, known at this time, would fill a huge volume, we shall limit ourselves to the more significant and better known ones.

Vitamin B or thiamine is, specifically, the vitamin preventing beri-beri and polyneuritis. Its presence in the diet maintains good appetite, aids in the functioning of the digestive tract, which includes good elimination of waste bowel products. Thiamine is also valuable in certain cases of heart disease and in some nervous and mental upsets. It is absolutely necessary in the diet so that the body can properly use the fats, sugars and starches (carbohydrates) eaten.

The extreme deficiency diseases such as beri-beri and polyneuritis are not often seen in this country, but below-normal intake of thiamine results in conditions quiet frequently brought about by poor diet: nervous depression and exhaustion, colitis and ulcers, constipation with a general lack of muscle tone and vigor, lowered resistance to infections are some of the common evidences. Anemia and neuritis can possibly be traced to the same deficiency. A pregnant or nursing mother must have much more in her diet than normally in order to offset the increased needs in the digestive tract and in the nerve system.

This valuable vitamin is best found in compressed and brewer's yeasts, wheat germ, whole wheat bread, cornmeal and cornmeal bread, egg-yolk, legumes such as peas, beans, lentils, also in nuts, glandular meats, lean pork, whole grain cereals. Other fair sources are leafy vegetables, dark green in color; potatoes eaten with their skins; tomatoes, grapefruit, oranges, asparagus, avocados, cauliflower, mushrooms, parsnips,

pineapple, and plums. There is little loss in cookery if small amounts of water are used and the food is not allowed to wilt before cooking.

Vitamin B_2, G, or riboflavin also aids in the digestion of the carbohydrate foods, sugars, starches. It shares in the work of normal body nutrition with calcium and vitamin A; it also promotes growth. Its lack in the diet shows itself in the scaliness of the skin on the nose and forehead; in the greasy material around the creases of the nostrils; in the horny cracking around the corners of the mouth and a magenta-colored sore tongue; and in itching, burning and dryness of the eyes, granulation and great redness of the inside of the eyelids and "twilight blindness" due to a change in the covering of the front of the eye, the cornea.

People likely to have these symptoms are those with a poor diet over a long period of time, due either to lack of proper foods or to the limitations of an invalid diet not balanced properly, or those afflicted with chronic alcoholism. Good sources of riboflavin are liver, dried yeast, dark green leafy vegetables, egg yolk, milk, evaporated milk, wheat germ, enriched flour, enriched breads and enriched cereals.

Niacin, less commonly called *niacin amide* or *nicotinic acid* (it has nothing to do with nicotine), is the anti-pellagra vitamin. This vitamin aids in the use of carbohydrates in the body, as do the other vitamin Bs mentioned above. The lack of this vitamin is very wide-spread in the poor parts of the United States, especially in the South where the meagre diet consists mainly of starchy foods, with very little meat and few greens.

The symptoms of a diet poor in niacin are lesions

in the lining of the mouth and in the skin over the nose, forehead, wrists, hands, knees and feet; and the same weakened condition of the digestive tract as we described under the other B vitamins. The very advanced stages of this vitamin deficiency show a clouding of the consciousness after a period of mental disorders, and death through insanity.

Good food sources for this vitamin are liver, kidney and muscular meats, fish, milk, evaporated milk, dark leafy vegetables, and peanuts; enriched flour, enriched breads and cereals, whole grains,' dried brewers', bakers' and compressed yeasts. Cooking does not destroy much of this vitamin.

Pyridoxine or B_6 is the anti-acrodynia vitamin; that is, pyridoxine prevents a certain kind of dermatitis of the hands and feet with itching and pain in these parts. Its lack in the diet is also connected with pellagra, as both niacin (the pellagra-preventive) and pyridoxine occur together in many foods. Pyridoxine is particularly concerned with nervousness, insomnia, cramping pains in the stomach, muscular weakness, and rigidity. It influences liver metabolism and the formation of hemoglobin in the blood. In the case of these last two functions, it is thought that pyridoxine is of value in some types of anemia. Vegetable fats, whole grain cereals, fish, meats, yeast and leguminous foods—peas, beans, and lentils are good sources of this vitamin.

Pantothenic acid is universally found in all animal cells and is necessary for proper health of tissues. It is believed to be used along with thiamine, riboflavin and niacin in aiding the body to make proper use of carbohydrates. It seems to affect growth and its lack in the diet will impair or harm the reproductive

system. It is not known what symptoms occur in man when it is not in the diet, but in fur animals the hair turns gray and in chicks there are incrustations about the eyes and corners of the mouth, as well as between the toes. Interestingly enough, it occurs in the same foods as most of the other B vitamins: liver, kidneys, yeast, milk, bran, whole-grained cereals, crude molasses. It was this vitamin that was advertized widely a few years ago as preventing gray hair; however, the following vitamin has been proven more influential in this respect in man.

p-Aminobenzoic acid affects growth and color of hair. It is found in nearly all plant and animal life.

Inositol is another B complex family member about which not much is known as to its effects on man, but in mice and rats there is a loss of fur and a severe dermatitis appears. In dogs, it increases peristalsis (movement in the digestive tract and in the bowel), and prevents fatty livers from containing large amounts of cholesterol. It occurs as a food source in fruits—especially citrus fruits, cereals, liver, kidneys, heart and other meats.

There are many more B complex vitamins which have recently been discovered, but scientists are working out their importance and effect on man. Since most of these members of the B family occur in the same foods, if you include in your diet such items as liver, kidneys, muscular meats, fish, green leafy vegetables, whole-grained cereals, enriched bread and cereals, milk, cheddar cheese, yeasts and eggs, you will be assured an adequate intake of these vitamins without resorting to proprietary compounds or pills.

You are probably still shuddering over de Joinville's lurid description of scurvy, so there is no need

to dwell further on this dread disease due to the lack of *vitamin C*. The absence of scurvy, however, by no means signifies that you are well supplied with the vitamin, for scurvy is the result of extreme deficiency. It is believed to have many functions; for example: there is evidence that it is essential for the normal formation of bone and teeth, working in cooperation with vitamin D. It is also required for the health of the cells lining the circulatory system and maintaining capillary resistance. It acts upon certain cementing substances in the matrices of bone, cartilage and dentin in teeth, and in capillary walls. It is also necessary for proper tissue respiration, glandular functions and defense of the cells of the above structures against bacterial attacks.

A mild deficiency of vitamin C is connected with weakness, restlessness, poor resistance to infections, digestive disturbance, headaches, defective teeth, retarded growth, lesions in the endothelial tissues, such as the lining of the circulatory system, and a tenderness felt in the joints. Extreme deficiency signifying scurvy is manifested in capillary hemorrhages, swollen joints due to periosteal hemorrhages as well as swollen, bleeding gums, loose teeth, fragile bones, possibly anemia, and respiratory and intestinal infections.

An abundance of fresh fruits and green vegetable salads will assure a good suply of vitamin C in the diet. Much of the potency of foods containing vitamin C is lost in storage; drying; cooking in open kettles or exposing the vegetable or fruit to air; and breaking up the pulp and letting it stand for some time, so that oxidation of the vitamin occurs and the valued vitamin C is lost. Preparation of foods for meals should be done at the last minute before eating them. Com-

mercially canned foods retain a great amount of potency. Fresh, canned or bottled citrus fruits and tomato juice are convenient and economical food sources, canned citrus fruit being the cheapest for the amount of vitamin C present.

Good sources of vitamin C are, fortunately, low in calories, which may be comforting news to those bent on reducing. Foods containing the highest amount of vitamin C are: black currants, broccoli, Brussels sprouts, cabbage (the green leaves), dandelion, mustard and turnip greens, kale, kohlrabi, red and green sweet peppers, parsley, spinach, sprouted grains, strawberries, and watercress. Other food sources which are fair ones with which to supplement the diet are asparagus (green), cantaloupe, chard, citrus fruits, green lima beans, fresh green peas, fresh pineapple.

Since any over-intake of this vitamin is readily excreted by the body, there is no chance for any ill effects from any possible over consumption. In fact, as first stated, a diet including plenty of fresh fruits and green vegetables will adequately fill normal needs without any recourse to pills or tablets of vitamin C and will give you the added assurance of other vitamins and minerals being taken in, of which will help promote good health.

It is wonderful to think that the sun, 93 million miles away, is the source of all things living on earth —the trees, the flowers, the birds, the animals and us human beings. Without the sun the earth would be a cold and lifeless planet. It is still worshipped by many peoples as the giver of life and of health, yet not until a few years ago did it become known that the sun is the creator of Vitamin D, the "sunshine" vitamin so plentiful in cod liver and haliver oil and so

necessary for the prevention of rickets, the commonest of nutritional diseases amongst children of the temperate zone.

Rickets may appear as early as the third month after birth. It is characterized by constipation, irritability, restlessness and loss of sleep in its earlier stages. The muscles of the legs, arms and abdominal region become lax. Later the ribs develop knobs or beads and "pigeon" breast develops. The head acquires a peculiar square shape and the long bones become bowed and curvatures of the spine develop. The sufferers from rickets are usually very sensitive to touch, they may have a slight fever and perspire profusely. They are stunted in their growth and are susceptible to respiratory infections which may lead to death. After the third year rickets are no longer active in form, although still active in effect.

While rickets is a disease of childhood, there is a similar disease known as osteomalacia (softening of the bones) which may develop in adults. It exists almost entirely among Mohammedan women in the East and is the result of the secluded life they practise. It is characterized by softening of the bone, hysteria and extreme muscular pain. It is soon curbed by the administration of cod liver oil.

In addition to the prevention of rickets, Vitamin D has an important part in tooth formation and in the maintenance of normal, healthy teeth. However, the cause of dental caries is in all reality still unknown and there is little evidence to prove that Vitamin D insures normal tooth formation or will actually prevent decay. All that can be said is that it is apparently a favorable influence towards normal teeth.

Vitamin D is also a potent factor in calcium and

phosphorus metabolism and is therefore needed even after full growth is attained and the danger of rickets is long passed.

Good natural sources of vitamin D are found in fish liver oils, egg-yolks and in liver; irradiated milk and other fortified foods containing fish oil concentrates are also good sources. The action of sunlight which affects the cholesterol present in the skin activates this provitamin into vitamin D.

Vitamin D is found in two distinct forms: ergosterol, which is the precursor or provitamin in vegetable organisms and when activated by irradiation becomes vitamin D_2; and 7-dehydrocholesterol, which is the provitamin in animal organisms and which upon activation by irradiation, becomes vitamin D_3. As this latter is found in fish liver oils it is sometimes called "natural vitamin D" and is one and one half times more efficient than the D_2 or vegetable-derived provitamin. There are several other provitamins, but most of these are toxic in effect.

Because this vitamin can induce more calcium deposits on bones than is normal and bring about tissue degeneration if taken excessively, you should not take concentrated forms of this vitamin without directions from your physician. Irradiated ergosterol is produced for medicinal purposes from yeast and is known to the medical profession as "viosterol"—"bottled sunshine." It is used for rickets as well as for pregnant and nursing mothers and babies and young children, all of whom need additional amounts of vitamin D, but *only upon specific prescription by your doctor as to amount and in what form to be taken.*

Normally a short sun bath, or a brisk walk each day in the open air, and proper diet including eggs,

liver and milk will provide adequate amounts of this vitamin as well as yielding other valuable nutrients and worthwhile results in good health. The adult requires very little, though this little is extremely important since a deficiency affects the calcium metabolism harmfully and results in decalcification of the bones, eventually leading to brittleness and the condition called osteomalacia. Its valuable bone-building qualities are particularly important for children whose bones and teeth are growing and forming. If a child does not have enough vitamin D, plus vitamin C and the necessary minerals for bone structure, excessive cartilage formation sets in and the joints become enlarged. Dental caries result, in part, from vitamin D deficiency.

Vitamin D, when it occurs in fats or oils as in fish oils or egg yolk will not be affected by cooking; homogenization, pasteurization, or canning do not lower the potency within a food to any great extent.

Ten years ago scientists were greatly puzzled by the fact that experimental animals, who were apparently fed on a well-balanced diet and who were apparently healthy, failed to produce offspring. Finally H. M. Evans of the University of California solved the mystery—certain foods contained a special fertility factor which was named vitamin E. This factor, upon further study, was discovered to be a group of vitamins having the same physiological effect: in the female, that of causing "resorptive sterility" (absorption of the embryo) or habitual loss of the embryo which is overcome by the presence of vitamins E; and, in the male, that of permanently damaging the functioning of the seminiferous tissues. The term "anti-sterility" is not quite truthful; the

presence of *vitamins E (alpha-tocopherol, beta-tocopherol, and gamma-tocopherol)* aids normal functioning of reproductive tissues. Its presence is also effective in maintaining normal behavior of the neuro-muscular system.

The exact action of this vitamin group is open to further study.

One need not worry unduly about the presence of this vitamin group in his diet as it occurs in the very foods which have been mentioned before as essential for good health. Excellent sources are vegetable oils found in plant materials such as whole-grained foods; seeds of the legumes, peas, beans, lentils; corn and cottonseed oils; and lettuce. There are also smaller amounts of the E vitamins in animal fats, as found in egg yolk, meats, and milk. This group of vitamins is quite stable to light and air, but readily destroyed by any change toward rancidity in associated fats and by ultra-violet light. The liver stores the E vitamins, and some is found in the heart and kidneys.

Biotin or vitamin H has been classified as one of the vitamin B complex. Little is known about the effect of this vitamin on human nutritional welfare, but clinical symptoms of its lack in the diet have resulted in great lassitude and sleepiness, muscle pains, distress in the region over the heart and stomach, and loss of appetite. The skin and mucous membranes take on an unusual, ashy pallor and the skin becomes increasingly drier. This vitamin seems to be manufactured by the bacteria in the colon in amounts large enough to make man independent of any food sources, but egg yolk, liver, kidney, yeast, milk and molasses contain biotin.

Vitamins K (K_1 *and* K_2), like biotin, are produced

by bacteria in the colon. Deficiency of this vitamin group produces hemorrhage due to sharp decrease of prothrombin in the blood which lengthens the blood-clotting time. As vitamins K do affect blood-clotting, these have been called "anti-hemorrhagic" and have been used to offset undue loss of blood in patients undergoing operations. It is very effective during child-birth as it prevents hemorrhage in the mother and intercranial and other hemorrhages in the new-born infant. A generally good diet, including green leafy vegetables such as spinach, cauliflower, cabbage, kale, as well as tomatoes and vegetable oils will provide for normal human needs.

Citrin or vitamin P is so-called because it is found in citrus fruits, particularly in lemon peel. This vitamin affects the permeability of blood-vessels and any deficiency of it in the diet results in the lowering of capillary resistance shown as skin hemorrhages, and in the ready seepage of blood through vascular tissues or blood-vessels. The clinical symptoms look very much like the scurvy we described under vitamin C; but in this case, the application of vitamin C does not change the condition and citrin, or vitamin P, is needed to clear up the scurvy-like hemorrhagic conditions of the skin. Citrin is also useful in clearing up inflamed and sore gums, the condition which is called gingivitis. Besides citrus fruits, citrin is found in paprika juice and in many other plant materials containing deep yellow coloring.

There are several other vitamins which, as yet, have been non-identified so far as human nutrition is concerned. This field of research is constantly growing. We have discussed here those which are now known to be important for good health and welfare.

Our brief review of the foods in which they are to be found should convince you that a good general diet will assure their being present—the known vitamins as well as the unknown.

You probably feel by this time that you'll never be able to eat a mouthful of food without thinking of vitamins and wondering whether you are developing some of the various dreadful symptoms we've just described—perhaps you feel that you have them this very minute. In reality, vitamins *per se* should not be taken *too* seriously by the average person. Living in an era when fresh food is abundant all year round and scientific methods of preserving retain the full value of the various components of foods, you are sure of getting all the vitamins you need if you eat a well-balanced diet containing plenty of fresh, very colorful vegetables and fruits, meat, fish, eggs and milk. Besides, the vitamins would be of no avail without energy-producing foods and their component minerals as well as tissue-building proteins. And no food is going to do much good if you don't see to it that your whole alimentary canal, from your month to your colon, is in good condition.

And by no means take it upon yourself to take vitamins in a concentrated form—not even through a so-called sun lamp. If you feel tired, have no appetite or can't sleep, or have more serious symptoms, consult your physician and not your well-meaning neighbor or friend. It takes years of study and practice to diagnose diseases or functional disturbances, and it is more than likely that the lack of vitamins—providing your diet is correct—is not the source of your trouble.