

**Quotations on Vitamins from
"The United States Department of
Agriculture Yearbook for 1939"**

LEE FOUNDATION FOR NUTRITIONAL RESEARCH

Milwaukee, Wisconsin

The material found in this booklet has been directly quoted from the 1939 Yearbook of the United States Department of Agriculture, entitled, "Food and Life."

Because this book has had limited circulation, and because the Lee Foundation feels that it contains vital information on the vitamin question, we have gathered excerpts and printed them in their entirety.

Certainly the United States Department of Agriculture must be recognized as one of the most reliable sources of information on nutrition.

This booklet is issued as a public service of the Lee Foundation for Nutritional Research of Milwaukee, Wisconsin. The Lee Foundation for Nutritional Research is a non-profit institution chartered by the State of Wisconsin to investigate and disseminate facts relating to nutrition.

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"The chief fault of many American diets is that they provide too little of the essential minerals and vitamins. This fault is due in large measure to the fact that refined foods are consumed in such amounts that the intake of mineral and vitamin-rich natural foods is lower than it should be."

Food & Life, Page 104

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VITAMINS AND MINERALS

"THE VITAMINS AND CERTAIN OF THE MINERALS have frequently been described as body regulators. Some of these, however, belong just as rightfully to specific body structures as do proteins, and certainly the buffer action of the proteins mentioned earlier is a regulatory function. Classification of the essential food constituents by type of function is therefore somewhat misleading.

"The vitamins have little in common in chemical composition or properties, but in one respect at least they are alike—each of them is required for normal nutrition only in very small amounts. Some of the minerals too are needed in very small quantities—those that are called trace elements—but there is no danger of confusing them with vitamins since there is not the remotest resemblance.

"The scientific investigation of the vitamins was begun scarcely more than 25 years ago. Because they are new and interesting, and because their presence or absence in the diet provides such startling and dramatic contrasts, the vitamins have been widely popularized. On the whole this is good, though some of the popularization has been at the expense of truth.

"The vitamins are essential to health at all ages but are particularly important during the period of growth and development, prenatal as well as postnatal. An inadequate supply of vitamins during this period may cause serious danger to normal development of the bones, teeth, and other body structures."

Food & Life, Page 115

VITAMIN A

"VITAMIN A is essential for life, health, and growth. It is indispensable for the maintenance of normal epithelium, a special kind of tissue which serves as a protecting layer of body surfaces. The lining of the digestive tract, for example, separates the living parts of the body from food which has not yet become a part of the body and from waste products which are to be excreted; it is, therefore, strictly speaking, a body surface. The linings of ducts or canals of glands, which carry secretions from the glands to the digestive tract, and the lining of the bladder are further examples of less obvious body surfaces. These epithelial structures undergo marked changes and cannot fulfill their normal functions as protecting layers unless the body is provided with vitamin A.

"VITAMIN A IS ESSENTIAL for the proper formation and normal development of teeth. It forms a part of the visual purple pigment of the retina of the eye. Unless sufficient vitamin A is provided for the formation of this pigment, the eyes gradually lose their ability to see normally in dim illumination—a condition known as night blindness. A severe and prolonged deficiency of vitamin A leads to total blindness.

"CAROTENE, the yellow pigment of carrots and of many other yellow and green plant foods, can be converted by the body into vitamin A. Three separate carotenes and a yellow pigment known as cryptoxanthin normally found in plant foods are thus converted and are frequently called provitamin A or precursors of vitamin A.

"A DEFICIENCY OF VITAMIN A results in defective tooth formation, in cessation of growth and of normal bone development, in structural change of the epithelial tissues whereby their normal protective function is lost, in night blindness, and, in experimental animals

at least, in loss of reproductive powers. The disease of the eyes known as xerophthalmia—the Greek word for 'dry eye'—is a result of changes in the epithelial tissues of the eye and the glands that secrete tears. This damage to the eye may become so severe that total blindness results. Recently Mellanby has reported that vitamin A deficiency in growing puppies causes structural changes in tissues resulting in deafness."

Food & Life, Pages 115-116

"A MORE SEVERE OR A MORE PROLONGED VITAMIN A DEFICIENCY results in extreme muscular weakness and changes in the structure of certain body cells—the epithelial cells—which form the protective covering of every surface of the body, including the surfaces of ducts and cavities within the body. The changes in these cell structures interfere with their proper functioning."

Food & Life, Page 223

"WHEN THE BODY CONTAINS A GOODLY STORE OF VITAMIN A and the food is adequate in vitamin A value, no further resistance to infection can be secured by the administration of increased amounts of Vitamin A—active foods or concentrates. However, when the body is suffering from a moderate or severe degree of vitamin A deficiency, most authorities are agreed that there would be a lowered resistance to infections. It is important to provide for fairly liberal stores of this vitamin in the body in order to bridge over periods of illness or emergencies attended with restricted vitamin A intake. This safeguard is also important because the absorption of vitamin A and carotene from the food may be low during illness."

Food & Life, Page 224

VITAMIN B

"WHAT USED TO BE KNOWN AS VITAMIN B WAS LATER FOUND TO BE A COMPLEX of several vitamins. One of these is now called vitamin B₁; another is vitamin G, or riboflavin. The old vitamin B is now generally referred to as the vitamin B complex.

"Vitamin B₁ is an essential dietary substance that cannot be synthesized in the normal processes of the human body and must therefore be supplied in the diet."

Food & Life, Page 229

A LACK OF VITAMIN B₁ IN THE DIET causes the human deficiency disease, beriberi. This disease has had widespread occurrence, particularly in the Orient, including the Philippines, among people whose principal article of diet is polished rice, refined by a milling process that removes the vitamin-containing outer coat of the seed. The disease, which has been known for a long time, was first shown to be due to an unbalanced diet in 1883, when an outbreak of beriberi in the Japanese Navy was controlled and further outbreaks prevented by supplementing the usual diet of polished rice and dried fish with meat, vegetables, and milk. The isolation and identification of vitamin B₁ as the substance necessary to prevent beriberi were the result of a long series of investigations begun by Eijkman in 1897 and carried on by research workers in many parts of the world. The story of the development of the vitamin theory and identification of many of the dietary factors is a long and interesting one that extends over a period of more than 40 years. During that time a science of nutrition has grown up that gives us an insight into the structure and function of many of these vital substances.

"Although a complete lack of vitamin B₁ in the human dietary may result in the occurrence of beriberi, there may be many degrees of the deficiency causing less well-defined symptoms. Any degree, from the mild form in which slight and unrecognizable symptoms occur, to the extreme case with severe metabolic disturbances, may occur in persons of all ages. Infantile beriberi has a rapid onset with short duration, leading to death if untreated, while adult beriberi in most cases develops gradually with vague and ill-defined symptoms. In the early stages the adult may complain of fatigue, stiffness, headache, nervousness, and loss of appetite. Later any one of these three types may be recognized: The so-called wet beriberi type (called wet because of the appearance of large amounts of fluid in the tissues, causing a generalized edema), regarded by some investigators as a critical stage in the development of the disease, in which swelling of tissues is probably caused by improper functioning of the heart; dry beriberi (so designated when the predominating symptom is a peripheral neuritis), considered to be a chronic form which may persist over a long period with possible involvement of nervous system changes; and a type described by some observers as acute pernicious beriberi, in which enlargement of the heart and related conditions may be found. The occurrence of peripheral neuritis, involving the nerves or the periphery or ends of the nervous system—also called polyneuritis—is a common symptom in the advanced stages of all these types of beriberi. Polyneuritis is a condition in which control of the muscles is affected, causing a loss of coordination in the movements, particularly, of the feet, legs, and arms. In severe cases even the muscles of the trunk may be affected. Patients in such advanced stages of the disease develop ataxia—uncontrolled muscle contractions—and lack of coordination."

Food & Life, Pages 230-231

VITAMIN C

"SOME IDEA OF HOW VITAMIN C ACTS in the body to prevent all of the visible and invisible ills that have been described and to strengthen the body's resistance to infection has been obtained from careful study of guinea pigs. It is possible by certain chemical tests to trace the vitamin as it is used by the body, and on observation to note the changes taking place when the vitamin is added or taken away. Such studies have shown that in guinea pigs an important change takes place around the cells in certain tissues, such as the marrow of the bones, the dentin that composes the principal mass of the teeth, and various connective tissues throughout the body. Normally these cells are surrounded by a stiff jellylike or cementlike substance, which in animals deprived of vitamin C becomes a thin watery liquid powerless to support the cells. When the vitamin is again supplied, the substance resumes its jellylike state. The thickening is similar to the effect of pectin in making jelly.

Undoubtedly many of the results of vitamin C deficiency are due to this liquefying of the intercellular substance. There is little question that this is so in and around the teeth, the bones, and the joints. Whether the break-down in the blood capillaries resulting in hemorrhages is due to a similar change or to some failure in the oxidation-reduction system is not definitely known. In a recent review in which the effects of vitamin C deficiency are discussed, much emphasis is given to the effect of growth and stress in determining where the most evident harm results from a lack of vitamin C. In growing children it will be in the developing bones and teeth. There may be some truth in the expression 'growing pains.' The stress of exercise or muscular work in older people determines where the breakdown of the capillaries will occur and hemorrhages appear.

"ANOTHER EFFECT OF LACK OF VITAMIN C that may be traceable to the failure of the intercellular material to jell is delayed healing of wounds. It has been demonstrated in guinea pigs that artificially produced wounds heal much more slowly when the animals are on diets low in vitamin C than when they are given plenty of the vitamin; and it has also been shown that during the slower healing process the wound tissue ruptures very easily. These results are thought to explain occasional breaking open of wounds with no evidence of infection in human beings. A study of the diet of such patients would probably show an inadequate supply of vitamin C. Peptic ulcers might be thought of as wounds, and it is now considered the best practice to prescribe additional vitamin C for ulcer patients. In the past, quite unwittingly, ulcer diets were actually almost entirely lacking in vitamin C, for the bland foods prescribed—milk and eggs—contain little or none of this vitamin.

"It is a temptation to go on illustrating how vitamin C acts by showing what it does, but one more illustration will have to be enough at this point—the relation of vitamin C to infections.

"After it became possible to determine the intake and output of vitamin C in the body it was found that a great deal more of it disappears during various infections than under normal conditions. Tuberculosis is an infectious disease in which there is a great drain on vitamin C, and for a long time it has been the custom to prescribe rather large amounts of orange juice or tomato juice in the dietary treatment of the disease.

"At first it was thought that the vitamin was destroyed by the organisms producing the infection, but there is now some evidence that it actually plays a part in combating the infection because it is necessary for the proper functioning of the blood-serum complement—a substance in the blood stream that acts

as the first line of defense against invasion by harmful agents. It has recently been shown in guinea pigs that the blood-serum complement loses its normal activity in the absence of vitamin C. In human beings, too, blood analyses have shown that a high content of vitamin C is accompanied by a high content of blood-serum complement, and vice versa. Just what reaction, if any, takes place between the blood-serum complement and vitamin C is not yet known. Both are oxidizing-reducing agents, and it is probably through this property that they act together in defending the blood."

Food & Life, Pages 238-239

"IN VITAMIN C DEFICIENCY the cells which produce intercellular substances undergo striking changes. The nutrition and structure of the teeth are affected very early in the absence of vitamin C intake. Later the tiny capillary blood vessels become weakened and cause hemorrhages throughout the body, bleeding of the gums takes place, the teeth loosen, the joints become swollen, and the bones become porous and fragile. These symptoms are characteristic of the vitamin C deficiency disease known as scurvy, which has been known for hundreds of years."

Food & Life, Page 117

"TO CARRY THE ANALOGY STILL FURTHER, the deficit of vitamin C in certain illnesses may not be due entirely to extra expenditures (increased use of the vitamin) but partly to lowered income (reduced intake) as the result of restricted diets. This was more often the case before vitamin C was known or its importance as a regular constituent of the diet was recognized—the days when sick people were told what not to eat instead of what to eat and physicians prescribed re-

stricted diets to eliminate food constituents that were harmful in special diseases without realizing that in so doing they were producing a state of vitamin C deficiency.

"The milk and egg diet for stomach ulcer as formerly prescribed without supplements is a good illustration of the use of a diet extremely low in vitamin C at a time when it is particularly needed to assist in the healing of the diseased tissues. Now it is considered that orange juice or tomato juice properly strained and diluted if necessary, should be given as soon as possible for their vitamin C content. The proverbial gruels and the toast-and-tea diets of early convalescence with their complete lack of vitamin C illustrate failure to cover the deficit incurred during the illness."

Food & Life, Page 250

"IT SEEMS FITTING TO END THIS DISCUSSION OF VITAMIN C requirements by considering the effect of infectious diseases on requirements, for this takes us back again to the guinea pigs which 45 years ago in the laboratories of the Bureau of Animal Industry were killed by the inoculation of an amount of an infectious organism they should have been able to resist. Since that time there have been reports too numerous to mention of the lowered resistance to various infections of guinea pigs on diets deficient in vitamin C, and of lowered values in the blood content and urinary output of vitamin C in human beings suffering from a variety of infectious diseases.

"In the most recent review available on this subject rheumatic fever, pulmonary tuberculosis, diphtheria, and pneumonia are listed as infectious diseases in the prevention and cure of which vitamin C 'undoubtedly plays a significant part,' although 'there is no unequivocal evidence that this nutrient has a specific role in the prevention or cure of any of them.'

"It is probable that the failure of intercellular substances to set to a jell in the absence of sufficient vitamin C accounts for lowered resistance to infections through breaking the first barriers of defense, as suggested earlier in this article. It is possible that the disappearance of vitamin C during the progress of infectious diseases accompanied by fever, as is usually the case, is due partly to the increased metabolism producing the rise in temperature. Evidence is increasing, however, that vitamin C does play an important part in the immunity defenses of the body and that increased allowances are necessary when these defenses are called into action to combat infections."

Food & Life, Page 253

"TO THE NEGLECT OF AN ATTENDANT and the keen observation of a brilliant scientist we owe what is probably the first description of experimentally induced scurvy and lowered resistance to infection due to a diet lacking in vitamin C.

"About 45 years ago Theobald Smith, then Chief of the Pathological Division of the Bureau of Animal Industry, was using some guinea pigs to test the virulence of certain organisms that had been isolated in the study of a disease of swine. He was getting irregular results; two of his guinea pigs, No. 254 and No. 255, were killed by an inoculation that they should have been able to resist easily. He began casting about for the cause of this susceptibility. He found it in the diet the animals were receiving. He wrote in his annual report for 1894-95:

"The death of No. 254 was undoubtedly due to the absence of such (green) food, as the attendant had neglected to provide it after the disappearance of grass in the fall of the year. Furthermore, No. 255 was weakened by the restricted diet and succumbed to an

inoculation which otherwise might have had no visible effect.'

"Not only were these animals unusually susceptible to infection; they developed, Dr. Smith noted, a 'peculiar disease' of their own, which he described as follows:

"When guinea pigs are fed with cereals (bran and oats mixed) without any grass, clover or succulent vegetables such as cabbage, a peculiar disease, chiefly recognizable by subcutaneous extravasation of blood (that is, hemorrhages under the skin), carries them off in four to eight weeks."

"But Smith's work was with domestic animals and not human beings, and since poultry, swine, and cattle manufacture their own vitamin C and do not need to have it furnished in their food as do guinea pigs, monkeys, and human beings, he naturally did not associate this disease of improperly fed guinea pigs with the recognized but little understood symptoms of human scurvy. It was not until more than 10 years later that this connection was made by some Norwegian investigators who found that a disease very prevalent among sailors on long voyages was identical in its symptoms with guinea-pig scurvy, and like guinea-pig scurvy could be cured by green food such as cabbage, or, more spectacularly, by orange juice or lemon juice.

"After the recognition of human scurvy as a vitamin-deficiency disease, 25 more years elapsed before the substance responsible for its prevention and cure — which was given the name vitamin C as the third vitamin to be recognized — was finally separated from foods, identified as a chemical compound of known structure, and manufactured for use in laboratory and clinical work. But even now, more than 6 years later, there is still considerable uncertainty as to how the vitamin acts in the body and how much of it is needed by people of different ages.

"One difficulty is that it is no longer a question simply of determining the quantity of the vitamin necessary to prevent the symptoms of scurvy — soreness and stiffness of the joints, swelling and bleeding of the gums with loosening of the teeth, and hemorrhages under the skin on various parts of the body. These more severe symptoms are now so seldom seen in this country that when cases of undeniable scurvy are found they are given considerable attention in medical journals and are even considered news by the popular press. This does not mean, however, that there is no occasion for most of us to worry about lack of vitamin C. On the contrary, there are probably thousands of people in this country who are suffering from an unrecognized deficiency of vitamin C. Many vague symptoms of ill-health, such as restlessness and irritability in infants and children and a run-down feeling in adults, particularly in the early spring (spring fever), are probably due to lack of vitamin C. In fact, even where there is not a single outward symptom of trouble a person may be in a state of vitamin C depletion more dangerous than scurvy itself. When such a condition is not detected and continues uncorrected, the teeth and bones may be damaged and, what may be even more serious, the blood system may be weakened to the point where it can no longer resist or fight infections not so easily cured as scurvy."

Food & Life, Pages 235-236

VITAMIN D

"VITAMIN D regulates the metabolism of calcium and phosphorus in the body, and thus is concerned in the proper formation of bones and teeth. The mechanism by which vitamin D functions has not been determined with finality, but it is believed that in some way it facilitates the absorption of calcium and phos-

phorus from the alimentary tract. It does not decrease the minimum requirement for calcium and phosphorus, however, and cannot produce good retention of these minerals in a person who receives too little of them."

Food & Life, Pages 255-256

"BECAUSE OF THE RELATIONSHIP OF VITAMIN D TO CALCIUM and phosphorus metabolism it would be natural to expect the need for it to be most evident at that period of life when the formation of bones from the calcium and phosphorus of the food is in most active progress. This period occurs during infancy and early childhood, when the soft cartilaginous bones of the newborn infant are being converted into firm, hard bone and at the same time the skeleton is undergoing considerable linear growth; and it is at this age that the characteristic vitamin D-deficiency disease—rickets—develops.

"This disease of infancy has in the past been very prevalent in this country, and it is still an ever-present menace to infants whose diets are not adequate with respect to calcium, phosphorus, and particularly vitamin D or its equivalent—adequate exposure to direct sunlight. For this reason the cause and treatment of rickets in infants have been the objects of intensive study by physicians and other interested scientists, and considerable information is now available regarding them.

"In older children and adults the results of possible vitamin D deficiency do not manifest themselves in such a striking manner. As a result there has not been such an extensive study of the vitamin D requirements of these age groups, not only because the stimulus to carry on such studies was not as great, but also because definite criteria for determining the presence of

vitamin D deficiency among individuals of these age groups do not exist."

Food & Life, Page 256

"IN DISCUSSING the dietary requirements for vitamin D it is always necessary to bear in mind that exposure of the body to direct rays of the sun serves the same purpose as the ingestion of vitamin D in the form of food materials or medicinal preparations."

Food & Life, Page 256

VITAMIN G

"THE PRIMARY FUNCTION OF NICOTINIC ACID in the body appears to be its part in the formation of a substance that plays a vital role in oxidation.

"Lack of nicotinic acid or of certain very closely related chemical substances which occur in many natural foods would seem to be the deficiency of first importance in pellagra, though this disease may be the result of several dietary deficiencies. Chronic alcoholism often results in the development of a condition very similar to if not identical with pellagra. In these cases, it is believed that bad food habits and poor condition of the digestive tract account for the dietary deficiency, or for the inadequate utilization of food, or both."

Food & Life, Page 119

"PELLAGRA is a disease with a long developmental period, and for this reason may become complicated with dietary deficiencies other than a deficiency of the pellagra-preventive factor, particularly those of vitamin B₁ and riboflavin. Pellagra may be associated with measles, typhoid fever, or other infectious diseases, but it is due primarily to the absence from the diet of a specific nutritional factor. It is therefore a

noncontagious disease characterized by a group of symptoms affecting particularly three systems of the body, the dermal system or the skin, the gastrointestinal or digestive system, and the nervous system. The disease is characterized by seasonal recurrences and relapses and may occur in persons of any age or race."

Food & Life, Page 267

"**THE ONSET OF THE DISEASE** is so gradual that the earliest symptoms may not be noticed by the patient. **Loss of strength in the legs, a change in appetite, a loss in body weight, and a change in mood or personality are the most usual early symptoms.** Changes in the skin do not always occur, but when observed they take the form of symmetric lesions on any portion of the body, though most commonly over the sites of irritation, that is, the hands, wrists, elbows, knees, and feet. There is a sharp line of demarcation between the affected area and the healthy skin. The lesion begins as a redness or erythema similar to sunburn; then the area becomes reddish brown, roughened, scaly, and horny. Intensity of pigmentation and thickening of the skin increase with each recurrence of the disease.

"The first noticeable symptoms in the digestive system are inflammation of the tongue and linings of the mouth and throat. Later the tip and the margin of the tongue become swollen and red, deep ulcers developing along the side and the tip, with intense swelling. The linings of the mouth and the stomach are similarly affected, causing burning sensations. Lack of hydrochloric acid in the stomach (achlorhydria) is not uncommon, and severe diarrhea invariably occurs in acute cases.

"Symptoms involving the nervous system are commonly nervousness, dizziness, headache, and numb-

ness or paralysis in the extremities. In advanced cases there may be degeneration of the spinal cord, resulting in spasmodic movements (spasticity) and loss of coordination (ataxia). Periods of mental depression and apprehension are experienced, and hallucination, confusion, delirium, and complete disorientation may develop. In the absence of treatment the patient is likely to become insane."

Food & Life, Page 268

"RIBOFLAVIN is a yellow water-soluble pigment widely distributed in the tissues of both plants and animals. This vitamin, it is believed, plays a part in the oxidative processes of all living cells. In this capacity it is combined with a protein to form an enzyme.

"A deficiency of riboflavin in animals is characterized by cessation of growth, marked loss of hair, nutritional cataract, appearance of a skin disorder, and a general failure in physical well-being. Riboflavin is widely distributed in natural foods. It seems unlikely that a deficiency would often be encountered without the appearance of other deficiencies at the same time."

Food & Life, Pages 118-119

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**WHAT YOUR GOVERNMENT THINKS OF
ANIMAL TESTS AS A MEASUREMENT
OF VITAMIN EFFICIENCY**

" . . . No one animal will do to represent the reactions of all animals, including human beings; nor can it be said positively that because one kind of animal reacts thus and so in a given experiment, other kinds of animals will react in the same manner; or because one kind of animal needs such and such an amount of a given nutrient, therefore another kind of animal needs a proportionate amount. All such conclusions must be tested directly on the other animal."

Food & Life, Page 12

"Biological methods are never precise, and their accuracy varies with knowledge of factors and conditions involved. As information regarding the physical and chemical properties of the vitamins has developed, chemical and physiochemical methods for assaying them in some instances have been devised; but these, although more precise than the biological methods, frequently yield results of yet undetermined accuracy and value."

Food & Life, Page 705

"We simply cannot apply to one species of animals conclusions derived from experiments on another. . . . For specific information about the reaction of any particular species of animal it will be necessary to make the actual trial on the species in question."

Food & Life, Page 151

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