My Love Affair with Vitamin C

Linus Pauling

Linus Pauling Institute of Science and Medicine
440 Page Mill Road, Palo Alto, California 94305

I had begun taking an ordinary vitamin-mineral supplement, containing the RDAs (Recommended Dietary Allowances), in 1941. It was not until 1966, however, that I began to develop an interest in vitamin C and other vitamins taken in far larger amounts than the RDAs.

In a talk in New York City I mentioned how much pleasure I took in reading about the discoveries made by scientists in their various investigations of the nature of the world, and stated that I hoped that I could live another 25 years in order to continue to have this pleasure. On my return to California I received a letter from a biochemist who had been at the talk. He wrote that he was sending me copies of some papers that he had just published, with the general title "Hypoascorbemia, a Genetic Disease," and that if I followed his recommendation of taking 3,000 milligrams of vitamin C (ascorbic acid, sodium ascorbate, potassium ascorbate, calcium ascorbate) I would live not only 25 years longer, but probably more. The 3,000 milligrams per day that he recommended is 50 times the RDA. My wife and I began taking this amount of the vitamin. Each of us felt that we were livelier and healthier. In particular,

the severe colds that I had suffered from several times a year all of my life no longer occurred. After a few years I increased my intake of vitamin C to 100 times, then 200 times, and then 300 times the RDA (now 18,000 mg per day).

Among the several arguments Irwin Stone presented to support his thesis that the proper physiological intake of vitamin C is 50 or more times the RDA were two that especially impressed me. Most vitamins are required exogenously by all species of animals. Presumably an early animal, eating plants as food, was getting enough of these vitamins in the food to come close to satisfying his needs, and the process of evolution led to the loss of the ability to manufacture them in the cells of his body. Vitamin C is an exception, however. Almost all animal species - dogs, cats, cows, horses, elephants, and so on - have continued to synthesize ascorbate. A likely reason for this is that animals require more ascorbate for good health than plants do. For one thing, ascorbate is required for hydroxylation reactions, and is used up during these reactions. A most important reaction of this sort for animals is the conversion of procollagen to collagen. Collagen is the principal structural protein of animals, strengthening the blood vessels, the skin, the bones, the teeth, and other tissues, whereas plants use a carbohydrate, cellulose, for this purpose, and hence do not need a large amount of ascorbate in order to synthesize collagen. One might conclude that for an animal to depend upon plants as a source of vitamin C would result in a deficiency of this vitamin.

The amount provided by an average diet for a human being is about 60 mg per day, the RDA.

The second fact that impressed me is that animals manufacture very large amounts of ascorbate. The amount manufactured is approximately proportional to the body weight, and, converted to the weight of a human being, ranges from about 2,000 to 20,000 milligrams per day. Irwin Stone concluded that human beings with an average diet are accordingly all suffering from hypoascorbemia, a deficiency of ascorbate in the blood and tissues.

In 1967 I happened to read a number of papers published by two psychiatrists in Saskatchewan, Canada, Dr. Abram Hoffer and Dr. Humphry Osmond. In these papers they reported that they had discovered that another vitamin, vitamin B_3 (niacin or niacinamide, nicotinic acid or nicotinamide) had considerable value in controlling mental disease in patients, especially schizophrenia. I was at first not very interested. I knew that there were drugs that were used to treat schizophrenic patients, and I did not have very much interest in drugs. A few days later, however, I realized that there was something extraordinary about their work. They were giving very large amounts of niacin to the schizophrenic patients, as much as 17,000 milligrams per day, which is 1,000 times the RDA. I was astonished that niacin and ascorbate, with the striking physiological property, when given in very small amounts, of preventing death from pellagra and scurvy, should be so lacking in toxicity that 1,000 times the effective

daily intake could be taken by a person without harm. This meant that these substances were quite different from drugs, which are usually given to patients in amounts not much smaller than the lethal dosages. I thought that these substances, normally present in the human body, and required for good health and life, deserved a name to distinguish them from ordinary pharmaceuticals, and I decided to call them "orthomolecular" substances. In 1968 I published two papers, one in Science on "Orthomolecular Psychiatry" and one in another journal on "Orthomolecular Somatic and Psychiatric Medicine." I said that orthomolecular therapy consists in the prevention and treatment of disease by varying the concentrations in the human body of substances that are normally present, such as the vitamins but also many other substances. The adjective "orthomolecular" was accepted, and there are now many orthomolecular physicians, also the Orthomolecular Medical Association and the Journal of Orthomolecular Medicine. In 1969 I was invited to give a short talk, one of several other talks such as one by George Beadle, at the ceremony of the dedication of a new medical school in New York, the Mt. Sinai Medical School. I tried to think of a medical subject that I could present in ten minutes, and decided to say that if a person were to take 3 grams of vitamin C regularly, he or she could decrease the incidence of and severity of the common cold. A professor of medicine then wrote me a scathing letter, denying the truth of my statement, and asking

if I could refer him to any randomized double-blind control trials supporting my statement. I searched the literature, finding papers describing four such trials, which I communicated to him. It turned out that this physician, Dr. Victor Herbert, simply refused to recognize that these studies had any value. During my search of the literature I found that the medical textbooks had either disregarded these studies or reported them incorrectly as showing that vitamin C had no value against the common cold or any other disease. By the first of August 1970 I had become so interested in the history of scurvy and the discovery of vitamin C and so exhilarated by the thought that I might be able to decrease the suffering of millions of people who developed severe colds in the way that I had in earlier years that I began writing a book, completing it on the last day of August. The book was published in November of 1970 by W. H. Freeman and Company. This book, "Vitamin C and the Common Cold," was quite a success with people who suffer from colds (a recent survey by Prevention magazine gave the result that 78% of the people in the survey expressed the opinion that vitamin C has value in controlling the common cold) and the book was given the Phi Beta Kappa award for the best scientific book of the year. I was, however, immediately attacked by physicians and medical journals, and for twenty years medical authorities have continued to say that large doses of vitamin C have no value in controlling the common cold or any other disease. Only recently have their statements been revised somewhat: Often it is said that vitamin C might decrease somewhat

the severity of a cold, even if it does not decrease its incidence.

Irwin Stone had pointed out in his papers, and again in his book "The Healing Factor: Vitamin C Against Disease" that a deficiency in intake of vitamin C by human beings might well lead to a decreased resistance against essentially all diseases. In his book, published in 1972, he discussed the published evidence about the value of an increased intake of vitamin C in relation to about 100 diseases, including infectious diseases, cancer, and cardiovascular disease and stroke. In checking up on vitamin C and the common cold in 1969 and 1970 I had read a number of reports about the value of megadoses of vitamin C and vitamin A in controlling cancer. I was invited to give the banquet address at the dedication of a new laboratory for the Ben May Laboratory of Cancer Research, Pritzker Medical School, University of California, by the Director, Dr. Charles Huggins. In my talk I stated that from my analysis of published studies and from general arguments such as those presented by Irwin Stone, I had concluded that the incidence of and mortality from cancer probably could be decreased by 10% by the proper use of vitamin C, in megadoses, as an adjunct to appropriate conventional therapy. A newspaper account of my statement was seen by Dr. Ewan Cameron, Chief Surgeon of Vale of Leven Hospital, Loch Lomondside, Scotland, who had been searching for an alternative treatment for cancer for a number of years and had written a book on this subject published in 1966. He had just become interested in the possibility that vitamin C might have some value in controlling cancer, and he

wrote to me to ask my opinion about how much should be administered. During the following years I went to Scotland several times to confer with Dr. Cameron. He came to our Institute in Palo Alto for one year, during which we wrote our book "Cancer and Vitamin C," and later he retired from his post in Vale of Leven Hospital and became Medical Director in the Linus Pauling Institute of Science and Medicine. He published a number of paper, some of them jointly with me, on the results obtained by him in cancer patients given ten grams of vitamin C per day, taken for the rest of their lives. His observations with a few hundred patients showed that most of them experienced a pronounced increase in the quality of life and in survival time. Recently some negative reports have been published by physicians who gave 10 grams of vitamin C to cancer patients for limited periods of time, ignoring the strong recommendation made by Dr. Cameron and me that the intake of megadoses of vitamin C never be stopped by a cancer patient, once that this vitamin has been begun as an adjunct to appropriate conventional therapy. I remain convinced that every cancer patient should begin taking large amounts of vitamin C as early as possible in the course of his diesease, as an adjunct to appropriate conventional therapy. One important observation is that when taken along with chemotherapy, it prevents to a large extent the misery of the side effects of the chemotherapeutic drugs. I regret that our efforts to get the National Cancer Institute and the American

Cancer Society interested in vitamin C, which we initiated in 1973, remained unsuccessful until two years ago, when the National Cancer Institute sponsored an international symposium on vitamin C and cancer. It is now generally accepted that an increased intake of vitamin C, niacin, and beta-carotene (a precursor of vitamin A) have value in controlling cancer, but large-scale trials to check Dr. Cameron's observations have not yet been carried out.

For a number of years the psychiatrist Dr. Abram Hoffer, now in Victoria, British Columbia, has had among his psychiatric patients a good number of cancer patients who were referred to him because of depression or anxiety, perhaps resulting from learning about the seriousness of their disease. For many years Dr. Hoffer has prescribed for his psychiatric patients large amounts of vitamin C, usually 12 grams per day, a good amount of niacin,1.5 or 3 grams per day, and mega-amounts of several other vitamins and certain minerals. Some of his cancer patients did not follow his recommendation. They died of cancer usually only a few months after having been registered with him. Those patients with various kinds of cancer who followed his regimen, in addition, for some of them, to receiving conventional therapy, have survived far longer, on the average about 16 times as long, years rather than months. Dr. Hoffer's patients seem to have benefitted considerably more than Dr. Cameron's, possibly because of the value of the large amounts of other vitamins and certain minerals taken by them, as well as a somewhat larger amount of vitamin C (average 12 grams

rather than 10 grams per day). I now recommend strongly that cancer patients follow the regimen prescribed by Dr. Hoffer, rather than just taking megadoses of vitamin C.

During recent years I have become much interested in cardiovascular disease. Heart disease and stroke are the cause of about 50% of deaths in the United States. During the last ten years the death rate from coronary vascular disease has decreased by 30% and the death rate from strokes has decreased by the same amount. I have been tempted to surmise that these decreases are the result of the large increase in intake of vitamin C by people in the United States during this period, but there is no direct evidence to support this conclusion. My associate Dr. Matthias Rath and I have, however, recently reached the conclusion that cardiovascular disease and strokes is a deficiency in ascorbate, which leads to weakness of the arteries because of the failure to synthesize enough collagen to strengthen them properly.

I have known Matthias Rath for nearly 10 years. I encouraged him to finish his medical studies and then to carry on medical research. About six years ago he began a study of the nature of atherosclerotic plaques in the arteries near the heart. He and his associates made a remarkable discovery, pulished in 1989. The discovery was that it is not low-density lipoprotein, LDL, that is laid down in the plaques, but instead it is a minor constituent of the blood, lipoprotein(a), which is

usually ignored when blood analyses are carried out. The lipoprotein(a) particle is larger than the LDL particle, because it has an additional protein constituent in the surface layer around the lipid core. Two years ago Dr. Rath and I formulated a theory of cardiovascular disease. It incorporates many of the ideas generally accepted by investigators of cardiovascular disease, but has some novel features. The primary cause is the occurrence of lesions in the arteries resulting from a deficiency in vitamin C, occurring in regions of increased stress, such as the high pressure close to the heart and turbulence when arteries join together. Various steps are taken to control these lesions, including deposition of fibrin and fibrinogen. Lipoprotein(a) has combining groups that react with haptenic groups on fibrin and fibrinogen, so that this lipoprotein is deposited in the plaques. Other efforts are made to control the situation.

This theory of cardiovascular disease suggests several ways in which the disease might be controlled. One is to increase the intake of vitamin C, in order to prevent the primary lesions from forming and also to decrease the rate of synthesis of lipoprotein(a) and increase the rate of destruction of cholesterol, which involves hydroxylation reactions requiring vitamin C. Moreover, there are inhibitors that interfere with the binding of

lipoprotein(a) to the vascular wall. One of these inhibitors is the amino acid L-lysine, an orthomolecular agent, which, taken regularly, might cooperate with vitamin C in decreasing the incidence of cardiovascular disease and in helping to control existing disease. Dr. Rath and I are at the present time hopeful that these new discoveries will contribute in a significant way to the control of cardiovascular disease and to the improvement of health of people in the United States and elsewhere.