

# In Memoriam — Linus Pauling

1901 - 1994

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Professor Linus Pauling died August 19, 1994, at 93 years of age. He was the most productive humanitarian scientist this world has ever seen. Of the world's 20 greatest scientists he is easily the foremost for his work, which spanned a period of more than 60 years. Dr. Pauling addressed three of the most serious problems facing humanity in the past 100 years. These are survival, prevention of disease, and improved treatment of disease.

His research into the structure of molecules and how they interact with other molecules provided a major base for modern chemistry and medicine. Modern medicine would have been delayed many decades had it not been for his important work, for which he was awarded his first Nobel Prize. The development of modern complex molecules targeted for specific receptors would have been delayed even longer. He showed that genes were responsible for the structure of protein, following his classic work with the abnormal structure of the hemoglobin in sickle cell anemia. From this work he originated his concept of molecular medicine which later became Orthomolecular medicine and psychiatry. To honor him he received close to forty honorary Ph.D.s and D.Sc.s. An Orthomolecular Chair in Psychiatry was donated in Israel at Ber Sheva Medical School by Edward Vickar and Marion Hoffer several years ago.

Professor Pauling had so much fun with his chemical research that he felt getting a Nobel Prize for that was a bit incongruous. His second Nobel Prize he appreciated a lot more, for he became very active in the anti-radiation and peace movement, and he did not enjoy that nearly as much. This time he felt it was well earned and he deserved it. His humanitarian spirit was challenged by his wife, Ava Helen, who urged him to do what he could in promoting world peace and in reducing the danger of atomic war and atomic radiation. This followed a presentation he made on the dangers of radiation when both the United States and Russia were doing their best to build up the most powerful nuclear arma-

ments. This made him very unpopular with the U.S.A. government and also with Joseph Stalin. It is highly likely that but for this activity he would have received a third Nobel Prize for being first to determine the double helix structure of DNA. The State Department seized his passport so he could not attend an important international meeting in London. Had he been there he would have gained the additional information he needed to deduce the correct chemical structure. Dr. Crick, one of the three Nobel Winners for the discovery of the structure of the DNA molecule, stated that Linus Pauling had showed them how to solve the problem.

His work for peace steeled him to persist in working for what he considered the humanitarian and ethical thing, preparing him for the last major effort of his career, his work in Orthomolecular medicine in which he was involved for about 30 years.

Pauling's work for peace did not arouse any massive opposition from established professional groups, but his entry into the field of medicine and therapeutics created a storm of opposition and criticism from the healing professions, physicians, psychiatrists, social workers, psychologists, nutritionists and dietitians. For 30 years, at an age when most people have retired, he involved himself in the pursuit of the action of nutrients, how vitamins could be used in megadoses with no harm, and their therapeutic potential when used in optimum amounts, not just in tiny RDA doses. He was not an M.D., but this surely should not have been a barrier since many of the world's most important medical discoveries were not made by medical doctors. One of the best examples is Louis Pasteur who discovered that bacteria are involved in disease. If he had had an M.D. his work would just as surely been opposed, as was our work with the treatment of schizophrenia, but he might have been spared some of the personal attack he had to face.

The problem was that Pauling had suddenly jumped from one paradigm to another.

The vitamin-as-prevention paradigm had been established by 1930 and has held sway. The vitamin-as-treatment paradigm, which is rapidly replacing the older one started in 1955 when Altschul, Hoffer and Stephen published the study which proved that niacin lowered total cholesterol levels. Paradigm battles can be most ferocious. This is probably why it may take forty years before a new idea is accepted into medicine.

The vitamin-as-prevention paradigm had been very useful in determining what vitamins were and the type of syndromes their absence generated. It too was accepted very slowly and with difficulty. The medical profession stoutly resisted it for many decades refusing to believe that a disease could be produced by the absence of something. Prof. Virchow, the preeminent pathologist in Europe had declared that no disease was ever caused by an absence. He practiced during the most active development of the connection between invaders and disease, i.e. bacteria, later viruses.

By 1950 the vitamin-as-prevention paradigm included a set of facts, more properly beliefs: (1) Vitamins are catalysts and therefore needed in minute quantities for the prevention of vitamin deficiency diseases such as beri beri, pellagra and scurvy. Catalysts are not destroyed. They are simply re-used. (2) Diseases not known as vitamin deficiency diseases should not be given vitamins. This follows the medical concept of one-drug-one-disease, or one vitamin one deficiency disease. Many physicians lost their license to practice because they violated this essential principal. In California it is considered malpractice to advise patients to take vitamin C if they have cancer. No one is allowed to tell their patients that the vitamin will be therapeutic. (3) Doses above those recommended, RDA doses, are contraindicated and even dangerous. Often where there is no toxicity it is invented, e.g. the false belief that vitamin C will cause pernicious anemia because it destroys vitamin B<sub>12</sub> (it does not), or that vitamin C will cause kidney stones when it does not. This old paradigm became the bible for modern nutritionists and for the medical profession which had fled from any serious consideration of the importance of nutrition since about 1950, leaving the field to non clinical dietitians and nutritionists, i.e. to people who could not possibly use

nutritional intervention as treatment and therefore could not see what nutrition or lack of nutrition could do. (4) A balanced diet will provide all the vitamins anyone needs.

Paradigms in medicine and science are replaced by better ones as more information accrues. Additional facts can no longer be accounted for by the old paradigm and eventually directly contradict it. This topples the old paradigm. The battle may be long and ferocious, and even when it is generally replaced there will remain a residue of fossilized scientists who will die swearing allegiance to it. Pauling was a respected member of the old paradigm, but one day his faith in it was seriously challenged and within a matter of days he had leapt from the old into the new, one of the first eminent scientists to make this quantum jump. The new vitamins-as-treatment paradigm which he endorsed and promoted so effectively, contains the following set of facts: (1) That vitamins are needed not only for deficiency diseases but for other conditions as well in optimum doses which may be small or large. There is no artificial restriction to only small doses. (2) They can be therapeutic for conditions not recognized as deficiencies, e.g niacin for decreasing cholesterol levels. This is not a deficiency disease and niacin is used in doses 300 times the RDA. (3) Vitamins, even in large doses, are safe, especially the water soluble ones. The toxicity of vitamins has been grossly exaggerated. (4) Very few people eat diets so well balanced they obtain adequate quantities of many of the vitamins even when they are well. When they are under stress or ill, no diet is adequate without the supplementation of the important nutrients.

Pauling described his increase in interest in megadose vitamin therapy many times. One afternoon he and Mrs. Pauling were visiting a friend who had a copy of "How To Live With Schizophrenia" on her coffee table. It had been given to her by a father of a patient who had recovered from her schizophrenia after five years of failure on standard treatment. He borrowed the book and spent that night reading it. He was surprised at the fact that we were using such high doses of vitamin B<sub>3</sub> and vitamin C with no harm to our patients. He then decided not to retire and instead he became interested in opening up this new field.

It was a logical extension of his previous interest in molecular medicine. In a speech at California Institute of Technology, May 16, 1938 (*Science* 87:563-566, 1938) he said, "Organic chemistry was developed into a great science during the nineteenth century, and it seems probable that all or nearly all its fundamental principles have now been formulated. There is, however, a related field of knowledge of transcendent significance to mankind which has barely begun its development. This field deals with the correlation between chemical structure and physiological activity of those substances, manufactured in the body or ingested in foodstuffs, which are essential for orderly growth and the maintenance of life, as well as of the many substances which are useful in the treatment of disease."

This quotation 30 years before his *Science* report shows how far advanced he was in his understanding of human biology and medicine. He was also in contact with Dr. Irwin Stone and had been taking ascorbic acid himself, three grams daily, and had found that troublesome colds which had continued to bother him vanished. In a lecture he expressed his wish that he could live another 25 years to be able to witness the interesting changes that would be forthcoming. Dr. Stone had assured him he could achieve his wish by taking megadoses of ascorbic acid. Dr. Stone invented the term megadose as applied to vitamins, not I, as some believe. He did live more than 25 years after starting to take the ascorbic acid.

Having read our book, Pauling asked several physicians if they were aware of our work. They replied that it was all a lot of nonsense. However, Pauling always did his own thinking and investigation. He examined the literature, could not find reports that our methods had been repeated. There was not a single negative report. He therefore was finally convinced this was a field worth examining. In 1968 his *Science* report, "Orthomolecular Psychiatry" he delighted those of us who were practising megavitamin therapy, but excited a tremendous amount of hostility and criticism from the psychiatric profession.

The American Psychiatric Association tried to suppress the publication of any information about the value of high dose vitamins in the treatment of schizophrenia. They eventually called Dr. Osmond and me before their committee on ethics in 1971 because a California psychiatrist had complained

about our paper describing the patient who recovered and whose father had indirectly introduced Pauling to our concepts. Had the APA had their way, Pauling might not have seen our work and his interest might have been mislaid or delayed. After a heated meeting the APA advised us they would let us have their decision in a few weeks. We have not yet heard from them.

Pauling became very supportive of the work being done by our colleagues. Within a few years we agreed that we were in fact practising Orthomolecular psychiatry and that we should officially adopt this term as representative of what we were doing. In 1973 Dr. Pauling co-edited a book called "Orthomolecular Psychiatry." The Committee on Therapy of the American Schizophrenia Association held one of their meetings in Dr. Ross Maclean's home in Vancouver. During this meeting, where there was a free exchange of data, it occurred to us that we had an immense amount of valuable material which ought to be made known to the world. We all agreed to contribute and Dr. David Hawkins agreed to undertake the role as editor. Later we asked Pauling if he would be the editor. He refused to be editor but agreed to be co-editor on condition that he see every manuscript and approve of it before it was published. He did not want to be only a name. We were delighted. This amazing book has sold well - except to psychiatrists - and contains an immense amount of essential information.

By now Pauling was fully identified with the new paradigm and with Orthomolecular psychiatry and medicine. In 1971 he established the Linus Pauling Institute of Science and Medicine. There he and his colleagues began to study the relation between vitamin B<sub>3</sub>, vitamin C and schizophrenia, but he could not do any clinical research. He was our guest speaker at three annual Nutritional Medicine Today conferences, once in Vancouver and twice in Toronto. In Vancouver well over 1,500 people came to hear him.

A few years later he became interested in vitamin C's anti cancer potential. He had been invited to address the Ben May Institute which had recently been opened. During his address he suggested that vitamin C might be useful in the treatment of cancer. But one of his most severe critics, Dr. Victor Herbert, was there

and was extremely critical of this statement. This challenged Pauling to examine the literature. He later met Dr. Ewan Cameron who was using vitamin C in treating his terminal cancer patients. Their book in 1979 was as major shock to the medical establishment. Had it been written by any other two people it would simply have been ignored.

This book was very exciting to me because by chance I had already seen what a combination of vitamin B<sub>3</sub> and vitamin C had done to a few patients with terminal cancer. I had concluded that vitamin B<sub>3</sub> was the main therapeutic factor but after reading the Cameron/ Pauling book realized that vitamin C was the key variable. Within a few years I began to receive large numbers of referrals from physicians in Victoria. By 1985 I had seen 41 patients. Most of them were terminal, having failed to respond to treatment, having relapsed, or were considered untreatable. I began to suspect that the patients on the regimen were doing better. I therefore examined carefully the outcome of all patients seen between 1978 and 1983. Eleven had not followed the program. Of this small group all were dead. They had lived 4.5 months after the day I first saw them. From the 26 who did follow the program 18 were alive and their mean survival was 16.2 months. I had decided to use the hardest, most reliable data available, i.e. the number of days alive after they were first seen.

Several years later I was at a Festschrift for Dr. Arthur Sackler. Pauling was there. He described his bitter debate with the Mayo Clinic and the New England Journal of Medicine. He was remarkably blunt and accused the Mayo group of lying about their study. The first morning I visited him in his motel room, next to mine. He had finished breakfast with Linus Jr. who had accompanied him to the meeting. I found him with a hand calculator doing some calculations. He told me he was recalculating electron orbitals. He added that he was able to understand them by doing his own calculations. I later told him that I believed he and Cameron were correct in their claim that vitamin C was helpful for the treatment of cancer. He asked me whether I intended to publish. I replied that I did not. I added that there was no point in preparing a report since no medical journal would accept it for publication. He then urged me to proceed with more careful

followup studies on the much larger group I had seen by then, and that he would help me find a journal that would publish. I agreed that this would be a good thing to do. But when I arrived home I changed my mind. I did not relish the massive work that would be involved in doing a large scale follow up and I was not certain Pauling really was serious about this. I thought he was simply trying to be nice and friendly by his encouragement. I did nothing until two years later I received a letter from Linus in which he asked where the data was. I promptly apologized to him and said I would get to it immediately. I did a follow up on the first 134 patients I had seen from 1978 over a ten year interval.

In the meantime, Pauling had become interested in methods of calculating probable outcome using cohorts of patients based upon the Hardin Jones biostatistical method. He applied this method to the data I had sent him. My examinations of the data convinced me that the patients on the regimen had a much better outlook. His examination was much more detailed and showed a very significant improvement of the treated compared to the untreated group. We published the results of this and a subsequent study in this journal because even the Academy of Sciences, Washington, refused to publish Pauling's clinical papers. Pauling had been criticized severely after the two Mayo clinic reports were published in the New England Journal of Medicine. Pauling was incensed by these reports, not because they could not find any beneficial effect from their use of ascorbic acid, but because they claimed that they had exactly reproduced the earlier Cameron clinical studies when they had not done so. The journal would not accept a rebuttal paper by Cameron and Pauling. After almost a year, Pauling discussed this with a New York lawyer who wrote to the editor. Shortly after that Dr. Pauling received a letter stating that they had misplaced his file but were now informing him they were rejecting his rebuttal. Pauling had requested to be told immediately so he could, if he wanted to, submit his rebuttal to other journals, but he preferred to have it published in the same journal which had carried the two Mayo reports. The New England Journal of Medicine has been a powerful defender of the old paradigm, and generally

refused to accept positive papers about megavitamin treatment.

Linus Pauling was a great teacher, a brilliant investigator, a sensitive and honest colleague, and a great humanitarian. The foundation he laid will never be forgotten and the work he started has a momentum so great that it can no longer be hindered or stopped. A scientist will be judged not only by the goodness of the work and by the opinion of his peers, but also by the quality of his enemies and critics. Professor Linus Pauling had innumerable friends and supporters from the lay public, from his co-workers and colleagues who knew him and his work well. There would be too many to list nor are they even all known. His critics were few. As listed in the news reports following his death they included: (1) Senator Joseph McCarthy, Senator from Wisconsin, Chairman of the Senate Permanent Committee on Investigations. He labeled him a communist. The State Department took away his passport in 1952. This probably cost him a Nobel Prize for discovering the three dimensional structure of the DNA molecule. (2) Joseph Stalin, considered him hostile to the Marxist views and condemned his theory of resonance of molecules as pseudo-scientific and vicious, as a example of the world hostile view. (3) Dr. Arthur Robinson, who had been his colleague and supporter, who accused him of suppressing his research because it did not agree with Pauling's view on ascorbic acid and cancer. At the 1979 meeting of the Canadian Schizophrenia Foundation held in Victoria, Dr. Robinson, invited to discuss the research being done at the Pauling Institute, instead launched an attack against Dr. Pauling. This was embarrassing to those at the meeting who did not have the slightest idea this is what he would do. He later accused Dr. Pauling of hurting his wife who had cancer by giving her vitamin C. (4) Dr. Matthias Rath has charged Pauling with stealing his ideas about vitamin C and its role in the genesis of arteriosclerosis. This suit has not been settled. (5) Dr. Victor

Herbert has enjoyed attacking Dr. Pauling for his views on vitamin C. He maintained that Pauling was psychotic about vitamin C, calling him delusional. On a national CBC TV program, Dr. Herbert maintained that Pauling had shortened his life by taking vitamin C. He added that had Pauling not taken any vitamin C he would have lived to age 105. He must have been privy to information not available to anyone else, but his criticisms were major spurs which persuaded Dr. Pauling to investigate the connection between vitamin C and the common cold and cancer. We should thank Dr. Herbert for having been such a stimulus. If he had not, perhaps a lot of the excellent work accomplished by Dr. Pauling might not have been done.

I have just returned from the September meeting in San Francisco sponsored by the Linus Pauling Institute of Science and Medicine. The topic was "Therapeutic Potential of Biological Antioxidants". A few months before this meeting it was suggested to Dr. Pauling that he record a statement to this meeting in the event that he died before it was held. He refused to do so, firmly believing he would be able to deliver it himself. As I listened to the various speakers, from about twenty universities from USA and around the world, it was amply clear that a meeting of this type could not have been held if Dr. Pauling had retired at age 65 when he first contemplated doing so. Tribute was paid to Dr. Pauling by scientists from France, from Croatia, from South America as well as from the United States and Canada.

#### Literature Cited

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