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The Future of Orthomolecular Medicine

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Mrs M:
Perhaps you could make a good typescript.
L.P.

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Thank you.

This has been a great day for me; yesterday too, especially to have so many of my old students, former students and collaborators here saying nice things about me. I wasn't sure that they would, when I heard that they were coming. I can say nice things about them, too. I feel that I've been very fortunate in having been associated with them and with the others who aren't here today. Much of the success of the work that we carried out was due to their contributions. Then of course I am pleased also with the other participants in this fine program. I dedicated my book Vitamin C and the Common Cold to Irwin Stone and also to Albert Szent-Györgyi, who discovered vitamin C, long ago, when he was trying to find out what it was that kept some fruits and vegetables from turning brown when they were exposed to light. Of course, it was an antioxidant; it turned out to be vitamin C.

Since they have talked, former students of mine and former associates, have talked about my past life, I thought that I should also talk a bit about my past life. Three days ago I gave two speeches, this in Italy. One of them, and this now I am able to live up to the pledge that I made that Dr. Catchpool mentioned, in December, 1947, that I would mention the need for world peace in every talk that I gave. One of my talks in Italy was about the need for peace in the world, about the path to world peace. I mentioned that it was hard to understand why the American people

were willing that the government should have the policy of spending 1.6 trillion dollars on militarism in the next five years, beginning this year, and that I thought that the answer was that the American people were misled about the missile crisis, about nuclear vulnerability, about the Russians having the Soviet Union having greatly, very great more nuclear missiles than we have or nuclear warheads having greater destructive power, so that that we have to catch up. I think that I even quoted the statement that Senator Christopher Dodd and Senator Paul Tsongas made last year, which was, "The President of the United States lies". This was unthinkable 20 years ago. Well, it was a shock to me to read this statement made by two senators here in the United States. Fortunately, at nearly the same time then I got a letter from a psychologist friend of mine who wrote about reality and fantasy. He said that he had reached the conclusion that President Reagan is unable to distinguish between reality and fantasy, and then he quoted President Reagan's fantasy that the Soviet Union has far greater nuclear destructive power than the United States, and then the fact. He quoted from the Pentagon Report of the Department of Defense of 1982 that there is an approximate equality of destructive power in the arsenals of the Soviet Union and the United States. Then, fantasy, again, President Reagan says that the campaign for a nuclear freeze is being orchestrated and led by communists. In fact, and he quoted in fact (I've forgotten what the source was) the State Department think that there is no evidence that communists are involved in any serious way in the campaign for nuclear disarmament. It's just good sense—good sense to stop wasting so much money on militarism, if we're going to solve the problems of the world. We have to cooperate,

all the people and all the nations in the world. The reason that I spend time thinking about medical problems, ~~and about medical problems~~ about vitamin C, for example, is that I believe that we are going to solve this problem of finding out how to keep the world from being destroyed in a nuclear war, and that it's worth while ~~then~~ to be thinking of making the world a better place for the coming generations of human beings. One way in which this can be done is by improving their health, by cutting down on the amount of suffering caused by hypo-ascorbemia, as Irwin Stone says, from which ~~everybody in the world~~ essentially everybody in the world is suffering. Only a few enlightened persons, who take 10 or 12 grams a day of vitamin C, are in the fortunate position of not suffering from this genetic disease that we have learned to control, but only just barely, by getting a diet that contains enough ascorbate to keep us from dying, but not enough, it's turned out, to put us in the best of health. ~~That can be done only with supplementary vitamin C.~~

The other talk that I gave ~~at a scientific talk~~ this symposium that I was attending, ~~was involved in~~, was on the role of the physical sciences in modern biology. I talked about one aspect of this, and in fact it's quite pertinent to what we have all been talking about: about vectors of disease and about the agents that we use to control these vectors of disease, and about the human body and how it functions. ~~I remember, but~~ I doubt that I thought much about the nature of life until 1929. I was then ~~working~~ carrying on research on the structure of minerals and other inorganic substances. ~~up to 1929, and then something happened in Pasadena~~ Then in 1929 Thomas Hunt Morgan came from Columbia

University, bringing with him Sturtevant, and Bridges and Emerson and Tyler. Sturtevant and Bridges were two of the three students who had cooperated with Morgan in developing the theory of the gene, in discovering the gene. It wasn't known, of course, that it consisted of polynucleotides, but they knew a lot about it even though they didn't know it's chemical composition. They kept talking about the specificity characteristic of life. One example of this specificity is that parents have children who resemble them. This resemblance we now know even goes so far as resembling them in terms of amino-acid sequences of the polypeptides that constitute the specific proteins in their bodies, and their specificity in the action of enzymes as catalysts,

Morgan was working on self sterility of Ciona, the sea squirt,

In 1935 and '36 I was working on diamagnetic oxygen as well as triplate oxygen, the normal state, with the idea that we could tell something about how oxygen molecules are held by hemoglobin molecules in the red cells of the blood, and the idea was that we could distinguish between two kinds of combination; one involving a mainly physical force which would leave the oxygen in the triplet state, leave it paramagnetic, and the other chemical combination, forming of chemical bonds which would make the oxygen

molcule diamagnetic. So we measured the magnetic susceptibility of venous blood and arterial blood, and found that there was a remarkable change. We found that oxygen molcules were held in the hemoglobin molecule by forming chemical bonds. They lose their magnetism and we also found a remarkable change in magnetic properties of the iron atoms when the hemoglobin in the red cells is oxygenated. I was giving a talk in New York in 1936 at the Rockefeller Institute for Medical Research, a seminar on this subject, and Landsteiner asked me to talk with him. Karl Landsteiner had discovered the A, B and O blood groups in 1900, and the others, L and M and Rhesus factor later on. He had been carrying out experiments in the field of immunology, immunochemistry, and he asked if I could explain his observations. I couldn't explain them, but he told me a great deal in several days of discussion; he told me a great deal about immunology, and I kept thinking about what he said, and finally I reached a conclusion or decision as to what I thought was going on, that permitted antibodies to show such remarkable specificity in their interaction with antigens. Landsteiner was making azoproteins, using simple chemical substances such as paraminobenzoic acid taken off the shelf, got out of the stock room, diazotizing these amines, coupling them with proteins, using these azoproteins as antigens, making antibodies then that would combine specifically with the simple chemical substance that had been attached to the original protein. Any protein could be used, and this appealed to me, in that I felt that I knew a lot about the simple chemical substances such as benzoic acid or parachlorobenzoic acid, meta-chloro, orthochloro- benzoic acid or toluic acid, and hundreds of

other substituted benzoic acids as well as other substances you could use instead of the benzoic acid.

By 1940, I had reached the conclusion that I knew the answer to the question, the basic answer to the question of the molecular basis of biological specificity, or the molecular basis of life. There were two ideas that had been discussed very clearly or discussed very much, but there were two reasonably simple ideas. A German physicist named Pascual Jordan published a paper in 1940, about the time that I published my paper about the structure of antibodies and the nature of serological reactions. He advocated one of these ideas, which is that identical molecules attract one another more strongly than nonidentical molecules because of the phenomenon of quantum mechanical resonance. Max Delbrück brought this paper to my attention, and I said, "I don't believe that the extra energy of attraction that you get from quantum mechanical resonance between identical molecules can possibly be the explanation, because this extra energy is less than the energy of thermal agitation. It just wouldn't work. But if, and this was in my paper on antibodies, if the antibody has a combining region that is complementary in its atomic structure, the arrangement of the atoms, to the haptenic group of the antigen, you get strong and highly selective interaction, so that the antibody is the antibody against benzoic acid and you replace one of the hydrogen atoms on the benzene ring with a chlorine atom, if the fit is tight enough, then this substituted benzoate ion will not be able to fit in the cavity. Well, so we wrote a paper in 1940 saying that biological specificity in general results from the detailed molecular complementariness

of the interacting groups, and that Jordan was wrong about his idea of quantum mechanical resonance. We also said the gene consists of two mutually complementary molecules, each of which, when they are separated, can act as a template for the synthesis of a replica of the other one, so that gene duplication occurs that way, using one half of the gene for the template for the other because of its complementariness. Well, of course, some years later examples of complementariness began to show up. The alpha helix and the pleated sheet are arrangements of polypeptide chains in which there are two complementary groups which interact, the NH group of peptide interacting with the oxygen atom of the carbonyl group of another peptide, and that is a highly directed interaction. You can achieve these hydrogen bonds by coiling the polypeptide chain in the helix or by arranging it in a somewhat staggered linear arrangement coming back on itself to make the pleated sheet where the hydrogen bonds are formed laterally. And then, of course, Watson and Crick discovered the double helix 13 years later, in 1953, in which they were able to show that two nucleotides - purine appearing and pyrimidine form four hydrogen bonds with another and two other nucleotides, purine and pyrimidine, form three hydrogen bonds with one another, and that the gene consists of two polynucleotides which are mutually complementary, adenine combining with thymene and guanine combining with cytosine.

So now by 1948, my students, and my associates Campbell and David Pressman, who worked for several years

on this project, had carried out studies of the interaction of antibodies with haptenic groups, hundreds of experiments, a thousand experiments perhaps, we made determining equilibrium constants. By 1958 we had tied down these ideas, so far as they are concerned with antibodies and antigens, so tidily that there was no possibility of saying we were wrong.

So, molecular complementariness, this tight fit of the complex of atoms in one molecule onto the complex of atoms in another molecule, is the basis of life. Biology now is developing, molecular biology is going along strongly, genetic engineering. We are going to get more control of ourselves, with a better understanding of the nature of our own bodies and the way in which these bodies function. I'm not going to make an effort to predict in detail what the future of orthomolecular medicine will be. I think that it's been done already, by the participants in this seminar; but I might make a quantitative statement. Someone sent to me a clipping saying that Dr. Pauling says that we can live to be 100 years old, and I in fact had said that, that by proper use of supplementary nutrients and other health practices, people in general could live 25 years longer than they do now, live to be a hundred years old, and lead good lives too, not have a long period of debility as the body begins to fail.

Well, Irwin Stone said that he hoped that, well he said something stronger than that, that he believed that I could live 50 years; that was 15 years ago when he made that statement, so he would say that he thinks that we can live 35 years more than presently accepted. It may well be that in a generation or two we shall have enough knowledge, expecially in the orthomole-

lar field, ~~so that~~ people in ~~general will~~ live to be 110 years old. I think that this is worthwhile; if you can extend the ~~period of well-being, the period in life when you haven't yet learned how to enjoy yourself, especially in the teens and the period toward the end of life when death is approaching are not included in this period of well being. If we can extend the~~ period of well-being, then we shall have extended the ratio of well-being to suffering, and I think that that would be worthwhile.

~~Well,~~ I've enjoyed myself for many years, after I got through the initial period of not understanding the world very well. I've enjoyed myself, and it's been a special pleasure for me to have been here today and yesterday. Thank you.