PROTEIN CHEMISTRY AND MEDICINE[1]

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WE have heard over and over again of the great contributions that the chemist has made to the well-being of our people through his contributions to medicine. These are gratifying successes and the chemist has a right to be proud of them. However, not all the attempts of the chemist to contribute to medicine have been crowned with success. There are many problems which are badly in need of solution, and upon which the chemist has worked but to date has not entirely succeeded. I should like to take one sector of the field of biochemistry in relation to medicine and spend a few minutes discussing an example or two of the unsolved problems. For isn't it essential for us to evaluate our failure as well as our successes? In considering chemistry's effort to help medicine, we can best appreciate the need of highly trained chemists—and more chemists—to continue the attack on such problems. When a field such as chemistry has not been able to provide medicine with a necessary drug, or an understanding of a particular biological process, or the fate of a substance in the body, or the structure of a certain compound, or a method of analysis for a particular constituent of the body, it usually means that somewhere along the line some piece of fundamental knowledge has been lacking. In order to obtain this knowledge, more fundamental research is absolutely necessary.

Now, then, what are some of these unsolved problems I am talking about? Well, let us consider a very important hormone which you have all heard about. I am thinking of insulin, the hormone which is essential for the utilization of sugar by the body, and which, as you know, is used medically in the control of diabetes. The chemist has done a creditable job of getting this hormone out in pure form and has contributed greatly to many aspects of the chemistry of this important compound; but chemists the world over for twenty years have tried to solve the riddle of insulin. Still we don't know why it possesses its remarkable physiological properties and how it brings about its miraculous effect.

We know that it is a protein, that is to say, that it is a very complex structure made up of many small building blocks, called the amino acids. But somehow the clue has eluded us as to how and why this substance can regulate the amount of sugar in the blood. Furthermore, it has defied synthesis! Why is this? Some will say, of course, that it is impossible to synthesize a protein and therefore it is impossible to synthesize insulin. Are we going to accept that? Of course not! But, if there is to be any hope of ever accomplishing the synthesis of insulin and of truly understanding its chemistry, we must start much further back, and must seek to understand more fully the fundamental chemistry of proteins. For this is the type of problem in which no one knows what the answer might be, nor from what direction the answer might come.

Just as insulin is elaborated by the pancreas to regulate sugar utilization in the body, a series of other proteins are elaborated by the pituitary gland to control various physiological mechanisms. For example, one of these proteins influences the mammary gland, another stimulates the thyroid, another affects the sex glands, and still another is vital for growth. These as well as other protein hormones all present problems similar to those mentioned in connection with insulin.

Akin in some respects to the problem of the chemistry of insulin and the other protein hormones is another problem, that is the chemistry of viruses, some of which have been shown to be a type of especially huge protein molecule. The solution of this problem is of particular importance to the advancement of medicine because viruses are causative agents of many diseases. Problems still more baffling than those posed by the protein hormones are here encountered. How does this particular type of protein multiply in the body? Furthermore, how can this multiplication be hindered? Perhaps in this way, some of the virus diseases might be counteracted. Even though brilliant contributions have already been made by virus chemists, many vitally important questions are yet to be answered.

There are still other proteins which possess remarkable properties the understanding of which is of importance to medicine. For instance, there is a protein of the blood which forms the blood clot, but just what change takes place in the protein during the formation of the clot, and exactly how the transformation takes place, remain to be worked out. There are other proteins in the blood likewise playing vital roles. It is the proteins of the blood, such as the albumin and globulin, that counteract the shock resulting from wounds. It is the need for these proteins that has made collection of human blood so important in the war effort. Other proteins in the blood, present in much smaller amounts, afford the body protection against many diseases such as measles and influenza. These are the so-called antibodies

1 Talk given during the intermission of the New York Philharmonic-Symphony United States Rubber broadcast on Sunday, February 25, 1945.

which confer on an individual immunity towards certain diseases. These intricate immunological processes abound in problems challenging the chemist and demand more fundamental knowledge of proteins. The same could well be said for enzyme chemistry, which involves an almost countless number of proteins which, at times in conjunction with the vitamins, possess remarkable catalytic powers.

Finally, I might point out that the whole process of the formation and breakdown of the host of proteins in the tissues within the body is still to be worked out. I need not point out that our skin and flesh and internal organs consist mainly of proteins, to have you realize how important protein chemistry becomes to the comprehension of the nature of the repair of tissues, of the healing of wounds, and of the many disease processes and even to the understanding of cancer.

I think that it is evident that more chemists—and even more highly trained chemists—will be needed in the years to come to carry on with these and other problems with their brother scientists in other fields, in order to afford the fundamental basis for still further advances in medicine and thus to help the doctor in his conquest of disease.

As we plan for the future, we must realize that it is easier to appreciate the need of scientific research directly connected with a practical application. It is harder to grasp the need of true fundamental, pioneering research. The type of research I mean is that required to solve that kind of problem of which we have been speaking, where no one knows what the answer may be or from what direction the answer may come.

In whatever planning and organization we may carry out in the postwar years, we must make very sure that we provide to scientists not only the facilities for fundamental research, but we must be very careful to preserve that type of environment which provides the complete freedom for the "playing" of his "hunches" and which allows him to travel without hindrance the pioneer trails that his curiosity beckons him to follow.

In thinking specifically of medicine, I might point out that medicine does need chemistry and chemists for the building of the medicine of to-morrow. The field of medicine to-day has assimilated the biochemistry and physiology of yesterday; and the biochemistry and physiology of to-day must be encouraged along fundamental lines to build the medicine of to-morrow. We can see in retrospect what chemistry has done for medicine, but it is so much harder for the human mind to grasp that the chemistry of to-day and to-morrow will likewise yield discoveries that will be of aid to the medicine of the future.

OBITUARY

LEON HATCHIG LEONIAN
1888–1945

AFTER an illness of sixteen months Dr. Leon H. Leonian, professor of mycology and mycologist in the Agricultural Experiment Station, West Virginia University, died on June 7 at the age of fifty-seven years. He remained active in his work until a month before his death.

He was born at Van, Armenia, on February 27, 1888, the son of Hatchig and Anna Leonian. He left Van after completing his secondary education, and after some journeys into Russia, Egypt and Greece, he came to the United States at the age of twenty. After several years in New York and Detroit he entered the University of Kentucky, from which school he received the B.S. degree in 1916. He then entered the University of Michigan for graduate training and received his M.S. degree in 1917. The following year he was assistant research horticulturist in the Experiment Station at Clemson College. He then went to New Mexico as assistant professor of botany and plant pathology in the New Mexico State College and Experiment Station. He later returned to the University of Michigan, where he studied mycology under Kaufmann; he received the Ph.D. degree in 1922. In that year he came to West Virginia University as assistant plant pathologist in the College of Agriculture and the Experiment Station. After various promotions he was made professor of mycology and mycologist of the station in 1936.

He established an international reputation in three distinct fields of science—plant diseases, the physiology of fungi and in plant breeding. The first phase of his life's work was devoted to the study and control of plant pathogens, particularly the downy mildew parasites, the Fusarium wilt and a wilt of peppers. As he studied the disease-causing organisms he was led gradually to the recognition of the mutability of fungi and to the influence of environment upon the life and character of microorganisms.

His well-known work on the taxonomy of the genus Phytophthora further increased his interest in physiological studies, and this second field of interest became so engrossing that it motivated his research program for the past fifteen years. Even as a graduate student he was primarily interested in understanding the conditions governing the life, growth and reproduction of microorganisms. During the last decade his