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## THE SEVENTH REMSEN LECTURE

May 23, 1952


Dr. Wm. Mansfield Clark

DeLamar Professor of
Physiological Chemistry
Johns Hopkins Medical School


The Remsen Memorial Lecture for this year will be held on Friday, May 23, at 8:15 P.M. in Remsen Hall on the Homewood Campus of The Johns Hopkins University, and is open to all who may be interested. A dinner in honor of Dr. Clark will be held at the Johns Hopkins Club before the meeting and is open to members of the section and their guests. Dinner reservations should be made on the enclosed card at an early date, since only the first fifty reservations can be accepted. Formal dress is optional.

Dr. Clark has chosen as his title "Some Reflections on the Coupling of Chemical Processes and the Biochemical Implications". He will discuss the organization of data on equilibrium states in contrast with what is commonly called "explanation" of the phenomena concerned, noting that there is some idealization in considering chemical processes as simple, separable and distinct. By adopting the concept of chemical potential as applied to protons and electrons, which are not themselves "free" in ordinary solutions, a consistent organization of data obtained with electric cells is obtainable but necessarily involves some approximations. A few data on organic redox systems will be presented to show the intimate relation between electron exchange and proton exchange as deduced from experiments with certain controlled conditions and to show the inseparable nature of these exchanges in reality.

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## CLARK THE SCIENTIST

Dr. Clark has been a Maryland resident for many years, so all of us are acquainted with some of his accomplishments. But for most Maryland chemists this knowledge is spotty and incomplete, so a resume of his activities will not be amiss.

Wm. Mansfield Clark is a native of New York state. A graduate of Williams College, he did his doctoral work at The Johns Hopkins University under Dr. Morse. Dr. Remsen was teaching in the department at that time, and Dr. Clark attended Professor Remsen's lectures in organic chemistry. Dr. Clark is the first Remsen Memorial Lecturer who studied under the great professor.

Upon completion of graduate training Dr. Clark went as chemist to the U. S. Department of Agriculture, then became professor of chemistry at the Hygienic Laboratory of the U. S. Public Health Service. These were the years when Dr. Clark devoted so much thought to the experimental determination of pH - the work which made him known as "pH Clark". In 1927 Dr. Clark was called to the Johns Hopkins Medical School as Director of the Department of Physiological Chemistry, and 1952 marks the twenty-fifth year of his association with the Medical School in this capacity.

Over the years Dr. Clark's research activities have centered in the field of physical biochemistry. His outstanding work here has led to many honors - the Nichols Medal, the Borden Award, honorary D.Sc. degrees from Williams College and the University of Pennsylvania. During World War II he was chairman of the Division of Chemistry and Chemical Technology of the National Research Council and Consultant to OSRD, and was awarded the President's Certificate of Merit for his war services. These services included extensive studies of the physiological mechanisms of toxic agents, malaria, and the survey of antimalarial drugs.

Dr. Clark has been an active member of the American Chemical Society and other professional organizations. He was Chairman of the Maryland Section in 1933 and a Councillor-at-large in 1941. He served as one of the Editors of the series of Monographs. The value placed upon Dr. Clark's contributions to bacteriology may be seen in his election as President of the Society of American Bacteriologists. He was elected to the same office by the American Society of Biological Chemists and served as an Editor of the Journal of Biological Chemistry for nearly twenty years.



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of the state of a system directed the approach. The new brilliant indicators selected and the buffer systems that were standardized provided a practical, simple method. The applications that followed are too many to recount here.

The experience accumulated in the field, especially by Dr. Clark and his associates, was made readily available in The Determination of Hydrogen Ions. Although statistics are lacking it may be asserted with confidence that no single recent work has been cited as frequently and widely in nearly every branch of chemistry and biology. In the thoughts of many "Clark" became almost synonymous with "pH".

Dr. Clark had meantime extended the scope of his investigations. Observations on the reduction of dyes and new studies of electrode potentials in bacterial cultures suggested an approach to oxidation and reduction. Methods were developed and applied, first to reversible oxidation-reduction indicators as models and tools, then to naturally occurring substances, and theoretical principles began to emerge. When Dr. Clark came to the Johns Hopkins Medical School the foundations had been laid for subsequent studies on systems of increasing complexity and for extensive applications in the developing field of biological energy metabolism.

Throughout the years, each new problem that Dr. Clark and his collaborators have worked upon has included new variables in addition to the old, has involved a more extensive and complex array of equilibria, and has required a more comprehensive formulation. The end is not yet in view. Without venturing to predict what the next variable will be, we wish Dr. Clark the pleasure of searching for it and the satisfaction of incorporating it into a still more inclusive continuum.

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Note: Dr. John Fuller Taylor did his doctoral research under Dr. Clark at The Johns Hopkins University. He is at present a member of the Department of Biological Chemistry of the Washington University School of Medicine in St. Louis.

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A set of parameters in addition to those involved in oxidation-reduction equilibria is involved when oxidized and reduced metalloporphyrins coordinate with certain Lewis bases. A few of many sets of data will be presented to show the intimate relation between proton and electron exchanges and the coordination phenomena involved in these systems. The systems are, from a purely physicochemical point of view, analogous to certain enzyme systems. Data on equilibrium states involving processes of the three types give a picture of chemical continuum. This is primitive when compared with that of the living cell where multiple components interacting in various ways do so harmoniously.

Dr. Clark will be introduced by his long time friend, Dr. A. Baird Hastings, Hamilton Kuhn Professor of Biological Chemistry at Harvard Medical School.

## WM. MANSFIELD CLARK - AN APPRECIATION

by

John Fuller Taylor

Professor Wm. Mansfield Clark is widely known for his distinguished scientific investigations. By those who have had the good fortune to work and study with him, he is held in highest esteem also for many other qualities. Those which have been admired and valued especially by his students can be traced to his experience and accomplishments in many fields of science throughout a life of vigorous activity. His attributes as an investigator, teacher, writer, golfer, counselor and friend may all be recognized as components of a "continuum" (to use his own word) which represents his complete life.

Dr. Clark has succeeded in imparting technical skill, knowledge, understanding and inspiration to his students partly by formal presentations in lectures and writings but much more by the subtle and often unsuspected influence of the example he has set. This influence has been enhanced by the favorable climate of his laboratory, where self discipline is the rule and patience and understanding spare the necessity of sterner measures.

His lectures have been models of organization, exposition and illustration, but their facts and principles often seem incidental to the contact which they establish with the achievements and perspective of the subject. Small wonder that a student should aspire to emulate such performance in his turn! Fortunately for students everywhere, a great deal of the material and still more of the spirit of these discourses has been captured and recorded in Dr. Clark's remarkable book, Topics in Physical Chemistry.

In the laboratory Dr. Clark's example and performance have been a constant challenge to students. Whether the problem involved preparation of new compounds, construction of apparatus designed to be just right for a purpose, calibration, testing for hidden errors or carrying out precise measurements, his first aim was to have us develop our own skills. If we faltered, he would come to our aid. The laboratory abounded with examples of his dexterity and ingenuity.

When we were tempted to speculate without evidence he demanded "experimental results, experimental results, EXPERIMENTAL RESULTS". When we were tempted to survey our results with pride, he spurred us on to develop the mathematical analysis which the situation demanded and led us to uncover the hidden implications to be explored by a return to experiment. When we came at last to write, we found again how much we could learn from him as editor and author.

The roots of Dr. Clark's training lay deep in the classical tradition of physical chemistry at Johns Hopkins. Studies in osmotic pressure, made with H. N. Morse, had demanded skill and precision in experiment and thinking. In the Department of Agriculture, extension of his experience to biological systems suggested the use of the principles and methods of physical chemistry in study and control of complex phenomena and solution of practical problems. The importance of pH as one index (to page 3