Professor Walter Nernst

On June 25, Professor Walter Nernst attains the seventy-fifth year of his life. The news will be a source of pleasure and satisfaction to his numerous pupils all over the world, and will be welcome to every body interested in science. There is hardly any scientist in this country who will not desire to join with his brother-scientists in Germany and other countries in offering Professor Nernst his warmest congratulations and in wishing him many more years of happy and active life.

It will be appropriate to the occasion to recall here some of the fundamental contributions of Prof. Nernst to Thermodynamics and Physical Chemistry. These contributions and discoveries now form an essential part of the frame-work of Physical Science and are well known to every student of Physics and Chemistry. The new "Heat Theorem" also called the third law of Thermodynamics or the principle of the Unattainability of the Absolute Zero, was first put forward in a paper published in January 1906 in the *Nachrichte der Gesellschaft der Wissenschaften Zu Gottingen.* It solved a problem which the first and second laws of Thermodynamics alone were unable to solve, namely, the calculation of Maximum work or free energy (A) from purely thermal data. The agreement between the values of A calculated on the basis of this theorem and the values obtained directly from measurements of vapour pressure, solubility or electromotive force, as also the calculations of transition points from the condition $A = 0$, provided sufficient justification for the assumptions underlying the new theorem. A direct evidence was also available in the experimental confirmation of the idea developed by Prof. Nernst in the paper referred to above, that the specific heats of all solid substances without exception assume negligibly small values at very low temperatures. The new theorem was, at first, applied to condensed system, *i.e.,* systems in which only liquids or solid substances are present. But it was later on found possible to extend it to gaseous systems also. The great utility of the extension of the theorem in this direction lies in the fact that it enables us to predict the position of equilibrium of a reaction that has never been studied experimentally. The new theorem required, for its test and application, reliable thermal data. This led Prof. Nernst to perfect methods for the determination of specific heats at low temperatures, in collaboration with Koref, Lindemann, Eucken, Pollitzer and Schwers. The result was the development of the vacuum calorimeter which has been successfully employed to obtain reliable data for the specific heats of solids and gases at very low temperatures. Incidentally, these experimental investigations yielded valuable information on the question of the general technique of low temperature work. The measurements of specific heats at low temperatures not only furnished reliable data for testing the validity of the new theorem, but also provided a foundation for the elucidation of Dulong and Petit's law and further theoretical advances in the theory of the solid state which have found expression in Debye's T^3-law.


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Investigations of gaseous equilibria at high temperatures by Prof. Nernst and his pupils and co-workers led to the improvement of old experimental methods and the perfection of new ones. Mention may here be made of the explosion method, in which high temperatures up to 3000° and even more are obtained by the explosion of a gaseous mixture in a closed bomb, the thermal conductivity method, the method of the semi-permeable wall in which platinum or iridium bulbs are employed, the method of the heated catalyst in which equilibrium is quickly attained by introducing a heated catalyst such as a platinum wire into the mixture, and the method of vapour density determinations at temperatures exceeding 2000°, in which small iridium bulbs are used. While speaking of equilibrium, one is at once reminded of Nernst's partition-law. The distribution of a solute between two liquid phases had been previously studied experimentally by Berthelot and Jungfleisch, but a thorough examination of the problem both from the theoretical and experimental aspect, was first undertaken by Prof. Nernst in 1891. Reference may also be made to his contribution to the subject of photo-chemistry. Every student of chemistry is familiar with his 'atom-chain reaction' theory which explains in a most satisfactory manner the high quantum efficiency of the reaction between hydrogen and chlorine under the influence of light.

The contributions of Prof. Nernst to the theory of solution are no less important and fundamental in character. In 1889, he put forward the theory of galvanic cells which explained the origin of electromotive force in terms of an "electrolytic solution pressure" of the metal electrodes and by a beautiful combination of kinetic considerations with thermodynamic reasoning derived an expression for the electrode potential, which is quite exact when the activity of the ion concerned can be set equal to its concentration. Other important work in this field includes investigations on diffusion in solutions, liquid contact potentials, solubility product relations and transport of water by ions.

The literary genius of Prof. Nernst has found expression in a number of writings, remarkable for their clear exposition of the subject and lucidity of style. His well-known text-book on "Theoretical Chemistry from the Standpoint of Avogadro's Rule and Thermodynamics" which was first published in 1893 and which has since appeared in a number of German and English editions, gives a masterly survey of the subject and remains indispensable to all students of chemistry. "The New Heat Theorem: its Foundation in Theory and Experiment" gives an authoritative, exhaustive and clear account of the theoretical and experimental investigations of the author and his co-workers on the subject. No serious student of physics and physical chemistry can do without this book. His "Experimental and Theoretical Applications of Thermodynamics to Chemistry" has appeared in a number of German and English editions. Besides, he has edited the *Zeitschrift fur Electrochemie*, the *Jahrbuch der Electrochemie*, and the *Zeitschrift fur Angewandte Chemie*.

It has not fallen to the lot of many to achieve what Prof. Nernst has been able to achieve in the field of Scientific Inquiry. His work which covers a wide field in physical science and extends over a period of nearly half a century, has already secured for him a high place among the scientists of all times. Let us hope and pray that he may live long to watch the results of his labours and make further valuable additions to the sum-total of human knowledge.

M. QURESHI.