

J. N. BRØNSTED MEMORIAL ISSUE

A Great Physical Chemist

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What makes a man a great scientist? Deep and searching interest in his problems. Faith in the importance of scientific research. Keen critical sense which enables him to distinguish the relevant from the irrelevant, avoiding at the same time prostration which searching criticism easily produces. To these indispensable qualities many more can be added as that of hard and systematic work. The late Johannes Nicolaus Brønsted had about all these qualities. His life was mainly spent in pursuing problems of physical chemistry, a science which he never ceased to consider just as important as beautiful. He mastered both lines of attack of physico-chemical research, the thermodynamic and the kinetic one.

Some of his most important work deals with the kinetics of reactions in electrolyte solutions on which our present understanding of kinetic salt effects largely rests. It was this work which led his attention to acids and bases and to the idea of general acid-base catalysis. But deep in his heart he was a thermodynamician. He used to say that kinetics is a difficult science which should preferably be left to the physicist, the chemist better restricting himself to the thermodynamical approach of his problems.

He started his career in the first years of this century by contributing to the theory and measurement of affinity changes, and it was the third of this series, written with remarkable lucidity and dealing with binary mixtures, which was presented for his doctor's degree in 1908. Much of his work on affinity had dealt with electrolyte solutions, and in the period 1918—24 these became his chief interest. His work led him to the establishment of several equally simple and important laws. In the thirtieth he was simultaneously engaged in studies on reaction kinetics, especially in non-aqueous solvents, and in the investigation of the effect of molecular size on the thermodynamic properties of hydrocarbons, polymers, and colloids.

In the last phase of his life his interest was focussed more and more on the fundamental basis and formulation of the laws of thermodynamics. He pursued his task, to which he attached the greatest importance, with great zeal and enthusiasm.

Scientific investigation can be pursued on more deductive lines, on the Newtonian pattern, following up a line of thought; it may be followed on more inductive lines as well, starting from a fortuitous observation as that of Becquerel on the photographic action of uranium rays, or that of Hess, observing an increased ionization in the upper layers of the atmosphere. Brønsted's sympathies and admiration were decidedly with the first mentioned type of scientific work. This is demonstrated among others by the following episode.

The writer of these lines had the privilege of associating with Brønsted in investigations on the separation of the isotopes of chlorine. Large volumes of highly concentrated hydrochloric acid were distilled at low temperature and very low pressure. Density measurements revealed that an appreciable separation of the chlorine isotope was obtained. At that time we discussed how far it is worth while to compare the density of the water samples obtained in the separation process as well. As, shortly before, two eminent German scientists, Otto Stern and Vollmer, had carried out a very detailed investigation of the diffusion of water vapour through porous membranes in search for then not yet discovered isotopes of hydrogen and oxygen, and this investigation led to an entirely negative result, we thought it was hopeless to look for such isotopes in our water samples which, as we know now, must have had densities deviating very appreciably from that of normal water. When, many years later, this episode was recalled, Brønsted remarked that a discovery like that of deuterium has to be made by following up a certain line of reasoning, as was Urey's procedure, and not accidentally.

In the course of four decades during which Brønsted directed the laboratory of physical chemistry at the Technical University of Copenhagen, a great number of research students clustered around him. As one of his most eminent pupils, R. P. Bell, mentioned very appropriately in his obituary notice, Brønsted did not suffer fools gladly among his research students, but, we may add, he offered unlimited inspiration to able and striving men, he offered them friendship as well which lasted for life-time.

A group of chemists coming from U. S. A. and working in the very modest premises then at the disposal of Brønsted in the building of the old Technical University have drawn the attention of Dr. Price, minister of the United States in Copenhagen, to the unsatisfactory housing of the physical chemistry institute. Dr. Price, a former University teacher, reported to New York and, as a result of his report, the Rockefeller Foundation decided to erect and

equip a modern institute for Brønsted. He proved to be an excellent architect, building and equipping a laboratory on as practical as esthetic lines. He was, besides being a chemist, an artist and he understood to combine practical requirements with those of esthetics when constructing a huge number of mostly novel apparatus which could not help impressing visitors of the physical chemistry institute.

Besides being a painter he took a keen interest in other branches of art and in literature as well. He was a great admirer of nature, and especially of birds, visiting in the company of his beloved wife each year another district of his native country, discovering new beautiful spots and new specimens of birds.

Death came to him with merciful suddenness, removing from our midst a great personality and a great chemist who contributed to a remarkable extent to the development of the chemical sciences.