

THE CHEMICAL BOND

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The historical development of the concept of the chemical bond and the physical understanding of chemical bonding is not only a fascinating chapter of chemistry as a scientific discipline. It also reflects human attempts to understand the material world and the process of conquering and changing matter at one's own discretion. It was not until 1927 that physical laws were available, which provided a basis for an understanding of the nature of the chemical bond in terms of fundamental physical forces. But even before this time heuristic bonding models had been proposed which had proved very useful as ordering principles and guidance for new experiments. The remarkable success of these models contributed to the booming development of the chemical industry as a very important part of wealth and economy. Chemistry can be seen as an example of significant progress being made in a scientific discipline without its fundamental basis being known.

The physical understanding of chemical bonding, introduced in 1927, was based on the newly developed quantum theory of Werner Heisenberg and Erwin Schrödinger. Following their work, Walter Heitler and Fritz London applied quantum theory to the nature of the chemical bond. They showed for the first time that the strong interatomic interactions leading to a chemical bond can be explained by fundamental physical laws. But the complicated mathematical formulation, which appeared intractable at a time when computers were not available, and the enormous difficulties in grasping the meaning of a quantum theoretical description of chemical bonding with a model accessible to the human mind were great obstacles to make quantum chemistry a valuable discipline competing with experiment.

In my lecture I will outline the historical development of the concept of the chemical bond and the physical understanding of chemical bonding, which is an ongoing topic of controversial – and thus fruitful – discussion.