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Physical Methods in Chemistry: NMR and Mass Spectrometry, 1950-1980

In mid-twentieth century, chemists took up novel kinds of instrumentation that had originated in physics and high-technology. Chemists integrated nuclear magnetic resonance spectroscopy (NMR), mass spectrometry, infrared and ultraviolet spectroscopy--to name only the most important techniques--in their research projects, and directed their research programs according to the opportunities and needs afforded by their instruments. Some scientists concentrated on the development of problem-solving, instrument-based methods for use in research fields they knew well. In doing so, they merged the objects of chemical inquiry--molecular structures and dynamics--with high-technological instruments. In this process, chemical substances became inextricably intertwined with physical apparatus, at the hardware level as well as in theoretical concepts. The transfer of instrumentation from physics to chemistry involved processes of adaptation and transformation. Moreover, it led to the emergence of a new type of scientists, specializing in the development of methods for use by other scientists. The disciplinary origins of such method makers were mainly in chemistry, with a focus on intermediary fields, e.g. chemical physics, physical organic chemistry, and analytical chemistry. In many instances, the impact of chemical theories, concepts, and research modes was imperative for the success of physical instruments in chemistry. As a result, this science was not reduced to physics by the acceptance of physical methods and instruments, but kept being an autonomous field of scientific inquiry.

In introducing physical methods in chemical research and routine analysis, the chemical sciences and technologies underwent a major transformation. Prior to

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World War II, chemists determined the constitution of an unknown substance through its chemical reactions with known compounds. By the 1970s, chemists commonly obtained their results using a variety of instruments that allowed the analysis of chemical substances in terms of their physical properties. This shift from chemical separation and analysis to physical identification and elucidation altered the research practices of chemists in all fields, changed the curriculum of chemistry as a discipline, and gave further impetus to the industry of instrument makers. It greatly expanded the scale and scope of chemistry: Physical instruments enabled the search for extraterrestrial life as well as tremendously improving the ability to search for minuscule traces of substances on earth. Moreover, instrumentation affected the social context of chemistry, though the introduction of technical apparatus did not lead to a complete changeover to Big Science. In many ways, the dominance of Big Science in physics, especially as the public perceived it, served both as model and as counterpart for chemistry. High-technology instrumentation became a characteristic feature of this science.