Timothy Lenoir

Theorie und Experiment; Über Helmholtz

Timothy Lenoir, geboren 1948 in den USA, studierte Wissenschaftsgeschichte und -philosophie an der Indiana University. Lehrtätigkeit an den Universitäten von Notre Dame, Arizona, Pennsylvania und der Hebrew University, wo er Direktor des Edelstein Center war. Gegenwärtig ist er Associate Professor am Department of History, Program in the History of Science, an der Stanford University. Hauptforschungsgebiet: Geschichte der Life Sciences in Deutschland im 19. und Anfang des 20. Jahrhunderts. Adresse: Department of History, Program in the History of Science, Stanford University, Building 200-033, Stanford, CA 94305, USA.

Thanks to the generous support of the Wissenschaftskolleg during 1987-88, I was able to complete two projects and make excellent progress toward completion of a third, major book project.

My first project was the completion of an edited volume consisting of nine papers on the relationship between theory and experiment in the development of science, entitled *Practice, Context, and the Dialogue between Theory and Experiment.* My introductory essay to the volume discusses recent work in the history and philosophy of science critical of the traditional account of science in which theory dominates. I examine the critical role of different types of practice — experimental, instrumental, and social practices — required to develop, articulate, and refine theory. The aim of the essay is to discuss the central assumptions behind the attempt to construct a contextualized approach to the production of scientific knowledge in which communities of investigators operate according to guidelines of practical reason rather than deductive logic. The essays in the volume are all case studies representing a spectrum of approaches to the problem of relating the construction of knowledge to its context. The volume will be published this fall (1988) by Cambridge University Press, as volume 2 in their series, *Science in Context.*

Central to an appreciation of practice in the production of knowledge is a critical rethinking of the relationships between "pure" and "applied" science; in fact a rejection of the dichotomy. The second project I under-

took during the year explored the relationship between academic science and industry at the turn of the twentieth century in Germany in an effort to determine whether an approach emphasizing a symbiotic rather than dichotomous relationship between knowledge and application might not be more fruitful. The growth of research in institutional settings outside the universities in several "research for profit" institutes in Germany at the turn of the twentieth century provided rich material for critically examining a central assumption in most discussions concerning the growth of scientific knowledge, an assumption reflected today, for instance, in many public forums on current problems confronting the funding of science; namely the need to preserve the autonomy of scientific inquiry. At the turn of the century in Germany the growth of scientific knowledge demanded facilities and an interdisciplinary form of cooperation on a scale impossible to achieve within the established institutional framework of academic science. In a number of fields this impasse was overcome through the construction of independent research institutes financed by private and public funds for the support of "basic research" of potential importance for both state and industry.

An exploratory article entitled "A Magic Bullet: Research for Profit and the Growth of Knowledge in Germany circa 1900", which appeared in the Spring, 1988 issue of *Minerva,* layed the groundwork for a study I plan to continue in the future. In the article, I show that due to the rapid increase in skill requirements for doing advanced work in immunology in the period between 1890 and 1905, a differentiation of research tasks and a tendency toward teamwork evolved in these early institutes, beginning with Koch's Institute. My suspicion is that these tendencies were further strengthened due to the intense international competition between similarly oriented institutes in France, England, and Germany in the field of tropical medicine around 1900. It was under these conditions that Paul Ehrlich was led to formalize these new organizational structures in order to regularize teamwork in his laboratory. The initial results of this new organizational style were more than promising in that they opened the way to a new generation of drug therapies, the most famous of which was Salvarsan, the first cure for syphilis.

The cooperative arrangement between academic science and industry and the stimulating effect of interdisciplinary teamwork on the growth of science in evidence at the Georg-Speyer Haus was capable of emulation in other fields. At a time when German science was generally felt to be stagnating, the Georg-Speyer Haus provided an organizational model for overcoming certain structural problems inhibiting the growth of knowledge in German universities. Specifically I argue that the plan for constructing the Kaiser-Wilhelm-Institutes, which was the culmination of

the movement to establish tighter linkages between academic science, industry, and the state in Imperial Germany, was deeply influenced by the Georg-Speyer Haus.

My main efforts during 1987/88 were devoted to the writing of a monograph on the work of Hermann Helmholtz in neurophysiology, physiological optics, and the relationship of these researches to the development of his views on epistemology. The study is focussed on Helmholtz's rejection of the nativist thesis in physiological optics, the most salient version of which had been defended by Helmholtz' teacher, the physiologist Johannes Müller. According to the version of the nativist thesis Helmholtz rejected, the fundamental aspects of visual experience, such as the three-dimensionality of space, are given in an immediate spatial intuition. In a research program extending over a decade and a half, involving extensive experimentation, the construction of a new generation of instrumentation, and the synthesis of the most advanced mathematics and physical theory of the day, Helmholtz fashioned a coherent empiricist theory of vision. According to Helmholtz's theory space is empirically constructed from physiological inputs, previous experience, and psychologically formed "hypotheses".

My study situates the formation of Helmholtz's views on these matters within the context of the political and ideological crisis in Germany after the failed revolutions of 1848. At the heart of the crisis was a deep-felt and much-discussed need on the part of intellectuals — expressed, for example, in popular journal literature as well as in philosophical treatises – for laying new foundations for the construction of knowledge. The conviction became widespread that it was imperative to reject all shades of idealism and to place one's energies instead in the practical problems of improving the economy by setting a resolute course toward industrialization, of improving the railroads, laying telegraphs, in short, embarking upon what was described in the literature as "the politics of material interests". The solution to the political problems of unifying Germany, the problem that had motivated the previous generation, would find its own solution through first solving these problems of the real world. What was required to press ahead with this project was a new vision, a new way of seeing things.

My claim is not that Helmholtz's work in physiological optics was motivated by the goal of finding a solution to these larger ideological and political concerns. Nor do I claim that Helmholtz looked to politics or other societal concerns in order to find a solution to the problems of physiological optics. Rather through analysis of the different layers of context in which Helmholtz's work was embedded — the struggle for recognition he waged at home with his father, in his professional struggles to gain a posi-

tion in the severely restricted and competitive academic market of the late 1840s and early 1850s, and in the struggle for the recognition of the new approach to problems of physics and physiology he was taking in works such as his treatise on the conservation of force *(Erhaltung der Kraft) — I* show that Helmholtz and his friends, Emil du Bois-Reymond and Werner Siemens, found themselves forced to take a stand on the questions of knowledge which others in their generation were confronting. Helmholtz's work on physiological optics, in particular, articulated a theory of vision, a constructive way of seeing things which articulated the epistemological underpinnings for the views of the progressive elements of his generation. This rich context helped to articulate the structure of the problems that Helmholtz attacked, to bring the edges and contours of the problems of vision sharply into focus, and assisted him in marshalling the various tools which he assembled into a powerful new science and epistemology. Through popular lectures in which he evaluated the work of Kant and Goethe — who along with Frederick the Great, were the main symbols of culture in the period — in light of the science he and his friends were creating, Helmholtz actively engaged in the public struggle over the definition of culture, the role of natural science in that culture, and the position of the practical man in the new German state.

This monograph, provisionally titled *The Eye as Measuring Device: The Nativist-Empiricist Controversy and the Politics of Material Interests in Germany. 1848-1871,* is likely to be completed by September 1988.