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Hermann von Helmholtz's Mechanism: The Loss of Certainty

A Study on the Transition from Classical to Modern Philosophy of Nature

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Preface to the English Edition

Focusing on Hermann von Helmholtz, this study addresses one of the nineteenth century's most important German natural scientists. Among his most well-known contributions to science are the invention of the ophthalmoscope and groundbreaking work towards formulating the law of the conservation of energy. The volume of his work, reaching from medicine to physiology to physics and epistemology, his impact on the development of the sciences far beyond German borders, and the contribution he made to the organization and popularization of research, all established Helmholtz's prominence both in the academic world and in public cultural life.

Helmholtz was also one of the last representatives of a conception of nature that strove to reduce all phenomena to matter in motion. In reaction to the increasingly insurmountable difficulties that program had in fulfilling its own standards for scientific explanation, he developed elements of a modern understanding of science that have remained of fundamental importance to this day.

This book is a translation of an abridged version of my German monograph *Wahrheitsgewissheitsverlust. Hermann von Helmholtz' Mechanismus im Anbruch der Moderne. Eine Studie zum Übergang von klassischer zu moderner Naturphilosophie.* Some passages and notes have been omitted to produce a condensed text. Bibliographical sources have been updated, English editions of Helmholtz's and other works added to the list. References to Helmholtz's works are page numbers in German editions. Lengthy, indented quotations have been taken from available translations whenever possible. The second page number refers to the corresponding English title listed along with the German title in the bibliography. Some of the English renderings have been tacitly improved.

I am grateful to Jed Z. Buchwald for including *Hermann von Helmholtz's Mechanism: The Loss of Certainty* in the Archimedes Series, to Springer's publishing manager Charles Erkelens for supervising the completion process, and to Cynthia Klohr for the translation. I also thank Felix Bräuer, Philip Flock, Uwe Schürmann, and Mirca Szigat for carefully organizing the footnotes and compiling the bibliography and the index.

Wuppertal
September 2008

Gregor Schiemann

Preface to the German Edition

Throughout the past two centuries, natural science has definitely contributed to revolutionizing social structures. Scientific findings exert sustained influence on people's minds. But in apparent antithesis to this enormous growth in significance, all the while the first signs were emerging, indicating that for various reasons, scientific knowledge was in the process of losing validity and heading ultimately towards progressive hypothesizing. Around the 1850s, as results from experimental research first came to be applied to large-scale industrial manufacturing and also accessible to a wider public, there seemed little reason to doubt that mankind could, basically, "comprehend the world entirely" (Hermann von Helmholtz). In subsequent decades, however, this changed fundamentally. Natural science's claim to knowledge underwent a crisis that peaked in early twentieth century physics. Today, striving for comprehensive and exclusively valid knowledge of nature has lost the esteem it once enjoyed. Today, such efforts represent merely one group of approaches within a complex spectrum of ways to establish theories in natural science.

The object of this book is to explore and understand features of the prehistory and formative phase of that transition, using Hermann von Helmholtz's doctrine of mechanism as an example. It focuses on claims to validity – some of which still seem familiar and others, which in many instances have meanwhile become obsolete. Historically, doubt about the scientific comprehensibility of the world, something that first prevailed in the twentieth century, can be traced well back into the past. Compared to an insight iterated since antiquity, namely that human knowledge is both limited in scope and essentially fallible, the pathos for science's claim to truth as proclaimed by nineteenth-century scientists seems difficult to follow. In fact, looking back, one might be inclined to presume that these scientists entertained motives other than an unselfish love of truth. But even if they perhaps primarily sought fame, social recognition, secure careers, or research funding, they probably could have discovered no better way to legitimate such goals than by announcing the pursuit of absolutely valid knowledge of nature – which itself is a prerequisite for its unrestricted utility.

The changes that the concept of science has undergone since the nineteenth century call for a very conscious effort to understand the previous self-image so widespread in natural research. Immersion in the historical material gives us a sense

of how earnestly these scientists sought the truth, how little they questioned the notion itself and how bitter the gradual revelation must have been, that the goal they pursued might, in principle, perhaps not be attainable at all. In terms of claims to validity, historical reflection reveals the remoteness of a past that in other respects still seems immediately tied to the present.

Remoteness and proximity characterize my study of a contradictory chapter in the history of science. This work originated at the Institute of Philosophy at the Technical University of Darmstadt (Germany), funded by a doctoral grant from the *Studienstiftung des Deutschen Volkes*, for which I am grateful. I especially thank Gernot Böhme for supervising my work, supporting it wholeheartedly from the start and exercising an untiring willingness to discuss it. Reading work by Alwin Diemer and Gert König initially stimulated my interest in elaborating the basic idea of the changes the concept of science underwent during the nineteenth century. König was the first to examine the process of change reflected in Helmholtz's notion of science. I presented my theses in Gernot Böhme's postgraduate colloquium and discussed them there with other doctoral candidates. I also encountered critical debate at the International Helmholtz Congress at Ringberg Castle and in lectures at the Faculty for Philosophy at the Ruhr University in Bochum and the Institute for the History of Sciences at the Georg-August University in Göttingen. Timothy Lenoir, Jed Z. Buchwald, David Cahan, Helmut Pulte and Michael Heidelberger discussed separate aspects of my work with me in great detail. I thank them all for their suggestions and encouragement and also thank Sidonia Blättler and Helmut Pulte for carefully reading the manuscript and proposing numerous improvements.

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Introduction

Searching for truth is still exciting in contrast to drab and dreary error; but the excitement is dwindling
(Friedrich Nietzsche, *Human, All Too Human*).

What is science? Today more substantiated, diverse answers to this question present themselves than ever before in the history of European culture and ideas. On the one hand, lingering, yet lively traditions in logical empiricism and critical rationalism still fundamentally and methodologically discern scientific knowledge from other, namely, aesthetic, kinds of knowledge. On the other hand we find equally convincing arguments, as propounded by Paul Feyerabend and Richard Rorty that no grounds can be found for distinguishing various kinds of knowledge from one another.[1] While some would characterize modern empirical science as simply a technically organized, basically inhumane mastery of nature, others have equally strong reasons for thinking that scientific knowledge is precisely what we need for dealing with nature rationally.[2] While some criteria for science are linked to universality, some notably sociological approaches reject all uniform concepts of science altogether and define science by a plurality of contingent, merely locally valid conditions.[3]

This confounding diversity of debatable definitions in the theory of science stands in notable contrast to the unanimity with which, in the theory of science, doubt about science's increasing cultural and social relevance is practically nonexistent. While science's growing significance remains uncontroversial, the sciences themselves, as a topic of reflection, continue to unravel into coexisting, partly diverging, partly converging concepts.

[1] Exemplary for one side are **Popper** (1935), **Carnap** (1936f.) and **Stegmüller** (1973ff.), Vol. II, Ch. IX; for the other see **Feyerabend** (1976) and **Rorty** (1991).

[2] Divergent positions have been taken on the scientific and technological command of nature. **Horkheimer** (1947) and **Heidegger** (1955) set the direction for the debate. Contemporary authors arguing that a rational relationship to nature will be judged by how science deals with ecological problems, are, among others, **Schäfer** (1993) and **Mittelstraß** (1992).

[3] **Popper** (1935), **Carnap** (1936f.), **Stegmüller** (1973ff.), **Horkheimer** (1947) and **Heidegger** (1955) can be contrasted with **Knorr Cetina's** (1984) sociological approach in the theory of science.

G. Schiemann, *Hermann von Helmholtz's Mechanism: The Loss of Certainty*,