

# Lectures on the History of Physics

**Author:** Eugene Guth

## 1. Introduction

As a start, I would like to point out to you a few things which might explain my interest in history and philosophy in general. You have all heard the slogan “Two Cultures,” the contrast and conflict between sciences on one hand and art on the other. However, in Hungary, where I come from, there was only “One Culture.” The Hungarian word for science is “tudomány.” It corresponds to the word “Wissenschaft” in German. These expressions designate one, all-embracing science, including everything from mathematics to music. The Hungarian Academy of Sciences has, at present, eight sections: languages, literary sciences, social and historical sciences, mathematics and physics, agricultural sciences, technical sciences, chemistry and biology, and a section on musical folklore under the well-known composer Zoltán Kodály, who recently visited this country and taught in a music summer school at Dartmouth College. Incidentally, we have also in our country at least one institution, the American Academy of Arts and Science, which emphasizes the union, rather than the contrast, between Arts and Science. However, as you know, this is an exception. Our National Academy of Science is concerned only with science, but not with the arts.

My interest in philosophy of science was kindled by Poincaré’s books. It was reinforced by the requirement for the Ph.D. degree in Vienna, which included philosophy. My finals consisted of two one-hour exams in physics, which was my major, a single one-hour exam in mathematics, my minor, and two one-hour exams in philosophy. These requirements forced one to study philosophy and to consider science in general, physical and mathematics in particular, in a more general context.

I managed somehow to take both one-hour exams in philosophy of science, since I had a sort of allergy to some parts of traditional philosophy. Fortunately, a friend of mine, Herbert Feigl, who is now a distinguished philosopher of science himself (Professor of Philosophy and Director of the Minnesota Center for Philosophy of Science at the University of Minnesota) tutored me. This way I did not have to read voluminous books on traditional philosophy.

One of the philosophers who examined me was M. Schlick. He was the founder of the “Vienna Circle” of logical positivists, also called logical empiricists. This direction goes back to Hume, Comte, and Mach. The circle had weekly sessions on philosophy of science, which were very interesting, but sometimes quite baffling, to me then. For example, there was a discussion about a book by Herman Weyl, “Was ist Materie” (What is Matter). There was an expression “es gibt” (there is). I remember a spirited discussion about the possible meaning of that expression. Being a young student of science, I did not at that time appreciate the significance of such semantic discussions. Later on, I realized that the precise meaning of statements in philosophy can be very important. Still, I

always remembered a saying by Goethe in "Faust": "Wo die Begriffe fehlen, stellt ein Wort zur rechten Zeit sich ein" (When the concepts are missing, a word shows up). Clearly, a new word is no substitute for a new concept!

## **2. History of General History**

After this bit of autobiographical introduction, I would like to discuss very briefly and in big historical jumps the "History of History" and the "History of History of Science."

History may be defined as a methodical reconstruction of the past of mankind. From Herodotos to Thucydides, from Livius to Tacitus, there was a gradually increasing sophistication leading away from the naive, purely narrative type of history. However, even with some sophistication, history was only an uncritical description of separated human events (like battles) and actions (by kings or other leaders).

General history, taking account of the dynamic forces emanating from the structure of a society, started only in the eighteenth century and actually developed only in the nineteenth century. Voltaire's "Siècle de Louis XIV" was, perhaps, the earliest general or cultural history. Gibbon, at least in some parts of his work, was another early bird. Sismondi, Thierry, and Michelet emphasized the role of communes and the rise of the "Third Estate" in medieval history. The British "Whig" historians, Hallam, Grote, and Macauley considered history as a successive unfolding of political liberty. Carlyle vainly tried to turn the clock back with his hero worship, as exemplified in his "History of the French Revolution."

Influenced by the philosophers, Comte and Spencer, Taine and Buckle were, perhaps, the first cultural historians. They emphasize social factors, ideas, and ideologies. Hegel and Marx catalyzed the dialectic materialism style of history, with all its excesses. However, they rightly emphasized that in an age of quickly changing social and industrial development in particular, and even more generally, the sociological and industrial factors played very important roles in all human endeavors. Lecky, following Buckle, emphasized (in his "History of the Rise and Influence of Rationalism in Europe" and in his "History of European Morals from Augustus to Charlemagne") the "practical, active, and social sides of history, in contrast to the "intellectual and speculative" side, as exemplified by Leslie Stephens' "English Thought in the Eighteenth Century." Of course, all these aspects of history are complementary and should enter together into a really general history.

Grand synthesis in history cannot be practiced without analytic specialization. As a matter of fact, analytic specialization is a pre-condition for a successful cultural synthesis. The great attention to innumerable details, documented by a large number of footnotes, was the style set by Ranke and, perhaps to a lesser extent, also by Mommsen, who for his monumental "History of the Roman Empire" received the literary Nobel prize. Detailed treatments of shorter epochs on history have been previously pioneered by Voltaire and Gibbon and developed by Macauley (famous third chapter of "History of England"), Taine ("Ancien Regime"), de Coulange ("La Cité Antique"), Dill ("Roman Society from

Nero to Marcus Aurelius”), although these cannot compete with Ranke in the number of footnotes!

Of course, a detailed study of any aspects in history is justified only if it can be used in the grand synthesis. Details which cannot be woven into the canvas of general history are clearly not significant. In other words, the details of any specialized historical study must be “embeddable” in the whole picture one attempts to paint, like a piece of mosaic is “embeddable” in the whole.

This “principle of embedding” is valid for any human endeavor and activity. Any human activity is the more important the more it interacts with and is related to other human activities. The abstract form of this principle goes back, perhaps, to Protagoras of Abdera, one of the first relativists. More concretely and recently, it has been applied by Felix Klein, David Hilbert, and John von Neumann to a relative valuation of different branches of mathematics and very recently by Alvin M. Weinberg to a relative valuation of different sciences.

The grand synthesis can be characterized also, again as all human endeavor, and more generally as all the nature around us, as a result of an evolution. This view is, of course, only valid if one “averages” over a longer time period. Over a short period, evolution looks more like the envelope or average of revolutions.