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Book Review

John L. Rudolph
How We Teach Science: What's Changed, and Why It Matters

Cambridge, MA: Harvard University Press
2019, 308 pp.

The introduction and further evolution of high school science in the United States from the latter half of the nineteenth century to present day shows many similarities with developments elsewhere in Western society. This is the result of a long and reciprocal exchange where not only curricular traditions and concepts have travelled across national borders but also ideals of scientific research. In the beginning of that period—when physics, chemistry and botany were beginning to challenge the position of the classical school subjects and gain entrance to "the magic circle of the liberal arts"—the influx of ideas came to the United States from Britain and Germany. As the century turned the transfer would eventually go in the opposite direction. Examples of that development are the advent of large curriculum projects after World War 2 or the recurrent demands on science teaching to solve upcoming shortages of researchers and engineers. Other features that have become common in most parts of the world—but not least Europe—are the phrase "scientific literacy" and the emphasis on extracurricular activities given at places such as science centres. Together they all bear witness of the American impact on post-war school science. John Rudolph's book *How We Teach Science: What's Changed, and Why It Matters*, which examines the different and competing descriptions of method in American high school science from the second half of the nineteenth century to today, is therefore highly relevant to understand how this phenomenon has developed in the Nordic countries. From a wider perspective it can also be consulted to better understand changes in Western education and the cultural history of science during the twentieth century.

Rudolph is a professor at the Department of Curriculum and Instruction at the University of Wisconsin-Madison and has written extensively on the history of science education in American high schools for more than two decades. His book is an engaging study that comprises much of his earlier works but also contains new research and more elaborated analyses. The questions he asks are: In what different ways have reformers, educators and scientists during the last 150 years portrayed the method of science and the process of knowledge construction in the curricular content of biology, physics and chemistry? What's changed? And why does it matter? Rudolph answers the last question by stating that schools are the most important and all-encompassing environments that convey images of scientific work to every member of society. Understanding the changing ways of teaching method in science is therefore a key to better explain "how they function in mediating the relationship between science and the public." (p. 8). The other questions are answered in the book's ten chapters which spans over

more than a century of rivalling pedagogical thoughts and practices. To some extent these struggles seemed to repeat themselves during the period. In the 1880s and 1890s, an influential group of university scientists successfully managed to change the portrayals of science to a large extent by introducing a shifting emphasis from textbook and rote learning to laboratory practice. To use "the laboratory method," as it was called, included much more of instrumental precision in measuring and weighing than before. It was valued as a means to not only train observational skills but also for intellectual and moral strengthening of the individual.

At the turn of the century, however, these views were becoming increasingly challenged by a newly professionalised group of science educators, inspired by ideas coming from such academic fields as child study and educational psychology. They criticised the emphasis of the laboratory method which they thought resulted in too much "pure science" and contained too little of practical uses for the citizen. During the interwar period this movement became successful through the heavy influence of John Dewey and his emphasis on "the scientific method" as something to be used rather as a problem-solving logic of everyday life. Rudolph underlines that as different as these two ideals of teaching on scientific method may seem, they both related to wider purposes connected to social change of benefit for the individual and/or society.

The post-war period meant a radical change in these matters. Science teaching, Rudolph claims, was still decided by its perceived societal purpose, but now that purpose was seen as "primarily of benefit to science itself as an enterprise or institution." (p. 224). The second world war had displayed the civil and military usefulness of scientific research and the Sputnik-crisis of 1957 had opened up for governmental funding of large curriculum projects in high school science. In a reaction to the "soft curriculum" of the 1930s, high profiled scientists were now brought back to make majors changes. According to them, there was no "scientific method" to be used as a universal guide for problem-solving. Instead, what should be taught was the procedures in which real scientists worked.

However, as the 1960s drew to an end, the large and ambitious projects in particularly physics and biology—the last one launching "the inquiry-based method"—were often apprehended as too complicated or demanding to implement in class room teaching. Again, the ideals of "real science" were seen as too distanced from both teachers and students.

The last decades of the twentieth century are described by Rudolph as a period when teaching about method in physics, chemistry and biology were overshadowed by a focus on content or technical skill. This is largely the result of seeing high school science as an instrument for economic growth and workforce training. Here too, as in many other parts of his study, the author sketches a situation that is not only American but also to a large extent global.

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