The Work of Richard von Mises: 1883-1953

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RICHARD VON MISES was born April 19, 1883, at Lwow, which belonged at that time to Austria. He was teaching as professor of applied mathematics from 1909 to 1918 at the University of Strassburg, from 1920 to 1933 at the University of Berlin, from 1933 to 1938 at the University of Istanbul, and from 1939 to 1953 at Harvard University. He died July 14, 1953, in Boston.

His field has been officially labeled "Applied Mathematics and Mechanics." In the community of scientists, one often meets the opinion that work of this kind preoccupies the mind with highly specialized technical problems and does not leave much room for broad generalizations or abstract theories let alone philosophical implications. Yet, in looking over the work of v. Mises, we cannot fail to recognize a whole spectrum of research, extending from the philosophical meaning of science to practical methods of numerical computation. v. Mises was always a truly broad-minded man, who found problems to suit his interests in many fields and turned his searchlight in many directions, picking up results wherever the picking was good; but, notwithstanding the wide range of his topics, his work shows great intrinsic unity: starting from a definite center, it branches out in systematic investigations of a great diversity of problems. Thus it would be a misinterpretation of his work if it were considered as the output of a versatile man who split his interests because he was casually attracted by many topics. Actually, v. Mises chose the topics according to a very definite viewpoint, determined by his ideas about the essence and method of every thoroughly scientific research.

As v. Mises saw it, applied mathematics is the field of central importance for every attempt at a philosophical picture of our world. In drawing such a picture, the central task is to understand the relationship between the direct sense observation of the experimental physicist and the conceptual system of science, which consists of expressions such as "increase of entropy" or "principle of relativity." Most physicists are inclined to say that the picture drawn and the principles devised by our inductive ability are eventually checked by actual measurement of physical quantities like length, weight, electric charge, and so forth, but they use the expression "measurement of a length" in a perfunctory way, forgetting that no numerical value can ever be assigned to a length by a *single* measurement. In fact, a long series of measurements is needed from which eventually "the value of the length" can be computed.

In contrast to the procedure of the physicist, applied mathematics concentrates its efforts on the problem: *how* can "values of length" be computed from sets of different readings? And, in a general way, it has become the business of applied mathematics to investigate the connection between "direct pointer readings" and the abstract conceptions (as length, or electromagnetic field) that occur in all laws of science —in Newton's mechanics as well as in Maxwell's theory of the electromagnetic field. This *problem of connection* between sense observations and abstract principles has always been the critical point in the philosophy of science. As we see the problem, it is tackled most precisely by the methods of applied mathematics, and it is in this sense that v. Mises dealt with the tasks of "Applied Mathematics and Mechanics," building upon the ideas of the great Austrian scientist and philosopher Ernst Mach, who regarded both science and its philosophy as theories of sensations.

Investigating this problem of connection, v. Mises discovered soon the all-important role that statistics plays in this task. He examined and presented this role in a precise and lucid way and removed the obscurity that had been inherent in the traditional presentation of statistics and probability.

Thus a very rational line of thought connects v. Mises' work in mechanical engineering (*Theorie der Wasserräder, Fluglehre,* and so forth) with his investigations into the logical foundations of probability. If we study his work in fields of such complex structure as plasticity or turbulence, we never find smug contentment with rules of thumb or quick transitions from a vague assumption to a long row of figures but meet everywhere the attempt to analyze these difficult problems in terms of rational mechanics and to examine critically traditional assumptions. We see him, on the other hand, freeing probability theory from semimystical formulations, according to which the concept of probability is derivable from our "ignorance." To do this, he had to construct an axiomatic system, based, as is every physical theory, upon the combination of a formal system and the physical interpretation of its terms. In probability, as well as in mechanical engineering, v. Mises investigated the complete range of problems that stretches from the construction of a suitable axiomatic system to methods of numerical computation. Looking at the great variety of topics in his papers, we may marvel at the broad abilities of the author, but we must admire the work of a mind that is forever searching for the central problem hidden under the apparent variety.

v. Mises summed up his ideas in several books, which are not the least known for the attractive presentation of topics that had suffered greatly in earlier presentations. Coherence in the large and precision in the small—both intimately connected with the nature of v. Mises' work—reappear in his style and give depth and clarity to his writing. With the *Differential- und Integralgleichungen der Mechanik und Physik,* he gave to those who wished to apply modern mathematics to physics and engineering problems, a lucid account of the mathematical fundamentals. This work, which first appeared in 1925, was reproduced (in German) in the United States during World War II for the benefit of all those working in defense research. In *Probability, Statistics, and Truth,* v. Mises offered a brilliant presentation of his general ideas on probability to a wider class of readers; it is perhaps still the best book to make a general scientist or, for that matter, any well-educated person familiar with the conception of probability and its applications.

In *Positivism, a Study in Human Understanding,* v. Mises gave us a summary of his views on many topics in science and life. In this book the word *positivism* is not meant to designate a sectarian doctrine of some philosophical school; v. Mises used it, rather, to characterize a way of presenting his views that takes its cue from the methods of science and should establish understanding among those willing to drop prejudice and accept what experience and reason suggest. Throughout the whole book, v. Mises did not fail to emphasize that the role played by human imagination is not less important in the invention of scientific theories than it is in the works of art and in religion. Perhaps it is best to characterize this book by the author's own words:

> Positivism does not claim that all questions can be answered rationally, just as medicine is not based on the premise that all diseases are curable, or physics does not start out with the postulate that all phenomena are explicable. But the mere possibility that there *may* be no answers to some questions is not sufficient reason for not looking for answers, or for not using those that are attainable.

He stressed the point that too many people interpret the present world struggle as a battle between two ideological systems of extremely metaphysical character:

> If this goes on, the predictions of those who believe that the next step toward the solution of the basic sociological problems must come from physical annihilation of one of the two groups of people will be borne out.
>
> In our opinion, the only way out is less loose talk and more criticism of language, less emotional acting and more scientifically disciplined thinking, less metaphysics and more positivism.

A Golden Anniversary

W. L. Everitt and J. F. Downie Smith

University of Illinois, Urbana, and *Iowa State College, Ames*

ENGINEERING research in our nation's colleges and universities has become a multimillion dollar operation. But still more important than its magnitude have been its effects. This research effort has been and is influencing the engineering education of both undergraduate and graduate students. Furthermore, the results of engineering research programs being conducted in our educational institutions represent valuable contributions to the growth of industry and to the national defense effort.

This year both the University of Illinois and Iowa State College are celebrating the 50th anniversary of their Engineering Experiment Stations. These research organizations, the first of their kind in the nation, were founded in the academic year 1903–04. They have been active and growing in size and concept ever since.

Before 1903, such research as was conducted in engineering colleges was done on an informal basis. In keeping with the systematization of agricultural and forestry research at the turn of the century, and with the industrial efficiency movement, the faculties at both Iowa State and Illinois believed it was necessary to formalize their research activity and provide a means for conducting research programs under the sponsorship of industry, state organizations, and engineering societies. In addition to furnishing useful information to these sponsors, they recognized that such research projects would provide graduate and undergraduate students with training in research methods and that the knowledge gained by them would represent advances in the science and art of engineering. Both schools also recognized the necessity for publishing research results in order to obtain the maximum benefits from their research programs. This is evidenced by the fact that each station issued its first bulletin during its first year of operation. In the course of the past 50 years, both stations have published numerous bulletins and have contributed, through their research staffs, a still greater number of papers and articles to the technical press.

Today both industry and government recognize the importance of research in the growth and security of