

### Three paths to truth and two ways of describing them

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**J. Mehra and H. Rechenberg.** *The Historical Development of Quantum Theory*.—Springer-Verlag, New York; Heidelberg; Berlin, 1982–1988. V. 1, pts. 1, 2, 878pp. V. 2, 355pp. V. 3, 334pp. V. 4, 322pp. V. 5, pts. 1, 2, 980pp.<sup>1</sup>

There is no doubt that a major event is taking place in the historiography of physics: five volumes (in seven books) have already been published of the historical development of quantum mechanics written by two professional historians of science—Jagdish Mehra and Helmut Rechenberg. The published volumes almost complete the first main part of the early history of this science unprecedented in the richness of its material. The last, sixth, volume devoted to the completion of the new mechanics which will cover the period from 1926 to 1935 has not yet been published.

But this will not complete the planned opus. Two more books (each in two parts) are promised which will be devoted to the development of the mathematical apparatus, the physical interpretation and the experimental tests of quantum mechanics. The temporal framework of the entire opus are restricted to the first third of our century (1900–1935). It is likely that fifty years is a reasonable interval which should separate the historians from the events described by them.

The authors also promise to add six compilations of reference material, containing portraits, notes on sources and bibliography, and also subject and author indexes.

The appearance of Mehra's and Rechenberg's history of quantum mechanics has its own history. It is based on a new idea. The senior author J. Mehra presents his own history in a lengthy (47pp.) introduction. His idea is that any historical investigation must be based on an archival collection of letters, drafts, documents which would enliven the articles published in journals by the participants in the events—articles which are necessarily dressed-up and which by no means always reflect the true course of the author's thinking. Of course, an analysis of archival materials and the attempts based on that to reconstruct (or even invent) the true history is not a reliable procedure, and Mehra has invented one more approach. The fellowship<sup>2</sup> awarded to him in 1952 enabled him to move freely throughout Europe, to meet almost all the participants of the great events of the 1920's and 1930's and to tape-record their reminiscences.

As a result Mehra assembled a unique archive containing recollections by almost all the physicists who participated in the creation of quantum mechanics.<sup>3</sup> Several years later similar collections appeared in the Bohr Institute in Copenhagen and in the USA where Thomas Kuhn was collecting "Sources for History of Quantum Physics".

Mehra's collection is now preserved in West Berlin in the Max-Planck-Gesellschaft zur Förderung des Wissenschaften.

On the basis of the assembled materials Mehra published several monographs and articles and became one of the most serious authorities on the history of physics of our century.

His junior coauthor Rechenberg studied with Heisenberg and was his last graduate student. His activity now also encompasses the publication of Heisenberg's works, three volumes of which have already been published. To describe the contents of the historical publication of J. Mehra and H. Rechenberg—more than 240 printer's pages—is practically impossible. The presentation follows a method characteristic of a book on the general history of the last century. In the history of Mehra and Rechenberg the attention of the authors is concentrated on the detailed and sequential analysis of events and biographies and, to a lesser extent, on an analysis of general philosophical questions. Their history is rather a "history of kings and generals" than a social history.

It is interesting that this presentation triggered a sharp reaction and a review printed in *Science* **220**, 824 (May 20, 1983). In this review the authors and the publishers are accused of violating established canons, being too trusting in unchecked stories, and other sins. Such accusations are clearly unjust, experience of several years has shown how useful these volumes are in preparation of lectures, in compilation of reviews and simply in satisfying the wish to study an interesting personalized history of quantum mechanics. No other field of physics, no part of its history has been presented in such detail and with such lively portraits of people. Apparently other sciences also cannot boast of such a written history.

Of course, such a tremendous opus cannot avoid including some small inaccuracies, some repetitions and omissions—defects for which the reviewers reproach the authors. But this is just a reflection of a different interpretation of the problems of history, of an argument similar to the "argument" which occurred in its time concerning the aims of history textbooks.

We will also add that the entertaining presentation is enlivened by many anecdotes and quotations from oral accounts.<sup>4</sup>

On reading this book the history of quantum mechanics presents itself according to the following pattern. During the first quarter of the century preparation, rapid accumulation of materials, the birth and accumulation of contradictions in explanations of atomic properties was taking place. This period is concluded by the unexpected, almost incomprehensible dissertation of de Broglie.

After this the development proceeded along three paths. Heisenberg discovered that the quantities in atomic physics are the unusual numbers-matrices (as M. Born understood); this worried him very much. Pauli developed a

different variant of quantum mechanics by constructing the theory of angular momenta in order to solve the hydrogen atom problem.

The second path is Schrödinger's path who saw in the new equations a reflection of the properties of wave fields. This enabled him to create a different nonmatrix mechanics-wave mechanics.

The third path is Dirac's path who was inspired by the matrix properties of physics quantities discovered by Heisenberg and Born. The independent free-ranging Dirac's mind here exhibited itself in its full brilliance. The result was the birth of Dirac's quantum mechanics—a theory inimitable in its beauty and power which encompassed within itself (as different representations) both quantum and wave mechanics. Contrary to the Russian tale all three paths (very dangerous ones) led to the same goal.<sup>5</sup> This is the modern (truthful) legend of the Great Miracle.<sup>6</sup>

The history of quantum mechanics could also have been presented in a different manner: without interviews, without digressions, but then this would have been a different book, an equally necessary one. In history there are two methods of describing events. The second path so far has not yet been as fully realized.<sup>7</sup>

It is highly desirable that the "History" of Mehra and Rechenberg should be examined by many readers. However, it is not easily available in our libraries!

<sup>1</sup>The complete titles of the volumes are: V.1, parts 1, 2: The Quantum Theory of Planck, Einstein, Bohr and Sommerfeld: Its Foundation and the Rise of Its Difficulties, 1900–1935. V.2: The Discovery of Quantum Mechanics, 1925. V.3: The Formulation of Matrix Mechanics and Its Modifications 1925–1926. V.4: The Fundamental Equations of Quantum Mechanics 1925–1926. The Reception of the new Quantum Mechanics 1925–1926. V.5: Erwin Schrödinger and the Rise of Wave Mechanics. Part 1. Schrödinger in Vienna and Zurich 1887–1925. Part 2. The Creation of Wave Mechanics; Early Response and Applications 1925–1926.

<sup>2</sup>The Fellowship was established by the German industrialist O. Henschel.

<sup>3</sup>It should be noted that Mehra became a very skillful interviewer. Even the taciturn Dirac remarked to him: "When I talk with you I almost become loquacious."

<sup>4</sup>An example. The Prussian Minister of Education asked Hilbert: "Herr Geheimrat, I hope that the departure of the Jewish mathematicians has not seriously affected the activities of your institute?" Hilbert replied: "No, Herr Minister, not at all." And after a pause: "It just doesn't exist anymore."

<sup>5</sup>The principal magician in all this story was, after all, Niels Bohr. Only he grasped all the many aspects of the nascent theory, and, as a general, unified them all, and he led them to victory.

<sup>6</sup>Unfortunately, insufficient space is devoted in the book to our physicists and our institutes. But this is not the authors' fault, but ours. This is a consequence of our neglect of our own history, and of the history of science in particular.

<sup>7</sup>One should regard as the best book of this second approach Jammer's book (M. Jammer, *The Conceptual Development of Quantum Mechanics*, McGraw-Hill, New York; London, 1966) which has not been translated into Russian, and is not well known in our country. [Note by Editor of *Sov. Phys. Usp.*: Apparently the reviewer is unaware of the translation published by Nauka, M., 1985].

Translated by G. M. Volkoff