Novelty to tradition: the soda king's legacy

The Solvay Conferences on Physics: Aspects of the Development of Physics since 1911

J. Mehra
415 pp. D. Reidel, Dordrecht, Holland, 1975. $56.00

Reviewed by Paul P. Ewald

Arnold Sommerfeld told his students that the quantum is a child of the twentieth century (Max Planck's energy quantization was published in 1900). The same can be said of large international conferences on physics, of which we now have such abundance. True, Humphrey Davy visited his French colleagues even while England and France were at war, and he took young Michael Faraday along; Lord Kelvin cruised on his yacht *Lallah Rook* in the seas around England and discussed hydrodynamics with his guest Hermann Helmholtz. But the first general international conference that comes to mind is the mathematicians' conference on the occasion of the Paris World Exhibition of 1900, at which David Hilbert formulated his famous ten problems. Otherwise, each country had its own scientific societies—specialized and general ones—which, even if a few outstanding foreign scientists were present, met on an overwhelmingly national scale.

The Solvay Conferences on Physics, of which the author Jagdish Mehra gives a learned account and paraphrase, started as an entirely novel type of meeting. The idea originated with Walther Nernst, the leading physical chemist at the time, whom Mehra rightly characterizes as a "great entrepreneur." In the spring of 1910, Nernst met Ernest Solvay in Brussels. Solvay had invented an economical process for producing carbonate of soda that soon outstripped the older methods and was adopted in all industrial countries. He became "immensely wealthy." In his short biography of the man, Mehra tells of the family background that led Solvay to regard wealth not as an aim in itself but as a means to further society. The chemist Solvay was deeply interested in three aspects of science: gravity and the constitution of matter, the mechanism of life, and the evolution of the individual and of social groups. For the further investigation of these problems, he donated large sums to the Université Libre de Bruxelles, and in 1912 he founded international institutes of physics and chemistry. The former took over the organization of the Solvay Conferences on Physics, after the first such conference had been held in 1911 with the active participation of Solvay himself.

Solvay had his own pet theory of gravitation, on which he worked with his assistants E. Herzen and G. Hostelet. He was unsuccessful in obtaining recognition for his theory, but on meeting Nernst he asked him whether he thought it possible to bring Solvay's ideas to the attention of such great physicists as Planck, Albert Einstein and Henri Poincaré. Nernst adroitly declared this to be feasible within the framework of an international conference that dealt with the most pressing problem of physics, namely the quantization of energy and the consequent deviations from the Maxwell–Boltzmann statistics. This conference, Nernst proposed, should be what would now be called a "workshop," attended by the most illustrious physicists who could contribute to the subject. Solvay at once recognized the perspective opened up by a gathering of this kind and promised financial backing. He entrusted Nernst with setting up a list of participants and sounding out their willingness to attend. Eventually, Solvay sent out the invitations for the conference to be held in Brussels from 30 October to 3 November, 1911. Except for Lord Rayleigh (who excused himself as "being a very poor linguist and not effective on occasions of this sort" and van der Waals (who was in bad health), all those invited accepted enthusiastically; H. A. Lorentz was asked to preside. Solvay gave the opening address of welcome, in which he also expounded his "Principes fondamentaux de la Gravito-Matérialitique," and was listened to with mute respect (this address is not mentioned by Mehra, nor is it in-

Participants at first Solvay Conference, 1911. Seated at the table (left to right) are Walther Nernst, Marcel Brillouin, Ernest Solvay, H. A. Lorentz, Emil Warburg, Jean Perrin, Wilhelm Wien, Marie Curie and Henri Poincaré. Behind them stand (also left to right) R. Goldschmidt, Max Planck, Heinrich Rubens, Arnold Sommerfeld, F. A. Lindemann, Maurice de Broglie, Vern O. Knudsen, Friedrich Hasenörhl, G. Hostelet and E. Herzen (Solvay's assistants), James Jeans, Ernest Rutherford, Heike Kamerlingh-Onnes, Albert Einstein and Paul Langevin. Meeting was held in Brussels.

cluded in the printed volume of reports).

This was the first of a series of 16 Solvay Conferences on Physics between 1911 and 1973, each of which has dealt with the most pressing problems of its time in physics and astrophysics. The subjects treated range from models of atomic and nuclear structure to matrix and quantum mechanics, wave mechanics, dispersion theory, statistics, field theory, elementary particles and astrophysics. The interpretation of quantum theory, in particular causality against stochastics, has emerged as a theme in several of the meetings; Mehra rightly includes the 27-page essay written for Einstein's seventieth birthday by Niels Bohr, wherein he summarizes their divergent views, which were discussed at several Solvay conferences. The 16 volumes of reports constitute a great source of information on the progress of experimental and theoretical physics in this half-century of tumultuous development, and Mehra's book is a valuable introduction to and guide through these volumes.

Mehra reports on each conference in considerable detail. He gives condensed accounts of the main invited papers and follows in many cases with the gist of the discussions. The great help the author provides for the reader lies in his resumés of the developments that occurred between conferences; the intervals, usually three years, lasted eight and 15 years at the time of the world wars. These "state-of-the-art" comments enable the reader to appreciate the historical significance of the meetings.

In condensing the 16 volumes of reports into one, the author had to decide between what seemed to him contributions deserving fairly full rendering and less important ones. The early conferences appear to be more fully reported than the recent ones. Inevitably, in any process of condensation, one makes subjective choices. In comparing Mehra's book to the original conference reports, I see the greatest loss in the curtailing of the discussions after each paper. In the discussions, tentative ideas and personal motivations appeared and gave the conferences their particular flavor. But a digest should not be expected to fully replace the whole. As it is, Mehra's book represents the first account of the impact of the Solvay–Nernst idea on the development of modern physics. The volume presupposes a fair amount of familiarity with the subject matter and requires attentive reading, but it effectively smooths the way to an understanding of that development, in contrast to the bewilderment that some of the congress reports create in a reader who has not actively taken part in the building up of field theory and particle physics. Mehra guides one through the early acts of a play still in progress.

The book is attractively published; if

anything, one could wish that the group photographs taken at the conferences were printed on glossy paper. These pictures do not appear in the original reports, and they give Mehra's book a happy personal touch.

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Paul P. Ewald, longtime physics professor emeritus at the Polytechnic Institute of New York, tells us he has never attended a Solvay Conference. His interest in the development of physics, however, is well established. Ewalds's research field is crystallography.

Molecular Spectroscopy

I. N. Levine
491 pp. Wiley, New York, 1975. $19.50

This is a textbook for a classical elementary-spectroscopy course. Ira Levine has designed the volume to provide a survey of principles for a number of the spectroscopic methods most frequently used by chemists. As the title states, the book constitutes an exploration of molecular spectroscopy. Subjects discussed include the rotational, vibrational and electronic energy levels of molecules. One chapter on magnetic resonance treats nuclear magnetic resonance for the most part, with a short section on electron-spin resonance.

The author presents his material with clarity, and solutions to standard problems, such as the Hamiltonian for rigid-body rotation, he derives carefully for the reader. The writing throughout is designed with the student in mind. Short sentences that refer to modern works should serve to enliven this book.

This is not a reference book for spectroscopists; Levine covers few topics in greater detail than may be found in standard references. With most of the problems treated, he assumes a simple molecular model in order to set up the Hamiltonian. Matrix elements do not appear in tabular form, nor are they specifically given.

Little formal discussion of terms beyond the lowest order—as for the rigid rotor or harmonic oscillator—occurs. Essentially, Levine's molecular wave function develops as a simple product function for each degree of freedom.

In this book, then, Levine addresses himself to molecular-spectroscopy students. The text will be valuable to them while they are learning, but it will not serve as a reference after they understand the material.

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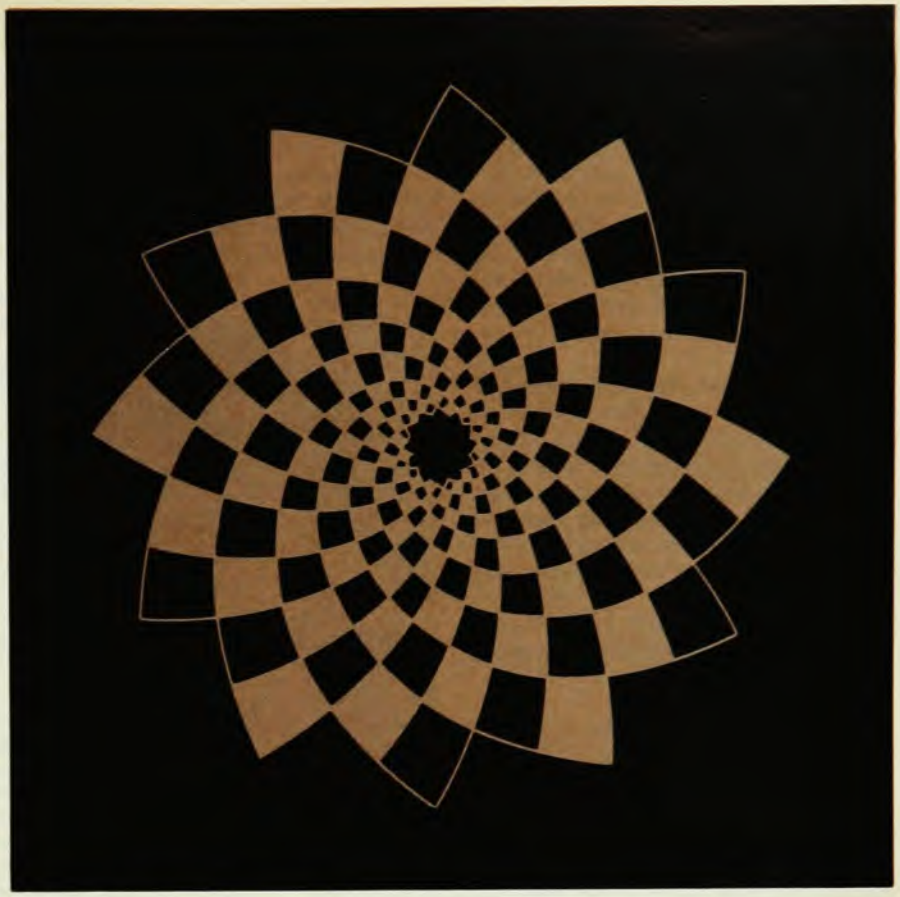

Multiple-threaded logarithmic spiral. The figure's symmetry is denoted as $24^{(s)}$, where s signifies a transformation that expands or compresses the spiral about a point. From *Symmetry in Science and Art* by A. Shubnikov and V. Koptsik (Plenum, New York, 1974).

Symmetry Discovered

J. Rosen
138 pp. Cambridge U.P., Cambridge, Mass., 1975. $11.95

Symmetry has always played an important role in Man's quest for an understanding of the world around him. However, the explicit recognition of symmetry as a powerful tool for investigating and extracting Nature's secrets is a relatively recent development. With the utilization of symmetry principles and group theory in crystallography, atomic physics and high-energy physics, symmetry ideas have become an integral part of modern-day physics. Unfortunately there is a dearth of readable material on symmetry principles and techniques in the physical sciences at the introductory-to-intermediate level. The author, who is presently at Tel-Aviv University and who first caught the "symmetry disease" as a graduate student in theoretical high-energy physics, has attempted a partial alleviation of this situation.

After a brief introduction to the meaning of symmetry and some terminology associated with symmetries, the author examines in turn geometrical symmetries, temporal symmetries, permutational symmetries, color symmetry and analogy. The last third of the book is devoted to approximate symmetries and symmetry breaking, symmetry in nature, and the use of symmetry in science. The last chapter contains several examples that show how symmetry ideas can greatly simplify the solution of some problems.

Throughout the book the author has introduced a smattering of group theory, in such a way that the reader may skip that material without ill effects if he so desires. The discussions are lucid, well illustrated and sprinkled with cleverly chosen excerpts from the writings of A. A. Milne (*Winnie-the-Pooh* and *The House at Pooh Corner*). There are also numerous problems inserted in the text, as well as an abundance of references. The bibliography contains over 150 entries listed under 19 subject headings.

Unfortunately the book is rather brief; it could easily have accommodated more extensive discussions of some topics, especially crystal symmetries and internal symmetries. In addition, the author could have emphasized the fact that there are (or at least seem to be) some exact conservation laws in nature, namely conservation of electric charge, baryon number, energy, momentum and angular momentum. In a few places, the author's desire for simplicity has led him to make