

tion; Joost A. Businger is well-known for his work on micrometeorology and air-sea interaction.

Traditionally, atmospheric physics is stratified in several ways: Meteorology is separated from aeronomy (the study of the upper atmosphere) by an imaginary surface at about 50 km. The authors have, wisely, decided not to cover aeronomy, because the physical disciplines required are different from those in the lower atmosphere.

This book is unique in that it avoids the second stratification, into dynamic meteorology (thermodynamics and hydrodynamics) and physical meteorology (optics, acoustics, radiation and cloud physics). As a result, the book manages to present, in a clear and concise manner, all the fundamental physics of the lower atmosphere. It is more complete than the first edition, in which atmospheric hydrodynamics was omitted.

The volume contains chapters on gravitational effects, properties of atmospheric gases, properties and behavior of cloud particles, atmospheric motions, radiation, transfer processes and atmospheric signal phenomena and concludes with some rather elementary sections on mathematical and basic physical topics. Each chapter is followed by several pages of problems and answers to the problem; they range from simple to quite difficult.

Although the book was originally intended to be a text, due to the conventional division of meteorology into dynamic and physical in university curricula, this is probably not its most important purpose. Instead, it is an outstanding work from which physicists, chemists, mathematicians and engineers can gain an understanding of the basic properties of atmospheric processes. It is also useful for students who have had courses in dynamic meteorology and seek an introduction to other branches of atmospheric physics.

The authors generally did an excellent job of covering many subjects clearly. I was particularly impressed by the new chapter on signal phenomena (leading to a useful summary of techniques of remote sensing, both from the ground and from satellites).

Of course, every reviewer will miss some material that seems more important than some that is included. In particular, at the beginning of the chapter on atmospheric motions, the authors quote L. F. Richardson on the possibility of weather forecasting on the basis of physical equations. However, they barely mention the extensive field of numerical modeling of the atmosphere, which has led to improved forecasting and to better understanding of atmospheric phenomena on all scales. While stratospheric pollution

is treated, another large subject, air-pollution modeling of the lower atmosphere, is not mentioned.

In spite of these omissions, I believe that the authors have produced an excellent volume, which I especially recommend to physicists.

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## The Early Years: The Niels Bohr Institute 1921-1930

Peter Robertson

175 pp. Akademisk Forlag, Copenhagen, 1979. \$12.00

Universitetets Institut for Teoretisk Fysik of the University of Copenhagen, more commonly known over the early years as the Bohr Institute and officially renamed in 1965 as the Niels Bohr Institute, has been considered by physicists as the most important center for the early research on the quantum theory of atomic structure. Its subsequent history has amply established its world-famous status. Students of the history of physics will therefore welcome this volume by a member of the Department of History and Philosophy of Science in the University of Melbourne, Victoria, Australia.

The period covered in the book, namely, from the founding of the Institute in 1921 to the end of the decade, has long been felt by many to have been the most exciting time in its history. It was early in this period that Bohr's fundamental grasp of the quantum theory interpretation of the periodic system of the elements was fully recognized and the element hafnium (named for the City of Copenhagen) was identified. The middle of the decade saw the invention of quantum mechanics and its promise of the successful evaluation of atomic energy levels for which the orbital interpretation of Bohr's original fundamental hypothesis could give only rough indications. All the leading figures in the rapidly unfolding drama of atomic physics were visitors at the Institute during those early years, and much vital research was performed there under the enormously stimulating influence of the Director. The whole story of what went on there is one of the most fascinating in the history of physics, and the author of the present volume has done ample justice to it within the space limitations to which he was subjected.

Bohr's outstanding ability as a shrewd promoter and administrator is well brought out in connection with the construction and equipping of the original Institute building, which after many vicissitudes was officially opened on 8 March 1921. It was a compact affair, with research laboratories in the

basement, a library and lecture room on the ground floor and living quarters for the director and his family on the second floor. The building was not added to until 1925, when considerable support was provided by the Rockefeller Foundation in the United States.

The book successfully portrays the high points of the achievements of the Institute during its first decade. These include the vital experimental spectroscopic and chemical work of Dirk Coster and George Hevesy, the development of matrix mechanics by Werner Heisenberg, with the formulation of the indeterminacy principle and its generalization by Bohr into the concept of complementarity. Not overlooked is the famous controversy with Erwin Schrödinger over the interpretation of wave mechanics and the initial development of the Copenhagen probabilistic interpretation of the significance of the atomic wave function. The book closes with a graphic account of the Bohr-Einstein controversy on the problem of determinism versus indeterminism in atomic physics.

Some 50 illustrations, mainly photographs of persons connected with the Institute, add to the interest of the volume. There is also a nearly complete list of visitors to the Institute and workers there during its first decade.

This book should be on the shelves of all physicists who are interested in the early development of the quantum theory of atomic structure.

R. BRUCE LINDSAY  
*Brown University*



Bohr (left) with James Franck and George de Hevesy (right) at the Institute in 1934.

## Photoacoustics and Photoacoustic Spectroscopy

A. Rosencwaig

321 pp. Wiley, New York, 1980. \$35.00

It is appropriate that on the hundredth anniversary of the discovery of the

photoacoustic effect by Alexander Graham Bell, this excellent book should make its appearance. It is written by Allan Rosencwaig, who is undoubtedly one of the principal developers of modern photoacoustics. Although the field of photoacoustic spectroscopy lay relatively dormant between 1880 and about 1970, in the past decade interest has mounted in this technique, which can be used to obtain information on samples as varied as weakly absorbing gases and optically opaque solids.

This book is Volume 57 in a series of monographs on analytical chemistry and its applications. However, physicists as much as chemists should be interested in its subject matter, especially its chapters on the theory of the photoacoustic effect in gases and condensed media. The book covers well the Rosencwaig-Gersho theory of photoacoustic spectroscopy and summarizes other, more complex theories. For the less theoretically inclined, Rosencwaig has included a brief summary chapter entitled "Photoacoustic Theory Made Easy."

The first third of the book covers PAS of gases. While Rosencwaig discusses the analytical aspects of this subject only briefly, he has included one interesting chapter on deexcitation studies and another that mentions such diverse topics as excited-state and high-resolution spectroscopy, photolysis, nonlinear effects, and microwave PAS. The real strength of the book lies in its description of PAS and the photoacoustic effect for condensed solids. After a fairly extensive introduction to the theory and instrumentation for this subject, Rosencwaig summarizes the applications of PAS in chemistry, biology, medicine, physics, and even microscopy. While many subjects are covered very briefly (although the bibliography is excellent), Rosencwaig has described some of his own applications of PAS to medicine in much greater detail.

In general, the reader should be able to obtain a good feeling for potential applications of photoacoustics and ultraviolet-visible PAS of solid samples. Unfortunately, the timing of the publication of the book precluded any mention of the recent important developments in Fourier-transform infrared PAS. From a practical viewpoint, I was disappointed that the author did not include a more detailed comparison of PAS with diffuse reflectance spectroscopy (which he summarily dismisses) for the analysis of solids. I would also have liked to see a completely practical chapter on the experimental optimization of PAS measurements included in a monograph in the Chemical Analysis series. Nonetheless, I found this to be an extremely well-



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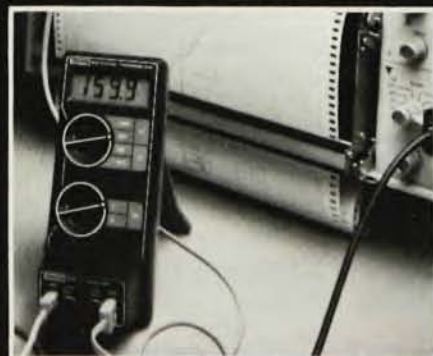
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