

municate or reflect the idea that technical precision is an obstacle to clarity of communication?

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A Short Course in Cloud Physics

R. R. Rogers

227 pp. Pergamon, New York, 1976.
\$14.50

Clouds, Rain and Rainmaking, 2nd edition

B. J. Mason

189 pp. Cambridge U.P., New York, 1976.
\$12.95

The study of cloud physics is one of the newest of the atmospheric sciences. Cloud physics is defined by the author of *A Short Course in Cloud Physics*, Roddy Rhodes Rogers, broadly and simply as the science of clouds in the atmosphere. Clouds produce most of the sensible weather of the earth—precipitation, fog, winds and electrical activity—as well as providing an important function of the heat engine for driving the larger-scale circulation of the atmosphere. They provide the means for cleansing the atmosphere of natural and man-made poisons and in turn are affected by the aerosols and effluent gases in the atmosphere. In the main, cloud physics is a rapidly progressing field, especially in the area of computer simulation of the larger-scale circulations that produce clouds and the qualitative understanding of the principles of cloud physics, the formation of clouds and the development of precipitation from them.

Rogers's book, written for the upper-division undergraduate and graduate students, fills a much needed requirement for a good text in cloud physics. The author thoughtfully and carefully guides the reader through a well chosen, coordinated set of physical problems. In the process he has culled out many spurious and contradictory works in the field. I highly recommend the book to scientists in other fields, especially those interested in atmospheric problems, as well as to the serious student of cloud physics.

The *Short Course* is a convenient size and weight and can be held in one hand while reading. In spite of all of its desirable features, I am very disappointed that the role of electrical forces and the electrification of clouds are processes not included among the important factors in the growth of precipitation. It is true that this consideration adds another dimension

to the study of cloud physics. The time required for the continued growth of precipitation from small cloud droplets after its initial formation is much shorter than that needed to get it started in the first place. It seems that electrical factors are the only processes available to explain this fact. I do agree that it is possible at this stage of our knowledge to exclude the consideration of radiative transfer from clouds in the microphysical growth of precipitation, but not from the development of clouds themselves. These subjects could be approached in this book in the manner of other subjects without taking it out of the "held-in-one-hand" class. Perhaps a second volume written along similar lines would be appropriate.

After reading this book, I read Basil J. Mason's recently published second edition of his popular book *Clouds, Rain and Rainmaking*, originally published in 1962. Mason's revised book partially fills in for the omission in Rogers's volume of the electrical forces and processes in clouds by discussing in a fairly technical manner the electrification of thunderclouds. Mason does not, however, discuss the relationship that the electrical forces created in this way have to the continued development of precipitation after it initially forms. Rogers's book covers physical, thermodynamic and dynamic processes in clouds and their environment as well as the microphysics of the precipitation formed within them.

In his book Rogers discusses a judicious mixture of theory, laboratory experiments, field research and applied programs. He includes an excellent evaluation of weather modification to increase precipitation and suppress hail, and he describes the role weather radar plays in cloud-physics research. A wide variety of readers should be interested in the discussion of the very controversial subject of weather modification. Rogers concludes, as does Mason in his second edition, that under the appropriate conditions, modest changes in cloud structure and precipitation can be effected by seeding.

Rogers goes on to treat briefly the local physical principles employed in the scientific justification for weather modification through cloud microphysical processes. The author also concludes, in his chapter on rain and snow, that while microphysical processes (of which the introduction of artificial ice nuclei is one) are all-important in the development and size distributions of precipitation particles, the intensity and duration of precipitation are essentially controlled by larger-scale kinematic and thermodynamic factors. The temperature at cloud base, the cloud thickness and the updraft speed are among factors controlled largely by the larger-scale meteorological conditions. Rogers has a good set of practical problems in cloud physics (evidently

student-tested) at the end of each chapter.

Mason's book is for informed readers of popular science, yet in some areas he goes into a bit more technical and scientific detail. The Mason text provides some fascinating photographs of clouds and ice crystals, and he includes chapters on cloud forms and features, but he does not include a discussion of numerical cloud models as does Rogers. Mason does describe some laboratory models, which the reader can investigate on his own.

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Vacuum Technology

A. Roth

496 pp. North-Holland, New York, 1976.
\$49.95

High-vacuum technology has been developed by specialists and has produced vocabulary, concepts and scope loosely related to physics and mechanical engineering. As a technology, it has been associated with molecular distillation, vacuum tubes and instruments, isotope production, vacuum metallurgy, space technology, thin films and surface studies.

A revival of interest has produced at least 25 textbooks during the last 15 years. Fortunately, this did not discourage Alexander Roth from writing another. The author is a deputy director (and former head of the vacuum technology department) at the Soreq Nuclear Research Center in Israel. His previous book, *Vacuum Sealing Techniques*, made an outstanding contribution to the subject.

Roth's new book contains a comprehensive collection of information on rarefied-gas flow, physical and chemical phenomena associated with vacuum technology, the production and measurement of high vacuum and sealing and leak-detection techniques. One finds a wealth of equations, numerical examples, tables, graphs and nomographs. The book is more a handbook than a source book of latest developments. It is suitable for teaching, but the wealth of organized data should also make the book highly useful to engineers.

The treatment is generally traditional. (A notable exception is the new material covering Roth's work on sealing techniques). The result is that the book is not free of old fallacies. For example, no distinction is made between ultimate pressure due to outgassing and internal pump limitation. Roth's treatment of conductances of vacuum ducts is made without caution about its applicability to short conductors or the geometric compatibility of entrance conditions. Also, in practice, the standard pump-down equation is not applicable to molecular

flow (page 125), because of outgassing effects. I doubt, too, that in practice mechanical-pump manufacturers can maintain 2-to-3-micron tolerances (pages 204 and 383). Although the references end in 1974, some subjects are not brought up to date—for example, the equipment descriptions for molecular pumps and diffusion pumps—while space is allocated to obsolete equipment such as evapor-ion pumps.

There are other minor faults: One is that references are unnumbered and not referred to chapters; thus, it is impossible to crosscheck from the alphabetical index back to the text.

Generally, the style is clear, the figures well made and chapters well organized. However, the book could profit from careful editing—it deserves it. (For example, on page 221 Roth informs us that pumps are made in sizes from two to 40 inches, but on page 227 a 48-inch pump is described.)

Roth's book has been advertised in relevant journals and through related engineering societies. It certainly deserves the exposure.

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Quantum Collision Theory

J. C. Joachain

710 pp. American Elsevier, New York, 1975.
\$89.95

The inevitable first questions about this book are: Is it necessary? and Is it worth the price?

The main competitors of this book are Marvin L. Goldberger and Kenneth M. Watson's *Collision Theory* (919 pp. Wiley, New York, 1964. \$37.50), Roger G. Newton's *Scattering Theory of Waves and Particles* (681 pp. McGraw-Hill, New York, 1966. \$26.00), C. S. Wu and Ohmura's *Quantum Theory of Scattering* (495 pp. 1962. \$16.95) and Leonard S. Rodberg and Roy M. Thaler's *Introduction to the Quantum Theory of Scattering* (398 pp. Academic, New York, 1967. \$18.00). Rodberg and Thaler's book covers only the basic essentials, so probably it should not be compared to the others. Wu and Ohmura's book is slightly more complete, but does not match the remaining books in completeness.

Of these remaining three, Joachain's is certainly the most complete. For example, Joachain and Newton both discuss the Fadeev equations extensively, whereas Goldberger and Watson do not; in fact, Joachain has a 63-page chapter on three-body problems. Joachain has a good 15-page treatment of dispersion relations while Newton spends about six pages on the subject, but Goldberger and

Watson's book has an excellent chapter of over 100 pages on the subject. The most complete discussion of the Mandelstam double-dispersion relation is in Newton's book. Again, Joachain has a good 19-page discussion of complex angular momentum and Newton has a 15-page chapter, but Goldberger and Watson's book does not mention the subject. There are several other subjects where Joachain shares a good treatment with either Newton or Goldberger and Watson, but not both. However, if you combine Newton's and Goldberger and Watson's volumes, you have a 1600-page book that covers almost everything in Joachain's book, plus a lot of extra electromagnetic-scattering material in Newton's book—all for \$26.45 less than the outrageous price of Joachain's book.

This brings us to the second question. Despite the fact that the first paragraph of the preface states "It is primarily aimed at graduate students . . .", my publishing and library friends tell me that the publisher is counting almost solely on the "captive" library buyers who have blanket orders with all major book companies. I cannot imagine a graduate student, or even a professor, buying this book at the listed price. Finally, on the subject of price, after being given a \$90 book I find it hard to write the above seemingly ungrateful comments.

Joachain's book deals mainly with nonrelativistic potential scattering, but it includes relativistic topics at appropriate points. Occasionally the reading gets tedious as the author belabors the fine points of topics that are his speciality. The book is divided into four parts: Description of Collision Processes, Potential Scattering, General Scattering Theory, and Applications. The first part is followed by twenty problems for students, and the second part is followed by sixty problems, but there are no problems for parts three and four.

Joachain is certainly well qualified to write a treatise on scattering theory. As the numerous references in each chapter indicate, he has many papers on the subject and has written many other papers jointly with several of the major contributors to the subject. His work ranges from esoteric theoretical development to the comparison of numerical calculations with atomic-scattering experiments.

The book is, in technical publishing terms, of the highest quality. I found not more than ten errors of any type in reading it. A publishing device that I found to be very convenient is the inclusion at the bottom of each odd-numbered page the statement "References and notes on page—." This enables one to find references for a particular chapter easily, both while reading that chapter and while reading later chapters—the latter being facilitated by the references' presence at the end of the chapter.

This is an excellent book, but I feel that the combination of Newton's, Goldberger and Watson's books is a better buy.

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Quantum States of Atoms, Molecules and Solids

M. A. Morrison, T. L. Estle, N. F. Lane

575 pp. Prentice-Hall, Englewood Cliffs, N.J., 1976. \$25.50

The subjects of atomic, molecular and solid-state physics have only rarely been treated at an advanced level in a single volume. The notable exception, of course, is John C. Slater's *Quantum Theory of Matter*. In the present book the three authors, Michael Morrison, Thomas Estle and Neal Lane, stress the unity among these fields by emphasizing the concept of electronic quantum states in atoms, diatomic molecules and crystalline solids. Such a combination should be of basic interest to students in a variety of scientific fields and also forms the basis for more advanced work in those three subjects themselves. This is a textbook of applied quantum mechanics directed to advanced undergraduate and graduate students in physics, chemistry and engineering; the authors assume a previous introduction to quantum mechanics.

After a review of basic quantum mechanics, the first part contains the solution to the one-electron atom, two chapters on approximation methods, two on spin and three on multi-electron atoms. In Part 2 the authors treat the diatomic molecule, first through the use of an exactly soluble one-dimensional model and then by approximation methods applied to a three-dimensional model. The emphasis is heavily on electronic states; vibrational and rotational motion are treated only very briefly at the end of the section.

In the third part, after a preliminary discussion of crystals, lattices and Brillouin zones, we get into a perturbation treatment of a one-dimensional model using the free-electron and the weak-binding approximations. Step by step, the authors then take us through two dimensions and finally to three, where concepts such as energy bands and the Fermi surface are introduced. As in Part 2, the principal focus is on electronic states, but a final chapter on vibrations in solids helps to round out the picture. The five short appendices include a welcome one on atomic units.

This carefully thought out and well written book should provide the student with a well paced introduction to each of the areas under consideration, at a somewhat lower level than Slater's book.