

(see M. Lacombe, B. Loiseau, J. M. Richard, R. Vinh Mau, P. Pires, R. de-Tourreil, *Phys. Rev.* **D12**, 1495, 1975) and with phenomenological potentials. Risking the charge of self-advertisement, I will express my disappointment at the omission of comparisons with new and old (see, for example, F. Partovi, E. L. Lomon, *Phys. Rev.* **D5**, 1192, 1972, and E. L. Lomon, H. Feshbach, *Ann. Phys.* [NY] **48**, 94, 1968, respectively) field-theoretical treatments of one-boson and two-pion exchanges.

Unfortunately the book has been produced with many typographical errors, some of them very consequential. I mention two such here to alert the reader. Figure 48a has the Reid soft-core and the dispersion-theoretical potentials mixed up, and Table 1 (page 422) should be headed "... from energy-independent analysis."

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A Taste of Science

R. J. Tykodi, ed.

134 pp. Technomic, Westport, Conn., 1975.
\$10.00

The subtitle of this odd collection of essays and excerpts brings out the author's intended purpose: "An anthology of writings by scientists, writings of good literary quality showing—among other things—the human side of science." A quote from one of the essays included, the introduction to Lewis and Randall's 1923 edition of *Thermodynamics and the Free Energy of Chemical Substances*, illustrates the editor's taste in good literary quality: "Science has its cathedrals, built by the efforts of a few architects and of many workers. In these loftier monuments of scientific thought a tradition has arisen whereby the friendly usages of colloquial speech give way to a certain severity and formality. While this may sometimes promote precise thinking, it more often results in the intimidation of the neophyte."

The author, I believe, has inadvertently given aid and comfort to some of the criticism he hopes to counter. The inhumanity of science, some have alleged, is manifested through the scientist's reliance on technical terms, precise usage and rule-governed reasoning. The selected essays attempt to undercut this allegation by showing that scientists can also be chatty and informal, can reminisce and ramble, can even give recipes for scientific success (Guess. Work out the implications of the guess. Test them and reject failures. Thus George Polya and Richard Feynman). The essays, unfortunately, rarely clarify the nature of science or the methods of disciplined

thought regarded as basic to science.

The selections included can be roughly grouped into three types. First there are accounts of the lives of scientists—autobiographical reminiscences by Nobel laureates and two essays concerned with Paul Ehrenfest's suicide. The account I found most informative was Peter Medewar's diagnosis of Charles Darwin's illness as Chagas disease (transmitted by a bug known to have bitten Darwin in Argentina) rather than neurosis. The second group consists of essays from different fields, stressing the non-technical aspects of science as the hard core of scientific explanation. The third group represents informal, or humorous, illus-

trations of scientific explanation. Some, like D'Arcy Thomson's "On Magnitude" and Erwin Schrödinger's "What is Life?" have the familiarity of established classics.

Many educators are concerned with the rising tide of antiscientific sentiment and the concomitant tendency to picture scientists as something more or less than human, as starry-eyed idealists or calculating people-manipulators. The present anthology nibbles a bit at the frothy Frankenstein by showing that scientists do indeed have human emotions, aspirations and even failings. Yet I wonder whether a teacher attempting to interest the non-scientist in science should com-

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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