dates of state pharmaceutical associations and schools of pharmacy, the dates on which laws concerned with pharmacy were passed (in the U.S.), publications of the American Pharmaceutical Association, and museums of pharmacy throughout the world.

Hitherto the book has been useful in the classroom and in pharmaceutical and science libraries. This revision not only fills the same roles, but will also be useful in public libraries as a source of information on pharmacy for the layman and in high school libraries as a service to interested upperclassmen and their guidance counselors.

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The Solvay Congresses

The Quantum Theory of Fields. Proceedings of the conference held at the University of Brussels, October 1961. Stoops, Brussels; Interscience, (Wiley), New York, 1963. 261 pp. Illus. $8.

This is the report on the 1961 Solvay Congress, the 50th anniversary of the first Solvay Congress. The subject of the conference was, perhaps, more general than those of the most recent Solvay congresses, and perhaps even more general than the title indicates: it encompassed the most important developments of the last few years on the frontiers of modern theoretical physics.

The outward organization of the congresses has changed little throughout the years: addresses by "rapporteurs" are followed by a general discussion. This conference had a galaxy of reporters—Bohr, Heitler, Feynman, Pais, Gell-Mann, Källén, Goldberger, Mandelstam, and Yukawa. The number of participants was also greater than usual, even though the increase in their number did not keep pace with the increase in the number of physicists throughout the world. In addition to the reporters, there were nine members from the United States, three from Great Britain, and one each from Denmark, Germany, Italy, Japan, Sweden, and Switzerland. Members of the secretarial staff and the official "auditeurs" participated in some of the discussions. Three Russians were invited but could not come.

If the outward form of the conference was very similar to that of the early congresses, the spirit of the conference did undergo radical changes. This fact emerged most clearly from Bohr's colorful introductory report in which he reviewed the earlier conferences in a somewhat nostalgic but most fascinating address. His report on the first few conferences, though he did not attend them, is just as vivid and charming as that of the later ones at which he had a leading part. At the early conferences, all participants were familiar with the work of all other participants—they formed a single family intellectually. At present, it is hard to find anyone who can fully appreciate all parts of all the reports, even though personal contact among participants is more frequent. However, this greater intellectual distance between participants made the conference more exciting and also made the report—this book—more useful. Earlier Solvay reports had as much human as scientific interest; the present one, while not diminished in human interest, is also scientifically a most useful volume, one that I have already seen in the hands of several colleagues.

The reports vary a great deal in character and sophistication, and it is not possible to review all of them. I particularly enjoyed reading the contributions of Feynman, Pais, and Gell-Mann—perhaps because I was more familiar with the subjects of the other contributions.

Feynman's contribution has two parts. The first is a sketchy but instructive description of the way concrete results are obtained from quantum electrodynamics. The results are compared with experiments in order to assess the validity of quantum electrodynamics. The possible deviations are expressed as modifications of the propagator, and it is concluded that such modifications, if any, are not appreciable below an energy of 600 Mev. The second part of Feynman's contribution is a stimulating analysis of the foundations of quantum electrodynamics and its conceptual limitations. This is the most interesting part of the review, and it also contains brief reference to dispersion theory. It is not everywhere easy to follow, and I also had my difficulties. The report is studded with delightful apercus, such as the following: "No problem can be solved without dragging in its wake new problems to be solved. But the incompleteness of our present view of quantum electrodynamics, although presenting us with the most interesting challenges, should not blind us to the enormous progress that has been made. With the exception of gravitation and radioactivity, all of the phenomena known to physicists and chemists in 1911 have their ultimate explanation in the laws of quantum electrodynamics."

Pais presents a splendid review of our state of knowledge concerning weak interactions, with particular emphasis on accurate and approximate invariances. He divides the processes induced by weak interactions into three groups. The processes of the first group result in a pair of *leptons*, that is electrons, neutrinos, or μ-mesons. The decays of the second category also result in a pair of leptons, but the decaying particle undergoes a greater change than in the processes of the first category: their "strangeness" changes. The processes of the third category do not produce a pair of leptons but a strongly interacting meson, such as a π. Pais discusses the experimental material concerned with each of the groups of processes and also the validity of the various invariance principles for them. Although his report reaches the boundaries of our knowledge, it could also serve as an introduction for the less initiated.

Symmetries are the theme of Gell-Mann's discussion. He mentions all the precise symmetries that we know, as well as charge, baryon (that is, heavy particle), and lepton conservation. He considers the approximate conservation laws as implying particularly simple equal time commutation relations—a view that surely needs further elaboration but one which will be most fruitful if confirmed.

In summary, this book reports on a very stimulating conference in a most stimulating fashion. It is a pleasure to read, and I enjoyed virtually all parts of it—but at times it was a strenuous pleasure.

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Principles and Applications

Mass Spectrometry. Charles A. McDowell, Ed. McGraw-Hill, New York, 1963. xii + 639 pp. Illus. $20.

As science continues to become more specialized, it is increasingly more common and understandable that books are "edited by" rather than written by one

person. *Mass Spectrometry* contains 12 chapters by 14 authors. The complexities of instrumentation and the application of mass spectrometers virtually require such an array of specialists. As one would expect (and as the editor admits), the style of this book is not uniform and is somewhat repetitive, but the volume is much more comprehensive than would be possible otherwise.

Of course, it becomes increasingly difficult to review volumes to which so many specialists have contributed. Accordingly, this review was done by a reviewer versed in electronics and vacuum techniques applied to mass spectrometers in cooperation with one who applies mass spectrometric analyses to chemical and geological problems.

The 12 chapters are: "Types of mass spectrometers," by J. B. Farmer (38 pp.); "Mass spectrometry in research," by W. A. Bryce (24 pp.); "Ion sources," by R. M. Elliott (35 pp.); "Ion optics," by L. Kerwin (75 pp.); "Electronic techniques," by D. C. Frost (22 pp.); "High-resolution mass spectrometers," by H. E. Duckworth and S. N. Ghoshal (74 pp.); "Vacuum techniques," by H. A. Tasman (59 pp.); "Chemical analysis by mass spectrometry," by V. H. Dibeler (41 pp.); "Isotope abundance measurements and their application to chemistry," by C. C. Mullen and H. G. Thode (67 pp.); "Mass spectrometry of free radicals," by F. P. Lossing (64 pp.); "The ionization and dissociation of molecules," by C. A. McDowell (83 pp.); and "Ion-molecule reactions," by D. P. Stevenson (28 pp.).

Those who are not familiar with mass spectrometry will find that the chapter on types of mass spectrometers is an excellent source of introductory material. Methods of producing ions from various types of samples are well covered in the chapter on ion sources. With this exception, the chapters concerned with the performance of analyzers are largely designer-oriented; that is, they stress the mathematical treatments of principles without much discussion of the actual construction of components. A very complete coverage of ion optics and high resolution mass spectrographs is presented on this level.

The chapter on electronic techniques is a brief discussion of the electronic current and voltage regulators and amplifiers used in the production and detection of ion beams. The presentation of the transistorized versions of these circuits updates this section over the previous literature. As a reference source this chapter would be enhanced if ion data-handling techniques had been placed after the discussion of the electrometer presented elsewhere in the text.

Although its authors disclaim completeness, the chapter on vacuum techniques is an excellent summary of the problems, materials, and components of vacuum systems peculiar to mass spectrometers. This chapter should be of interest to individuals who construct their own equipment.

Because the authors attempt to review such a vast realm the chapter on mass spectrometry in research is abortive. Isotopic studies applied to geochemistry and cosmochemistry are covered in less than two pages, and the latest reference to sulfur isotopes is ten years old. Fortunately, Mullen and Thode's excellent chapter on isotopic abundance measurements salvages this field of endeavor.

"The purpose of this book is to provide a detailed and authorative account of the basic principles of mass spectrometry and the more important types of applications." We believe that this purpose, for the most part, has been obtained. But, the high cost of the book is regrettable.

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Astronautical Sciences

Progress in the Astronautical Sciences. vol. 1. S. F. Singer, Ed. North-Holland, Amsterdam; Interscience (Wiley), New York, 1962. xii + 416 pp. Illus. $14.50.

Many regret that the regular journals are no longer the sole outlet for new scientific and technical ideas. It complicates life a good deal to have to keep abreast of articles published in a variety of new books rather than limiting one's library (and reading) to the relatively few standard journals in a given field. In fact, I know one Nobel prize winner who does not consider an idea "published" until it appears in a journal. He may have a good point, but books are apparently here to stay—and we must welcome a good book.

Volume 1 of *Progress in the Astronautical Sciences*, edited by S. Fred Singer, is just the kind of book that complicates life, since it cannot very well be ignored. Each of its seven chapters is by a highly qualified author (or authors), each is a review of a given subject related to the field of astronautics (the upper atmosphere, space physics, space flight technology, and the like), and so far as I can tell each contains some interesting new ideas.

Singer states that the purpose of this new series is to fill a need for "a publication which reports advances in the various astronautical disciplines in a manner easily intelligible to the scientist or engineer, regardless of his field of specialization." The chapters are inevitably uneven in meeting this goal, but I am convinced that each can serve as a useful and authoritative source of information—as long as the reader recognizes that our knowledge about most of these subjects is advancing so rapidly that already *some* of the ideas are dated. (This is one trouble with a book, whose cover conveys a false impression of permanence to the words therein.)

The chapters by D. G. King-Hele, "Properties of the atmosphere revealed by satellite orbits," and F. S. Johnson, "The physical properties of the earth's ionosphere," will both stand the test of time very well, I think, even though there is now more that could be said about these broad scientific areas. The chapters by A. M. Stone and G. C. Weiffenbach, "Radio doppler method of using satellites for geodesy, navigation, and geophysics," and George Leitmann, "The optimization of rocket trajectories—A survey," will probably appeal to the engineer who wants to be brought up to date in these two important technical subjects. The two chapters by Ernst J. Öpik, "Surface properties of the Moon" and "Atmosphere and surface properties of Mars and Venus," are sure to delight all who are interested in our neighbors in space. Öpik has a very high place, in my estimation, among the astronomers who have made real contributions to our knowledge of the solar system, and, while there are points about which we disagree, these chapters are excellent reviews of three controversial areas. I noted with amusement the salty Öpikian comments on a variety of new Soviet lunar "discoveries." The last chapter, "Biodynamics of space flight" by Henning E. Von Gierke and Edwin P. Hiatt, is a comprehensive review of a rela-