many copolymers consist of long segments of homopolymer, and their infrared spectra are often superpositions of the two homopolymers.

Some highly significant contributions have been made in the field of infrared spectroscopy of high polymers in the last couple of years; unfortunately this book only covers the subject effectively through 1961. However, its coverage up to that point is excellent.

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Mathematics for Teachers

Elementary Contemporary Mathematics. Merlin M. Ohmer, Clayton V. Aucoin, and Marion J. Cortez. Blaisdell (Ginn), New York, 1964. xiv + 382 pp. Illus. $7.50.

In 1960 a committee of the Mathematical Association of America published recommendations on the undergraduate training of teachers of mathematics. Part of the suggested program for prospective elementary teachers was a two-course sequence on the structure of the real number system and its subsystems. At that time little text material was available for such a sequence. *Elementary Contemporary Mathematics*, based on courses at the University of Southwestern Louisiana, tries to meet this need, and its contents closely mirror the outline given by the committee. The topics included are elementary logic, set theory, the counting numbers, numeration systems, the integers, elementary number theory, the rationals, decimals and the reals, and finite number systems.

Since approximately these same elements can be found in texts designed for one-term courses, the authors might have explored related topics as well. But they have instead chosen to treat the same items with greater attention to detail than is customary. The book abounds in carefully analyzed examples. This feature combined with the extensive lists of exercises, many with answers, and with the clear proofs of most theorems should make large portions of the book accessible to the general reader. The authors' efforts to achieve clarity are, indeed, sometimes almost self-defeating. In places the exposition is highly repetitious, and, at times, unusual symbolism is introduced only to be discarded a few pages later. However, the interrelationships of the various topics are well developed. The logical symbolism of the first chapter, for instance, is used effectively but not to excess throughout the book.

Unfortunately, the chapter on decimals and the reals falls short of the standards set in the rest of the book. The proofs of two of the theorems contain flaws. Furthermore, the sequence concept and the idea of convergence are used without definition or even the acknowledgement that new ideas are being introduced. A lack of rigor in dealing with the reals is inevitable in a book at this level, but it is inappropriate to give the impression that no new problems exist. Finally, even the misprints in this chapter seem more likely to cause confusion than do those found in other chapters.

No serious attempt is made in this book to clarify the relation between the mathematics under discussion and the "real" world. A few gestures are made in this direction, but the reader will have to look elsewhere for any systematic treatment.

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Lecture Notes

Strong Interactions and High Energy Physics. Scottish Universities' Summer School, held at Edinburgh in July and August 1963. R. G. Moorhouse, Ed. Plenum Press, New York, 1964. xvi + 475 pp. Illus. $22.50.

The number of summer schools in physics has increased to the point where there are almost as many schools as there are physicists. One of the effects of these schools is the production of an unbelievable quantity of lecture notes. The quality of the notes is naturally not uniform; in too many cases they consist of material that would otherwise, and for good reason, be thrown directly into the waste basket. It is consequently gratifying to see this volume, which consists of lectures given at the 1963 Scottish Universities Summer School. One reason why the book is, on the whole, good is that the lecturers are all very active physicists who are enthusiastic about their subject.

The lead-off article in *Strong Interactions and High Energy Physics* is an introduction to relativistic S-matrix theory, by Euan Squires (University of Edinburgh) who curiously is not listed among the lecturers. After reviewing the Mandelstam representation for potential scattering and the general properties of partial wave amplitudes in nonrelativistic theory, Squires invites the reader to consider, in seven pages, the following topics in what is called relativistic S-matrix theory: Lorentz invariance, crossing symmetry, CPT and the connection between spin and statistics, maximal analyticity, and extended unitarity. These rather difficult ideas are not discussed with religious zeal, and Squires is quite frank about the tentative and uncertain aspects of the "axiomatization" of S-matrix theory. The remainder of his article is devoted to the singularities of the S-matrix and their relation to the unitarity condition and to attempts at dynamical calculations for two-particle scattering processes based on the Mandelstam representation.

A. O. Barut (University of Colorado) discusses the application of group theoretical methods to study the structure of S-matrix elements for reactions involving arbitrary numbers of particles with arbitrary spins. It is a rather highbrow treatment, and it is frequently difficult to tell what is being proved and what has been assumed about the analytic properties of the S-matrix. The methods introduced seem very general and powerful, but in one of the few parts that I could understand they lead to wrong results: The number of scalar amplitudes in photon-spin zero scattering is 2, not 4, and in photon-spin one-half scattering the number is 6, not 12.

In a rather short article, A. Martin (CERN) shows how, by extremely clever use of unitarity and analyticity, one can deduce interesting statements about high-energy scattering amplitudes and the extent to which a knowledge of the scattering amplitude in the elastic region determines it everywhere.

The relation between the singularities of scattering amplitudes regarded as functions of complex angular momenta and high-energy scattering processes is discussed exhaustively by R. Oehme (University of Chicago). This is a very complete and careful treatment of Regge poles in the relativistic

two-particle problem. Recent developments such as the existence of cuts are discussed and the effects of these, as well as other theoretically possible singularities in the angular momentum plane, on high-energy scattering. The possibility of "elementary particles" of conventional field theory being Regge poles is also treated.

The phenomenology of what the author cheerfully admits is the most naive application of the Regge pole hypothesis to high-energy scattering is described by B. M. Udgoankar (Tata Institute). The possibility of using Regge ideas in the low-energy pion-nucleon system is also discussed.

A detailed model for very high-energy reactions in which very many particles are produced is presented by S. Fubini (Università degli Studi di Padova). The relation between this approach and Regge ideas is explained.

What is perhaps the most elaborate dispersion theoretic attack extant on the low-energy pion-nucleon system is very coherently discussed by J. Hamilton (University College, London). All of the intricacies of this problem are carefully revealed, and the rug covering 10 years of dirt is raised.

One of the most appealing ideas to grow out of dispersion theory, although the idea is actually much older, is that all so-called elementary particles are composites of each other. This idea is refreshingly presented by F. Zachariasen (California Institute of Technology). The possibility of symmetries—for example, charge independence of strong interactions—emerging from self-consistency requirements is explained by simple, quantitatively unreliable, model calculations.

R. Blankenbecler (Princeton University) addresses himself to the problem of how one may hope to do actual computations in the real world of strongly interacting particles. He describes a formalism which is an elaboration of the so-called determinental approach to scattering problems. This D-(determinant) matrix theory has considerable formal beauty and is at least in theory free of some of the complications encountered in other current approaches.

After a slightly pretentious introduction, C. Lovelace (Imperial College, London) describes his own version of the theory of three-particle systems, based on the theory of Faddew who first attempted to give a rigorous formulation of the three-body system. The connection between various approximate treatments, in which the true three-particle states are roughly represented as one particle and a resonating pair treated as a particle, and the exact formulation is discussed. At the end of the article the reader is assigned a number of exercises which might be completed by the time of the next summer school session on the present topic.

This is a good and useful book for both students and advanced workers in the field.

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Organic Chemistry

Solvolysis Mechanisms. Edward R. Thornton. Ronald, New York, 1964. viii + 258 pp. Illus. $7.

The study of solvolysis reactions has received a great deal of attention from organic chemists in recent years. The mechanisms of these reactions, among the simplest we know about from a gross viewpoint, are exceedingly subtle when the fine points are critically examined. Classical organic techniques often prove inadequate and recently such approaches as investigations of linear free-energy relationships and isotope effects have been used to bring more evidence to bear on the subject. However, the story is far from complete, and the use of additional physical techniques, such as relaxation methods, will probably be required before the final answers are known.

Thornton's book, a volume in the "Modern Concepts in Chemistry" series, is not a review work but a discussion, and a rather successful one at that, of the important concepts generated by the investigation of simple solvolysis mechanisms. The various theoretical treatments involved are, in general, well integrated with the clear and quite readable qualitative discussions. The recent literature is used extensively, and particularly good lists of references, which are placed at the end of each chapter, give suggestions for further reading. Two chapters, one dealing with isotope effects and another with the more classical mechanistic aspects, are especially good, although it is regretable that a fuller discussion of nonclassical carbonium ions was not included. In another chapter the author gives a good discussion of linear free-energy relationships and other aspects of the study of reaction rates, and, in a fourth chapter, he deals with the theory of reaction rates and molecular orbital theory. This last chapter is the weakest portion of the book. Thornton introduces the theories at the simplest level, but then progresses rapidly to more advanced levels in a way that is not entirely satisfactory for the more advanced student or for the beginner. The portion on molecular orbital theory, although important to the subject of the book, seems out of place because very few results are ever discussed in terms of the theory.

The objections raised should not be considered particularly serious. The author obviously is well acquainted with the subject, and, in general, he presents the material very well. It is suggested in the preface that this book may be useful as an introduction to theoretical organic chemistry. Although I feel that there are better choices available for this purpose, Thornton's book is highly recommended as a perceptive discussion of the many aspects of physical organic chemistry involved in the study of solvolysis mechanisms.

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Statistics and Biology

Stochastic Models in Medicine and Biology. Proceedings of a symposium (Madison, Wisconsin), June 1963. John Gurland, Ed. University of Wisconsin Press, Madison, 1964. xvi + 393 pp. Illus. $6.

The inherent variability in almost all biological data strongly suggests that probabilistic techniques are required to derive the maximum information from them. Stochastic models are required for the elucidation of many phenomena in the life sciences, and indeed theoretical models seem to have appeared and proliferated with only the slenderest motivation from experiments. This volume, the proceedings of the Wisconsin symposium, is a good sample of current research; it illustrates not only the scope of such research, but also the large fluctuations