Instrumental Aspects

Introduction to Infrared and Raman Spectroscopy. Norman B. Colthup, Lawrence H. Daly, and Stephen E. Wiberley. Academic Press, New York, 1964. xiv + 511 pp. Illus. $12.

Recently there has been a big crop of books dealing with the chemical aspects of infrared and Raman spectroscopy. Most of them cover much the same ground and refer to essentially the same range of scientific literature. They differ in their degree of clarity and detail, in their varying emphasis on different aspects of technique or application, and in the flavor that stems from an author's personal experience in the field.

This book combines many excellent qualities, and brings together a wealth of information, set out clearly and concisely. It is well illustrated by diagrams of all sorts (those relating to molecular vibrations are particularly noteworthy). The first chapter is an account of molecular energy levels, the rules for transitions between them, and the essential features of infrared and Raman bands. Chapter 2 outlines the experimental methods for both infrared and Raman work, involving sources, dispersing systems, detectors, methods for sample handling, and other accessories. There is a useful account of vibrational modes in crystalline solids and the significance of using polarized radiation. The third chapter deals with molecular classification in terms of symmetry considerations, point groups, and group theory, and leads to the use of selection rules and other methods of assigning molecular vibration frequencies. The designation of vibrations according to their geometric form is then explained, and factors that affect the vibration frequencies—such as bond force constants, internal molecular structural features, coupling effects, and hydrogen bonding—are discussed.

Chapters 5 through 12 provide a detailed commentary on the characteristic localized vibrations of key groups when present in organic or inorganic compounds. For a given class of compound, not only the key group vibrations are given, but also other bands that usually arise. Chapter 13 should be very valuable to all who are concerned with molecular structure. It includes, first, a set of correlation charts that show the probable location of key group vibrations in the range 4000 to 200 cm^{-1}, and also a table that indicates the ranges over which different solvents can be used. There follows a set of more than 600 spectra of all kinds of compounds, on each of which the main absorption bands are identified with the corresponding vibrating group concerned.

Chapters 14 and 15 provide a complete treatment of the assignment of the vibration frequencies of chloroform, a study of the molecular force field, and the calculation of the thermodynamic properties.

There is no doubt that this book will be welcomed not only by workers in industry, but also by university students and others who wish to obtain a good appreciation of the main principles of this subject.

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Limnology

Ergebnisse der Limnologie. vol. 2, *Remains of Animals in Quaternary Lake and Bog Sediments and Their Interpretation*. David G. Frey, Schweizerbart'sche, Stuttgart, Germany, 1964. ii + 114 pp. Illus. Plates. DM. 23.

The appearance of the new series of publications *Ergebnisse der Limnologie* by the editors of the *Archiv für Hydrobiologie* will arouse considerable interest among limnologists. If the paper under review represents the standards to be maintained, we can be satisfied that an extremely useful series of review articles is well under way.

Remains of Animals in Quaternary Lake and Bog Sediments and Their Interpretation, by David G. Frey, is a detailed review of the present state of information on the occurrence of recognizable fossils in lake sediments and the ecological interpretations that can be based on the fossils.

As a lake ages and fills in, the sediments that build up contain fragments of organisms, some of which are recognizable to genus or species, and considerable information exists about the change of biota over time in several lakes. Much of Frey's own work has been directed toward making specifically recognizable the little chips of chitin that are parts of the head capsules of chydorid Cladocera, and it is now possible for him to write a complete list of species of these animals in lakes at different ages in the past. This work provides greatly expanded knowledge of natural succession in lakes and enables development of improved concepts of species composition and succession in aquatic communities. The present paper will be an important source of information to those who wish to enter this field and to those who wish to learn what is available in it.

Nipkow's remarkable results in hatching rotifer eggs from sediments of known age suggest that other fossils may not be beyond the reach of the neolimnologist, and one might suggest that an attempt to develop resting stages of other organisms from sediments might permit much more interpretation than is presently available from dead fossils.

Frey's review is entirely concerned with morphological characteristics of fossils, and it seems likely that the most complete and detailed interpretations will be based on them. Biochemical knowledge of fossils is not as advanced and seems inherently more limited, but the exciting discovery of a pigment specific to *Oscillatoria rubescens* in lake sediments gives hope that there can be a development of knowledge based on chemical components of sediments, which will give equally useful information.

The paper under review is a fine example of a type of publication that we need, and the list of titles in preparation is promising.

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Scientists at Work

The Management of Scientists. Karl Hill, Ed. Beacon Press, Boston, Mass., 1964. xvi + 143 pp. Illus. $4.95.

This book consists of a collection of six essays that were delivered in a lecture series under the same title, sponsored by Northeastern University in 1963.

The fact that the book has been published underscores the need for a discussion of the whole problem of the management of scientists. One can infer from the title that there is a need to manage scientists and that the process is necessarily different from that of managing other categories of mankind. One cannot deny that these things are true. There is an undeniable tendency for scientific projects to grow larger, and in most areas of science we have

long since left behind the era of the single scientist working alone in his laboratory. With the emergence of the group scientific effort, there also emerges the need for management. Whether it is the nature of scientists which makes them more difficult to manage, or whether it is simply that one is faced with the problem of managing a group of individuals of above normal intelligence, we just do not know.

The discussions in this book consider some, but by no means all, of the problems involved in the management of scientists. The act of management in this area has three principal factors: hiring, firing, and providing a proper environment. Only the last of the three aspects is discussed here. Anyone who has been involved in the management of scientists, however, will recognize the great importance of the first two, and it is somewhat surprising that they are not discussed in a book with this title.

In the first chapter Everett Mendelsohn gives an excellent and revealing history of the emergence of science in the 19th century, with some illuminating insights into the problems of those times and some remarkable parallels to our problems today.

The chapter entitled "The psychology of scientists," by Anne Roe, is perhaps an unfortunate inclusion, for it provides a detailed analysis of a nonrandom sample of scientists. Perhaps all that is proved is that scientists make reasonably good actors, for the list which she provides of the traits of productive scientists is exactly what one would expect. It preserves intact the image of the scientist.

The chapters by Royden Sanders and Albert Siepert, on the problems of managing research, provide a strong contrast. Siepert's analysis of government laboratories is an excellent article that provides a constructive discussion of this kind of laboratory, but the one by Sanders, on industrial laboratories, is replete with such exhortations as "provide proper climate," "nurture the creative," "recognize good ideas," "learn to communicate," "have courage," and "guard against complacency" —advice which may be good, but is not constructive.

Norman Kaplan's article on the organization of science is interesting because of its healthy criticism of industrial laboratories and their attempt to emulate the university atmosphere, a trend which has certainly not been a universal success and one which certainly needs reevaluation.

In the final article, on the adaptive process, Herbert Shepard attempts to strike an analogy between adaptive biological organisms and the research laboratory, an analogy that he pursues to the bitter end. Some of the examples are apt and amusing, but others show the strain of a forced fit.

It is difficult to know who, if anyone, is likely to profit from reading the book, for those already involved in the management of scientists will learn little (with the possible exception of some of Sanders' quotations), and those who are newly faced with the problem of managing scientists will find little to guide them on their chosen path. Perhaps if the title had been less dogmatic, less inclusive, and more cautious, one could recommend the book to nonprofessionals as a source of some illuminating sidelights on the world of science, scientists, and their administrative environment.

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Russian Popularization

Accelerators of Charged Particles. B. S. Ratner. Translated from the Russian edition by L. A. Fenn. H. W. Curtis, Translation Ed. Pergamon, London; Macmillan, New York, 1964. viii + 120 pp. Illus. $3.50.

The conquest of the air through the development of the airplane and the conquest of outer space by means of telescopes and rockets have been heralded almost daily in our newspapers, and it is a dull boy indeed who cannot give an adequate account of either field (although he might get a bit foggy in dealing with the distant parts of outer space). The conquest of inner space, the world of the atom and within that of the electron and proton, remains less well known. Although rockets and telescopes are familiar to all, their equivalents for exploring the inner world, the accelerators of charged particles, are not as well known.

B. S. Ratner of Moscow has set for himself the task of explaining these tools to the general reader and has written *Accelerators of Charged Particles* with the assumption that all the terms and concepts of atomic physics are unfamiliar to his readers. Thus, he begins with a review of the atomic world and of how we have come to know of the properties of atoms through, for example, the classical scattering experiments of Rutherford. Proceeding to a description of the early and very simple accelerators, such as the transformer-rectifier generator of Cockcroft and Walton or of the electrostatic machine of Van de Graaff, he then explains how beams of particles produced by such machines can be used to "see" into the nucleus.

In subsequent chapters Ratner deals with more sophisticated machines such as cyclotrons or betatrons which give higher energy and which were used especially in the early exploration of the nucleus, largely in the era before 1940. This brings him to the golden age of his subject, the last 15 years, during which time remarkably large and complex accelerators have been constructed to study the properties of the subnuclear particles—the proton, the electron, various kinds of mesons, as well as the rich and exotic forms of these particles that can be created by collisions between them. It is during this period that the Russians have participated vigorously in the field and have attempted to be competitive with, possibly even superior to, researchers in this country. The book is at its best at this point in giving simple explanations of the ideas and principles underlying the construction of such machines as the synchrocyclotron (phasotron), the synchrotron, the linac (linear accelerator), and the proton synchrotron (synchrophasotron).

The translation has not been carefully made; most of the names, having been twice transliterated, come out badly misspelled. It is inexcusable to read about the bevatron at the California Institute. I would also criticize Ratner for not having explained more fully the reason for building the large machines and for not giving more of a taste of the beautiful and multifarious results that have made the building of so many great accelerators such a justifiable activity. Although he gives a rather complete introduction to the techniques and experiments of classical nuclear physics, the author has almost totally ignored the techniques and experiments of high energy physics, techniques and experiments that, after all, are part and parcel of the accelerators themselves.

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