The book is important not only because it reviews and explicates Machian theories, experiments, and doctrines. It also gives an evaluative account of the life of this giant of science and philosophy. Most importantly, it traces in their Machian background some roots of important segments of modern science and shows how they developed in line with one man's need not only to know but to know consistently within an embracing context. Ratliff has written an unusual and valuable book.

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Biomedical Engineering

Biomedical Electronics. Howard M. Yanof. Davis, Philadelphia, 1965. xii + 361 pp. Illus. $12.50.

With the growth of biomedical engineering, numerous attempts have been made to write electronic engineering textbooks for biologists and physicians [Brown's *Instrumentation with Semiconductors for Medical Researchers* (Thomas, 1964); Donaldson's *Electronic Apparatus for Biological Research* (Butterworth, 1958); and Whitfield's *An Introduction to Electronics for Physiological Workers* (Macmillan, ed. 2, 1960)]. The present text, *Biomedical Electronics*, tries to provide a textbook for biologists and physicians and also to educate engineers regarding problems and instrumentation in biomedicine. Its outstanding merit is the comprehensiveness of its survey of instruments and techniques, which is supplemented by a great number of excellent photographs and line drawings. It will be a very valuable source book of information about commercially available electronic instruments and systems.

The book, however, has serious inadequacies with regard to its primary purpose—that of training biologists and physicians in electronics. In this respect, it does not differ greatly from most of the other texts in this field, for none of the authors seem to appreciate fully the magnitude of the task they are undertaking. Yanof devotes seven chapters (159 pp.) to this end. He covers the appropriate topics in chapters entitled "Basic physical concepts," "Introduction to ac circuit theory," "The measurement of voltage and current," "The rectifier and the diode," "Amplification," "The oscillator," and "The power supply." The second section, comprising about six chapters (158 pp.), covers biomedical instruments, transducers, signal display and recording, noise and its elimination, and examples of biomedical instrumentation. The first section covers the material in the same fashion that a jet plane covers a terrain from 40,000 feet. If the reader is already familiar with the subject, he will recognize familiar concepts. It seems unbelievable that a novice could obtain any firm understanding of electronics from this treatment. In my experience, to educate a biology student in electronics requires four or five classroom and laboratory hours per week for several semesters of work. In order to succeed with this program, the student must be adequately prepared in general physics and mathematics including a working knowledge of the calculus. Most texts in this field, including the present volume, try to teach elementary calculus. I consider this an exercise in futility.

The second section will serve as a useful survey of current instrumentation for engineers who are trained in physiology. Biologists will not be able to appreciate fully the discussion of instrumentation problems if their training is limited to the presentation of electronics given in the first part of this book. To add to the students' problems, the text in both sections is marred by careless mistakes—for example, formulas 2.42 and 2.43 and the formula for source noise on page 308.

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Fundamentals of Botany Series

Vascular Plants: Form and Function. Frank B. Salisbury and Robert V. Parke. Wadsworth, Belmont, Calif., 1964. viii + 184 pp. Illus. $2.35.

This volume is one of a series of seven paperback volumes edited by W. A. Jensen and L. G. Kavalijian; the other volumes are *The Plant Cell* by Jensen; *Reproduction, Heredity, and Sexuality* by S. A. Cook; *Nonvascular Plants: Form and Function* by W. T. Doyle; *Plants and the Ecosystem* by W. D. Billup; *Evolution and Plants of the Past* by H. C. Banks; and *Plants and Civilization* by Herbert G. Baker.

In a volume of only 184 pages some areas of interest must be omitted. The authors wisely left out discussions of photosynthesis and respiration. They have included chapters on growth, hormones, transpiration, translocation, photobiology, biological time measurements, the physiology of flowering, and the physiology of germination.

Unfortunately some important recent work has been omitted. In the discussion of plant growth the elegant work of Erickson and others on root growth is not mentioned, nor is the concept of the Plastichron index as a new and important measure of plant growth.

No indication about the authors' intended audience is given in the foreword; presumably it is a student audience. If so, there is a serious lack of reference information; a general bibliography is included, but there are no specific citations in the text. For example, the important term *vapor pressure deficit* is mentioned parenthetically in the text. A specific reference to one of the standard works would be helpful to the reader who is puzzled about the relationship between vapor pressure deficit and transpiration.

Those parts of the book that deal with plant taxonomy and morphology are basically sound and well presented.

The first chapter includes comments on the nature and methods of classification and provides a system of classification in keeping with present-day knowledge. Some readers, however, may be startled to find the bryophytes and vascular plants included along with the green algae in the Division Chlorophyta, which is given equal rank with such units as the Euglenophyta, Cyanophyta, and Rhodophyta. In this chapter, the major groups of vascular plants are described in capsule form, a presentation that is remarkably successful despite its brevity.

Errors, such as incorrect use of the word "isodiametric" in connection with cork cambium and ray cells, are few.

As the information about plant science becomes more extensive and, at the same time, more specialized, books such as this have a place in the literature along with the research paper, the review article, and the conventional textbook. For the professional biologist whose elementary botany is an experience of the distant past, and for the graduate student with somewhat different interests, such a book serves well for purposes of review and orientation. For the beginning student it could also be of value, if accompanied by a well-planned series of lectures and a carefully presented sequence of laboratory exercises.

An excellent glossary is included, and the illustrations are for the most part clear and well done. The authors are to be complimented on a very useful publication.

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Mathematics

Markov Processes. vols. 1 and 2. E. B. Dynkin. Translated from the Russian by J. Fabius, V. Greenberg, A. Maitra, and G. Majone. Academic Press, New York; Springer, Berlin, 1965. vol. 1, xii + 365 pp.; vol. 2, viii + 274 pp. Illus. $12 each.

Diffusion Processes and Their Sample Paths. Kiyosi Itô and Henry P. McKean, Jr. Academic Press, New York; Springer, Berlin, 1965. xviii + 321 pp. Illus. $14.50.

The theory of Markov processes has undergone a remarkable development in recent years. Two decades ago, many of what are now important parts of the subject were completely unknown, or were known only in an embryonic form. Although some special types of process had been studied in detail, the general (continuous time) theory consisted mostly of theorems which established, under various regularity conditions, that Markov transition probabilities were the solutions of certain functional equations. Little was known about path functions, aside from some sufficient conditions for continuity or step-function character.

A very different picture of the subject is presented in the volumes reviewed here. Dynkin's treatise, *Markov Processes*, gives an overall view of the general theory, almost to date. The work begins with the study of semigroups of transition probabilities, proceeds to the measure theoretic definition of Markov (and strong Markov) processes, and then turns to the relationship of the two aspects with each other. (The author has made fundamental contributions to this subject, among others.) These matters occupy about one-third of his book. The main topics treated in the remainder are functionals and their use in transforming one process into another, potential theory (not including boundaries), and strong Markov processes with continuous paths, especially the one-dimensional case. There are a sizable mathematical appendix and a brief historical one.

Markov Processes is a remarkable accomplishment, and the author is to be congratulated on creating a summary that will be indispensable for specialists in the field. It is not easy to read, because the number of definitions and notations which must be remembered becomes very large as one progresses through the book. Not much motivation is provided either, and unless the reader is sufficiently acquainted with special cases or "old fashioned" theory to supply his own, the going will be hard indeed. But in the hands of its proper audience, Dynkin's book should prove to be a great asset in performing further research.

"Diffusion processes" are strongly Markovian processes with continuous paths. (Dynkin uses the term in a more restrictive sense.) Their mathematical theory—and indeed, that of general Markov processes—began with Norbert Wiener's construction of the "Brownian motion" process, although physically motivated work had revealed glimpses of many of their properties before a rigorous foundation was available. Like the general theory, of which it forms a substantial part, the study of such diffusions has recently made great advances; Itô and McKean have themselves provided major contributions. Their book, *Diffusion Processes and Their Sample Paths*, has evolved with the subject during a ten-year period, and in its final form gives a remarkably comprehensive survey of an interesting and useful part of probability theory.

Diffusion Processes begins with a thorough study of the standard Brownian motion process on the line, which serves not only as the leading example but forms a basis for the construction of other diffusions. The most general one-dimensional diffusion is discussed very completely, and many deep properties of the sample paths are established. The multidimensional Brownian motion and its close relatives are then treated at some length, and finally a sketch of the general, as yet very incomplete, theory is given.

There is some overlap of content with Dynkin's book, *Markov Processes. Diffusion Processes*, restricted to a narrower field, goes more deeply into the subjects treated by both; in addition it contains many more of the details and examples which can make a subject "come to life." On the whole the style is pleasantly informal. However, the book is decidedly difficult to read, largely because the proofs are often very condensed. There are many interesting problems, usually with an outline of the solution.

Despite their differences of style and content, certain remarks apply to both of the books under discussion. Neither is for beginners, or suited to the casual reader—even the casual mathematical reader. But it is equally clear that both are major works, which will have no small influence on research and researchers in the theory of Markov processes for years to come.

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Faraday Reprint

Experimental Researches in Electricity. vols. 1 to 3. Michael Faraday. Dover, New York, 1965. vols. 1 and 2, 896 pp. (bound as one volume); vol. 3, 602 pp. Plates. $15.

It seems incredible that these volumes have never been reprinted in their entirety in the 20th century. They, and the facsimile reprint made by Bernard Quaritch in the 1870's, have become increasingly rare until they have now attained the status of a collector's item that sells for upwards of $200 a set.

Their value is not due entirely to their rarity but also to their contents. Here is the record of one of the most extraordinary intellectual adventures in the history of science. And, like a true adventure, it builds from humble, even commonplace, beginnings to a soaring conclusion. For what is recorded here are the origins of field theory from Faraday's first tentative and highly cautious rejection of action-at-a-distance, through his successful use of