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

his own concepts in electrochemistry, to the triumphant application of the concept of the field and the line of force in his magnetic researches in the 1840's and 1850's. To read these papers is to experience, with Faraday, the thrill of discovery.

Dover has produced this reprint handsomely and at a moderate price. My only complaint is that the letters to Tyndall on diamagnetism and the lines of force, letters that were published in *The Philosophical Magazine* after the third volume of the *Experimental Researches* had been published, were not included, for they end the story. Despite this, these volumes can still be heartily recommended to anyone interested in the life of science.

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A Survey of Recent Research in Poland and the U.S.S.R.

Catalysis and Chemical Kinetics. A. A. Balandin and others. Wydawnictwa Naukowo-Techniczne, Warsaw, Poland; Academic Press, New York, 1964. xii + 255 pp. Illus. $10.

This slender volume is of exceptional interest to English-speaking readers who are concerned with kinetics and catalysis. The interest lies in the technical content and in the unusual nature of the book.

In a sense this is a one-volume version of *Advances in Catalysis* (also published by Academic Press) that surveys the research carried out in Poland and the U.S.S.R. during the postwar period. There are 14 chapters, each in the nature of a review article; six are by Soviet authors, eight by Polish. Coverage is highly selective, which is perhaps justifiable as a practical necessity in so vast a field.

The *raison d'être* of the book is somewhat enigmatic. The volume was printed in English, in Warsaw. In the preface, W. Trzebiatowski of the Wroclaw Technical University indicates that the book is intended to review the extensive work on catalysis and kinetics carried out in Poland. He does not refer to the Russian authors, although their contributions constitute almost 40 percent of the volume.

The introductory chapter, by Balandin, is a brief but well-balanced survey of Soviet advances in catalysis and kinetics; Balandin, in turn, makes no reference to the Polish investigators represented in the volume. Balandin, in fact, dominates the Soviet contributions. Aside from the introductory chapter, he provides in chapter 3 an updating of his multiplet theory of catalysis, emphasizing particularly the relation between bond strengths and activation energies predicted for the postulated model of substrate-catalyst complex.

Two other chapters are by co-workers of Balandin. In chapter 5 Vasyunina discusses the hydrolytic hydrogenation of polysaccharides, in the presence of phosphoric acid and ruthenium, in terms of Balandin's multiplet theory. Again the treatment goes beyond the geometrical framework, in which the original theory was couched, to the consideration of activation energies and the prediction of regular trends in energy as the result of systematic substitution in the reactants. Klabunovskii, also from Balandin's school, provides a brief and unsatisfactory discussion of asymmetric reactions carried out over optically active catalysts (chap. 6). The attempt to relate this work to enzymatic reactions is again framed in the language of the multiplet theory.

In chapter 2 Dubinin, whose studies of adsorption, particularly on active carbons, have been well known to a Western audience for some 40 years, summarizes the theoretical and experimental work of his school on the physical adsorption of gases and vapors on energetically heterogeneous carbon surfaces. Dubinin uses the (Polanyi) potential theory of adsorption and illustrates the extraordinary power of this approach to account for the experimental data on physical adsorption.

Two articles by Boreskov and Bielański are of exceptional interest. Both are concerned with understanding catalytic activity in terms of the electronic structure of the catalysts. Boreskov summarizes work carried on at the Karpov Institute of Physical Chemistry on the general problem of rational catalyst selection, both for metallic and transition metal oxide catalysts (chap. 5). The treatment is broad, rather than deep, but very stimulating nevertheless. In the United States Bielański's work at Cracow is less well known than that of Boreskov. His article is specifically concerned with changes in electrical conductivity during catalytic reaction over semiconducting oxides (chap. 7). A portion of the article, treating alcohol dehydrogenation over oxides, is taken almost verbatim from an earlier paper presented by Bielański and his co-workers at the Second International Congress of Catalysis (1960). It is interesting that both Boreskov and Bielański independently, and properly, warn that subtle but substantial changes may occur in the catalyst as a result of interaction with the reactants, which in turn may greatly affect the catalyst activity.

A third article concerned with the fundamental characterization of catalysts is by Trzebiatowski (chap. 10). Trzebiatowski, who has published with Selwood, applies Selwood's magnetic methods to establish the degree of dispersion of paramagnetic and ferromagnetic catalysts.

In a rather long article Sokalski discusses the problem of energetic heterogeneity in Fischer-Tropsch catalysts (chap. 8). He is concerned both with the development of heterogeneous surfaces during the impregnation from solution of a polydisperse support and with the adsorption of gases on such heterogeneous surfaces. Unfortunately the presentation is difficult to follow because of complicated nomenclature, much of which is inadequately defined.

Treszczanowicz summarizes studies on the kinetics and catalyst selectivity of alcohol dehydrogenation-dehydration, particularly over zinc-iron alloy catalysts (chap. 9). In chapter 11 Yatsimirskii reviews the astonishing versatility of the catalyzed iodide–hydrogen peroxide reaction, which in the hands of Yatsimirskii and his students has been utilized as the basis of extremely sensitive methods for the quantitative determination of molybdenum, tungsten, iron, tantalum, and zirconium.

Bretsznajder discusses the mechanism of nucleation in the thermal dissociation of solid phases, a field in which his own contributions have been great (chap. 12).

Jezowska-Trzebiatowska concerns herself with the mechanism of redox reactions in solution, and especially with establishing, by isolation of intermediate species and measurement of kinetics, whether reduction occurs by direct transfer of electrons or by transfer of atoms or groups (chap. 13). The discussion centers about the reduction of the oxyanions of manganese, iron, and rhenium.