able as are those who point to "production" or "generatings" that are unobservable. And thus far the two theories of causal connnection will be on a basis of equality. We cannot now use the argument that unobservable sequences should not be countenanced, for one of Harré's main points in this book is that theoretical constructions of general conceptual schemes are to be judged and understood in terms of the success of the scientific enterprise which is undertaken in their terms.

The essay now proceeds to discuss the hierarchy of mechanisms of explanation. It is often the case that one theory which explains the observable regularities in nature is, in turn, explained by another theory. Whether this "imbedding" (as it might be called) of one explanatory theory in another is feasible will depend on what the general conceptual scheme allows.

In the Newtonian general conceptual scheme, a certain process, the motion of a free body in a straight line, is invariant, and certain properties (energy, momentum, and mass) are conserved. These conservations and invariants are not obtained as the direct result of experiment, but are parts of the G.C.S. But, as the author urges, some invariants of these sorts are necessary for prediction. There are, in the G.C.S. with which Harré is concerned, certain general principles that he calls regulative principles, such as those of sufficient reason and universal causality. In the Newtonian conceptual system, in particular, there are assumptions about the regularities of coexistence and succession. And in this system there are basic individuals, the minimal atomic constituents of matter, basic properties of such individuals, mass, extension, figure, and basic relation of time, space, and motion. Finally, there are two kinds of interaction: namely, impact and gravity.

In the second part of his essay, Harré discusses in succession Gassendi, Bacon, Boyle, Galileo, Locke, and Newton to illustrate the variety of methods and arguments used in the 17th century to recommend the G.C.S. of the corpuscularian philosophy. The distinction between the qualitative and quantitative features of perceptual experience was the basis for the most important ingredients of the G.C.S. of most of the 17th-century philosophers of science. The distinction was construed as a distinction between the real features of the physical world, and those qualitative features that were ascribed to the effects of interaction between the percipient and the bodies affecting his senses—that is, the distinction between primary and secondary qualities. Harré distinguishes three different methods by which their distinction was argued: the general method of Boyle, the empirical method of Bacon, and the analytical method of Galileo and Locke. These methods of argument were soundly criticized by Berkeley who showed that they were all philosophically deficient. Harré's main point about this criticism amounts to the following: Berkeley's arguments are not fatal to the corpuscularian philosophy. Berkeley did succeed in proving that this philosophy will not do as a theory of knowledge. But the justification of the corpuscularian philosophy "does not consist in the impossible task of demonstrating that perceptual experience forces the primary properties of matter upon us, but in the power to unify and underwrite the laws of the superficial relations of phenomena."

Harré has done a very valuable service in reminding us that this G.C.S. was an important part of the great 19th-century enterprise which launched physical science in the form that assured its permanent success. Without some such metaphysics to justify the procedures it might never have gotten under way, and, certainly, would have taken a different form. The philosophical deficiencies of this metaphysics which Berkeley revealed did not deter the scientists of the time, and it is fair to say that the unacknowledged metaphysics of science to this day bears marks of its 17th-century origin. Harré's book may be read by contemporary scientists with profit in this connection.

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Dynamics of Chromatography

A welcome addition to the literature on chromatography is this first part of a three-volume treatise, *Dynamics of Chromatography*. In part 1, **Principles and Theory** (Dekker, New York, 1965. 335 pp., $11.50), the author, J. Calvin Giddings, attempts to unify all forms of chromatography with one common theory and language. The "rate theory" is presented to the virtual exclusion of other theories (the plate theory is discussed briefly); discussion of the thermodynamics of the separation process is intentionally omitted. (A companion volume on the equilibrium aspects of chromatography by Keller is promised.) Zone spreading is treated from the dynamic, nonequilibrium point of view based on the model of a random walk. The author has had a significant role in the development of this theory, and his book strongly reflects his viewpoints. Because the theory is still in the process of development, there are undoubtedly those who will disagree with parts of the presentation [see, for example, a recent exchange of letters in *Anal. Chem.* **38**, 489 (1966)].

Unfortunately some of the conventional symbols have had to be changed to achieve a common language. However, confusion has been kept to a minimum by repeated definitions and useful appendices of symbols and significant equations.

Each chapter contains references to primary sources, totaling about 300. Of these approximately 45 cite the author's own work. Most of the references are from the period 1954 to 1964. Adequate author and subject indices are included.

This book will appeal to many because it is not "primarily a theoretical work designed to cast ideas into mathematics; it is more an interpretive work whose object is to make physical sense of theoretical developments in chromatography." Although this goal has been achieved, the book is not devoid of mathematical equations and derivations.

The treatment is thorough and comprehensive and ranges all the way from "difficult" theoretical parts ("may be omitted without loss of continuity") to practical applications of theory (often in the form of "rules-of-thumb"). In order to comprehend the material at either level, some background in chromatography is required. Parts of the book, most notably chapter 4, are so theoretical that they will be of little interest to the practicing chromatographer.

The nonmathematical parts are clearly written. All chapters are extensively subdivided for easy reading. The author often concludes and summarizes individual sections, using short definitive statements.

While the practical chromatographer may not be willing to take the time

to wade through the entire book, he will find parts of it to be useful, and the academician should make use of most of it. If parts 2 (*Gas Chromatography*) and 3 (*Liquid Chromatography*) build upon the theory from part 1 as anticipated, then the value of part 1 will be further enhanced.

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Steroid Metabolism

Elucidation of the chemical changes involved in the biosynthesis and catabolism of steroid hormones represents one of the great triumphs of biochemical endocrinology during the past quarter of a century. The development of excellent chromatographic methods for the separation of innumerable closely related steroids, and of isotopic and other procedures for the microestimation of these substances, are among the major factors responsible for the astounding progress in this field, which has had immense bearing on many clinical problems. This new edition of Ralph Dorfman and Frank Ungar's treatise **Metabolism of Steroid Hormones** (Academic Press, New York, 1965. 726 pp., $32) is a monumental feat of documentation of the vast and ever expanding literature on steroid metabolism, and correlates well many disparate experimental and clinical investigations.

The volume is divided into nine chapters, beginning with a brief but incisive treatment of the nomenclature and conformational analysis of steroids. There follows an account of the presence of steroids (excluding bile acids) in various animal tissue and body fluids. Like many of the other chapters, this consists of a relatively concise text, followed by a series of comprehensive tables, and then depiction of every relevant structural formula. A useful part of this second chapter is a thoughtful consideration of the various artifacts that may arise during hydrolysis, extraction, and isolation of various steroids, particularly from urine. The third section deals with pathways for the biosynthesis of steroid hormones in the gonads, adrenal cortex, and placenta, and pathways for the formation of steroid conjugates in various peripheral tissues. It also summarizes the nature and locus of action of known inhibitors of steroid biosynthetic reactions, as well as the actions of hypophyseal trophic hormones and other substances that stimulate these processes. The next chapter ties together a vast amount of recent work on microbiological transformations of steroids.

The fifth section is largely comprised of 60 tables and 46 accompanying figures dealing with the catabolism of neutral and phenolic steroids, including the formation of conjugates of the various products. Chapter 6 discusses the enzymatic basis of steroid metabolism. Although it is comprehensive and provides a thorough bibliography, I find this the least satisfactory part of the book. In my opinion, not enough emphasis is placed on the meaning and reliability of studies of steroid transformations carried out with highly refined enzymes as compared with very crude tissue extracts. In the discussion on hydroxysteroid dehydrogenase reactions, for example, practically nothing is said about the clear-cut insight into the equilibria between various steroids and pyridine nucleotides, or about the stereospecificity of the hydrogen transfers, which could only be obtained with the few enzymes of this class that have been purified to a very high degree.

The next chapter, "A system of steroid metabolism," contains 72 tables, replete with structural formulas, of the possible metabolic transformations of about 60 neutral and phenolic steroids. The following chapter deals with the relationship between tissue steroids and metabolites in blood and urine; it includes a useful account of our knowledge of the levels of biologically active steroids in blood plasma. The book ends with a survey of recent studies on steroid hormone production rates in normal individuals and in various disease states.

Conspicuously absent from this volume is any discussion of the possible relationship of the metabolic transformations and tissue distribution of steroid hormones to the molecular mechanisms by which these substances regulate the growth and function of cells. But perhaps that is all for the best, considering the extent of our present ignorance concerning the latter topic. It is inevitable that misprints and even misquotations should creep into such an encyclopedic catalog, although I noted very few. As befits a work of this nature, there are extremely thorough indexes to authors and subjects. The organization of the numerous tables and charts is such that it is very easy to find where any particular steroid is located in the body and how it is manufactured and disposed of.

As the authors state in the preface, the volume was avowedly fashioned for the novice as well as the expert, and with the requirements of both the clinician and the laboratory investigator in mind. In this and many other respects *The Metabolism of Steroid Hormones* succeeds admirably. Dorfman and Ungar have rendered an important service to biochemistry and endocrinology in compiling this up-to-date and handy reference work.

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New Books

Mathematics, Physical Sciences, and Engineering

Advances in Fluorine Chemistry. vol. 5. M. Stacey, J. C. Tatlow, and A. G. Sharpe, Eds. Butterworth, Washington, D.C., 1965. 294 pp. Illus. $14.95. Two papers: "Oxyfluorides of nitrogen" by C. Woolf and "Fluorides of phosphorus" by R. Schmutzler.

Analysis. vol. 2. Einar Hille. Blaisdell (Ginn), Waltham, Mass., 1966. 686 pp. Illus. $10.50. A Blaisdell Book in the Pure and Applied Sciences.

Asymptotic Expansions for Ordinary Differential Equations. Wolfgang Wasow. Interscience (Wiley), New York, 1966. 372 pp. Illus. $14. Pure and Applied Mathematics Series, edited by R. Courant, L. Bers, and J. J. Stoker.

Chemical Aspects of Polypeptide Chain Structures and the Cyclol Theory. Dorothy Wrinch. Munksgaard, Copenhagen, Denmark, 1965; Plenum Press, New York, 1966. 195 pp. Illus. $9.50.

The Circular Functions. Clayton W. Dodge. Prentice-Hall, Englewood Cliffs, N.J., 1966. 188 pp. Illus. $5.95.

Coatings of High-Temperature Materials. Henry H. Hausner, Ed. Plenum Press, New York, 1966. 306 pp. Illus. $15. Three papers: "Coatings of high-temperature materials" by G. V. Samsonov and A. P. Epik [translated from the Russian work (Moscow, 1964)]; "Properties of coated refractory metals" by W. A. Gibeaut and E. S. Bartlett; and "Coatings on refractory metals" by D. H. Leeds.

A Concept of Limits. Donald W. Hight. Prentice-Hall, Englewood Cliffs, N.J., 1966. 152 pp. Illus. $3.95. Teachers' Mathematics Reference Series, edited by Bruce E. Meserve.

Design of Film Bearings. Paul Robert Trumpler. Macmillan, New York, 1966. 272 pp. Illus. $9.95.