differences, the method of integral relations, and the method of characteristics. "Bluntness effects in hypersonic small perturbation theory," by J. P. Guiraud, D. Vallee, and R. Zolver, is concerned with the analogy between hypersonic flow and blast wave. "The stability of parallel flow," by W. H. Reid, includes a discussion of the adjoint Orr-Sommerfield equation. In actual calculation of the inviscid part of the characteristic equation two methods are suggested. One is direct numerical integration of the inviscid equation, and the other is based on transforming it into a first-order Riccati equation and then expanding the solution in powers of wavenumber. "Blast wave theory," by Akira Sakurai, is concerned with perturbation of similarity solutions and its application to explosions, magnetohydrodynamics, and other unsteady phenomena. "Laminar boundary layers on cambered walls," by F. Schultz-Grunow and W. Breuer, is devoted to the effect of curvature on boundary-layer theory. The skin friction and heat transfer, the velocity, vorticity, and shear distributions, and boundary-layer thicknesses are given as functions of curvature and Reynolds number.

Each article contains extensive references. The present volume is recommended as a reference for graduate students and research workers in fluid dynamics. A second volume on cavitation and reacting gases is planned.

MAHINDER S. UBEROI
Department of Aerospace Engineering Sciences, University of Colorado, and *Joint Institute for Laboratory Astrophysics, Boulder*

Biochemical Reactions

A carefully composed text on the kinetics of enzyme reactions would be of considerable value to both scientists and students in the biosciences. Unfortunately, Charles Walter's **Enzyme Kinetics: Open and Closed Systems** (Ronald, New York, 1966. 108 pp., illus. $7) is not the text.

A very brief chapter on the concept of a stationary state for open systems and the associated thermodynamics of irreversible processes (after Prigogine) is followed by a chapter on "Stationarity in closed systems" which refers to the steady-state approximations. The author places a great deal of emphasis on the approximate nature of the steady-state equations and warns that the habit of using such approximations may be hazardous to the interpretation of kinetic data. Unfortunately, he offers no prescription for "kicking the habit" and gives no clear indication of how serious the hazard is in practical cases. Indeed, a later and somewhat confusing chapter discusses the steady-state equations for a few mechanisms without further ado.

Other chapters include "Kinetics of the early stages of enzyme reactions," "Labeled reactant distribution," and "Relaxation methods." In all these chapters some rather complicated kinetic expressions are presented, but there is virtually no discussion of the experimental and practical limitations of the techniques and equations. The difficulties which arise with such complicated equations are emphasized by a cumbersome notation and an insufficiency of graphs. Is it not remarkable that a text on enzyme kinetics does not include even one complete graph on the kinetics of an enzyme reaction?

The final chapter, on chemical oscillations, appears to have been added as an afterthought. In contrast with the other chapters, it is not concerned with the kinetics of a single enzyme reaction and there are a lack of equations and an abundance of pretty but largely irrelevant graphs.

The author's paraphrasing of the papers he cites frequently results in cumbersome, misleading, or even incorrect statements. The selection of material—the good as well as the bad—demonstrates neither a critical eye, a comprehensive understanding of the literature, nor any serious attempt to integrate and digest such information. Those interested in understanding enzyme kinetics would do best to spend their money on postage stamps and xerox copies of the original papers.

JOSEPH HIGGINS
Department of Biophysics and Physical Biochemistry, University of Pennsylvania, Philadelphia

Origins of Behavior

Ethology is a method of studying animal behavior that has developed in Europe principally during the last 30 years, although it certainly has its roots in investigations that were carried out around the turn of the century by an American zoologist, Charles Whitman, and by a European zoologist, Oskar Heinroth. During the 1930's and '40's studies of animal behavior in Europe and in the United States were markedly divergent and proceeded with practically no communication between investigators on the two continents. While the European ethologists emphasized the biological bases of behavior, the comparative psychologists in the United States stressed the importance of learning processes, and essentially rejected the notion of genetically based differences in behavior. Thus, upon being introduced to the notions of ethology, the behavioristic psychologists of this country felt that these presented a challenge to their own position, and for a time there were heated polemics on the question of whether unlearned behavior existed. In the last few years, however, there have been many meetings between American psychologists and European ethologists, and many of the original misunderstandings of each other's positions have been resolved. In fact, the relationships between the two disciplines have evolved to the point where there is now developing an extremely useful dialogue.

Animal Behaviour (McGraw-Hill, New York, 1966. 544 pp., illus. $10.50), by the English ethologist Robert A. Hinde, represents an ambitious attempt to integrate the methods and findings of ethologists with those of comparative psychologists, particularly with respect to the question of causation and development of behavior in the individual, a common area of interest of psychology, physiology, and ethology. Hinde's book is of value in pointing out ways in which comparative psychologists may profitably apply biological concepts to their investigations. It is also a good reference source for much ethological work which is not generally known in this country. Many chapters provide good reviews of certain research areas and problems, particularly chapter 7, on orientation, chapter 16, on conflict, chapter 24, on developmental aspects of learning, chapter 27, on evolution and behavior, and chapter 28, on the adaptedness of behavior and its role in speciation.

While Hinde rightly asserts that ethology has an especially important contribution to make to the analysis of learning processes, and fully discusses the aspects of learning investigations to which ethological concepts are relevant, it must be said that, because of his own theoretical biases, he does not present a complete exposition of important ethological concepts. Especial-

ly obvious are his treatments of the fundamental concepts of "action-specific energy" and "releaser." These two terms are not listed in the subject index. Hinde studiously avoids them even when he discusses research reports which have been considered by ethologists as classic examples of these very concepts. Thus he deals with phenomena that have been commonly evoked to illustrate action-specific energy in terms of "waning in absence of muscular fatigue and sensory adaptation." Similarly, he speaks of "selectivity in responsiveness" rather than of the "innate releaser mechanism" (although he has not completely ostracized the latter term from his treatise). Certainly he has a right to disagree with the use of these terms or concepts, but to dismiss them in such an oblique fashion would seem to be a disservice to the reader.

On the positive side, Hinde has presented material regarding the "fixed action pattern" admirably and has used this concept fully, particularly in his discussion of the evolution of behavior. He also presents several observations of his own which support the usefulness of this concept. He has also given fairly adequate consideration to several classical learning theory concepts and presents well their present-day complexities. It is not until nearly the end of the book, however, that he arrives at one of today's prepotent questions, "What is learning?" Clearly, current learning theory is beset by many issues, and Hinde apparently has reflected this state of affairs as adequately as is possible within the limits of his book's purposes.

There are a few instances in which Hinde omits to mention an important point which has been made by the particular research study under discussion. For example, he discusses at considerable length, from Schneirla's (1952, 1965) and Lehrman's (1953) early viewpoints, the controversy regarding whether pecking behavior develops by means of learning in the chick embryo. This learning of pecking, it may be recalled, was thought to be based on experience with the embryonic heartbeat. However, Hinde neglects to answer the question, raised by Lorenz (1961), of why other avian species, which presumably have the same ontogenetic experience of the heartbeat in the egg, do not peck, but gape, in order to obtain food immediately after hatching, and still others, such as ducks, dabble, or shove their own bills into the parents' mouths, as do pigeons.

Another example of omission is that, while Hinde mentions (page 352) a research report by Meyers and McCleary (1964) showing that there is interocular transfer of a learned visual-pattern discrimination in cats that have been deprived of pattern vision—which indicates that not even pattern-vision experience is necessary in order for cats to have binocular equivalence when first exposed to the normal visual world—he neglects to apply this finding to an earlier discussion (page 349), and records in the conclusion to the chapter (page 357) that binocular experience is a prerequisite for binocular equivalence in cats.

In spite of such flaws, Hinde's book is of significance in presenting a particular viewpoint, a combination of ethological and comparative psychological notions, regarding the causation and development of behavior in the individual organism as a member of a particular species. Particularly sensible, for example, is his statement that "It is thus not profitable to search for general theories of drive applicable to all types of behaviour in all organisms." He makes it clear that in his view both genetic and experiential factors play roles as determinants of individual behavior. Certainly it is true, as the ethologists themselves have repeatedly recognized, that the problem of the causation of behavior is by no means solved simply by calling specific instances either "innate" or "learned" behavior, for there are also the stupendous tasks of determining how genetically coded factors influence the development of behavior and how environmentally constituted factors do the same. For example, as Hinde says, "even when the processes of tissue growth and differentiation have led to the development of an eye, that eye may not be functional until it has been exposed to the light." Even so, there are indubitably genetic processes which have led to the development of that eye. Ethologists have stressed that the genetically given behavioral tools, the "fixed action patterns," must be known before the role of environmentally induced changes in behavior, particularly those of learning, can possibly be understood.

Thus Hinde's book represents a beginning of a forthcoming inevitable event: the development of a science of behavior which takes full advantage of ethological, psychological, physiological, and neurological techniques and knowledge. The integration of these fields of research in behavior, whether animal or human, is a process that will lead to a new and exciting phase in the progress of science.

It is regrettable that the publishers have produced the book so poorly, the most apparent deficiency being in the quality of the illustrations.

ECKHARD H. HESS
Department of Psychology,
University of Chicago,
Chicago, Illinois

Titanium Compounds

The Organic Chemistry of Titanium, by Raoul Feld and Peter L. Cowe (Butterworth, Washington, 1965. 221 pp., illus. $9.95), is an unusually complete and compact book. It covers all the organic derivatives of titanium, those in which the titanium is linked to carbon through oxygen, nitrogen, or sulfur as well as those in which the linkage is direct. It describes not only the products and their properties, but also their structures and uses, and cites all the pertinent references and patents. It covers such diverse aspects of its subject as titanium-modified silicones, chelate complexes, and the Ziegler catalysts. Anyone who wants to know about titanium or has wondered about its present-day chemical uses will need this book.

Chapter 1 takes up the direct titanium-carbon linkage, in terms of both classical sigma-bonded alkyl compounds and pi complexes. Chapter 2 takes up the tetraalkyl and tetraaryl titanates, and chapter 3 the corresponding alkoxy- and aroxy-titanium halides. The fourth chapter is devoted to the complexes of a wide variety of titanium compounds with chelating agents, and the fifth, on compounds of titanium and polyols, includes a section on the analysis of titanium by photometric methods. There follow chapters on compounds of titanium and carboxylic acids, compounds of titanium with other metallic elements, addition compounds of titanium halides, and compounds of titanium in the lower valences. Compounds containing Ti-N, Ti-O-S, Ti-O-P, and Ti-O-B linkages are treated in chapter 10, together with titanium thiocyanates and copolymers. Chapter 11 is devoted to the Ziegler