that some compounds that are negative in the mouse can induce tumors in other species. Some compounds have given negative results when applied to the skin but have been quite active when injected subcutaneously. Compounds potent for the skin and subcutaneous tissue are found to be inactive when introduced directly into the liver. The susceptibility of the lungs does not necessarily parallel that of the skin or the subcutaneous tissue. Details of the mode of administration may also influence results. Average latent period may affect the expression of carcinogenic potency, and diet, too, may be an important factor. Another pitfall is the attempt to carry over to man conclusions based on animal experiments. We do not know whether man is more or less susceptible than mice to particular carcinogens. Some animal species, such as the rat, rabbit, and dog, are much more resistant to certain chemical carcinogens than is the mouse, and vice versa, and in the monkey none of the powerful pure carcinogens has been shown to produce tumors. (Recently, Sugiura, Smith, and Sunderland succeeded in producing papillomas and squamous cell carcinomas in monkeys by painting with catalytically cracked petroleum (*Cancer Research,* 9, 631 [1949]).

Although no evidence has been found that such cancer-producing chemicals exist in the normal body, it is possible that they may arise under abnormal conditions from some chemically related substances known to be present. Knowledge of the production of cancer with pure chemicals may provide the key to the secret of cancer formation, prevention, and cure.

Jonathan Hartwell deserves praise for this valuable addition to cancer literature, and students of cancer may greatly profit from it. The bibliography includes 2055 papers, written by 1744 scientists, alone or jointly.

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Outline of Fundamental Pharmacology: The Mechanics of the Interaction of Chemicals and Living Things. David Fielding Marsh. Springfield, Ill.: Thomas, 1951. 219 pp. $6.00.

Since the classical monographs of A. J. Clark, published in the thirties, no comprehensive treatise has appeared on the general principles of the mode of action of drugs. Yet, the great advance of pharmacology in the past decade has led to many changes in our general concept and rendered this science much more complex. Marsh's book thus supplies a long-felt want.

This book is ideal for introducing the student to pharmacological research or for showing the interested scientist what pharmacology and bio-assay really are. In the first chapter, pharmacology is defined by its aims, problems, and history, but the book as a whole serves excellently to extend this by demonstrating its methods, its "way of thinking," and its spirit. The succeeding chapters deal with factors influencing drug action (age, sex, weight, environment, pathologic conditions, other drugs, species variation, etc.); the principles of quantitative pharmacology and bio-assay; mode of action of drug antagonism and synergism; experimental aspects of the site of action of drugs; principles of the absorption, distribution, and fate of drugs in the organism; mechanism of action of drugs; and relationship between chemical constitution and biological action. In an appendix, the applications of pharmacology are briefly described. All chapters are masterfully illustrated with specific examples and highlights from the history of pharmacology. The entire structure of the book demonstrates great pedagogic ability. The book serves as a valuable guide into pharmacological bibliography, listing (partly in the text, partly among the references) the most important handbooks, general references, and typical papers dealing with the points under consideration. Ethical and legal aspects of pharmacology and allied sciences are discussed.

To young men interested in the medical sciences, the book of Ramon y Cajal (*Regeln und Ratschläge zur Wissenschaftlichen Forschung* [1933]) on the philosophy of medical research is usually recommended. If they then show specific interest in pharmacology, Marsh's book would be the ideal reading material.

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Psychology

The Study of Instinct. N. Tinbergen. New York: Oxford Univ. Press, 1951. 228 pp. $7.00.

The present volume deals with the scientific study of behavior or, as the author prefers to call it, ethology. The author seeks an answer to the age-old question: Why does the animal behave as it does? The book is a study of the biology of innate behavior. It considers the relationship between specific experimental and observational material and neurophysiology, ecology, taxonomy, psychology, and even sociology.

In discussing psychology, the author distinguishes between what he calls the largely nonobjective psychology of Europe and objective American psychology. He correctly points out that objective American psychology has not emphasized the study of innate behavior. He feels that this failure is due to the fact that many American psychologists do not recognize that learning and the other so-called higher psychological processes must be considered as secondary modifications of innate mechanisms. He contends that a study of the learning process should be preceded by a full knowledge of the innate foundations of behavior, preferably obtained under natural or field conditions.

Care must be exercised by the reader in remembering the way many technical terms are used by the author. The term "sign stimulus," for example, has a

special meaning in the book. Animals react only to a small segment of all the changes in the environment that activate their sense organs and presumably also their central nervous systems. This selection of certain energies as sign stimuli by the organism is indeed held to be basic in understanding instinctive behavior.

An example of response to only a small part of a stimulus pattern is the reaction of birds such as ducks to flying birds of prey. By experimentation it is shown that the releasing value of the sign stimulus in this situation may be related to specific and identifiable characteristics of the movement and shapes of cardboard models of birds. A model was used with symmetrical anterior and posterior wing edges. It had a short protuberance at one end and a long one at the other. When sailed with one end forward the model had a short neck and a long tail. This movement elicited escape movements in ducks. When flown with the long neck forward it did not elicit such actions.

By a wealth of illustrative detail taken from the study of many animal forms, such as fish, birds, and insects, it is pointed out that the causation of behavior is more complex than has generally been assumed. Many internal and external factors act upon central nervous structures at all times in determining behavior. Occasionally, automatic central nervous system units "explode" and produce muscle actions in the absence of external releasing stimuli. This fact has led Lorenz, a collaborator of Tinbergen's, to put forward the rather specific hypothesis that some instinctive responses are controlled by specific endogenous neural factors.

The author points out that the exact study of behavior in relation to evolution has lagged behind the study of comparative morphology.

The final pages of the volume are devoted to the study of the behavior of man. Here the relationship between physiological, psychological, and, in the present author's term, ethological approaches to an understanding of human action are brought out by reference to such phenomena as food-seeking.

This volume is an expansion of lectures delivered in New York at the American Museum of Natural History and at Columbia University. Its pages summarize much ingenious experimental work and present a point of view that is bound to have an influence on later behavior studies.

The concrete evidence of the book makes the American anti-instinct psychology of a few decades ago seem bizarre indeed. Some scientifically trained objective students of behavior who read its pages may wish for more rigorous definitions of some of the concepts presented. Such students may also feel that the failure of the author to provide information on controls and details of statistical analysis detracts somewhat from the value of much of the brilliant work he reports.

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Vocabulaire de la Psychologie. Publié avec la collaboration de L'Association des Travailleurs Scientifiques. Henri Piéron, Ed. Paris: Presses Universitaires de France, 1951. 356 pp. 1300 fr.

Assisted by 15 collaborators from the Association of Scientific Workers, Piéron has edited a dictionary of some 3700 terms commonly employed in French psychological writings. American psychologists will recall that Piéron served on the editorial board of the Warren dictionary, published in 1934. In a prefatory note he remarks that the Warren opus is now out of date. The rapid developments in clinical, industrial, and educational psychology have brought many new terms and concepts into use during recent years. In particular, the impact of new theoretical constructs has revolutionized the field of psychology. The precise vocabulary of psychophysics, once the central interest of scientific psychologists, has receded into the background. Terms and concepts representative of enthusiasm for dynamic, molar approaches to the field have been introduced rapidly into psychological writing, both in this country and abroad. The vocabulary is in a state of flux. Except for basic terms still in current use to denote phenomena in psychophysics, nosology, neurology, anatomy, and other areas of knowledge from which contemporary dynamic psychology has developed, the older dictionaries are inadequate. Not only is the vocabulary of psychology constantly growing, but the denotations and the connotations of many traditional words have been radically altered in current use.

This dictionary is of considerable interest to the American student of psychology. First, it affords an opportunity to discover what terms and concepts used in this country have influenced his colleagues in France. For instance, there is some emphasis upon TAT, Rorschach, and Rosenzweig PF—but the omissions indicate a lack of enthusiasm for *tests de projection.* Dynamic concepts in psychopathology receive scant attention, whereas the traditional nosological syndromes are emphasized. Concepts from social psychology reflect a conservative point of view, although a few of the Lewinian terms are briefly defined. Other evidence will be found to justify the inference that French psychology is more parochial than American. Second, the American psychologist will be interested to discover those of his colleagues whose work has affected contemporary French psychology. For example, Sheldon has apparently attracted more attention than Hull. Similarly, there is an opportunity to survey the processes of selective perception with reference to contemporary British psychology. It is the reviewer's inference that classical German psychology is more adequately represented here than are the concepts now used by American or British psychologists.

A few minor errors have crept in. Jost's law, for example, is not sharply differentiated from retroactive inhibition. Dementia praecox is defined from a static point of view, with no inclusion of terms designating the psychodynamic aspects of the disorder. An initial

in F. W. H. Myers (p. 318) is incorrect. On the whole, however, the book is remarkably free from typographical errors. It will prove to be an invaluable addition to the personal library of American psychologists, and its purpose seems to have been accomplished in an admirable manner. The American student of psychology is likely to use it for quite a different purpose from that intended by Piéron and his co-workers—namely, as a convenient exercise in overcoming his own ethnocentrism.

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Cerebral Mechanisms in Behavior: The Hixon Symposium. Lloyd A. Jeffress, Ed. New York: Wiley; London: Chapman & Hall, 1951. 311 pp. $6.50.

The Hixon Symposium has significance for anyone concerned with the theory of human behavior and even for those who wish to understand some of the contraptions man himself has built—namely, computing and cybernetic machinery. The book has one of the defects of symposia, being a series of separate reports by experts not too much interested in one another's views nor primarily giving a complete account of the field. However, the excellent discussion by each of the experts on the other papers, and by an equally distinguished panel of discussants, does much to fill in the gaps and link the main papers. The job of editing is splendidly done, and the reader will find that he need not be an expert in the theory of automata to understand von Neumann, for example, nor a professional psychologist to understand Lashley (although it would be too much to expect that the nonspecialist will follow in all detail).

The first paper, by John von Neumann, deals with computers and so on as related to brain function; the second, by Warren S. McCulloch, with brain function as it bears on the theory of computers and with mathematical "models" of brain function. This reviewer (who has admitted elsewhere an incapacity to understand papers in this field) is happy to report that he found these papers readable and stimulating. They might be generally recommended as an introduction to the more technical literature.

The remaining papers are by psychologists. K. S. Lashley discusses serial organization in speech and complex motor skills, clarifying a general problem instead of reporting specific research. Heinrich Klüver reviews his earlier work on the temporal lobe and discusses more recent experiments on "extracerebral" (biochemical) agents in behavior (this paper may be the least easy to follow as far as organization is concerned). Wolfgang Köhler describes a specialized experiment in perception (also reported with Held in SCIENCE, **110**, 414 [1949]). Ward Halstead summarizes his book *Brain and Intelligence.* The volume concludes with Henry W. Brosin's pulling together the preceding material and linking it to current psychiatric problems.

In a period of rapid development in neurophysiology, a 1948 symposium may be somewhat out of date in 1952, which explains the omission of some important topics. There is nothing on the extrasensory thalamic mechanisms (Morison, Jasper, Magoun, *et al.*), on such work as that of Bender and Teuber or of Woolsey on the mechanics of perception, or that of Bard and many others on emotion and the amygdala cingulate gyrus, and so forth. The book did not, therefore, give a complete survey of the field even in 1948. But as a symposium, and especially if the apparently amicable little digs in discussion sessions are not neglected, the reader will find this a stimulating, readable, and (most of the time) authoritative work.

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Language and Communication. George A. Miller. New York–London: McGraw-Hill, 1951. 298 pp. $5.00.

This is intended as an advanced college text on the psychology of speech and communication. The author, in a foreword, correctly says, "Most teachers will find that they are able to lecture far beyond the content of the text in several of the chapters, but few will be able to do so for every chapter." He suggests that the book divides into two parts—that courses for students with backgrounds in linguistics and the engineering sciences should emphasize the first part, and courses for students in psychology and sociology should emphasize the second.

It ought to be added that the general reader will find throughout much that is interesting and novel to him. Studies of speech and hearing made by Harvey Fletcher, N. R. French, and other Bell Telephone Laboratories engineers are featured, as is another development from the same intellectual center—namely, C. E. Shannon's treatment of information. (It is remarkable that, although in 1609 Lord Bacon clearly stated the essential characteristics of a code, elaboration of his approach was not begun until the 1920s.)

Chapter titles include: "The Phonetic Approach," "The Perception of Speech," "The Statistical Approach," "Rules for Using Symbols," "The Role of Learning," "Verbal Habits," "Words, Sets, and Thoughts," and "The Social Approach." The excellent index refers to many investigators, with repeated mentions of the work of such people as S. S. Stevens, E. L. Thorndyke, M. Wertheimer, G. U. Yule, G. K. Zipf. Relevant publications by S. C. Dodd are not described, and E. U. Condon is inadvertently assigned the initials E. V.

The book is pleasantly printed; it appears as work done in part at Harvard under an ONR contract. To notice omissions from this excellent pioneer compilation is not particularly profitable, since the author himself emphasizes that selection was unavoidable. Yet the description of vowel sounds, sung, spoken, or whispered, as recurrent, damped oscillations might

well have been included. Telemetering and automatic computing machines are not mentioned, although, with the rapid progress engineers are bringing about here, some well-deserved future edition may alter the statement that "In most communication systems the source of the information is a human being."

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The Earth Sciences

Mathematische Grundlagen der höheren Geodäsie und Kartographie: Das Erdsphäroid und seine konformen Abbildungen, Vol. I. R. König and K. H. Weise. West Berlin: Springer-Verlag, 1951. 522 pp. Cloth DM 49.60; paper DM 46.

In the field of theoretical geodesy and cartography, the Germans have enjoyed an enviable position from the time of the mathematician C. F. Gauss, whose fundamental work on conformal representation of surfaces upon planes and other surfaces might properly be called the beginning of modern geodesy. His papers on cartography gave the rigorous mathematical formulation of projections already envisioned 50 years earlier by J. H. Lambert. The two-volume treatise by F. R. Helmert, *Die mathematischen und physikalischen Theorieen der höheren Geodäsie,* has been the bible of geodesists through the years, although important and outstanding contributions have appeared in recent years—notably C. F. Baeschlin's *Textbook of Geodesy.* But the present work of König and Weise is that once-in-a-century type of outstanding classic in a field.

Part I, Chapters 1 through 10, under the general title "The Earth-spheroid and its Conformal Projection," with which this review is concerned, is the first volume of an extensive, but compact, two-volume treatise. Parts II through IV, Chapters 11 through 22, under the general title "The Fundamental Problem of Higher Geodesy," will appear as the second volume.

The following remarks seem apropos concerning the general format of Volume I. Immediately after the table of contents there is a most useful summary explanation of the mathematical symbols and notations used in the text. Some of the notations, such as those used for geographical latitude and longitude, are not those commonly used, but this is a minor point and in no way detracts from the masterful treatment. Throughout the volume, figures are plentiful and many are done in two colors for clarity; the bibliography includes all the important extant works in the fields of geodesy and cartography. A useful index concludes the volume.

In Chapter 1 are found the constants of the oblate ellipsoid of revolution (spheroid); numerical values of the constants for the Bessel and International Spheroids; parametric representation of the meridian ellipse by means of the geographical latitude; arc element of the meridian; curvatures associated with the spheroid; trigonometric developments and power series expansions for the various curvatures and associated functions; the meridian arc, complex representation and power series developments in terms of geographical latitude; geographical latitude as a function of meridional arc; the parallel arc element; the surface element and evaluations. The chapter concludes with a summary of the power series developments obtained, including middle latitude formulas.

Chapter 2 includes the parametric representation of a revolute by means of geographical latitude and longitude, with the specializations to the sphere and the spheroid; the linear element of the spheroid; the isometric latitude for the sphere and spheroid; the isothermal parameters; three complex fundamental surface variables by means of which the conformal projections are characterized; relationships between these three complex fundamental variables for the sphere and spheroid; the transverse Mercator projection of the sphere; Gauss-Krüger projection of the spheroid; summary of complex variables for points, curves, and fields.

Chapter 3 deals with the conformal projection of one plane upon another by means of the analytic function of a complex variable; the curvature of plane curves; specific determination and continuation of the projection on a large scale; examples of conformal projections by means of elementary functions; conformal projections by means of elliptic functions of elliptic integrals; conformal projections by means of algebraic functions and integrals.

In Chapter 4 are found the geometric relations between the three fundamental complex variables for characterizing the conformal projections (originally defined in Chap. 2); application to the particular case of the sphere; projection of the spheroid by means of exponential functions and their linear transformations; a summary of the results obtained. In Chapter 5 the analytic developments in series are presented for the relationships between the three fundamental variables and their exponential functions; the conformal projection of the spheroid upon the sphere; a summary of the series developments; summary of the singular points of the various projections discussed; numerical examples of the computation of the fundamental variables.

Chapter 6 develops the conformal projections of the spheroid upon a plane (Mercator, transverse Mercator, Gauss-Krüger); the spheroid upon a sphere; the spheroid upon a second spheroid. A summary of the projections discussed is given at the end of the chapter, and numerical examples of these projections are presented.

The stereographic projection (in its various forms, polar, equatorial, etc.); spherical projection; and the general projection by elemental arcs for spheroids form the subject matter of Chapter 7. A summary of the important projections is followed by numerical examples. The transformations of isothermal coordinate systems is the subject of Chapter 8; they are discussed with respect to the Gauss-Krüger system, the Lambert spherical projection, etc. Chapter 9 is concerned with some of the already established projections of the reference ellipsoid upon the plane, upon the sphere, or upon a second spheroid.

Chapter 10 is called "Aids from Analysis." It treats of complex numbers and elementary functions; differentiation of a product (the product formula of Leibnitz); differentiation of a function of a function (composite function); general analytic functions and their representations; exponential series; general ordering theorems; general exponential series (Weierstrass-Laurent series); the particular case of trigonometric series; trig-