III, IV, and V and covers the fundamentals of group theory: homomorphisms, normal subgroups, groups with operations, series of subgroups, direct products, and so forth. The elements of free groups and defining relations are treated in chapter V.

Part II in volume I consists of chapters VI, VII, and VIII and deals with the theory of abelian groups. Chapter VI is concerned mainly with free abelian groups and finitely generated abelian groups and gives the usual structure theory. Ulm's theorem, characterizing countable periodic abelian groups, is given in that chapter, and chapter VIII contains a discussion of torsion-free abelian groups, including the work of Baer and others.

Chapters IX and X, in part III, go into the deeper properties of free groups, free products, and groups given by generators and relations. The structure of subgroups of free groups, and of free products, is discussed in chapter IX. Part of chapter X is devoted to the recent work of B. H. Neumann, H. Neumann, and G. Higman, including the theorem that every countable group can be embedded in a two-generator group. The remainder of part III (chapters XI and XII) deals with lattice-theoretic methods in group theory, direct decompositions, group extensions, and an introduction to the Eilenberg-MacLane cohomology theory for groups.

In part IV (chapters XIII, XIV, and XV) there is a detailed account of recent work, much of it by Soviet mathematicians, in the theory of solvable and nilpotent groups.

TREVOR EVANS
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**Scientific Inference.** Harold Jeffreys. Cambridge University Press, New York, rev. ed. 2, 1957. 236 pp. $4.75.

This is a fascinating book and, also, a valuable contribution to fundamental research. That should be sufficient praise for any review, but let me make the judgment plausible. This is virtually a new book, by comparison with the first editions (1931, 1937). It is by the author of the monumental *Theory of Probability,* the masterly *Methods of Mathematical Physics,* and an incisive geophysical study, *The Earth.* No one who is familiar with these works would expect less than great analytical ability and a remarkable range of knowledge, but even such a reader would still be greatly impressed. The main purpose of the present volume is to show that scientific method can be understood only by way of an understanding of probability; but, in the course of this enterprise, we find substantial discussions of transfinite arithmetic and the foundations of mathematics, including the Gödel theorem, biological classification, dimensional analysis, Newtonian dynamics, the history of astronomy, relativity, quantum theory, Euclidean geometry as a mensurational theory, and numerous philosophical problems (for example, solipsism and determinism).

It will be seen that the 231 pages of text are at a level quite unlike that of any ordinary category of book on the American market. They cut across academic boundaries, but not in the sense of any "general survey." This is a postdoctoral interdisciplinary course, marked by considerable originality and great common sense.

It is worth adding some specific comments. I do not consider satisfactory the suggestion (page 21) that the barber paradox is self-contradictorily formulated whereas the liar paradox is not. In each case, the paradox arises on examination of an apparently consistent assertion. The suggestion that scientists know more about causality than philosophers do (pages 12, 60) is surely only superficially plausible, like the idea that linguists "must" know about linguistics. Scientists are suckers for the hoariest philosophic eccentricities [as Jeffreys ably demonstrates in the cases of Eddington (page 223), Born (page 221), and von Mises (page 81)], just as philosophers are sometimes suckers for the latest scientific craze. A man with eyes all 'round his head probably would not know which way to go.

A good many of the early developments of probability theorems (Chapter 2) are open to serious difficulties, owing to Jeffreys' use of the propositional calculus notations with their well-known peculiarities. For example, the idea that a contradiction implies "every proposition in the language" (page 27) (derived from the *Principia Mathematica* notation) forces Jeffreys to introduce a requirement of consistency on the data. He defends this by saying, "In science we are not interested in inferences from self-contradictory data" (*ibid.*). But we are; reductio ad absurdum proofs are crucial in mathematics and have an obvious analog in identifying faulty instruments and hypotheses. Besides, the thesis that *any* proposition follows from a contradiction is surely very extreme, and certainly avoidable [we can retain $(p \rightarrow \backsim p) \rightarrow \sim p$ and reject $(p \backsim p) \rightarrow q$, although at some cost in systematic simplicity].

Some modern analytical philosophers will be made uneasy by various remarks —for example, that a hypothesis *entails* (rather than implies) observable consequences (page 34); that conventions could produce reasons (page 39); that a wavelength definition of "red" would make the red sensation useless as an indicator (page 172); that entropy directly measures the passage of time (page 173); and that psychoanalytic insight cures neuroses (page 195). But it is hard to imagine a reader of this book who will not be greatly stimulated and educated. Its pedagogical message alone is indisputable and valuable—specifically, that a scientist who is untrained in statistics is seriously handicapped and, generally, that the boundaries of subject matter are barriers to creation.

MICHAEL SCRIVEN
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**A Symposium on the Chemical Basis of Heredity.** Sponsored by the McCollum-Pratt Institute of Johns Hopkins University with support from the A.E.C. W. D. McElroy and Bentley Glass, Eds. Johns Hopkins Press, Baltimore, Md., 1957. 834 pp. $12.50.

Probably no field in modern biology is of more fundamental significance and interest, is more intriguing and exciting to the imagination, is more rapidly developing, and involves the application and integration of more varied disciplines than is the subject of this symposium volume, the chemical basis of heredity. The major chapters—"Cellular units of heredity," "Role of the nucleus, nucleic acids and associated structures in cell division and protein synthesis," "Nucleic acids as transforming agents," "Viruses as bearers of heritable characteristics," "Nucleic acids, chemical composition and structure," "Synthesis of nucleotides and nucleic acids," "Mechanism of duplication"—include presentations and interpretations of the latest experimental results by most of the leaders in each of the many and varied fields represented. The discussions following each section are perhaps even more valuable and interesting than the formal papers.

Although major questions, such as the detailed structure of genetic units, the mechanism of information coding, transfer, and expression, the molecular basis of mutation, and the mechanism of duplication of genetic material, cannot as yet be answered definitively, they are carefully analyzed and evaluated in illuminating detail. These analyses include the clarifying introduction of useful new terms and definitions, such as the *recon* (smallest genetic recombination unit), the *muton* (smallest genetic unit susceptible to mutation), and the *cistron* (smallest functional genetic unit); the classification of genetic replication schemes into "conservative," "semi-conservative," and "dispersive"; and the classification of recombination mecha-

nisms into "fragmenting" and "non-fragmenting."

The 834 pages cover too wide a scope of subjects even to list here by topics or authors, as is evidenced by the admirable 77-page summary (chapter VIII), which shows, to paraphrase, "as in a Glass, [not so] darkly, the shapes of things to come." Altogether, this fascinating volume is a "must" for all biologists, whether biochemically or genetically orientated, and whether their interests are specific or general.

E. L. TATUM

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**Professional Amateur.** The biography of Charles Franklin Kettering. T. A. Boyd. Dutton, New York, 1957. xii + 242 pp. Illus. $4.50.

He who reads *Professional Amateur* unconsciously recalls two other inventive Americans who ministered to their country's industrial advance—Franklin and Edison. Charles Franklin Kettering more closely resembles the former in his wide and general concern, which even verges on the philosophical, but is more like Edison in that he gears his endeavors to the practical developments of which his time has need.

For dollar-minded readers, this is truly an American success story. For Kettering, the reward was principally reckoned by other standards. His start was in a farm home and a country school, with a very bothersome handicap—poor eyes—that delayed his graduation from college until his 28th year. After graduation from Ohio State University's College of Engineering, he was employed by the National Cash Register Company. There, in 5 years, he guided the production of three major improvements in their machines. In that period he also developed a program of private research which, by 1909, prompted his withdrawal from the laboratory of the National Cash Register Company. In the 10 years that followed, he and his associates improved automobile ignition, developed and set up a factory for the Delco Lighting System, demonstrated the virtues of high-octane gasoline, and put a self-starter on the Cadillac automobile. In 1919, he accepted, with some reservations, the headship of the newly established General Motors Research Laboratory. From that laboratory, during the 27 years of his direction, came "ethyl" gasoline, new finishes for quick car-painting, a new, efficient diesel engine for use in marine and rail service, and a high-compression automobile engine, ready for production.

His marginal activities during these years included a share in the study of heat for medical therapy, the production of a pilotless plane for use in World War I, and a part in the planning and financing of an institute for cancer research. His response, even though reluctant, to a call for help is credited with "saving the Winters National Bank of Dayton [Ohio] from collapse" in 1924. It was his own initiative, however, that put him in business with a home-town (Loudonville, Ohio) concern in order "to elevate living conditions and general prosperity of the people of the town." The success of this venture was, in dollars, about 30 times greater than he had expected.

Kettering retired in 1947. Since that time he has been almost as active as before. Four interests claim his attention—cancer research, photosynthesis, magnetism, and the design of better and less expensive light airplanes. In pursuit of the last, he has resumed flying and is now the owner of three planes. He is a frequent visitor at Antioch College, for it is there, under the auspices of the Kettering Foundation, that 30 scientists are trying to find out "why grass is green." No doubt his plane often lands at La Grange, Ill., where his son Gene is chief engineer of the Electro-Motive Division, which produces rail diesel engines. It is the diesel's inventor, as well as the father and grandfather, who makes these visits.

T. A. Boyd, a former research associate of Kettering's, makes generous use of quoted excerpts from the latter's writings and speeches in this book. For Kettering, like Franklin, is very apt in phrasing semiphilosophical asides in his conversation and speeches. The author is frankly laudatory and gives scant space to mention of any personal quirks. However, the book's chronicle does effectively bring to the reader a sense of actual encounter with "Boss Ket" in person. And, withal, it does this through an interesting, absorbing narrative.

B. CLIFFORD HENDRICKS

*Longview, Washington*

## New Books

*A Revision of the Australian Chafers* (Coleoptera: Scarabaeidae: Melolonthinae), vol. 1, E. B. Britton. British Museum (Natural History), London, 1957. 193 pp. £4.

*Experimental Designs.* William G. Cochran and Gertrude M. Cox. Wiley, New York; Chapman & Hall, London, ed. 2, 1957. 630 pp. $10.25.

*Physiology of Prematurity.* Transactions of the first conference, 21–23 Mar. 1956, Princeton, N.J. Jonathan T. Lanman, Ed. 151 pp. $3.25. *Neuropharmacology.* Transactions of the third conference, 21–23 May 1956, Princeton, N.J. Harold A. Abramson, Ed. 381 pp. $4.50. Josiah Macy, Jr., Foundation, New York, 1957.

*The Molecular Theory of Solutions.* I. Prigogine. North-Holland, Amsterdam; Interscience, New York, 1957. 468 pp. $13.25.

*The Physiology of Induced Hypothermia.* Proceedings of a symposium 28–29 Oct. 1955. Publ. 451. Robert D. Dripps, Ed. National Academy of Sciences–National Research Council, Washington, D.C., 1956. 460 pp. $3.50.

*Plymouth Marine Fauna.* Notes on the local distribution of species occurring in the neighborhood of Plymouth, including some other records of species found on the south coasts of Devon and Cornwall and the adjacent offshore waters of the English Channel. Marine Biological Association of the United Kingdom, ed. 3, 1957 (order from the director of the laboratory, Citadel Hill, Plymouth, Devon). 500 pp.

*Prevention of Chronic Illness.* vol. 1 of *Chronic Illness in the United States.* Commission on Chronic Illness. Published for the Commonwealth Fund, Harvard University Press, Cambridge, Mass., 1957. 360 pp. $6.

*Pure Food and Drugs in California.* August F. Glaive. National Press, Palo Alto, Calif., 1957. 214 pp. $4.50.

*The Quicksilver Doctor.* The life and times of Thomas Dover, physician and adventurer. Kenneth Dewhurst. Wright, Bristol, England, 1957. 201 pp. 21s.

*Science Looks at Smoking.* A new inquiry into the effects of smoking on your health. Eric Northrup. Coward-McCann, New York, 1957. 190 pp. $3.

## Miscellaneous Publications

*(Inquiries concerning these publications should be addressed, not to* Science, *but to the publisher or agency sponsoring the publication.)*

*South African Pollen Grains and Spores.* pt. II. E. M. Van Zinderen Bakker. Balkema, Amsterdam, Netherlands, and Cape Town, S.A. 1956. 71 pp. 15s.

*Considerations about Cesalpinus' and Harvey's Works on the Blood Circulation Discovery.* Alcmaeon Publications, 217 E. 116 St., New York 29, 1957. 27 pp.

*Blood Tests in Mental Illness.* Papers and discussions presented at the Annual Scientific Conference of the Brain Research Foundation, Chicago, Ill., 12 January 1957. Brain Research Foundation, Chicago, 1957. 47 pp.

*Meterological Programme, Lists of Stations, International Geophysical Year 1957–1958.* World Meteorological Organization, Geneva, Switzerland, 1957. 108 pp. F. 8.

*The Population Council, Inc., Reports of the Executive Officers for the Year Ended December 31, 1956.* The Council, 230 Park Ave., New York, 1957. 20 pp.

*Hormones Controlling the Chromatophores of the Dwarf Crawfish, Cambarellus Shufeldti: Their Secretion, Stability, and Separation by Filter Paper Electrophoresis.* Studies in Zoology, vol. 5, No. 7. Milton Fingerman and Mildred E. Lowe. Tulane University, New Orleans, La., 1957. 21 pp. $0.40.