ical and clerical aids which suggests that much thought has been given the problem. This is true. The documentalists can point with pride to such heroic reference achievements as the catalogue of the Library of Congress, the decennial index to *Chemical Abstracts,* the U.S. Patent Office classification system, and the many devices, manual and automatic, that now serve the scientist and librarian.

Unfortunately, the automatic features of such aids apply only after the arduous intellectual labor of analysis, classification, indexing or coding is completed. These tasks are semiroutine but by no means semiskilled. They call for scientifically trained, well paid workers and the production rate is agonizingly low.

Some authorities insist that such work will never be relegated to machines, that the human brain will continue to be the central element in the organization and processing of information. This seems unduly pessimistic, but to solve the problem will require scientific thinking of an extraordinarily high level in fields often neglected and by some not considered scientific at all. It will require the combined best efforts of the logicians, information theorists, communications engineers, grammarians, and semanticists, and no doubt others. The need, however, is real and the search will be rewarding.

ROBERT TUMBLESON

Office of Scientific Information,
National Science Foundation

The Mechanism of Economic Systems. An approach to the problem of economic stabilization from the point of view of control-system engineering. Arnold Tustin, Harvard Univ. Press, Cambridge, Mass., 1953. xi + 161 pp. Illus. $5.

Arnold Tustin, head of the Department of Electrical Engineering, University of Birmingham, explores the relationship that exists between the feed-back mechanism of engineering control systems and the behavior of economic systems. For example, the simplest Keynesian model in which investment is exogenous and consumption is a linear function of income is analogous to an electric generator that is partly but not wholly self-exciting, the closed sequence income-consumption-production-income being analogous to the feed-back of the dynamo. This leads Tustin to suggest that "perhaps in this electrical age, the conventional metaphor of 'priming the pump' might be dropped in favour of 'exciting the dynamo.'" In other words, the rapid progress in the development of automatic control systems (automatic pilots, thermostats, and so forth) in the engineering world may contribute to the solution of problems of economic stabilization.

To demonstrate this a series of economic models, particularly those of Hicks, Kalecki, and Goodwin, are discussed in an attempt to outline the characteristics of a model that will produce fluctuations similar to those observed in the real world. Linear systems are rejected since the oscillations produced by them either explode, die away, or continue with constant amplitude and period. The introduction of erratic shocks (for example, exogenous investment) into the model to explain why the fluctuations continue with varying amplitude and period is not entirely satisfactory since the theory remains incomplete if the shocks are not explained. The conclusion is drawn therefore that economic models must contain both nonlinearities and complex time dependencies. The difficulty of computing the solutions of such systems can be overcome, it is suggested, by constructing physical systems that are analogous to the economic systems under study. A physical analog computer will then produce the results as graphs of the variations of the principal variables. To assist the economist in understanding the properties of engineering systems, over one-third of the book is devoted to a geometric, rather than the usual algebraic, analysis of the behavior of systems in terms of sinusoidal components of variation.

JOHN A. SAWYER

Research and Development Division,
Dominion Bureau of Statistics, Ottawa, Canada

Radiation Biology, vol. I: *High Energy Radiation,* Parts I and II. Alexander Hollaender, Ed. McGraw-Hill, New York–London, 1954. ix + 1265 pp. Illus. $17.50.

This comprehensive volume, in two parts, deals with the radiation biology of high energy radiations. It is the first of a three-volume set, the latter of which are to deal with ultraviolet and related radiations and visible light. Its 18 chapters have been contributed by authors of national and international reputation for their contributions in the fields with which they individually deal.

The material and the arrangement initially cover the principles of radiologic physics, measurement, and chemical effects of radiation, as well as basic actions on biological systems. These subjects are dealt with in complete and well-organized form and, although much of this material could be obtained from other sources, it is fundamental for the understanding of the later chapters.

The next group of chapters deals with genetic, mutational, and chromosome aberration effects. The authors have rendered a considerable service in bringing a large mass of material into accessible form, documented by excellent bibliographies. As a reference book this has many advantages, but as a textbook it might have been improved by more editorial commentary and reorganization for readibility.

The last group of chapters deals with radiation effects on the group cellular level of pathological physiology, hematology, histology, and carcinogenesis. The considerable amount of work in these fields has been summarized with commendable thoroughness; it suffers largely because of the incompleteness of knowledge in this rapidly changing field rather than from lack of diligence of the authors in trying to include

all the important work current at the time of writing. These chapters particularly will be an extremely valuable reference source to all workers in the field of radiation biology.

This volume is a definitive addition to the libraries of radiobiologists, radiologists, radiological physicists, and a large group of other scientists whose work brings them in contact with the effects of ionizing radiations on living tissues.

RICHARD H. CHAMBERLAIN
Department of Radiology,
University of Pennsylvania Hospital

The Horse-Flies (Diptera: Tabanidae) of the Ethiopian Region. vol. II: *Tabanus and Related Genera.* H. Oldroyd. British Museum (Natural History), London, 1954. x + 341 pp. Illus. + plates. £2 5s.

Here is a handsomely printed and abundantly illustrated companion volume to the first of the series on another tribe, the Haematopotini, of the same region. The third, to appear later on the entire subfamily Pangoniinae, will complete the series. This outstanding monographic work by a world authority on an important blood-sucking group of insects constitutes a monumental contribution to an understanding of insects of medical and veterinary importance in Africa. It will be the chief reference in its field for many years. The British Museum (Natural History) is to be congratulated for sponsoring this more than ample treatment at a time when printing costs are up and publication of large systematic, faunal studies, even of an important group like this, are more often discouraged than stimulated.

The author brings to bear a wealth of world experience with this family of flies, and integrates the latest refinements in classification with those on other continents. Not since the very inadequate and incomplete work of Surcouf and Ricardo in 1909 has there been available any comprehensive treatment of the complex group of flies related to the genus *Tabanus sens. lat.* for the region. The keys in particular will be welcomed and they appear to be highly practical, supplemented by 238 critical figures of which the author himself has drawn many. There are 31 maps showing distribution of species groups for a total of 147 species, 17 new. For the great majority of these, Oldroyd has studied the types and redescribed fresh specimens, including the males of about half. This was facilitated by the wealth of material uniquely accessible to him in the British Museum and in other collections. It is remarkable that only 8 species of *Tabanus* are deleted from the Ethiopian list as wrongly or doubtfully located, or unrecognizable.

The author discusses previous efforts and difficulties in attempting to break up the "great, unorganized mass of species" in the "all-embracing *Tabanus*" and accomplishes some restriction himself, but further admits that "it is certain that very many of the species included [in his *Tabanus sens. str.*] are not strictly congeneric with *Tabanus bovinus,* and therefore there is little one can say about the group in a positive sense." Three new genera are proposed and four, based on new conceptions and in part on recognition of primitive elements through the bare basicostas on the wings, are raised from previous subgeneric status.

Though the basic purpose of the book is a systematic review, there are introductory discussions of such subjects as morphology, collecting and preserving, early stages and habits, transmission of disease, and phylogeny which make interesting and informative reading for many not particularly interested in taxonomy *per se.* One stated aim in this regard is most admirable: "I have brought together everything I could find in the hope of stimulating more study of the behavior of the living flies, and more collecting and breeding of the larvae and pupae." This volume should certainly stimulate progress in that direction, particularly since a new world of previously supposed rare or unknown tabanids has been opened up incidental to the study of mosquito denizens high up in the jungle canopy.

The considerable upsurge in world-wide interest in the Tabanidae is reflected in the author's references including unpublished studies of Ovazza and Taufflieb on possible discovery of new characters of internal female genitalia. A marked advance in world classification of suprageneric categories is anticipated in the studies of Mackerras of Australia (also in press) on genitalia of both sexes which should integrate nicely with the third Ethiopian volume still to come.

CORNELIUS B. PHILIP
National Microbiological Institute,
Rocky Mountain Laboratory, Hamilton, Montana

Ferromagnetic Domains. K. H. Stewart. Cambridge Univ Press, New York, 1954. viii + 176 pp. Illus. + plates. $4.75.

A review or monograph inevitably reflects the principal interests of its author. The recent Cambridge monograph, *Ferromagnetic Domains,* is no exception. The author has given an admirable treatment of the phases of the subject with which he has had most intimate association in his research activities. A consequence of this is that the value of this work is to be found not so much in the early chapters devoted to the nature, background, and origin of the domain concept in ferromagnetism and their properties but rather in the treatment of the outward manifestations of their existence in influencing macroscopically measurable material properties. Thus the chapters on time effects in ferromagnetic materials and on hindrances to domain wall motion are a welcome addition to the literature in that they provide a coherent though succinct survey of developments in this direction. By contrast, the early chapters on magnetostriction and domain arrangements leave much to be desired in simplicity and coherence of presentation and as a potential source for the liberal education of the novice in the fundamentals of domain theory.