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.

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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.

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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