The two botanical strips, which are well done, depend largely upon drawings and diagrams to present the facts and the concepts. Some of the figures appear in the text, some have been redrawn to change the presentation, and some do not appear in the book at all. The third, on life through the ages, is largely material that does not appear in the text. Each film is designated to accompany a specific chapter or chapters in the book.

It is hoped that more of these visual aids will become available, and it is presumed they will if the present three are well accepted. Debate will flourish over the merits of a film strip compared to individual projection slides. Yet the story to be told follows a logical sequence, and there are the added advantages of lower price and ease in handling. The reviewer recommends that the readers see these film strips to learn what can be done at relatively little cost to him.

I. B. HANSEN

The George Washington University

Scientists starred 1903-1943 in "American Men of Science": a study of collegiate and doctoral training, birthplace, distribution, backgrounds, and developmental influences. Stephen Sargent Visher. Baltimore: Johns Hopkins Press, 1947. Pp. xxiii + 556. (Illustrated.) $4.50.

This book possesses significance and guidance value for the postwar era of science and higher education. It is a study which should, for example, be taken into account in connection with two current proposals: (1) recommendations by the President's Commission on Higher Education to double by 1960 the Nation's present collegiate enrollment, subsidized largely on the basis of the financial need of applicants; and (2) proposed legislation to create a National Science Foundation to grant Federal collegiate scholarships and graduate fellowships in science upon the basis of competitive tests. Pertinent considerations with respect to such action are supplied in Prof. Visher's analysis of the background and training of 2,607 distinguished scientists whose work has been a vital factor in the achievements of American science during the past four decades and more.

The 2,607 scientists are the total of those listed with asterisks in the 7 editions of the directory, *American men of science*, published from 1906 to 1944. The creator of the directory was the late J. McKeen Cattell, eminent psychologist, educator, and editor of *Science*.

In the first edition, which included approximately 4,000 scientists, Cattell starred one-fourth of them as outstanding in accordance with the judgment of leading research scientists in 12 sciences, as of 1903. This system of voting by scientific peers was continued in subsequent editions. Dr. Visher does not overlook the shortcomings of the Cattell system in the light of the development of other scientific fields beyond the original 12 or of the increasing number of scientists in proportion to those starred. Nevertheless, the starred scientists do form "the largest highly and impartially selected group," and, as such, there is importance in this extensive study of their collegiate and doctoral training, their birthplaces, their distribution, their backgrounds, and their developmental influences.

Out of the wealth of deductions from the evidence Dr. Visher has assembled, the following are a few:

"It is impossible to conclude how much is biological heredity and how much is social environmental heredity." Enthusiasm for research is the one common characteristic of the group. "In other respects they differ widely. . . . Many have been highly trained, often in famous institutions; others have attended only little known and perhaps relatively weak institutions."

"Large classes and student body are unfavorable to the production of future scientists." Science students "must have intimate contact with stimulating teachers."

Qualities which the starred scientists themselves considered most significant are "perseverance, curiosity, mental alertness, initiative and critical insight."

RAYMOND WALTERS

University of Cincinnati

The scientists speak. Warren Weaver. (Ed.) New York: Boni & Gaer, 1947. Pp. xiii + 369. $3.75.

In all probability, the reader of this review heard several of the intermission science talks broadcast on the Philharmonic Symphony program during recent years. Unless he were especially unlucky, he heard good talks—sound, clear, informative, and interesting ones and, often, containing a bit of inspiration. These talks, collected in a volume, have lost none of their appeal. They constitute an impressive survey of scientific knowledge and a remarkable exhibit of science exposition.

Most authors have not been content to parade their facts but have also given some glimpse of procedures or reasoning or implications, or of the attitudes that guide a good scientist or the manner in which he operates. The "springs" of science thus lie outlined through its upholstery of accumulated information. This is rare and good in science popularization. Little is accomplished by making the public gape at faintly adumbrated wonders achieved by a modern medicine man; much, by helping people understand the importance of expertness, the power of rational experimentation, the compulsion of evidence, the dedication to impersonal ends.

The editor has given the volume continuity in two ways. First, he has grouped the 81 talks into 14 chapters, e.g. "The Science of the Earth," "Atoms and Molecules," "Science and Health," "Science and the War," "The Long-term Values," some of which are surprisingly coherent and all of which gain perspective by introductory notes. Second, he has supplied a prefatory chapter, "Science and Complexity," which outlines the history of scientific thought and method in a manner hard to surpass. Dr. Weaver presents the sequence of: "problems of simplicity," involving two or few variables, solved by the classical physical approach before this century; "problems of disorganized complexity," solved by probability theory and statistical mechanics dealing with large numbers, solved mainly after 1900; and "problems of organized complexity," those of a large but limited number of variables which interact as part of an organic

whole rather than at random, for which rigorous methods are not yet at hand. This illuminates the old and new physics and focuses attention on the relation between the sciences of the material world and those of living organisms and of human societies.

Here is an excellent volume for a scientist to give his layman friends (it includes reading lists) and—since who among us is not a layman in most of the wide stretch of science?—an excellent volume for him to read himself.

R. W. GERARD

The University of Chicago

Life: its nature and origin. Jerome Alexander. New York: Reinhold, 1948. Pages vii + 291. (Illustrated.) $5.00.

What is life? One darned thing after another; something one relaxes from on the psychoanalyst's couch; a question of importance only to an embryo; a matter of the liver; a matter of catalysis, says Dr. Alexander.

Catalysis is defined by Dr. Alexander as the process whereby a specific particulate unit or surface (the catalyst) continuously brings about chemical union, breakdown, or structural change in other units as a result of very close contact or approach. This view of the nature of life is now of respectable antiquity, and Dr. Alexander claims no title to it. Indeed, he quotes many earlier workers who have identified themselves with this viewpoint. L. P. Troland, for example, has resumed the viewpoint very clearly in his statement that "life is fundamentally a product of catalytic laws acting in colloidal systems of matter throughout long periods of geologic time." I am, however, somewhat astonished to find that the two works in which this viewpoint has been admirably presented find no mention whatever in the pages of Dr. Alexander's book. I refer to A. I. Oparin's *The origin of life* (Macmillan, 1938) and R. Beutner's *Life's beginning on earth* (Williams & Wilkins, 1938), the latter being a particularly pleasant as well as informative book. Can it be that Dr. Alexander has never heard of them?

However that may be, Dr. Alexander's book, though by no means an original contribution to the subject, is full of the most interesting and chemically recondite facts and theories. Expert and general reader alike will find the book both readable and informative. There is a brief, simple coverage of nuclear physics, with especial reference to the smallest particles of matter and the manner in which molecules make masses. The author then considers the nature of living units (bionts), and emerges with a definition of a living unit as one which can direct chemical changes by catalysis and at the same time reproduce itself by autocatalysis, as for example, genes, bacteriophages, and ultrafiltrable viruses.

The evidence, the author suggests, indicates that the primal cause of evolution is a heritable change in existing and potential biocatalysts. The discussion of this subject in relation to genetics is most stimulating.

The final chapter, "Philosophy, the Guide of Mental Life," is rather more to the point than most such concluding chapters, in which the writer frequently reminds one of the pure mathematician, referred to by Dr. Alexander, who is never so happy as when he doesn't know what he is talking about!

Dr. Alexander's book has it faults, it sometimes wanders and the reader wonders, but I hope I have said enough to indicate that it is a book very well worth reading.

M. F. ASHLEY MONTAGU

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Experimental designs in social research. F. Stuart Chapin. New York-London: Harper, 1947. Pp. x + 483. $3.00.

After a preliminary characterization of experiments by "trial and error," Chapin makes a study of three types of experimental designs which he takes to be superior: (1) the "cross-sectional" (which attempts to establish present relationships), (2) the "projected" (which involves a relationship between the present and future), and (3) the "ex post facto" (which involves a relationship between the present and past). Each method is treated both in a general way and through specific illustrative research projects. The limitations and possibilities of these approaches are considered in some detail in the last two chapters. In this last portion of the book Chapin also provides a listing and classification of available types of social measurement and discusses some of the representative testing procedures.

The experimental designs are species of a methodological approach that combines J. S. Mill's *Method of Difference* and *Method of Concomitant Variations*; that is, Chapin seeks to impose controls by keeping all variables constant save one, which he attempts to "correlate" with the phenomenon in question, and thus set up causal connections. This is a restricted view of scientific method, since it fails to take into account the new methods developed to handle a large number of variables simultaneously, a method which is perhaps more suited to social research (see R. A. Fisher's *Statistical methods for research workers*). Though Chapin acknowledges the fact that complete control is impossible, he does not provide a criterion by which we can determine which are the relevant and critical variables, thus failing to account for the traditional criticism directed against Mill's methods (see, for example, *An introduction to logic and scientific method,* by Cohen and Nagel).

Chapin takes measurement to be quantification along a scale of units and then proceeds to cite many so-called psychological and sociological scales. But in considering such "measures" as are found in attitude and status studies, he fails to recognize that, although there is quantification and ordering of some sort, there is no scale, since the units of measurement are unknown. As yet there are few sociological "feet" or "pounds."

The book is important because it points out a real possibility for advance in social experimentation and directs attention to the sorely neglected study of method in the social sciences. It is questionable, however, that real advances in research can come from an analysis of method which has not absorbed such important methodological contributions as are to be found in pragmatism