against the petty bureaucracy and intrigue of the British Communist Party. But he was a proud and stubborn man of very strong loyalties, and he seems to have lacked the will or ability to criticize the communist philosophy as a whole and remained a Marxist in a number of important respects, although tending in his later years more and more toward the Hindu philosophy of nonviolence. It is probable that his mind was inherently a dialectical one and that his attachment to dialectical materialism was in part a consequence of this. I strongly suspect that the extreme simplicity of his style (which was frequently close to C. K. Ogden's "Basic English") was part of a syndrome that included an extreme political naiveté.

Deeply erudite classical scholar and philosopher, theoretical geneticist and popular journalist, bloody-minded bomber officer in World War I and humane animal-lover in his later years, supremely objective in his science and subjective in his politics, "in some respects . . . the cleverest man I ever knew" yet "not a profoundly original thinker" (in the words of Sir Peter Medawar), Haldane remains something of an enigma. Clark has painted him faithfully, "warts and all." Not for him the evasions of N. W. Pirie, who has implied (*Biographical Memoirs of Fellows of the Royal Society*, vol. 12, p. 237) that Haldane was *not* frequently rude to people who annoyed him. For a man who seems never to have met Haldane, Clark is (as far as the present reviewer is able to judge) extremely accurate in his facts; the only actual errors noted are in the spelling of a few names—Sir Allen Mawer (p. 150), E. L. Tanner (p. 173), and A. de Zulueta (pp. 134 and 173). Lastly, he has been able to do something that even many of Haldane's admirers were unable to do—appreciate the courage and mental quality of Helen Spurway, the dominant influence in Haldane's later years.

It may be worthwhile to point out that the U.K. edition of this book contains an interesting preface by Sir Peter Medawar, which has been omitted from the American edition [an essay by Medawar based on this preface appeared in the *New York Review of Books*, 10 Oct. 1968—Ed.], and 21 photographic illustrations as compared with 13 in the U.S. edition.

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Aspects of Genetic Research

Genetic Mosaics and Other Essays. CURT STERN. Harvard University Press, Cambridge, Mass., 1968. xiv + 185 pp., illus. $6.50. John M. Prather Lectures, Harvard University, 1965.

Four essays—covering the evolution of human genetics, mosaics in humans, developmental genetics, and a brief discourse on the philosophy of research—make up this scholarly and elegant book by Curt Stern. The first gives a history of the tortuous development of human genetics as a respectable science, emphasizing paths of inheritance of scientific thought in this area. His intellectual pedigrees are an interesting variation on those devised by Sturtevant in his *A History of Genetics*. Here also the reader will find a fresh account (based on new sources of information) of the events leading to the formulation of the Hardy-Weinberg law.

The second essay deals with mosaics in humans. Student, instructor, and research worker all will profit from Stern's exposition of the various types of human mosaics, including those for sex characteristics, blood groups, and other antigenic properties. The discussion takes an interesting and original turn when it focuses on the immunological implications of mosaics and the concept of mosaicism in antibody-forming cells. The merits of the Russell-Lyon "single active X hypothesis" are critically appraised.

Bristle formation in *Drosophila*, as a function of autonomy of cell action, and the influence of tissue prepatterns (topics which have been the object of his own recent research and that of his associates) provide the author with a golden opportunity to illustrate the successive stages in development of a fruitful biological hypothesis. Appropriate illustrations clarify the argument, and the complexities of the genetics used are sensibly dismissed with simplified explanations. The thrust of this essay is toward the synthesis of classical embryology and modern *Drosophila* genetics at its best.

The last short section thoughtfully appraises the relationship of the scientist to his work. It takes no great imagination to realize that introspection and autobiography must have fashioned the expressed attitudes. The gentle solicitude expressed for the unproductive or unsuccessful scientist comes as a cool breeze in the harsh, uncompromising desert of Big Science.

The style is pleasant and relaxed. Occasional bits of whimsy—the account of the Lasquenet who bears a child, or the tongue-in-cheek suggestion that women must be endowed with greater versatility of genetic functioning than men—lighten the presentation. The text is remarkably free of the embarrassing typographical errors that creep into every first edition (although Tarkowski loses his Polish origin and becomes a Russian at one point). Inevitably the reviewer must differ on some minor points. The suggestion that Morgan was a direct intellectual descendant of Mendel and de Vries hardly squares with Morgan's unrestrained attacks on Mendelism prior to his conversion in 1910 as a result of his own work with *Drosophila*. Similarly I would have preferred to trace the heritage of Beadle and Tatum not directly from Mendel, but through Morgan and Sturtevant, as well as Ephrussi. The book might have profited from a more extensive discussion of the startling work of Tarkowski and Mintz on cell fusion and of Hadorn and his students Gehring and Nöthiger on transdetermination; however, in a slim volume of essays one cannot expect to find a comprehensive survey of the field. Finally, some readers may find it difficult to forgive the author for providing the translation (parenthetically) of "Eureka."

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5-Hydroxymethylcytosine and After

Virus-Induced Enzymes. SEYMOUR S. COHEN. Columbia University Press, New York, 1968. xxiv + 320 pp., illus. $11.50. Columbia Biological Series, No. 24.

Virus-Induced Enzymes is a series of six lectures given in 1967 at Columbia University. As is explained in the introduction, it is the author's intention to illuminate the role played by biochemistry in elucidating the events that occur after a phage particle adsorbs to the host bacterium. I can think of no one more qualified to discuss this subject than Cohen, who was certainly responsible for the initial discoveries that were instrumental in proselyting a segment of the biochemical community to exploit the phage-host system. His discovery

(together with Wyatt) of a novel pyrimidine, 5-hydroxymethylcytosine, which completely replaces cytosine in the DNA of the T-even phages, provided a "handle" for studying the metabolism of a small island of phage DNA in a large pool of bacterial DNA. On the other hand, it posed the question, Where do the enzymes come from which must be involved in the synthesis and interconversions of this unique pyrimidine base? That Cohen is not unaware of the impact this discovery had on virology in general and biochemical virology in particular is evidenced by the headings of his first three chapters—"Biochemical virology before 5-hydroxymethylcytosine," "From virus pyrimidines to virus-induced acquisition of function," and "Deoxycytidylate hydroxymethylase and thymidylate synthetase, two virus-induced enzymes"—which are followed by three more chapters describing other "early" proteins, the life cycle of some virulent DNA phages, and the expression of a viral genome. The personal involvement of Cohen in the early discoveries, and his continued productivity in this field, must have created an excitement in the audience for these lectures, and the excitement carries over to the reader. The prose has more of a narrative than a didactic character, which I found refreshing. This informality belies the thorough treatment of the subject matter, which is well organized, thoroughly referenced, and adequately indexed.

Although the title "Virus-Induced Enzymes" may have been appropriate for the series of lectures, I think it is an unfortunate choice for the book, because in one sense it is too broad and in another too narrow. The discussion is confined almost exclusively to a particular group of viruses, the bacteriophages. Second, much more is covered than the enzymes themselves. The author has used the induction of the phage-specific enzymes as a hub from which radiate discussions of the coding problem, colinearity of gene and polypeptide, the rII product, virus-induced RNA, the problem of gene selection, and the turning on and off of viral functions. A more descriptive title would be "The Biochemistry and Molecular Biology of Phage Infection," although I am aware of the agitation that might be provoked by putting these two disciplines together on one book cover.

This book will be appreciated by the graduate student, the lecturer, or the researcher. An outstanding feature is the clear distinction Cohen makes between what we know, what some workers think we know, and what we certainly do not know. Cohen leaves us with the feeling that, far from being worked out, the study of the biochemistry of bacteriophage-host relationships will be instrumental in clarifying our notions of enzyme induction and repression and of biological differentiation and development, but he warns us that in order to discover these secrets we will have to transcend the narrow confines of biochemistry and genetics and "become organic chemists, polymer chemists, electron microscopists, cytologists, and cell physiologists." Wow!

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Putting a Science Back on the Track

General System Theory. Foundations, Development, Applications. LUDWIG VON BERTALANFFY. Braziller, New York, 1969. xvi + 290 pp., illus. Cloth, $8.95; paper, $3.95.

This volume consists of 10 essays and a short appendix dealing with general system theory, its role in the study of biological and social organisms and in the unification of science as a whole. All but one of these essays have appeared previously in one form or another, most of them being less than ten years old but the earliest dating from 1940.

Bertalanffy felt impelled to prepare this book in large part because, as he indicates in the foreword,

> . . . systems theory—originally intended to overcome current overspecialization—[is becoming] another of the hundreds of academic specialties. Moreover, systems science, centered in computer technology, cybernetics, automation and systems engineering, appears to make the systems idea another—and indeed the ultimate—technique to shape man and society ever more into [a] "megamachine" . . . .

It is his hope that a restatement of the general character of system theory as he originally envisioned it, in the original words and in historical perspective, may in part counteract this trend, a trend all the more deplorable to Bertalanffy because, as he explicitly and repeatedly states, he regards his holistic system-theoretic views as an ethically as well as scientifically preferable alternative to simple-minded reductionistic mechanism:

> The mechanistic world view, taking the play of physical particles as ultimate reality, found its expression in a civilization which glorifies physical technology that has led eventually to the catastrophes of our time. Possibly the model of the world as a great organization can help to reinforce the sense of reverence for the living which we have almost lost in the last sanguinary decades of human history.

These words were written in 1955.

For pointing out and emphasizing the original motivations of system theory—the deep homologies that appear as if of themselves between different sciences concerned with organization—and for meeting a variety of philosophical objections to system-theoretic viewpoints, a more eloquent discussion could hardly be imagined. This is not surprising, since there is probably no one better qualified to write on the integrative aspects of system theory than Bertalanffy, who was among the first to notice them and who has been developing them consistently for nearly 30 years. The reading, however, is by no means easy; many essays are as much concerned with philosophy as with science, and the text is densely sprinkled with further references which must be consulted to clarify the often terse exposition (the bibliography, characteristically, runs to more than 25 pages) on a plethora of subjects ranging from atomic physics through Hopi linguistics. Nevertheless, there is a wealth of knowledge and insight to be gained from these pages.

Despite the long period of time over which the chapters in this volume were composed, the editing is such that there are surprisingly few anachronisms in need of correction. There are a number of minor lapses, as for instance on page 57, where it is apparently suggested that an arbitrary dynamical system must have "steady states," and even that a system will have only one "steady state." More serious, in the reviewer's opinion, and in fact partly comprising the only important shortcoming in the book, are the repeated distinctions made between dynamical systems and systems with feedback, and between dynamical system theory and automata theory. For it is one of the major insights of dynamical system theory that the distinction between feedback control systems and dynamical systems is only one of emphasis, both kinds of system being essentially comprised within the mathe-