To the dilemmas arising from our neotechnical culture there can be no simple solution—certainly not the too widespread, passive confidence that "science," through sheer expanding activity, will bail us out of any extremity. Rather we must rely, with Boulding, upon the rich diversity of human talent and hope for its effective and continuing collaboration.

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Educational Trends

Schools in an Age of Mass Culture. An exploration of selected themes in the history of 20th-century American education. Willis Rudy. Prentice-Hall, Englewood Cliffs, N.J., 1965. x + 374 pp. $6.95.

Willis Rudy has written a simple, unloving account of recent trends in American education. He provides some helpful compendia of such matters as the controversy over religion in the public schools, the changing role of the school superintendency, the vicissitudes of intelligence testing, the ideology of life-adjustment education, and the background of the 1954 school-integration decision. But he also misapplies a whole generation of cultural criticism.

His major point he derives from the kind of social comment that became popular during the 1950's: America, he hears the critics say, has become a "mass culture" in which every failure to decide issues in favor of the intellectual minority is a step toward burying individualism. School superintendents he sees as men who have succumbed to the pressures of conformism but who may yet reassert their virtue. Religious education appears to him to have accepted American group-mindedness, relying on indoctrination rather than promoting "authentic personal experience." Racial integration leaves him wistful, and he laments that neither Negro nor white leaders have had the courage to advocate segregation on the basis of purely individual ability. But the "mass" that frightens Rudy is a slogan concept. He shows no curiosity about the content of popular culture, and no awareness that people whose education has been other than the conventional academic course may still produce authentic, unstereotyped intellectual responses. He is properly dissatisfied with the insipidity of official school culture, and with the insipidity that he thinks he sees in the lives of the mass of children. But he sets against this insipidity only last year's jargon about excellence.

Leadership he sees as a eugenic proposition, for which he finds authority in writings by Herbert Muller, Ernst Mayr, and Edward L. Thorndike. He accepts uncritically the older mechanistic conceptions of intelligence, making only enough concession to environment to conceal his ignoring of recent work on the emotional and cultural factors in cognition. But it is partly on these revisions in psychological thinking that planners have based their efforts to raise the quality of American education. Really excellent work has been tending not only toward the discovery and "pursuit of excellence," but also toward the solution of generic problems that have impeded the communication of ideas to individuals of all ages and all levels of ability.

No one, perhaps, wishes to bother denying genetic factors in intelligence, and there is room for serious argument whether modern social conditions tend to depress or elevate average genetic intelligence. But the mere eugenicist position is an out-of-date mediocrity that offers no help to the understanding of what has actually happened in the schools.

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The Many-Body Problem

Quantum Field Theory and the Many-Body Problem. T. D. Schultz. Gordon and Breach, New York, 1964. viii + 150 pp. Illus. Paper, $3.95; cloth, $5.95.

The beginning of a new series of books devoted to the "many-body problem," of which this book is the first volume, shows the recent wide interest in this particular branch of theoretical physics. Another book, much more detailed and advanced than the present volume, was published recently—*Methods of Quantum Field Theory in Statistical Physics*, by A. A. Abrikosov, L. P. Gorkov, and I. E. Dzyaloshinski [see the review in *Science* **143**, 599 (1964) for a general discussion of its subject matter]. Both books emphasize the so-called Green's function techniques. But the present book is better suited for use in an introductory study. It is written for those who are not familiar with the perturbation theory used in quantum field theory. It starts from the beginning, with second quantization and the definition and properties of one-particle Green's functions. The bulk of the book is devoted to diagrammatic representations of perturbation terms, and this is done for the many-fermion system and the electron-phonon system at zero temperature. The many-fermion system at finite temperatures is also treated briefly in the last chapter.

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Biochemistry

The Biochemical Approach to Life. F. R. Jevons. Basic Books, New York, 1964. 184 pp. Illus. $4.50.

F. R. Jevons' delightful book will serve extremely well as a stimulating introduction to biochemistry and should be comprehensible to anyone with an elementary knowledge of science. Jevons has given his treatment of biochemistry a strong historic flavor that enables the reader to view the whole of biochemistry in its proper perspective. This aspect is often overlooked in textbooks of biochemistry. Where, for example, can one find a narrative about the stormy controversy between Pasteur and Liebig which culminated in the little skit published by Wöhler in Liebig's *Annale der Chemie*? The mention of the Nobel prize winners throughout the text emphasizes that biochemistry is one of the frontiers of science.

The emphasis is placed on biochemistry as a way of explaining the phenomena of life, stressing the comparative aspects. The author has been very successful in building up a rationale of the biochemical approach. Beginning with a discussion of isolated molecules and events on the molecular scale, typified by proteins and isolated enzyme reactions (chapter 2), Jevons moves on to the collaboration between enzymes and finally to the organization

of the enzymes and macromolecules above the molecular level into subcellular particles (chapters 3 and 4). In the next chapters attention is directed to the problems of finding out how molecular events underlie macroscopic phenomena, with special reference to the modes of action of vitamins, drugs, and genetic factors. The simple diagrams are accompanied by copious notes, in smaller print, which describe the transformations in more detail, but in the same clear and easy style. Chapters 5, 8, and 9 seem to be out of place in the text. If chapter 5, "Two approaches to biological explanation—analogy and analysis," followed chapter 1, "Biochemistry in relation to biology and chemistry," and chapters 8 and 9, "A common currency for energy transactions—ATP" and "Transmitting information—biochemical genetics," were placed immediately after chapter 4, "Organization and efficiency —subcellular particles and biological oxidations," the arrangement would be more coherent.

I can recommend this book very highly, not only to the uninitiated but also to more experienced biochemists. It should also be in the science libraries of high schools.

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Soil Properties

Soil Clay Mineralogy. A symposium held at Blacksburg, Virginia, in July 1962. C. I. Rich and G. W. Kunze, Eds. University of North Carolina Press, Chapel Hill, 1964. xvi + 330 pp. Illus. $8.

A seminar on soil clay mineralogy, sponsored by the Southern Regional Cooperative Research Project S-14 on Soil Properties, was held at the Virginia Polytechnic Institute in July 1962. Nine authorities on clay mineralogy were invited to give lectures in their specialties, and the stated object of this volume is to present condensed versions of these lectures "to the scientific community at large, particularly to all those working with clay mineralogy regardless of their ultimate interest in this subject."

Unlike papers in the series *Clays and Clay Minerals* (the proceedings of the National Clay Conferences, now the Clay Minerals Society), the chapters in this volume are not technical presentations of new data, nor do they form a textbook of elementary clay mineralogy. The contributions are aimed at an audience that is already familiar with the rudiments of clay mineral structure, chemistry, and nomenclature, and, with two principal exceptions, they are mainly reviews of the state of the art in each of several methods used to analyze clay minerals. The first exception is the first and longest chapter (73 pp.), a discussion by W. D. Keller (University of Missouri) of the physical-chemical factors involved in origin and alteration of clay minerals. The strong geologic orientation of this chapter emphasizes the fact that the material in this book is applicable to other disciplines as well as soil science.

The chapter "Structure and mineral analysis of soils," by Roy Brewer (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia), is in textbook form and treats the classification of soil structures, definitions of soil structure terms, and illustrations of soil structure features. In the section on mineral analysis, Brewer is concerned with the factors to be considered in analysis rather than with the description of analytical techniques.

The short (11 pp.) chapter on x-ray diffraction analysis, by W. F. Bradley (University of Texas), appears to be a considerably condensed version of his lecture; owing to its somewhat formidable, though accurate, language this chapter will probably be useful only to readers who are already familiar with the physics of x-ray diffraction. However, it is supplemented by a discussion of x-ray methods and interpretation in the chapter by M. L. Jackson (University of Wisconsin) on mineralogical analysis.

In the chapter on application of the electron microscope, Thomas F. Bates (Pennsylvania State University) presents illustrations of distinguishing features of clay minerals and discusses factors that affect their appearance in electron micrographs. Preparation techniques for electron microscopy are detailed in the chapter by John L. Brown (Georgia Institute of Technology).

Three chapters concern the history, theory of operation, and application to clay mineralogy of particular analytical tools—infrared analysis by R. J. P. Lyon (Stanford Research Institute); thermal analysis by R. C. Mackenzie (Macaulay Institute for Soil Research, Aberdeen, Scotland); and x-ray spectrographic analysis by A. H. Beavers and Robert L. Jones (University of Illinois).

In the final chapter, M. L. Jackson and R. C. Mackenzie discuss the principles of quantitative estimation of clay minerals from standard chemical analyses. This chapter, together with Jackson's chapter on mineralogical analysis, contains what appears to be as complete a catalog, in brief, of the many varied and often quoted analytical methods used by Jackson and his co-workers as any previous publication of which I am aware. Not every reader will wish to follow all the procedures in this book, but the procedures illustrate well what may be involved in a highly detailed analysis of a clay-bearing sample.

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Modern Geometric Optics

Mathematical Theory of Optics. R. K. Luneburg. With a foreword by Emile Wolf and supplementary notes by M. Herzberger. University of California Press, Berkeley, 1964. xxx + 448 pp. Illus. $12.50.

This book by the late R. K. Luneburg is based on the lecture notes that he used at Brown University during the summer of 1944. Those notes have long been regarded as an original and, in fact, classical treatment of modern geometric optics. We are fortunate to now have the same material made more readily available in the form of a book, for which Emile Wolf has written a foreword.

In chapter 1, it is shown how the two main avenues of optics, wave optics and geometric optics, can both be developed from Maxwell's equations. In chapter 2, Hamilton's theory of geometric optics is formulated, and, in chapter 3, some of its applications are outlined. These include complex lens systems, aspherical surfaces, media of radially symmetrical refractive index, spherical aberration and coma, and the "Luneburg lens." A lens of this type images two spherical surfaces stigmat-