tions represents a fulfillment of historical laws. These are all excuses of one kind or another, and pretty thin excuses."

Such an argument from consequences might lead the unwary to suppose that the author would be on the environmental side of every argument; but this is not so. To begin with, he says (page 58) "It is extremely difficult to think of any social habit or act of legislation that has *no* genetic consequences. Penal, fiscal, social, moral, medical, political, or educational laws, schemes, treatments, habits or observances will all make *some* mark on our genetic structure." Medawar gives many illustrations of this fundamental axiom of eugenics. Building on the argument presented in the first two chapters of his earlier book, *The Uniqueness of the Individual* (Methuen, 1957; Basic Books, 1958), he points out that the continued development of the present tendency toward early completion of families will ultimately bring about the earlier appearance of the hereditary pathologies of the latter half of life—Huntinton's chorea, some manic depressive psychoses, and some kinds of cancer. Good intentions alone cannot save us from the unwanted consequences of our acts.

The treatment of the inheritance of intelligence is thorough and courageous. "Some people speak with angry contempt of 'so-called intelligence tests'; having satisfied themselves of the absurdity of claims which psychologists no longer make for them (and which the better psychologists never did make), they dismiss the entire subject from their minds. Others profess to attach no meaning to the word 'intelligence'—but try calling them *un*intelligent and see how they react. At the risk of being peremptory . . . I shall take the view that intelligence tests measure intellectual aptitudes which are important, though very far from all-important; and that these aptitudes make up a significant fraction of what we all of us call 'intelligence' in everyday life" (pages 74–75). He discusses in detail the meaning of the extensive surveys of Scottish children made in 1932 and 1947, which showed a slight increase in 'intelligence' for boys and a considerable one for girls. Antieugenicists have cited these results as a refutation of genetic fears. Medawar points to two environmental factors that could easily account for the apparent rise. First, there was an even greater increase in the physical development of the 11-year olds surveyed at the later period; since "mental" and "physical" are not really independent variables, this fact indicates that the chronological 11-year olds tested in 1947 were biologically older than the same nominal age group in 1932. Second, since our intelligence tests lean heavily on verbal ability the children tested in 1947, by virtue of radio and television, were more experienced in verbal techniques than the children of the preceding generation.

As I mentioned earlier, Medawar's book is remarkable in combining exceptionally clear exposition on a fine scale with an over-all complex structure. I would like to try to explain the reasons for the complexity, proceeding from relatively certain points to the relatively more controversial. First, we should note that these essays were originally given as lectures on the BBC. In spite of their difficulty (it would be inconceivable that an American broadcasting company would initiate such a series), they have a certain loose-jointed conversational way of "beating around the bush." This is certainly good for a lecture, and not bad for a book.

Second, in preparing the lectures for publication Medawar understandably felt obliged to add notes—documenting, justifying, and qualifying his spoken words. The result is a volume in which 19 percent of the content is in the form of notes. For the usual economic reasons the notes are not literally *footnotes* —that is, notes at the foot of the page— but are rather "tailnotes"—that is, notes placed at the end of the book. The argument is thus dispersed by the bibliographic machinery. The serious reader will find [as W. E. K. Middleton remarked in *Isis* **51**, 338 (1960)] that reading such a book "involves two bookmarks and about fourteen fingers, nineteen if he decides to make an index card of the reference."

The third (and most controversial) reason for the complexity is related to the "sensitiveness" of the topics discussed—eugenics, intelligence, value-bound individual differences, racial differences, and freedom in a population-harassed world. Whatever may be the best answers to the questions, we can assume a priori that these answers threaten every traditional political position, "conservative," "liberal," or what have you. A scholar, like all men, is a social animal, and he cannot entirely avoid being "other-directed," to use Riesman's phrase. As a result, when the scholar presents the heresies implied by new knowledge, his exposition may sometimes border on the ambivalent. (In the present instance, see Medawar's remarks on race, pages 60–63.)

To say *The Future of Man* is complex is not to damn it. It is one of the powers of an artist that he turns the necessities of time and medium to good use, and Medawar is a real artist with words, in the great English traditions of the Huxleys and Haldane. Like them, he shows by example that a love of scientific precision and a strong aesthetic sense are not mutually exclusive.

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Theory of Elementary Particles. Paul Roman. North-Holland, Amsterdam; Interscience, New York, 1960. xii + 575 pp. Illus. $12.

An examination of any volume of *Physics Abstracts* would indicate that the theory of elementary particles is one of the major subjects of investigation in contemporary physics. In spite of this, there is an absence of useful textbooks in the field, with the result that the beginning student must study the original literature, often without a reliable guide to the relevant papers. Roman's book is an attempt to provide such students with an introduction to the main theoretical principles which are used in elementary particle physics, with particular emphasis on the symmetry properties of the interactions of particles. Regrettably, his book is only partly successful in fulfilling this aim.

The most valuable parts of the book are the first two chapters, which present the elements of group theory, the representations of the four-dimensional orthogonal group, and the algebraic aspects of the Dirac, Klein-Gordan, and Fierz-Pauli equations. The discussion here is clear and the writing style interesting.

In the next section of the book, the symmetries of space reflection, time reversal, and charge conjugation are discussed, and the implications of recent theoretical and experimental work on weak interactions are presented. The presentation here, while on the whole useful, is marred by several misstatements, and any student reading the book must exercise care. For example, this chapter includes a "proof" of the false theorem that if charge conjugation invariance holds, the effect of parity nonconservation cannot be detected if the final state is weakly interacting.

The final chapter deals with isotopic spin and its generalizations. It is in the theory of strong interactions that present-day elementary particle theory is faced with its greatest problems; hence, it is here that a textbook is hardest to write. The author has chosen to present many highly speculative ideas, some of which have already been made obsolete by newer developments, without making clear that the evidence for them is somewhat weaker than for Lorentz invariance, for instance. The inclusion of such material in a textbook is probably unwise. It will perhaps be impossible to write a really adequate text on the theory of elementary particles until more of the major problems of that theory have been solved.

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Atlantic Hurricanes. Gordon E. Dunn and Banner I. Miller. Louisiana State University Press, Baton Rouge, La., 1960. xx + 326 pp. Illus. $10.

The large, rotary, tropical storm known regionally as the "hurricane," "typhoon," or "tropical cyclone" has a capacity for death and destruction well known to coastal and island inhabitants of the United States, Mexico and other Central American countries, Japan, China, the Philippines, and the South Pacific and Indian oceans. As many as 300,000 people have perished in a single storm, and two storms in the United States—Diane (1955) and Donna (1960)—have each caused damage that amounted to nearly $1 billion. Their energy output borders on the fantastic: the conversion of one day's hurricane winds would supply the electrical power requirements of the United States for six months. An average hurricane produces 20 billion tons of fresh water a day, which someday may be used by thirsty and ingenious future generations.

This book, written by two members of the Weather Bureau's hurricane forecast center at Miami, Fla., contains background information and safety features which could well mean the difference between life and death for large numbers of Americans who, in recent years, have moved to ocean beaches or who have ventured forth in boats into areas vulnerable to hurricanes. Much recent progress has been made in hurricane detection, tracking, and prediction by use of weather reconnaissance aircraft, radar, hurricane "beacons," and statistical and dynamical techniques involving use of electronic computers. These developments, combined with more effective dissemination of warnings, have brought the ratio of fatalities to property damage down by a factor of 60 in the past 30 years.

A glimpse into the potential contribution of weather satellites is given by a picture of the pinwheel clouds of a tropical cyclone observed near New Zealand on 10 April 1960 by the first weather satellite, Tiros I.

The book is given sharp focus by several fascinating eyewitness accounts made by survivors, some of them professional meteorologists, of outstandingly destructive hurricanes. A brief account of normal tropical weather patterns is followed by discussion of hurricane climatology, characteristics, energy, theories of forecasting, and destructive storm tides, surges, waves, rain floods, and winds. Sections of considerable practical value are devoted to the hurricane warning system, how to prepare for hurricanes, ways to improve zoning laws and building codes, and how to survive when the storm hits. The appendixes contain a listing of hurricanes that afflicted the United States from 1653 to 1958 and a useful glossary of meteorological terms.

Of particular interest are the sections devoted to the results of recent hurricane research, particularly those stemming from the extensive field activities of the National Hurricane Research Project; this project, the largest ever devoted to the study of a single meteorological phenomenon, owes its establishment to the increased federal support which was provided after the disastrous hurricanes of 1954 and 1955. In answer to the inevitable question of hurricane control, there is a brief account of several inconclusive hurricane seeding experiments as well as an account of the formidable problems involved in counteracting such energetic atmospheric phenomena.

For the more scientifically minded, the book will not serve as an adequate substitute for the chapter on tropical storms contained in Riehl's *Tropical Meteorology* (1954) or for the section on climatology and the record of storm movement and behavior found in Tannehill's *Hurricanes* (1944). Perhaps the book's greatest shortcoming is its failure to put in specific terms the principal unresolved problems concerning hurricane structure, behavior, and movement or to show how progress in the solution of these problems could contribute to improved understanding and prediction. By and large, however, the book provides interesting reading for the layman and vital information to state and city officials, construction engineers, and others concerned with alleviating hurricane damage.

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The Search for Order. Cecil J. Schneer. The development of the major ideas in the physical sciences from the earliest times to the present. Harper, New York, 1960. xvii + 398 pp. Illus. $6.

This is one of many recent books designed to introduce science to the general reader. More than most, it succeeds in portraying science as an essential part of our cultural heritage and as a framework for modern ideas and beliefs.

Necessarily the author limits himself to a few topics, to "scientific ideas which in my opinion have had the greatest influence on the evolution of civilization." These ideas progress from the cosmology of the solar system to mechanics, thermodynamics, evolution, field theory, relativity, and quantum theory. Chemistry and geology are limited to brief chapters, biology appears only in the discussion of evolution, and stellar astronomy is hardly mentioned. No two scientists would agree completely about the wisdom of this distribution, but certainly the topics selected provide material for a coherent, colorful, many-faceted, and often exciting story. The story is told with great zest, good humor, and broad understanding. Scientific ideas are set against a background of history and philosophy which serves admirably to bring out their relevance to the development of Western civilization. The author should be commended especially for his vivid and unorthodox biographical sketches of eminent scientists—sketches accompanied by numerous apt quotations from their writings.

The major shortcoming of the book is the brevity of its treatment of the scientific ideas themselves. There is no escape from this, of course, if the historical and philosophical material is to be retained and if the book is to be held to a reasonable length. The relation of force to acceleration, the con-