

order Aptera (Diplura) with Thysanura, since these two groups of insects are fundamentally more unlike than caddisflies and butterflies and moths, or Homoptera and Hemiptera. Despite the very few reservations I have mentioned, this book will always be handy on my desk, even though I am puzzled by the choice of a male ant (*Formica* sp.) as the illustration to introduce each chapter.

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Quantum Field Theory

PCT, Spin and Statistics, and All That.

R. F. Streater and A. S. Wightman.
Benjamin, New York, 1964. x + 181
pp. Illus. Paper, \$4.95; cloth, \$9.

The subject of this book is the rigorous mathematical investigation of the quantum theory of fields. Quantum field theory was until recently the generally accepted language in which the most basic laws of physics were expressed. During the last few years a strong group of physicists has attacked the notion of a quantum field and claimed that local fields should have no place in physics. At the same time a second strong group, led by Arthur Wightman, senior author of this book, has undertaken a fundamental rejuvenation of field theory by deepening its mathematical foundations. The program of the Wightman group is to clarify by exact analysis the nature and scope of field theory, such analysis being an indispensable preliminary to any final judgment of its physical relevance.

Wightman and Streater here summarize the achievements of rigorous field theory since its beginnings, 10 years ago. Three important things have been done: (i) The establishment of field theory as a strict mathematical discipline, conforming to the standards of modern mathematics, in startling contrast to the sloppy mess of inconsistent half-theory that had existed earlier. (ii) The formulation of specific sets of axioms which define in a precise way the physical ideas of "relativity," "field-particle duality," "causality," "permutation symmetry," and so forth, which are directly derived from observations of the real world. (iii) The proof by beautiful and nontrivial mathematics of some substantial theorems, asserting logical connections between

the various physical ideas. These three achievements have together created a body of theory which has an air of solidarity and permanence, a body of theory that is growing steadily year by year.

PCT and Spin-and-Statistics are the names of two of the principle theorems of field theory. PCT asserts a symmetry of the world under a simultaneous reflection in space and time and reversal of electric charge. Spin-and-Statistics asserts that precisely those particles which have half-integer spin, and no others, obey the Pauli exclusion principle. Both theorems express facts which are known to be true in the real world. The importance of a proof of such theorems lies in the insight which it provides into the deeper reasons why the world is the way it is.

The exposition in this book is consistently excellent, interspersing formal mathematical argument with informal comment in just the right proportions. The authors know well that the physical reality of quantum field theory has been questioned, and that all the theory contained in this book has not led to the calculation of a single number verifiable by experiment. They defend their subject vigorously, but with modesty and humor.

In the informal remarks that accompany the mathematical deductions, they show a many-sided understanding of the history and purposes of physics, which some of their opponents would do well to emulate.

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American Way of Life?

The Prospect of Immortality. Robert C. W. Ettinger. Doubleday, Garden City, N.Y., 1964. xxii + 190 pp. \$3.95.

Science fiction is ordinarily so labeled. A writer assumes some set of physical or biological phenomena (preferably startling and usually in the indefinite future) and then proceeds to build a story around it. When the idea is ingenious and the writing is good, we enjoy the story and forgive the nonsense—besides, who knows whether it will always be nonsense? However, when an author takes his idea seriously enough to write a treatise, the situation is very different.

In his foreword, Robert Ettinger, the author of this book, states that the "argument will attempt to show: first, that immortality (in the sense of indefinitely extended life) is technically attainable, not only for our descendants but for ourselves; second, that it is practically feasible and does not raise any unsurmountable new problems; third, that it is desirable from the standpoint of both the individual and of society." He then devotes 180 pages to the attempt.

The idea is that human beings can be kept for an indefinite period of time at very low temperatures and rewarmed at will without the procedure having produced any irreversible damage. It is only necessary, then, to store people until a method has been devised for repairing the defects which have killed them (yes, indeed, if they are preserved soon enough) or which are about to kill them. The idea is, further, that everyone wants to and ought to live forever. The idea is, still further, that the human race and its individual members will benefit incalculably. Presumably the author himself will be among the first to benefit from the new cold-storage technique.

The arguments for the feasibility of the proposal rest substantially on quotations from the works of a number of people, especially biologists and physicians who have studied the freezing and thawing of cells, tissues, and whole animals. The author's sources also include a number of writings in the popular press. The arguments for the benefits to be derived from universal immortality are not easily identified. They seem to rest largely on emotional and philosophical reflections on man and society, supplemented also by suitable quotations. There are two prefaces, one by Jean Rostand and the other by Gerald Gruman.

To pass from the descriptive to the critical, one may take this kind of thing seriously, or one may not. If one does, the book can only be considered the work of an utterly confused optimist. Only a fervent and naive believer in the imminence of ultimate good would be able to under-rate so completely the inertia, complexity, and inconsistency of human thought and behavior, as well as the complications of biological structure. Only such a man could quote people so uncritically and so out of context, or, having noted a few of the semantic and philosophical inconsistencies that plague us all, could imply that their

early resolution will lead to great good.

There is absolutely no evidence that low-temperature storage and recovery procedures will be possible in the near future with live human beings, let alone dead ones. Arguments based on appeal to authority are irrelevant and misleading. Does Ettinger think that force equals mass times acceleration simply because so eminent a man as Newton has said so? And Ettinger taught physics for more than 10 years!

The discussion of the legal, religious, economic, and philosophical problems that arise along the road to immortality might be entertaining in another context. How much will the processing cost? What about the birth-rate? Would refusal to be preserved be tantamount to suicide? If the parts of a man are progressively replaced with artificial substitutes, is it still the same man?

Perhaps the author has been pulling our legs. Maybe it's science fiction after all. The publisher must have fooled us with the dust cover.

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Geobotanical Mapping

Short Guide to Geo-Botanical Surveying. S. V. Viktorov, Ye. A. Vostokova, and D. D. Vyshivkin. Translated from the Russian edition (Moscow, 1959) by J. M. MacLennan, Pergamon, London; Macmillan, New York, 1964. xii + 158 pp. Illus. \$9.

Guide for Surveying Phreatophyte Vegetation. USDA Handbook No. 266. J. S. Horton, T. W. Robinson, and H. R. McDonald. U.S. Department of Agriculture, Washington, D.C., 1964 (order from GPO, Washington, D.C.). 37 pp. Illus. 20¢.

At an early stage in any study of natural resources, an appraisal of the distribution and characteristics of the resource is necessary. Appraisal and survey of the topography, geology, water, and soils of the United States were started during the last century and are continuing today. Why a comparable appraisal of vegetation is simultaneously disregarded is a puzzle. Russia, in contrast, is well along in mapping vegetation and relating the plant cover to the environment. In this book, *Short Guide to Geo-Botanical Surveying*, different methods of mapping and of col-

lecting and compiling data are described in detail.

The methods are familiar to all geologists and foresters. Reconnaissance, to familiarize the investigators with plants and their environmental relations, is followed by detailed observations along transects, usually supplemented by studies of aerial photographs and observation from airplanes. Transect surveys are made along lines drawn on base maps or photographs across the trend of the topography to insure sampling of most habitats. Grid surveys are used to compile large-scale maps where detail is required. All habitats are observed in continuous outline surveys that provide the greatest detail and accuracy. Vegetation types are defined by the dominant species.

Special surveys emphasize problems peculiar to different vegetation types and to man's use of the resources at his command. Forest surveying is discussed, but no references to the American or Western European literature on the identification of trees and the estimation of their volume from aerial photographs are mentioned. Different methods of surveying bogs and wetland provide data for the peat industry, agriculture, road location, and hydrologic studies and show the value of these resources and the interest taken in them. Surveys to understand range problems consider grazing and hay requirements in semidesert, desert, and tundra regions. The authors recommend that desert vegetation be mapped by mapping different types of topography and inferring different vegetation types. Correlations between vegetation and topography, so inferred, are invalid, and error could be introduced into their mapping program.

Surveys of vegetation types associated with variations in hydrology, geology, and soils are made to stress the indicative value of vegetation.

To evaluate water loss by evapotranspiration, a measure of vegetation is essential, and the USDA Handbook No. 266, *Guide for Surveying Phreatophyte Vegetation*, goes a long way to aid in describing and measuring riparian vegetation in semiarid regions. The authors state that several methods of sampling and measuring vegetation are available, but they suggest a standard method so that separate surveys can be compared. Only after many data are collected can the validity of the method be judged, but it seems to be technically and statistically sound.

The two reports, appearing at the

same time, are interesting in contrast. The USDA report is a straightforward, objective discussion of methods of describing, sampling, and measuring vegetation and of analyzing the results. The Russian report is vague, some of the methods are subjective, and it leaves the impression that a method is valid because it was suggested earlier. The translation is invaluable, however, because it provides us with information about what the Russians are doing in vegetation mapping.

The two reports may indeed be the stimuli needed to start an appraisal of a little known resource—wild plants.

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Science for the Layman

A Star Called the Sun. George Gamow. Viking, New York, 1964. xiv + 208 pp. Illus. \$5.75.

This book is dedicated, in the words of its author, "to the memory of my book, *The Birth and Death of the Sun*, published . . . in 1940." He goes on: "Twenty-four years is much too long . . . for any book on a rapidly developing subject to stand its ground, and today *The Birth and Death of the Sun* is hopelessly obsolete." In fact, Gamow overstates the case here. In view of the fact that the earlier book was written when the great expansion of our understanding of the atomic nucleus had just gotten under way, and that the sun is essentially a gigantic nuclear reactor, Gamow's new book extends and fills out the ideas presented in the earlier volume, rather than superseding them. Our conceptions of the nature and life history of bodies like the sun changed far less from 1940 to 1964 than they changed from 1916 to 1940, and although *A Star Called the Sun* is more than a revision of its predecessor, the earlier book is recognizably its parent.

The book has seven chapters. The first tells how astronomers have determined the distance, size, mass, and surface temperature of the sun. The second introduces the most powerful and successful of all methods of solar investigation—spectroscopic analysis of light. Gamow presents the interpretation of the sun's spectrum in terms of modern atomic theory. The third chapter describes the solar surface as