Books

Astrophysics. A Topical Symposium. Edited by J. A. Hynek. 703 pp. McGraw-Hill Book Company, Inc., New York, 1951. $12.00.

The present volume is a compendium of fourteen separate monographs on various astrophysical topics, which are treated by well-known authorities in their respective fields. Included in the contents are an introduction by Bengt Stromgren, Classification of Stellar Spectra by P. C. Keenan and W. Morgan, Interpretation of Normal Stellar Spectra by L. H. Aller, Analysis of Peculiar Stellar Spectra by O. Struve, Molecular Spectra in Cosmic Sources by P. Swings, The Growth of Our Knowledge of the Physics of Stars by B. Stromgren, The Sun and Stellar Radiation by E. Pettit, Comets by N. T. Bobrovnikow, The Origin of the Solar System by G. P. Kuiper, Visual Binary Stars and Stellar Parallaxes by G. Van Biesbroeck, Spectroscopic Binaries by J. Hynek, Eclipsing Binaries by N. L. Pierce, Intrinsic Variable Stars by C. Payne-Gaposhkin, Interstellar Matter by J. Greenstein, and Structure and Sources of Energy of Stars by S. Chandrasekhar.

A symposium, or collection of monographs of this type, is chiefly of value as a reference book. It is not intended as a text, nor is it suitable as one; on the other hand it could well be assigned as collateral reading in courses on astrophysics. Each monograph is written as a summary of the present situation in that branch which is covered and presents the results of many workers in each respective field. While there is no general summing up, nor tables of data at the end, much useful data is contained in the individual articles.

As with all such compendia, the difficulties facing the editor are twofold. First, the various papers discuss particular subjects and omit others. Hence one can look in vain for many of the interesting phenomena of astrophysics, such as a detailed discussion of the observations of the number, characteristics, etc. of novae, and the various theories of such explosions. On the other hand the quantitative analysis of stellar atmospheres is treated twice. Two authors give a detailed account of the methods of measurement and interpretation of the widths of spectral lines. It is pleasing indeed to see that astrophysicists are well aware that the spectral lines of most elements in most stars show largely radiation damping intrinsic width profiles, in contrast to the belief held by many physicists (who certainly should know better) that the widths are primarily due to Doppler broadening. Both accounts, although approached from differing directions and differing in considerable detail in the forms presented, are competent and understanding accounts of the situation, and show a broad familiarity with the contributions of the various persons, such as Russell, Stewart, Unsold, Minnaert, and others, who have worked in this field.

This reviewer feels that the title "Astrophysics" should really read "Special Topics in Astrophysics". The shorter form is misleading, and we would guess was chosen by the publisher. Yet the book is a useful one, and many persons as well as libraries will welcome it on their shelves. The book permits much useful material to be quickly obtained which otherwise would require extensive searches in the original literature. The book is remarkably free from errors, the printing and paper are of good quality and the binding presents a pleasing appearance.

Serge A. Korff
New York University
University Heights

Space-Time Structure. By Erwin Schrödinger. 119 pp. Cambridge University Press, New York, 1950. $3.00.

In view of the history and direction of development of theoretical physics in the last 35 years, the appearance of any volume on a subject which is essentially relativity *per se* rather particularly engenders the question: Why?

To what extent are a more illuminating attitude and interpretation brought to the exposition of the subject by virtue of the author's special qualifications, researches, or particular ability of expression? To what extent is new and well-established material presented?

To anyone who has followed developments in this field, the answers to these questions must on all scores be obvious. The stated *leitmotiv* of the volume, at least for essentially the first ten chapters, is the investigation of the geometry of the 4-dimensional continuum through its logical evolutionary stages: (1) the unconnected manifold under general invariance only; (2) the affinely-connected manifold; and (3) the metrically-connected manifold. Particular notice is taken of those concepts which are peculiar to each stage and accessible at that stage, but which have no meaning at the previous stage. The grace notes, so to speak, are the last two chapters which deal briefly with the formal and physical aspects of "Conservation Laws and Variational Principles" and "Generalizations of Einstein's Theory".

Possibly at the risk of appearing tautological or emphasizing what is obvious to some readers, the first of these two chapters devolves on the issue that in an infinitesimal geometry it is not permissible to use comparisons-at-a-distance; that is, it is not possible to compare (Euclidian fashion) the lengths of two line elements at *different* points of space. Hence one finds respectively: (1) the concepts of tensor "at a point" and infinitesimal displacements "bound to a point", being characteristics which are engendered by the bare notion of "derivative"; (2) manifolds which are such that

every point of them is affinely-related to its neighborhood, employing the principle of transference of direction, that is, of vectors; and (3) manifolds which are such that every point of them is metrically-related to its neighborhood, employing the principle of transference of distance or length, in addition to the existence of a measure determination.

The usual exposition, more or less following original historical development (before Weyl), totally or tacitly slides over the second stage without comment. Professor Schrödinger carefully does not, and carefully examines how far one can make physical progress at the affine stage only, and notes the implications of the fact that an affine relationship is inherent in metrical space.

The treatment and interpretation of conservation laws and variational principles is interesting for its own sake and integral to Schrödinger's formulation of the generalized Einstein field theory via the method of Palatini in deriving the original Einstein field equations. The immediately apparent issues here are, of course, the lifting of the usual symmetry conditions in the two basic connections of the space-time manifold: the one, the quasi-metrical one by the metrical coefficients, the other the affinity or coefficients of affine connection. Relaxing the symmetry requirements on the former leads to apriori problems as to the symmetry requirements on the latter; this is, so to speak, left open by Palatini's variational formulation—from which it evolves that attempting to uphold the usual symmetry leads to failure. The original and generalized Einstein equations are elegantly obtained; though, as is well-known, the latter have not led to any as yet identifiable or interpretable new results. It may be particularly interesting to note that within the frame of the less ambitious theory the purely affine approach leads automatically to Einstein's field equations *with cosmological term.*

The book is divided into the three stated parts, according to chapters: (1) Invariance, Vectors and Tensors; (2) Integrals, Densities, Derivatives; (3) Invariant Derivatives; (4) Some Relations between Ordinary and Invariant Derivatives; (5) The Nature of Parallel Transfer; (6) The Curvature Tensor; (7) The Geodesics of an Affine Connection; (8) The General Geometric Hypothesis about Gravitation; (9) Metrical Affinities; (10) The Meaning of the Metric According to the Special Theory of Relativity; (11) Conservation Laws and Variational Principles; and (12) Generalizations of Einstein's Theory.

The whole subject of space-time structure holds a peculiar fascination for almost everyone and, even when passing through familiar territory, many readers will find that making this short journey with Professor Schrödinger will reveal familiar concepts in sharper outline and in a sense will lead to a new awareness of the necessary and sufficient bases of all too often casually accepted results. The entire attitude is one which will most appeal to the graduate student and theoretical physicist, and follows that curiously easy and elegant vein which is Schrödinger's own.

The format and typography are of the excellence which one takes for granted in books appearing under the Cambridge colophon.

E. M. Corson
Institute for Mathematics and Mechanics
New York University

200 Miles Up. By J. Gordon Vaeth. 207 pp. The Ronald Press Company, New York, 1951. $4.50.

The great interest in upper atmosphere research on the part of military and civilian scientists of a number of nationalities in the past decade has resulted in enormous improvement in the classic vehicles for such investigations, rockets and balloons. Rocket techniques may be said to have come of age in 1942, when the first successful V-2 flight was made in Germany, and, similarly, the development in 1947 of the single-cell polyethylene balloon, made famous by Project Skyhook, represents a turning point in balloon work. *200 Miles Up,* subtitled "The Conquest of the Upper Air," is an attempt to describe the operation and applications of the several modern high altitude vehicles in the two categories that have come into prominence since these dates.

In addition to investigations concerned primarily with the properties of the atmosphere itself, such as temperature, composition, and winds, high altitude research deals with phenomena which, because of their atmospheric interactions, cannot be satisfactorily measured at the earth's surface. The solar ultra-violet spectrum in the region below about 2,900 angstroms, for instance, must be determined above the absorbing ozone layer of the stratosphere. Cosmic rays, whose composition and properties vary considerably with altitude, necessitate the attainment of extreme elevations in the evaluation of their primary component. Also, the possibility of space travel calls for extensive experimentation into the biological effects of cosmic rays and enormously high accelerations, to name but two factors involved, and rockets and balloons are being actively utilized in this work.

200 Miles Up starts with a discussion of the various properties of the upper atmosphere, followed by a brief consideration of the general principles behind the instrumentation designed to provide information on them. The remaining eight chapters of the eleven in the book are devoted to a short account of the fundamentals of rocket flight and detailed descriptions of (1) flights of 72-foot polyethylene balloons by the General Mills group, (2) White Sands Proving Ground, and (3) the V-2, Aerobee and Viking rockets. The language employed is, for the most part, clear and graphic, as exemplified by the recounting of the incidental aspects of rocket launchings which brought back vivid memories to this reviewer. However, despite the author's skillful writing and technical competence, this book suffers from the selection of material used and is actually misleading in several respects.

In the first place, from the point of view of the non-