the so-called indirect effect consists of two parts, one of which is entirely due to these displacements.

Isostasy is still over-emphasized. It has been known since about 1913 that it ordinarily leaves residuals far larger than the errors of observation; later work has fully confirmed this and also found regions where the residuals, on any isostatic model, are ten times greater still. At best it is a rough approximation with some flagrant exceptions. Glennie started a method that treats the form of the interface as an unknown to be found. As a supplement to explosion seismology it has given important results in American waters and in Russia.

H. JEFFREYS

STELLAR STRUCTURE

Stellar Structure

Edited by Lawrence H. Aller and Dean B. McLaughlin. (Stars and Stellar Systems, Vol. 8.) Pp. xx+648+10 plates. (Chicago and London: University of Chicago Press, 1965.) \$17.50; 126s.

THIS volume of the Compendium of Astronomy and Astrophysics has been eagerly awaited. There are relatively few books on stellar structure, and in a rapidly developing field a comprehensive review of the subject is most welcome in spite of the inevitably long delays in publication.

The book consists of eleven articles on different facets of the problem of stellar structure, each written by an author or authors actively engaged in the subject. Absolutely vital to any study of stellar structure is a knowledge of the elemental abundances, and the cross-sections for thermonuclear reactions and radiative absorption of the material. It is therefore fitting that the first three chapters, which are also the longest in the book, should deal with these topics. The first chapter is devoted to the origin of the chemical elements and deals with the various nuclear reactions which affect abundances, the variation of abundances from star to star, and the relation of the abundances of the elements to the age of astronomical objects. The second discusses stellar energy sources and gives in some detail the theory of thermonuclear reactions involving light nuclei. A most valuable part of this contribution is the extensive tabulation of rate coefficient parameters and the nuclear energy level diagrams, although the data are not completely free from error. The third chapter deals with stellar absorption coefficients and opacities, and includes a comprehensive review of previous work, but the presentation of the results and the methods as two separate historical sequences seems awkward. The results of new calculations by the author for a number of astrophysical mixtures are given, together with an analysis of the effects of line absorption on opacity.

The next two chapters, both of which are shorter than might have been expected, are devoted to models of main sequence stars and sub-dwarfs and to the theory of white dwarfs. The results of model calculations of main sequence and sub-dwarf stars are presented, while the direct concern in the treatment of white dwarfs is the physics of the problem. Conspicuously absent in both these chapters are discussions and details of the methods of model construction.

There follow chapters dealing with novae, supernovae, various aspects of the internal dynamics of stars (including a substantial and detailed treatment of the more general problem of stellar stability) and with stellar evolution and age determinations.

Perhaps the least satisfactory part of the volume is the combined preface and introduction, to which is relegated a brief statement of the basic equations and problems of stellar structure. Nevertheless, in spite of its shortcomings, the book will serve, both directly and indirectly, as a valuable reference to the many aspects of the subject.

T. R. CARSON

DUST EVERYWHERE

Particles in the Atmosphere and Space

By Richard D. Cadle. Pp. viii+226. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1966.) 80s.

THIS work is a survey of what is known about the many different small particles to be found throughout the universe. The treatment is largely descriptive and covers particles whose sizes lie between 0.05 micron and 1 cm, and ranges from the lower troposphere to interstellar space. The author describes the nature, mode of formation and effects of the atmospheric particles originating from the oceans, forest fires, dust storms, volcanoes and meteoritic dust. Much space is devoted to air pollution and cloud physics and there is a detailed chapter on radioactive fallout. Dr. Cadle is most at home in the atmosphere of the Earth, for the astronomical chapters which follow are somewhat sketchy and the references quoted are not always the most recent.

The book is well printed and adequately illustrated and indexed. There are few misprints, but the photographs of noctilucent clouds on page 76 have been printed upside down. A minor defect is the mixture of units employed; on two successive pages of text there are used feet, miles and kilometres, cubic centimetres and cubic yards, and acres. Each chapter ends with a copious list of references, making the book a useful source of information on a wide range of topics.

M. F. INGHAM

EXPERIMENTS IN SPACE

Scientific Experiments for Manned Orbital Flight

Edited by Peter C. Badgley. (American Astronautical Society Science and Technology Series, Vol. 4.) Pp. xiv+358. (Baltimore, Md.: American Astronautical Society, 1965. Distributed by Western Periodicals Co., North Hollywood, California.) \$14.25.

THIS book contains a selection of the papers presented at the Third Goddard Memorial Symposium on "Scientific Experiments for Manned Orbital Flight" held in March, 1966, in Washington, D.C. The purpose was to discuss the scientific aims and potential value of manned orbital flight. The first paper by the Deputy Administrator, United States National Aeronautics and Space Administration, the late Hugh L. Dryden, summarizes the opportunities and procedures for American and international participation in the scientific programme of NASA manned space flights. He emphasizes the large number of scientific experiments which it will be possible to carry out in the extended *Apollo* and later programmes.

Approximately two-thirds of the book is taken up by ten papers which deal with the uses of various types of remote sensors, particularly infra-red, in the determination of certain characteristics of the surface of the Earth from an orbital vehicle. They vary in content from the description and the results of tests of apparatus which record infra-red responses to the interpretation of infra-red and radar returns. Of particular interest is a paper by Colwell and Shay in which they describe recent experimental evaluations of reading the energy emitted and reflected from the ground in analysing the type, growth and health of crops and forests. It is difficult, however, to understand the relevance of the papers to the subject of manned orbital flight because most of the sensors can be operated remotely.

In a concise paper, Singer advances the thesis that a manned space vehicle provides an economical method for investigating the value of satellite meteorology. Trombka, Gill and Lewyn of NASA recount the lessons learnt from *Mercury* and early *Gemini* space flight concerning the flexibility which human beings bring to experiments